COMPREHENSIVE CLIMATE ACTION PLAN ANALYSIS
FRESNO COUNTY

FRESNO
Council of Governments

Prepared by:

Fresno Council of Governments
2035 Tulare Street, Suite 201
Fresno, CA 93721

With Assistance from LSA
2565 Alluvial Avenue, Suite 112
Clovis, California 93611

LSA

SOUTHWEST STRATEGIES GROUP

February 2026

FINAL REPORT

COMPREHENSIVE CLIMATE ACTION PLAN ANALYSIS: FRESNO COUNTY

Prepared for:

The Climate Pollution Reduction Grant Program,
State and Local Climate and Energy Program, and
United States Environmental Protection Agency

Prepared by:

Fresno Council of Governments
2035 Tulare Street, Suite 201
Fresno, CA 93721

With Assistance from LSA
2565 Alluvial Avenue, Suite 112
Clovis, California 93611

and

Sustainability Solutions Group (SSG)

Project No. 20241866

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 98T76401 to the Fresno Council of Governments. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document. The Comprehensive Climate Action Plan Analysis is a conceptual exploration of strategies and potential paths to implementation for GHG reduction. This plan will not regulate any industry names and/or commit any parties to further action. The concepts modeled may illustrate improvements occurring by public or private parties, but do not imply that any party assents to the plan or is taking steps to advance the development of GHG reductions. The strategies and measures outlined are contingent upon availability of funds from the State and Federal government.

February 2026

EXECUTIVE SUMMARY

The Fresno Council of Governments (Fresno COG) received a planning grant from the Climate Pollution Reduction Grants (CPRG) Program, which was appropriated by the Inflation Reduction Act (IRA) to the United States Environmental Protection Agency (EPA). The CPRG program includes $5 billion in funding nationwide, with $250 million for planning grants to develop greenhouse gas (GHG) reduction plans and $4.6 billion for implementation of priority measures identified in those plans.

The Priority Climate Action Plan (PCAP) was the first component of the Regional Climate Action Plan that Fresno COG developed for the CPRG grant funding. The PCAP included a regional GHG inventory, a public outreach process, identification and quantification of priority GHG emissions reduction measures, a benefit analysis for low-income and disadvantaged communities, and identification of implementation authorities. The PCAP was the first region-wide climate action planning effort in Fresno County. It provided valuable education and capacity-building for local communities and municipal staff. However, due to the constrained timeline (5 months) for the PCAP development, the process for many components of the PCAP was shortened or simplified. Per the CPRG Program guidelines, the next step in the planning process is the preparation of this Comprehensive Climate Action Plan Analysis (CCAP-A) that builds on the PCAP, addresses the additional requirements for the CCAP, and expands and enhances the PCAP components.

The CCAP-A includes an updated and refined emissions inventory for Fresno County, GHG emission reduction measures with quantified emissions reductions for all sectors that are potential sources of GHG emissions in the county, along with an analysis of co-benefits and potential impacts to low-income and disadvantaged communities (LIDACs). The identification of implementation authorities, a workforce analysis, and metrics for tracking the success of future implementation actions are also included in the document.

The CCAP-A is a conceptual exploration of strategies and potential paths to implementation for GHG reduction. This plan will not regulate any industry names and/or commit any parties to further action. The concepts modeled may illustrate improvements occurring by public or private parties but do not imply that any party assents to the plan or is taking steps to advance the development of GHG reductions. The measures are contingent upon the availability of funding from State and federal sources.

Fresno County generates approximately 12.4 million metric tons of GHG emissions annually, with transportation, agriculture, and buildings accounting for the majority of emissions. Without new action, emissions are projected to remain flat through 2050, perpetuating harmful impacts on air quality and community health related to climate change. Importantly, more than half of the County’s emissions sources disproportionately affect low-income and disadvantaged communities (LIDACs), reinforcing the need for equity-driven solutions. The CCAP-A identifies that reducing GHGs will not only address climate change but also deliver co-benefits such as improved air quality, lower household energy costs, and new economic opportunities in clean energy and sustainable agriculture.

To achieve these outcomes, the CCAP-A identifies a portfolio of sector-based strategies. These include electrifying public and commercial fleets, expanding transit and charging infrastructure, promoting energy efficiency and rooftop solar in buildings, reducing methane from dairy operations, diverting organic waste, and supporting renewable energy generation and water system efficiency. Aligned with the priority measures developed under the PCAP, the CCAP-A provides Fresno County with a clear and prioritized set of strategies that strengthen the County's ability to pursue future state, federal, regional, and philanthropic funding opportunities. Together, these measures provide a roadmap for the County to significantly reduce emissions, protect vulnerable populations, and align with future investment opportunities. These strategies also support job growth in clean energy, sustainable agriculture, and infrastructure sectors, ensuring benefits extend across the County's workforce and communities. As mentioned previously, this plan is an exploration of benefits and strategies to be taken to achieve emission reductions.

Fresno COG has utilized a three-pronged approach to developing the CCAP-A. First, a robust public outreach process, using multiple platforms, engaged the general public and prioritized outreach to LIDACs identified in the PCAP process. As a parallel process, a Stakeholder Steering Committee was formed to provide input and guidance on the overall process. The draft plan was published for public review, with comments accepted over a 40-day period. The third and final step of the CCAP-A development process was presentation of the CCAP-A to Fresno COG's three standing committees (i.e., the Transportation Technical Committee, the Policy Advisory Committee and the Policy Board) for review and acceptance.

TABLE OF CONTENTS

APPENDICES

FIGURES AND TABLES

FIGURES

TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
AB	Assembly Bill
ACF	Advanced Clean Fleets
ACT	Advanced Clean Trucks
AMMP	Alternative Manure Management Program
ATP	Active Transportation Program
BAP	business as planned
BAU	business as usual
BMI	body mass index
BNSF Railway	Burlington Northern Santa Fe Railway
BPS	building performance standards
BUILD	Building Initiative for Low Emissions Development
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CalRecycle	California Department of Resources Recycling and Recovery
CalSHAPE	California Schools Healthy Air, Plumbing, and Efficiency Program
CAPs	Criteria Air Pollutants
CARB	California Air Resources Board
CAT	Climate Action Tracker
CBOs	community business owners
CCAP-A	Comprehensive Climate Action Plan Analysis
CDC	Centers for Disease Control and Prevention
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEJST	Climate and Economic Justice Screening Tool
CH_4	methane
CHEEF	California Hub for Energy Efficiency Financing
CMAQ	Congestion Mitigation and Air Quality Improvement

CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COBRA	Co-Benefits Risk Assessment
COP21	United Nations Climate Change Conference
COPD	chronic obstructive pulmonary disease
CORE	Clean Off-Road Equipment Voucher Incentive Program
C-PACE	Commercial Property Assessed Clean Energy
CPRG	Climate Pollution Reduction Grants
CPUC	California Public Utilities Commission
CSP	Conservation Stewardship Program
DAC-SASH	Disadvantaged Communities – Single-Family Solar Homes
DC	District of Columbia
DDRDP	Dairy Digester Research and Development Program
DERA	Diesel Emission Reduction Act
DOE	United States Department of Energy
EDC	Fresno County Economic Development Corporation
EDA	United States Economic Development Administration
EJScreen	Environmental Justice Screening and Mapping Tool
EO	Executive Order
EPA	United States Environmental Protection Agency
EPIC	Electric Program Investment Charge
EQIP	Environmental Quality Incentives Program
ESAP	Energy Savings Assistance Program
ESCO	energy service company
EUI	energy use intensity
EV	electric vehicle
FARMER	Funding Agricultural Replacement Measures for Emission Reductions
FAX	Fresno Area Express
FCRTA	Fresno County Rural Transit Agency
Fresno COG	Fresno Council of Governments

FTA	Federal Transit Administration
GDP	gross domestic product
GHG	greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GSAs	Groundwater Sustainability Agencies
GSPs	Groundwater Sustainability Plans
Gt	gigatonnes
GWP	global warming potential
H_2S	hydrogen sulfide
HAPs	Hazardous Air Pollutants
HDV	heavy-duty vehicle
HFCs	hydrofluorocarbons
HOAs	Homeowners Associations
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
I	Interstate
IBEW	International Brotherhood of Electrical Workers
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
kt	kilotonne
kWh	kilowatt-hours
LC Scenario	Low-Carbon Scenario
LCFS	Low Carbon Fuel Standard
LFG	landfill gas
LIDACs	low-income and disadvantaged communities
MDV	medium-duty vehicle
MMBtu	million British thermal units
MMT	million metric tons
Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
MPO	Metropolitan Transportation Organization
MSA	Metropolitan Statistical Area
MT	metric tons

MWh	megawatt-hours
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NDC	Nationally Determined Contributions
NEVI	National Electric Vehicle Infrastructure
NF_3	nitrogen trifluoride
NO_2	nitrogen dioxide
NOIP	Notice of Intent to Participate
NO_x	nitrogen oxides
NPV	net present value
O_3	ozone
OECD	Organization of Economic and Cooperative Development
Pb	lead
PCAP	Priority Climate Action Plan
PFCs	perfluorocarbons
PG&E	Pacific Gas and Electric Company
$PM_{2.5}$	particulate matter less than 2.5 microns in size
PM_{10}	particulate matter less than 10 microns in size
PPA	power purchase agreement
PPP	Public-Private Partnerships
PV	photovoltaic
RCD	Resource Conservation District
REAP	Rural Energy for America Program
RNG	renewable natural gas
Roadmap	Industrial Decarbonization Roadmap
RPS	renewable portfolio standard
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
RTPA	Regional Transportation Planning Agency
SB	Senate Bill
SBT	science-based target
SF_6	sulfur hexafluoride

SGIP	Self-Generation Incentive Program
SGMA	Sustainable Groundwater Management Act
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_2	sulfur dioxide
SORE	Small Off-Road Engine
SR	State Route
SS4A	Safe Streets and Roads for All
SSG	Sustainability Solutions Group
SWEEP	State Water Efficiency and Enhancement Program
SWIFR	Solid Waste Infrastructure for Recycling
TDS	transmission, distribution, and storage
UC	University of California
UHI	urban heat island
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UPRR	Union Pacific Railroad
USDA	United States Department of Agriculture
USDOT	Department of Transportation
USEER	United States Energy and Employment Report
UV	ultraviolet
VMT	vehicle miles traveled
VOCs	volatile organic compounds
ZEV	zero-emission vehicle
ZNE	zero net energy

1 Introduction

Fresno Council of Governments

LSA

1.0 INTRODUCTION

1.1 CPRG OVERVIEW

In August 2022, President Biden signed into law the Inflation Reduction Act (IRA), which provides $370 billion in grants, loans, and other investments to build a new clean energy economy, combat the pollution that has driven the climate crisis, and create good-paying jobs. The IRA provides many tools to reduce greenhouse gas (GHG) emissions, one of which is the Climate Pollution Reduction Grants (CPRG) program. Section 60114 of the IRA appropriates $5 billion to the United States Environmental Protection Agency (EPA) to support State, regional, and local efforts to reduce GHGs through the CPRG program. Among the $5 billion, $250 million was allocated as planning grants to eligible entities to develop GHG reduction plans, and $4.6075 billion was allocated to fund the implementation of the GHG reduction measures identified in the GHG reduction plans developed through the planning grants.

The CPRG planning grants were made available by the EPA via a formula to the eligible entities, including states, municipalities, air pollution control agencies, regional governments, territories, and tribes. The funding level for the eligible entities is as follows:

- $3 million for each of the 50 states, District of Columbia (DC), and Puerto Rico, for a total of $156 million
- $1 million for each of the 67 Metropolitan Statistical Areas (MSA) with highest population, for a total of $67 million
- $25 million to tribes and tribal consortia
- $2 million to United States territories

The Fresno Metropolitan Area, which covers the entire Fresno County, ranks among one of the 67 most populous Metro Areas in the nation, and was eligible for a $1 million planning grant. Through close coordination with partner agencies in the Fresno region, especially with the City of Fresno, the largest municipality in Fresno County, and the San Joaquin Valley Air Pollution Control District (SJVAPCD), the Fresno Council of Governments (Fresno COG) assumed the responsibility to lead the region in the development of a Regional Climate Action Plan. Fresno COG is a federally designated Metropolitan Transportation Organization (MPO), a State-designated Regional Transportation Planning Agency (RTPA), and a Council of Governments. Its membership includes the 16 jurisdictions in the Fresno Metropolitan Area. It operates under a joint power agreement that was signed by the membership, which consists of all 16 local governments in Fresno County.

Serving as an RTPA, Fresno COG plays a pivotal role in coordinating transportation and land-use planning efforts within Fresno County. Fresno COG facilitates collaboration among local governments, State agencies, transit agencies, community organizations, and other stakeholders to address the region's infrastructure and mobility challenges. Fresno COG is instrumental in developing the Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), which outlines transportation priorities and investments, and promotes sustainability, safety, equity, and other regional priorities through integrated transportation and land-use planning. By fostering partnerships and providing a forum for regional decision-making, Fresno COG contributes to the development of comprehensive, forward-thinking strategies that enhance the quality of life for residents while promoting responsible and efficient regional development.

Fresno COG filed a Notice of Intent to Participate (NOIP) with the EPA on March 31, 2023, and submitted a grant application in May 2023. The grant application was approved by the EPA in the summer of 2023. The grant received from the EPA supported Fresno COG in conducting comprehensive climate action planning and preparation of this Comprehensive Climate Action Plan Analysis (CCAP-A) for the Fresno County region, including 15 incorporated cities and the unincorporated Fresno County areas.

1.2 CCAP-A PURPOSE AND SCOPE

Building on the work conducted to support the development of the Priority Climate Action Plan (PCAP), this CCAP-A was supported by public input and guidance provided by the Stakeholder Steering Committee. The PCAP, submitted to the EPA in March 2024, was the first component of the Regional Climate Action Plan and includes a GHG inventory, a public outreach process, identification and quantification of priority GHG emissions reduction measures, a benefit analysis for low-income and disadvantaged communities (LIDACs), and identification of implementation authorities. Outreach to stakeholders and the general public, especially the LIDACs, was a key component of the PCAP and a priority for Fresno COG.

For the CCAP-A, the Fresno County emissions inventory has been further refined with Fresno County-specific activity data, and GHG emission reduction measures for each sector have been developed. Emission reduction targets were developed for Fresno County, in alignment with California goals for statewide emission reductions and carbon neutrality by key milestone years of 2030 and 2045. To support the visioning conducted for the CCAP-A, a benefits analysis, a workforce analysis, and an implementation scenario have been included in the plan, along with analysis of how the GHG emissions reductions may specifically impact LIDACs in the planning area.

1.2.1 Organization of the CCAP-A

The CCAP-A for Fresno County includes the following chapters:

- **1.0 Introduction:** Provides an overview of Fresno County and describes the environmental and regulatory setting for GHGs. This section also describes the public outreach and stakeholder process conducted by Fresno COG during the CCAP-A development process, including summaries of public events held, comments received, survey results, and how public input and Stakeholder Steering Committee guidance was utilized in the selection of the GHG reduction measures.

- **2.0 Greenhouse Gas Inventory:** Accounts for the sources of emissions in Fresno County using a base year for the inventory of 2019, including a detailed methodology for how the inventory was developed, and is supported by two appendices.

- **3.0 Near-Term and Long-Term GHG Emission Reduction Targets:** Developed for Fresno County based on the emissions inventory to show alignment with California goals included in State legislation for emission reductions in 2030 and 2045.

- **4.0 GHG Emissions Projections:** For business as usual (BAU) and business as planned (BAP) scenarios, projecting the baseline emissions inventory from the base year of 2019 through 2050.

- **5.0 GHG Emission Reduction Measures and Implementation Scenario Projections:** Describes the measures selected for inclusion in the CCAP-A, as well as estimated emissions reductions to be achieved from the implementation of these measures. This section also summarizes the implementation authority for the proposed GHG reduction measures.

- **6.0 Benefits Analysis:** Describes the potential co-benefits for air quality and discloses potential increases in criteria pollutants that may have adverse effects. Financial impacts were also modeled and are discussed in this section, along with specific analysis of how the measures would impact low income and disadvantaged communities.

- **7.0 Workforce Planning Analysis:** Discusses potential workforce implications of the measures included in the CCAP-A and coordination that could result in positive impacts for local communities.

1.2.2 Fresno County Regional Overview

Situated in the center of California, Fresno County spans approximately 6,000 square miles and is geographically positioned between the Sierra Nevada Mountain range to the east and the coastal ranges to the west. Fresno County's topography varies from near sea level in the west to over 14,000 feet in the Sierra Nevada Mountain peaks, contributing to a diverse climate and ecological zones.

Fresno County is in a Mediterranean Climate Zone. Mediterranean Climate Zones occur on the west coast of continents at 30 to 40 degrees latitude and are influenced by a subtropical high-pressure cell most of the year. Mediterranean climates are characterized by sparse rainfall, which occurs mainly in winter. Summers are hot and dry. Summertime maximum temperatures often exceed 100 degrees Fahrenheit (°F) in the San Joaquin Valley. The subtropical high-pressure cell is strongest during spring, summer, and fall, and produces subsiding air that can result in temperature inversions. Winter-time high-pressure events can often last many weeks, with surface temperatures often lowering into the range of 30°F. The mild Mediterranean climate of the region makes it ideal for growing a variety of agricultural crops.

The central and western areas of Fresno County are part of the fertile San Joaquin Valley, where agricultural production serves as the region's top industry. Fresno County showcases a dynamic blend of agricultural and urban landscapes, with its globally renowned agricultural sector producing an extensive array of crops. As one of the highest grossing agricultural counties, Fresno County's agricultural product gross value was $8.5 billion in 2023. Fresno's agriculture-based economy is highly dependent on moving agricultural products efficiently from farm to market, which mostly relies on the streets and highway networks in the Fresno region. Key transportation corridors, including State Route (SR) 99 and Interstate 5 (I-5), enhance regional connectivity and facilitate the movement of goods. SR-41 is one of the primary corridors to Yosemite National Park, which is one of the most visited national parks in the nation. Recreational trips are served by several State highways, including SR-41, SR-33, SR-168, SR-180, SR-99, and I-5. In addition to the streets and highways, the existing rail lines, including the Burlington Northern Santa Fe Railway (BNSF Railway) and Union Pacific Railroad (UPRR), offer potential for future expansion of goods movement. Furthermore, there is an expanding multi-modal transportation network that provides services to meet various mobility needs for the residents in Fresno County. The Fresno Area Express (FAX), Clovis Transit, and Fresno County Rural Transit Agency (FCRTA) provide public transportation services throughout the region. Amtrak serves Fresno and is experiencing increasing ridership, and Fresno-Yosemite International Airport provides a hub airport for its service areas beyond Fresno County. The expanding active transportation network provides mobility options for residents in the region. Figure 1-1 shows the multi-modal network in Fresno County.

Although the region has made significant investments in transit and active transportation networks, transportation by private automobile remains the dominant mode of transportation. According to the Central California Household Travel Survey conducted in 2022 by the eight MPOs in the San Joaquin Valley, the most popular means of transportation in Fresno County are illustrated on Figure 1-2.

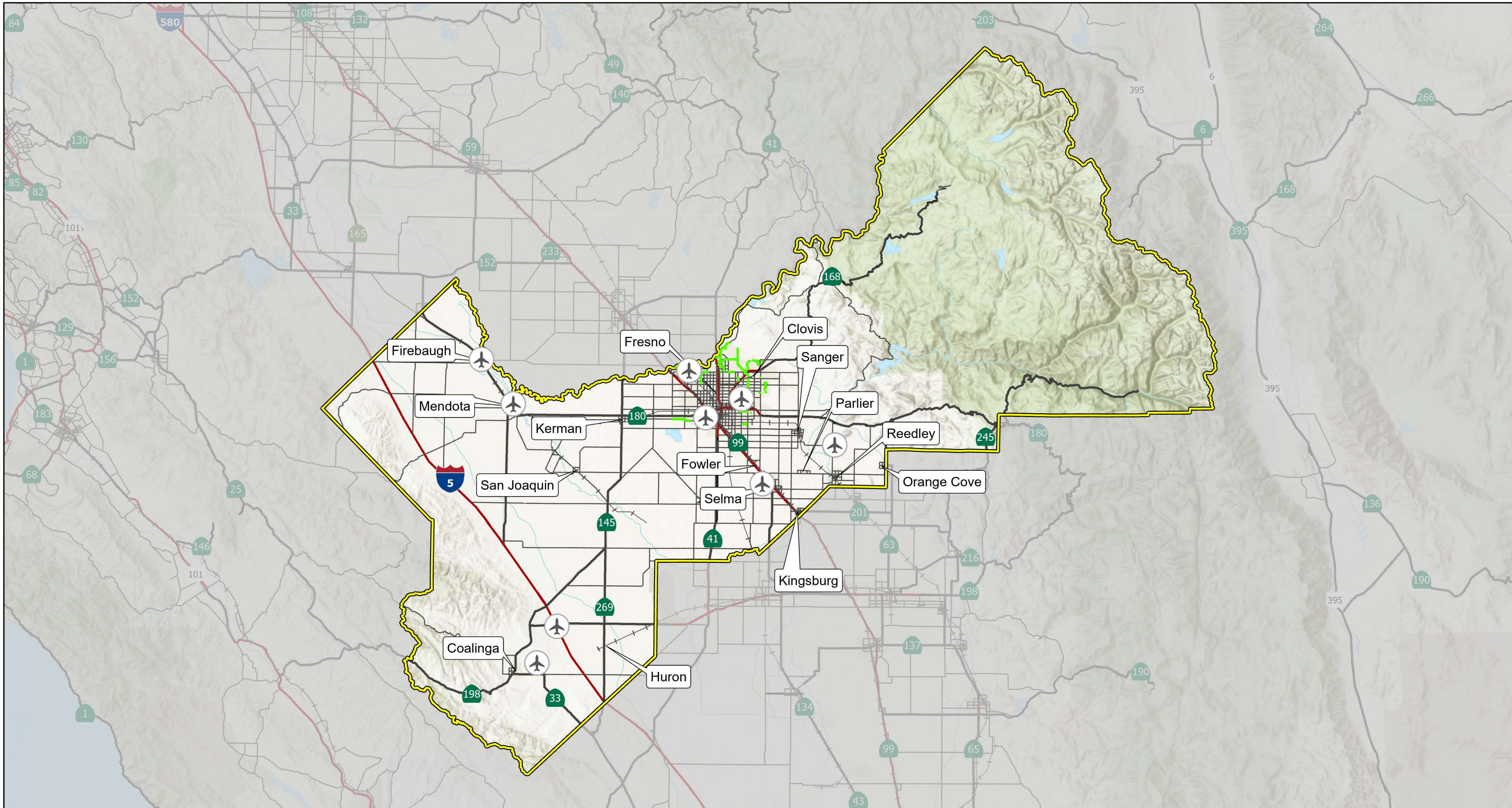
Based on California Department of Finance estimates,[1] as of January 1, 2025, the population of Fresno County is 1,037,053. A breakdown of the population by jurisdiction in Fresno County is provided in Table 1.A.

Table 1.A: Fresno County Population by Jurisdiction

Jurisdiction	Population Estimates at 1/1/2025	Percent Share of County
Clovis	129,121	12.5%
Coalinga	17,608	1.7%
Firebaugh	8,714	0.8%
Fowler	7,667	0.7%
Fresno	557,032	53.7%
Huron	6,932	0.7%
Kerman	17,535	1.7%
Kingsburg	13,285	1.3%
Mendota	12,710	1.2%
Orange Cove	9,717	0.9%
Parlier	14,649	1.4%
Reedley	26,603	2.6%
Sanger	27,037	2.6%
San Joaquin	3,654	0.4%
Selma	24,585	2.4%
(Unincorporated) Fresno County	160,204	15.4%
Total	**1,037,053**	**100.0%**

Data Source: California Department of Finance (DOF). 2025. E-1 Population Estimates for Cities, Counties and the State with Annual Percent Change — January 1, 2024 and 2025.

1 California Department of Finance (DOF). 2025. January Population and Housing Estimates: E-1 Cities, Counties, and the State Population and Housing Estimates with Annual Percent Change – January 1, 2024 and 2025. Website: https://dof.ca.gov/forecasting/demographics/estimates/ (accessed June 17, 2025).



LSA

Project Location - Fresno County
Bike and Pedestrian Trails
Rail
AirportsWithinFresnoCounty
Freeways
Expressways
Super Arterials

0 7.5 15
Miles

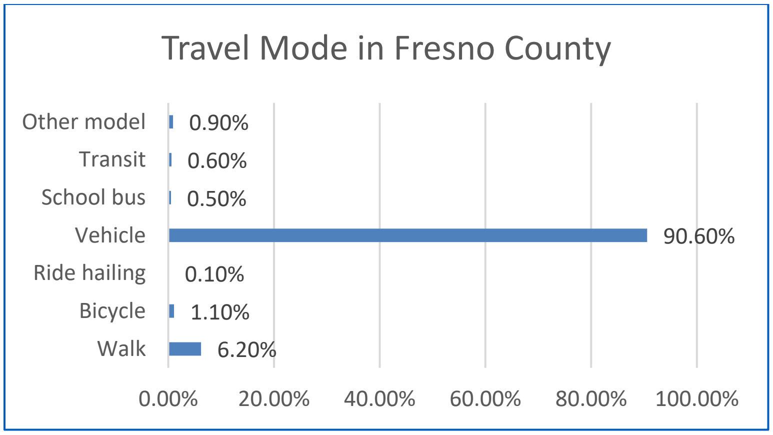
SOURCE: Esri World Topo (2025)

I:\2024\20241866\GIS\Pro\Fresno County Comprehensive Climate Action Plan\Fresno County Comprehensive Climate Action Plan.aprx (Fig 1-1 - Multi-Modal Transportation Network in Fresno County)
10/10/2025 1:08 PM

FIGURE 1-1

Fresno County Comprehensive Climate Action Plan Analysis

Multi-Modal Transportation Network in Fresno County



Source: LSA (2024).

Figure 1-2: Utilization of Different Travel Modes in Fresno County

The population demographics in Fresno County reflect a diverse mix of ethnicities and socioeconomic backgrounds. Figure 1-3 shows the concentration of ethnic minority populations in comparison to White population in the county. Fresno County has a slightly larger percentage of ethnic minority races than the State average (approximately 54.9% compared to 40.4%). Figure 1-4 illustrates employment by industry in Fresno County. Note that employment in the agricultural sector in Fresno County (6.5%) is much higher than statewide (2.0%) and national (1.6%) statistics.

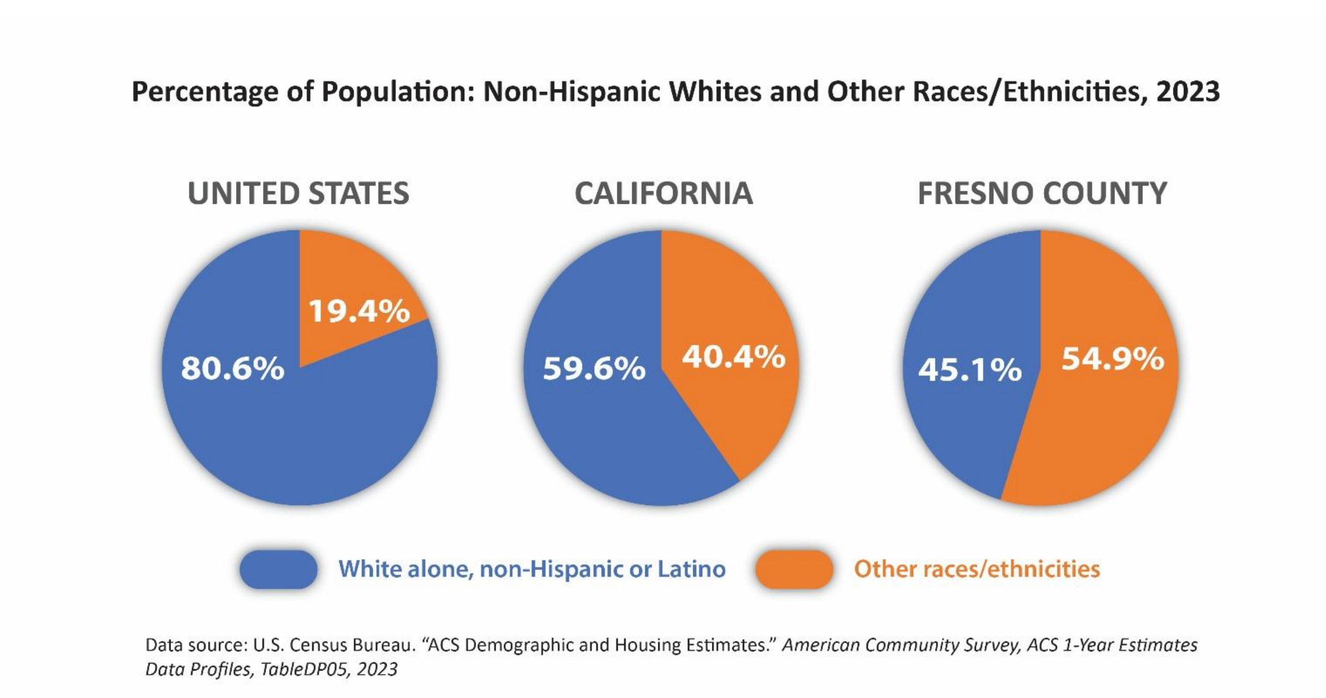


Figure 1-3: Fresno County Demographic Makeup by Percentage

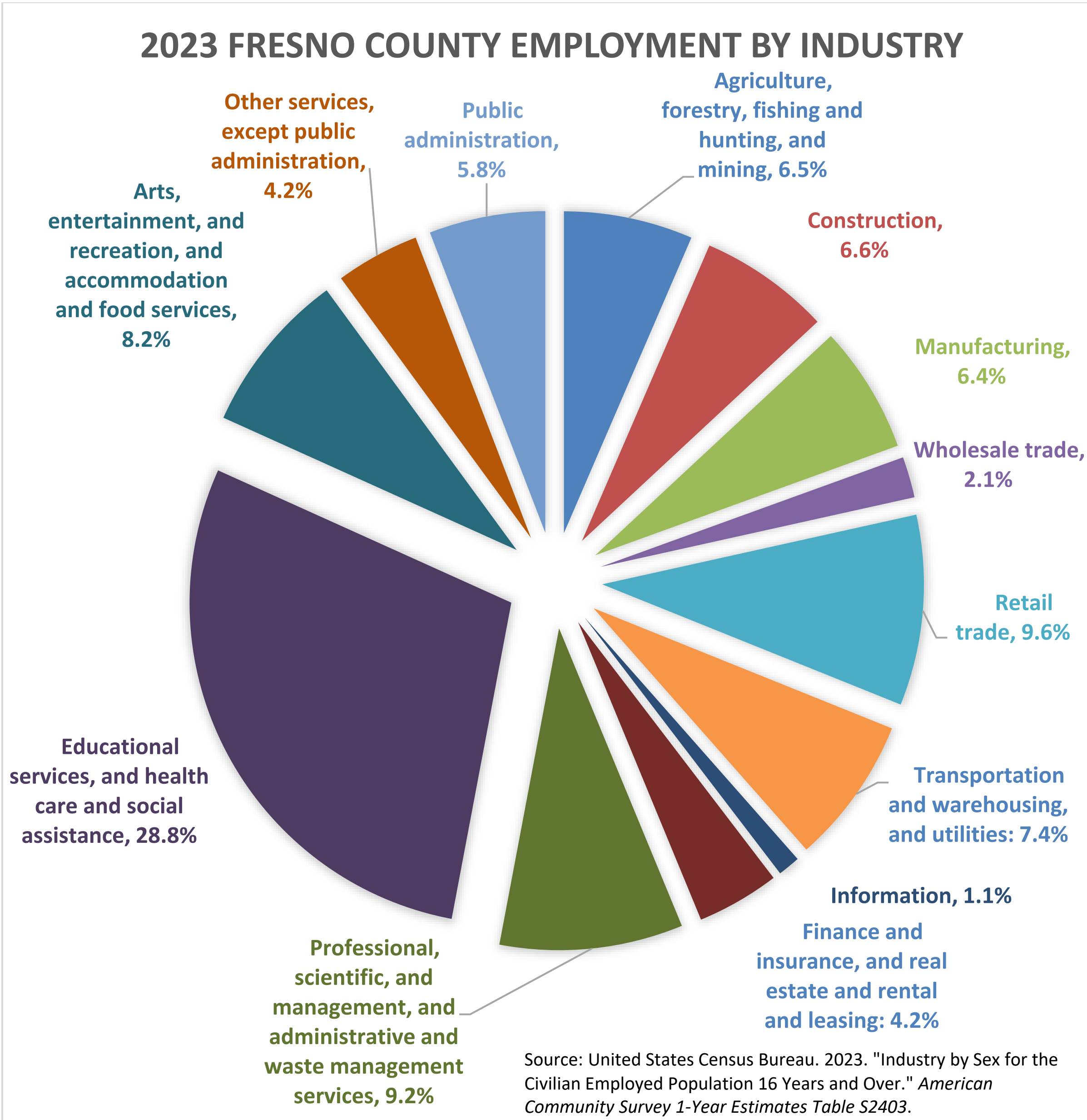
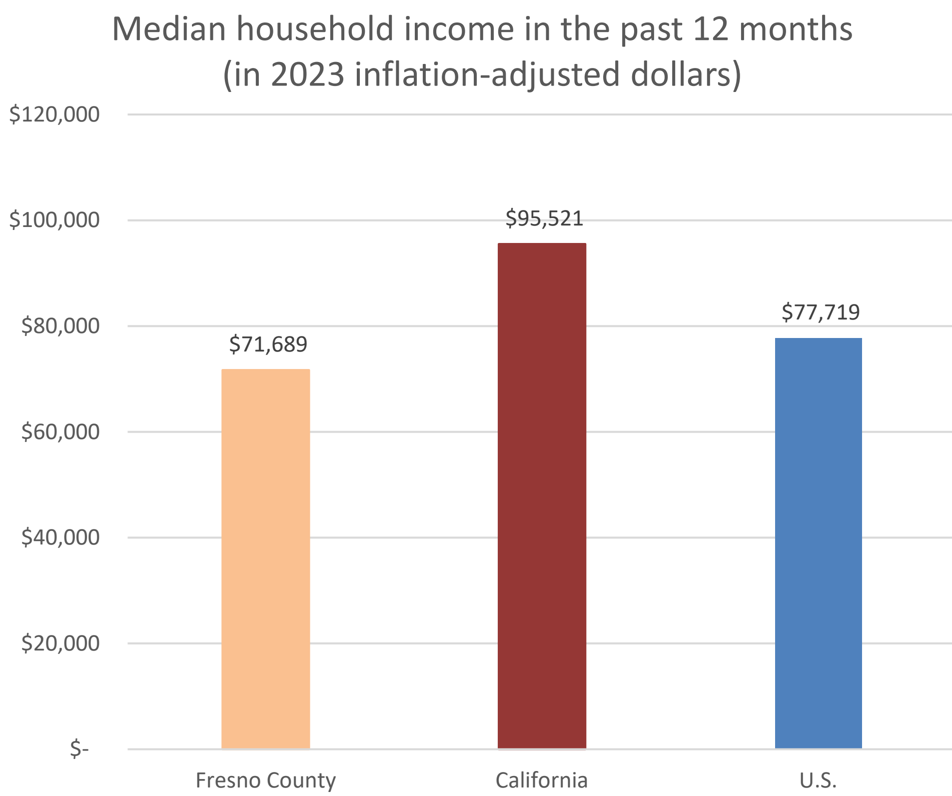


Figure 1-4: 2023 Fresno County Employment by Industry

As shown on Figure 1-5, the median household income in Fresno County is lower than the median income for the State of California and the rest of the nation.



Source: United States Census Bureau. 2023. "Median Household Income in the Past 12 Months (in 2023 Inflation-Adjusted Dollars)." *American Community Survey, ACS 1-Year Estimates Detailed Tables, Table B19013*.

Figure 1-5: Median Household Income in Fresno County

This CCAP-A provides the unique Fresno County region a roadmap for future climate action that can be utilized by local jurisdictions to reduce GHG emissions and envision the next steps for a lower carbon future. The grant awarded to Fresno COG supports long-term planning that reflects the unique needs, values, industries, and voices in the region. The targets and goals included in the CCAP-A reflect alignment with California State goals for emissions reductions, as included in State legislation and the 2022 California Air Resources Board (CARB) Scoping Plan,[2] which call for emissions reductions to be achieved by near term (2030) and long-term (2045) target years, with a goal of achieving carbon neutrality by 2045.

2 California Air Resources Board (CARB). 2022. *2022 Scoping Plan for Achieving Carbon Neutrality*. December.

1.3 APPROACH TO DEVELOPING THE CCAP-A

As identified in the work plan submitted to the EPA as part of the Planning Grant application, Fresno COG utilized a three-pronged approach to developing the CCAP-A.

First, a robust public outreach process with a multimedia platform was conducted to reach the public, especially the LIDACs identified during the process. The public was informed of the project and the potential opportunities that the project could provide for the region. Public feedback was also gathered to inform the development of the plan.

As a parallel process, a Stakeholder Steering Committee was formed to provide input and guidance on the overall process. The Committee consisted of representatives from the 16 local governments, the SJVAPCD, the Building Industry Association, FCRTA, and the Central Valley Foundation, which is a community organization that provided representation for the disadvantaged communities and other community interests. The Stakeholder Steering Committee has met to review the draft emissions inventory and assumptions; and has participated in a visioning exercise that supported the selection of the measures included in the CCAP-A. Both the public and the Stakeholder Steering Committee were surveyed about the emission reduction measures to gain information about community preferences for types of measures to include in the CCAP-A and perceived barriers to implementation.

During the CCAP-A development process, Fresno COG met with sector representatives, community organizations, and interested project member agencies. Fresno COG also participated in workshops and meetings organized by the EPA and CARB, as further detailed below. The CCAP-A was developed over a 2-year timeline in 2024 and 2025. The third and last step of the CCAP-A development process was the presentation of the CCAP-A to Fresno COG's three standing committees (i.e., Transportation Technical Committee, Policy Advisory Committee, and Policy Board), with final Fresno COG Policy Board acceptance and report finalization occuring prior to submittal to the EPA in early 2026. Figure 1-6 illustrates the plan development timeline, including key milestones and meetings.

Figure 1-6: Fresno County CCAP-A Development Process and Timeline

1.3.1 Public Outreach

Fresno COG's approach for developing the CCAP-A was to conduct a robust public process supported by available quality data. The region is known for its poor air quality and extreme heat conditions during the summer months. The extreme climate events exacerbate air quality issues, causing severe impacts on people living in the region. People living in the LIDACs bear the brunt of the extreme climate conditions because they lack resources to mitigate the impacts.

Fresno COG, along with its member agencies, were committed to a comprehensive and engaging public process with the following three-pronged approach:

- A far-reaching public outreach with a multimedia platform to reach the general public, especially the LIDACs, and inform them of the project and solicit feedback
- A Stakeholder Steering Committee with representation from the local governments, sector representatives, transit agencies, community groups, and other interested general public that provided guidance and input on the overall process
- Fresno COG's three standing committees (i.e., Transportation Technical Committee, Policy Advisory Committee, and the Policy Board) that reviewed and recommended approval of all deliverables

Fresno COG engaged with LSA to assist with technical analysis, supported by Sustainability Solutions Group (SSG), and with an outreach firm, Southwest Strategies, to support public engagement for this project.

1.3.1.1 Engagement Website

Fresno COG began with the development of a Community Engagement Hub website for CPRG planning grant activities and products. The PublicInput.com online platform was used to create the hub, which is available at the following link: https://publicinput.com/p6786 (see Figure 1-7). The website can be translated into multiple languages, including Spanish and Hmong.

The website contains tabbed information, including the following:

- Fresno COG’s PCAP and CCAP-A (previously named the CCAP) development timeline, which identifies milestones within the process, what work is complete, and what is yet to be done.
- Summaries of all opportunities to “get involved” in the planning process are included in the Get Involved tab. This section lists upcoming outreach, links to a priority measure survey and results, and includes options to submit public comments or ask questions about the plan.
- All past and upcoming committee and public meeting information, including dates, times, agenda links, webinar registration links, PowerPoint presentations, and recordings of the Stakeholder Steering Committee meetings are included on the Meetings page.

- The Stay Updated page offers an opportunity to sign up to receive notifications about the CCAP-A.
- The About CPRG page hosts CPRG background information, links to maps, and link to the EPA's CPRG website.
- The Resources section addresses the Disadvantaged Community Comparison Maps and mapping tool.
- The Contact Us page provides direct contact information for the Fresno COG office and CCAP-A staff.

Figure 1-7: Fresno County CCAP-A Public Website

1.3.2 Stakeholder Steering Committee

Fresno COG convened a Stakeholder Steering Committee comprising representatives of all 16 local governments in Fresno County and other key stakeholders in developing the CCAP-A. The role of the Stakeholder Steering Committee is to provide input and guidance to the CCAP-A process and approve recommendations by considering comments from external stakeholders and connecting staff with tribes, community groups, additional industry stakeholders, and the public. The Stakeholder Steering Committee meetings were scheduled to coincide with project milestones. With careful consideration, the project manager sent a request for representation from each of the 16 jurisdictions for designation on the Stakeholder Steering Committee. The membership of the Stakeholder Steering Committee is shown in Table 1.B.

Table 1.B: Fresno County CCAP-A Stakeholder Steering Committee

Name	Agency/Industry
Ryan Burnett	City of Clovis
Larry Miller	City of Coalinga
Ben Gallegos	City of Firebaugh
Dawn Marple	City of Fowler
Sophia Pagoulatos	City of Fresno
Virginia Penaloza	City of Huron
John Jansons	City of Kerman
Christina Windover	City of Kingsburg
Jeffrey O'Neal	City of Mendota
Chris Howard	City of Orange Cove
Javier Andrade	City of Parlier
Rodney Horton	City of Reedley
Eric VonBerg	City of San Joaquin
Derek Sylvester	City of Sanger
Lupe Macias	City of Selma
Mohammad Khorsand	County of Fresno
Celina Chavez	San Joaquin Valley Air Pollution Control District
Sarah Sharpe	Central California Asthma Collaborative
Nicola Steelnack	Leadership Counsel for Justice and Accountability
Rowenea Bush	Governor's Office of Land Use and Climate Innovation
Angela Castellanos	Central Valley Community Foundation
Moses Stites	Fresno County Rural Transit Agency
Steve Haze	Tranquility Resource Conservation District

All materials from the Stakeholder Steering Committee meetings were published and noticed to members of the public who subscribed to the Community Engagement Hub. Materials included the agenda, presentation, and recordings (see Figure 1-8). These materials are posted and available for review at the following link: https://publicinput.com/p6786#tab-44607

Committee meetings were publicized through the online hub, by email, and via social media posts.

Through September 2025, five meetings have been held. The Stakeholder Steering Committee met on October 9, 2024; December 18, 2024; April 17, 2025; and August 14, 2025. These meetings provided an opportunity to share updates and obtain feedback on the plan development, with the group's membership representing a wide variety of perspectives and areas of expertise.

Fresno COG convened a special meeting on August 21, 2025, to obtain input on the workforce planning component of the CCAP-A. Invitees included the Stakeholder Steering Committee members as well as economic development organizations, chambers of commerce, community business owners (CBOs), and entities focused on education and workforce training. This session helped identify priority occupations, transition needs, and opportunities for workforce capacity building. As a follow-up to the Workforce Planning Focus Group Meeting, on September 11, 2025, the CCAP-A team met with representatives from the agriculture industry, as well as staff from the SJVAPCD. This meeting was convened to collect targeted feedback about agricultural operations, near-term implementation barriers, and opportunities to align the CCAP-A with existing air district programs and regulations.

1.3.3 Outreach to Fresno County Communities

1.3.3.1 Online Surveys

Fresno COG's primary tool for collecting community input were two surveys, also built on the PublicInput.com platform, available online and in hard copy in English and Spanish. The surveys were designed to help identify residents' priorities and concerns, as well as potential reduction measures. Survey respondents were asked to provide information about themselves and then were able to provide input on top priorities and barriers to implementation of potential GHG emission reduction measures across each of the sectors included in the CCAP-A. The first survey ran from January 31 to May 7, 2025, and the second survey ran from July 21 through September 8, 2025. Results from each survey are attached for reference as Appendix A.

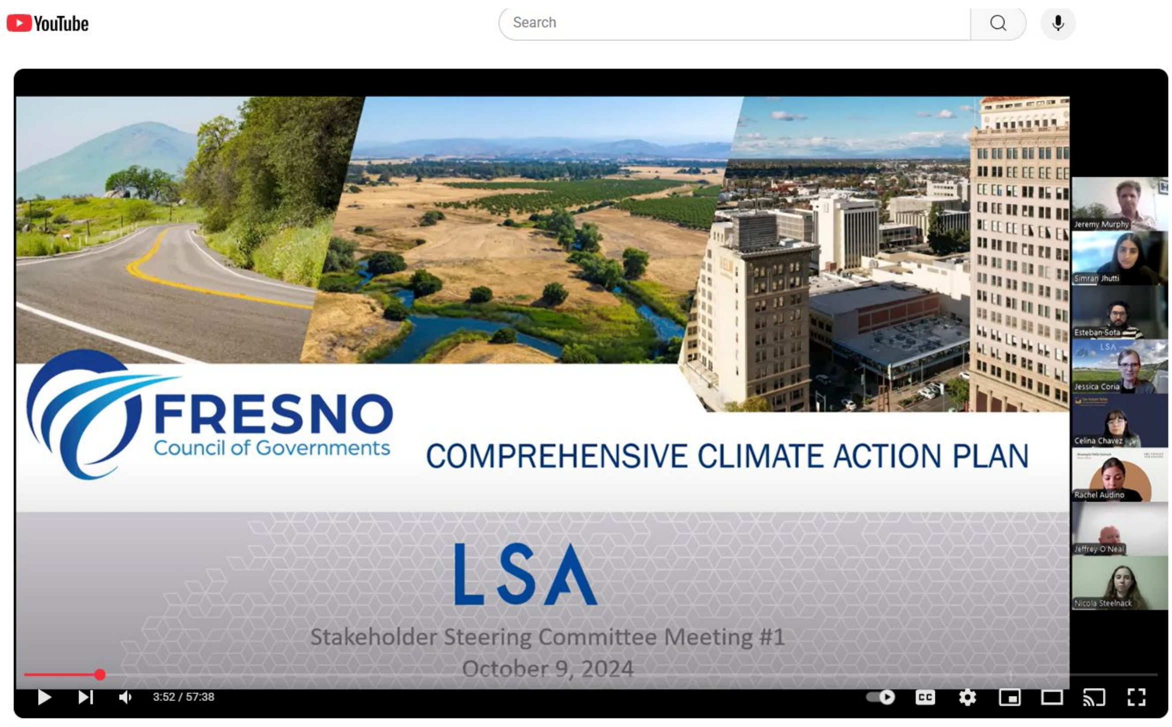


Figure 1-8: Example of SSC Meeting Recording Posted Online

An example of a Spanish Survey[3] is shown on Figure 1-9, and the English Survey[4] is shown on Figure 1-10.

1.3.3.2 Reaching the Community

Fresno COG publicized the first survey through community partners and stakeholders who shared survey links and invitations with their contacts. Fresno COG also used social media posts on Facebook, Instagram, LinkedIn and Twitter/X accounts (see Figure 1-11 below), and distributed focused emails and newsletters to Fresno COG's contact database of up to 5,204 contacts. The database includes representatives from all of Fresno COG's member agencies, area school districts, community organizations, tribal governments, industry consultants, public agencies, and seniors, among many others. Fresno COG's GHG Reduction Measures Survey hub also publicized a dedicated email account and voicemail to allow residents to submit comments in other forms. To promote the survey, Fresno COG distributed two eblasts in English and Spanish.

[3] Fresno Council of Governments (Fresno COG). 2025. Encuesta sobre el Plan Integral de Acción Climática. Website: https://publicinput.com/CCAPencuesta (accessed June 16, 2025).

[4] Fresno Council of Governments (Fresno COG). 2025. Comprehensive Climate Action Plan Survey. Website: https://publicinput.com/s55650 (accessed June 16, 2025).

Figure 1-9: Public Survey Interface (Spanish Version)

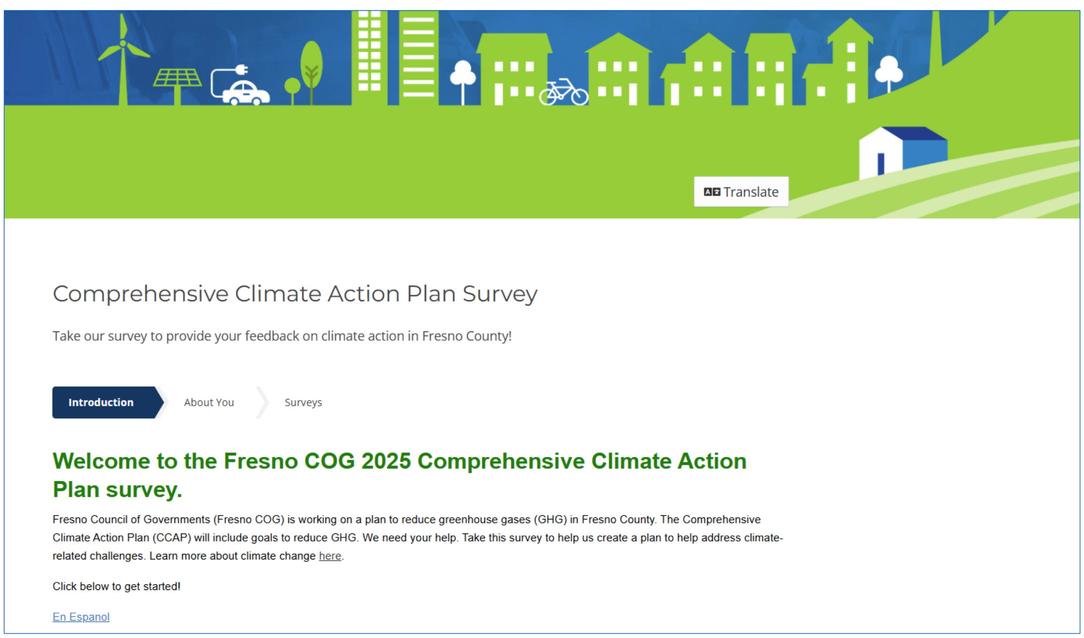


Figure 1-10: Public Survey Interface (English Version)

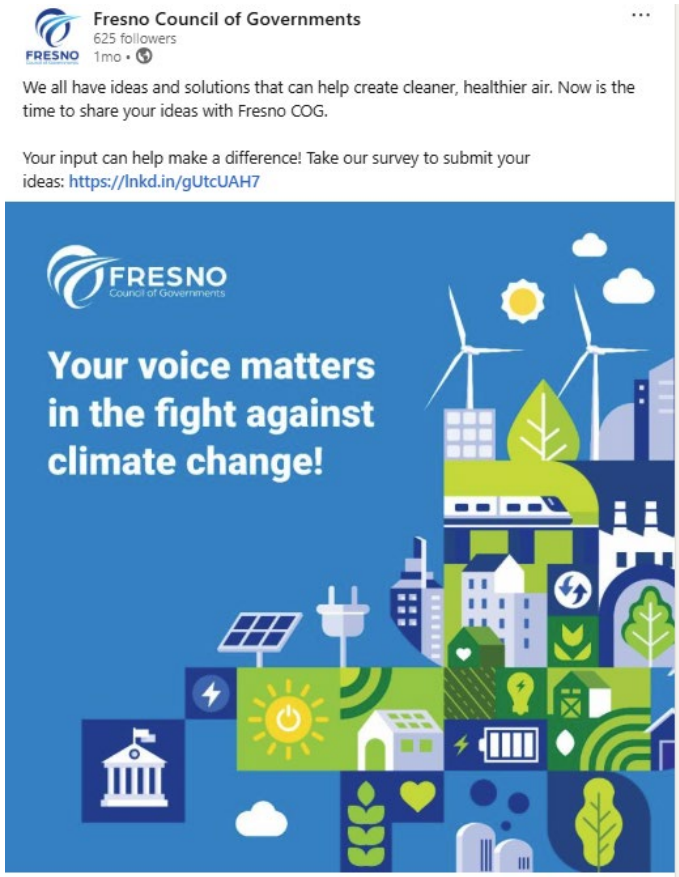


Figure 1-11: Example Social Media Post

For the second survey, in addition to asking members of the project's Stakeholder Steering Committee to share both surveys on their own platforms, Fresno COG engaged a number of third parties to disseminate the survey. The team sent suggested social media content and newsletter copy to 135 contacts, including the Fresno County Board of Supervisors, the Mayors and City Council members from every incorporated city within the county, representatives from CBOs, and other stakeholder groups.

Metrics from these communications are provided in Table 1.C:

Table 1.C: Eblast Outreach Engagement Metrics

Name	Sends	Opens	Clicks	Bounces	Unsubscribes
Eblast #1	1,873	603	51	92	2
Eblast #2	1,822	625	69	92	0
Eblast #3	681	277	45	26	1
Eblast #4	677	273	50	24	0

A total of 12 social media posts helped promote the surveys to Fresno COG's followers on Facebook, Instagram, Twitter/X, and LinkedIn. Metrics from these posts are provided in Table 1.D.

Table 1.D: Social Media Post Engagement Metrics

Post Name	Impressions	Reach	Engagement
Kick Off	111	58	17
Post 1	276	86	17
Post 2	245	41	12
Post 3	132	42	10
Post 4	120	64	5
Post 5	127	48	5
Post 6	133	48	5
Post 7	189	76	13
Post 8	155	78	7
Post 9	76	38	1
Post 10	34	22	0
Post 11	58	39	0

1.3.3.3 Community Meetings

The team coordinated pop-up booths at events across the county to meet people where they are, provide information, and promote digital surveys to obtain feedback from members of the community (see photo below). Specific events included:

- Reedley College Club Rush and Resource Fair
- Selma Earth Day Celebration
- Kerman Almond Festival
- Tranquility Transformative Climate Communities Outreach & Engagement Meeting
- Clovis Old Town Farmers Market

Additionally, Fresno COG distributed fact sheets about the CCAP development, among other projects, at five events prior to the survey launch:

- Central California Women's Conference
- Fresno County Fair Senior Day
- Kingsburg Crayfish Festival
- Reedley Fiesta
- Sanger Trunk or Treat

The draft CCAP was released for public review on October 10, 2025. Fresno COG hosted a virtual meeting in October 2025 to support public review and public comments on the draft plan. This meeting was planned to ensure interested community members had an opportunity to ask questions of the project staff and the consultant.

To support the technical review of model inputs and agricultural measures, the CCAP-A was presented to the SJVAPCD/Study Agency San Joaquin Valley Agricultural Technical Committee on October 27, 2025, providing CARB, the EPA, and industry stakeholders an opportunity to comment on the modeling methodologies and sector-specific strategies.

Based on comments received during the public review period, the project team prepared updates to the draft document and published a revised version that identified all changes for transparency. To facilitate sufficient time for public and stakeholder review of these updates, the comment period was extended through November 20, 2025. The final plan was presented to the Fresno COG Transportation Technical Committee, Policy Advisory Committee, and Policy Board for review and acceptance in January 2026, prior to submittal to the EPA.

Photo 1-1: Outreach Booths at Community Events Provided Information About the CCAP-A and Promoted Survey Participation

2 Greenhouse Gas Inventory

FRESNO Council of Governments

LSA

2.0 GREENHOUSE GAS INVENTORY

The following discussion describes existing greenhouse gas (GHG) emissions in Fresno County. The methodology utilized to update the initial emissions inventory developed for the Comprehensive Climate Action Plan Analysis (CCAP-A) is discussed, and the results of the emissions inventory are presented.

As background, emission inventories are compilations of emissions generated by sources in a geographic area at a given time. GHG emission inventories are reported in units of metric tons (MT) of carbon dioxide equivalent (CO_2e) emissions per year. Emission inventories identify the contribution of each type or category of emissions to the total inventory of pollutants of interest. Emission inventories help rank sources by size to determine those that are most important to control. Inventories are required to determine existing conditions and to forecast emissions in future years to account for the effects of growth.

Emission inventory protocols have been developed for many emission sources by governmental and independent agencies, and professional associations. The emissions inventory developed for the Priority Climate Action Plan (PCAP) was based on the emissions inventories developed by the United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). For the CCAP-A emissions inventory update, the Fresno County GHG emissions inventory has been updated utilizing an activity-based approach, referencing the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) protocol. The GPC provides a global standard framework for cities to measure and report their GHG emissions. California-specific emission factors and data are available for many sources that, when used, produce a more accurate inventory than the initial PCAP emissions estimates, as further discussed below.

2.1 INVENTORY METHODOLOGY

The GHG inventory created for the Fresno County CCAP-A used the GPC Emissions Basic+ framework. The complete inventory can be found in Appendix B.

This framework calculates GHG emissions[5] from the following sources across the project area over the course of a single calendar year:

- **Buildings:** Commercial, residential, industrial/manufacturing, and institutional emissions from building systems are often put in a category called Stationary Energy Use, which includes:
  - Use of electricity inside buildings; and
  - Use of fuel in residential, commercial, or industrial furnaces, generators, or other stationary combustion equipment.
- **Transportation:** This category includes emissions from fuel and energy sources used to move people, freight, and equipment within the community, including:

[5] Some of these sources are optional according to the GPC framework.

- On-road passenger travel (including public transportation), freight motor vehicle travel, and energy used to move waste;
- Freight and passenger rail;
- Off-road vehicles and equipment;
- Aviation; and
- Waterborne shipping in and out of ports in the community.

- **Waste and Materials Management:** This category includes emissions from energy used to treat waste and wastewater, and emissions produced during the decomposition of waste (described as nonenergy). Examples include:
  - Use of energy in potable water treatment and distribution (through pumping);
  - Solid waste deposited in landfills or composted; and
  - Energy used in wastewater pumping and treatment processes, including filtering and aeration and chemical, ultraviolet (UV), and other treatments.
- **Industrial Emissions:** These are emissions produced through industrial processes. They include:
  - Fugitive emissions, which are gases (most commonly natural gas) that leak out of wells and distribution pipes, directly into the atmosphere; and
  - Emissions of a number of GHGs that are produced during chemical reactions and processes from industrial facilities.
- **Agriculture, Natural and Working Lands:** This category includes energy-based and non-energy-based emissions resulting from agricultural practices, as well as emissions from and sequestration in natural systems, including:
  - Energy used to run agricultural equipment, machinery, and transportation;
  - Emissions from livestock, manure, crops, and soil; and
  - Carbon sequestration in forests and other plants and in wetlands.

The GPC GHG inventory is a production-based protocol that is used to report primarily on the following:

- Emissions released directly from sources within the project area. Examples include emissions from natural gas furnaces or from gas cars driving in the area.
- Emissions that are a result of the activities occurring within the project area but may be produced outside the area. For example, electricity may be generated by a facility outside the community, but the emissions released to produce the amount of electricity that the community uses are reported on the community's GPC inventory.

- The most common GHGs, specifically carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).[6]

All communities that produce a GPC Basic GHG Inventory can be relied upon to report on the same key categories and sources of emissions. As a result, it is reasonable to compare them to each other and to aggregate them into a single regional inventory. Those producing a GPC Basic+ GHG Inventory are reporting on more sources of emissions than they would in a GPC Basic GHG Inventory; therefore, they can be compared to each other but should not be considered comparable to (or aggregated with) communities' GPC Basic GHG Inventories.

This inventory quantifies GHG emissions produced within Fresno County for the calendar year 2019 (the "base year"). This year was selected because it was the most recent year for which all the required data were available. This inventory is the "baseline inventory," which now becomes a reference point to which future emissions for the area can be compared.

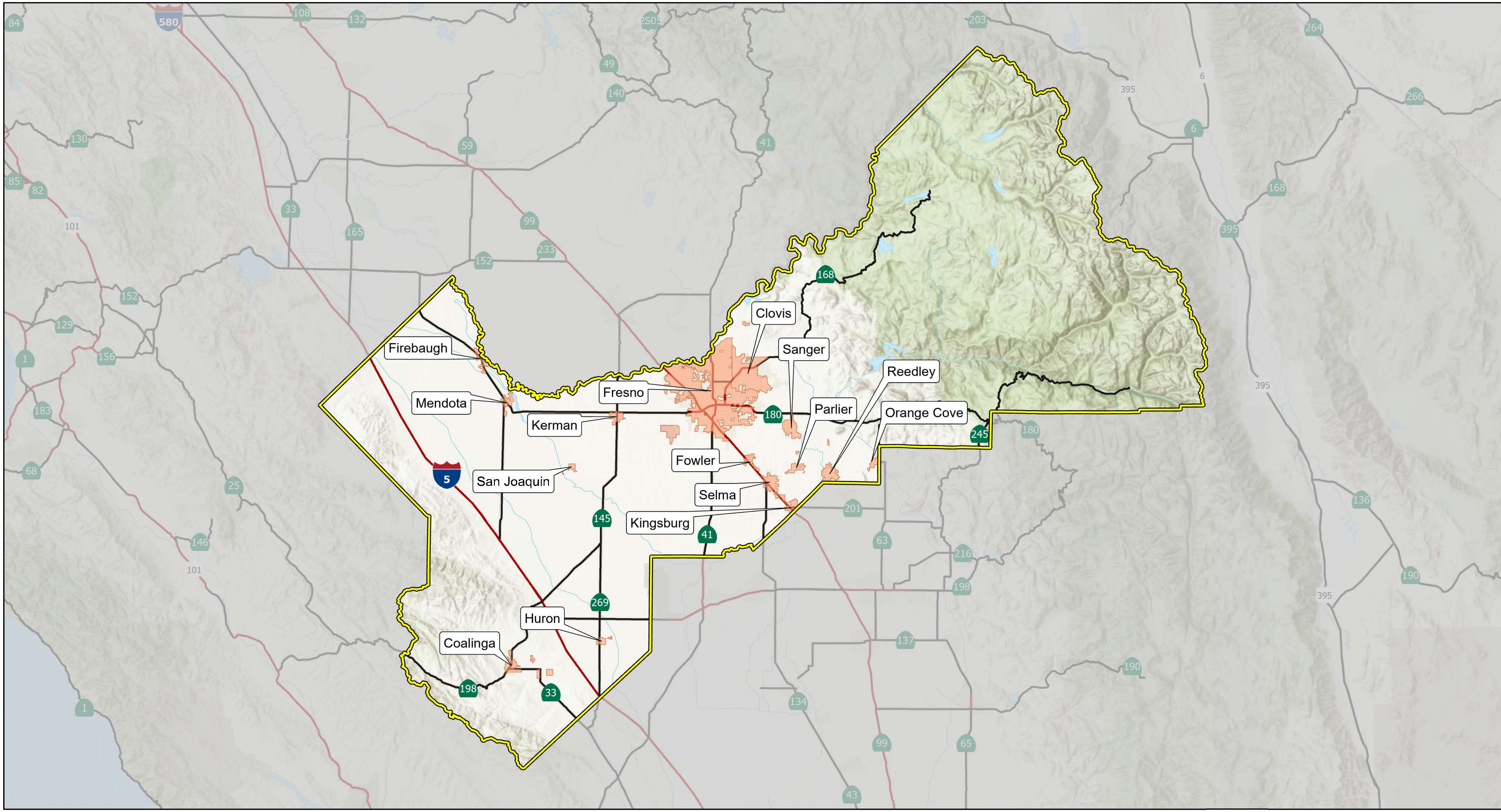
The geographic area included in Fresno County's CCAP-A includes 15 incorporated cities and the unincorporated portions of Fresno County (Figure 2-1). The incorporated cities are Clovis, Coalinga, Firebaugh, Fowler, Fresno, Huron, Kerman, Kingsburg, Mendota, Orange Cove, Parlier, Reedley, Sanger, San Joaquin, and Selma. Energy and emission inventories were completed for Fresno County as a whole and for each municipality. The estimated emissions inventory for each municipality is provided in Appendix C.

2.1.1 Electricity Generation

In developing the emissions inventory, electricity generation within Fresno County does not appear as a distinct emissions sector in the inventory totals. Instead, emissions from electricity generation are attributed to the end-use sectors, particularly buildings, based on their energy consumption. GPC guidelines recommend that emissions be reported by end use to reflect actual energy consumption patterns, showing how and where energy is consumed in Fresno County.[7] End-use sectors are also better aligned with local government policy levers because they can have direct influence over energy demand and emissions at the point of use through tools like building codes or zoning. Electricity generation (grid and local) will be presented as a "fuel type" through the CCAP-A. This ensures that emissions are counted only once and are attributed to the end-use sector driving the demand.

6 In accordance with the requirements of the Climate Pollution Reduction Grants, this CCAP-A also identifies industrial GHGs (e.g., hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulfur hexafluoride [SF_6], and nitrogen trifluoride [NF_3]), if they are released in the project area.

7 World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability. 2017. Greenhouse Gas Protocol, Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities, Version 1.1. Website: https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf (accessed May 20, 2025).



LSA

Project Location - Fresno County

Incorporated Area

FresnoCounty_Mask

0 7.5 15

Miles

SOURCE: Esri World Topo (2025)

FIGURE 2-1

Fresno County Comprehensive Climate Action Plan Analysis

Geographic Scope and Sub-Scopes of the Fresno County CCAP

I:\2024\20241866\GIS\Pro\Fresno County Comprehensive Climate Action Plan\Fresno County Comprehensive Climate Action Plan.aprx (Fig 2-2 - Geographic Scope and Sub-Scopes of the Fresno County CCAP)
10/6/2025 4:15 PM

2.2 BASELINE INVENTORY RESULTS

The baseline GHG inventory completed for Fresno County's CCAP-A indicates that in 2019, sources within Fresno County emitted a total of 13.2 million metric tons (MMT) CO_2e. With the inclusion of sequestration from Working and Natural Lands, the County's net emissions were 12.5 MMT CO_2e in 2019. Table 2.A and Figure 2-2 show these emissions by end-use sector. A breakdown of emissions inventory estimates by municipality is provided in Appendix C.

Table 2.A: Baseline Fresno County GHG Emissions by End-Use Sector

Sector	2019 Baseline Emissions (MT CO_2e)	Share of Total Emissions
Agriculture	2,815,105	22.5%
Commercial	753,075	6.0%
Fugitive	14,644	0.1%
Industrial	1,303,689	10.4%
Municipal	253	0.0%
Residential	1,104,464	8.8%
Working and Natural Lands	-708,300	-5.7%
Transportation	6,781,635	54.1%
Waste	468,641	3.7%
Total Emissions	**12,533,206**	**-**

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MT = metric tons

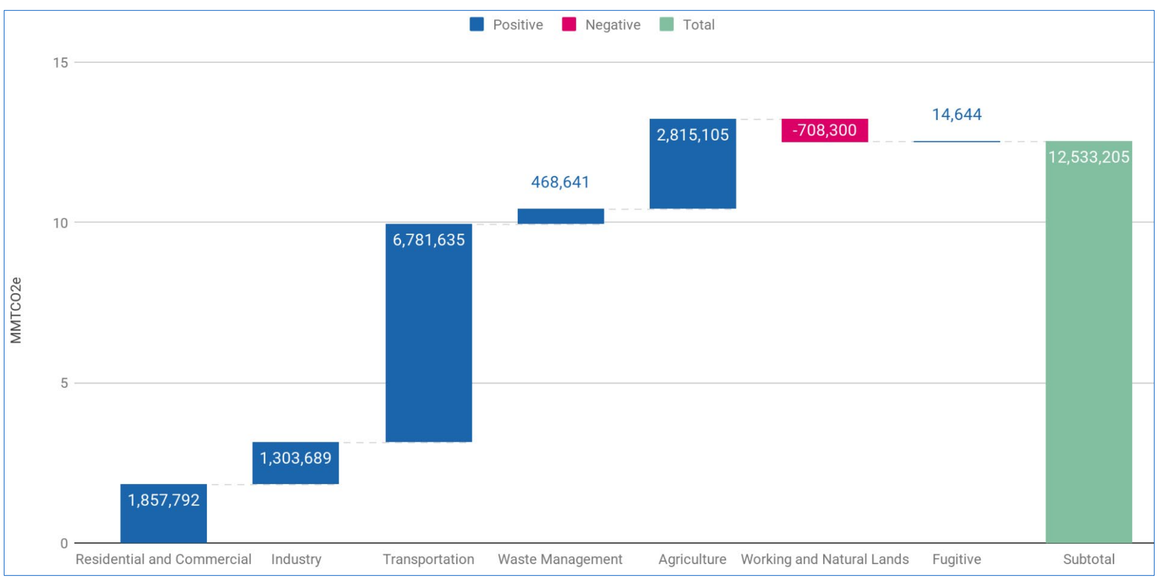


Figure 2-2: Baseline Fresno County GHG Emissions by End-Use Sector

The breakdown of emissions by sector and fuel type is shown in Figure 2-3 and indicates the following:

- The primary source of GHG emissions in Fresno County is from the transportation sector, which are generated by gasoline and diesel vehicles and account for 54% of the total GHG emissions from the region in 2019. The transportation sector includes all vehicle types, including off-road vehicles, freight vehicles, medium and heavy-duty vehicles (trucks), in addition to personal vehicles.

- The agriculture sector accounts for 22.5% of the total emissions. These are non-energy emissions that are largely due to manure management practices and fertilizer use.

- Building emissions are driven by natural gas use for space and water heating.

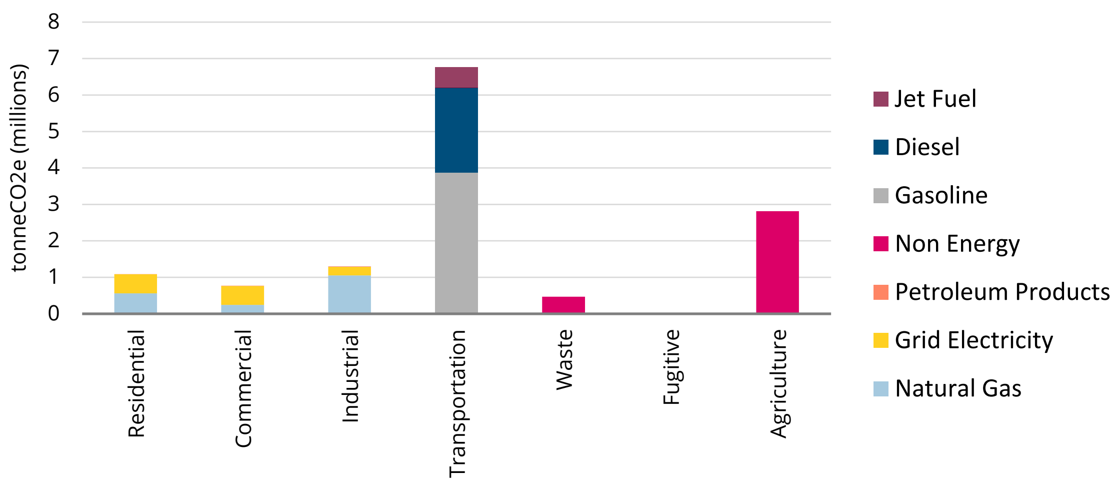


Figure 2-3: GHG Emissions by Sector and Fuel Type Within the Fresno County Project Area for 2019

With a population of nearly 985,000 in 2019, Fresno County's per capita emissions were 12.7 MT of CO_2e per person. Although lower than the national per capita emissions of 15.09 MT of CO_2 per person in 2019,[8] Fresno County's per capita emissions were higher than the State's 10.5 MT of CO_2e per person in the same year.[9]

8 United States Environmental Protection Agency (EPA). 2025. Climate Change Indicators: U.S. Greenhouse Gas Emissions. Website: https://www.epa.gov/climate-indicators/climate-change-indicators-us-greenhouse-gas-emissions (accessed May 20, 2025).

9 California Air Resources Board (CARB). 2025. Latest State Greenhouse Gas Inventory Shows Emissions Continue to Drop Below 2020 Target. Website: https://ww2.arb.ca.gov/news/latest-state-greenhouse-gas-inventory-shows-emissions-continue-drop-below-2020-target (accessed May 20, 2025).

2.2.1 Differences from the PCAP

The GHG inventory results presented in the CCAP-A differ from those in the PCAP due to the use of more detailed, locally sourced data. Although the PCAP relied on state-level estimates scaled down to the county level, the CCAP-A incorporates local-level inputs (e.g., electricity and natural gas consumption), resulting in a more accurate and spatially representative emissions profile.

Due to this improved data resolution, the total emissions reported in the CCAP-A inventory are approximately 1.3 MMT CO_2e lower than in the PCAP. This reduction is largely attributed to lower reported natural gas use in the residential, commercial, and industrial building sectors.

2.3 INVENTORY TRENDS AND ANALYSIS

Located in California's San Joaquin Valley, Fresno County experiences long, hot, and dry summers, frequently exceeding 100 degrees Fahrenheit (°F), driving high energy demand for cooling while cool winters can trap air pollutants and exacerbate local air quality issues.

Transportation is a dominant source of emissions in Fresno County, largely due to the region's expansive, auto-dependent development pattern. Over 90% of trips are made by private vehicle. Fresno County also serves as a major freight corridor, with key routes including State Route (SR) 99 and SR-41.[10]

Fresno County's economy is heavily agriculture dependent, with over $8 billion in annual production.[11] Employment is also concentrated in transportation, warehousing, and food service sectors that are inherently energy and emissions intensive. Agriculture contributes a large share of the County's GHG emissions, particularly through manure management, fertilizer use, and fuel consumption in off-road equipment.

Fresno County's growing population, estimated at over 1 million in 2023, and relatively large household sizes compared to State and national averages (3.0 versus 2.8 in California and 2.5 nationally)[12] contribute to upward pressure on energy and transportation demand. Much of Fresno County's housing growth occurs in low-density areas, which further entrenches car dependency and limits the feasibility of low-carbon mobility options.

Fresno County is home to a high proportion of LIDACs, many facing disproportionate exposure to pollution and higher energy burdens.[13] These communities are particularly vulnerable to climate impacts and must be prioritized in the implementation of mitigation strategies.

These trends illustrate the challenges Fresno County faces in reducing emissions. Without deep interventions, population and economic growth will continue to drive emissions higher.

---

10 Fresno Council of Governments (Fresno COG). 2024. Fresno Priority Climate Action Plan. March. Website: epa.gov/system/files/documents/2024-03/fresno-cog-pcap.pdf (accessed May 15, 2025).

11 Fresno Council of Governments (Fresno COG). 2024. Fresno Priority Climate Action Plan. March. Website: epa.gov/system/files/documents/2024-03/fresno-cog-pcap.pdf (accessed May 15, 2025).

12 Fresno Council of Governments (Fresno COG). 2024. Fresno Priority Climate Action Plan. March. Website: epa.gov/system/files/documents/2024-03/fresno-cog-pcap.pdf (accessed May 15, 2025).

13 Fresno Council of Governments (Fresno COG). 2024. Fresno Priority Climate Action Plan. March. Website: epa.gov/system/files/documents/2024-03/fresno-cog-pcap.pdf (accessed May 15, 2025).

3 Near-Term and Long-Term GHG Emission Reduction Targets

3.0 NEAR-TERM AND LONG-TERM GHG REDUCTION TARGETS

The United States Environmental Protection Agency (EPA) Climate Pollution Reduction Grants (CPRG) Program requires that grant recipients develop greenhouse gas (GHG) reduction targets as part of the development of the Comprehensive Climate Action Plan Analysis (CCAP-A). The funding requires the following:

1. Near-term economy-wide goals (e.g., 2030–2035)
2. Long-term economy-wide goals (e.g., 2050)

In addition, the CPRG target-setting guidance recommends the following:

1. Near-term economy-wide 2030 and 2050 targets
2. Sector-based 2030 and 2050 targets (strongly encouraged)
3. Setting the baseline year at 2005

Goals should be consistent with the United States' international commitment to reducing economy-wide emissions 50% to 52% below 2005 levels by 2030 and achieving net-zero emissions by 2050. Grant recipients do not have to adopt the national targets; however, the guidance recommends adoption so that the national target time frames and scope have the following benefits:

1. National program impacts are easier to assess
2. Alignment can help facilitate cooperation between grantees
3. Sector-based targets lead to a more rigorous and informed plan design

Grantees may use existing GHG targets but are encouraged to update, modify, or expand those targets as appropriate (e.g., developing sector-based targets). All grantees have unique target-setting considerations (e.g., mitigation efforts to date, economic considerations, emissions sources). Grantees should focus their target-setting analysis on the following factors:

- GHG emissions sources (e.g., the relative magnitude of emissions sources within their jurisdiction)
- Science (e.g., recognizing that the United States' pledge is consistent with an effort to hold total global temperature increases to well below 2 degrees Celsius [°C] and pursue efforts to avoid 1.5 degrees of warming)
- Technical and economic feasibility
- State, local, tribal, and territorial mitigation priorities

The consideration of State priorities was key in the development of the emission reduction targets included in the Fresno County CCAP-A. California has established more aggressive emission reduction targets than the federal emission reduction targets for advanced milestone years of 2030 and 2045, as codified in State legislation including Assembly Bill (AB) 32, Senate Bill (SB) 32, Executive Order (EO) S-03-05, AB 1279, and other relevant regulations. Established goals for emission reductions by key milestone years are as follows:

- **2030:** Reduce emissions 40% below 1990 levels
- **2045:** Reduce emissions 85% below 1990 levels and achieve carbon neutrality

Most recently, the CARB 2022 Scoping Plan outlines the following specific emission reduction goals:

- **2030:** Reduce emissions 48% below 1990 levels
- **2045:** Reduce emissions 85% below 1990 levels and achieve carbon neutrality

Consistent with input received from the Stakeholder Steering Committee, the Fresno County CCAP-A targets will be aligned with the 2022 Scoping Plan emission reduction goals. Countywide 1990 emissions levels are not available, which is the case for many local jurisdictions in California. Therefore, the CCAP-A's reduction targets were developed relative to countywide emissions in the base year of 2019 and established in proportion with statewide reductions for all emissions sectors included in the available emissions inventory, consistent with CARB guidance. Estimating equivalent reductions needed from the 2019 baseline, the percentage reductions that would align with the State goals included in the 2022 Scoping Plan[14] are outlined in Table 3.A below.

Table 3.A: Adjusted Emission Reduction Goals for Base Year 2019

Year	Senate Bill 32		Scoping Plan 2022	
	Emissions (MMT CO_2e)	% Below 2019	Emissions (MMT CO_2e)	% Below 2019
2019	404	--	404	--
2030	259	36%	108	45%
2045	65	84%	65	84%

Source: Compiled by LSA (2025); emission reductions sourced from CARB 2022 Scoping Plan.
CARB = California Air Resources Board
CO2e = carbon dioxide equivalent
MMT = million metric tons

The following sections discuss CPRG Program guidelines in more detail, as well as existing federal and State reduction goals, along with the results of the Fresno County specific targets developed for the CCAP-A.

3.1 WHY SET GHG EMISSION REDUCTION TARGETS?

At a foundational level, targets align policies and investments with a desired outcome, which in this case is preventing dangerous levels of climate change. Current global emission trends are pushing temperatures toward a 3°C (5.4°F) increase, which is far above the safe 1.5°C (2.7°F) threshold.

14 California Air Resources Board (CARB). 2022. *California's 2022 Climate Change Scoping Plan Update*. December.

GHG reduction targets signal a direction to investors, businesses, and residents. Clear targets and pathways drive capital towards sustainable development, technology deployment, and infrastructure renewal, thereby creating pathways to a low-carbon economy that aligns with global targets. Targets also enable the development of policies, regulatory instruments, and laws that avoid further emissions and provide the policy framework for action implementation.

3.1.1 Net-Zero Emissions

Since 2018, "net zero by 2050" has been the universal benchmark for national, state, and local governments worldwide, recognizing that reaching this milestone minimizes the risk of severe climate impacts. As of 2024, 147 countries, including the United States, have committed to reach net zero by 2050.[15]

Achieving net-zero emissions requires that GHG emissions produced by human activity are reduced to as close to zero as possible, and any remaining emissions are balanced with an equivalent amount of carbon removal from the atmosphere (e.g., natural carbon removals through the restoration of forests or wetlands, technological carbon capture, and storage).

The pathway to achieve net-zero emissions will determine the pace of GHG emissions reductions and have a significant impact on the cumulative total emissions released to the atmosphere (Figure 3-1). For example, setting more ambitious GHG reduction targets in the near-term provides a significant benefit regarding early reductions in GHG emissions and lower cumulative total GHGs emitted over the timeline. Cumulative emissions will determine the level of global temperature increase and whether we will remain below the threshold of 2.0°C. Although long-term targets are important, effective near-term targets help to reduce a region's cumulative emissions in a given timeframe and therefore reduce the cumulative emissions and contribution to global climate change.

Figure 3-1: Aggressive Near-Term Targets Help Reduce Cumulative Regional Emissions for Long-Term Net-Zero Emissions Scenarios

3.1.2 Paris Agreement

The Paris Agreement represents the collective global response to climate change. Adopted by 196 parties at the United Nations (UN) Climate Change Conference (COP21) in Paris, France, on December 12, 2015, its overarching goal is to hold "the increase in the global average temperature

15 United Nations Environment Programme (2024). Executive summary. In Emissions Gap Report 2024: No more hot air … please! With a massive gap between rhetoric and reality, countries draft new climate commitments. Nairobi. https://doi.org/10.59117/20.500.11822/46404.

to well below 2°C (3.6°F) above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C (2.7°F) above pre-industrial levels." Although the United States has previously joined the Paris Agreement, the United States has withdrawn from the agreement twice, once with a formal withdrawal as of November 4, 2020, and again on January 27, 2025, when an EO was issued for the country to withdraw from the agreement and notification was provided to the United Nations.[16]

3.1.3 Intergovernmental Panel on Climate Change

The role of the Intergovernmental Panel on Climate Change (IPCC) is to advance scientific knowledge about climate change caused by human activities. The IPCC evaluates the global carbon budget that is required to limit warming to 1.5°C (2.7°F) or 2°C (3.6°F). The most recent IPCC report estimates that the carbon budget to keep warming below 1.5°C with 83% certainty is 300 gigatonnes (Gt) of carbon dioxide (CO_2), and for limiting warming to 2°C, the carbon budget is 900 Gt CO_2. The report states that within every scenario, global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO_2 and other GHG emissions occur.

Carbon budgets started out as a communication tool to represent how much carbon the world has left to emit before exceeding our desired global temperature increases, but now jurisdictions are using carbon budgets to place restrictions on the total cumulative amount of GHGs that can be emitted over a certain period of time. Countries and cities (e.g., the United Kingdom; Germany; Edmonton, Canada; and Oslo, Sweden) have adopted carbon budgets into their climate action planning to align with the IPCC recommendations.

3.1.4 Science-Based Target Setting

A science-based target (SBT) downscales the global objective of limiting warming to 1.5°C (2.7°F) or 2°C (3.6°F) to a country, state, or local government. Besides being guided by the latest climate science, SBTs must be equitable and complete.

Equitable or "fair share" considerations require jurisdictions to take into account their contribution to historical emissions and their socioeconomic welfare when setting their emission reduction targets. For example, a government with a high gross domestic product (GDP) per capita and a developed economy would be required to set a target closer to 70%–75% reduction by 2030.

"Complete" means that jurisdictions are developing comprehensive targets that include emissions from at least Scope 1 and Scope 2 (ideally including Scope 3 emissions as well) and considering GHGs beyond CO_2 like HFCs, CH_4, and N_2O. Scope 1 emissions are direct GHG emissions that occur within the jurisdiction's boundary, Scope 2 are emissions from energy production to provide for the community's energy use, and Scope 3 are emissions occurring outside of the jurisdiction's boundary but are a result of the community's activities (i.e., emissions from food production).

[16] Haskett, Jonathan D. 2025. U.S. Withdrawal from the Paris Agreement: Process and Potential Effects. Library of Congress. Website: https://www.congress.gov/crs-product/R48504 (accessed June 20, 2025).

3.1.5 National Targets

Countries set national targets according to a mechanism in the Paris Agreement called the Nationally Determined Contributions (NDC). The target and actions committed to by each country are determined by that country and submitted to the United Nations. The United States NDC sets a target of reducing United States GHG emissions by 50% to 52% below 2005 levels in 2030 and net zero by 2050.

The Climate Action Tracker (CAT) rates the United States target as “Almost sufficient” when compared to modeled domestic emissions pathways but falls short of achieving the reductions required to meet the Paris Agreement’s 1.5°C (2.7°F) warming limit. The CAT analysis indicates a more ambitious target of 58% by 2030 would better align with a 1.5°C (2.7°F) compatible pathway, including providing support for emissions reductions in developing countries.

When compared with its fair-share emissions allocation, the United States target is rated as “Insufficient” because it does not fully meet the emissions reductions needed based on its historical contributions and economic capacity.

3.1.6 CPRG Requirements

The CPRG program recommends target and base year alignment with United States national targets to enable assessment of program impacts and to provide consistency across sectors and jurisdictions. Targets set by grantees should be consistent with international commitments. In addition to economy-wide goals, CPRG encourages short- and long-term sector-specific targets.

3.1.7 California’s State Targets

In 2006, California established its first statewide climate target with the passage of AB 32, aiming to return to 1990 GHG levels (431 million metric tons [MMT] carbon dioxide equivalent [CO_2e]) by 2020—a goal the State achieved several years ahead of schedule. In 2016, SB 32 (i.e., Pavley, Chapter 249, Statutes) set a 2030 target, requiring the State to reduce anthropogenic emissions by 40% below 1990 levels by 2030. The CARB updated the State climate plan in 2022 and aims to exceed the mandated 2030 target by cutting GHGs by 48% below 1990 levels in 2030. The updated climate plan aligned with the passage of AB 1279 (i.e., Muratsuchi, Chapter 337, Statutes of 2022), which codified a target to reduce anthropogenic emissions by 85% below 1990 levels by 2045 and achieve carbon neutrality by 2045.

3.1.8 Fresno County’s Targets

To date, Fresno County does not have any economy-wide targets beyond the State’s mandates. Cities within Fresno County have taken steps to reduce their emissions and increase their accounting and accountability. The City of Fresno developed a Greenhouse Gas Reduction Plan, which aims to achieve the targets set under AB 32, thereby aligning with the statewide goal of returning emissions to 1990 levels by 2020. Other cities in Fresno County (e.g., Reedley) have developed their own Climate Action Plans, while cities such as Clovis include environmental analyses in their general plans as required by State law.

3.1.9 Sector-Specific Targets

3.1.9.1 Energy

The federal government has set the target of 100% clean electricity by 2035. This objective is part of President Biden's broader climate strategy and is supported by various federal programs, policies, and funding mechanisms, including the IRA.

In California, SB 100 mandates that 60% of electricity sales must come from renewable sources by 2030, with a goal of achieving 100% zero-carbon electricity by 2045. The legislation sets interim renewable portfolio standards (RPS) to ensure steady progress toward these goals and fully decarbonize the electric grid.

The Renewable Energy Generation Requirements in SB 100 are:

- 33% by 2020 (target met);
- 50% by 2026;
- 60% by 2030; and
- 100% by 2045.

California's SB 100 explicitly prioritizes zero-carbon energy sources, which include renewable generation and other technologies like nuclear and large hydropower.

Several cities in California have set renewable energy targets that are more ambitious than the State's mandates:

- **San Francisco:** The City and County of San Francisco have committed to achieving 100% renewable electricity by 2025, and 100% renewable energy by 2040, both of which are ahead of the State's 2045 target.

- **San Diego:** San Diego's Climate Action Plan targets 100% renewable electricity citywide by 2035. The County of San Diego joined efforts with the City of San Diego and set the same target in their 2024 Action Plan.

Pacific Gas and Electric Company (PG&E), as the primary utility for Fresno County, has set a voluntary target of 70% RPS for clean electricity by 2030, which exceeds the State's mandated 60% RPS target under SB 100. This commitment demonstrates leadership in advancing clean energy deployment and signals an opportunity for local jurisdictions to align with higher renewable energy ambitions.

3.1.9.2 Buildings

The federal government has not established targets for private commercial and residential buildings but has committed to reducing building emissions 50% by 2032 and achieving net-zero building emissions by 2045 in federally operated buildings.

California has not set specific targets for reducing building emissions outside of SB 32, which aims to reduce statewide emissions 40% by 2030. To achieve this target, the State has identified the building sector as a key to unlocking emission reductions and clearly defined how the sector will be transitioned in the 2022 Scoping Plan. Targets for the building sector include the following:

- 3 million all-electric, electric-ready homes by 2030 and 7 million by 2035
- 100% of residential home appliance sales are electric by 2035
- Over 6 million residential electric heat pumps installed Statewide by 2030
- 80% of commercial appliances sales are all-electric by 2035 and 100% by 2045

The California Energy Efficiency Strategic Plan, developed in 2008 and updated in 2011,[17] also sets out ambitious goals for the State, including the following:

- All new residential construction will be zero net energy (ZNE) by 2020
- All new commercial construction will be ZNE by 2030
- 50% of commercial buildings will be retrofitted to ZNE by 2030
- 50% of new major renovations of state buildings will be ZNE by 2025

Although these aggressive targets were established and action plans have been developed as recently as 2015 to support the implementation of the plan, some of the targets established have not been met; however, progress continues to be made through the implementation of California's Building Energy Efficiency Standards included in Title 24, Part 6 of the California Building Standards Code and Title 24, Part 11, the California Green Building Standards Code.

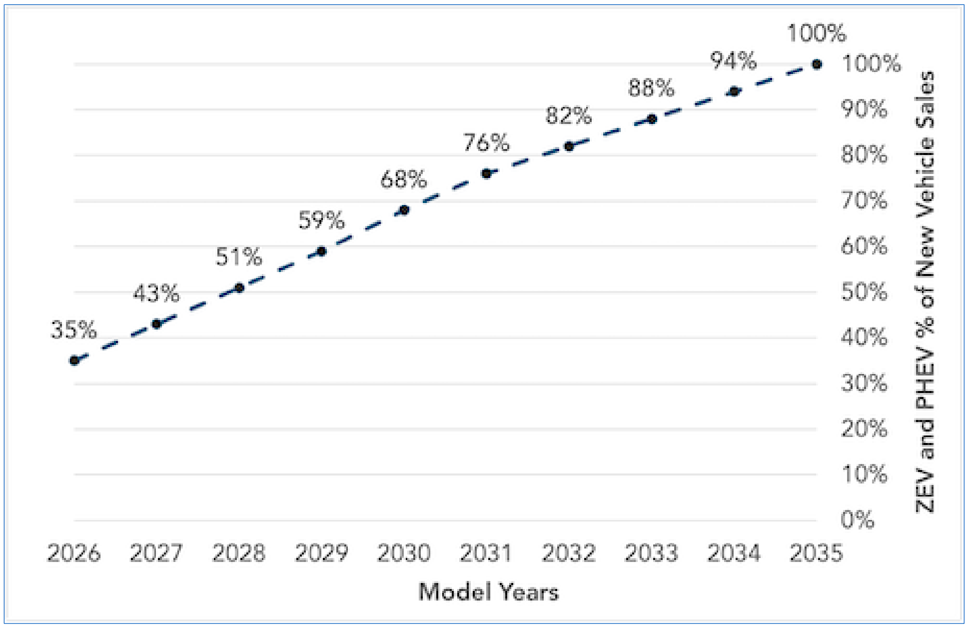
3.1.9.3 Transportation

As a part of President Biden's climate commitments, the federal government had set a target of 50% of new light-duty car sales to be zero emission vehicles (ZEVs) by 2030; however, this target was revoked by President Trump through an EO.[18]

Under Section 209(b) of the federal Clean Air Act (CAA), the State of California is uniquely authorized to seek waivers from the EPA to implement motor-vehicle emission standards more stringent than federal requirements. This authority, administered through CARB, has been central to advancing the State's GHG reduction and zero-emission vehicle (ZEV) goals. Waivers have enabled landmark programs (e.g., Advanced Clean Cars II, Advanced Clean Trucks, and the Heavy-Duty Low NO_x Omnibus regulation) that directly reduce GHG and criteria-pollutant emissions from the transportation sector. The State of California has an accelerated target under the Advanced Clean Cars II regulation, which was adopted in 2023 and requires 35% of new vehicle sales to be ZEVs in 2026 and 100% of new vehicle sales to be ZEVs by 2035 (Figure 3-2).

17 California Public Utilities Commission (CPUC). 2011. California Energy Efficiency Strategic Plan, January 2011 update. Website: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/energy-efficiency-strategic-plan (accessed May 20, 2025).

18 Whitehouse.gov. 2025. Website: https://www.whitehouse.gov/presidential-actions/2025/01/unleashing-american-energy/ (accessed June 20, 2025)



Source: CARB.

Figure 3-2: Advanced Clean Cars II Requirements for New EV Sales

While Advanced Clean Cars II focuses on light-duty passenger vehicles, EO N-79-20 takes aim at reducing emissions from medium-duty vehicles (MDV) and heavy-duty vehicles (HDV), including off-road vehicles, by setting the target of 100% of new MDV and HDV sales are ZEVs by 2040 and 100% of off-road vehicles and equipment are ZEVs by 2035, where feasible. The transition is mandated through the Advanced Clean Fleets regulation and the Advanced Clean Trucks rule, as part of CARB's strategy to reduce emissions related to trucking in the state.

In addition to increasing the number of electric vehicles on the road, California set vehicle miles traveled (VMT) reduction targets to reduce reliance on single-occupancy vehicles, instead promoting transit and active transportation and encouraging compact land use. In response to SB 375, the State aims to reduce VMT to 25% below 2019 levels by 2030, and 30% below 2019 levels by 2045.

Other local jurisdictions in the State have their own VMT reduction targets. For example, the Sacramento Area Council of Governments aims to reduce VMT by 15% by 2030 through new residential and office/business development.

The State has also set targets to reduce emissions in aviation and freight industries that may be relevant to Fresno County:

- 20% of aviation fuel demand is met by electricity (batteries) or hydrogen (fuel cells) by 2045.
- 100% of passenger and other locomotive sales are ZEV by 2030.
- 100% of line haul locomotive sales are ZEV by 2035.

Off-road vehicles are also included in the transportation category. CARB has established requirements to phase out older diesel engines and replace them with newer, low, or zero-emissions engine equipment through the In-Use Off-Road Diesel-Fueled Fleets Regulation and the Small Off-Road Engine (SORE) regulation. The San Joaquin Valley Air Pollution Control District (SJVAPCD) Off-Road Replacement program historically supported the deployment of clean air technology construction equipment, along with State programs (e.g., the Carl Moyer Memorial Air Quality Standards Attainment Program [Moyer Program] and the Clean Off-Road Equipment Voucher Incentive Program [CORE]) administered by CARB and CALSTART.

Due to technological and economic feasibility issues related to electrifying agricultural equipment, the SJVAPCD, in partnership with the agricultural community and CARB, implements incentive programs to help accelerate the adoption of clean air technology agricultural equipment, including agricultural pumps, tractors, feed mixers, utility vehicles, and other off-road equipment. This nationally recognized program is focused on reducing criteria pollutant emissions in the region but also serves to reduce GHG emissions through electrification of equipment where technologically feasible and the deployment of cleaner technology engines where electrification is not feasible due to the unique requirements of agricultural operations. These types of incentive programs have served to accelerate reductions of GHG emissions in the county and continue to support the deployment and technological advancement of clean air technology equipment.

3.1.9.4 Industry

The United States Department of Energy's Industrial Decarbonization Roadmap (Roadmap) is a pathway to net-zero emissions by 2050 across industries. The Roadmap focuses on chemical manufacturing, petroleum refining, iron and steel, food and beverage, and cement industries because they are the largest emitters. To achieve net zero, the Roadmap establishes four core pillars, including energy efficiency; industry electrification; low-carbon fuels, feedstocks, and energy sources; and carbon capture, utilization, and storage.

California broadly does not have specific GHG emission reduction targets for the industrial sector. As of now, only the cement industry will be given guidance on decarbonizing. SB 596 tasks CARB with developing a comprehensive strategy to reduce emissions from cement use and production, aiming to achieve a GHG reduction of 40% below 2019 levels by 2035, and net zero by 2045.

Hydrogen has been identified as playing a key role in decarbonizing the sector. In 2022, the adoption of SB 1075 required the CARB, the California Energy Commission (CEC), and the California Public Utilities Commission (CPUC) to develop a Hydrogen Development, Deployment, and Use report that will detail how much and how quickly hydrogen will be transitioned in the market. The full report has not been produced yet.

Other industrial emitters are assumed to reduce emissions based on a trickle-down effect from other sectoral decarbonization. For example, oil and gas extraction and refining are assumed to have a reduced demand and in turn to reduce supply. Additionally, the 2022 Scoping Plan commits to building no new gas plants.

3.1.9.5 Waste

In 2020, the EPA announced a new national recycling target that hopes to increase United States recycling to 50% by 2030. In 2023, the national average rate of recycling was 32%.

In California, AB 341, adopted in 2011, targets a recycling rate goal of 75% by 2020; however, the State has struggled to meet this target rate. When the target was adopted, the diversion rate was 66%, but recycling has fallen to around 40% in 2018 and 2019.

SB 1383, the Climate Pollutants Reduction Act, aims to cut organic waste disposal (e.g., food scraps, yard waste) by 75% by 2025, and requires counties to lead the planning necessary for diversion and food recovery. The Climate Pollutants Reduction Act also establishes the statewide goal of recovering at least 20% of surplus edible food for human consumption by 2025.

Because cities tend to have direct management and jurisdiction over waste collection, they are at the forefront of zero waste commitments. Zero waste commitments set out to achieve diversion rates as high as 80%–100%, with typical milestone target years including 2030 and 2040. The City of Fresno was an earlier advocate, adopting a Zero Waste Action Plan in 2005. A number of other smaller cities and counties in California are also participating in this initiative, including Fairfax, Sunnyvale, Oceanside, Burbank, Sonoma County, and Marin County.

3.1.9.6 Agriculture

The Global Methane Pledge signed in 2021 by the United States and the European Union aims at reducing global CH_4 emissions by 30% below 2020 levels by 2030. The agriculture and land use sectors will be key to reducing CH_4 emissions.

In California, SB 1383 requires CH_4 emissions reduction of 40% below 2013 levels by 2030 and sets an equivalent CH_4 emissions reduction target specifically for the dairy and livestock sector.

Actions that support emission reductions from the agricultural sector include the phase out of agricultural burning required by SB 705 and implemented by the SJVAPCD. Effective January 1, 2025, a near-complete burn ban is in effect, with no burning allowed for mandated crop-types with some exceptions (SJVAPCD can issue permits for agricultural burning for specific crop types and to prevent disease). Furthermore, SB 859 established healthy soils practices to help reduce GHG emissions from agricultural lands and requires the quantification of the program's GHG emission reductions. The 2022 Scoping Plan aims to increase organic agriculture to 20% of all cultivated acres by 2045 to support California in achieving carbon neutrality. The SJVAPCD implements two rules specifically for agricultural operations that serve to reduce GHG emissions in addition to criteria air pollutants: Rule 4570, Confined Animal Facilities, which requires specific mitigation measures for manure handling and animal housing, and Rule 4550, Conservation Management Practices, which requires the implementation of practices such as conservation tillage for larger agricultural operations.

The California Department of Food and Agriculture (CDFA) administers two complementary programs that significantly reduce methane emissions from the State's dairy and livestock sector: the Dairy Digester Research and Development Program (DDRDP) and the Alternative Manure Management Program (AMMP). The DDRDP provides cost-share grants for the installation of anaerobic digesters that capture and convert methane from manure into renewable electricity, compressed natural gas, or pipeline-quality biomethane, effectively displacing fossil fuels. In contrast, the AMMP supports projects that avoid methane formation altogether by transitioning from flush-based systems to scrape or dry manure handling, enhancing solids separation, installing compost-bedded pack barns, or expanding pasture-based management. Together, these programs advance California's statutory target under SB 1383. The majority of DDRDP and AMMP projects have been implemented in the San Joaquin Valley, including Fresno County, due to the region's high concentration of dairy operations and associated methane reduction potential.

Complementary industry and nonprofit initiatives (e.g., those led by Dairy Cares, the California Dairy Research Foundation, and other regional partners) have played a key role in program implementation, producer education, and quantification of achieved reductions.[19] According to recent reports, California dairies have already reduced sectoral methane emissions by approximately 5 MMT CO_2e per year,[20] equivalent to achieving more than two-thirds of the 2030 target. These reductions are attributed to a diversified mitigation portfolio combining methane capture (DDRDP) and methane avoidance (AMMP) strategies. Continued coordination among CDFA, CARB, and industry stakeholders, along with continued funding support, will be critical to maintain progress, facilitate broader adoption of climate-smart manure management practices, and ensure further emission reductions in Fresno County.

Beyond GHG emissions targets, the Sustainable Groundwater Management Act (SGMA), enacted in 2014, requires critically overdrafted basins, including those in Fresno County, to achieve groundwater sustainability by 2040. Local Groundwater Sustainability Agencies (GSAs) are responsible for developing and implementing Groundwater Sustainability Plans (GSPs) that balance groundwater withdrawals with recharge. SGMA has direct implications for the agricultural sector, as compliance often requires reducing groundwater pumping, which is projected to lead to the fallowing or conversion of large acreages of irrigated cropland across the San Joaquin Valley.

Reduced irrigation threatens farm revenue, employment, and food production. Research indicates that land retirement can provide pathways for habitat restoration, dryland farming, groundwater recharge basins, or renewable energy installations.[21] State initiatives such as the Multibenefit Land Repurposing Program (established by SB 170, 2021) are supporting local agencies and landowners in planning transitions that align with SGMA while advancing climate and community goals.[22]

Given the magnitude of anticipated land use change, SGMA implementation is expected to be a defining driver of agricultural GHG outcomes and climate adaptation in the San Joaquin Valley. Local planning efforts should monitor and incorporate SGMA-related acreage transitions when estimating agricultural sector emissions and evaluating opportunities for Working and Natural Lands carbon

---

19 Dairy Cares. 2024. *California dairy sustainability progress report: Delivering on climate goals.* Website: dairycares.com (accessed October 2025).

20 California Department of Food and Agriculture. 2024. CDFA Dairy Digester Research and Development Program (DDRDP) and Alternative Manure Management Program (AMMP) annual report: 2023–2024 progress update. Website: https://www.cdfa.ca.gov/oefi/ (accessed October 2025).

21 Van Schmidt, N. D. et al. 2022. *Linkages between land-use change and groundwater under SGMA requirements*.

22 Public Policy Institute of California (PPIC). 2024. *Managing Water and Farmland Transitions in the San Joaquin Valley*.

sequestration. Chapter 4 of this document, GHG Emissions Projections, further discusses research and assumptions related to land use conversions due to SGMA requirements.

3.1.9.7 Working and Natural Lands

At the federal level, the United States emphasizes nature-based solutions and land-sector carbon sinks through the White House Nature-Based Solutions Roadmap[23] and resource guides, alongside United States Department of Agriculture (USDA) programs that fund climate-smart agriculture and forestry (e.g., Environmental Quality Incentives Program [EQIP]/ Conservation Stewardship Program [CSP] expansions under the Inflation Reduction Act [IRA] and the Partnerships for Climate-Smart Commodities).[24] These initiatives aim to increase soil carbon, reduce CH_4 and N_2O, and restore forests and wetlands, although funding design and availability have been in flux in 2025.

California sets the strongest, most specific direction for Working and Natural Lands. The 2022 Scoping Plan integrates Working and Natural Lands as a critical, durable carbon sink. AB 1757[25] requires the California Natural Resources Agency, CARB, California Environmental Protection Agency, and CDFA to establish sequestration and nature-based climate-solution targets for 2030, 2038, and 2045 and to align the targets in the Scoping Plan. EO N-82-20[26] and the 30×30 Initiative further commit to conserving 30% of lands and coastal waters by 2030, with an updated Natural and Working Lands Climate Smart Strategy guiding implementation.

AB 2251[27] requires California Department of Forestry and Fire Protection (CAL FIRE) to complete a statewide strategic plan to achieve a 10% increase in tree canopy cover in urban areas by 2035, prioritizing tree coverage in low-income and disadvantaged communities (LIDAC) and low-canopy areas. This has direct local relevance: cities and counties within Fresno County will need to coordinate urban forestry programs, track canopy growth, and align with equity-based State targets. Fresno's collaboration with Tree Fresno and other community-based organizations is already moving in this direction, setting the stage for locally specific tree-planting targets and GIS-based monitoring.

Locally, relevant policies include SGMA-driven groundwater sustainability (affecting land fallowing/conversions and habitat opportunities); Fresno-area planning (e.g., General Plans and Fresno COG climate planning) also frame farmland conservation, habitat restoration, and GHG reductions. SGMA has become one of the most significant drivers of land-use change, as groundwater pumping restrictions are leading to large areas of land fallowing and conversion. This presents both risks (e.g., dust and loss of agricultural productivity and jobs) and potential opportunities (e.g., habitat

23 Biden-Harris Administration. 2022. *Opportunities to Accelerate Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity & Prosperity*. The White House. November.

24 United States Department of Agriculture, Natural Resources Conservation Service. 2023. *Conservation programs: EQIP and CSP climate-smart practices*. Washington, DC: USDA NRCS. Retrieved from https://www.nrcs.usda.gov/programs-initiatives

25 California Legislature. 2022. *Assembly Bill 1757: Natural and Working Lands, Carbon Sequestration Targets*. California State Legislature.

26 California Governor's Office. 2020. *Executive Order N-82-20: Addressing the Climate Crisis, Protecting the Environment, and Advancing Related Priorities*. State of California. October.

27 California Legislature. 2022. *Assembly Bill 2251 (Chapter 186, Statutes of 2022): Urban forestry: statewide strategic plan*. Public Resources Code § 4799.10.2.

restoration, carbon sequestration, and solar deployment). GSAs and stakeholders are actively evaluating how to repurpose these lands in ways that advance climate goals.

Locally adopted General Plans and specific climate planning efforts through Fresno COG also establish farmland conservation, tree canopy, and habitat goals that overlap with State Working and Natural Lands targets. One of the central outputs of the Fresno COG *Extreme Heat Analysis and Shade Adaptation Plan*, currently under development, will be a prioritized list of native and drought-tolerant tree canopy and vegetative cover project areas for implementation, particularly in disadvantaged or low-canopy neighborhoods.[28,29] This connects directly to broader State-level goals (e.g., AB 2251's 10% urban tree canopy increase) and is expected to inform General Plan updates, long-range plans, infrastructure retrofits, and capital improvement planning in cities and Fresno County.

3.2 FRESNO COUNTY CCAP-A TARGETS

Fresno County's economy-wide GHG targets Fresno County's economy-wide GHG targets reduction targets are designed to align with California's long-term climate goals while recognizing the County's unique baseline year and emissions profile. Targets were informed by SB 32, which requires statewide emissions reductions of 40% below 1990 levels by 2030, and the 2022 California Scoping Plan, which charts a path to carbon neutrality by 2045.

Because the State uses 1990 as its baseline, Fresno County adjusted the statewide targets to reflect a more recent starting point. The year 2019 was selected as the County's baseline because it was the most recent year with a complete and verified GHG inventory. This adjustment ensures that local targets are both rigorous and achievable, while maintaining consistency with the intent of California's broader climate policies. Fresno County's reduction goals also account for GHG sequestration from natural and working lands.

Table 3.B summarizes Fresno County's adjusted reduction goals and compares them to modeled business as usual (BAU) and business as planned (BAP) scenarios.

As shown, under a BAU pathway, emissions would increase modestly from 12.5 MMT CO_2e in 2019 to 12.7 MMT CO_2e in 2030, leaving the county far from the 36% reduction target (to 8.0 MMT CO_2e), a shortfall of 4.7 MMT CO_2e in 2030. Under the BAP scenario, emissions decline to 10.5 MMT CO_2e in 2030, reflecting the impact of existing federal, State, and local policies. However, this still falls short of near-term reduction target, with emissions exceeding the goal by 2.5 MMT CO_2e annually. Looking further ahead, by 2045, the BAU pathway results in emissions of 14.5 MMT CO_2e, an increase of 16% compared to 2019 levels. In contrast, the BAP scenario continues to reduce emissions, reaching 8.8 MMT CO_2e by 2045. Although this represents some progress, it only delivers a 30% reduction from 2019, falling well short of the 84% reduction target required to align with California's climate commitments. These projections are illustrated in Figure 3-3, below.

28 Fresno Council of Governments (Fresno COG). 2024. Request for Proposals: Fresno County Extreme Heat Analysis & Shade Adaptation Plan. October.

29 California Department of Transportation (Caltrans). 2024. *Sustainable Transportation Planning Grants: Fiscal Year 2024-25 Award List*. California Department of Transportation.

Table 3.B: Adjusted County Emission Reduction Goals for Base Year 2019

Year	Reduction Targets (%)	Target Emissions (MMT CO_2e)	BAU Projection (MMT CO_2e)	BAU Gap	BAP Projection (MMT CO_2e)	BAP Gap
2019	Base Year	12.5	12.5	0	12.5	0
2030	36%	8	12.7	4.7	10.5	2.5
2045	84%	2	14.5	12.5	8.8	6.8

Source: SSG (2025).
BAP = business as planned
BAU = business as usual
CO_2e = carbon dioxide equivalent
MMT = million metric tons

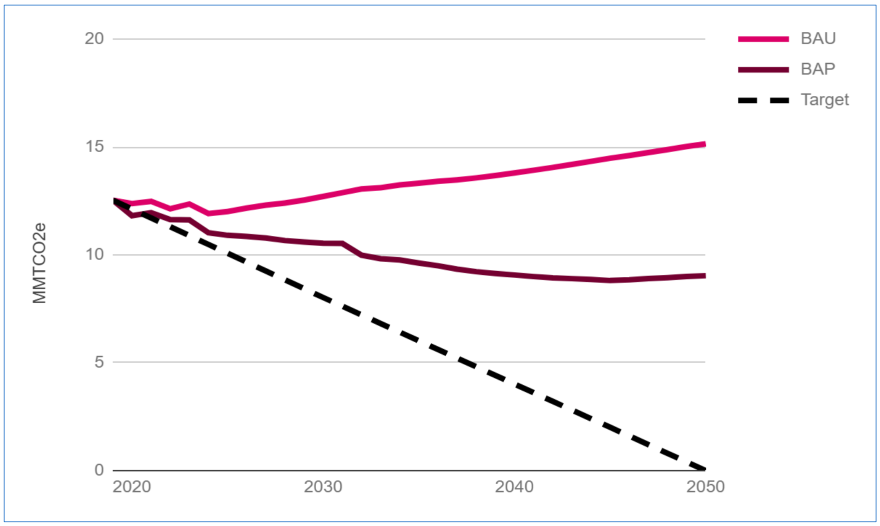
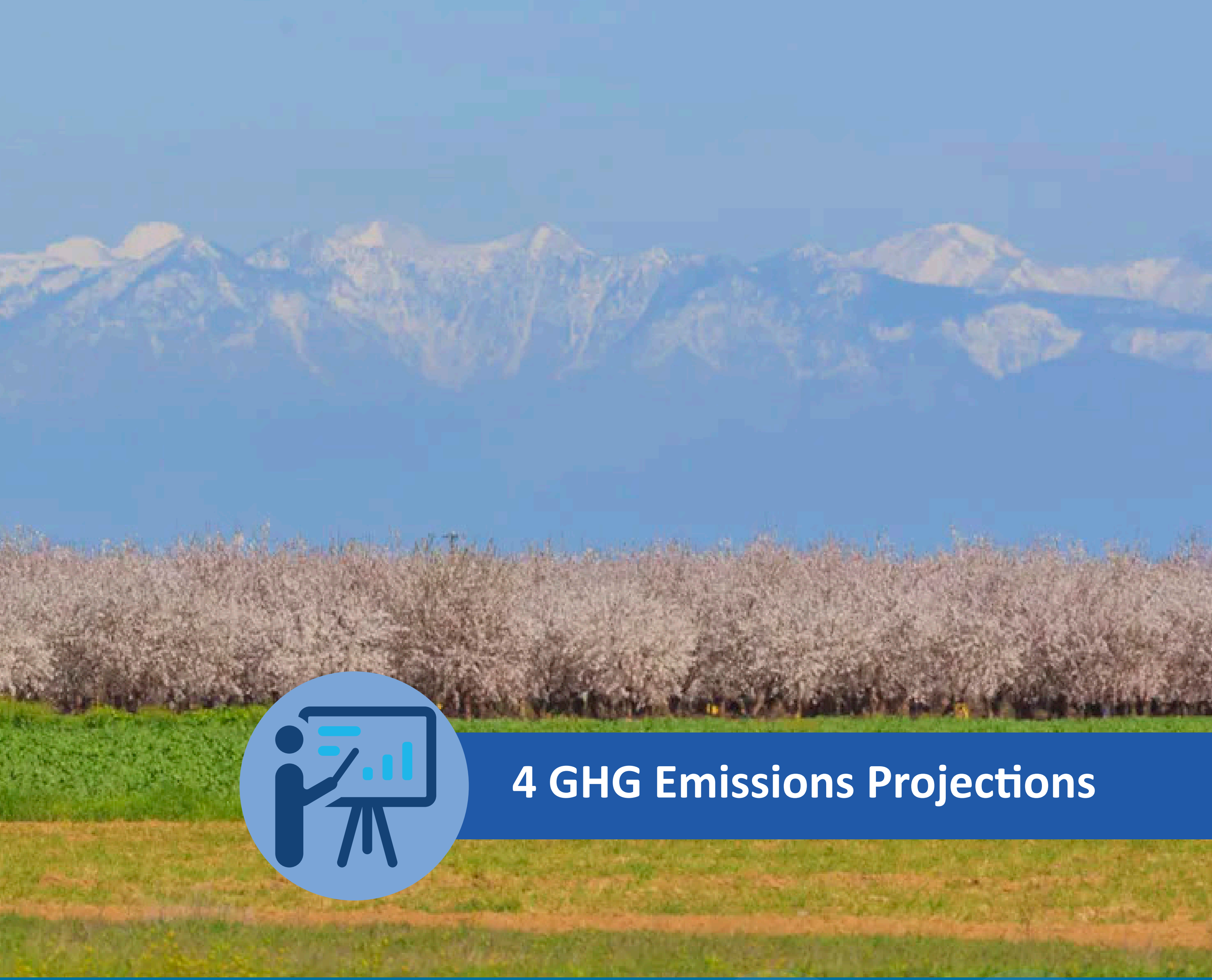


Figure 3-3: BAU and BAP Projection Scenarios Compared to Fresno County's Target

These targets are grounded in California's statutory requirements and climate policy trajectory, ensuring local consistency with SB 32, the 2022 Scoping Plan, and the State's 2045 carbon neutrality goal (as included in AB 1279). The use of a 2019 baseline reflects the most recent pre-pandemic year with complete data, avoiding distortions associated with the economic slowdown in 2020 while providing a reliable foundation for measuring progress. Establishing a County-specific baseline also ensures comparability across sectors and alignment with regional planning efforts. Importantly, the targets are not only about compliance with State law; they also reflect Fresno County's opportunity to capture significant co-benefits, including improved air quality, enhanced public health, lower household energy costs, and strengthened resilience for disadvantaged communities.

The shortfalls shown in Table 3.B make clear that while existing policies will reduce emissions, they are insufficient to achieve the County's share of California's climate goals. This gap underscores the importance of the CCAP-A as the vehicle for identifying new measures to bridge the difference, positioning Fresno County to both meet legal obligations and maximize local benefits.



4 GHG Emissions Projections

4.0 GHG EMISSIONS PROJECTIONS

The Fresno Council of Governments (Fresno COG) developed two reference scenarios to project greenhouse gas (GHG) emissions through 2050. These scenarios provide a framework for understanding how emissions could evolve in the absence of additional climate action and serve as a foundation for long-range climate planning. The projections are organized into two distinct scenarios:

- **Business as Usual (BAU):** Assumes that no new GHG reduction policies or programs are implemented beyond those in place today.
- **Business as Planned (BAP):** Reflects the emissions trajectory if all currently adopted and committed policies, plans, and regulations are fully implemented.

The difference between the BAU and BAP scenarios allows for the isolation of the emissions reductions expected from current policy commitments and to evaluate how much further action is needed to meet long-term climate goals. These scenarios help illustrate the emissions gap that remains without further intervention and inform the development of strategies in the CCAP-A.

This section describes the methods for developing the scenarios and the projection results. More detailed information on data sources, modeling techniques, assumptions, and quality assurance processes can be found in the Data, Methods, and Assumptions (DMA) Manual in Appendix C.

Table 4.A summarizes GHG emission projections for the base year, 2030, and 2050 by sector under both the BAU and BAP scenarios, providing a foundation for understanding how Fresno County's emissions might change in the future.

Table 4.A: Total GHG Emissions by Scenario and Sector (MT CO_2e)

Sector	2019 Base Year Emissions	BAU Scenario		BAP Scenario	
		2030	2050	2030	2050
Agriculture	2,815,106	1,821,052	2,108,890	1,660,780	1,613,131
Commercial	777,503	820,116	890,974	608,872	300,745
Fugitive	14,673	15,586	17,189	15,005	16,408
Industrial	1,304,491	1,574,607	1,764,583	1,426,147	1,391,356
Municipal	-708,300	-708,300	-708,300	-708,300	-708,300
Residential	254	253	255	225	176
Working and Natural Lands	1,094,008	949,654	1,087,780	705,409	435,751
Transportation	6,769,971	7,352,218	8,834,232	6,170,299	5,153,450
Waste	468,391	884,116	1,150,887	662,382	833,356
Total Emissions	**12,536,096**	**12,709,300**	**15,146,490**	**10,540,821**	**9,036,073**
% Change Over Base Year		**1%**	**21%**	**-16%**	**-28%**

Source: SSG (2025).
BAU = business as usual
BAP = business as planned
CO_2e = carbon dioxide equivalent
MT = metric tons

4.1 SCENARIO PROJECTIONS METHODOLOGIES

To understand how emissions in Fresno County could change over time, two emission projection reference scenarios were created and analyzed through 2050. These scenarios are not predictions for the future, but plausible, evidence-based pathways that illustrate how emissions may evolve based on current data, anticipated trends, assumptions about the key drivers for emissions, and supplemented by community feedback. This section describes the approach to developing the scenarios.

4.1.1 Modeling Tool

To explore future energy and emissions pathways in Fresno County, analysis was conducted using SSG's ScenaCommunity model. ScenaCommunity is an integrated, multi-sector, multi-fuel energy systems model that combines demographic, building, transportation, and energy-use data to simulate the evolution of energy demand, GHG emissions, and financial changes over time.

Each community is modeled as a system of interdependent "stocks and flows." For example, the stock of space heating equipment and the flow or replacement at the end-of-life cycle. This allows the model to represent how long-lived infrastructure-like buildings influence emissions trajectories differently than shorter-lived assets like vehicles. These dynamics are also used in financial assessments. For example, the cost of replacing a gas boiler with a new electric boiler is modeled differently than switching to a heat pump, which has different installation and operating costs. These interactions help ensure climate action planning is responsive to both sector-specific impacts and system-wide feedback.

For more details on model inputs, assumptions, and calibration methods, please refer to the Data, Methods, and Assumptions Manual (Appendix C).

4.1.2 Reference Scenarios

Table 4.B summarizes the reference scenarios modeled for the GHG emissions projections.

Table 4.B: Descriptions of the Reference Scenarios Developed for Fresno County

Scenario Label	Title	Description
BAU	Business as Usual	A scenario that extrapolates current demographic patterns into the future to illustrate energy use and GHG emissions (and sinks, if applicable) if no additional plans, policies, programs and projects are implemented. This scenario answers the question, "What would happen if no further actions are taken?"
BAP	Business as Planned	A reference scenario that extrapolates current demographic patterns into the future while taking into account existing and approved plans, legislations and targets that would affect energy use and emissions, and assuming no additional climate action interventions are taken. This scenario answers the question, "What would happen if only current actions, plans and policies are implemented?"

4.1.3 Modeling the Scenarios

After the base year inventory was completed, BAU and BAP scenarios were modeled to forecast energy use and emissions annually out to 2050. The ScenaCommunity spatial energy and emissions modeling tool was used to develop these scenarios based on the key assumptions described in Table 4.C on the following page.

For additional information on the modeling process and its inputs and assumptions, see the Data, Methods and Assumptions Manual (Appendix C).

4.1.4 Limitations

The methodology and results presented here do not and cannot fully account for all the factors that could shape the future of energy use and GHG emissions in Fresno County. The resulting projections are intended not to predict the future, but to help us understand how different choices and changes could affect the path forward.

4.2 BAU PROJECTIONS RESULTS

In the BAU scenario, population, employment, and housing continue to grow, while energy sources, transportation patterns, and land use remain consistent with current trends. Under the BAU scenario, emissions are projected to decline slightly by about 1%, reaching net emissions of 12.7 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) by 2030, but are also projected to increase by 21%, up to 15.1 MMT CO_2e by 2050. Early reductions are due to effects of the COVID 19 pandemic and slowed population growth. By 2050, anticipated development and jobs across the region would steadily increase emissions.

Figure 4-1 shows Fresno County's total GHG emissions, excluding carbon sequestration from the Working and Natural Lands sector. Total emissions refer to the gross amount of GHGs released from emissions sources like transportation, while net emissions account for CO_2e that has been removed through sequestration by forests and natural lands. Without factoring sequestration into the BAU scenario, total emissions were 13.2 MMT CO_2e in 2019, projected to be 13.4 MMT CO_2e by 2030, and projected to increase to 15.9 MMT CO_2e by 2050.

4.3 BAP PROJECTIONS RESULTS

The BAP scenario represents Fresno County's projected energy use and emissions pathway if no new climate actions are taken beyond those already adopted or underway. The BAP scenario incorporates existing plans, policies, legislation, and regulations, as well as expected growth in population and employment. The BAP scenario does not include unapproved proposals or aspirational targets that lack committed resources.

The BAP scenario serves as the baseline against which the measures in the Low-Carbon Scenario are assessed within the CCAP-A. Once implementation begins, it also provides a reference point for measuring the impact of climate policies and programs.

Table 4.C: Modeling Parameters and Assumptions for BAU and BAP Scenarios

Category	BAU Scenario	BAP Scenario
Demographics	• 0.98 million people in 2019 • 1.07 million people by 2035 ○ (avg of 0.82% per year) • 1.13 million people by 2050 • (avg of 0.64% per year) • Average rate of growth 4,548 people per year[1]	Same as BAU

Employment Growth	• 0.44 million jobs in 2019
	• 0.50 million jobs by 2035
	  ○ (avg of 0.5% per year)
	• 0.53 million jobs by 2050
	  ○ (avg of 0.7% per year)
	• Average rate of growth 2,802 jobs per year[1]
		Same as BAU

Heating and Cooling Degree Days	• Projections of Heating and Cooling degree days for the County - Climate Explorer[2]	Same as BAU
New Residential Building Growth	• 69,470 new residential units are added between 2022 and 2060. Of this 49,900 (72%) will be single-family and 19,560 (28%) will be multi-family.[1]	Same as BAU
New Non-Residential Building Growth	• Growth based on projected growth in employment. Building types added based on the building mix of the county where job growth is happening.[1]	Same as BAU
Energy Use by Building	• Baseline building equipment types/stocks held from 2019–2050.	Residential buildings built after 2020 use 7% less energy than baseline due to 2019 Building Energy Efficiency Standards. Non-residential buildings built after 2020 use 30% less energy than baseline due to 2019 Building Energy Efficiency Standards.[3]
Rooftop PV Solar	• Baseline rooftop solar generation held from 2019–2050.	2019/2022 Title 24 Building Energy Efficiency Standards include the solar mandate, which requires that all new residential and non-residential buildings be built with solar PV systems.[4] Solar installations on existing residential buildings remain constant aligned with CaliforniaDGStats.[5]
Appliances	• Baseline rates of heat pumps and efficiency standards of appliances held from 2019–2050.	Increased installation of heat pumps due to the 2022 California Energy Code update.[3] All appliances must comply with the 2022 Appliance Efficiency Standards as summarized in Section 110 of the California Energy Code.[6]
Agricultural Projections	• Agricultural projections are based on historical averages (2009–2023) from the Annual Crop & Livestock Report,[7] combined with REMI's Farm Output forecasts for 2023–2050.	Builds on BAU projections and implements Alternative Manure Management Program (AMMP),[8] State Water Efficiency & Enhancement Program (SWEEP),[9] and Healthy Soils Initiative.[10] Incorporates SGMA reductions in irrigated agricultural land by removing 124,327 acres from production by 2040 and extrapolating this reduction to 2050.[11]
On-Road Transportation Projections	• Transportation projections use EMFAC data[12] and Fresno COG's Transportation Model[13] to estimate trends for VMT, vehicle stock by type, and trip counts	Same projection sources as BAU. Rate of PUV and commercial vehicle electrification based on EMFAC CARB.[14] Implement Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles, and Phase 1 and Phase 2 of EPA Fuel Standards for Medium- and Heavy-Duty Vehicles.[15]

Table 4.C: Modeling Parameters and Assumptions for BAU and BAP Scenarios

Category	BAU Scenario	BAP Scenario
Publicly Owned Vehicle Projections	• Baseline vehicle types held from 2019–2050.	Rate of transit electrification based on this EMFAC CARB:[12] • **FAX (metro):** Fully transition its bus fleet to zero-emission by 2040. • **FCRTA (rural):** Plans for full electrification by 2025 Following jurisdictions committed to EV fleets: Coalinga, Firebaugh, Fresno. Huron, Kerman, Mendota, Reedley, San Joaquin, Selma, Fresno County[16]
Off-Road Projections	• Baseline vehicle types held from 2019–2050.	Off-road fuel consumption projections based on EMFAC.[12]
Aviation Fuel	• Baseline fuel type held from 2019–2050.	Sustainable fuels target for the aviation sector of at least 20% by 2030.[17]
Waste Sector	• Waste generation is influenced by population and employment growth.	Aligned with emission reductions and diversion targets of SB 1383, Short-Lived Climate Pollutant Reduction Act, organic waste methane emissions reductions.[18]

1 Fresno Council of Governments, 2024 Fresno COG 2023–2060 Growth Projections, adopted November 21, 2024, https://www.fresnocog.org/wp-content/uploads/2023/11/2024-Fresno-COG-2023-2060-Growth-Projections-adopted-Nov_21_2024.pdf.
2 National Environmental Modeling and Analysis Center (NEMAC), Climate Explorer, http://nemac.org.
3 California Energy Commission, accessed May, 2025, https://www.energy.ca.gov/.
4 California Energy Commission, 2022 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, CEC-400-2022-010-CMF, December 2022, https://www.energy.ca.gov/sites/default/files/2022-12/CEC-400-2022-010_CMF.pdf.
5 California Distributed Generation Statistics, Data Visualizations and Charts, accessed May, 2025. Website: https://www.californiadgstats.ca.gov/charts/.
6 California Energy Commission, Appliance Efficiency Proceedings – Title 20 https://www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-title-20/appliance-efficiency-proceedings.
7 Fresno County Department of Agriculture, Annual Crop & Livestock Report, accessed June, 2025, https://www.fresnocountyca.gov/Departments/Agricultural-Commissioner/Annual-Crop-Livestock-Report.
8 California Department of Food and Agriculture, Alternative Manure Management Program: Project Level Data, accessed June, 2025, https://www.cdfa.ca.gov/oefi/AMMP/docs/AMMP_Project_Level_Data.pdf.
9 California Department of Food and Agriculture, State Water Efficiency and Enhancement Program (SWEEP), accessed June, 2025, https://www.cdfa.ca.gov/oars/sweep/.
10 California Department of Food and Agriculture, Healthy Soils Program, accessed June, 2025. Website: https://www.cdfa.ca.gov/oars/healthysoils/.
11 Public Policy Institute of California. 2023. Managing Water and Farmland Transitions in the San Joaquin Valley. Website: https://www.ppic.org/publication/managing-water-and-farmland-transitions-in-the-san-joaquin-valley (accessed September 2025).
12 California Air Resources Board, EMFAC Emissions Inventory, accessed June, 2025, https://arb.ca.gov/emfac/emissions-inventory/0f3cc7b32ce9428aeafac800649972fdcce340ec.
13 Fresno Council of Governments, Regional Transportation Plan, accessed May, 2025, https://www.fresnocog.org/project/regional-transportation-plan/.
14 California Air Resources Board, EMFAC Emissions Inventory, https://arb.ca.gov/emfac/emissions-inventory/46af25266f2696217e1cf4c429bdeea4524f15b8.
15 National Highway Traffic Safety Administration, Corporate Average Fuel Economy (CAFE) Standards, https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy.
16 Fresno Council of Governments, Electric Vehicle Readiness Plan, 2021, https://www.fresnocog.org/wp-content/uploads/2017/06/FCOG-EVRP-2021-1.pdf.
17 California State Legislature, Assembly Bill 1322 (2021–2022): Aviation Greenhouse Gas Emissions Reduction Plan, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1322.
18 California Department of Resources Recycling and Recovery (CalRecycle), Short-Lived Climate Pollutants (SLCP): Organic Waste Methane Emissions Reductions, https://calrecycle.ca.gov/organics/slcp/.

BAP = business as planned
BAU = business as usual
CARB = California Air Resources Board
EPA = United States Environmental Protection Agency
EV = electric vehicle
FAX = Fresno Area Express
FCRTA = Fresno County Rural Transit Agency
Fresno COG = Fresno Council of Governments
PUV = public utility vehicle
PV = photovoltaic
SB 1383 = Senate Bill 1383
VMT = vehicle miles traveled

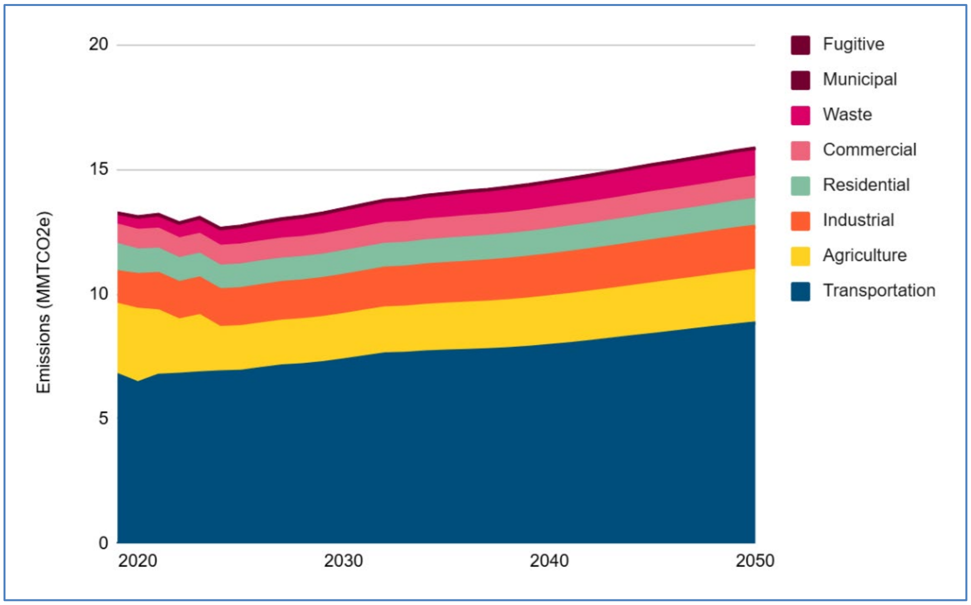


Figure 4-1: Projected GHG Emissions by Sector in the BAU Scenario

4.3.1 BAP Projections for Total Community GHG Emissions

Under the BAP scenario, Fresno County's net GHG emissions are projected to decline from 12.5 MMT CO_2e in 2019, to 10.6 MMT CO_2e by 2030, and then further decline to 9.0 MMT CO_2e by 2050. Referencing the total emissions in Figure 4-2, Fresno County emissions fall from 13.2 MMT CO_2e in 2019, to 11.3 MMT CO_2e in 2030, and then further decline to 9.7 MMT CO_2e in 2050, which is a 27% reduction.

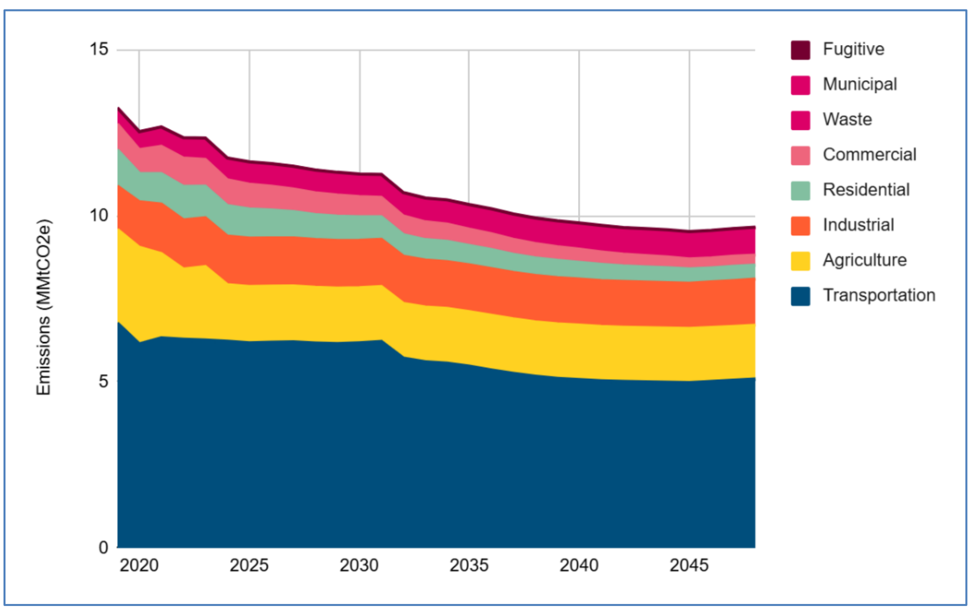


Figure 4-2: Projected GHG Emissions by Sector in the BAP Scenario

This steady decline demonstrates the impact of already-enacted climate and energy policies. A few policies contributing to these reductions include the following:

- SB 100, which mandates 100% clean electricity by 2045
- Title 24 Building Energy Efficiency Standards set energy performance requirements for new buildings and major retrofits
- Corporate Average Fuel Economy (CAFE) standards improve fuel efficiency in passenger vehicles
- Alternative Manure Management Program (AMMP) supports reductions in CH_4 emissions from dairy and livestock operations

All policies and programs included in the BAP scenario are outlined in Section 4.1.2 and highlighted in the sector sections below.

Although the BAP scenario shows significant progress, it also highlights the limitations of relying solely on currently adopted policies. The projected 28% reduction in net emissions by 2050 still falls short of the deeper cuts needed to align with California's long-term climate goals.

In 2019, Fresno County's emissions were dominated by five fuel types (Figure 4-3):

1. Gasoline was the largest contributor, responsible for 3.9 MMT CO_2e or 30% of total emissions.
2. Diesel accounted for 2.3 MMT CO_2e (18%).
3. Natural gas accounted for 1.9 MMT CO_2e (15%).
4. Non-energy emissions, or emissions not resulting from combustion but instead emissions from landfill or manure management, made up a substantial 20% of total emission at 2.6 MMT CO_2e.
5. Grid electricity contributed 10%, primarily through fossil-fuel-based electricity generation.

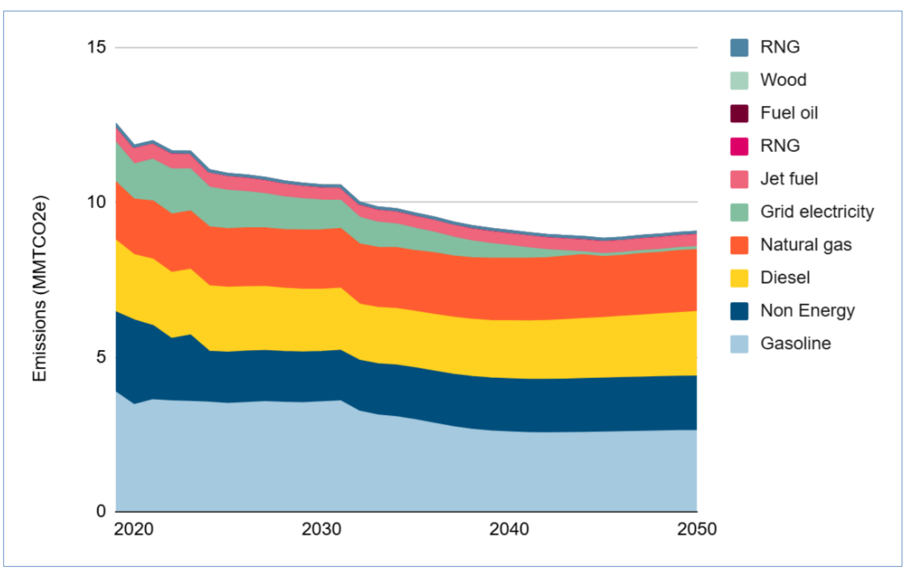


Figure 4-3: Projected GHG Emissions by Fuel Source in the BAP Scenario

By 2050, the emissions profile shifts, but fossil fuels continue to drive emissions. Gasoline emissions decline by 33%, falling to 2.6 MMT CO_2e, though they still account for 29% of total emissions. This indicates that vehicle electrification is underway in current policy trajectories but does not achieve a full transition to electric vehicles. Diesel emissions decrease slightly to 2.1 MMT CO_2e, showing that emissions standards are reducing pollution but impacts are limited.

Natural gas emissions rise, increasing 12% to 2.1 MMT CO_2e, and make up 23% of total emissions in 2050. Under current plans, natural gas remains a dominant fuel for water and space heating, and industrial applications.

Non-energy emissions show notable improvement, declining to 1.9 MMT CO_2e (19%) by 2050. This reduction is likely the result of State-supported programs to reduce agriculture and waste emissions.

Grid electricity emissions are eliminated by 2045, in line with SB 100, which mandates 100% carbon-free electricity. This achievement highlights the impact of enforceable clean energy standards and affirms the power sector's potential as a leading contributor to long-term emissions reductions.

In 2019, Fresno County's GHG per capita emissions were 12.7 MT CO_2e per person. Under the BAU scenario, emissions decline slightly to 12.2 MT CO_2e per person by 2030 but rise to 13.5 MT CO_2e per person by 2050, driven by population growth and ongoing fossil fuel use (Figure 4-4).

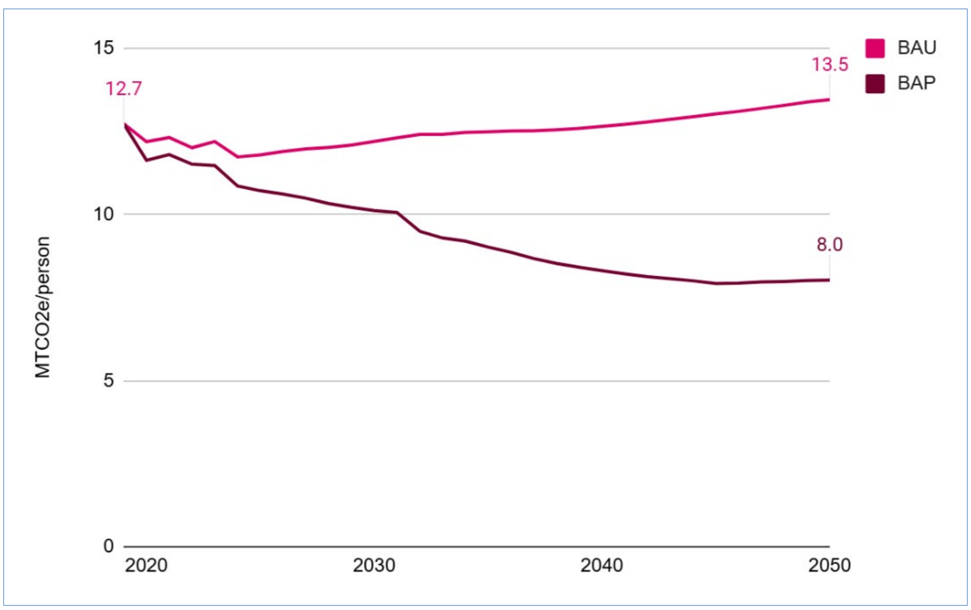


Figure 4-4: Projected GHG Emissions Per Capita in the BAU and BAP Scenarios

In the BAP scenario, emissions fall more significantly to 10.1 MT CO_2e per person by 2030 and 8.0 MT CO_2e per person by 2050, reflecting the impact of existing policies as previously discussed. Fresno County's per capita emissions are higher than the State's target of 6 MT CO_2e per person by

2030.[1] Compared to similar sized counties in California, per capita emissions are still higher than other averages. For example, Sacramento County is projected to fall below 4.95 MT CO_2e per person by 2030.[2]

Figure 4-5, below, illustrates emissions by zone under the BAP scenario for 2019 and 2050, illustrating the concentration of GHG emissions in urban areas and near major transportation corridors in the county. Dark blue areas indicate lower emissions, and yellow areas indicate higher emissions.

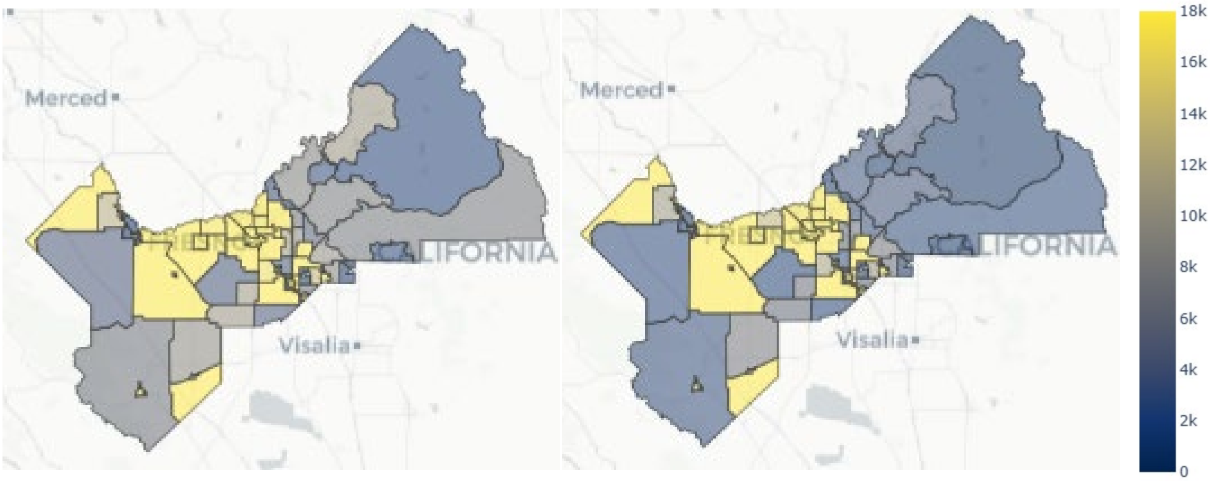


Figure 4-5: Projected Emissions by Zone in the BAP Scenario, 2019 (left) and 2050 (right)

4.3.2 BAP Outlook by Sector

4.3.2.1 Building Sector

In the BAP scenario, GHG emissions from the Building Sector (including residential and commercial buildings) in Fresno County are projected to decline 60% by 2050, despite growth in both population and building stock. This reduction is driven by existing policies and programs that enhance energy efficiency, promote building electrification, and decarbonize the electricity grid.

Between 2019 and 2050, emissions from the Residential Sector are projected to fall from 1.1 MMT CO_2e to 0.44 MT CO_2e, while emissions from the commercial sector are expected to decline from 0.78 MT CO_2e to 0.3 MT CO_2e. This downward trend is shaped by a suite of State policies included in the BAP scenario, notably the Title 24 Building Standards, which mandate improved energy efficiency and require rooftop photovoltaic (PV) solar systems on new residential and commercial buildings.

---

1 California Air Resources Board (CARB). 2017. California's 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target. Website: https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf (accessed May 2025).

2 Sacramento County Planning and Environmental Review. 2022. Climate Action Plan. August. Website: https://planning.saccounty.gov/PlansandProjectsIn-Progress/Documents/Climate%20Action%20Plan/Final%20Climate%20Action%20Plan.pdf (accessed May 2025).

Emissions from grid electricity decline sharply and approach zero by 2045, consistent with SB 100, which mandates 100% renewable electricity statewide by that year. However, natural gas remains the dominant source of building emissions through 2050. As seen in Figure 4-6, natural gas use is largely still connected to space and water heating as well as industrial processes. End uses that rely on electricity (e.g., lighting, appliances, and space cooling) have no emissions when the grid electricity has fully transitioned to clean energy source. Policies and programs like the 2022 California Energy Code that encourage the use of heat pumps for space heating are stabilizing natural gas use in buildings but fall short of eradicating it.

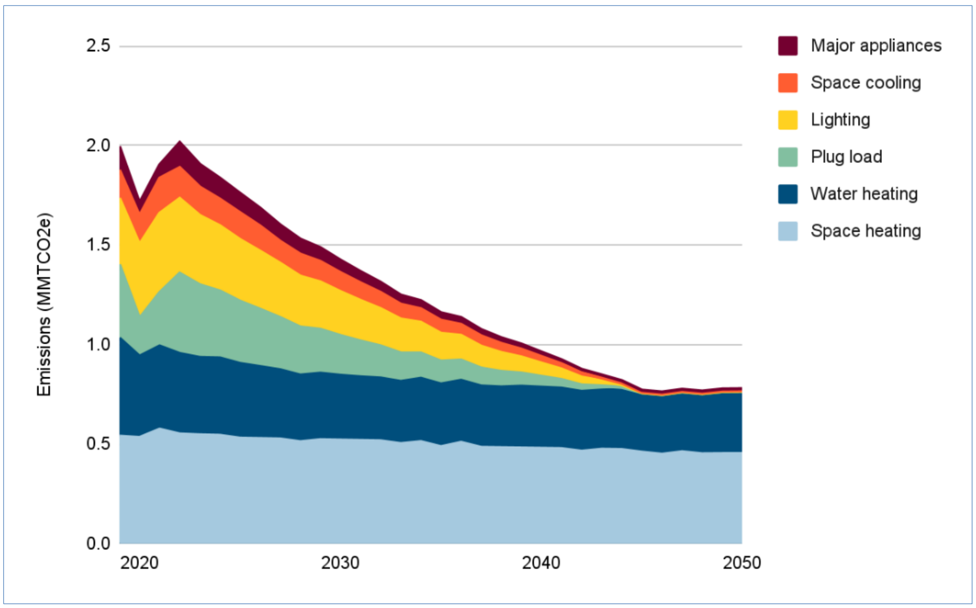


Figure 4-6: Projected Building Sector GHG Emissions in the BAP Scenario by End Use

Although the BAP scenario reflects significant progress, it also underscores the need for deeper interventions to phase out natural gas and accelerate building electrification. Expanded retrofit programs, targeted fuel-switching incentives, and net-zero building codes will be needed to align Fresno County's emissions with the State's long-term emission reduction goals.

4.3.2.2 Transportation Sector

California's long-standing Clean Air Act (CAA) waiver authority enables the State to adopt and enforce motor-vehicle emission standards that exceed federal requirements, driving programs (e.g., Advanced Clean Cars II and Advanced Clean Trucks) that are central to statewide GHG reductions. However, recent federal actions under the Congressional Review Act and ongoing litigation before the United States Supreme Court have introduced uncertainty regarding the future of these waivers. The BAP scenario analysis assumes continuation of California's adopted regulatory framework, consistent with existing EPA-approved waivers and CARB implementation schedules as of 2024. However, this assumption is accompanied by recognition of the regulatory risk environment, including the following:

- If federal action to revoke or delay waiver implementation is upheld, statewide ZEV adoption and associated GHG reductions could be delayed or reduced relative to current expectations.

- Litigation outcomes could influence long-term certainty for both light- and heavy-duty vehicle standards, affecting market and infrastructure readiness.

The potential benefits that would be realized through the implementation of planned State policies, as further modeled below, underscores the critical importance of California's waiver authority in maintaining the State's ability to achieve deep, long-term transportation-sector emission reductions in Fresno County and beyond.

As modeled under the BAP scenario, transportation-sector emissions fall from 6.8 MMT CO_2e in 2019 to 5.2 MMT CO_2e in 2050, which is a 24% reduction. Figure 4-7 shows a steady decline in emissions through 2030 from cars and light-duty trucks due to the adoption of electric vehicles and driven by Advanced Clean Cars II. A forecasted increase in traffic volumes accounts for a projected increase in emissions after 2030 through to 2050, despite existing regulatory requirements.

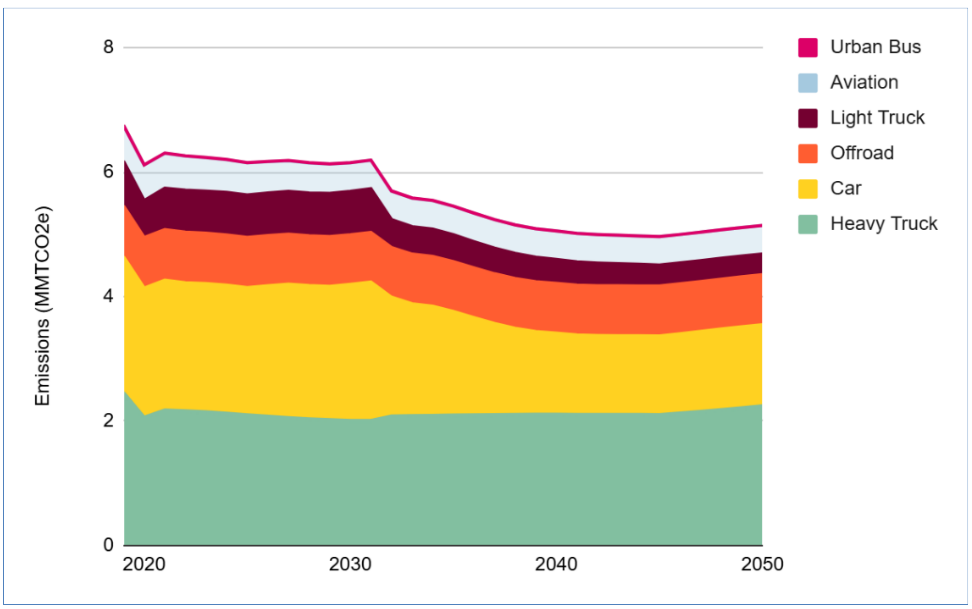


Figure 4-7: Projected Transportation Sector GHG Emissions in the BAP Scenario by Vehicle Type

To further highlight the transition to personal use electric vehicles (EVs), Figure 4-8 shows that gasoline emissions drop from 3.9 MT CO_2e in 2019 to 2.6 MT CO_2e in 2050, which is a 33% reduction. The coupling of grid decarbonization and EV adoption substantially lowers emissions from cars and trucks as these vehicles shift from gasoline to electricity, and grid electricity becomes increasingly powered by renewable energy sources. Additionally, reductions are due to the implementation of CAFE standards, local government fleet electrification commitments, and the Fresno Area Express (FAX) and Fresno County Rural Transit Agency (FCRTA) commitments to fully electrify their respective transit fleets.

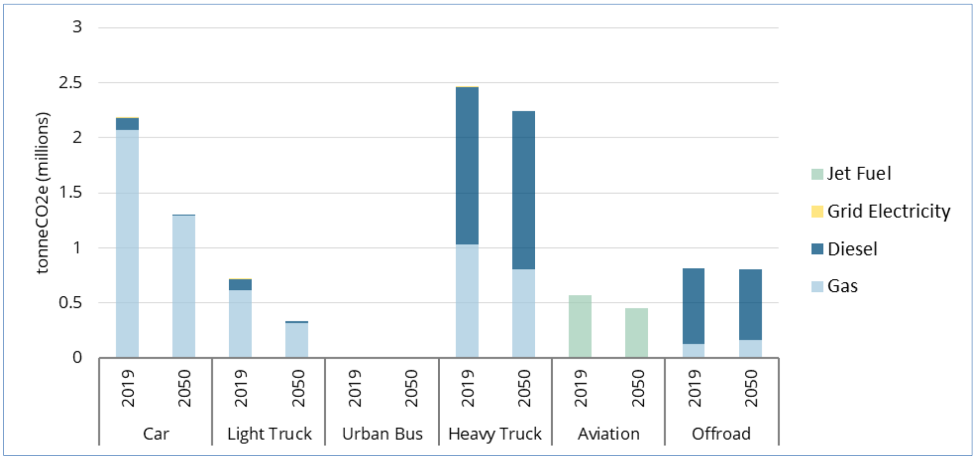


Figure 4-8: Projected Transportation Sector GHG Emissions in the BAP Scenario by Fuel Source

Diesel emissions slightly decrease, reaching 2.1 MT CO_2e by 2050. Policies like EPA Emission Standards for Heavy-Duty Highway Engines and Vehicles, Innovative Clean Transit Regulation, and the California Sustainable Freight Action Plan slow emissions from keeping pace with population and job growth, but they are not sufficient to significantly reduce freight-related emissions overall.

Additionally, emissions from off-road equipment and aviation remain relatively steady. AB 1322, which requires that at least 20% of aviation fuel be sustainable by 2030, was included in the scenario projections. The California Air Resources Board (CARB) Off-Road Emissions Inventory that includes existing CARB regulations was used to project emissions for the off-road sector.

The BAP scenario highlights the need for expanded interventions to reduce emissions from hard-to-decarbonize transportation sources.

4.3.2.3 Industrial Sector

Under the BAP scenario, emissions from the Industrial Sector are projected to grow from 1.3 MMT CO_2e in 2019 to 1.4 MMT CO_2e by 2050, which is a 7% increase.

Figure 4-9 shows a relatively flat trajectory for industrial emissions in the BAP scenario, reflecting the continued reliance on natural gas and other fossil fuels for on-site combustion, process heat, and manufacturing operations. The BAP scenario assumes no major fuel-switching or industrial decarbonization.

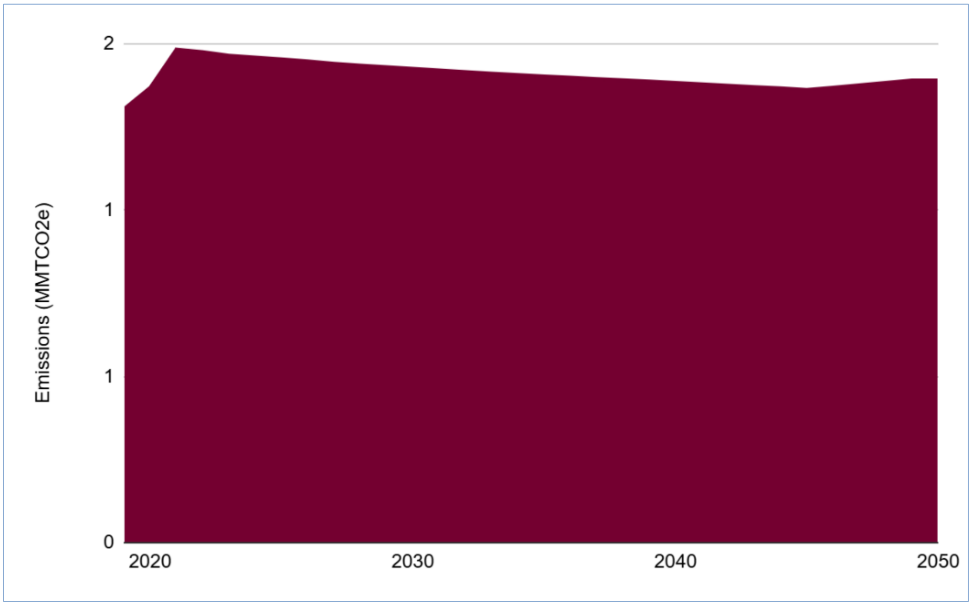


Figure 4-9: Projected Industrial Sector GHG Emissions in the BAP Scenario

4.3.2.4 Waste Sector

Waste Sector emissions rise from 0.5 MMT CO_2e in 2019 to 0.8 MMT CO_2e in 2050, which is a 77% increase, as seen in Figure 4-10. Sectoral growth is slower than in the BAU scenario, which is anticipated to grow by 145% between 2019 and 2050, indicating existing policies are expected to be effective at compacting emissions from this sector.

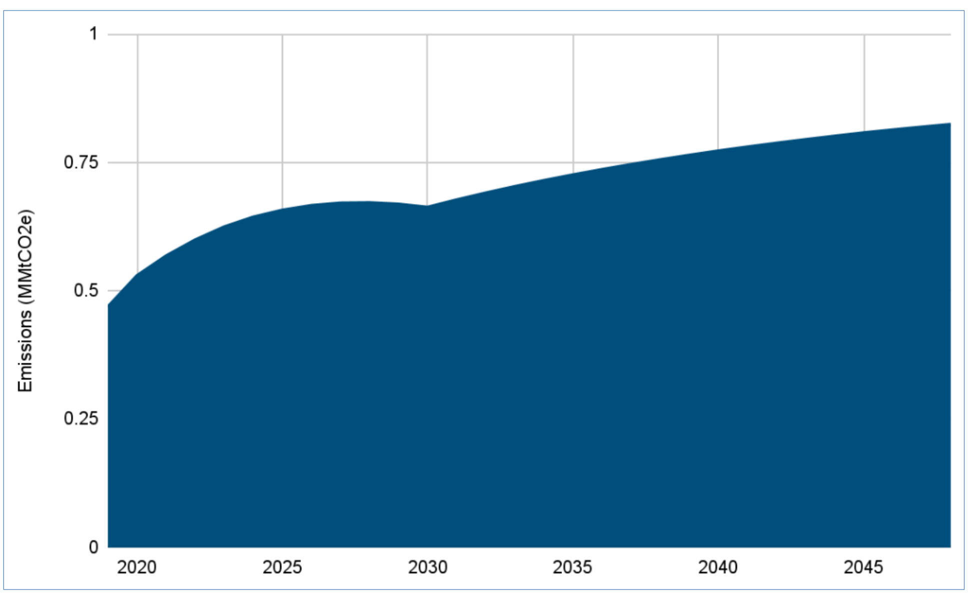


Figure 4-10: Projected Waste Sector GHG Emissions in the BAP Scenario

The BAP scenario includes several policies intended to reduce landfill emissions, particularly methane (CH_4). For example, SB 1383 targets a 40% reduction in CH_4 emissions from the waste sector by 2030, primarily through organics diversion and enhanced landfill gas capture.

4.3.2.5 Agriculture Sector

Under the BAP scenario, agricultural emissions fall from 2.8 MMT CO_2e in 2019 to 1.6 MMT CO_2e by 2050, which is a reduction of approximately 43%. The decline in the BAP scenario highlights the scale of Fresno's agricultural economy and the reach of current emissions reduction programs into high-emitting activities (e.g., enteric fermentation, manure management, and fertilizer use). The BAP also considers the impacts of the Sustainable Groundwater Management Act (SGMA), which is set to protect groundwater resources but will limit agricultural growth.

Figure 4-11 shows a steep initial drop-off due to reductions in agricultural revenue sourced from REMI Economic Models. Limited decline from 2025 to 2050 shows the impacts of funded programs reaching their emission reduction potential and SGMA taking effect in Fresno County. There are several key State programs included in the BAP scenario:

- The AMMP supports the installation of low-emission dairy manure handling systems (e.g., composting and solid-liquid separation).
- The State Water Efficiency and Enhancement Program (SWEEP) funds improvements in irrigation efficiency, which can reduce both energy use and nitrous oxide (N_2O) emissions from over-irrigated fields.
- The Healthy Soils Initiative increases soil organic matter and enhances carbon sequestration (e.g., cover cropping and reduced tillage).
- SGMA impacts reduces the acreage of viable agricultural lands.

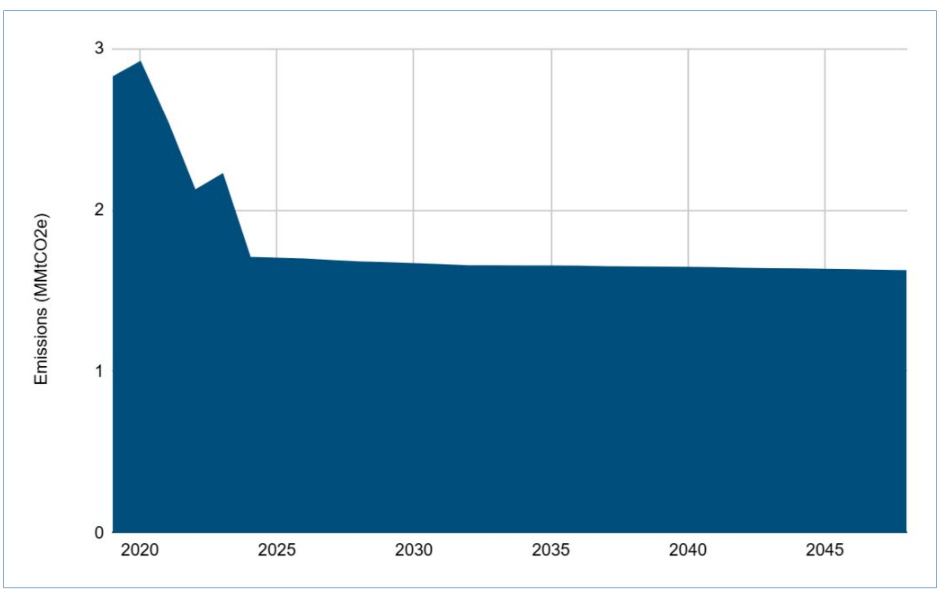


Figure 4-11: Projected Agriculture Sector GHG Emissions in the BAP Scenario

4.3.2.6 Local Electricity Generation

Local electricity is not represented as a stand-alone emissions category in the inventory or the BAU and BAP scenarios since emissions are allocated to the end-use sectors (e.g., buildings and industry) and are based on electricity consumption. However, modeling electricity generation is valuable for energy planning and generation capacity projections, and the Low-Carbon Scenario includes climate action measures aimed at expanding renewable energy infrastructure. For these reasons, local electricity generation is included in the analysis even though its emissions are accounted for under end-use sectors.

Total in-county electricity generation increases from approximately 1,242,320 megawatt-hours (MWh) in 2019, to over 4,436,020 MWh by 2050, a nearly fourfold increase in local generation capacity (Figure 4-12).

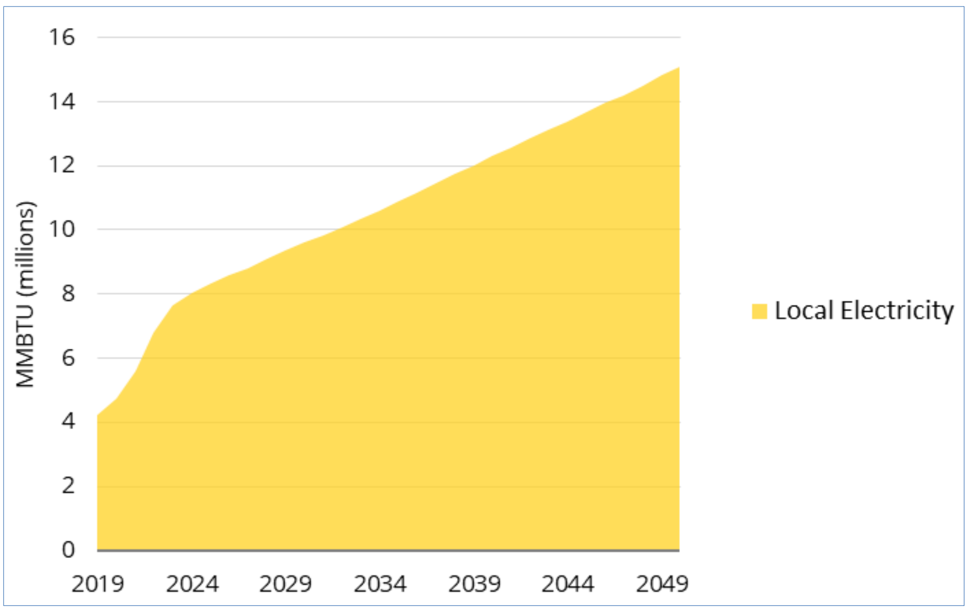


Figure 4-12: Projected Local Electricity Generation BAP Scenario

This substantial growth is driven by policies like SB 100, which mandates a fully renewable electricity grid by 2045 and catalyzes new renewable generation infrastructure, both utility-scale and distributed. Additionally, Title 24 Building Energy Efficiency Standards (2019 and 2022 updates) mandate rooftop solar PV installations on most new residential and non-residential buildings.

The BAP scenario reflects a strong upward trajectory in Fresno County's local electricity generation, growing nearly 258% by 2050. Local generation will be essential to meet growing energy demand from building electrification and electric vehicle adoption, supports regional energy resilience, and aligns with California's broader clean energy transition.

5 GHG Emission Reduction Measures and Implementation Scenario Projections

5.0 GHG EMISSION REDUCTION MEASURES AND IMPLEMENTATION SCENARIO PROJECTIONS

Projections in Fresno County's business as usual (BAU) and business as planned (BAP) modeling make it clear that current policies, regulations, and market trends will not be enough to deliver on California's statewide goal of carbon neutrality by 2045. Even with 100% clean electricity and other State mandates already factored into the BAP scenario, the County's emissions are projected to only be reduced by approximately 28% by 2050, short of the deep reductions needed to align with State targets.

To close the gap, bold action would need to be taken in all sectors that shape the County's economy and community in a Low-Carbon (LC) Scenario. This scenario would include:

- Moving to cleaner sources of energy;
- Making homes and buildings more efficient and electric;
- Shifting cars, trucks, and buses to zero-emission models;
- Cleaning up local industries;
- Improving waste systems;
- Adopting climate-forward agricultural practices; and
- Protecting the farmland, forests, and natural areas that sustain us.

When modeled together, these strategies show that Fresno County could reduce greenhouse gas (GHG) emissions from 12.5 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) in 2019 to 2.9 MMT CO_2e in 2045, an 80% reduction (Figure 5-1), with a 93% reduction projected to be achieved by 2050. The successful implementation of the LC Scenario pathway does not just help the County contribute to meeting the State's climate goals, it also means cleaner air, fewer extreme-heat risks, more resilient communities, and new opportunities for good local jobs. Table 5.A, below, summarizes the emission reductions that could be realized through implementation of the LC Scenario pathway.

Table 5.A: Low-Carbon Scenario Emissions Reductions

Description	Baseline 2019	2030	2035	2040	2045	2050	Cumulative Reductions (2026–2050)
Total Emissions (MMT CO_2e)	12.5	7.8	5.3	3.4	2.9	1.0	119.8
% change over 2019		-38%	-58%	-73%	-77%	-92%	
Per capita (MT CO_2e/person)	12.7	7.5	5.0	3.1	2.6	0.9	
% change over 2019		-41%	-61%	-76%	-80%	-93%	

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MT = metric tons
MMT = million metric tons

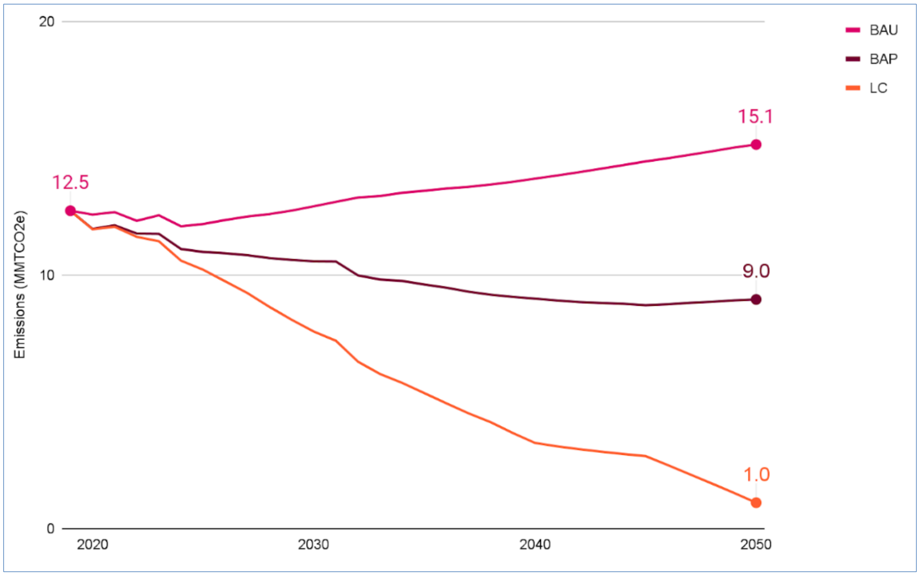


Figure 5-1: Projected Total Community GHG Emissions in the BAU, BAP, and LC Scenarios

On a per capita basis, emissions would be expected to fall from 12.7 metric tons (MT) CO_2e per person in 2019 to just 0.9 MT CO_2e per person in 2050 under the LC Scenario, a 93% decrease, as illustrated in Figure 5-2. For comparison, California's statewide average was about 9.3 MT CO_2e per person in 2019,[1] and the United States average was closer to 15.8 MT CO_2e per person.[2]

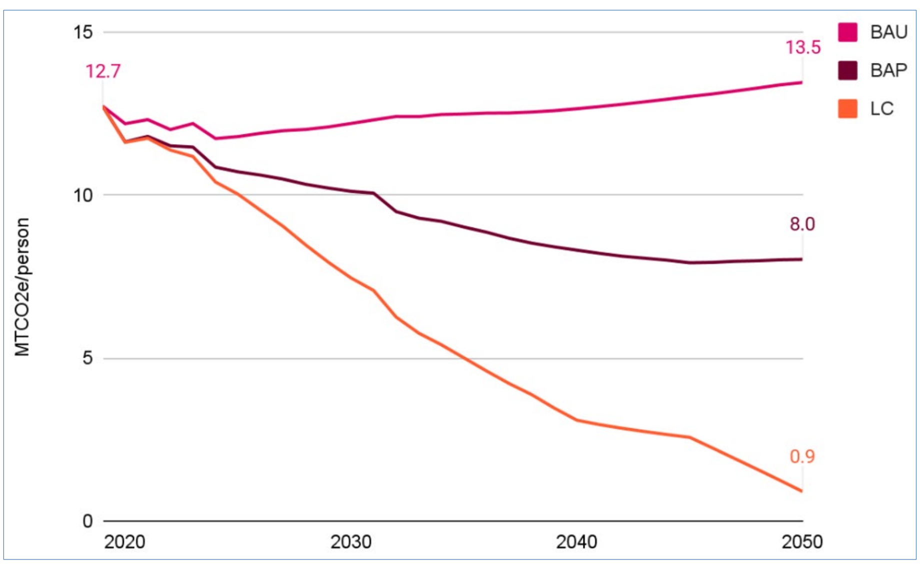


Figure 5-2: Projected per Capita Emissions in the LC Scenarios

[1] California Air Resources Board (CARB). 2022. California Greenhouse Gas Emissions for 2000–2020, Trends of Emissions and Other Indicators.

[2] United States Environmental Protection Agency (EPA). 2021. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019.

As established in Chapter 3, to support State emissions reduction goals by key milestone years, Fresno County would need to achieve a 36% reduction from 2019 levels of GHG emission by 2030 and an 86% reduction by 2045. In the LC Scenario, Fresno County meets the near-term target by reducing emissions by 38% in 2030, but falls short of achieving the 2045 goal, remaining about 1.1 MMT CO_2e above the intended target (Figure 5-3). By 2050, emissions continue to decline, and Fresno County would be able to achieve the 2045 target, emitting approximately 1.0 MMT CO_2e annually, falling 0.75 MMTCO2e below the 2045 target level.

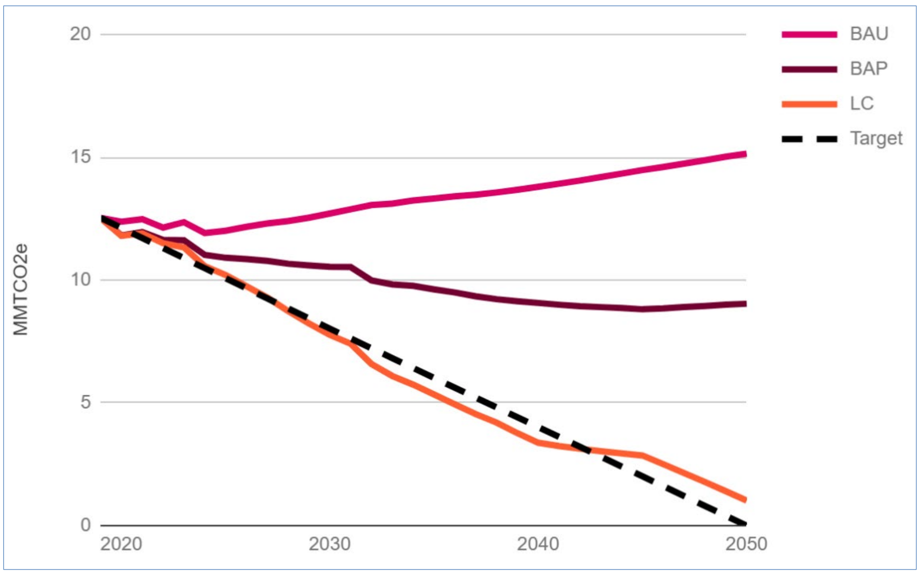


Figure 5-3: Projected Total GHG Emissions in the BAU, BAP, and LC scenarios Compared to Local Target

This gap underscores the need for deeper action across Fresno County's hardest-to-decarbonize sectors including agriculture, industry, and transportation. Closing the gap to support the State's goals for emission reductions in 2045 will require scaling up existing programs (e.g., improved manure management, industrial efficiency programs, and cleaner off-road vehicles), while also advancing innovative strategies that go beyond current policies and technologies.

5.1 GHG EMISSION REDUCTION MEASURES SUMMARY

The Comprehensive Climate Action Plan Analysis (CCAP-A) LC Scenario builds on the BAP Scenario to show how additional actions can help Fresno County meet its emission reduction targets. The modeling assumptions for the CCAP-A measures are described in Table 5.B. Appendix C provides full details of the modeling methodology used. As previously noted, the measures described in this LC Scenario are not presented as regulations for any industry and do not commit any parties to further action. These measures are intended to provide a conceptual exploration of potential strategies that would contribute to an overall reduction of GHG emissions consistent with State reduction goals. The strategies and measures as outlined are contingent upon availability of funds from the State and federal government.

Table 5.B: Emission Reduction Measures

Sector	Measure	Description	Assumption

Buildings / Electricity Generation	Bundle Solar + Savings for Residences	Accelerate the deployment of solar and low-emission technologies in existing homes by bundling on-site renewable generation (primarily rooftop solar PV with storage) with energy efficiency retrofits (e.g. insulation, windows) and clean equipment upgrades (e.g. heat pumps for space and water heating, induction cooking, EV charging). Pair local generation and storage with aggregation programs (e.g. PG&E's Solar Choice Program) to give households affordable access to zero-emission energy and home electrification.	• 1,814 MW of installed capacity on residences by 2030; 3,113 MW in 2050
			• Increase deep retrofits to reduce EUI by 50%
			  ○ 25% of homes are retrofit by 2032
			  ○ 50% by 2038
			  ○ 100% by 2045
			• 80% of new appliance sales are electric by 2030; 100% by 2035

Buildings / Electricity Generation	Green-up Commercial Buildings	Upgrade Fresno County's commercial and institutional buildings by installing on-site renewable energy systems, paired with energy storage and whole-building retrofit packages. These retrofits upgrade efficiency, modernize building systems, and electrify space and water heating and other building equipment. Use aggregation models to reduce costs through bulk procurement and expand access to clean power. Build on California's C-PACE financing, already authorized by both the County of Fresno and the City of Fresno, to lower upfront costs and expand participation.	• 1,373 MW of installed capacity on commercial buildings by 2030
			• Increase deep retrofits to reduce EUI by 50%
			  ○ 35% of commercial buildings are retrofit by 2035
			  ○ 70% by 2040
			  ○ 100% by 2045
			• 80% of new appliance sales are electric by 2030; 100% by 2035

Buildings / Electricity Generation	Build Net-Zero New Homes	Ensure that 100% of new residential buildings are net-zero by 2030, with all-electric systems, on-site renewables, and continuous efficiency improvements by adopt solar and EV-readiness requirements for all new buildings, providing builder incentives (e.g. fast-track permitting, density bonuses), and expanding builder training programs.	• 100% of new residential buildings are net zero by 2030, including:
			  ○ All electric homes with heat pumps for space heating and cooling
			  ○ On-site renewables
			  ○ EUI improves 5% every 3 years, aligned with IECC efficiency increases

Buildings / Electricity Generation	Advance Net-Zero New Commercial Buildings	Construct new commercial and institutional buildings in Fresno County to be all-electric, solar-powered, and storage-ready. These buildings will lead Fresno's shift to a clean economy, delivering lower operating costs, improved air quality, and greater resilience for businesses and communities. Adopt solar and EV-readiness requirements for all new buildings, providing builder incentives (e.g. fast-track permitting, density bonuses), and expanding builder training programs.	• 100% of new commercial buildings are net zero by 2030, including:
			  ○ All electric buildings
			  ○ On-site renewables
			  ○ EUI improves 5% every 3 years, aligned with IECC efficiency increases

Transportation	Expand Transit Options across the County	Enhance the public transportation system by maintaining/expanding the existing transit system and implementing other transit strategies (e.g., micro-transit). Invest in bus rapid transit, expanded service frequency, integrated ticketing, and last-mile connections. Prioritize routes serving employment centers, schools, and disadvantaged communities. Pair service improvements with affordable fare programs and clean bus fleets to make transit reliable, equitable, and low emission.	• Increase transit mode share to 8% by 2050 (transit for Fresno County is currently around 2%)

Table 5.B: Emission Reduction Measures

Sector	Measure	Description	Assumption
Transportation	Build out the Bike and Pedestrian Network	Expand protected bike lanes, sidewalks, and multi-use trails, and implement Complete Streets policies to integrate biking and walking into roadway design. Support programs like Safe Routes to School, bike share, and micromobility hubs, with a focus on closing infrastructure gaps in disadvantaged neighborhoods.	• County-wide mode share goals to achieve by 2045: ○ Walking: 7% ○ Biking: 5%
Transportation	Promote Carpool, Vanpool, and Shared Mobility Options	Provide incentives for carpool and vanpool, and other shared mobility options. Implementation measures could include commute trip reduction programs, end-of trip facilities, car-sharing program, employer-sponsored vanpool/shuttle, priced workplace parking, and/or employee parking "cash-out" programs. Promote employer-based carpool/vanpool incentives, expand Fresno COG's existing vanpool program, and support shared mobility platforms for rural and underserved areas. Encourage mobility-as-a-service pilots that integrate transit, rideshare, and micromobility into a single system.	• Increase carpooling to 20% of means of transportation to work by 2045.
Transportation	Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan	Expand EV-charging infrastructure at homes, workplaces, and public sites. Provide incentives and financing for EV purchases, especially for low- and moderate-income households. Partner with PG&E and State programs to increase grid readiness and integrate smart charging.	• All new passenger vehicles to be ZEV by 2035
Transportation	Electrify Commercial & Public Vehicle Fleets	Support fleet conversion grants, charging hubs, and utility make-ready investments. Launch municipal fleet transition plans and expand clean school bus programs. Encourage private sector fleet operators to adopt EVs through bulk purchase programs and corridor charging infrastructure. Continue to convert the municipal fleet (including transit) into ZEVs and provide a sustainable and reliable support system for a zero-emission fleet including, but not limited to, maintenance, charging facilities, training of personnel, etc. (Implementing measures could include fleet electrification, installation of EV charging infrastructure, etc.)	• All commercial new light-duty passenger vehicle sales are zero-emission by 2035 • Government light-duty vehicles are converted to ZEVs at end of life, starting in 2026 • All public transit transitions to ZEVs by 2040
Transportation	Advance Zero-Emission Freight Vehicles	Develop freight EV charging and hydrogen fueling hubs, particularly along highways and at industrial parks. Support incentives for clean truck adoption, partner with the Port of Oakland and regional logistics hubs, and expand the use of zero-emission drayage trucks serving distribution centers in Fresno.	• 2,000 ZEV medium- and heavy-duty freight vehicles in Fresno County by 2030 • 100% of all medium- and heavy-duty vehicle sales are ZEVs by 2040
Transportation	Transition Off-Road Vehicles & Equipment to ZEVs	Support adoption of electric tractors, forklifts, and construction equipment, paired with utility incentives for charging infrastructure. Expand participation in CARB's off-road incentive programs and establish local pilots demonstrating the benefits of zero-emission equipment in Fresno's agricultural and construction sectors.	• 100% of off-road equipment purchases are ZEVs in 2040 ○ 25% hydrogen and 75% electric

Table 5.B: Emission Reduction Measures

Sector	Measure	Description	Assumption
Waste	Scale Up Waste Diversion and Circular Economy Programs	Expand programs and incentives to reduce and divert waste, focusing on food, yard, and other organic materials in Fresno County. Implement programs and incentives to expand curbside collection, composting, and anaerobic digestion. Implement neighborhood and business programs to increase recycling and composting participation; educate and perform outreach to inform residents and businesses about waste prevention, reuse, and zero-waste practices; and innovate pilot projects (e.g., waste-to-energy and circular economy initiatives) to create local value from diverted materials.	• Divert 75% of organic and recyclable waste from landfills by 2030
Waste	Develop Landfill Gas Capture and Utilization	Installs landfill gas capture systems in Fresno County to cut methane emissions and create value from recovered gas. Upgrading, expanding, and modernize landfill gas wells, piping, and treatment systems to increase capture efficiency. Prioritize projects that use captured landfill gas for renewable electricity generation, renewable natural gas for pipeline injection, or direct use in industrial facilities, reducing reliance on fossil fuels. Improve leak detection, monitoring, and reporting protocols to ensure compliance with State methane reduction rules (Assembly Bill 32, Senate Bill 1383). Install or upgrade gas capture systems at inactive or closed landfill sites to prevent fugitive emissions when viable.	• Increase landfill methane capture and utilization by 75% by 2045
Waste	Clean up Wastewater Facilities	Install solar PV, battery storage, and energy efficiency upgrades at wastewater treatment facilities in Fresno County to reduce grid electricity use, cut operating costs, and lower emissions. Implementation begins with feasibility studies, applying for funding, and phasing in solar deployment along with retrofits and ongoing performance monitoring	• Increase facilities energy efficiency, reducing EUI by 25% by 2035 and 50% by 2045 • Increase on-site solar generation by 50% by 2030, on existing facilities and continuing to increase generation capacity to meet facilities' needs
Industry	Decarbonize Industry with Efficiency, Electrification, and Clean Fuels	Develop a Fresno County industrial decarbonization taskforce, collaborating with major sectors like food processing, cement, and manufacturing and utilities to design and adopt a plan to cut emissions through efficiency upgrades, electrification, on-site renewables, and hydrogen adoption. Taskforce will work with local governments to set shared goals for GHG reductions, energy benchmarking, and clean technology adoption. Launch an efficiency and innovation challenge to connect industry to technical and financial support, then convene an Industrial Decarbonization Summit to showcase progress, align strategies, and attract additional funding.	• Increase industrial energy efficiency 25% by 2030 and increase efficiency 10% every 5 years • Electrify process heat 15% in 2032, 35% in 2038, and 50% in 2045 using induction, radiative heating, or advanced heat pumps • Increase green hydrogen use 25% by 2045 in industrial processes • On-site renewables provide at least 50% of the energy required for industrial processes by 2045

Table 5.B: Emission Reduction Measures

Sector	Measure	Description	Assumption
Agriculture	Amp up Alternative Manure Management Program in Livestock & Poultry Operations	Continue and expand funding support to further reduce methane emissions from Fresno County's dairies and poultry farms by expanding AMMP practices, aiming for widespread adoption and implementation by 2040. The County will connect farms to State and federal funding (CDFA AMMP, USDA NRCS), offer local cost-share or low-interest financing, and provide technical assistance and outreach through partners like the UC Cooperative Extension and Resource Conservation Districts. Education programs will expand awareness across farms of all sizes, and a monitoring program will track adoption, methane reductions, and co-benefits (e.g., improved soil health, water quality, and odor reduction).	• Increase dairy digester methane capture, and implement 50 projects from 2026 to 2050. • Increase participation in the alternative manure management program. Implement 124 projects from 2026 to 2050.
Agriculture	Plow the Way to Zero-Emission Agricultural Equipment	Accelerate the shift to zero-emission agricultural equipment by promoting electric tractors, forklifts, pumps, and other machinery, supported by utility incentives for charging infrastructure in Fresno County. This measure includes interagency coordination to support expanded participation in CARB's CORE and FARMER programs, leverage federal funds, and launch local pilot projects to demonstrate benefits. Through partnerships with grower associations, UC Cooperative Extension, and equipment dealers, farmers will receive education, financing options, and technical support and adoption and emission reductions will be tracked countywide.	• 100% of off-road agricultural equipment purchases are ZEVs in 2040 ○ 25% are hydrogen and 75% are electric.
Natural and Working Lands	Grow the Urban Tree Canopy	Expand urban forestry programs in Fresno County by planting and maintaining 160,000 new trees by 2045, prioritizing neighborhoods with low canopy coverage and high heat and air quality burdens. Support new trees with long-term maintenance, irrigation, and workforce training to increase survival and growth. Partner with schools, community-based organizations, and housing developments to plant trees in public and private places. State and federal funding and utility partnerships may support municipal costs (e.g., CAL FIRE's Urban and Community Forestry Program) to provide local incentives and free or subsidized trees. Progress will be tracked through GIS-based canopy mapping, with public dashboards to ensure transparency and equity in tree distribution.	• Double tree canopy cover in urban areas by 2045.

Source: SSG (2025).
AMMP = Alternative Manure Management Program
C-PACE = Commercial Property Assessed Clean Energy
CAL FIRE = California Department of Forestry and Fire Protection
CARB = California Air Resources Board
CDFA = California Department of Food and Agriculture
CORE = Clean Off-Road Equipment Voucher Incentive Program
EUI = energy use intensity
EV = electric vehicle
FARMER = Funding Agricultural Replacement Measures for Emission Reductions
GIS = geographic information systems
IECC = International Energy Conservation Code
NRCS = Natural Resources Conservation Service
PG&E = Pacific Gas and Electric Company
PV = photovoltaic
MW = megawatts
UC = University of California
USDA = United States Department of Agriculture
ZEV = zero-emission vehicle

5.2 LOW-CARBON SCENARIO PROJECTIONS

In the LC Scenario, Fresno County's total annual GHG emissions are projected to decline substantially, falling 38% by 2030 and 92% by 2050 relative to 2019 levels (Table 5.C). This downward emissions trajectory seen in Figure 5-4 (provided on the following page) is the result of the combined impact of all modeled measures working together across the transportation, buildings, industrial, waste, agriculture, and natural lands sectors.

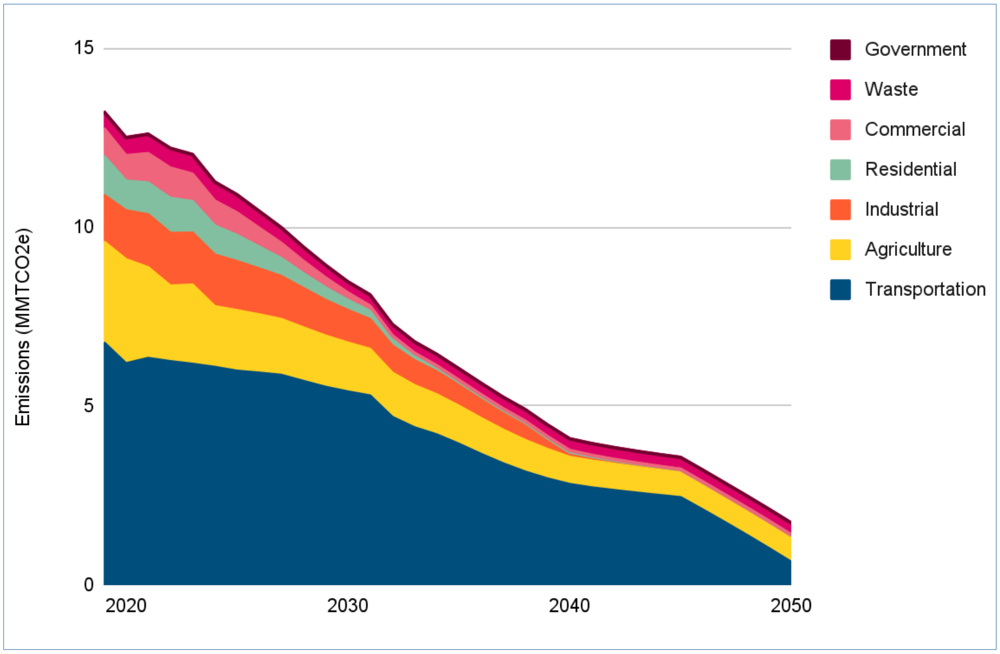
As discussed in preceding sections, the LC Scenario in this CCAP-A represents a conceptual exploration of strategies and potential paths to implementation for GHG emissions reductions in Fresno County. The CCAP-A does not regulate any industry or commit any named party to further action. The concepts modeled may illustrate improvements occurring by public or private parties, but do not imply that any party assents to the plan or is taking steps to advance the development of GHG reductions. The strategies and measures as outlined are contingent upon availability of funds from the State and federal government.

Table 5.C: Implementation Scenario Emissions by Sector

Sectors	2019	2030		2045		2050	
	Total Emissions (MMT CO_2e)	Total Emissions (MMT CO_2e)	% Change Over 2019	Total Emissions (MMT CO_2e)	% Change Over 2019	Total Emissions (MMT CO_2e)	% Change Over 2019
Agriculture	2.8	1.4	-51%	0.7	-74%	0.7	-75%
Buildings	1.9	0.5	-74%	0.0	-100%	0.0	-100%
Industry	1.3	0.9	-30%	0.1	-95%	0.1	-95%
Natural and Working Lands	-0.7	-0.7	0%	-0.7	0%	-0.7	0%
Transportation	6.8	5.4	-20%	2.4	-64%	0.6	-91%
Waste	0.5	0.3	-34%	0.3	-30%	0.3	-29%
Total Emissions	12.5	7.8	-38%	2.9	-77%	1.0	-92%

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MMT = million metric tons

Key drivers of potential change include the electrification of homes and businesses, which eliminates nearly all building emissions by 2045, and the widespread transition to electric and zero-emission vehicles, which cuts transportation emissions by more than 91% by 2050. Industrial emissions would also fall steeply, 95% below 2019 levels by 2045, largely due to efficiency improvements, cleaner fuels, and electrification as grid energy transitions to clean electricity generation. Waste-related emissions decrease gradually through expanded diversion and methane gas capture. Agriculture emissions fall by nearly 51% by 2030 but level off at around 0.7 MMT CO_2e by 2045 as investments are made in programs to transition agriculture equipment to cleaner alternatives and promote improved manure management practices. With the additional tree plantings, natural and working lands continue to act as a stable carbon sink, capturing 0.7 MMTCO_2e annually. The following figures illustrate the projected GHG emissions by sector (Figure 5-4) and by fuel source (Figure 5-5) under the LC Scenario.



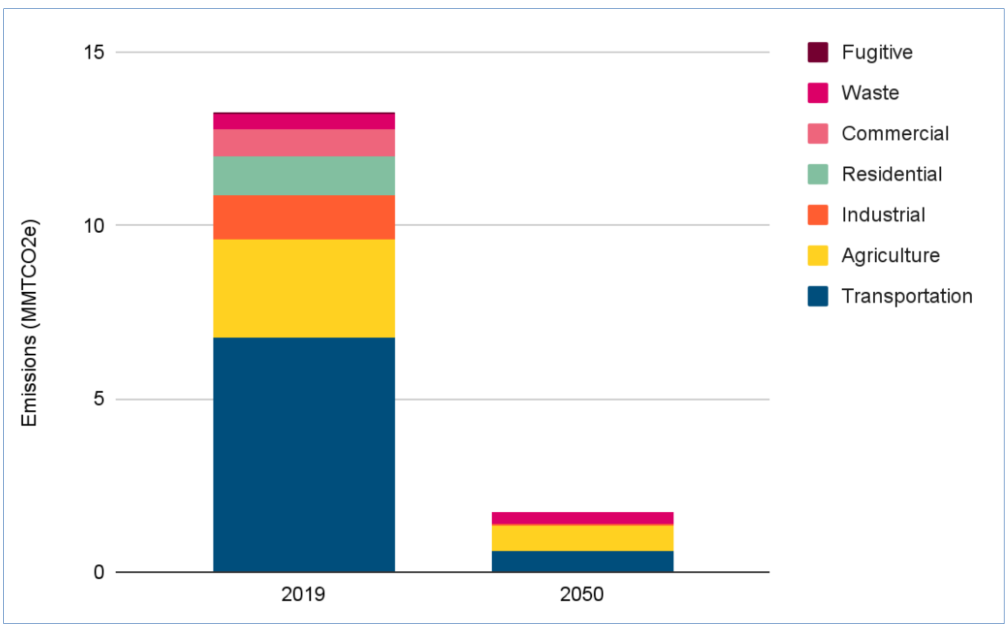
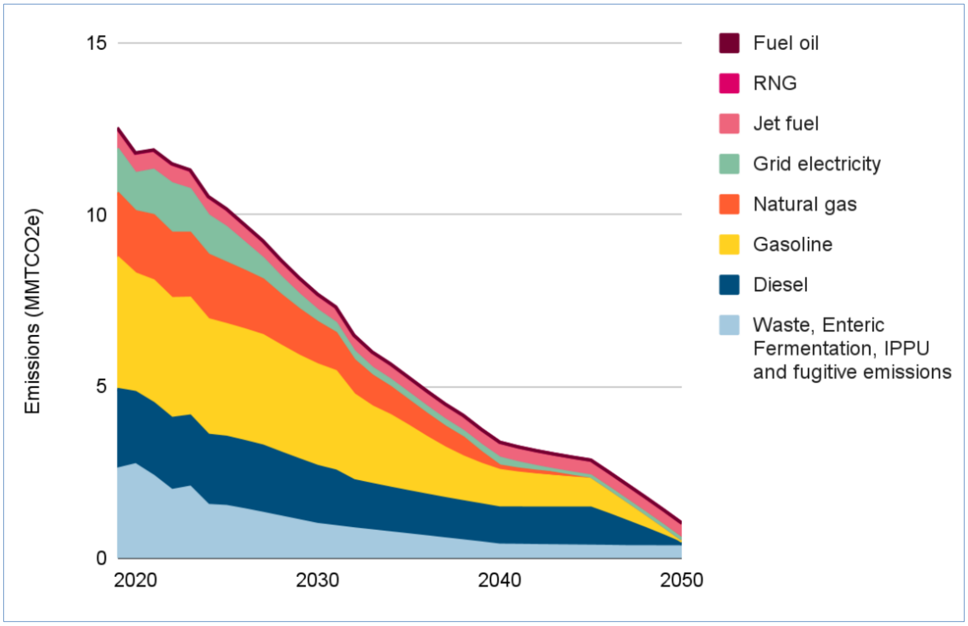


Figure 5-4: Projected GHG Emissions by Sector in the LC Scenario



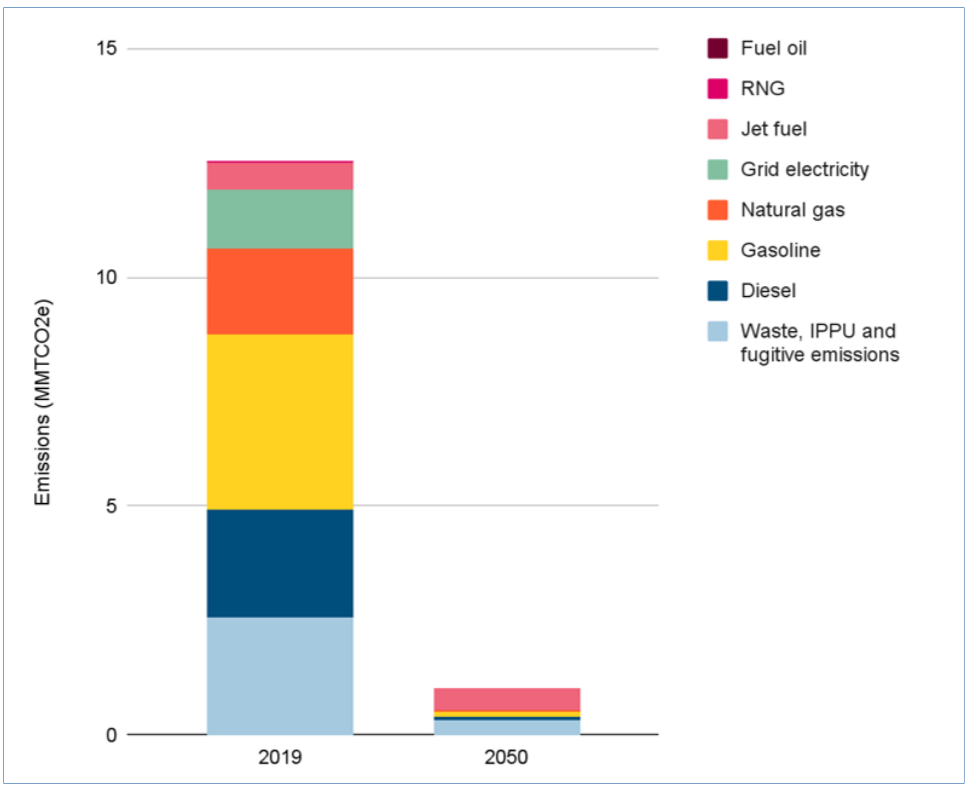


Figure 5-5: Projected GHG Emissions by Fuel Source in the LC Scenario

Gasoline, the largest fuel source in 2019, accounting for 3.85 MMT CO_2e, declines by 98% to just 0.08 MMT CO_2e in 2050, showing the impact of a widespread transition to zero-emission passenger vehicles (Figure 5-5). Diesel follows a similar trajectory, falling from 2.33 MMT CO_2e in 2019 to 0.09 MMT CO_2e in 2050 as freight trucks, construction equipment, and agricultural off-road vehicles switch to electric or alternative clean fuels.

In the buildings and industrial sectors, natural gas use would drop from 1.9 MMT CO_2e in 2019 to 0.1 MMT CO_2e in 2050. This shift is driven by large-scale adoption of electric heat pumps, electrification of industrial heat processes, and efficiency retrofits across homes, businesses, and industry. Grid electricity, once a significant source of emissions (1.3 MMT CO_2e), would fall to zero by 2045 in line with California's Senate Bill (SB) 100, which mandates a 100% clean power grid.

Despite these substantial gains, harder-to-decarbonize fuels remain. Non-energy emissions, which include methane from livestock, waste decomposition, and industrial processes, are reduced by nearly 87%, from 2.6 MMTCO2e in 2019 to 0.3 MMTCO2e in 2050. Jet fuel emissions stay constant at about 0.5 MMT CO_2e annually and are the largest source of emission in both 2045 and 2050, highlighting the ongoing challenge of decarbonizing aviation

Projected emission reductions (Figure 5-6, provided on the following page) show that no single measure meets the challenge of achieving carbon neutrality, but rather, significant progress comes from scaling up and innovating solutions across the buildings, transportation, industry, waste, agriculture, and land-use sectors.

Measures targeting the built environment are among the earliest and most impactful. The measures, Bundle Solar + Savings for Residences (12.2 MMT CO_2e cumulatively reduced) and Green-up Commercial Buildings (9.7 MMT CO_2e) would steadily lower emissions from electricity and natural gas use, while Build Net-Zero New Homes and Advance Net-Zero Commercial Buildings would push new construction toward zero emissions. These measures would eliminate almost all building-related emissions by mid-century.

Transitioning away from gasoline and diesel is driven by several key measures. The measures with the biggest impact are Accelerating Zero-Emission Personal Vehicles and Implementing the Electric Vehicle (EV) Readiness Plan, which reduces 12.3 MMT CO_2e cumulatively, alongside Advancing Zero-Emission Freight Vehicles (13.6 MMT CO_2e reduction) and Transitioning Off-Road Vehicles & Equipment to ZEVs (6.4 MMT CO_2e reduction). Additional strategies that expand transit, bike and pedestrian networks, and shared mobility would reduce vehicle miles traveled (VMT) and further cut emissions.

Complementing these efforts in the agricultural sector, Plow the Way to Zero-Emission Agricultural Equipment would reduce an additional 7.1 $MMTCO_2e$, advancing electrification, vehicle efficiency, and fuel-switching across farm operations. Beyond vehicle emissions, Amp Up the Alternative Manure Management Program in Livestock & Poultry Operations would achieve 16.0 $MMTCO_2e$ of cumulative reductions. Together these measures would cut nearly 23 $MMTCO_2e$ and significantly curb methane.

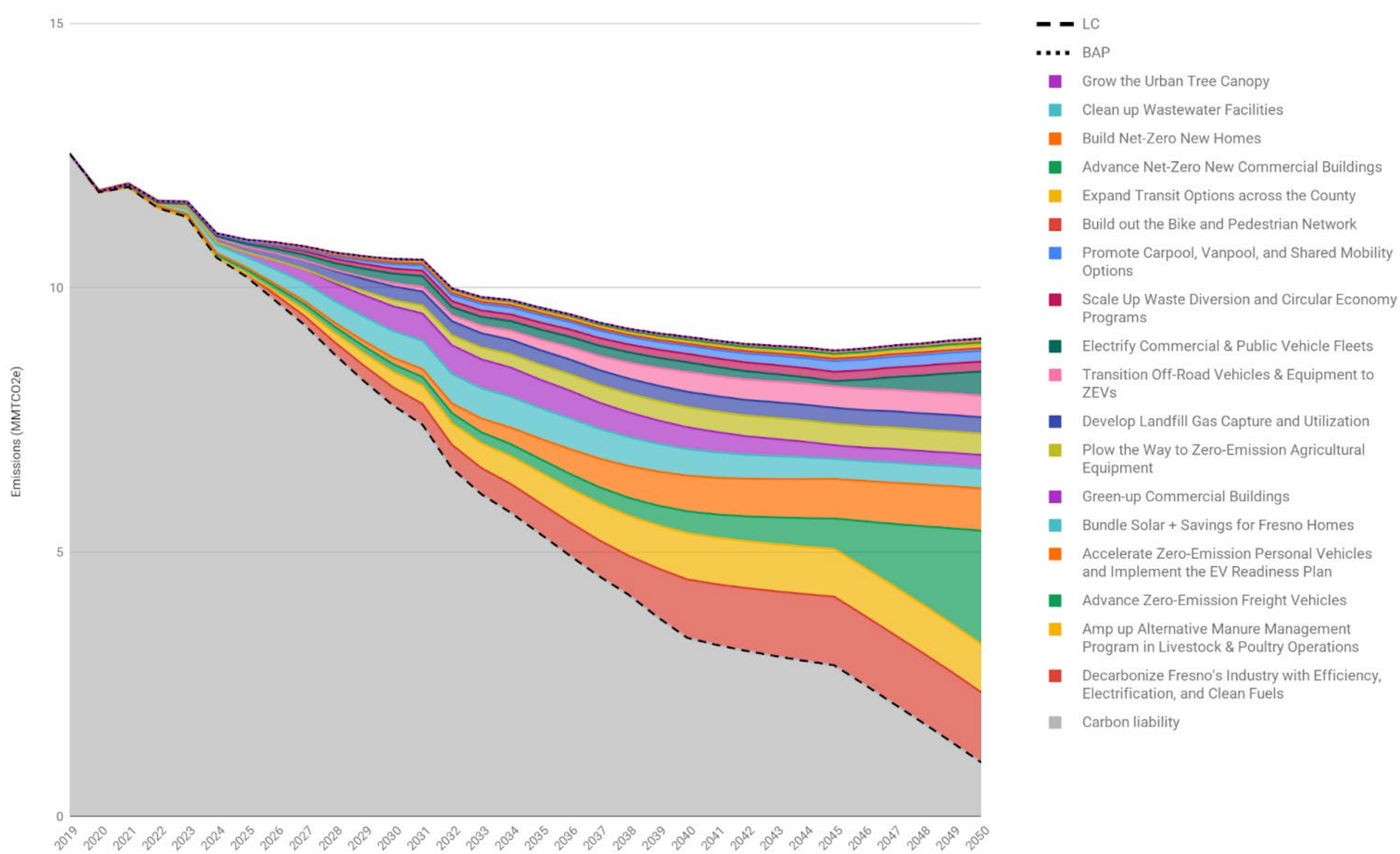


Figure 5-6: Projected Emissions Reductions by Measure for the Low-Carbon Scenario

The measure with the largest emission reductions is Decarbonizing Industry with Efficiency, Electrification, and Clean Fuels, which accounts for over 20 MMT CO_2e of cumulative reductions, nearly one-fifth of the total. Industrial improvements deliver consistent emission reductions throughout the scenario, with sharp declines after 2040 as grid emissions are reduced to zero.

Waste measures would deliver steady reductions, with Scale Up Waste Diversion and Circular Economy Programs (3.7 MMT CO_2e) and Develop Landfill Gas Capture and Utilization (7.0 MMT CO_2e) tackling methane emissions.

Although smaller in emission reductions, measures such as Grow the Urban Tree Canopy provide important co-benefits (e.g., cooling neighborhoods, reducing urban heat island effects, improving air quality, and providing shade) that lowers household energy costs. Expanding tree cover also enhances stormwater management, supports biodiversity, and improves overall community health and well-being. Therefore, although not as impactful on emission reductions, this measure can make communities in Fresno County more livable and vibrant.

Measures with the highest cumulative emissions reductions in 2026–2050:

- Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels: 20.5 MMT CO_2e
- Amp up Alternative Manure Management Program in Livestock & Poultry Operations: 16 MMT CO_2e
- Advance Zero-Emission Freight Vehicles: 13.6 MMT CO_2e
- Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan: 12.3 MMT CO_2e
- Bundle Solar + Savings for Residences: 12.2 MMT CO_2e
- Green-up Commercial Buildings: 9.7 MMT CO_2e

5.3 FINANCIAL IMPACTS OF THE LOW-CARBON SCENARIO

This section outlines the economic impacts of LC Scenarios. Key concepts that are used to analyze the financial impacts of the pathways are summarized below.

- **Net Present Value (NPV)** is the balance between an investment and what it saves or earns over time. This analysis looks at four cost/benefit categories: upfront costs, energy savings or costs, operations and maintenance savings, and revenue. A negative NPV means benefits are greater than costs, and a positive NPV means costs are higher than savings.
- **Discount Rate** shows how much we value the future compared to today. In this analysis, a 3% rate is used; therefore, $1 of benefits in 50 years is worth about $0.23 today. Higher rates give less weight to future savings, and lower rates treat today and future impacts more equally.
- **Abatement Cost** is the cost to reduce one metric ton of GHG emissions, calculated by dividing a measure's NPV by its total emissions reductions. For example, a project with an NPV of $1,000 that avoids 10 MT CO_2e has an abatement cost of $100 per MT of CO_2e. Abatement costs help

compare the cost-effectiveness of different climate actions and can help guide investment toward measures that deliver the greatest emissions reductions per dollar spent.

The LC Scenario would not only deliver significant emissions reductions but would also have the potential to generate substantial long-term financial savings for the residents of Fresno County (Figure 5-7). By 2050, total capital expenditures are projected at $25 billion, but these upfront costs are offset by major savings in other areas. Operations and maintenance expenditures are reduced by $5.2 billion and energy expenditures decline by $36.6 billion, as cleaner and more efficient systems lower fuel and utility costs. Operations, maintenance, and energy savings begin outweighing investment cost between 2033 and 2034. Overall, the LC Scenario has an NPV of $16.8 billion between 2026 and 2050 (Figure 5-8). On a per capita basis, this translates to roughly $17,000 in savings per Fresno County resident over 25 years (or about $680 per year), demonstrating that bold climate action is environmentally, socially, and financially advantageous.

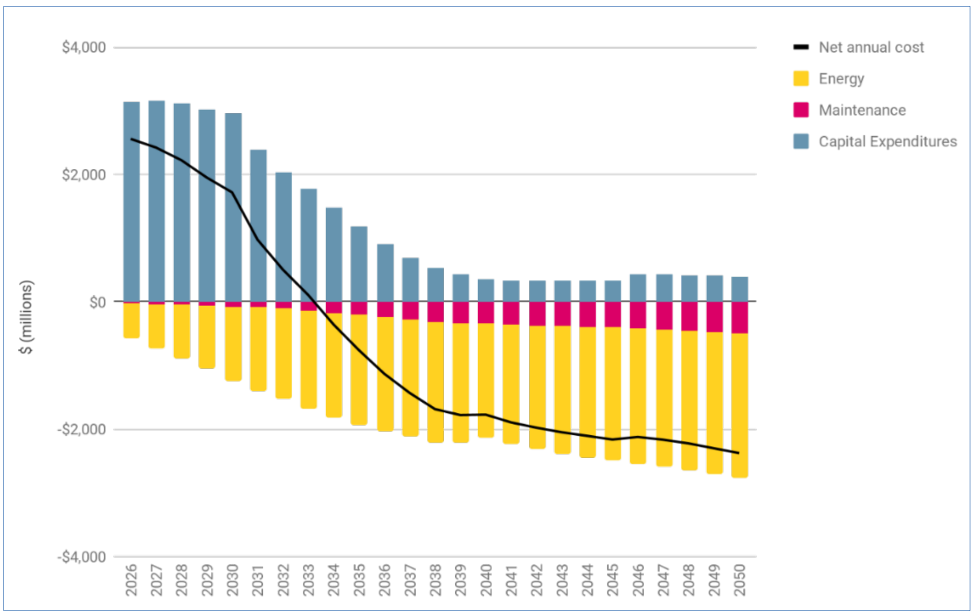


Figure 5-7: Annual Investments and Savings in the LC Scenario, 2026-2050

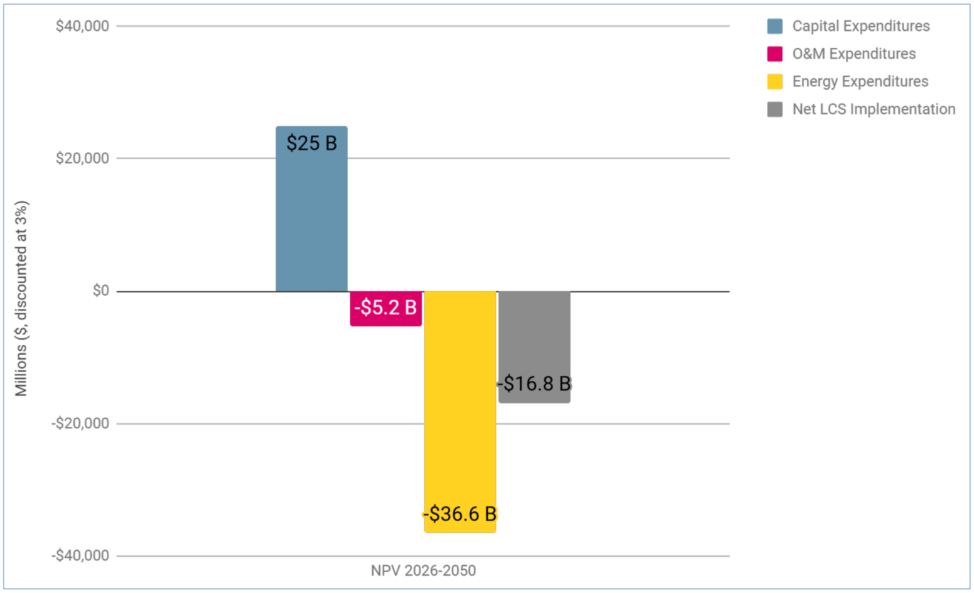


Figure 5-8: Cumulative Investments and Returns in the LC Scenario

The LC Scenario would require significant investments, averaging about $1.2 billion annually between 2026 and 2050 (Figure 5-9, provided on the following page). Although this is a significant commitment, it is only roughly 2% of Fresno County's annual gross domestic product (GDP) ($60 billion in 2023). The largest investments would need to be made in the building sector, particularly under the measure Bundle Solar + Savings for Residences, which alone requires $14 billion to add solar, increase efficiency, and electrify homes in Fresno County. Similarly, Green-up Commercial Buildings requires significant up-front costs, roughly $7 billion, but expected gain on investment could be $11.5 billion. The incremental costs of constructing Net-Zero Homes and Commercial Buildings are remarkably lower, only $500 million between 2026–2050.

Decarbonizing Fresno's Industry would also be among the largest investments, reaching $6.7 billion by 2050, but savings reduce the NPV to $3.2 billion. Transportation measures also represent a major share of expenditures ($2.6 billion), although they transition to net savings quickly with reduced fuel and maintenance costs. Measures in waste, agriculture, and natural land require relatively smaller investments but deliver valuable methane reductions, sequestration, and resilience benefits.

The abatement cost curve (Figure 5-10) shows that Fresno County can achieve the bulk of its emission reductions through high-value, negative-cost measures, especially in industry, transportation, and building solar, while also strategically investing in higher-cost actions (e.g., tree canopy expansion) that deliver broader resilience and community benefits. The most cost-effective measures (shown with negative abatement costs) include the following:

- **Industrial Renewables (-$5,510 per MT CO_2e):** By far the largest cost-saving opportunity, showing that substituting fossil fuels with renewables in industrial operations generates both deep emissions cuts and significant financial benefits.

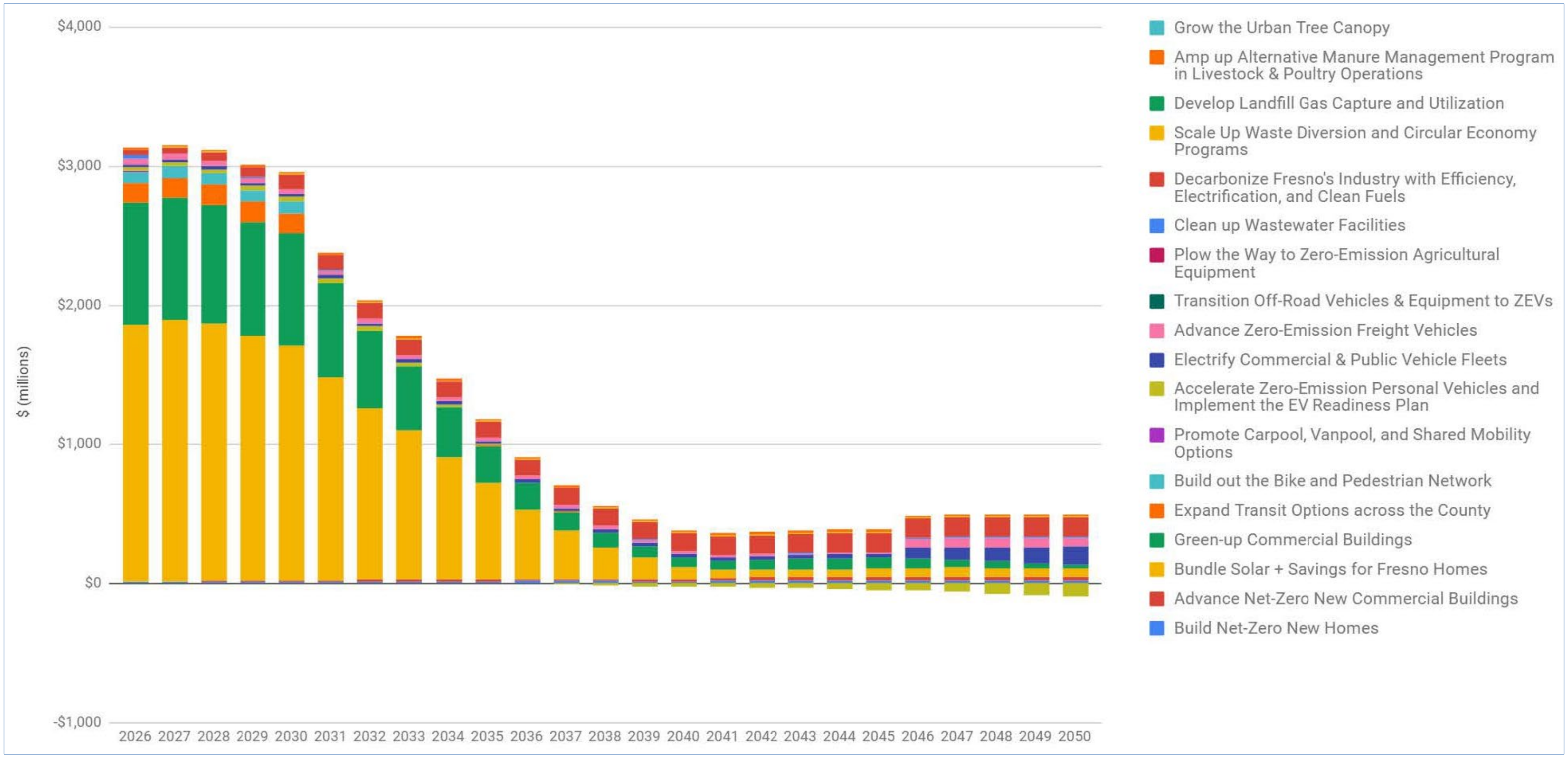


Figure 5-9: Annual Capital Investments in the LC Scenario By Measure, 2026-2050

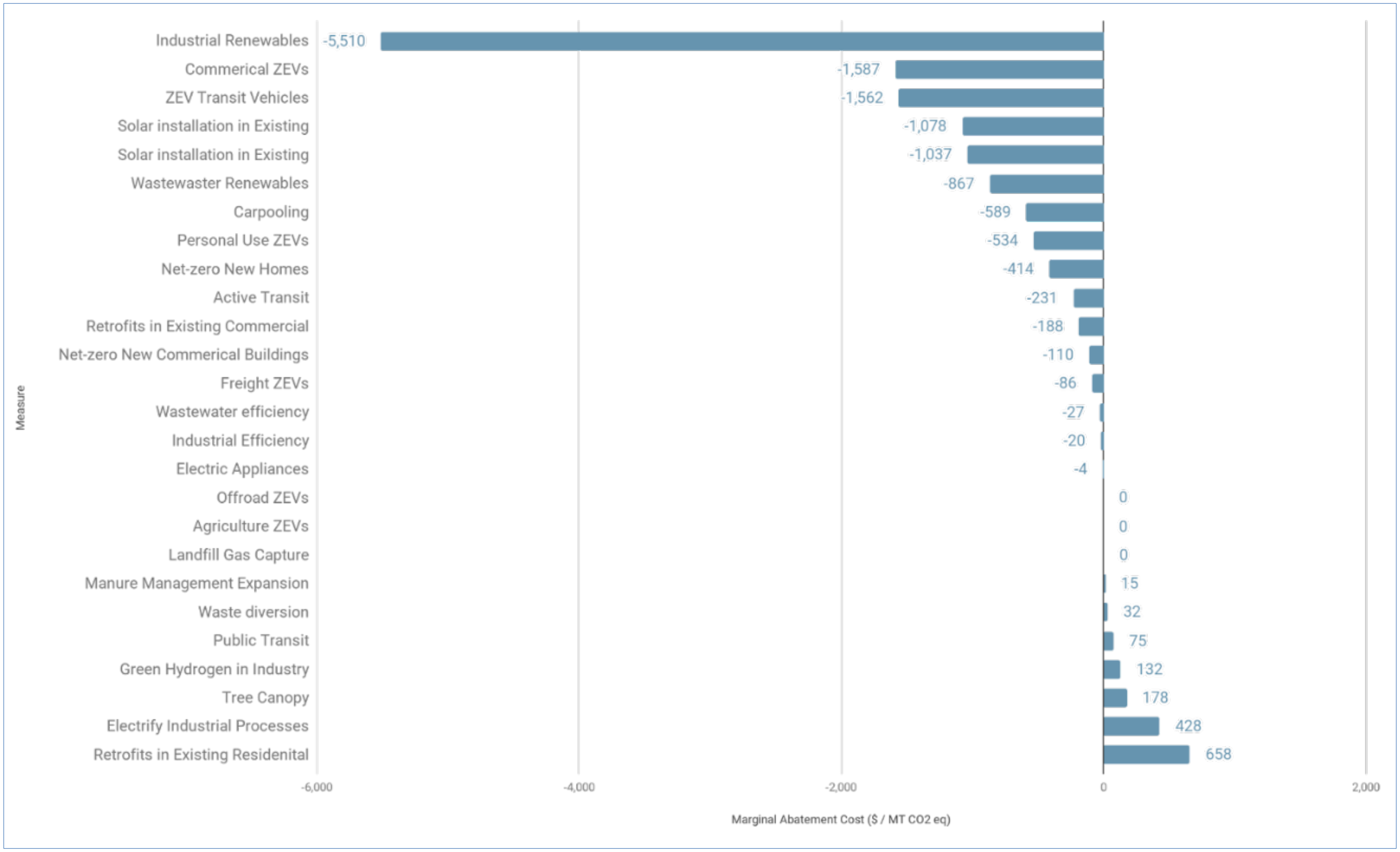


Figure 5-10: Marginal Abatement Curve of the LC Scenario

- **Commercial Zero-Emission Vehicles (ZEVs) (-$1,587 per MT CO_2e) and ZEV transit (-$1,561 per MT CO_2e):** Electrifying fleets and buses provides large-scale fuel and maintenance savings, alongside air quality improvements.
- **Building Solar on Existing Buildings, Both in Commercial (-$1,078 per MT CO_2e) and Residential (-$1,037 per MT CO_2e):** Delivers substantial cost savings by reducing reliance on grid electricity and stabilizing long-term energy costs.

Other negative-cost measures include wastewater renewables, carpooling, personal ZEVs, net-zero homes, and active transit, all of which combine emissions reductions with direct household, business, or community-wide savings.

At the other end of the spectrum, a handful of measures carry positive abatement costs, meaning they are more expensive per ton reduced. Examples include retrofits in existing residential buildings ($658 per MT of CO_2e), electrification of industrial processes ($428 per MT of CO_2e), and tree canopy expansion ($178 per MT of CO_2e). These measures, although costlier per ton, provide critical co-benefits (e.g., resiliency, health, and livability) that are not fully captured in the cost-per- calculation.

5.4 CCAP-A OUTLOOK BY SECTOR

This section provides a roadmap to execution for the CCAP-A. It identifies concrete steps for jurisdictions within Fresno County to implement identified GHG emissions reductions actions, as well as suggested partnerships for successful measure implementation.

To implement the measures identified in the LC Scenarios, the region will require clear legal authority, sufficient and sustained funding, and timelines for implementing action. This section outlines how each measure could be executed, identifying potential lead agencies, their current authorities, and any additional powers that may be needed. It also provides implementation timelines, estimated costs, funding sources, and metrics to track success.

The CCAP-A is a conceptual exploration of strategies and potential paths to implementation for GHG reduction. Although potential implementing entities are identified in this section, this plan will not regulate any industry and/or commit any parties to further action. The concepts modeled may illustrate improvements occurring by public or private parties, but do not imply that any party assents to the plan or is taking steps to advance the development of GHG reductions. The strategies and measures as outlined are contingent upon availability of funds from the State and federal government.Measures are presented as a toolbox for decision-makers, not as a ranked list of priorities. Every measure will require further assessment, including legal review, economic analysis, and, in some cases, new policies or legislation. Each measure is structured to give decision-makers, stakeholders, and the public a clear view of its role in meeting the region's climate goals. Each measure includes the following:

- **Measure Title and Description:** What the action is and how it works
- **Authority to Implement:** Which entities currently have the legal authority to carry out the measure and where new authorizations may be needed

- **Potential Implementing Entities and Responsibilities:** Which organizations could lead or support the measure and the roles they would potentially play under a successful implementation scenario
- **Implementation Timelines:** Illustrative steps and sequencing to guide planning, aligned with the LC scenario and modeled benefits
- **Costs and Savings:** Estimated investment needs and potential returns
- **Funding Sources:** Potential federal, State, local, and private funding sources, from grants and tax credits to loan programs, including where lack of funding availability would jeopardize measure implementation (even for implementation-ready actions)
- **Metrics for Tracking Progress:** Indicators that could be utilized by implementing agencies to monitor whether a measure is delivering results

5.4.1 Buildings Sector

In 2019, the building sector, including residential, commercial, and government buildings, accounted for 1.88 MMT CO_2e, or about 15% of Fresno County's total GHG inventory. Residential buildings contributed the majority, with 1.09 MMT CO_2e, underscoring the importance of household-level interventions (e.g., appliance electrification, efficiency upgrades, and rooftop solar). By 2050, building emissions are projected to fall to 2.35 kilotonne (kt) CO_2e, representing a dramatic reduction of more than 99% from 2019 levels. The largest declines are expected in the residential sector, and 1.73 kt CO_2e of emissions are projected to remain in the commercial sector, primarily from continued natural gas use for space and water heating (Figure 5-11).

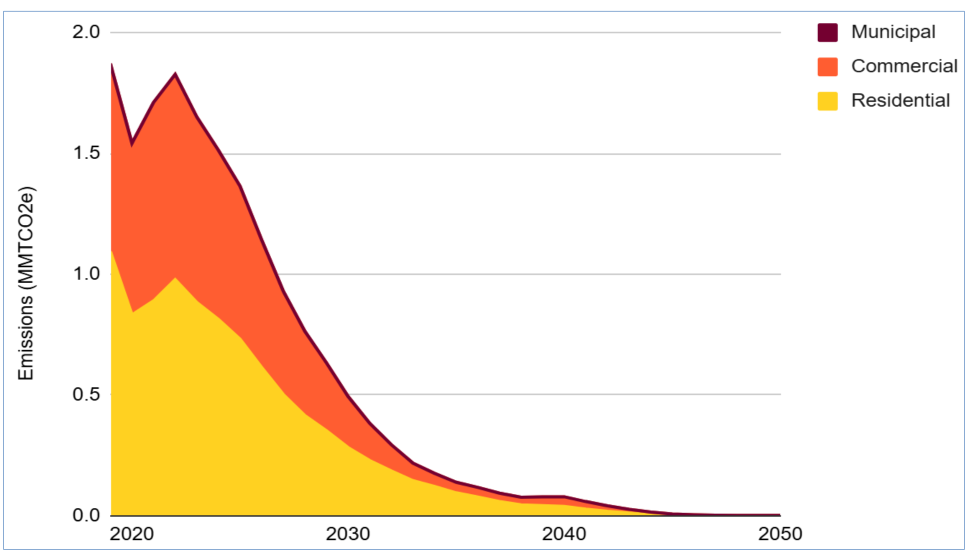


Figure 5-11: Projected Building Sector (Excluding Industrial Buildings) GHG Emissions in the LC Scenario by Sector, 2019–2050

Based on the emissions by energy source (Figure 5-12), grid electricity accounted for 1.28 MMT CO_2e (or 40% of building emissions) in 2019, and natural gas contributed 1.86 MMT CO_2e (or 59%), although this figure also includes some industrial building process emissions. Under SB 100, California requires a transition to 100% zero-carbon electricity by 2045, which means grid-related building emissions would fall to zero by 2050. Although greatly reduced, natural gas emissions are projected to persist in 2050, accounting for 2.27 kt CO_2e, making it the dominant source of building-related emissions, which is largely due to space and water heating in commercial buildings (Figure 5-13).

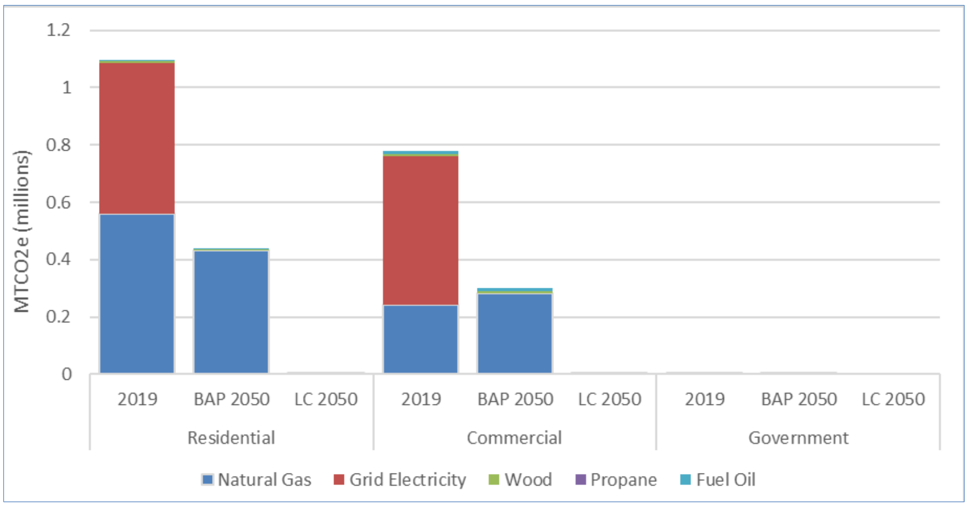


Figure 5-12: Projected Building Sector GHG Emissions by Fuel Type in the LC Scenario, 2019–2050

Although these measures can drive substantial emission reductions, as illustrated in Figure 5-13, their success depends on a fully decarbonized grid under SB 100. Without clean electricity, electrification alone will not deliver the expected benefits. Figure 5-13 shows the projected building sector GHG emissions by fuel type. Therefore, achieving Fresno County's building-sector decarbonization requires not only strong implementation of local retrofit and electrification measures but also sustained alignment with statewide clean energy policies to eliminate fossil fuels from the power supply. Table 5.D summarizes the potential emissions reductions that could be realized through successful deployment of the building sector measures.

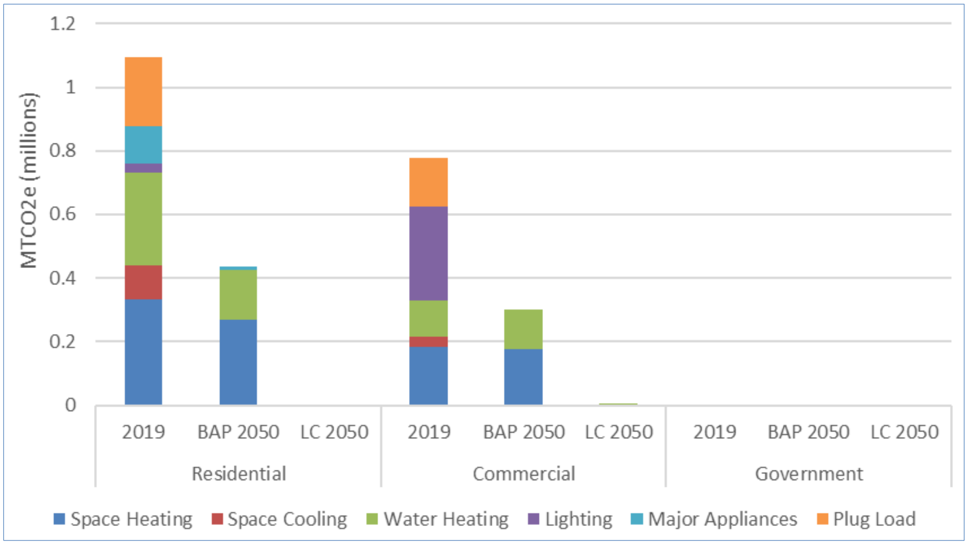


Figure 5-13: Projected Building Sector GHG Emissions by End-Use in the LC Scenario, 2019–2050

Table 5.D: Building Sector Emissions Reductions by Measure

Modeled Actions	Total GHG Emissions Reductions ($MMT\ CO_2e$)		Cumulative GHG Emissions Reductions ($MMT\ CO_2e$)
	2026 to 2030	2031 to 2050	2026 to 2050
Advance Net-Zero New Commercial Buildings	0.05	0.74	0.79
Build Net-Zero New Homes	0.013	0.71	0.73
Bundle Solar + Savings for Residences	2.00	9.60	11.61
Green-up Commercial Buildings	1.63	7.90	9.54

Source: SSG (2025).
CO_2e = carbon dioxide equivalent MMT = million metric tons

5.4.1.1 Bundle Solar + Savings for Residences

Description. Accelerate the deployment of solar and low-emission technologies in existing homes by bundling on-site renewable generation (primarily rooftop solar photovoltaic [PV] with storage) with energy efficiency retrofits (e.g., insulation, windows) and clean equipment upgrades (e.g. heat pumps for space and water heating, induction cooking, EV charging). Pair local generation and storage with aggregation programs (e.g., Pacific Gas and Electric Company's [PG&E] Solar Choice Program) to give households affordable access to zero-emission energy and home electrification. Potential implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.E) and metrics for tracking progress.

Authority to Implement. Local Governments (County and Cities), California Energy Commission (CEC), California Public Utilities Commission (CPUC), California Air Resources Board (CARB)

Table 5.E: Bundle Solar + Savings for Residences Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Streamline permitting for rooftop solar, battery storage, and electrification retrofits. Launch homeowner and renter outreach on federal and State incentives.	Cities and County Building Departments, Fresno COG, Community Organizations
2027	Establish residential retrofit workforce pipeline. Launch HVAC/heat pump installer certification at community colleges and expand electrical apprenticeship slots for home wiring upgrades. Create bilingual homeowner assistance to guide low-income households through rebate applications.	Community Colleges, Workforce Boards, CEC, Local Governments
2028	Deploy large-scale residential incentive programs: bulk-purchase solar panels and heat pumps to lower costs. Launch neighborhood aggregation pilots with PG&E to pool storage and rooftop solar. Prioritize installations in LIDAC communities with ≥50% cost coverage.	PG&E, Local Governments
2029	Adopt solar-ready and electric-ready requirements for residential equipment replacements in alignment with Title 24 updates. Expand utility on-bill financing for heat pumps and induction stoves.	Local Governments, County, CEC, PG&E
2030	Conduct and publish program evaluation.	Fresno COG, San Joaquin Valley Air Pollution Control District, State Agencies, Local Governments
2035	Scale programs to reach majority of eligible households. Integrate smart home technologies and demand-response incentives.	PG&E, Local Governments, CPUC, CEC
2040	Enforce requirement that all replacement of residential water and space heating systems be zero-emission. Expand financing for low-income homeowners and renters to cover 80–100% of retrofit costs.	Local Governments, CPUC, CEC

Source: SSG (2025).
CEC = California Energy Commission
CPUC = California Public Utilities Commission
Fresno COG = Fresno Council of Governments
HVAC = heating, ventilation, and air conditioning
LIDAC = low-income/disadvantaged communities
PG&E = Pacific Gas and Electric Company

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **County and Cities**
  - Adopt and enforce streamlined solar/storage permitting (e.g., SolarAPP+)
  - Integrate solar- and electric-ready requirements in codes
  - Outreach and education through sustainability offices or partner community-based organizations (CBOs)
- **PG&E and Community Choice Aggregations (CCAs) (if any emerge)**
  - Provide rebates, on-bill financing, and aggregation options (Solar Choice, Community Solar)
  - Implement interconnection and grid integration
- **Contractors and Workforce Development Partners (e.g., Fresno Economic Opportunities Commission (EOC), community colleges, unions)**
  - Train and certify heating, ventilation, and air conditioning (HVAC) professionals, electricians, and solar installers
  - Deliver retrofits at scale

- **Community-Based Organizations**
  - Target outreach and education to LIDACs
  - Provide language-accessible outreach and tenant/landlord assistance

- **Regional Agencies (Fresno Council of Governments [Fresno COG] and San Joaquin Valley Air Pollution Control District [SJVAPCD] for co-benefits)**
  - Coordinate regional funding applications, ensure equity alignment

- **State and Federal Agencies (CEC, CARB, United States Environmental Protection Agency [EPA], Treasury):**
  - Approve reach codes, administer incentive/grant programs, and distribute funding

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Financial Incentives and Funding:** Leverage rebates, grants, tax credits, and low-interest financing (e.g., State or Federal rebates, on-bill financing, TECH Clean California, and Disadvantaged Communities-Single-family Solar Homes [DAC-SASH]) to make solar, storage, and electrification affordable and accessible.
- **Permitting and Codes:** Streamline permitting for rooftop solar, storage, and electrification retrofits. Adopt solar-ready and electric-ready requirements so that when residents replace equipment (e.g., water heaters, HVAC, stoves) the defaults are clean options.
- **Workforce Development and Technical Assistance:** Expand training and certification programs for HVAC contractors, electricians, and solar installers. Provide homeowners and tenants with technical support through a one stop shop information hub and neighborhood outreach campaigns to simplify participation.
- **Utility and Aggregation Partnerships:** Partner with PG&E's Solar Choice and community solar/aggregation programs to expand affordable access to clean energy and resilience benefits from storage.
- **Targeted Community Programs:** Prioritize incentives, outreach, and assistance for low-income and disadvantaged households and address barriers (e.g., upfront costs, landlord–tenant split incentives, and language access).

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure, for both retrofits and solar installations:

Retrofits in Existing Residential Buildings	
Incremental Capital Costs (million USD)	$12,470
Incremental Maintenance Costs (million USD)	-$110
Incremental Energy Costs (million USD)	-$6,170
Incremental Total Costs (million USD)	$6,190
Return on Investment	-50%
Cumulative Emissions Reduction (kt CO_2e)	9,409
Marginal Abatement Cost (USD per MT CO_2e)	$660
Solar Installations in Existing Residential Buildings	
Incremental Capital Costs (million USD)	$1,340
Incremental Maintenance Costs (million USD)	$210
Incremental Energy Costs (million USD)	-$4,360
Incremental Total Costs (million USD)	-$2,810
Return on Investment	182%
Cumulative Emissions Reduction (kt CO_2e)	2,710
Marginal Abatement Cost (USD per MT CO_2e)	-$1,040

Source: SSG (2025).

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA Climate Pollution Reduction Grants (CPRG) Implementation Grants: Primary program for CCAP-A follow-through
  - Inflation Reduction Act (IRA) Tax Credits: 30% Investment Tax Credit (ITC) plus bonus credits for solar, storage, heat pumps, efficiency; available to local governments via direct pay
  - United States Department of Energy (DOE) Home Energy Rebate Programs: High-Efficiency Electric Home Rebate Program, Home Efficiency Rebates (HOMES) rebate program
- **State**
  - TECH Clean California: Heat pumps, space/water heating
  - CEC BUILD Program: Residential new construction electrification, some retrofit opportunities
  - Self-Generation Incentive Program (SGIP): Battery storage rebates
  - DAC-SASH
  - Energy Savings Assistance Program (ESAP): Low-income energy efficiency upgrades
- **Local/Utility**
  - PG&E Solar Choice and Community Solar Programs
  - On-Bill Financing for efficiency and electrification upgrades
  - Local Fresno COG/County Coordination with Financing Partners (e.g., regional green banks, low-interest loan pools)
- **Private/Other**
  - Third-party solar providers (leases/power purchase agreements [PPAs])
  - Community banks/credit unions (low-interest retrofit loans with IRA leverage)

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of homes retrofitted annually and cumulatively (single-family, multifamily, mobile homes)
- Megawatts (MW) of rooftop solar and battery storage installed (annual and cumulative)
- Number of heat pumps installed (space and water heating)
- Percentage of residential appliance replacements that are zero-emission (e.g., heat pumps, induction stoves, electric dryers)
- Share of incentives reaching LIDAC participation rate households
- Average household energy cost savings

5.4.1.2 Green-up Commercial Buildings

Description. Upgrade Fresno County's commercial and institutional buildings by installing on-site renewable energy systems, paired with energy storage and whole-building retrofit packages. These retrofits upgrade efficiency, modernize buildings systems, and electrify space and water heating and other building equipment. Use aggregation models to reduce costs through bulk procurement and expand access to clean power. Build on California's Commercial Property Assessed Clean Energy (C-PACE) financing, already authorized by both the County and the City of Fresno, to lower upfront costs and expand participation. Timelines and major milestones for the measure are detailed in Table 5.F (provided on the following page).

Authority to Implement. Local Governments (County and Cities), CEC, CPUC, CARB

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation**:**

- **County and Cities**
  - Adopt local ordinances (building performance standards [BPS], permitting reforms).
  - Expand outreach to property owners about C-PACE and local financing.
  - Integrate clean-energy retrofits into public procurement for schools, hospitals, and civic buildings.

- **Fresno County C-PACE Program Administrators/Capital Providers**
  - Finance clean energy and retrofit projects.

- **Commercial Building Owners/Institutions (schools, hospitals, universities)**
  - Participate in retrofits, apply for financing and incentives, maintain compliance with performance standards.

- **Utilities (PG&E)**
  - Provide rebates, interconnection, demand-management programs, on-bill financing.

Table 5.F: Green-up Commercial Buildings Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Streamline permitting and interconnection for commercial solar and storage. Launch outreach to businesses on C-PACE and other tax credits.	Cities and County, Fresno COG, Chambers of Commerce
2027	Expand C-PACE participation through targeted campaigns. Provide technical assistance and energy audits for large employers, schools, and institutions - this could be tied to a local building retrofit challenge.	County of Fresno, City of Fresno, Trade Associations
2028	Launch bulk-purchasing and aggregation pilots for multi-building retrofits. Begin portfolio-wide retrofits in schools and municipal facilities.	Cities and County, Fresno COG, PG&E, School Districts, Public Agencies
2029	Adopt electric-ready and solar-ready requirements for major commercial retrofits, align with Title 24 code updates. Convene cities and the County to adopt consistent local BPS, so building owners face uniform rules across Fresno County.	Cities and County, CEC Fresno COG
2030	Implement benchmarking and disclosure for large commercial, institutional, and multifamily buildings under BPS. Require all replacement of space and water heating systems to be zero-emission.	Cities and County, CEC, CARB
2035	Require performance improvements to reduce building emissions and energy use and continue support for whole-building retrofit programs.	Cities and County, CPUC, Utilities
2040	Enforce BPS emissions targets for large commercial buildings. Require all replacement of space and water heating systems to be zero-emission.	Cities and County, CEC, CARB

BPS = building performance standards
C-PACE = Commercial Property Assessed Clean Energy
CARB = California Air Resources Board
CEC = California Energy Commission
CPUC = California Public Utilities Commission
Fresno COG = Fresno Council of Governments
PG&E = Pacific Gas and Electric Company

- **CBOs and Chambers of Commerce**
  - Conduct outreach to small businesses, disadvantaged commercial districts.
- **Workforce and Contractors**
  - Deliver audits, retrofits, installation of solar/storage/heat pumps, and operation and maintenance services.
- **Public-Private Partnerships (PPP)**
  - Pilot demonstration projects and co-fund aggregation models.

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Financing and Incentives:** Expand use of California's C-PACE program to finance retrofits and clean energy upgrades with no upfront cost, offer rebates/tax credits, and create a green revolving loan fund to lower upfront costs.
- **Bulk Procurement and Aggregation:** Launch bulk-purchasing programs for commercial-scale solar, storage, and heat pumps to drive down costs. Develop aggregation models (e.g., multi-building or portfolio retrofits) to enable smaller businesses and institutions to participate. Use public procurement standards to ensure highly efficient, clean energy upgrades in schools, hospitals, and government facilities.

- **Policy and Permitting:** Develop local BPS and adopt ordinances requiring commercial and institutional buildings to meet energy efficiency and emissions reduction targets over time. Streamline permitting and interconnection for solar, storage, and electrification projects. Adopt solar/electric-ready requirements for commercial retrofit and align with Title 24 and SB 100 targets.
- **Technical Assistance:** Provide technical assistance and energy audits for building owners to identify retrofit opportunities. Create a commercial retrofit resource hub to guide businesses through financing and permitting processes.
- **Partnerships and Pilots:** Partner with utilities, chambers, and institutions to design programs. Launch demonstration projects in schools and public buildings. Encourage public-private partnerships to leverage private capital for building modernization.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure, for both retrofits and solar installations:

Retrofits in Existing Commercial Buildings	
Incremental Capital Costs (million USD)	$3,520
Incremental Maintenance Costs (million USD)	-$90
Incremental Energy Costs (million USD)	-$4,690
Incremental Total Costs (million USD)	-$1,260
Return on Investment	36%
Cumulative Emissions Reduction (kt CO_2e)	6,712
Marginal Abatement Cost (USD per MT CO_2e)	-$190
Solar Installations in Existing Commercial Buildings	
Incremental Capital Costs (million USD)	$2,970
Incremental Maintenance Costs (million USD)	$460
Incremental Energy Costs (million USD)	-$6,650
Incremental Total Costs (million USD)	-$3,220
Return on Investment	93%
Cumulative Emissions Reduction (kt CO_2e)	2,978
Marginal Abatement Cost (USD per MT CO_2e)	-$1,080

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants: Primary federal funding mechanism tied to .
  - IRA Tax Credits: 30% ITC; bonus credits for energy communities, low-income, domestic content, storage, efficiency, etc. Commercial owners can use tax equity or transferability.
  - DOE Loan Programs Office: For aggregation or portfolio-scale retrofits.
- **State**
  - C-PACE: Already authorized locally.
  - CEC Building Initiative for Low-Emissions Development (BUILD): Some overlap with commercial/institutional retrofits.
  - SGIP: Battery storage.

- Energy Savings Assistance and utility programs for commercial efficiency.
- California Schools Healthy Air, Plumbing, and Efficiency Program (CalSHAPE): HVAC, plumbing upgrades in schools.

- **Local/Utility**
  - PG&E rebates for efficiency and electrification.
  - Utility on-bill financing.
  - Revolving loan funds managed by County/City or regional green banks.

Metrics for Tracking Progress. Key metrics for this measure include:

- Participation rate in C-PACE and other financing programs.
- MW of solar PV and battery storage installed on commercial and institutional buildings (annual and cumulative).
- Number and square footage of buildings retrofitted.
- Percentage of commercial equipment replacements that are zero-emission (heat pumps, electric water heating, induction cooking, etc.).
- Energy use intensity (EUI) reductions in buildings subject to BPS.
- Share of retrofits in LIDAC communities.

5.4.1.3 Build Net-Zero New Homes

Description. Ensure that 100% of new residential buildings are net-zero by 2030, with all-electric systems, on-site renewables, and continuous efficiency improvements by adopting solar and EV-readiness requirements for all new buildings, providing builder incentives (e.g. fast-track permitting, density bonuses), and expanding builder training programs.

Residential net-zero building standards should be aligned with commercial standards in both implementation mechanisms and timelines to ensure consistent requirements, streamlined permitting, coordinated utility planning, and a unified path toward 100% net-zero new construction by 2030.

Potential implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as illustrative timelines and milestones for the measure (Table 5.G) and metrics for tracking progress.

Authority to Implement. Local Governments (County and Cities), CEC, CPUC, CARB

Table 5.G: Build Net-Zero New Homes Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch builder outreach and training programs on all-electric design, solar integration, and EV-ready construction.	Cities and County, Fresno COG, Builder Associations, Education Institutions
2027	Introduce voluntary incentives like fast-track permitting, reduced fees, and density bonuses for net-zero projects. Begin coordination with PG&E on grid capacity for new all-electric developments.	Cities and County, PG&E
2028	Adopt ordinances requiring solar-ready and EV-ready infrastructure in all new residential construction to be effective in 2030. Expand PG&E interconnection support for rooftop solar and storage.	Cities and County, CEC, PG&E
2029	Publish net-zero building design templates and provide technical assistance. Integrate PG&E demand-response pilots into new developments	Cities and County, Fresno COG, Builder Associations, Education Institutions, PG&E
2030	Mandate 100% of new residential buildings meet net-zero standards (all-electric, on-site renewables, high efficiency).	Cities and County, CEC

Source: SSG (2025).
CEC = California Energy Commission
EV = electric vehicle
Fresno COG = Fresno Council of Governments
PG&E = Pacific Gas and Electric Company

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation**:**

- **County and Cities**
  - Adopt and enforce net-zero ordinances by 2030
  - Provide local incentives (fast-track permitting, fee reductions, density bonuses)
  - Lead builder outreach, training, and publication of net-zero design templates
- **CEC**
  - Approve local reach codes and align Title 24 improvements with net-zero standards
- **PG&E**
  - Coordinate grid upgrades for all-electric load growth
  - Support interconnection of solar/storage in new subdivisions
  - Implement demand-response pilots for net-zero communities
- **Builder Associations and Community Colleges/Universities**
  - Provide training and capacity-building for builders, inspectors, and contractors
  - Coordinate regional outreach and technical assistance
- **Developers and Builders**
  - Incorporate net-zero design features into new construction
  - Participate in training and pilot projects

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Codes and Standards:** Adopt local ordinances requiring all-electric, solar-ready, and EV-ready new homes in 2030; align with Title 24 efficiency improvements
- **Permitting Incentives:** Offer fast-track permitting, reduced fees, or density bonuses for early adopter projects meeting net-zero standards
- **Builder Incentives:** Provide financial incentives or rebates for early adoption of net-zero designs and technologies
- **Training and Capacity Building:** Expand builder, contractor, and inspector training programs on all-electric design, solar integration, and advanced efficiency standards (i.e. Passive House)
- **Utility Coordination:** Partner with PG&E to ensure grid readiness and incentives for new net-zero developments
- **Outreach and Technical Assistance:** Develop guidance, design templates, and technical support for developers and builders to simplify compliance

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$260
Incremental Maintenance Costs (million USD)	-$20
Incremental Energy Costs (million USD)	-$330
Incremental Total Costs (million USD)	-$90
Return on Investment	30%
Cumulative Emissions Reduction (kt CO_2e)	810
Marginal Abatement Cost (USD per MT CO_2e)	-$110

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants (for local program implementation)
  - IRA Tax Credits (30% ITC for solar/storage; 45L energy-efficient new home tax credit for builders; bonus credits for domestic content, low-income, and energy communities)
  - DOE Loan Programs Office (community/development scale projects)
- **State**
  - CEC BUILD: Incentives for all-electric new residential construction
  - TECH Clean California (supports heat pump deployment in new and existing homes)
  - SGIP (for battery storage paired with new residential solar)
- **Local/Utility**
  - PG&E new construction rebates (New Homes Program)
  - Local revolving loan funds or green banks to support early adoption

- **Private/Other**
  - Builder financing paired with IRA/CEC incentives
  - Public-private partnerships for net-zero demonstration communities

Metrics for Tracking Progress. Key metrics for tracking future implementation of this measure would include:

- Percentage of new buildings meeting net-zero standards (annual and cumulative)
- Number of new homes built with solar-ready and EV-ready infrastructure
- Number of builders, contractors, and inspectors trained in net-zero and all-electric construction practices
- Average permitting time for net-zero versus standard projects (to measure effectiveness of fast-track incentives)
- Number of projects approved under net-zero development incentives (density bonuses, fee reductions, etc.)

5.4.1.4 Advance Net-Zero New Commercial Buildings

Description. Construct new commercial and institutional buildings in Fresno County to be all-electric, solar-powered, and storage-ready. These buildings will lead the region's shift to a clean economy, delivering lower operating costs, improved air quality, and greater resilience for businesses and communities. Adopt solar and EV-readiness requirements for all new buildings, providing builder incentives (e.g. fast-track permitting, density bonuses) and expanding builder training programs.

Commercial net-zero building standards should be aligned with residential standards in both implementation mechanisms and timelines to ensure consistent requirements, streamlined permitting, coordinated utility planning, and a unified path toward 100% net-zero new construction by 2030. The timeline and milestones for the measure are included in Table 5.H.

Authority to Implement. Local Governments (County and Cities), CEC, CPUC, CARB

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **County and Cities**
  - Adopt and enforce net-zero ordinances by 2030
  - Provide permitting incentives, administer density bonuses, and publish technical guidance
  - Lead training and outreach programs in partnership with associations

- **CEC**
  - Approve local reach codes and align Title 24 improvements with net-zero standards

Table 5.H: Advance Net-Zero New Commercial Buildings Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch outreach and training programs for architects, engineers, and contractors on net-zero commercial design, electrification, and solar and storage integration.	Cities and County, Fresno COG, Builder Associations, Educational institutions
2027	Introduce voluntary incentives like fast-track permitting, reduced fees, density bonuses and recognition program for net-zero commercial projects. Begin coordination with PG&E on grid and interconnection capacity for large buildings.	Cities and County, PG&E
2028	Adopt ordinances requiring all-electric, solar-ready, storage-ready, and EV-ready infrastructure in all new commercial and institutional buildings by 2030.	Cities and County, CEC
2029	Provide technical assistance and toolkits for developers and publish model design standards for net-zero commercial buildings.	Cities and County, Fresno COG, Builder Associations
2030	Mandate 100% of new commercial and institutional buildings meet net-zero standards (all-electric, on-site renewables, storage-ready).	Cities and County, CEC

Source: SSG (2025).
CEC = California Energy Commission
EV = electric vehicle
Fresno COG = Fresno Council of Governments
PG&E = Pacific Gas and Electric Company

- **PG&E**
  - Coordinate grid capacity and interconnection for large, all-electric developments
  - Provide rebates and incentives for electrification, solar, and storage

- **Builder Associations and Community Colleges/Universities**
  - Provide training and capacity-building for builders, inspectors, and contractors
  - Coordinate regional outreach and technical assistance

- **Commercial Developers and Institutions (schools, hospitals, universities, public agencies)**
  - Incorporate net-zero design features into new construction
  - Participate in pilot/demonstration projects

- **CBOs and Chambers of Commerce**
  - Promote participation, especially for small and mid-sized businesses
  - Provide language-accessible and sector-specific technical assistance

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Codes and Standards:** Adopt ordinances requiring all-electric, solar-ready, storage-ready, and EV-ready infrastructure in all new commercial and institutional buildings by 2030, aligned with Title 24

- **Permitting Incentives:** Offer fast-track permitting, reduced fees, or density bonuses for net-zero commercial developments

- **Builder Incentives:** Provide financial rebates, grants, or recognition programs to encourage early adoption of net-zero commercial design
- **Training and Capacity Building:** Expand training for architects, engineers, contractors, and inspectors on net-zero design, building electrification, and solar and storage integration
- **Utility Coordination:** Work with PG&E to ensure grid capacity, interconnection, and incentives for commercial-scale solar and storage
- **Technical Assistance and Guidance:** Create design toolkits, technical guidance, and model projects to support developers in meeting net-zero requirements

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$220
Incremental Maintenance Costs (million USD)	-$20
Incremental Energy Costs (million USD)	-$500
Incremental Total Costs (million USD)	-$300
Return on Investment	138%
Cumulative Emissions Reduction (kt CO_2e)	730
Marginal Abatement Cost (USD per MT CO_2e)	-$410

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants (for local net-zero code adoption, training, and pilot projects)
  - IRA Tax Credits
  - DOE Loan Programs Office (large-scale or aggregated net-zero commercial projects)
- **State**
  - CEC BUILD: Incentives for all-electric new residential construction
  - CEC EPIC Program: Funding for demonstration of advanced efficiency and grid-integrated building systems
  - SGIP (for battery storage paired for commercial facilities)
  - California Hub for Energy Efficiency Financing (CHEEF)
- **Local/Utility**
  - PG&E new construction rebates (New Homes Program)
  - Local revolving loan funds or green banks to support early adoption
  - Local revolving loan funds, C-PACE expansion to commercial new construction
- **Private/Other**
  - Energy service companies (ESCOs) and performance-based contracting

   - Public-private partnerships for demonstration projects (schools, hospitals, government buildings)

Metrics for Tracking Progress. Key metrics for this measure include:

- Percentage of new commercial and institutional buildings meeting net-zero standards (annual and cumulative)
- MW of solar PV and storage capacity installed on new commercial buildings
- Percentage of new buildings constructed with EV-ready infrastructure (charging stations or conduit)
- Number of builders, architects, engineers, and inspectors trained in net-zero commercial design and construction
- Average permitting time for net-zero projects compared to standard projects
- Number of projects approved under net-zero development incentives (fast-track permitting, density bonuses, fee reductions, recognition program)

5.4.2 Transportation Sector

The transportation sector is the largest source of emissions in Fresno County, producing 6.77 MMT CO_2e in 2019 and representing 52% of the County's total GHG inventory. Within this sector, heavy-duty trucks contributed 2.46 MMT CO_2e (35%), fueled by both gasoline and diesel, while cars accounted for 2.19 MMT CO_2e (31%), driven primarily by gasoline use. In total, gasoline produced 3.85 MMT CO_2e or 55% of transportation emissions, and diesel produced 2.33 MMT CO_2e (33%). Although comparatively small, off-road vehicles and aviation combined accounted for 20% of transportation emissions and pose a potentially larger challenge in terms of decarbonization.

The LC Scenario presents pathways to transform transportation in Fresno County, shifting fuels and technologies. By 2050, fossil fuels are expected to be replaced by cleaner energy sources like electricity from a decarbonized grid and green hydrogen. Under this scenario, electricity provides 55% of transportation energy in 2050, while green hydrogen supplies 38%, enabling the transition for heavy-duty trucks and other hard-to-electrify vehicles. To meet State requirements, aviation emissions are reduced to 0.46 MMT CO_2e, a 20% reduction in jet fuel use. Similarly off-road vehicle emissions are projected to decline to near zero as equipment transitions to zero-emission alternatives. Figure 5-14, below, illustrates the projected transportation sector GHG emissions under the LC Scenario by vehicle type, while Figure 5-15 illustrates the projections by fuel type.

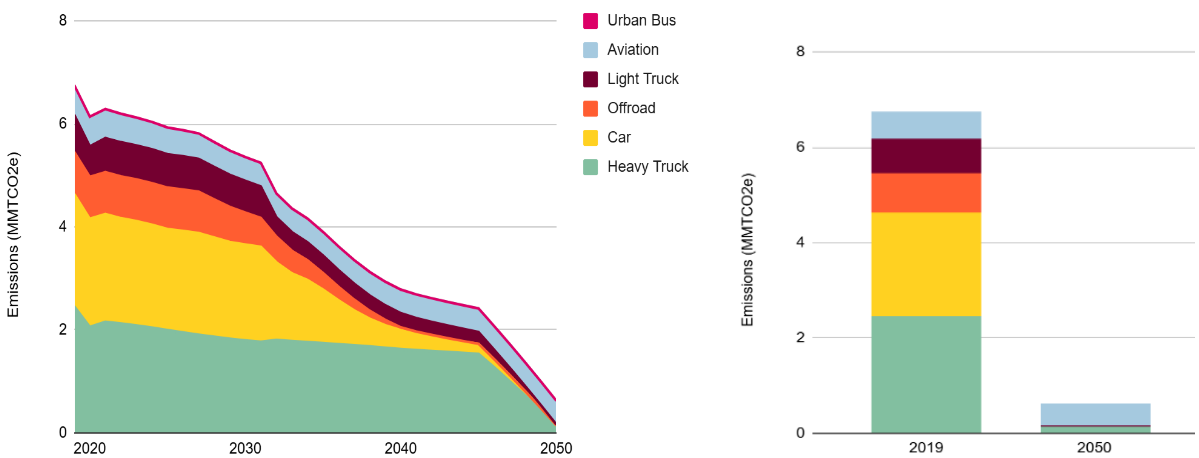


Figure 5-14: Projected Transportation Sector GHG Emissions in LC Scenario by Vehicle Type

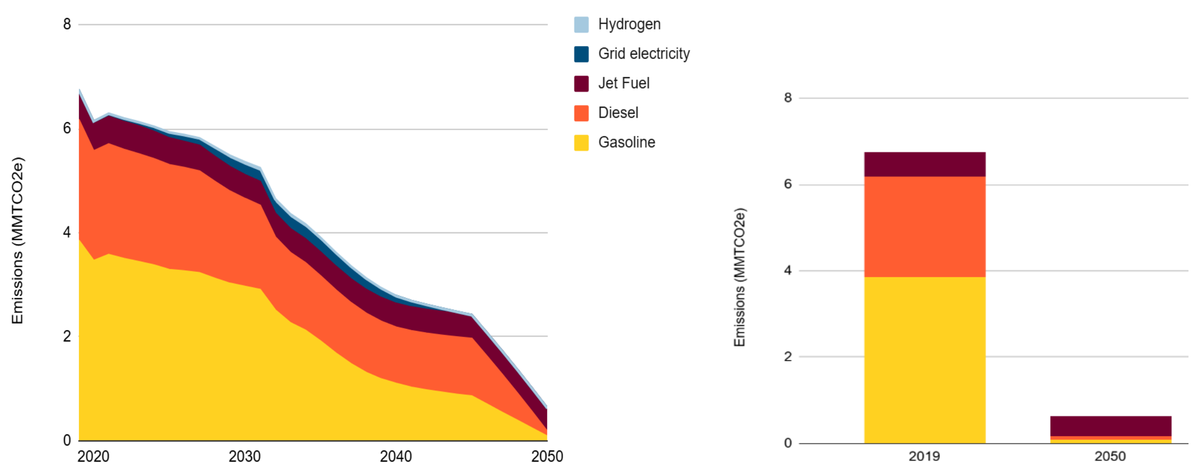


Figure 5-15: Projected Transportation Sector GHG Emissions in LC Scenario by Fuel Type

A comprehensive suite of measures is needed to achieve these reductions. Although the State's waiver authority remains a cornerstone of California's clean air and climate policy, ongoing federal review and litigation highlight the importance of maintaining diversified, locally driven strategies to ensure continued progress toward long-term emission-reduction goals. This includes expanding active and public transportation, promoting shared mobility options, and accelerating the adoption of zero-emission vehicles across personal, commercial, freight, and off-road fleets. Taken together, these measures form one of Fresno County's most important decarbonization pathways. Their success will require not only widespread technology deployment and supportive policies, but also a fully decarbonized electricity grid and the development of sufficient green hydrogen supplies. Coordinated action across all vehicle types, backed by infrastructure investment and distributed access, will be essential for meeting the County's long-term climate goals. Table 5.I summarizes the emission reductions that could be achieved through the implementation of the measures further discussed in the following section.

Table 5.I: Transportation Sector Measures Summary

Modeled Actions	Total GHG Emissions Reductions ($MMT\ CO_2e$)		Cumulative GHG Emissions Reductions ($MMT\ CO_2e$) 2026 to 2050
	2026 to 2030	2031 to 2050	
Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan	0.40	11.77	12.17
Advance Zero-Emission Freight Vehicles	0.600	12.75	13.35
Build out the Bike and Pedestrian Network	0.16	0.90	1.06
Electrify Commercial and Public Vehicle Fleets	0.65	4.11	4.76
Expand Transit Options across the County	0.10	0.93	1.03
Promote Carpool, Vanpool, and Shared Mobility Options	0.24	3.25	3.49
Transition Off-Road Vehicles and Equipment to ZEVs	0.13	6.24	6.37

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
EV = electric vehicle
GHG = greenhouse gas
MMT = million metric tons
ZEV = zero-emission vehicle

5.4.2.1 Expand Transit Options Across the County

Description. Enhance the public transportation system by maintaining/expanding the existing transit system and implementing other transit strategies (e.g., micro-transit). Invest in bus rapid transit, expanded service frequency, integrated ticketing, and last-mile connections. Prioritize routes serving employment centers, schools, and disadvantaged communities. Pair service improvements with affordable fare programs and clean bus fleets to make transit reliable, equitable, and low-emission. Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.J, provided on the following page) and metrics for tracking progress.

Authority to Implement. Local Governments (County and Cities); Fresno COG; Transit Operators (Fresno Area Express [FAX], Fresno County Rural Transit Agency [FCRTA], Clovis Transit); CARB; California Department of Transportation (Caltrans); Federal Transit Administration (FTA); EPA

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Clovis Transit (Round Up and Stageline), FAX, and FCRTA**
  - Operate fixed-route and rural transit, pilot micro-transit, manage fleet electrification and fare programs.
- **Fresno COG**
  - Integrate expanded transit into RTP/SCS, prioritize disadvantaged communities, program Congestion Mitigation and Air Quality Improvement (CMAQ) and other federal/State funds.

Table 5.J: Expand Transit Options Across County Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Expand bus service frequency on priority routes. Launch fare subsidy programs for students, seniors, and disadvantaged riders using Measure C funding.	FAX, FCRTA, Fresno COG
2027	Pilot micro-transit and commuter shuttles in partnership with employers, schools, and community-based organizations. Apply for funds for bus electrification.	FAX, FCRTA, Fresno COG, Employers, Schools
2028	Build zero-emission bus charging depots in coordination with PG&E. Adopt a regional integrated fare/ticketing system across transit operators. Implement TOD policies to boost ridership in urban corridors.	FAX, FCRTA, PG&E, Fresno COG
2030	Achieve 25% zero-emission bus fleet compliance under ICT. Add bus rapid transit corridors serving employment centers and schools.	FAX, FCRTA, CARB
2035	Achieve 75% zero-emission bus fleet compliance. Expand service coverage to disadvantaged communities identified in Fresno COG's RTP/SCS.	FAX, FCRTA, Fresno COG, CARB
2040	Reach 100% zero-emission fleet as required under ICT Regulation. Expand rural transit and on-demand transportation options to all municipalities.	FAX, FCRTA, CARB

Source: SSG (2025).

CARB = California Air Resources Board
FAX = Fresno Area Express
FCRTA = Fresno County Rural Transit Agency
Fresno COG = Fresno Council of Governments
ICT = Innovative Clean Transit
RTP/SCS = Regional Transportation Plan/Sustainable Communities Strategy
TOD = transit-oriented development

- **Cities and County**
  - Adopt transit-oriented development policies, build supportive infrastructure (bus stops, shelters, lanes, complete streets).
- **CARB**
  - Provide regulatory oversight (Innovative Clean Transit [ICT] fleet mandates) and incentive programs.
- **Caltrans**
  - Administer Sustainable Transportation Planning grants, bulk purchasing programs.
- **PG&E**
  - Coordinate grid upgrades and charging infrastructure.
- **Employers, Schools, Health Institutions**
  - Launch shuttle/micro-transit partnerships.
- **CBOs**
  - Outreach and engagement to ensure equitable access and affordability.

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Transit System Expansion and Infrastructure Investment:** Use State and federal transit grants (e.g., FTA, CARB's Low Carbon Transit Operations Program [LCTOP]) to expand bus rapid transit, rural transit, on-demand transit, and clean bus fleets. Build and upgrade bus stops, dedicated bus rapid transit lanes, shelters, and last-mile connections (bike share, scooters). Offer fare subsidies and reduced-price passes for students, seniors, and disadvantaged riders.
- **Planning:** Incorporate transit expansion into Fresno COG's Regional Transportation Plan and Sustainable Communities Strategy. Integrate SB 375 (Sustainable Communities Strategy) into planning efforts and prioritize transit-oriented development to boost ridership. Coordinate FAX, Clovis Transit, and FCRTA to streamline regional service planning.
- **Partnerships:** Partner with large employers, schools, and health institutions to launch commuter shuttle programs. Use Caltrans Sustainable Transportation Planning grants to develop last-mile toolkits and launch micro-transit pilots. Collaborate with utilities (PG&E) for charging infrastructure.
- **Procurement:** Participate in statewide bulk purchasing agreements for zero-emission buses and chargers coordinated by CARB and Caltrans.
- **Monitoring, Evaluation, and Transparency:** Track fleet compliance with ICT Regulation, ridership growth, and service coverage. Publish annual reports showing findings and improvements in access for disadvantaged communities.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$650
Incremental Maintenance Costs (million USD)	-$280
Incremental Energy Costs (million USD)	-$300
Incremental Total Costs (million USD)	$70
Return on Investment	-10%
Cumulative Emissions Reduction (kt CO_2e)	900
Marginal Abatement Cost (USD per MT CO_2e)	$70

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - FTA Sections 5307/5311 (urban/rural transit capital and operations)
  - FTA Low or No Emission Vehicle Program ("Low-No")
  - EPA CPRG Implementation Grants
- **State**
  - CARB LCTOP
  - CARB Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

- Caltrans Sustainable Transportation Planning grants
- State Transit Assistance (STA) and Transit and Intercity Rail Capital Program (TIRCP)

- **Local/Utility**
  - Fresno COG programming of CMAQ/STBG funds
  - PG&E make-ready infrastructure and charging incentives

- **Private/Other**
  - Employer-based commuter shuttle contributions
  - Public-private partnerships for mobility-as-a-service pilots

Metrics for Tracking Progress. Key metrics for tracking potential future implementation of this measure would include:

- Percentage of bus fleet that is zero-emission
- Annual ridership (total and percentage growth from baseline)
- Percentage of population in LIDAC communities with access to transit within 0.5 mile
- Number of micro-transit options and commuter shuttle routes operating countywide
- Average service frequency (minutes between buses) on major corridors

5.4.2.2 Build Out the Bike and Pedestrian Network

Description. Expand protected bike lanes, sidewalks, and multi-use trails, and implement Complete Streets policies to integrate biking and walking into roadway design. Support programs like Safe Routes to School, bike share, and micromobility hubs, with a focus on closing infrastructure gaps in disadvantaged neighborhoods. The timelines and milestones for the project are detailed in Table 5.K (provided on the following page).

Authority to Implement. Local Governments (County and Cities); Fresno COG; United States Department of Transportation (USDOT) (Federal Highway Administration [FHWA], FTA); EPA

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **County and Cities**
  - Adopt/implement Complete Streets policies, design and construct infrastructure (bike lanes, sidewalks, trails)
  - Integrate bike/pedestrian requirements into development approvals

- **Fresno COG**
  - Program regional, State, and federal funding
  - Coordinate region-wide planning and performance tracking

Table 5.K: Build Out the Bike and Pedestrian Network Implementation Timelines

Year	Action	Potential Lead Entities
2026	Adopt or update Complete Streets policies across Fresno County jurisdictions. Set annual targets for miles of protected bike lanes and sidewalks added to the County. Apply for California ATP and USDOT funding for priority projects.	Cities and County, Fresno COG
2027	Launch Safe Routes to School initiatives in partnership with school districts. Build protected bike lanes and sidewalks, prioritizing disadvantaged neighborhoods.	Fresno COG, Cities and County, School Districts, Community-Based Organizations
2028	Collaborate with large employers, schools, and institutions to expand multi-use trails to connect neighborhoods with employment centers and schools.	Fresno COG, Cities and County, Employers
2030	Reach milestone of protected bike lanes and trails. Track bike lane usages and ensure connections with major transit stations.	Fresno COG, Transit Agencies, Cities
2035	Expand protected bike land network covers all major corridors. Publish report on project progress.	Cities and County, Fresno COG
2040	Ensure countywide access to safe bike and pedestrian routes. Realize pedestrian-friendly design in downtowns and commercial corridors.	Cities and County, Fresno COG, Transit Agencies

Source: SSG (2025).
ATP = Active Transportation Program
Fresno COG = Fresno Council of Governments
USDOT = United States Department of Transportation

- **Caltrans District 6**
  - Coordinate bike/pedestrian projects on State Routes; implement Complete Streets on State-controlled corridors
- **School Districts and CBOs**
  - Implement Safe Routes to School, walking school buses, education/outreach programs
- **Employers and Institutions**
  - Support micromobility hubs, bike share, and commuter programs
- **Transit Agencies (FAX, FCRTA)**
  - Ensure integration with transit stops and hubs

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Infrastructure Investment:** Leverage State and federal programs (e.g., California's Active Transportation Program [ATP], Safe Routes to School funds, and USDOT grants) to expand bike and pedestrian infrastructure.
- **Planning and Regulations:** Adopt and enforce Complete Streets policies requiring bike lanes, sidewalks, and crosswalks in roadway projects. Integrate bikeway and pedestrian standards into local development codes.
- **Partnerships and Collaboration:** Partner with schools, employers, and community organizations to launch bike share programs, Safe Routes to School, walking school buses, and micromobility hubs. Provide toolkits and planning support to build capacity.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$370
Incremental Maintenance Costs (million USD)	-$290
Incremental Energy Costs (million USD)	-$340
Incremental Total Costs (million USD)	-$260
Return on Investment	66%
Cumulative Emissions Reduction (kt CO_2e)	1,128
Marginal Abatement Cost (USD per MT CO_2e)	-$230

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - FHWA programs (Transportation Alternatives Program, CMAQ, Surface Transportation Block Grant (STBG) Program)
  - USDOT Safe Streets and Roads for All (SS4A)
  - FTA funding for first/last-mile active transportation connections
  - EPA CPRG implementation grants

- **State**
  - California ATP
  - Caltrans Sustainable Communities Planning Grants
  - Safe Routes to School funds (Caltrans)
  - State Transportation Improvement Program (STIP) augmentation for bike/pedestrian projects

- **Local/Utility**
  - Fresno COG programming of CMAQ/STBG to Cities and County
  - Local transportation sales tax (Measure C)
  - PG&E partnerships for micromobility charging stations

- **Private/Other**
  - Corporate/employer contributions for micromobility hubs
  - Philanthropic foundations supporting Safe Routes to School and Vision Zero initiatives

Metrics for Tracking Progress. Key metrics for this measure include:

- Miles of new protected bike lanes, sidewalks, and multi-use trails built (annual and cumulative).
- Number of bike trips on main corridors (percent change over time).
- Percent of residents commuting by bike (Census data)
- Number of schools participating in Safe Routes to School programs.
- Pedestrian and cyclist injury and fatality rates (per 100,000 residents).

5.4.2.3 Promote Carpool, Vanpool, and Shared Mobility Options

Description. Provide incentives for carpool and vanpool, and other shared mobility options. (Implementation measures could include commute trip reduction programs, end-of trip facilities, car-sharing program, employer-sponsored vanpool/shuttle, priced workplace parking, and/or employee parking "cash-out" programs.). Promote employer-based carpool/vanpool incentives, expand Fresno COG's existing vanpool program, and support shared mobility platforms for rural and underserved areas. Encourage mobility-as-a-service pilots that integrate transit, rideshare, and micromobility into a single system. Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.L) and metrics for tracking progress.

Table 5.L: Promote Carpool, Vanpool, and Shared Mobility Options Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Expand Fresno COG's Valley Vanpool subsidies with deeper discounts for rural and LIDAC riders. Launch employer outreach campaign.	Fresno COG, Employers, Cities and County
2027	Provide grants and support for employers that sponsor vanpools, carpools, or shuttles.	Cities and County, Employers
2028	Apply for funding and offer vehicle subsidies for zero-emission vans/shuttles and shared mobility providers in LIDAC and rural areas.	Fresno COG, CARB, Shared Mobility Operators
2029	Develop end-of-trip infrastructure (priority carpool parking, EV chargers, bike lockers) at employment centers.	Cities and County, Employers, PG&E
2030	Launch first MaaS platform pilot integrating vanpool, carpool, transit, and micromobility. Evaluate VMT and GHG reductions.	Fresno COG, Transit Agencies, Mobility Providers
2035	Scale vanpool and MaaS programs countywide. Continue expanding shared mobility hubs in rural areas.	Cities and County, Employers
2040	Achieve a full transition majority of employer-sponsored vanpools/shuttles to zero-emission fleets.	Fresno COG, CARB, Utilities, Shared Mobility Operators

Source: SSG (2025).
CARB = California Air Resources Board
EV = electric vehicle
Fresno COG = Fresno Council of Governments
GHG = greenhouse gas
LIDAC = low-income/disadvantaged communities
MaaS = mobility-as-a-service
VMT = vehicle miles traveled

Authority to Implement. Fresno COG; Local Governments (County and Cities); Employers; CARB; Utilities (PG&E); EPA

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno COG**
  - Expand vanpool program, administer subsidies, coordinate mobility-as-a-service (MaaS) pilots
- **Cities and County**
  - Employer outreach, cash-out policy adoption, permitting shared mobility hubs

- **Employers**
  - Sponsor vanpools/shuttles, provide end-of-trip facilities, participate in incentives
- **Transit Agencies**
  - Integrate MaaS with existing transit systems
- **CARB**
  - Incentives for zero-emission vans/shuttles
- **PG&E**
  - Charging infrastructure deployment
- **Shared Mobility Providers**
  - Operate carpool/vanpool/MaaS services, expand to rural/LIDAC areas
- **CBOs**
  - Outreach to rural and disadvantaged residents to encourage adoption

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Rider Subsidies:** Expand Fresno COG's vanpool program with monthly fare discounts and vouchers, especially for rural and LIDAC riders
- **Employer Incentives:** Offer grants or parking cash-out support for employers that sponsor vanpools, carpools, or shuttles
- **Vehicle and Program Support:** Provide subsidies for zero-emission vans/shuttles and seed funding for shared mobility providers in LIDAC areas
- **Infrastructure Support:** Work with PG&E to support costs for priority EV chargers in carpool parking and end-of-trip facilities at workplaces
- **Shared Mobility Integration:** Pilot MaaS platforms that combine vanpool, carpool, transit, and micromobility into a single system
- **Monitoring and Reporting:** Track and publish annual participation, VMT reductions, and GHG reductions

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$20
Incremental Maintenance Costs (million USD)	-$1,000
Incremental Energy Costs (million USD)	-$1,070
Incremental Total Costs (million USD)	-$2,050
Return on Investment	12,540%
Cumulative Emissions Reduction (kt CO_2e)	3,491
Marginal Abatement Cost (USD per MT CO_2e)	-$590

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants
  - FTA Section 5307/5311 (commuter vanpool and rural transit eligible)
  - CMAQ funds (through Fresno COG)

- **State**
  - CARB's HVIP for zero-emission vans/shuttles
  - Low Carbon Transportation Investments
  - Caltrans Sustainable Transportation Planning Grants (MaaS integration)

- **Local/Utility**
  - Fresno COG Valley Vanpool program funding (CMAQ/STBG)
  - PG&E make-ready infrastructure for EV charging

- **Private/Other**
  - Employer contributions (parking cash-out, vanpool sponsorships)
  - Shared mobility company investments (carshare, MaaS platforms)

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of monthly and annual vanpool riders
- Number of employers offering vanpool, carpool, or shuttle programs
- Percent of zero-emission vans or shuttles
- Number of shared mobility hubs or MaaS platforms operating countywide
- VMT reduced annually from solo driving

5.4.2.4 Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan

Description. Expand EV charging infrastructure at homes, workplaces, and public sites. Provide incentives and financing for EV purchases including e-bikes, especially for low- and moderate-income households. Partner with PG&E and State programs to increase grid readiness and integrate smart charging. The timelines and milestones for the measure are included in Table 5.M.

Authority to Implement. Local Governments (County and Cities); Fresno COG; CEC; CARB; CPUC and PG&E; Federal (EPA, USDOT, Treasury)

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno COG**
  - Coordinate regional EV planning, manage loan fund, and oversee EV Resource Center

Table 5.M: Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan Measures Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch Fresno County EV Resource Center to provide guidance on incentives, permitting, charging options, and financing tools. Streamline permitting processes for home and multi-family Level 2 charger installations. Establish a revolving loan fund to support EV purchases and multi-family charging installations.	Fresno COG, Cities and County
2027	Partner with PG&E to plan for increased grid capacity and begin pilots for off-peak smart charging. Roll out employer incentive programs for workplace chargers through PG&E's EV Fleet and EV Charge Network.	PG&E, Cities, Employers
2028	Expand State program participation (CARB Clean Cars 4 All, CEC CALeVIP, E-Bike Incentive Project) to maximize local rebate access and funding for multi-family and workplace Level 2 chargers. Provide technical support for apartment owners and HOAs to deploy shared chargers.	Fresno COG, State Agencies, Property Owners
2029	Collaborate with community colleges and apprenticeships to scale workforce training programs for EVSE installation and EV servicing. Integrate with PG&E workforce pipeline efforts.	Community Colleges, Workforce Boards, PG&E
2030	Achieve countywide coverage of public DC fast-charging hubs in LIDAC and rural communities. Promote higher % of EV-installed spaces in new developments (above Title 24 minimums). Integrate V2G programs into residential, workplace, and public charging systems. Evaluate performance of loan fund and expand financing pool.	PG&E, Cities and County, CEC, Fresno COG
2035	Expand EVSE workforce training. Evaluate impacts of smart charging on grid performance. Ensure 100% of workplaces and multi-family buildings have EV charging access.	Cities and County, PG&E

Source: SSG (2025).

CALeVIP = California Electric Vehicle Infrastructure Project
CARB = California Air Resources Board
CEC = California Energy Commission
EV = electric vehicle
EVSE = Electric Vehicle Supply Equipment
Fresno COG = Fresno Council of Governments
GHG = greenhouse gas
HOAs = Homeowners Associations
LIDAC = low-income/disadvantaged communities
PG&E = Pacific Gas and Electric Company
V2G = vehicle-to-grid

- **Cities and County**
    - Streamline permitting, adopt EV-ready codes, and administer local rebates
- **PG&E**
    - Deploy EV Fleet/EV Charge Network programs, expand grid capacity, pilot smart charging, and vehicle-to-grid (V2G)
- **CEC/CARB**
    - Provide incentives (California Electric Vehicle Infrastructure Project (CALeVIP), Clean Vehicle Rebate Project (CVRP), Clean Cars 4 All, E-Bike Incentives)
- **Employers and Property Owners**
    - Install workplace and multi-family chargers

- **Community Colleges/Workforce Boards**
    - Deliver training for electricians, auto technicians, and contractors
- **CBOs**
    - Provide outreach to rural and LIDAC communities, ensuring equitable participation

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Enhanced Purchase Incentives:** Expand access to CARB Clean Cars 4 All, CVRP, and the State E-Bike Incentive Project. Provide local top-up rebates or low-interest loans for EVs and e-bikes, with higher support for low- and moderate-income households.
- **Workplace & Public Charging:** Incentivize employers to install chargers (e.g. PG&E EV Fleet and EV Charge Network programs)
- **Revolving Loan Fund:** Establish a countywide revolving loan fund to finance workplace and multi-family charging installations and EV purchases, with repayments reinvested to expand future access. Revolving loan fund can be used for other measures in the CCAP-A.
- **Utility Coordination:** Partner with PG&E to expand grid capacity, support off-peak and smart charging, and align with the EV Readiness Plan. Collaborate on bolstering incentives and financing options for installing chargers.
- **Home & Multi-Family Charging:** Streamline permitting for Level 2 charger installation in homes and apartments. Provide technical support for property owners and Homeowners Associations (HOAs).
- **Technical Assistance:** Create a regional EV resource center to provide households, businesses, and property managers with guidance on incentives, permitting, charging options, and financing tools.
- **Partnerships:** Collaborate with State programs (e.g., CARB Clean Cars 4 All, CEC CALeVIP, E-Bike Incentive Project) to leverage funding and expand access.
- **Workforce Development:** Expand training opportunities for electricians, contractors, and auto technicians to install and maintain EV charging equipment and service EVs through community colleges and apprenticeships.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	-$120
Incremental Maintenance Costs (million USD)	-$2,990
Incremental Energy Costs (million USD)	-$3,430
Incremental Total Costs (million USD)	-$6,540
Return on Investment	1,687%
Cumulative Emissions Reduction (kt CO_2e)	12,261
Marginal Abatement Cost (USD per MT CO_2e)	-$530

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants
  - FHWA National Electric Vehicle Infrastructure (NEVI) program (via CEC/Caltrans)

- **State**
  - CARB Clean Cars 4 All, CVRP, E-Bike Incentive Project
  - CEC CALeVIP rebates for chargers
  - TECH Clean California (supports electrification measures overlapping with EV readiness)

- **Local/Utility**
  - Fresno COG revolving loan fund (seeded with CPRG/State funds)
  - PG&E EV Fleet and EV Charge Network programs
  - Utility make-ready infrastructure incentives (CPUC-approved)

- **Private/Other**
  - Employer and property-owner investments (with rebate leverage)
  - Green banks or CDFIs supporting low-interest loans for EV adoption

Metrics for Tracking Progress. Key metrics for this measure include:

- Percent of registered light-duty vehicles that are zero-emission in Fresno County (annual and cumulative)
- Number of Level 2 chargers installed
- Number of DC-fast chargers installed
- Number of households, businesses, and property managers served by the EV Resource Center annually
- Number of electricians, contractors, and auto technicians trained in charging installation and EV servicing

5.4.2.5 Electrify Commercial & Public Vehicle Fleets

Description. Support fleet conversion grants, charging hubs, and utility make-ready investments. Launch municipal fleet transition plans and expand clean school bus programs. Encourage private sector fleet operators to adopt EVs through bulk purchase programs and corridor charging infrastructure. Continue to convert the municipal fleet (including transit) into zero emission vehicles and provide a sustainable and reliable support system for such zero-emission fleet which could include, but not limited to maintenance, charging facilities, training of personnel, etc. (Implementing measures could include fleet electrification, installation of EV charging infrastructure, etc.). Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.N) and metrics for tracking progress.

Table 5.N: Electrify Commercial & Public Vehicle Fleets Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Establish a revolving loan fund to finance municipal, school, and commercial fleet electrification projects and charging installations. Expand outreach to secure HVIP and Advanced Clean Fleets funding.	Fresno COG, Cities and County of Fresno, CARB
2027	Develop municipal fleet transition plans with procurement policies requiring all new light- and medium-duty purchases to be zero-emission. Provide technical assistance to school districts applying for Clean School Bus funding.	Cities and County of Fresno, School Districts
2028	Begin installation of fleet charging hubs at municipal yards, bus depots, and schools, with PG&E grid upgrades through make-ready investments.	Cities and County of Fresno, PG&E
2029	Secure electric school buses in LIDAC districts. Launch rebates and fee-reduction programs for private fleets to adopt EVs.	School Districts, Fresno COG, County of Fresno
2030	Scale revolving loan fund to support private fleet charging infrastructure. Expand revolving loan fund to cover medium-duty delivery fleets and service vehicles.	Cities and County of Fresno, Private Fleets, Fresno COG
2035	Expand fleet charging hubs countywide. Transition to all new school bus purchases to electric.	Cities and County of Fresno, School Districts
2040	Achieve 100% compliance with ICT for transit and municipal fleets. Continue distributing revolving loan funds to support fleet conversion and charging infrastructure.	FAX, FCRTA, Fresno COG, County of Fresno

Source: SSG (2025).
CARB = California Air Resources Board
FAX = Fresno Area Express
FCRTA = Fresno County Rural Transit Agency
Fresno COG = Fresno Council of Governments
HVIP = Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICT = Innovative Clean Transit
LIDAC = low-income/disadvantaged community
PG&E = Pacific Gas and Electric Company

Authority to Implement. Cities and County (procurement policies, municipal fleet transition, school bus electrification), in coordination with Fresno COG for funding, planning, and regional reporting. State (CARB, CEC) and federal agencies (EPA, DOE) provide funding and regulatory frameworks.

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **County and Cities**
  - Develop municipal fleet transition plans, procure EVs for light-, medium-, and heavy-duty use, install charging hubs, and coordinate school district support
- **Fresno COG**
  - Convene local governments and private fleet operators, integrate fleet electrification into RTP/SCS, and administer revolving loan fund where feasible
- **CARB**
  - Provide funding through HVIP and Advanced Clean Fleets compliance oversight
- **EPA**
  - Fund school bus electrification through the Clean School Bus Program

- **School Districts**
  - Apply for funding, procure electric buses, coordinate depot charging
- **PG&E**
  - Provide make-ready investments and grid upgrades to support charging hubs
- **Private Fleets and Businesses**
  - Participate in bulk purchasing, rebate programs, and charging investments
- **FAX and FCRTA**
  - Transition transit fleets to meet ICT requirements

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Revolving Loan Fund:** Establish a local revolving loan fund to complement grants and rebates, helping fleets finance vehicle purchases and charging infrastructure with repayments reinvested into new projects. Revolving loan funds will be used to support other transportation measures as well.
- **Fleet Conversion Grants and Incentives:** Expand access to State and federal programs (e.g., CARB's HVIP, EPA Clean School Bus Program, Advanced Clean Fleets) to offset upfront purchase costs for commercial, municipal, and school vehicles. Offer rebates, incentives, or bulk-purchase agreements for businesses to electrify service and delivery fleets.
- **School Bus Electrification:** Expand participation in the California Clean School Bus Program to replace diesel buses with electric models, prioritizing disadvantaged school districts.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure, for both commercial fleets and public fleets:

Commercial Fleets	
Incremental Capital Costs (million USD)	$590
Incremental Maintenance Costs (million USD)	-$590
Incremental Energy Costs (million USD)	-$7,710
Incremental Total Costs (million USD)	-$7,710
Return on Investment	1318%
Cumulative Emissions Reduction (kt CO_2e)	4,860
Marginal Abatement Cost (USD per MT CO_2e)	-$1,590
Public Fleets	
Incremental Capital Costs (million USD)	$10
Incremental Maintenance Costs (million USD)	-$90
Incremental Energy Costs (million USD)	-$10
Incremental Total Costs (million USD)	-$90
Return on Investment	578%
Cumulative Emissions Reduction (kt CO_2e)	55
Marginal Abatement Cost (USD per MT CO_2e)	-$1,560

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- CARB HVIP
- EPA Clean School Bus Program
- CARB Advanced Clean Fleets program incentives
- DOE Loan Program Office (infrastructure financing)
- State/Local Revolving Loan Funds (County-administered, reinvested repayments)
- PG&E make-ready and EV infrastructure incentives
- Public-private partnerships for bulk fleet procurement

Metrics for Tracking Progress. Key metrics for this measure include:

- Percentage of municipal fleet vehicles electrified (light- and medium-duty)
- Percentage of school buses electrified across districts
- Number of commercial fleet vehicles converted to zero-emission
- Number and capacity (MW) of fleet charging hubs installed at depots, yards, and schools
- Total dollars distributed through the revolving loan fund and number of projects financed

5.4.2.6 Advance Zero-Emission Freight Vehicles

Description. Develop freight EV charging and hydrogen fueling hubs, particularly along highways and at industrial parks. Support incentives for clean truck adoption, partner with the Port of Oakland and regional logistics hubs, and expand the use of zero-emission drayage trucks serving distribution centers in Fresno. The timeline and major milestones for the measure are detailed in Table 5.O.

Authority to Implement. Local Governments (County and Cities); Fresno COG; School Districts; CARB; EPA; CPUC and PG&E

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Cities and County**
  - Develop municipal fleet transition plans, adopt procurement policies, install charging hubs at yards

- **Fresno COG**
  - Administer revolving loan fund, outreach, and regional coordination

- **School Districts**
  - Apply for Clean School Bus Program grants and replace diesel buses with EVs

Table 5.O: Advance Zero-Emission Freight Vehicles Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch the Freight Decarbonization Taskforce with Fresno COG, SJVAPCD, PG&E, fleet operators, and others. Taskforce sets ZEV freight adoption and emissions reduction targets.	Fresno COG, SJVAPCD, PG&E, Fleet Operators
2027	Taskforce initiates technical assistance and hosts first innovation challenge to support clean freight pilots. Expand outreach for HVIP and ACT incentives to local fleets.	Taskforce, CARB, Fresno COG
2028	Begin construction of first freight charging depot and hydrogen fueling hub at industrial parks along SR-99 and PG&E begins make-ready grid upgrades at pilot sites.	Fresno COG, PG&E, Private Developers
2029	Launch zero-emission drayage trucks serving distribution centers in Fresno County, supported by HVIP and bulk purchasing agreements.	Fleet Operators, Fresno COG, CARB
2030	Expand incentives and financing for fleets. Open additional charging/fueling hubs near major warehouses. Taskforce publishes 5-year progress report.	Taskforce, PG&E, CARB
2035	Achieve 100% of new drayage trucks entering service as zero-emission (per ACF mandate). Scale regional charging/fueling hubs across freight corridors.	CARB, Fleets, Fresno COG, PG&E
2040	Expand clean freight infrastructure to long-haul corridors. Scale hydrogen fueling stations to meet heavy-duty freight demand.	Fresno COG, CARB, Utilities, Hydrogen Providers
2045	Ensure all industrial parks and freight corridors in Fresno County have ZEV fueling/charging hubs.	CARB, Fresno COG, County, Fleets
2050	Complete full transition of regional freight fleets to zero-emission. Taskforce transitions to long-term oversight of innovation, workforce training, and infrastructure optimization.	Fresno COG, SJVAPCD, CARB, PG&E

Source: SSG (2025).
ACF = Advanced Clean Fleets
ACT = Advanced Clean Trucks
CARB = California Air Resources Board
Fresno COG = Fresno Council of Governments
HVIP = Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
PG&E = Pacific Gas and Electric Company
SJVAPCD = San Joaquin Valley Air Pollution Control District
SR-99 = State Route 99
ZEV = zero-emission vehicle

- **CARB**
  - Enforce Advanced Clean Fleets (ACF) requirements and distribute HVIP and Clean School Bus funds
- **EPA**
  - Provide Clean School Bus awards and CPRG support
- **PG&E**
  - Provide make-ready infrastructure and interconnection upgrades for depots and schools
- **Private Fleet Operators (logistics, service, delivery companies)**
  - Participate in bulk purchase programs and rebates and install private charging
- **CBOs/Workforce Boards**
  - Provide outreach and support workforce training for fleet maintenance and charging installation

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Freight Decarbonization Taskforce:** Establish a regional taskforce with Fresno COG, San Joaquin Valley Air District, PG&E, major fleet operators, and others to coordinate clean freight planning, incentives, and infrastructure. Taskforce sets targets for emissions reductions and fleet transitions. Taskforce supports innovation challenges, provides technical assistance, and coordinates bulk purchasing agreements for fleets to lower truck and infrastructure costs.
- **Freight Charging and Fueling Hubs:** Build regional EV fast-charging depots and hydrogen fueling stations along highways, at distribution centers, and industrial parks.
- **Incentives and Financing:** Expand access to CARB Advanced Clean Trucks (ACT), and HVIP programs to offset the cost of zero-emission trucks.
- **Drayage Truck Transition:** Prioritize incentives and mandates for zero-emission drayage trucks serving warehouses and distribution centers in Fresno County.
- **Utility Coordination:** Work with PG&E and other utilities to ensure grid capacity for freight charging depots, including make-ready investments and demand-management programs.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$590
Incremental Maintenance Costs (million USD)	-$540
Incremental Energy Costs (million USD)	-$1,210
Incremental Total Costs (million USD)	-$1,160
Return on Investment	198%
Cumulative Emissions Reduction (kt CO_2e)	13,586
Marginal Abatement Cost (USD per MT CO_2e)	-$90

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA Clean School Bus Program (diesel bus replacement)
  - EPA CPRG Implementation Grants (for fleet charging, planning, and equity-focused pilots)
  - FTA Low-No Emission Vehicle Program (for transit fleets, bus depots)
- **State**
  - CARB HVIP
  - CARB ACF compliance support funds
  - California Clean School Bus Program
  - Caltrans Sustainable Freight and Clean Transportation programs

- **Local/Utility**
  - PG&E make-ready infrastructure and charger incentives
  - Fresno COG Revolving Loan Fund (seeded with CPRG/State funds)

- **Private/Other**
  - Employer/fleet capital investment (leveraged by rebates and bulk-purchase agreements)
  - ESCOs or third-party fleet service contracts

Metrics for Tracking Progress. Key metrics for this measure include:

- Percent of drayage trucks in Fresno County that are zero-emission (annual and cumulative)
- Number of freight charging depots and hydrogen fueling hubs built and operational
- Annual number of zero-emission trucks deployed through HVIP, ACT, and bulk purchase agreements
- MW of grid capacity added by PG&E to support freight charging hubs
- Number of fleets participating in technical assistance, innovation challenges, or bulk purchasing agreements

5.4.2.7 Transition Off-Road Vehicles & Equipment to ZEVs

Description. Support adoption of electric tractors, forklifts, and construction equipment, paired with utility incentives for charging infrastructure. Expand participation in CARB's off-road incentive programs and establish local pilots demonstrating the benefits of zero-emission equipment in Fresno's agricultural and construction sectors. Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.P) and metrics for tracking progress.

Authority to Implement. Local Governments (County and Cities); Fresno COG; SJVAPCD; CARB; CPUC and PG&E; EPA

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno COG**
  - Regional coordination, pilot design, competitive grant administration, outreach

- **SJVAPCD**
  - Manage incentive program participation, fund replacements, ensure compliance

- **CARB**
  - Expand Clean Off-Road Equipment (CORE) participation, provide vouchers for forklifts, yard trucks, and construction machinery

Table 5.P: Transition Off-Road Vehicles and Equipment to ZEVs Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Expand participation in CARB's CORE Voucher Program for forklifts and yard trucks. Partner with PG&E's make-ready program to support grid upgrades at warehouses and construction sites.	Fresno COG, SJVAPCD, CARB, PG&E
2027	Host Fresno's first annual ZEV Off-Road Vehicle Expo to showcase technology. Begin funding first local pilot projects with electric excavators and forklifts.	Fresno COG, Cities and County, Manufacturers, Trade Associations
2028	Launch first competitive grant round for fleets and contractors replacing high-use diesel equipment. Begin contractor outreach for future procurement requirements.	SJVAPCD, CARB
2029	Adopt local procurement and contracting requirements to take effect in 2030 - all publicly funded projects must include a minimum % of ZEV or Tier 4 Final off-road equipment.	Cities and County
2030	Launch first bulk purchasing program for electric forklifts and construction machinery across fleets and contractors. Continue to expand CORE participation in Fresno County.	Fresno COG, Fleets, Equipment Dealers
2035	Require at least 50% ZEV off-road equipment use on all public projects. Scale competitive grants and bulk purchasing to support small contractors.	Cities and County, SJVAPCD
2040	Expand make-ready upgrades to cover large industrial parks. continue hosting the ZEV Off-Road Expo to highlight new tech and build market demand.	PG&E, Fresno COG, County
2045	Require 100% ZEV off-road equipment on all publicly funded projects.	Cities and County, SJVAPCD

Source: SSG (2025).
CARB = California Air Resources Board
CORE = Clean Off-Road Equipment Voucher Incentive Program
Fresno COG = Fresno Council of Governments
PG&E = Pacific Gas and Electric Company
SJVAPCD = San Joaquin Valley Air Pollution Control District
ZEV = zero-emission vehicle

- **Cities and County**
  - Adopt procurement standards and lead by example in public projects
- **PG&E**
  - Implement make-ready upgrades at warehouses, depots, and construction sites
- **Fleets and Contractors (agriculture, construction, warehousing)**
  - Apply for vouchers, adopt ZEV equipment, and participate in bulk purchasing
- **Manufacturers, Dealers, Trade Associations**
  - Showcase equipment at Expos, expand availability, and support bulk deals
- **CBOs/Workforce Partners**
  - Outreach to small contractors and ensure equitable access to grants and training

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Incentives and Grants:** Expand participation in CARB CORE Voucher Program and local incentives for forklifts, yard trucks, and construction machinery. Consider administering competitive grant rounds for fleets and contractors seeking to replace high-use diesel equipment with ZEVs.
- **Utility Coordination:** Partner with PG&E's make-ready programs to cover grid upgrades at warehouses, depots, and construction sites - utilities fund site electrical work while fleets cover charging equipment costs.
- **Local Pilots:** Provide seed funding and technical support for demonstration projects (e.g., electric excavators at public construction sites, ZEV forklifts in distribution centers) to showcase feasibility. Host an annual ZEV off-road vehicle show to showcase performance and savings. Collaborate with manufacturers, dealerships, and trade associations to expand equipment availability and connect Fresno fleets to vendor incentive programs.
- **Government Procurement and Contracting:** Require or incentivize use of ZEV or low-emission off-road equipment for publicly funded construction projects, and set efficiency standards for contractors.
- **Bulk Purchasing Programs:** Coordinate aggregated purchases across fleets, construction firms, and warehouse operators to negotiate lower upfront prices with equipment manufacturers.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$0
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$0
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	6,368
Marginal Abatement Cost (USD per MT CO_2e)	$0

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants (pilot projects, loan funds)
  - EPA Diesel Emission Reduction Act (DERA) grants for non-road diesel replacement
- **State**
  - CARB CORE Voucher Program (off-road equipment)
  - SJVAPCD incentive programs: Funding Agricultural Replacement Measures for Emission Reductions (FARMER) (for agriculture tractors), Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) (construction and off-road)
  - CEC Electric Program Investment Charge (EPIC) funds for pilots/demonstrations

- **Local/Utility**
  - PG&E make-ready infrastructure incentives
  - Fresno COG competitive grants seeded with CPRG or CMAQ funds

- **Private/Other**
  - Fleet/operator capital investments leveraged with vouchers
  - Dealer/manufacturer financing for bulk purchase programs

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of off-road ZEVs deployed (forklifts, yard trucks, construction equipment)
- Percent of publicly funded construction projects using ZEV or Tier 4 Final equipment
- MW of grid capacity added through PG&E make-ready upgrades for off-road charging
- Number of fleets and contractors receiving CORE vouchers or local competitive grants
- Annual attendance and vendor participation at Fresno's ZEV Off-Road Vehicle Expo
- Number of bulk purchasing agreements completed and pieces of equipment purchased through them

5.4.3 Waste Sector

In 2019, the waste sector produced 0.47 MMT CO_2e, representing about 4% of Fresno County's total GHG emissions. Without intervention, these emissions would nearly double in the BAU and BAP scenarios, driven primarily by methane from landfills and organic waste decomposition. Measures proposed in the CCAP-A, however, could reduce waste emissions by 30% to 0.33 MMT CO_2e by 2050, with significant cumulative reductions achieved through targeted strategies (Figure 5-16).

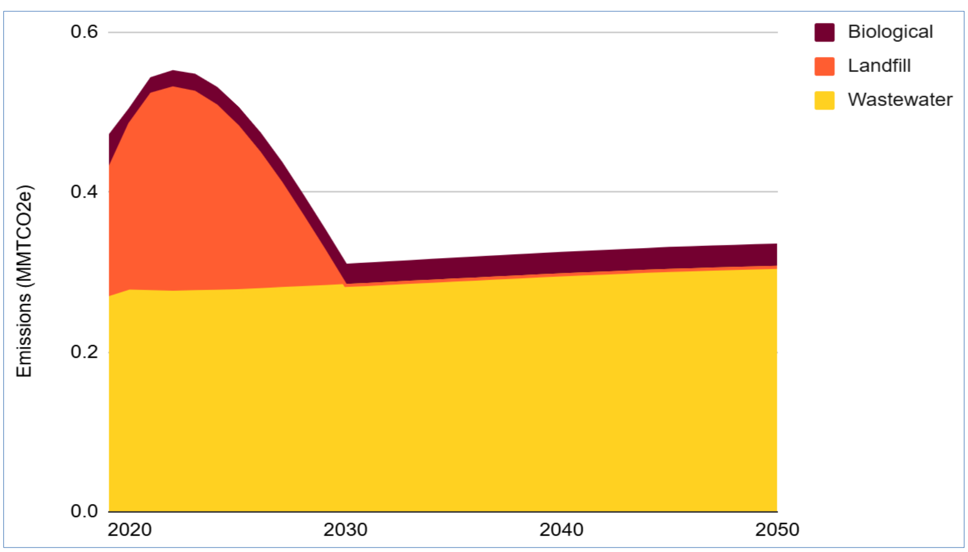


Figure 5-16: Projected Waste Sector GHG Emissions in LC Scenario, 2019–2050

As summarized in Table 5.Q, the measure "Develop Landfill Gas Capture and Utilization" offers the largest reduction potential, avoiding an estimated 6.8 MMT CO_2e by 2050. This measure focuses on upgrading and expanding gas collection systems at the County's largest landfills, with major reductions occurring after 2030 as new capture infrastructure comes online. "Scale Up Waste Diversion and Circular Economy Programs" also delivers significant benefits, cumulatively cutting 3.47 MMT CO_2e by 2050 by diverting food and organic waste, expanding composting and anaerobic digestion capacity, and developing circular economy solutions that create value from diverted materials. "Clean up Wastewater Facilities," plays a supporting role by reducing energy demand and emissions from treatment plants through solar PV, battery storage, and efficiency retrofits. Although smaller in scale, these actions contribute to the overall resilience of the waste sector and support co-benefits (e.g., lower operating costs).

Table 5.Q: Waste Sector Measures Summary

Modeled Actions	Total GHG Emissions Reductions (MMT CO_2e)		Cumulative GHG Emissions Reductions (MMT CO_2e) 2026 to 2050
	2026 to 2030	2031 to 2050	
Clean Up Wastewater Facilities	0.05	0.17	0.22
Develop Landfill Gas Capture and Utilization	0.984	5.82	6.80
Scale Up Waste Diversion and Circular Economy Programs	0.39	3.08	3.47

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MMT = million metric tons

5.4.3.1 Scale Up Waste Diversion and Circular Economy Programs

Description. Fresno County will expand programs and incentives to reduce and divert waste, focusing on food, yard, and other organic materials. Programs and incentives expand curbside collection, composting, and anaerobic digestion, neighborhood and business programs increase recycling and composting participation, education and outreach inform residents and businesses about waste prevention, reuse, and zero-waste practices, and innovation pilot projects (e.g., waste-to-energy and circular economy initiatives) create local value from diverted materials. The timeline and milestones for the measure are detailed in Table 5.R.

Authority to Implement. Local Governments (County and Cities); California Department of Resources Recycling and Recovery (CalRecycle); County Public Works and Waste Management Agencies; EPA; CARB

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Cities and County**
  - Adopt/implement SB 1383 ordinances, expand curbside collection, conduct education campaigns
- **Waste Haulers (Republic, Mid-Valley Disposal, etc.)**
  - Operate curbside collection and processing

Table 5.R: Scale Up Waste Diversion and Circular Economy Programs Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch multilingual education campaign on Senate Bill 1383 requirements and household composting.	Cities and County of Fresno, Waste Haulers
2027	Pilot neighborhood composting hubs and school composting programs.	Cities and County of Fresno, Chambers of Commerce, School Districts
2028	Expand curbside green bin collection for food and yard waste to all Fresno County jurisdictions.	Cities and County of Fresno, Waste Haulers
	Launch circular economy pilots (e.g., construction debris reuse marketplace, food waste-to-products innovation grants).	Cities and County of Fresno, Fresno COG, CalRecycle
2029	Scale up institutional zero-waste programs (schools, universities, hospitals, municipal facilities). Create Zero Waste Business Certification program to recognize leaders.	Cities and County of Fresno, Chambers of Commerce, School Districts
2030	Construct or expand local composting facilities to process an additional 50,000 tons of organics per year. Conduct countywide evaluation of SB 1383 compliance and diversion rates.	County Public Works, Waste Facility Operators, Private Developers
2035	Expand anaerobic digestion capacity and integrate compost into regional agriculture and landscaping markets.	Cities and County of Fresno, Agricultural Commission, Waste Operators
2040	Require large commercial generators (e.g., supermarkets, universities, event venues) to meet defined zero-waste thresholds (e.g., 90% diversion). Embed circular economy purchasing into public procurement.	Cities and County of Fresno, Business Associations
2045	Achieve 90% waste diversion across all jurisdictions.	Cities and County of Fresno, CalRecycle

Source: SSG (2025).
CalRecycle = California Department of Resources Recycling and Recovery
Fresno COG = Fresno Council of Governments

- **County Public Works/Waste Facility Operators**
  - Build and expand composting and anaerobic digestion infrastructure
- **CalRecycle**
  - Provide technical assistance, monitor compliance
- **Chambers of Commerce, Business Associations, and School Districts**
  - Partner on zero-waste programs
- **Agricultural Commission and Farmers**
  - Integrate compost into agriculture/landscaping markets
- **Private Sector/Developers**
  - Invest in new facilities and circular economy pilots
- **CBOs/Community Groups**
  - Support outreach, language access, and local neighborhood composting hubs

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Expanded Collection Programs:** Increase curbside organics, recycling, and composting collection services countywide
- **Processing Infrastructure:** Invest in local composting and anaerobic digestion facilities to handle organic waste at scale
- **Education and Outreach:** Conduct countywide campaigns to inform residents and businesses about waste prevention, composting, recycling, and reuse practices
- **Business and Neighborhood Programs:** Launch zero-waste initiatives with schools, large institutions, restaurants, and commercial districts to boost participation
- **Innovation Pilots:** Support circular economy projects (e.g., reuse marketplaces and repair workshops) to generate local value from diverted materials
- **Monitoring and Reporting:** Track diversion rates, facility performance, and GHG emissions reductions from reduced landfill disposal

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$120
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$120
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	3,668
Marginal Abatement Cost (USD per MT CO_2e)	$30

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants (waste diversion/circular economy)
  - EPA Solid Waste Infrastructure for Recycling (SWIFR) grants
  - United States Department of Agriculture (USDA) funding for composting and rural waste diversion pilots
- **State**
  - CalRecycle Organics Grant Program (organics infrastructure)
  - CARB Greenhouse Gas Reduction Fund (GGRF) funds for waste diversion and composting
  - California Department of Resources Recycling and Recovery (SB 1383 implementation support)

- **Local/Utility**
  - Local tipping fees, franchise agreements with haulers
  - Fresno COG competitive grants (seeded with CPRG)

- **Private/Other**
  - Public-private partnerships for anaerobic digestion/composting
  - Corporate sponsorships for zero-waste recognition programs
  - Foundations/funds supporting circular economy innovation pilots

Metrics for Tracking Progress. Key metrics for this measure include:

- Percent of total waste diverted from landfill
- Annual tons of food and yard waste processed through composting or anaerobic digestion
- Percent of households and businesses with access to and actively using curbside organics and recycling collection
- Tons per year of new or expanded composting and anaerobic digestion capacity
- Number of businesses, schools, or institutions recognized as meeting zero-waste or diversion targets
- Number of innovation pilots or repair/reuse/recycling marketplaces established

5.4.3.2 Develop Landfill Gas Capture and Utilization

Description. Fresno County installs landfill gas (LFG) capture systems to cut methane emissions and create value from recovered gas. Upgrading, expanding, and modernize landfill gas wells, piping, and treatment systems to increase capture efficiency. Prioritize projects that use captured LFG for renewable electricity generation, renewable natural gas (RNG) for pipeline injection, or direct use in industrial facilities, reducing reliance on fossil fuels. Improve leak detection, monitoring, and reporting protocols to ensure compliance with State methane reduction rules (Assembly Bill [AB] 32, SB 1383). Install or upgrade gas capture systems at inactive or closed landfill sites to prevent fugitive emissions when viable. Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.S) and metrics for tracking progress.

Authority to Implement. Fresno County (Public Works, Solid Waste, Sustainability Offices) in coordination with State agencies (CalRecycle, CARB) and EPA Landfill Methane Outreach Program (LMOP)

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno County**
  - Lead feasibility studies, permitting reform, grant applications, and compliance oversight

Table 5.S: Develop Landfill Gas Capture and Utilization Measure Implementation Timelines and Milestones

Year	Action	Potential Lead Entities
2026	Conduct feasibility studies at active and closed landfills to identify priority sites for capture expansion, RNG conversion, and utilization projects.	County of Fresno, Waste Facility Operators
2027	Apply for CalRecycle, EPA LMOP, and other methane reduction grants. Pursue tax credits and low-interest loans to finance upgrades.	County of Fresno, Waste Facility Operators
228	Streamline permitting and interconnection processes for LFG-to-energy and RNG projects. Initiate partnerships with PG&E, SoCalGas, and private developers. Secure PPAs and supply contracts.	Cities and County of Fresno, Utilities, Private Developers, Utilities, Industrial Partners
2029	Begin infrastructure upgrades at largest active landfills: new wells, piping, and treatment systems to improve capture efficiency.	Waste Facility Operators, County Public Works
2030	Launch first RNG pipeline injection and/or renewable electricity generation project.	Utilities, Waste Facility Operators, Industrial Partners
2035	Expand infrastructure upgrades and integrate continuous methane monitoring and leak detection systems for compliance with Assembly Bill 32 and Senate Bill 1383.	Waste Facility Operators, CARB, CalRecycle
2040	Scale RNG production and direct-use agreements with local industries. Extend gas capture systems to viable closed or inactive landfills.	County of Fresno, Utilities, Industrial Partners

Source: SSG (2025).
CalRecycle = California Department of Resources Recycling and Recovery
CARB = California Air Resources Board
EPA = United States Environmental Protection Agency
Fresno COG = Fresno Council of Governments
LFG = landfill gas
LMOP = Landfill Methane Outreach Program
PPAs = power purchase agreements
RNG = renewable natural gas
SoCalGas = Southern California Gas Company

- **Cities and County Public Works**
    - Collaborate on siting, infrastructure upgrades, and closed landfill retrofits
- **Waste Facility Operators (Public and Private)**
    - Implement wellfield upgrades, pipeline injection, and renewable electricity projects and operate and maintain systems
- **Utilities (PG&E, SoCalGas)**
    - Partner on RNG injection, interconnection, and energy distribution agreements.
- **Industrial Partners**
    - Secure direct-use agreements for recovered gas in manufacturing/processing
- **State Agencies (CARB, CalRecycle)**
    - Provide funding, oversight, and compliance with AB 32, SB 1383.
- **EPA (LMOP Program)**
    - Provide technical assistance and federal funding support

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Feasibility Studies:** Conduct engineering and economic assessments of active and closed landfills to identify priority sites for LFG capture expansion, RNG conversion, and utilization projects
- **Permitting Reform:** Streamline permitting for LFG-to-energy and RNG projects, including interconnection with electricity and gas utilities
- **Funding Tools:** Apply for State and federal grants (CalRecycle, EPA LMOP), tax credits, and low-interest loans to finance capture and utilization projects
- **Utility and Industry Partnerships:** Partner with PG&E, SoCalGas, private developers, and industrial facilities for RNG pipeline injection, renewable electricity generation, and direct-use agreements
- **Market Development:** Secure PPAs for LFG-to-electricity and long-term contracts for RNG supply to utilities and industrial users
- **Monitoring and Reporting:** Deploy continuous methane monitoring and leak detection systems. Require transparent annual reporting and third-party verification to ensure compliance with AB 32 and SB 1383

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$1
Incremental Maintenance Costs (million USD)	$1
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$2
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	7,044
Marginal Abatement Cost (USD per MT CO_2e)	$0

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- CalRecycle methane reduction and organics grants
- EPA LMOP
- Federal investment tax credits and production tax credits (IRA)
- USDA Rural Energy for America Program (REAP)
- Low-interest loans (e.g., State Revolving Fund, DOE Loan Program Office)
- Public-private partnerships with utilities and industrial buyers

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of landfills with upgraded or newly installed capture systems
- Annual tons of methane captured and prevented from release

- Percentage of methane captured at active landfills (capture efficiency)
- Million British thermal units (MMBtu) of RNG produced and injected into pipelines
- MW of renewable electricity generated from landfill gas

5.4.3.3 Cleanup Wastewater Facilities

Description. Install solar PV, battery storage, and energy efficiency upgrades at wastewater treatment facilities in Fresno County to reduce grid electricity use, cut operating costs, and lower emissions. Implementation begins with feasibility studies, applying for funding, and phasing in solar deployment along with retrofits and ongoing performance monitoring. The timing and major milestones for the measure are detailed in Table 5.T.

Table 5.T: Clean up Wastewater Facilities Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Conduct feasibility studies at all major wastewater treatment plants to identify solar PV, storage, and efficiency retrofit opportunities.	Cities, County Public Works, Wastewater Utilities
2027	Apply for State and federal funding (e.g., EPA Clean Water State Revolving Fund, CEC grants) and utility incentives.	Wastewater Utilities, Cities and County,
2028	Begin phased deployment of solar PV and battery storage and pump and motor efficiency retrofits at largest/highest energy-use facilities.	Wastewater Utilities, Private Contractors
2029	Develop and implement workforce training for facility operators.	Wastewater Utilities, Workforce Development Boards
2030	Evaluate performance data (energy generation, storage utilization, cost savings, GHG reductions) and refine deployment strategies.	Wastewater Utilities, Fresno COG
2035	Complete full deployment of solar PV and battery storage across all major facilities. Integrate demand-response capabilities with PG&E.	Wastewater Utilities, PG&E
2040	Continue performance monitoring and optimization. Upgrade monitoring systems and adopt advanced energy management practices where necessary.	Wastewater Utilities, Cities and County

Source: SSG (2025).
CEC = California Energy Commission
EPA = United States Environmental Protection Agency
EV = electric vehicle
Fresno COG = Fresno Council of Governments
GHG = greenhouse gas
PG&E = Pacific Gas and Electric Company
PV = photovoltaic

Authority to Implement. Local Governments (County and Cities); CalRecycle; CARB; EPA; CPUC; Utilities (PG&E, SoCalGas)

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **County and Public Works**
  - Conduct feasibility studies, pursue funding, and manage permitting
- **Waste Facility Operators (private landfill operators, municipal facilities)**
  - Install/operate gas collection wells, piping, and treatment systems

- **CalRecycle and CARB**
  - Provide oversight, enforce compliance, and fund methane reduction programs
- **EPA LMOP**
  - Technical support, reporting protocols, and grants
- **PG&E/SoCalGas**
  - Partner on RNG injection, interconnection upgrades, and PPAs
- **Private Developers and Industrial Facilities**
  - Invest in LFG-to-energy projects and secure RNG/renewable power offtake agreements
- **Third-Party Verifiers**
  - Conduct methane monitoring and compliance reporting

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Feasibility Studies:** Conduct site assessments to identify solar PV, storage, and efficiency upgrade opportunities at wastewater treatment plants
- **Funding & Incentives:** Apply for State and federal grants (e.g., EPA, CEC programs) and utility incentives to cover capital costs
- **Phased Deployment:** Install solar PV and battery storage in stages, starting with high-priority or high-consumption facilities
- **Efficiency Retrofits:** Upgrade pumps, motors, lighting, and HVAC systems to reduce baseline energy use
- **Utility Coordination:** Partner with PG&E for interconnection, demand management, and potential grid services participation

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure, for both wastewater efficiency upgrades and wastewater on-site renewables:

Wastewater Efficiency Upgrades	
Incremental Capital Costs (million USD)	$30
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	-$30
Incremental Total Costs (million USD)	$0
Return on Investment	16%
Cumulative Emissions Reduction (kt CO_2e)	170
Marginal Abatement Cost (USD per MT CO_2e)	-$30
Wastewater On-Site Renewables	
Incremental Capital Costs (million USD)	$30
Incremental Maintenance Costs (million USD)	$10

Wastewater Efficiency Upgrades	
Incremental Energy Costs (million USD)	-$80
Incremental Total Costs (million USD)	-$40
Return on Investment	116%
Cumulative Emissions Reduction (kt CO_2e)	51
Marginal Abatement Cost (USD per MT CO_2e)	-$870

- **State**
  - CalRecycle Organics and Methane Reduction Grants
  - CARB Low Carbon Fuel Standard (LCFS) credits for RNG pipeline injection
  - CEC RNG innovation funds

- **Local/Utility**
  - PG&E/SoCalGas utility RNG procurement contracts
  - Fresno County landfill tipping fees to finance upgrades

- **Private/Other**
  - Public-private partnerships with RNG developers
  - Long-term PPAs with industrial users for direct-use methane/RNG

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of wastewater facilities upgraded
- MW of solar PV installed at wastewater treatment plants
- Megawatt-hours (MWh) of battery storage capacity installed and utilized annually
- Percentage of facility electricity demand met by on-site renewable generation and storage
- Annual energy savings from efficiency retrofits (kilowatt-hours [kWh] reduced)

5.4.4 Industrial Sector

In 2019, the industrial sector accounted for 1.3 MMT CO_2e, about 10% of Fresno County's total emissions. These emissions are driven primarily by energy-intensive activities in food processing, cement, and manufacturing. The CCAP-A consolidates industrial strategies under one measure, "Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels." This measure captures industrial electrification, efficiency upgrades, fuel switching to green hydrogen, and installation of on-site renewables. Among these strategies, electrifying industrial processes offers the greatest impact, with the potential to cumulatively reduce 10.91 MMT CO_2e by 2050. Industrial efficiency also plays a critical role, reducing 9.03 MMT CO_2e cumulatively by mid-century. Green hydrogen and industrial renewable deployment provide smaller but still important reductions of 0.29 MMT CO_2e and 0.23 MMT CO_2e. Overall, the industrial sector provides the largest decarbonization opportunity, with cumulative emission reductions exceeding 20.5 MMT CO_2e by 2050 (Figure 5-17). Table 5.U summarizes projected emission reductions from the LC Scenario.

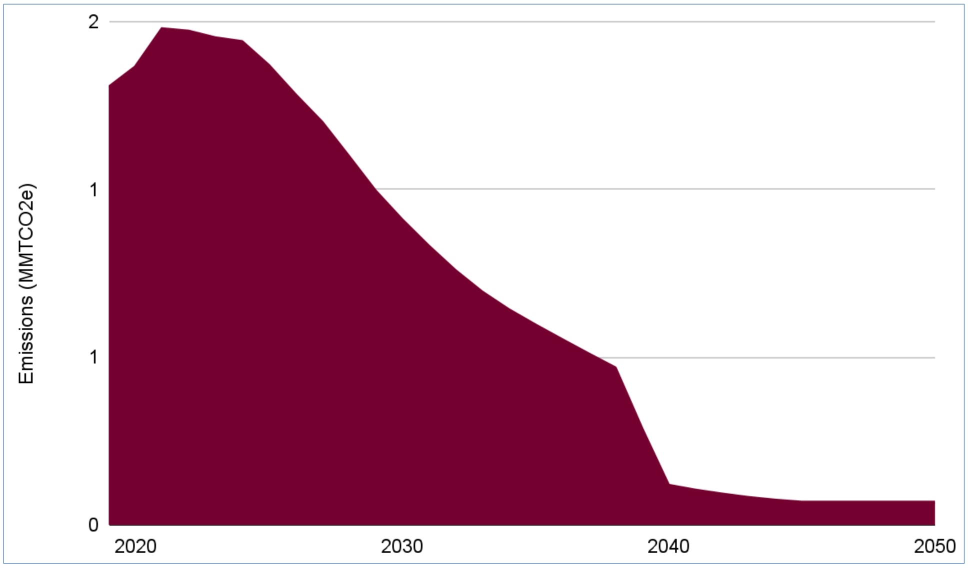


Figure 5-17: Projected Industrial Sector GHG Emissions in the LC Scenario, 2019–2050

Table 5.U: Industrial Sector Measure Summary

Modeled Actions	Total GHG Emissions Reductions ($MMT\ CO_2e$)		Cumulative GHG Emissions Reductions ($MMT\ CO_2e$)
	2026 to 2030	2031 to 2050	2026 to 2050
Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels	1.15	19.25	20.40

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MMT = million metric tons

5.4.4.1 Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels

Description. This measure would develop an industrial decarbonization taskforce, collaborating with major sectors like food processing, cement, and manufacturing and utilities to design and adopt a plan to cut emissions through efficiency upgrades, electrification, on-site renewables, and hydrogen adoption. The industrial sector remains one of the most difficult areas to decarbonize due to existing technological and economic feasibility barriers. Therefore, reducing GHG emissions in Fresno County would require a collaborative, committed effort by local industrial representatives, businesses, municipalities, utilities, and agencies to fund and deploy zero- and net-zero emissions technologies.

A successful taskforce would work with local governments to set shared goals for GHG reductions, energy benchmarking, and clean technology adoption. Key actions would include the launch of an efficiency and innovation challenge to connect industry to technical and financial support, then convene an Industrial Decarbonization Summit to showcase progress, align strategies, and attract additional funding. Potential implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.V).

Table 5.V: Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Establish an Industrial Decarbonization Taskforce with major sectors, utilities, and local governments. Set shared GHG reduction and clean technology adoption goals.	Cities and County of Fresno, Fresno COG, Industry Leaders, PG&E
2027	Launch the Industrial Efficiency and Innovation Challenge to fund and showcase advanced clean technology projects.	Fresno COG, State Agencies, Philanthropic Partners
2028	Provide technical assistance and audits to help facilities understand their baseline. Launch pilot projects for efficiency retrofits, electrified process heat, and on-site renewables.	Industry Partners, State Agencies, Utilities
2029	Develop and adopt an industrial benchmarking framework aligned with BPS used for commercial buildings. Require large facilities to begin baseline reporting of energy use and emissions in 2030.	Taskforce, Industry Associations, CARB, Local Governments
2030	Convene first Industrial Decarbonization Summit to highlight Industrial Efficiency and Innovation Challenge results, showcase early adopters, and align strategies for scale-up.	Taskforce, Fresno COG, Industry Associations
2035	Require emission and energy use performance improvements under benchmarking/BPS. Scale adoption of electrified process heat (induction, advanced heat pumps) and expand on-site renewable and hydrogen pilot projects.	Industry Leaders, Utilities, CEC, DOE
2040	Integrate hydrogen and renewable fuels at commercial scale. Continue requiring emissions and energy use reductions in industrial facilities under BPS requirements.	Industry Partners, Utilities, CARB, Local Governments

Source: SSG (2025).
BPS = building performance standards
CARB = California Air Resources Board
CEC = California Energy Commission
DOE = United States Department of Energy
Fresno COG = Fresno Council of Governments
PG&E = Pacific Gas and Electric

Authority to Implement. Local Governments (County and Cities); CARB; CEC; United States DOE; EPA; Utilities (PG&E, SoCalGas)

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno COG and Local Governments**
    - Convene the taskforce, coordinate reporting/benchmarking, manage Innovation Challenge, host Industrial Decarbonization Summit
- **Industry Partners (food processing, cement, manufacturing)**
    - Participate in Taskforce, implement upgrades, pilots, and benchmarking
- **CARB and CEC**
    - Provide regulatory alignment, technical support, and incentive programs
- **DOE and EPA**
    - Provide funding for pilots, electrification, and hydrogen
- **PG&E and Utilities**
    - Partner on grid readiness, efficiency programs, hydrogen/electrification pilots

- **Workforce Boards and Community Colleges**
  - Develop workforce training in electrification, hydrogen, and efficiency technologies
- **Philanthropic Partners and Research Institutions**
  - Support innovation funding and knowledge sharing

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful me\asure implementation:

- **Taskforce Formation:** Establish an Industrial Decarbonization Taskforce with industry leaders, utilities, and local governments to coordinate strategies and set shared GHG reduction targets for the industrial sector.
- **Energy Benchmarking and BPS Alignment:** Require or incentivize large industrial facilities to track and report energy use and emissions using a framework consistent with commercial BPS. This creates a unified countywide reporting system and allows phased performance requirements over time.
- **Efficiency and Electrification Programs:** Provide technical assistance, audits, and incentives for efficiency upgrades, electrified process heat, and on-site renewables.
- **Clean Fuels Deployment:** Support pilots and partnerships to introduce green hydrogen and renewable fuels in energy-intensive processes.
- **Innovation Challenge:** Launch a competitive program to connect industries with grants, financing, and technical support for clean technology adoption.
- **Workforce Development:** Train workers and engineers on advanced efficiency, electrification, and hydrogen technologies.
- **Summit and Knowledge Sharing:** Convene an Industrial Decarbonization Summit to showcase progress, align regional strategies, and attract investment.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure, for industrial efficiency upgrades, electrifying industrial processes, green hydrogen deployment in industry, and industrial on-site renewables:

Industrial Efficiency Upgrades	
Incremental Capital Costs (million USD)	$1,530
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	-$1,710
Incremental Total Costs (million USD)	-$180
Return on Investment	12%
Cumulative Emissions Reduction (kt CO_2e)	9,029
Marginal Abatement Cost (USD per MT CO_2e)	-$20
Electrifying Industrial Processes	
Incremental Capital Costs (million USD)	$0
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$4,670
Incremental Total Costs (million USD)	$4,670
Return on Investment	No direct financial return

Industrial Efficiency Upgrades	
Cumulative Emissions Reduction (kt CO_2e)	10,905
Marginal Abatement Cost (USD per MT CO_2eq)	$430
Green Hydrogen Deployment in Industry	
Incremental Capital Costs (million USD)	$0
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$40
Incremental Total Costs (million USD)	$40
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	293
Marginal Abatement Cost (USD per MT CO_2e)	$130
Industrial On-Site Renewables	
Incremental Capital Costs (million USD)	$360
Incremental Maintenance Costs (million USD)	$100
Incremental Energy Costs (million USD)	-$1,750
Incremental Total Costs (million USD)	-$1,290
Return on Investment	278%
Cumulative Emissions Reduction (kt CO_2e)	233
Marginal Abatement Cost (USD per MT CO_2e)	-$5,510

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - DOE Industrial Demonstrations Program (IDP)
  - DOE Office of Clean Energy Demonstrations (OCED)
  - EPA CPRG Implementation Grants
  - DOE Loan Programs Office (LPO) for industrial decarbonization pilots
- **State**
  - CEC EPIC Program (industrial innovation, electrification, hydrogen)
  - CARB LCFS for hydrogen/renewable fuels
  - CalRecycle/Cal OES grants for industrial efficiency and resilience overlaps
- **Local/Utility**
  - PG&E industrial energy efficiency and demand response programs
  - Local revolving loan funds (seeded with CPRG/State funding)
- **Private/Other**
  - Industry cost-share and corporate capital investment
  - Philanthropy (e.g., Breakthrough Energy, regional foundations) supporting innovation challenges
  - University/industry partnerships

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of participants and industries participating in the Taskforce
- Number of facilities participating in the Industrial Efficiency and Innovation Challenge

- Percent of large industrial facilities reporting energy use and emissions through benchmarking
- Annual energy savings (MWh and therms) from industrial efficiency upgrades
- Percent of industrial processes electrified (low-, medium-, and high-heat applications)
- MW of on-site renewable generation installed at industrial facilities
- Annual volume of green hydrogen or renewable fuels used in industrial processes

5.4.5 Agriculture Sector

Agriculture is the backbone of Fresno County's economy, culture, and identity and it also presents one of the County's greatest opportunities for climate leadership. In 2019, the sector produced 2.8 MMT CO_2e, accounting for 22% of the County's total GHG emissions. As illustrated in the BAU modeling scenario, investments made by agricultural operators and efforts through partnerships between the agricultural industry, State, and local agencies have resulted in significant GHG emissions reductions from the sector to date and projected out to 2045. This demonstrates the benefits that can result from the implementation of clean-air practices that reduce both GHG emissions as well as criteria pollutant emissions. As discussed in this section, with further funding support and ongoing partnerships, emissions from the sector could be cut to 0.7 MMT CO_2e annually, while positioning local producers at the forefront of sustainable farming.

Two measures were identified to support the further reduction of GHG emissions from the agriculture sector. The first measure, Amp up the Alternative Manure Management Program in Livestock & Poultry Operations, would expand critical incentive-based support for practices that can reduce GHG emissions related to manure management (e.g., compost pack barns, solid-liquid separation, and pasture-based management), while scaling up dairy digesters to reduce GHG emissions, especially methane, from dairy lagoons. This measure has the potential to cut 16.01 MMT CO_2e cumulative missions by 2050, while also improving soil health, water quality, and odor control, and potentially strengthening farm productivity.

The second identified measure, Plow the Way to Zero-Emission Agricultural Equipment, would support the continued shift to electric and hydrogen powered tractors, forklifts, and other farm machinery, where technologically feasible, through incentive funding support to help make the transition to zero-emissions equipment economically feasible. This measure has the potential to reduce 7.1 MMT CO_2e cumulatively by 2050. Beyond GHG emissions reductions, this shift lowers fuel costs, improves air quality for workers and rural residents, and creates new opportunities in clean technology and workforce development. These measures both represent increased funding and participation in currently available State and local programs.

Achieving these benefits will require increased investment and participation in existing State and federal programs such as the California Department of Food and Agriculture (CDFA) Alternative Manure Management Program (AMMP) and Dairy Digester Research and Development Program (DDRDP), the CARB FARMER and Moyer Program, and USDA Natural Resources Conservation Service (NRCS) programs. Continued State and federal funding support for existing programs and outreach efforts is critical. Expanding partnerships with the University of California (UC) Cooperative Extension, Resource Conservation Districts, and equipment dealers will ensure that producers of all sizes can take part.

By embracing innovation, Fresno's agricultural sector can demonstrate how climate-forward farming strengthens both the economy and the environment. With broad participation and sustained support, local producers can lead the way in building a resilient, productive, and low-carbon future for the County. Table 5.W summarizes the emissions reductions that could be achieved through successful implementation of the agriculture sector measures.

Table 5.W: Agriculture Sector Measures Summary

Modeled Actions	Total GHG Emissions Reductions (MMT CO_2e)		Cumulative GHG Emissions Reductions (MMT CO_2e) 2026 to 2050
	2026 to 2030	2031 to 2050	
Amp up Alternative Manure Management for Livestock and Poultry Operations	0.87	15.13	16.01
Plow the Way to Zero-Emission Agricultural Equipment	0.23	6.83	7.06

Source: SSG (2025).
CO_2e = carbon dioxide equivalent MMT = million metric tons

5.4.5.1 Amp up Alternative Manure Management for Livestock & Poultry Operations

Description. Livestock and poultry operations are among the largest methane sources in Fresno County. Expanding the use of both anaerobic digesters and alternative manure management practices represents one of the most significant opportunities to cut GHG emissions while delivering co-benefits for water quality, soil health, and community well-being.

Manure methane emissions can be reduced through two primary methods—installation of an anaerobic digester and alternative manure management practices. Anaerobic digesters capture methane-rich biogas for beneficial uses, including in electricity generation and fossil natural gas displacement. Alternative manure management practices reduce manure methane emissions in ways that do not involve an anaerobic digester. Examples include solid separation, conversion to dry scrape, and pasture-based management. Both digester and alternative manure management practices reduce GHG emissions and can improve water quality and nutrient management.[34]

Funding has historically been available to support the installation of dairy digesters or the implementation of alternative manure management practices though the CDFA DDRDP and AMMP, as well as through federal funding (e.g., the USDA NRCS Environmental Quality Incentives Program [EQIP]). There are not large, commodity-specific programs for poultry operators targeting manure management like there are for cattle operations, but poultry operations in the County are eligible for incentives through the EQIP program for measures that can support alternative manure management and sustainable farming. Data from these programs has been utilized to support the quantification of emissions reductions that could be achieved through this measure.

This measure would cut methane emissions from Fresno County's dairies and poultry farms by providing increased and ongoing incentive funding support for increased deployment of dairy

[34] University of California, Davis, California Biomass Collaborative. 2020. Research and Technical Analysis to Support and Improve the Alternative Manure Management Program Quantification Methodology. Stephen Kaffka, Robert B. Williams, Hamed Elmashad. April.

digesters in the county, as well as incentive support and education supporting increased implementation of practices recommended in the CDFA AMMP as feasible, aiming for widespread adoption and implementation by 2040. Ongoing support is needed to connect farms to State and federal funding (CDFA AMMP, USDA NRCS), offer local cost-share or low-interest financing, and provide technical assistance and outreach through partners like Dairy Cares, the UC Cooperative Extension and Resource Conservation Districts. Continued State and federal funding for education programs would help to expand awareness across farms of all sizes, and a monitoring program will track adoption, methane reductions, and co-benefits (e.g., improved soil health, water quality, and odor reduction). Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.X, provided on the following page).

Authority to Implement. Local Governments (County and Cities); CDFA; USDA NRCS; CARB; Federal (EPA, USDA)

Potential Implementing Entities and Responsibilities: The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Fresno COG and County**
  - Program coordination, advocacy, funding alignment, reporting.
- **Industry coalitions, UC Cooperative Extension, and CDFA**
  - Farmer outreach and engagement.
- **Industry coalitions, UC Cooperative Extension, and Resource Conservation Districts (RCDs)**
  - Technical assistance, workshops, peer-to-peer training, workforce development.

Table 5.X: Amp Up Alternative Manure Management Program in Livestock and Poultry Operations Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Launch county-level outreach campaign with CDFA, UC Cooperative Extension, and RCDs to expand farmer participation in CDFA AMMP, Dairy Digester Program, and USDA NRCS EQIP.	County of Fresno, CDFA, UC Cooperative Extension, RCDs, CDFA
2027	Host annual field days and peer-to-peer workshops. Establish a local cost-share and low-interest financing program to supplement State/federal funding for manure management projects.	UC Cooperative Extension, RCDs, County of Fresno, CDFA, Industry Partners
2028	Begin funding pilot demonstration projects (compost pack barns, solid-liquid separation, pasture-based management). Provide technical assistance teams for on-farm project design and implementation.	UC Cooperative Extension, RCDs, CDFA
2029	Scale workforce training programs for farmworkers and technicians on AMMP technologies, digester operations, and composting; integrate into community colleges.	UC Cooperative Extension, Workforce Boards, Community Colleges, CDFA
2030	Publish first countywide methane reduction and co-benefit report.	UC Cooperative Extension, RCDs, CDFA, CARB
2035	Expand adoption of enrolled dairies and poultry farms enrolled in AMMP or digester programs. Increase State/federal advocacy for expanded funding allocations.	Industry Partners, CDFA, CARB

Table 5.X: Amp Up Alternative Manure Management Program in Livestock and Poultry Operations Measure Implementation Timelines

Year	Action	Potential Lead Entities
2040	Reach widespread adoption of AMMP practices countywide. Establish digester and composting networks producing soil amendments and renewable energy.	County of Fresno, CDFA, Industry Partners
2045	Ensure long-term sustainability of AMMP and digester operations with ongoing financing, technical assistance, and monitoring; publish final progress toward methane neutrality in the agriculture sector.	County of Fresno, UC Cooperative Extension, CDFA, USDA, CARB

Source: SSG (2025).
AMMP = Alternative Manure Management Program
CARB = California Air Resources Board
CDFA = California Department of Food and Agriculture
RCDs = Resource Conservation Districts
UC = University of California
USDA = United States Department of Agriculture

- **CDFA**
  - Funding and program administration.
- **USDA NRCS**
  - EQIP program funding and cost-share.
- **Community Colleges and Workforce Boards**
  - Workforce training and certification.
- **Waste Management/Private Developers**
  - Operate digesters and composting facilities; integrate renewable energy and soil amendment markets.
- **Industry Associations**
  - Promote adoption, share best practices.

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Incentives and Financing:** Expand access to CDFA's AMMP and DDRDP, as well as USDA NRCS EQIP funds. Advocate for more funds to be allocated to these programs at the State level. Collaborate with UC Cooperative Extension, RCDs, and CDFA to coordinate funding applications, outreach, and technical support, and where possible, offer local cost-share programs and low-interest financing to help farms cover upfront costs.
- **Technical Assistance:** Provide on-farm guidance through UC Cooperative Extension and Resource Conservation Districts to help producers design and implement manure management projects. Conduct workshops, field days, and peer-to-peer learning programs to raise awareness and increase participation among dairies and poultry farms of all sizes.
- **Local Pilots and Demonstrations:** Fund demonstration projects showcasing AMMP practices (e.g., compost pack barns, solid-liquid separation, pasture-based management) and dairy digesters to highlight performance and co-benefits.

Workforce Development: Train farmworkers and technicians on AMMP technologies, digester operations, and composting practices to build local expertise.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$240
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$240
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	16,006
Marginal Abatement Cost (USD per MT CO_2e)	$10

Funding Sources. Funding availability and the State's allocation of funding to support this potential measure is critical to support measure implementation and meaningful continued GHG emissions reductions from the agricultural sector. At the time of this writing, additional funding for these important actions is not available in the State or federal budgets for the coming fiscal year.

If funding was made available, funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - EPA CPRG Implementation Grants for methane reduction
  - USDA NRCS EQIP for manure management practices
  - USDA Climate-Smart Commodities Program
  - USDA REAP for digester/renewable energy projects

- **State**
  - CDFA AMMP and DDRDP
  - CARB Cap-and-Trade (GGRF) allocations

- **Local**
  - County revolving loan funds and cost-share programs
  - Local bond programs (if feasible for ag infrastructure)

- **Private/Other**
  - Cooperative agreements with dairy and poultry producers
  - Partnerships with private digester and compost developers
  - Philanthropy/foundations supporting methane reduction and soil health

Metrics for Tracking Progress. Key metrics for this measure include:

- Percentage of dairies and poultry farms enrolled in AMMP or digester programs (annual and cumulative)

- Number of AMMP and digester projects funded through CDFA, USDA, and local cost-share programs
- Tons of manure diverted to AMMP practices (e.g., compost pack barns, solid-liquid separation)
- Number of pilot and demonstration projects launched and showcased through field days
- Number of farmworkers and technicians trained in AMMP and digester operations

5.4.5.2 Plow the Way to Zero-Emission Agricultural Equipment

Description. The deployment of zero-emission agricultural equipment is one of the most impactful strategies to cut both GHGs and criteria pollutants while advancing sustainable farming practices. This measure would support deployment of zero-emissions agricultural equipment by promoting electric tractors, forklifts, pumps, and other machinery, supported by utility incentives for charging infrastructure.

The SJVAPCD administers several effective incentive programs that help replace diesel-powered equipment with zero-emission alternatives. These programs were originally developed to reduce criteria air pollutants due to the region’s longstanding air quality challenges, but also deliver substantial GHG emissions reductions. However, these programs are consistently oversubscribed, and funding has been constrained in recent years. In 2024, applications exceeded available funds by a significant margin, leaving many growers unable to participate despite readiness to adopt cleaner equipment.

Incentive-based support is essential to overcome three main barriers:

1. The significantly higher upfront cost of zero-emission equipment compared to diesel alternatives.
2. Charging and fueling infrastructure installation costs.
3. Current technological limitations, where commercially available electric and hydrogen tractors may not yet provide the horsepower and runtime required for the intensive agricultural operations typical in Fresno County.

Expanded State and federal funding is required to support increased participation in CARB incentive programs (e.g., CORE and FARMER) administered locally by SJVAPCD. Local pilot projects should be launched to demonstrate performance, build confidence in emerging technologies, and drive continued innovation. Through partnerships with the UC Cooperative Extension and equipment dealers, farmers will receive education, financing options, and technical support, while adoption and emission reductions are tracked countywide.

Through coordinated investment, education, and pilot demonstrations, this measure will help Fresno County plow the way toward cleaner, healthier, and more resilient agricultural practices while showcasing the region as a leader in advancing zero-emission farm technology. Suggested timing and major milestones for this measure are detailed in Table 5.Y.

Table 5.Y: Plow the Way to Zero-Emission Agricultural Equipment Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Expand participation in CARB's CORE Voucher Program and FARMER Program for tractors, forklifts, and pumps. Provide technical support to small farms.	SJVAPCD, CARB, County of Fresno
2027	Partner with PG&E to deploy make-ready upgrades at farms and ag facilities. Begin on-farm pilot projects with electric tractors and pumps.	PG&E, County, UC Cooperative Extension, SJVAPCD, CARB, Industry Partners
2028	Host first annual Zero-Emission Ag Equipment Field Day to demonstrate equipment. Expand farmer outreach and financing support. Launch workforce training programs for farmworkers and mechanics on advanced ZEV ag machinery.	UC Cooperative Extension, Equipment Dealers, Community Colleges, SJVAPCD, CARB
2029	Launch cooperative bulk purchasing program through grower associations to lower equipment costs.	Industry partners, Grower Cooperatives
2030	Expand CORE and FARMER participation in Fresno County. Launch first local competitive grant round for high-use diesel replacement.	County of Fresno, CARB, SJVAPCD
2035	Scale adoption and achieve at least 30% ZEV ag equipment penetration across eligible equipment types. Expand grid upgrades and charging infrastructure at major ag hubs. Report on project progress and reevaluate initiatives.	SJVAPCD, CARB, PG&E
2040	Expand workforce training programs for farmworkers and mechanics on advanced ZEV ag machinery. Continue hosting field days to showcase cost savings and emissions reductions.	Community Colleges, UC Cooperative Extension, CDFA
2045	Report on project progress and reevaluate initiatives.	County of Fresno, CARB, SJVAPCD

Source: SSG (2025).
CARB = California Air Resources Board
CDFA = California Department of Food and Agriculture
CORE = Clean Off-Road Equipment Voucher Incentive Program
FARMER = Funding Agricultural Replacement Measures for Emission Reductions
PG&E = Pacific Gas and Electric Company
SJVAPCD = San Joaquin Valley Air Pollution Control District
UC = University of California
ZEV = zero-emission vehicle

Authority to Implement. Local Governments (County and Cities); SJVAPCD; CARB; CEC; USDA; Utilities (PG&E)

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **SJVAPCD**
  - Local administration of FARMER and CORE funds, funding advocacy, tracking metrics
- **CARB and CEC**
  - Incentive programs and funding allocations for zero and near-zero emissions equipment and charging infrastructure
- **Grower Cooperatives and Equipment Dealers**
  - Outreach, bulk purchasing, farmer support

- **UC Cooperative Extension and Community Colleges**
  - Technical assistance, training, and workforce development

- **PG&E**
  - On-farm grid readiness and charging infrastructure

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Incentives and Grants:** Expand participation in CARB's CORE Voucher Program and FARMER Program to provide point-of-sale discounts and rebates for electric tractors, forklifts, pumps, and other ag equipment. Leverage federal USDA funding to supplement costs.
- **Utility Coordination:** Partner with PG&E's make-ready programs to fund grid upgrades and on-farm charging infrastructure, ensuring reliable power for high-demand agriculture equipment.
- **Local Pilots and Demonstrations:** Launch on-farm pilot projects showcasing electric tractors, irrigation pumps, and forklifts. Host an annual Zero-Emission Agriculture Equipment Field Day with UC Cooperative Extension and dealers to highlight performance and cost savings (featured event as a part of the larger ZEV Offroad Vehicle Show).
- **Bulk Purchasing Programs:** Organize cooperative purchasing agreements through grower associations to lower costs for smaller farms by aggregating equipment demand.
- **Workforce Training:** Train farmworkers, equipment operators, and mechanics through UC Cooperative Extension and community colleges on the operation, repair, and safety of ZEV ag machinery.
- **Partnerships and Technical Assistance:** Collaborate with local agencies, UC Cooperative Extension, equipment dealers, and cooperatives to provide financing options, educational workshops, and technical support for farmers.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$0
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$0
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	7,060
Marginal Abatement Cost (USD per MT CO_2e)	$0

Funding Sources. Funding availability and the State's allocation of funding to support these potential measures is critical to support measure implementation and meaningful continued GHG emissions reductions from the agricultural sector. At the time of this writing, additional funding for this important action is not available in the State or federal budgets for the coming fiscal year.

If funding was made available, funding sources that could potentially support the implementation of this measure include the following:

- **Federal**
  - USDA NRCS EQIP (on-farm electrification support)
  - USDA REAP (charging, renewable energy for farms)
  - EPA CPRG for agricultural ZEV adoption
- **State**
  - CARB CORE Voucher Program
  - CARB FARMER Program (regional allocation through SJVAPCD)
  - CARB Moyer Program (administered by SJVAPCD)
  - CEC EPIC Grants (tech demonstrations)
- **Local**
  - County revolving loan fund (shared with transportation/ag measures)
  - Cost-share or pilot funding through Fresno County
  - SJVAPCD Technology Advancement grant program
- **Private/Other**
  - Co-op purchasing agreements
  - Equipment dealer financing programs
  - Philanthropy (e.g., climate-smart ag initiatives)

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of zero-emission agricultural equipment deployed (tractors, forklifts, pumps, etc.)
- Percent of agricultural equipment electrified countywide (by equipment type and overall)
- Number of farms participating in CORE, FARMER, or local grant programs
- Number of cooperative bulk purchasing agreements completed and farms benefitting
- MW of grid capacity added through PG&E make-ready upgrades at agricultural sites
- Number of participants at annual Zero-Emission Agriculture Equipment Field Days

5.4.6 Natural and Working Lands Sector

Fresno County's extensive forests, including the Sierra National Forest and Sequoia National Forest, sequester approximately 0.71 MMT CO_2e annually, serving as a carbon sink for the County and is treated as a negative emission factor in the scenarios, helping reduce net emissions. Conserving, protecting, and maintaining existing natural lands is essential to preserve current sequestration levels.

Although the GHG reductions from urban forestry are small compared to other sectors, the co-benefits are significant. Expanding urban tree canopy, particularly in LIDAC communities, deliver both localized climate benefits and community co-benefits. Doubling Fresno County's tree canopy as proposed here would require planting more than 150,000 new trees by 2050, but an expanded canopy reduces extreme heat exposure, improves air quality by filtering pollutants, enhances stormwater management, and provides shaded, walkable streets that improve public health and livability. Table 5.Z, below, summarizes the expected emissions reductions for the sector.

Table 5.Z: Natural and Working Lands Sector Measure Summary

Modeled Actions	Total GHG Emissions Reductions (MMT CO_2e)		Cumulative GHG Emissions Reductions (MMT CO_2e) 2026 to 2050
	2026 to 2030	2031 to 2050	
Grow the Urban Tree Canopy	0.00	0.02	0.02

Source: SSG (2025).
CO_2e = carbon dioxide equivalent
MMT = million metric tons

5.4.6.1 Grow the Urban Tree Canopy

Description. Expand urban forestry programs to plant and maintain 160,000 new trees by 2045, prioritizing neighborhoods with low canopy coverage and high heat and air quality burdens. Support new trees with long-term maintenance, irrigation, and workforce training to increase survival and growth. Partner with schools, community-based organizations, and housing developments to plant trees in public and private places. State and federal funding and utility partnerships will support municipal costs (e.g., CAL FIRE's Urban and Community Forestry Program) to provide local incentives and free or subsidized trees. Progress can be tracked through GIS-based canopy mapping, with public dashboards to ensure transparency and equity in tree distribution. Implementing authorities, responsibilities, costs and savings, and potential funding pathways are further discussed below, as well as the timeline and milestones for the measure (Table 5.AA, provided on the following page) and metrics for tracking progress.

Authority to Implement. Cities and County governments (planning, parks, and public works), coordinated through Fresno CG

Potential Implementing Entities and Responsibilities. The following listing provides an overview of the key implementing entities and responsibilities to support successful measure implementation:

- **Cities and County**
  - Adopt ordinances, manage municipal tree planting/maintenance, and incorporate tree canopy into local General Plans and Climate Action Plans
- **Fresno COG**
  - Use the Extreme Heat Analysis to prioritize neighborhoods for tree planting; integrate canopy expansion into RTP/SCS and secure regional funding
- **SJVAPCD**
  - Provide funding support for projects that deliver air quality and PM_{10}/ozone co-benefits, track pollutant reductions, and align with District incentive programs

Table 5.AA: Grow the Urban Tree Canopy Measure Implementation Timelines

Year	Action	Potential Lead Entities
2026	Conduct GIS-based canopy assessment to identify priority planting areas - prioritizing LIDACs and urban heat islands. Secure CAL FIRE and federal grants for tree planting and maintenance.	Cities and County, Fresno COG, CAL FIRE
2027	Launch first large-scale planting campaign with community-based organizations and schools. Distribute free or subsidized trees to residents and businesses.	Cities and County, Community-Based Organizations, Housing Developers, School Districts
2028	Establish workforce training programs for tree planting, irrigation, and maintenance. Begin annual monitoring of tree survival and canopy growth.	Educational Institutions, Workforce Boards, Nonprofits, Cities
2030	Reach milestone of approximately 20,000 new trees planted. Ensure high-heat, low-canopy neighborhoods have access to irrigation and maintenance systems.	Cities and County, Utilities, Community Partners
2035	Reach milestone of approximately 60,000 trees planted. Conduct a GIS analysis of tree coverage and target low-canopy areas with new plantings. Strengthen community stewardship programs.	Cities and County, Fresno COG, CAL FIRE, Utilities, Community Partners
2040	Reach milestone of approximately 110,000 trees planted. Expand and monitor pest/disease management to maintain tree health.	Cities and County, Community-Based Organizations
2045	Complete planting of approximately 160,000 new trees. Maintain a full GIS canopy map and public dashboard to ensure equitable distribution and long-term survival.	Cities and County, Fresno COG, CAL FIRE, Utilities

Source: SSG (2025).
CAL FIRE = California Department of Forestry and Fire Protection
Fresno COG = Fresno Council of Governments
GIS = geographic information systems
LIDAC = low-income/disadvantaged communities

- **CAL FIRE/USDA Forest Service**
  - Administer State and federal urban forestry funding programs
- **Caltrans**
  - Provide Sustainable Transportation Planning Grants for street greening and urban canopy expansion along major corridors and transit routes
- **Utilities (PG&E, SoCalGas)**
  - Partner on shade/energy efficiency programs, irrigation system support, and co-funding opportunities
- **Community-Based Organizations**
  - CBOs (e.g., Tree Fresno) could lead community engagement, planting, and long-term stewardship; coordinate with schools, housing developers, and nonprofits
- **Workforce Boards and Educational Institutions**
  - Train and employ local workers in tree planting, irrigation, and maintenance

Implementation Mechanisms. The following listing provides an overview of the key implementation mechanisms to support successful measure implementation:

- **Funding and Incentives:** Leverage CAL FIRE Urban and Community Forestry grants, federal funding, and utility partnerships to cover planting and maintenance costs. Provide free or subsidized trees for residents and businesses.
- **Community Engagement and Partnerships:** Collaborate with schools, community-based organizations, housing developments, and nonprofits to expand planting on both public and private lands. Run outreach and education programs to engage residents in not only planting, but caring for and stewarding trees in their neighborhoods.
- **Maintenance and Irrigation Programs:** Establish sustainable maintenance programs, including irrigation systems, pruning, and pest management, to support tree health over time. Train and employ local workers in tree planting, irrigation, and long-term maintenance to ensure high survival rates.
- **Monitoring and Transparency:** Use GIS-based mapping and public dashboards to track canopy expansion, survival rates, and distribution of new trees.

Costs and Savings. The following table provides an overview of the potential costs and savings related to the measure:

Incremental Capital Costs (million USD)	$4
Incremental Maintenance Costs (million USD)	$0
Incremental Energy Costs (million USD)	$0
Incremental Total Costs (million USD)	$4
Return on Investment	No direct financial return
Cumulative Emissions Reduction (kt CO_2e)	24
Marginal Abatement Cost (USD per MT CO_2e)	$178

Funding Sources. Funding sources that could potentially support the implementation of this measure include the following:

- CAL FIRE Urban and Community Forestry Program
- USDA Forest Service Urban Forestry funds
- Caltrans Sustainable Transportation Planning Grants (corridor/tree canopy integration)
- SJVAPCD incentive programs (air quality co-benefits)
- IRA Climate Pollution Reduction Grants (resilience)
- FEMA BRIC (for urban greening as resilience infrastructure)
- Local City/County budgets and utility partnerships

Metrics for Tracking Progress. Key metrics for this measure include:

- Number of new trees planted annually and cumulatively
- Percent increase in urban tree canopy coverage (GIS-based)
- Tree survival rate after 3, 5, and 10 years
- Acres of priority neighborhoods (low canopy, high heat) planted with new trees
- Number of residents, schools, and community groups engaged in planting and stewardship
- Number of workers trained and employed in urban forestry and tree maintenance

5.4.7 Electricity Generation Transition Impacts

Although electricity generation is not modeled as a standalone end-use sector in this analysis, the decarbonization of electricity generation is foundational to achieving Fresno County's climate goals. Electrifying vehicles, homes, and industry will only cut emissions if the electricity powering them comes from clean, zero-carbon sources. California has already set a pathway toward this future through SB 100, which requires the State to achieve 100% clean electricity by 2045. Large-scale solar projects developed within Fresno County will contribute to meeting this mandate while also creating local jobs and investment.

Alongside statewide grid decarbonization, on-site solar installations on homes, businesses, and industrial facilities will play a critical role in both cutting emissions and building local resiliency. Local electricity generation is projected to increase from 4.2 million MMBtu in 2019 to 34.3 million MMBtu in 2050, supporting the electrification of vehicles, buildings, and industry. At the same time, grid electricity demand will continue to rise, from 24.3 million MMBtu in 2019 to 28.3 million MMBtu in 2050, underscoring the need for both central grid decarbonization and distributed clean energy deployment.

Measures proposed in the building and industrial sectors can achieve significant cumulative emission reductions in terms of electricity generation:

- **Bundle Solar + Savings for Residences**
  - Solar installation in existing residential buildings: 2.71 MMT CO_2e reduced by 2050

- **Green-up Commercial Buildings**
  - Solar installation in existing commercial buildings: 2.98 MMT CO_2e reduced by 2050

- **Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels**
  - Industrial renewables: 0.23 MMT CO_2e reduced by 2050

These measures strengthen Fresno County's ability to meet rising electricity demand with clean, local sources, reduce dependence on fossil fuels, and protect residents against grid outages as well as supporting lower energy costs for households and businesses.

6 Benefits Analysis

FRESNO
Council of Governments

LSA

6.0 BENEFITS ANALYSIS

6.1 INTRODUCTION

Taking action to reduce greenhouse gas (GHG) emissions is not just about fighting climate change; it is also about building healthier, safer, and more vibrant communities in Fresno County.

As shown in Figure 6-1 (provided on the following page), many of the same steps taken to lower emissions (e.g., improving public transit, planting more trees, or upgrading homes to use less energy) also help create better places to live. The measures proposed in the Comprehensive Climate Action Plan Analysis (CCAP-A) can lead to cleaner air, lower utility bills, more good jobs, and stronger neighborhoods; and go hand-in-hand with community priorities like public health, economic growth, and making Fresno communities more resilient to extreme weather.[35]

This section draws on research on the broader societal impacts of GHG mitigation measures in the Low-Carbon Scenario to show the potential co-benefits of undertaking climate action. For example, studies show that reduced air pollution can be as or more valuable than the emissions reductions themselves.[36] This section evaluates the co-benefits of the Low-Carbon Measures to illustrate how these actions can be a lever for achieving broader community goals.

6.2 OVERVIEW OF CO-BENEFITS AND CO-HARMS

6.2.1 What Are Co-Benefits and Co-Harms?

Many actions aimed at reducing GHG emissions also produce additional positive outcomes; these are known as *co-benefits*. The Intergovernmental Panel on Climate Change (IPCC) defines co-benefits as "the positive effects that a policy or measure aimed at one objective might have on other objectives."[37] For example, a measure designed to lower emissions may also improve air quality, enhance public health, or support economic development.

While co-benefits represent the added value of a climate action, *co-harms* refer to any unintended negative consequences that may occur. Although GHG reduction measures often have positive effects, there is still potential for co-harms and negative effects. For example, higher-density development reduces emissions by encouraging walking, cycling, and public transit use but can increase exposure to air pollution if not carefully planned, including for at-risk groups like children and older adults traveling on foot or by bike on busy roads.

35 Kamal-Chaoui, Lamia, and Alexis Robert. 2009. *Competitive Cities and Climate Change*. Paris: OECD. Website: http://www.oecd-ilibrary.org/governance/competitive-cities-and-climate-change_218830433146 (accessed August 2025).

36 Organization of Economic and Cooperative Development (OECD). 2000. *Ancillary Benefits and Costs of Greenhouse Gas Mitigation*. Paris: OECD Publishing. March.

37 Intergovernmental Panel on Climate Change (IPCC). 2014. *Annex II: Glossary*. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. 1757–1776. Cambridge: Cambridge University Press.

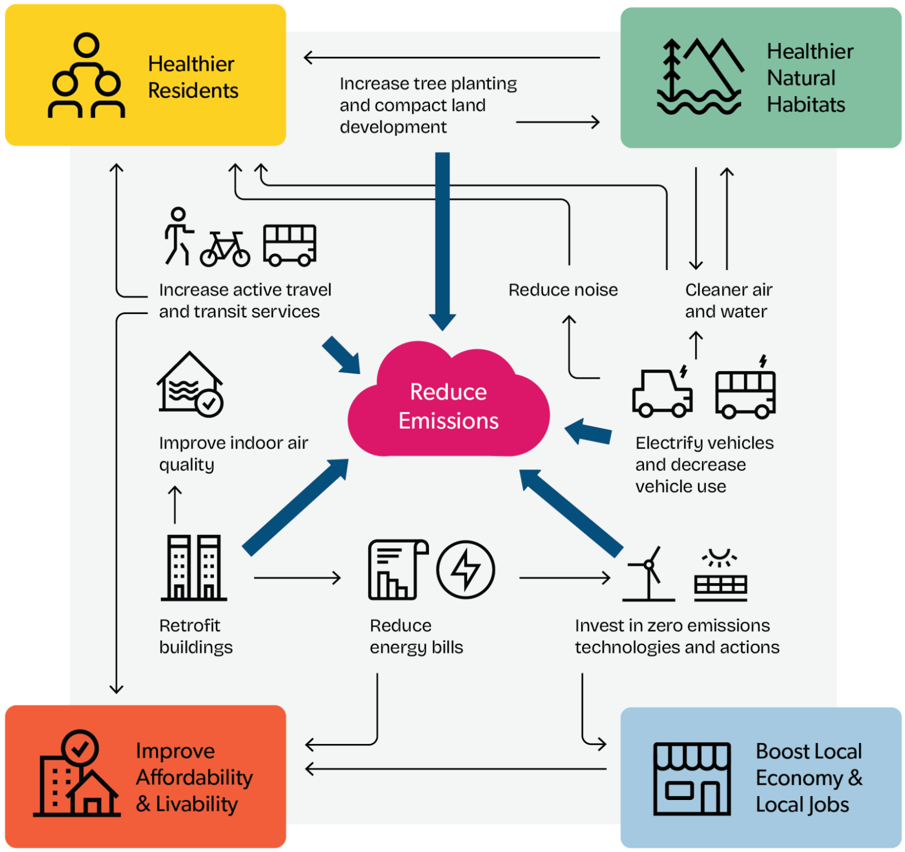


Figure 6-1: Benefits of Actions that Support Emissions Reductions

Co-benefits and co-harms, also referred to as "ancillary effects" or "ancillary benefits and costs," are additional outcomes that occur alongside the main goal of a policy or action. In this analysis, they are defined as any expected positive or negative effects beyond the measure's impact on GHG emissions.

These effects are often unintended and shaped by local conditions. However, governments can design climate actions in ways that intentionally maximize co-benefits (e.g., improved health or economic opportunities) while minimizing potential harms. This requires thoughtful policy development that considers GHG reductions alongside broader outcomes like public health and community well-being.

6.2.2 Not All Co-Benefits or Co-Harms Are Equal

Not all co-benefits or co-harms carry the same weight. It is helpful to identify and prioritize criteria for evaluating co-benefits, such as:[38]

[38] Fay, Marianne, Stephane Hallegatte, Adrien Vogt-Schilb, Julie Rozenberg, Uwe Deichmann, and Tomoko Uchimura-Shiroishi. 2015. *Decarbonizing* Development*: Three Steps to a Zero-Carbon Future*. Washington, DC: World Bank.

- **Synergies:** Many low-carbon actions deliver multiple socio-economic benefits like improved transit, energy efficiency, and compact urban design.
- **Urgency:** Some actions take time to show results (e.g., wetland conservation or compact community development) and require prompt implementation to avoid irreversible outcomes, escalating costs, or locking in long-term emissions.[39]
- **Cost-effectiveness:** Early action is often less expensive than delayed action, especially when delayed action involves ongoing investments in high-emitting infrastructure, activities, and utilities that will need to be dismantled later on.
- **Longevity:** Long-term investment decisions can lock in emissions for decades, if not centuries.
- **Distribution effects:** The low-carbon measures will affect populations differently, with implications for different effects across income groups, generations, regions, and marginalized communities.

Based on these considerations, decision-makers should prioritize actions that have multiple co-benefits, such as synergies with other priorities, the ability to propel forward momentum, avoiding or reducing future costs, and positive impacts on low-income and disadvantaged communities (LIDACs).

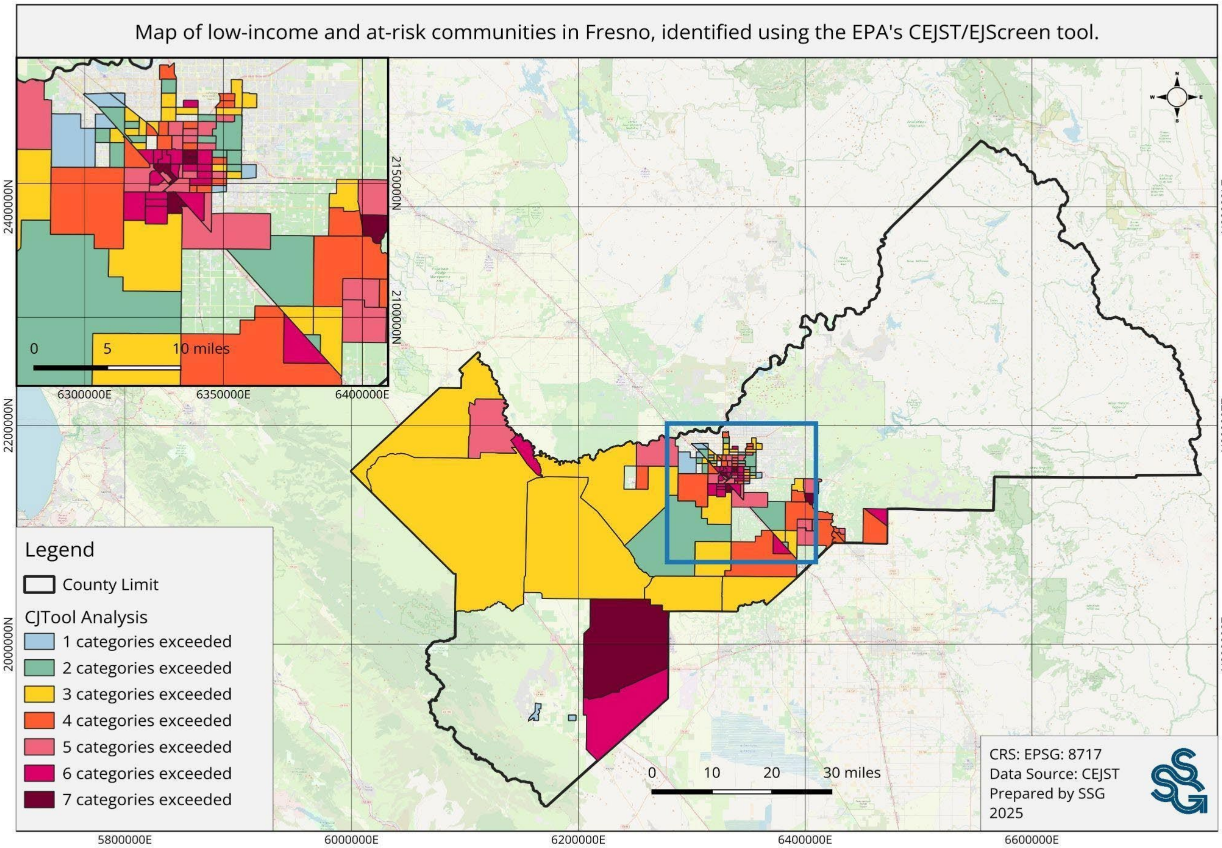
6.2.3 Understanding Low-Income and Disadvantaged Communities

LIDACs were identified for this analysis by reviewing census tract-level data within Fresno County using the United States Environmental Protection Agency's (EPA) Environmental Justice Screening and Mapping Tool (EJScreen) and the Climate and Economic Justice Screening Tool (CEJST) (Figure 6-2, provided on the following page). Further information about the methodology used to identify LIDACs can be found in Appendix C.

Under CEJST criteria, a census tract is considered disadvantaged if it meets both of the following conditions:

- It is at or below the 65th percentile for median household income; and
- It is at or above the 90th percentile for at least one environmental or climate burden indicator across eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

[39] Lock-in effect refers to implementation of a strategy or action that improves performance of an object or activity in the short term but is prohibitive to future change. Lock-in effect can refer to building upgrades or land use for example. As an example, where quick building retrofits are undertaken, no additional improvements in the equipment installed can be expected over the course of its lifetime without considerable additional expense. In this way, lower levels of energy reductions can be locked in for a long period.



Source: SSG (2025).

Figure 6-2. Map of Low-Income and Disadvantaged Communities in Fresno County, Identified Using CEJST and EJScreen

This approach ensures that the analysis prioritizes communities in Fresno County facing the dual challenge of low income and elevated environmental burdens. See Figure 6-2 for a map of CEJST-identified disadvantaged tracts in Fresno County.

6.2.4 Co-Benefits in the CCAP-A

Co-benefits and co-harms were quantified or assessed qualitatively for the region as a whole for the Low-Carbon Scenario. A summary of the assessment and analytical method used is described in Table 6.A. and in Appendix C.

Table 6.A: Overview of Co-Benefits and Co-Harms Categories, Specific Impacts, Indicators, and Analytical Method

Category	Impact Overview	Indicators	Analytical Method
Co-Benefit and Co-Harms: Health			
Outdoor air quality	Improvement in outdoor air quality	• Avoided mortality and incidence of disease • Dollar value of total health benefits	Calculated using air pollutants from modeling input into the EPA Co-Benefits Risk Assessment (COBRA) tool
Indoor air quality	Improvement in air quality inside homes and businesses	• Number of homes using electric appliances • Total square footage of non-residential buildings using electric appliances	Correlation between use of gas appliances in the home and indoor air quality
Co-Benefit and Co-Harms: Economic Prosperity			
Employment	New employment opportunities are created. Existing employment opportunities are lost.	Jobs created/lost by sector	Employment multipliers for every dollar spent on decarbonization
Financial Energy Savings	Energy efficiency will reduce household building and transportation costs	Household energy and travel expenditures	Calculated in the ScenaCommunity model (change in expenditures on transportation and housing)[1]
Co-Benefit and Co-Harms: Climate Adaptation and Resilience			
Passive survivability	Populations are able to withstand extreme weather events and power outages	• Number of buildings with deep retrofits • Number of batteries installed alongside renewable energy systems • Electricity provided within micro-grids or district energy systems	Calculated in the ScenaCommunity model
Reduction of urban heat island effect	Planting trees for shade and expanding green infrastructure reduces local temperatures	• Number of trees planted or acres of landscape restored	Calculated in the ScenaCommunity model and correlated with reductions in local temperature

[1] See the Data, Methods, and Assumptions (DMA) Manual for more information about SSG's ScenaCommunity model.

6.3 CO-BENEFITS AND CO-HARMS: HEALTH

6.3.1 Outdoor Air Quality

6.3.1.1 Observations

Improving air quality is one of the most immediate and significant public health co-benefits of reducing GHG emissions. Many of the same activities that drive climate change (e.g., burning fossil fuels for energy, transportation, and industry) also release harmful air pollutants that threaten human health throughout the lifespan of the pollutant.

These pollutants discussed in this section fall into two regulatory categories: Hazardous Air Pollutants (HAPs) and Criteria Air Pollutants (CAPs).

HAPs are toxic air contaminants known or suspected to cause serious health effects, including cancer, reproductive and developmental harm, and damage to the nervous system. Examples include benzene, perchloroethylene, methylene chloride, and certain heavy metals. HAPs are typically released from industrial processes, vehicle exhaust, and the combustion of fuels.

CAPs are six common pollutants regulated by the EPA under the National Ambient Air Quality Standards (NAAQS). These include ground-level ozone (O_3), fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb).

In this plan, a subset of CAPs and related co-pollutants were selected for modeling based on their strong association with fossil fuel combustion and availability of local emissions data. These include:

- **Fine Particulate Matter ($PM_{2.5}$):** Tiny particles less than 2.5 microns in diameter that can lodge deep in the lungs and bloodstream, contributing to respiratory, cardiovascular, and neurological illnesses.

- **Nitrogen Oxides (NO_x):** Gases emitted during fuel combustion, especially from vehicles and industrial processes. NO_x contributes to the formation of ozone and particulate matter and is associated with respiratory illnesses and lung irritation.

- **Volatile Organic Compounds (VOCs):** Organic chemicals that easily evaporate into the air and react with NO_x to form ground-level ozone and smog. Some VOCs are also directly toxic.

- **Carbon Monoxide (CO):** A colorless, odorless gas that reduces oxygen delivery in the body. Although high indoor exposures can be fatal, even lower levels outdoors can worsen cardiovascular conditions and increase hospital visits during smog events.

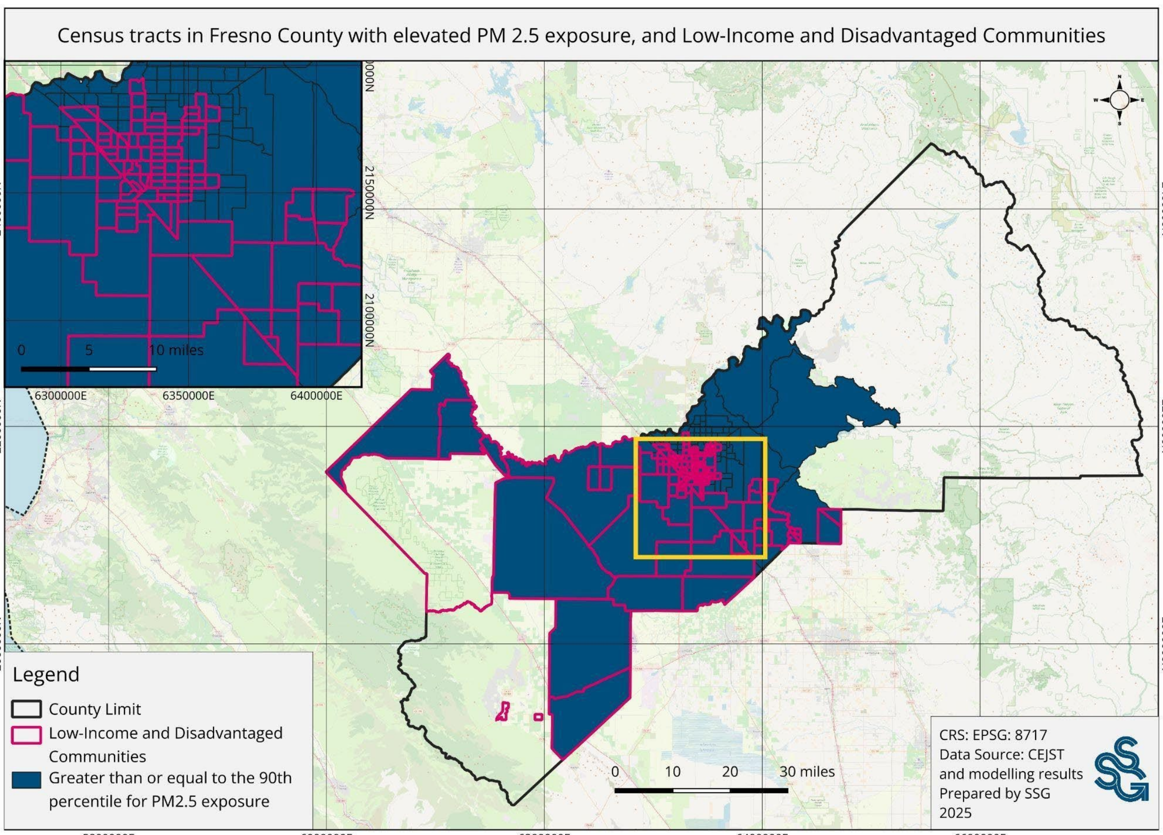
Among all pollutants, $PM_{2.5}$ is especially harmful and serves as a central indicator of outdoor air quality. These fine particles are less than 2.5 microns in diameter and small enough to bypass the body's natural defenses and enter the lungs and bloodstream. Exposure to $PM_{2.5}$ has been linked to increased risk of asthma, bronchitis, cardiovascular disease, neurological disorders, and early death, particularly among older adults, children, and people with chronic illness.[40]

Air pollution can affect every stage of life, from prenatal development to old age. It damages multiple organ systems and worsens many chronic conditions. In Fresno County, this burden is made worse by the valley's geography and climate, which trap pollution close to the ground and prolong exposure.

40 California Air Resources Board (CARB). 2022. *Scoping Plan for Achieving Carbon Neutrality, Appendix G: Public Health*. December.

Fresno County is part of the San Joaquin Valley Air Basin, a region that has struggled with air quality issues due to the region's unique topography and meteorology. The air basin is classified as nonattainment of recommended federal and State standards for both fine particulate matter pollution and for ozone. Climate change is expected to further worsen air quality by increasing the number of high-ozone and wildfire smoke days. Warmer temperatures, longer droughts, and drier vegetation all contribute to conditions that intensify smog and wildfire events.

The health burden of air pollution is not shared equally. Many LIDACs in Fresno County are located near major roadways, industrial facilities, or agricultural operations, placing them at higher risk of exposure (Figure 6-3). These same communities may also face additional stressors or cumulative burdens like limited access to healthcare and cooling infrastructure, higher rates of pre-existing conditions, and greater occupational exposure due to outdoor work (e.g., farmworkers, outdoor workers).



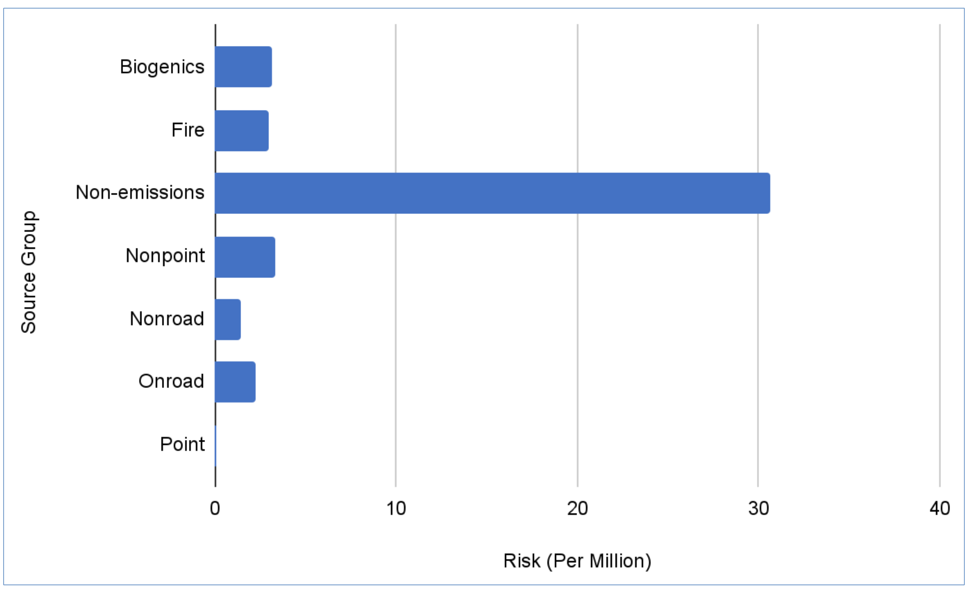
Source: CEJST, EPA JScreen (2025).

Figure 6-3: Census Tracts in Fresno County with Elevated $PM_{2.5}$ Exposure and LIDAC Designation

Spatial analysis confirms that many LIDAC-designated tracts experience both high $PM_{2.5}$ concentrations and high energy burden. This means residents pay a disproportionate share of income on utilities while facing the health risks of poor air quality.

Air pollution also increases long-term cancer risk. The EPA's 2020 AirToxScreen analysis estimates lifetime cancer risk based on exposure to air pollution source group. In Fresno County, the estimated incremental lifetime cancer risk attributed to ambient air toxics is approximately 44 per 1 million residents. In other words, if 1 million people were exposed to current levels of air toxics in Fresno County over a typical 70-year lifetime, about 44 additional individuals are expected to develop cancer due to that exposure.

Figure 6-4 below illustrates the contribution of different source groups to this estimated risk (cancer sources that were not emissions groups, including background and secondary sources, are not included in this figure).[41] The largest share (about 70%) is from non-emissions, which refers to pollutants that are not directly emitted into the air but are formed through chemical reactions in the atmosphere (e.g., secondary pollutants) or represent background levels transported from outside the region. These are often beyond local control, but still influence public health. Other notable contributors include nonpoint sources, which are small and widespread emitters such as residential wood combustion and solvent use; on-road emissions from vehicles operating on highways and local streets; and non-road emissions from equipment and vehicles not typically used on roads, including those used in construction, recreation, and agriculture. Additional sources include biogenics, which are natural emissions from trees and vegetation, fire-related emissions from wildfires or prescribed burns, and point sources (i.e., large, fixed facilities like industrial plants or power stations).

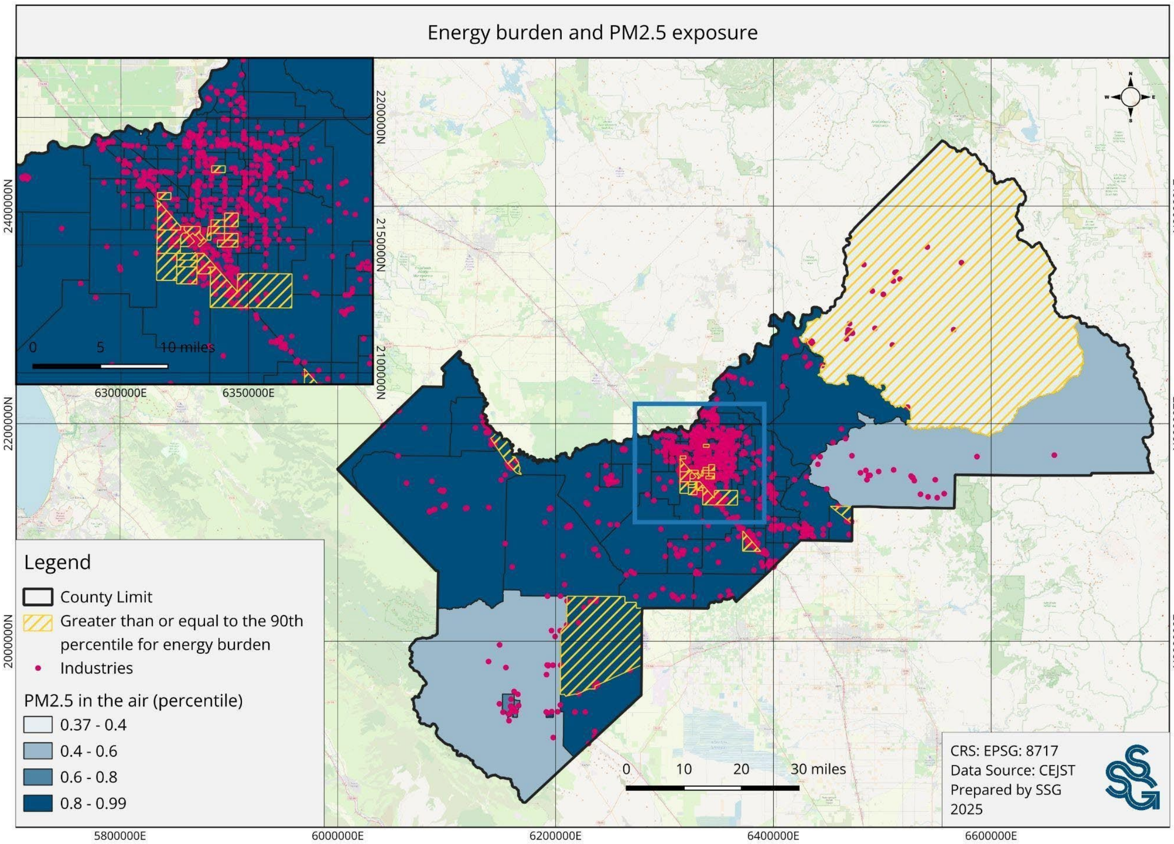


Source: SSG (2025).

Figure 6-4: Cancer Risk (Per Million) in Fresno County by Air Pollution Source Group

41 United States Environmental Protection Agency (EPA). 2025. 2020 AirToxScreen: Assessment Results. Website: https://www.epa.gov/AirToxScreen/2020-airtoxscreen-assessment-results (accessed August 4, 2025).

These overlapping environmental and economic burdens are especially concerning for communities already facing structural barriers to health and safety. Figure 6-5 highlights areas of Fresno County where $PM_{2.5}$ burden and high energy costs coincide, indicating neighborhoods with disproportionate environmental exposure and economic vulnerability.



Source: SSG 2025. Developed from the Council on Environmental Quality (2022).

Figure 6-5: Energy Burden and $PM_{2.5}$ Exposure in Fresno County

The map shows that the highest levels of $PM_{2.5}$ exposure are concentrated in the central region of Fresno County, where clusters of industrial facilities (pink dots) are also located, along with major transportation corridors and urban centers. These same areas experience higher energy burdens, suggesting that residents are both paying more for energy and breathing more polluted air, which are compounding risk factors for health and affordability.

6.3.1.2 Measures That Reduce Outdoor Air Pollution and GHG Emissions Simultaneously in Fresno County

The following Table 6.B provides an overview of GHG reduction measures that will reduce outdoor air pollution in Fresno County, and Table 6.C provides quantification of the expected reduction in fossil fuel combustion and associated cobenefits projected to occur under the different scenarios modeled as part of this analysis, including through the BAP, BAU, and Low-Carbon (LC) Scenarios in 2050 as compared to the baseline.

Table 6.B: Overview of GHG Reduction Measures in the CCAP-A That Will Reduce Outdoor Air Pollution

Sector	Measure
Buildings/Electricity Generation	• Bundle Solar + Savings for Fresno Homes • Green-Up Commercial Buildings • Building Net Zero New Homes • Advance Net-Zero New Commercial Buildings
Transportation	• Expand Transit Options across the County • Build out the Bike and Pedestrian Network • Promote Carpool, Vanpool, and Shared Mobility Options • Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan • Electrify Commercial & Public Vehicle Fleets • Advance Zero-Emission Freight Vehicles • Transition Off-Road Vehicles & Equipment to ZEVs
Waste	• Scale Up Waste Diversion and Circular Economy Programs • Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels
Industry	• Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels
Agriculture	• Amp up Alternative Manure Management Program in Livestock & Poultry Operations • Plow the Way to Zero-Emission Agricultural Equipment
Working and Natural Lands	• Grow the Urban Tree Canopy

Table 6.C: Reduction in Fossil Fuel Combustion and Related Co-Pollutant Reductions in the Scenarios in the CCAP-A

Sectors	Base Year	BAU (2050)	BAP (2050)	LC (2050)
All Sectors — Energy (MMBtu, millions)	151	191	155	84
Cumulative MMBtu of fossil fuels combusted (millions) (2021–2025)	–	4,873	3,991	2,254
Particulate matter released ($PM_{2.5}$ MT)	563	15,661	14,515	7,515
Particulate matter released (PM_{10} MT)	34,225	1,212,172	805,413	574,100
NO_X released (MT)	9,533	220,043	206,304	116,870
SO_2 released (MT)	2,421	84,998	56,550	40,216
VOCs released (MT)	7,817	205,261	197,245	99,918
CO (MT)	84,693	2,235,955	2,129,254	1,119,520
HC (MT)	3,880	85,149	79,239	52,480

Source: SSG (2025).
BAP = business as planned
BAU = business as usual
CCAP-A = Comprehensive Climate Action Plan Analysis
CO = carbon monoxide
HC = hydrocarbons
MMBtu = million British thermal units
MT = metric tons
NO_X = nitrogen oxides
$PM_{2.5}$ = particulate matter less than 2.5 microns in size
PM_{10} = particulate matter less than 10 microns in size
SO_2 = sulfur dioxide
VOCs = volatile organic compounds

6.3.1.3 Impacts

The transition to a low-carbon future in Fresno County is projected to reduce not only GHG emissions, but also co-pollutants (e.g., particulate matter, NO_X, and VOCs). Table 6.C summarizes projected emissions across multiple scenarios. Compared to the business as usual (BAU) and business as planned (BAP) scenarios, the Low-Carbon Scenario shows substantial declines in fossil fuel use and associated co-pollutants, especially $PM_{2.5}$ and NO_x, which are major contributors to air-related health conditions.[42]

Reducing outdoor air pollution not only improves public health but also delivers significant economic benefits by reducing medical expenses and minimizing productivity losses. To estimate these benefits, the EPA Co-Benefits Risk Assessment (COBRA) model was used to quantify health-related cost savings associated with reduced $PM_{2.5}$ emissions under the Low-Carbon Scenario (Figure 6-6).

The modeling estimates millions of dollars in annual benefits from avoided premature deaths, fewer asthma-related emergency room visits, reduced respiratory symptoms, and fewer missed work and school days. Among these outcomes, reduced asthma incidence and fewer lost school days represent particularly large health gains for Fresno County residents.

These health improvements are especially important in areas of Fresno County where outdoor air pollution is most severe. Figure 6-7 shows projected reductions in $PM_{2.5}$ concentrations by 2050 under the Low-Carbon Scenario, alongside current census tracts with high traffic proximity and disadvantaged status. As illustrated, reductions in $PM_{2.5}$ concentrations would have direct benefits to residents in disadvantaged communities. These gains reflect the cumulative effect of actions across multiple sectors (e.g., transportation, energy, and industry).

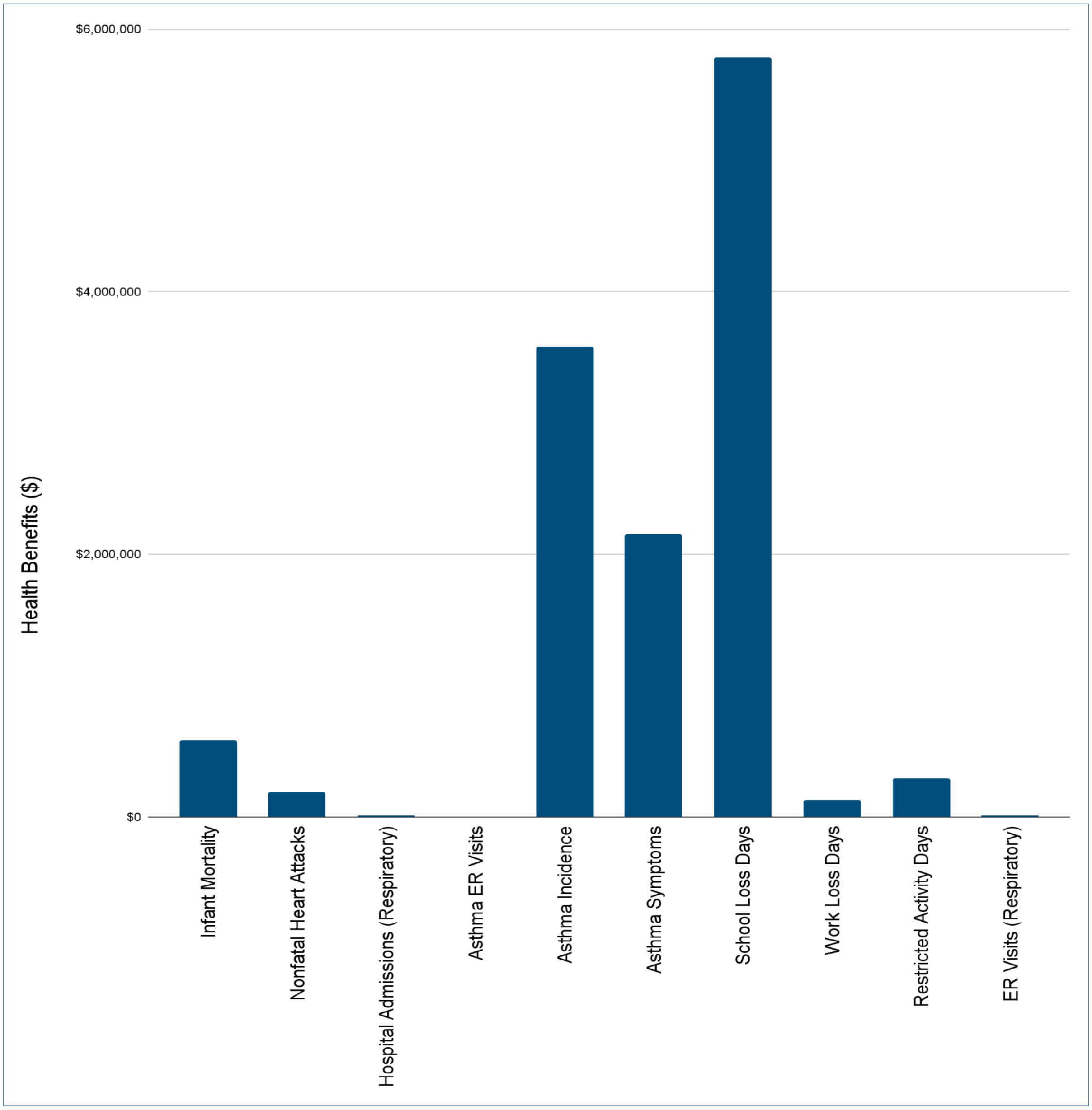
Several measures stand out for their significant co-pollutant reduction potential. As shown in Table 6.D, actions aimed at cleaning up wastewater facilities and decarbonizing industrial operations account for some of the largest overall reductions in $PM_{2.5}$ and NO_x (two pollutants strongly associated with cardiovascular disease, asthma, and premature death). These two measures alone are estimated to eliminate over 110 million pounds of $PM_{2.5}$ and nearly 120 million pounds of NO_x by 2050.[43] Similarly, actions to transition freight and agricultural equipment to zero-emission technologies yield some of the highest cumulative reductions across multiple pollutants. Although these benefits increase significantly after 2030, their long-term impact underscores the importance of investing early in sectors where pollution burdens are disproportionately high.

Local Air Quality Impacts of Dairy Digesters. Although agricultural measures in the CCAP-A offer significant GHG and co-pollutant reduction potential, certain strategies, particularly the use of dairy digesters, can produce localized air quality impacts depending on how they are implemented. According to CARB's emissions matrix, biogas utilization methods (e.g., reciprocating engines and flaring) are associated with higher emissions of NO_x, VOCs, CO, and other pollutants, while pipeline injection and fuel cells result in significantly lower emissions across all criteria pollutants.[44]

42 The methodology, activity data, and emission factors used to calculate these values are detailed in the Data, Methods, and Assumptions (DMA) Manual in Appendix C.

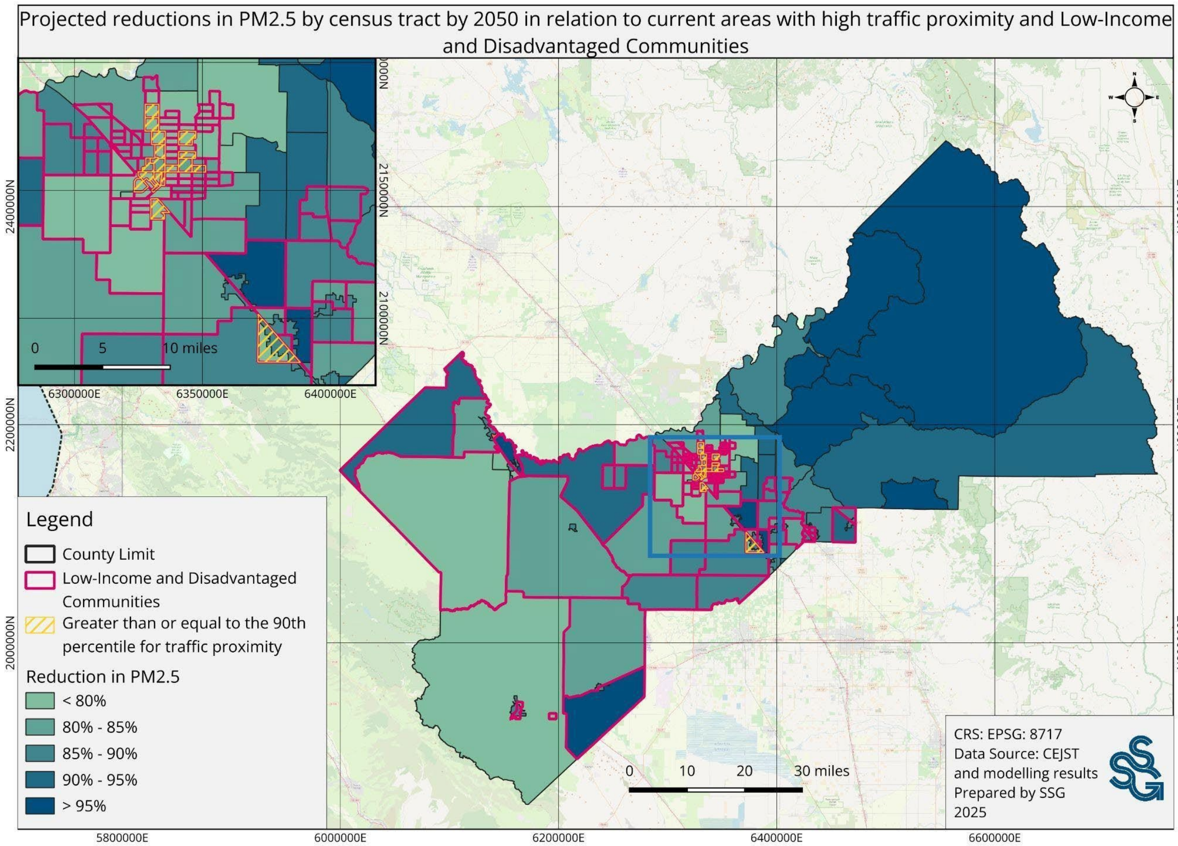
43 The methodology, activity data, and emission factors used to calculate these values are detailed in the Data, Methods, and Assumptions (DMA) Manual in Appendix C.

44 California Air Resources Board (CARB). 2018. Dairy Digester Emissions Matrix and Assumptions. Website: https://ww2.arb.ca.gov/resources/documents/dairy-digester-emissions-matrix (accessed September 15, 2025).



Source: SSG (2025). Elaborated using EPA's COBRA tool.

Figure 6-6: Annual Health Benefits in Dollars by Health-Related Indicators in the Low-Carbon Scenario, 2050



Source: SSG (2025).

Figure 6-7: Projected Reductions in $PM_{2.5}$ by Census Tract by 2050 in Relation to Current Areas with High Traffic Proximity and LIDACs in Fresno County in the Low-Carbon Scenario

Table 6.D: CCAP-A Modeled Measures and Co-Pollutant Reduction Impacts in US Tons, 2026–2050

Modeled Actions	Total VOC Emissions Reductions		Total $PM_{2.5}$ Emissions Reductions		Total PM_{10} Emissions Reductions		Total NO_X Emissions Reductions		Total SO_2 Emissions Reductions		Total CO Emissions Reductions	
	2026 to 2030	2031 to 2050	2026 to 2030	2031 to 2050	2026 to 2030	2031 to 2050	2026 to 2030	2031 to 2050	2026 to 2030	2031 to 2050	2026 to 2030	2031 to 2050
Build Net-Zero New Homes	1.8	62.1	2.1	76.2	2.1	77.0	19.2	543.4	3.7	91.3	500.0	500.0
Advance Net-Zero New Commercial Buildings	0.0	673.2	0.4	12.7	208.1	5,833.8	9.8	250.1	14.4	404.6	420.0	11,235.0
Bundle Solar + Savings for Fresno Homes	500.0	636.9	3.6	27.9	1,110.1	6,239.6	42.7	238.7	77.0	432.9	1,500.0	10,000.0
Green-up Commercial Buildings	1,000.0	2,353.1	5.4	103.2	1,662.7	22,661.8	59.8	881.4	115.4	1,572.3	2,000.0	38,500.0
Expand Transit Options across the County	1,000.0	201.6	26.6	429.4	26.8	431.9	263.2	4,343.3	4.0	55.8	1,000.0	8,840.6
Build out the Bike and Pedestrian Network	1,500.0	3,319.3	17.3	140.4	2,457.6	18,304.8	210.2	2,046.6	173.8	1,286.5	3,500.0	56,500.5
Promote Carpool, Vanpool, and Shared Mobility Options	2,000.0	1.9	1.5	4.4	1.6	4.4	7.5	36.0	0.5	1.0	0.0	69.1
Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan	6,000.0	62.1	2.1	76.2	2.1	77.0	19.2	543.4	3.7	91.3	500.0	500.0
Electrify Commercial & Public Vehicle Fleets	3,500.0	52.2	2.9	50.7	2.9	50.7	22.7	441.3	0.5	7.8	0.0	500.0
Advance Zero-Emission Freight Vehicles	9,500.0	1,344.9	173.1	1,408.5	177.8	1,439.2	593.3	4,990.2	41.1	337.0	500.0	9,297.8
Transition Off-Road Vehicles & Equipment to ZEVs	7,500.0	638.0	1.8	28.8	698.6	6,444.6	29.5	248.0	48.5	447.2	1,000.0	11,500.0
Clean up Wastewater Facilities	14,500.0	8,695.3	28.7	398.2	5,748.5	91,865.8	1,155.8	13,408.3	396.3	6,368.8	9,500.0	90,968.3
Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels	1,000.0	35,419.5	43.2	1,781.0	51.8	2,128.3	687.0	27,797.4	0.7	46.1	7,500.0	316,549.9
Scale Up Waste Diversion and Circular Economy Programs	0.0	367.8	71.6	432.6	73.6	438.2	405.4	3,216.5	21.2	94.7	1,000.0	4,921.7

Source: SSG (2025).

A 2024 study analyzing 55 California dairy digesters found that, although digesters substantially reduce methane emissions, they can increase emissions of co-pollutants like NO_x, ammonia (NH_3), VOCs, and hydrogen sulfide (H_2S) depending on how the biogas is processed. These emissions can worsen local air quality and lead to 50–80% higher health-related damages per dairy, particularly when biogas is used in combustion-based systems.[45] The study also highlights that most dairy digesters in California are located in low-income, rural areas (e.g., the San Joaquin Valley) raising concerns about disproportionate exposure to air pollution among LIDACs.

To mitigate these co-harms while maximizing climate benefits, Fresno County should prioritize low-emission digester technologies (e.g., pipeline injection and fuel cells), which have been shown to produce fewer criteria pollutant emissions than combustion-based systems. Additionally, given that many digesters are sited in low-income, rural communities, it is important to incorporate community-level health considerations and ensure that local exposure to air pollution is minimized through careful siting and regulatory oversight.

6.3.2 Indoor Air Quality

6.3.2.1 Observations

Most people in the United States spend the majority of their lives inside; an estimated 90% of daily life occurs indoors. However, indoor environments can be significantly more polluted than outdoor spaces, with concentrations of airborne pollutants up to 2 to 5 times higher, especially in poorly ventilated buildings.[46] This reality is particularly concerning for the most vulnerable populations, including young children, older adults, and individuals with preexisting health conditions (e.g., asthma, chronic obstructive pulmonary disease [COPD], or cardiovascular disease) who may spend even more time indoors due to caregiving, disability, or extreme heat and wildfire smoke events that discourage outdoor activity.

A growing body of evidence highlights the major contributors to indoor air pollution, especially in homes and buildings that rely on fossil fuel-powered appliances. Common indoor pollutants include $PM_{2.5}$, NO_2, CO, VOCs, and methane (CH_4), many of which are released through everyday appliances (e.g., gas stoves, ovens, space heaters, and hot water heaters).[47]

As of 2022, 55% of households in Fresno County rely on utility gas as their primary heating fuel compared to approximately 34% that rely on electricity. An additional 5% used bottled gas, and 1% relied on wood, highlighting the continued reliance on combustion-based systems in residences.[48] This heating fuel profile suggests that fossil fuel appliances remain widespread across Fresno's housing stock, particularly in older homes. These appliances emit NO_2, CO, and $PM_{2.5}$ directly into the indoor environment during use, especially when not paired with effective ventilation systems like

45 Jiang, Jia, Yiting Li, and Michael Kleeman. 2024. *Air Quality and Public Health Effects of Dairy Digesters in California*. Website: https://doi.org/10.1016/j.atmosenv.2024.120588 (accessed September 15, 2025).

46 United States Environmental Protection Agency (EPA). *Indoor Air Quality*. Website: https://www.epa.gov/indoor-air-quality-iaq (assessed July 2025).

47 Seals, Brady, and Krasner, Andee. 2020. *Gas Stoves: Health and Air Quality Impacts and Solutions*. RMI. https://rmi.org/insight/gas-stoves-pollution-health (assessed July 2025).

48 United States Census Bureau. 2023. *House Heating Fuel, 2022: American Community Survey 5-Year Estimates (Table B25040)*. April.

range hoods or exhaust fans. Methane, the primary component of natural gas, can also leak from appliances even when not in use, exposing residents to both health risks and climate pollutants.[49]

The health risks associated with these pollutants are well documented:

- **Nitrogen Dioxide (NO_2):** Linked to increased respiratory infections, exacerbation of asthma, and the development of chronic respiratory conditions. Children exposed to elevated NO_2 levels in homes with gas stoves are estimated to have a 20% higher risk of developing a respiratory illness.[50] Homes with gas stoves can have NO_2 concentrations that are 50% to 400% higher than those with electric stoves.[51]

- **Carbon Monoxide (CO):** A colorless, odorless gas that can be deadly in high concentrations. Even low-level exposure can lead to headaches, fatigue, nausea, and dizziness, especially in poorly ventilated homes.[52]

- **Fine Particulate Matter ($PM_{2.5}$):** These particles can penetrate deep into the lungs and enter the bloodstream, contributing to heart disease, respiratory issues, and cognitive decline.

- **VOCs (e.g., benzene, toluene, hexane):** Emitted from unburned natural gas and combustion, many VOCs are known or suspected carcinogens and can irritate the eyes, skin, and respiratory tract.[53]

- **Methane (CH_4):** Although not directly toxic, methane leaks contribute to climate change and often co-occur with other dangerous VOCs. Studies in California and Massachusetts have shown that methane can leak from stoves and ovens even when turned off, and that unburned gas contains dozens of hazardous air toxics.[54,55]

---

49 Seals, Brady. 2020. "Indoor Air Pollution: The Link between Climate and Health." RMI. May. Website: https://rmi.org/indoor-air-pollution-the-link-between-climate-and-health (accessed August 2025).

50 Lin, Weiwei, Bert Brunekreef, and Ulrike Gehring. 2013. *Meta-Analysis of the Effects of Indoor Nitrogen Dioxide and Gas Cooking on Asthma and Wheeze in Children. International Journal of Epidemiology* 42, no. 6: 1724–1737. Website: https://doi.org/10.1093/ije/dyt150 (accessed August 2025).

51 Seals, Brady, and Krasner, Andee. 2020. *Gas Stoves: Health and Air Quality Impacts and Solutions*. RMI. https://rmi.org/insight/gas-stoves-pollution-health (assessed July 2025).

52 United States Environmental Protection Agency (EPA). 2023. "Nitrogen Dioxide's Impact on Indoor Air Quality." Website: https://www.epa.gov/indoor-air-quality-iaq/nitrogen-dioxides-impact-indoor-air-quality (accessed August 2025).

53 Michanowicz, Drew R., et al. 2022. "Home Is Where the Pipeline Ends: Characterization of VOCs in Natural Gas." *En*vironmental Science & Technology 56, no. 14 (July 19): 10258–10268. Website: https://doi.org/10.1021/acs.est.1c08298 (assessed August 2025).

54 Lebel, Eric D., Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson. 2022. "Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes." *Environmental Science & Technology* 56, no. 4: 2529–2539. Website: https://doi.org/10.1021/acs.est.1c04707 (assessed August 2025).

55 Michanowicz, Drew R., et al. 2022. "Home Is Where the Pipeline Ends: Characterization of Volatile Organic Compounds Present in Natural Gas at the Point of the Residential End User," Environmental Science & Technology 56, no. 14 (July 19): 10258–10268, Website: https://doi.org/10.1021/acs.est.1c08298 (assessed August 2025).

According to one study, the cumulative leakage of methane in United States local gas distribution systems is estimated to be five times greater than what is reported to the EPA.[56] In many homes, odorants added to natural gas for leak detection may be insufficiently concentrated, allowing slow leaks to persist without detection. A 2022 study from Stanford University found that gas stoves leak methane not just during operation but even when turned off.[57] In a separate study conducted in Massachusetts, researchers analyzed unburned gas samples from homes and detected 21 hazardous air pollutants, including benzene (a chemical linked to leukemia and other blood disorders) in 95% of samples.[58]

These exposures are not distributed evenly across the population. Residents in low-income and historically underserved communities often face compounding risks due to older or poorly maintained buildings, lack of ventilation, higher occupant density, and the use of gas stoves or ovens for heating when central systems are broken or unaffordable. These conditions are more common in LIDAC communities, where housing upgrades may be less accessible and respiratory illness rates and pollutant exposure are often higher.[59] In Fresno County, where asthma emergency department visits are among the highest in the state, indoor air quality concerns intersect with housing-related burdens. As of 2023, approximately 44 asthma-related emergency room visits occurred per 10,000 people in Fresno, compared to a statewide average of 34.[60] This elevated rate reflects the region's heightened vulnerability to respiratory illness, driven in part by housing and indoor environmental conditions. Inadequate kitchen facilities, poor ventilation, and aging infrastructure can worsen exposure to indoor air pollutants, especially in households that rely on gas-powered appliances. Figure 6-8 (provided on the following page) visualizes the overlap between asthma prevalence and housing inadequacy, highlighting communities facing multiple layers of risk.

Figure 6-8 highlights where asthma rates and poor housing conditions overlap across Fresno County. The highest-risk areas (i.e., the north-central and southeastern parts of the county) are where improvements to indoor air quality could have the biggest health benefits.

---

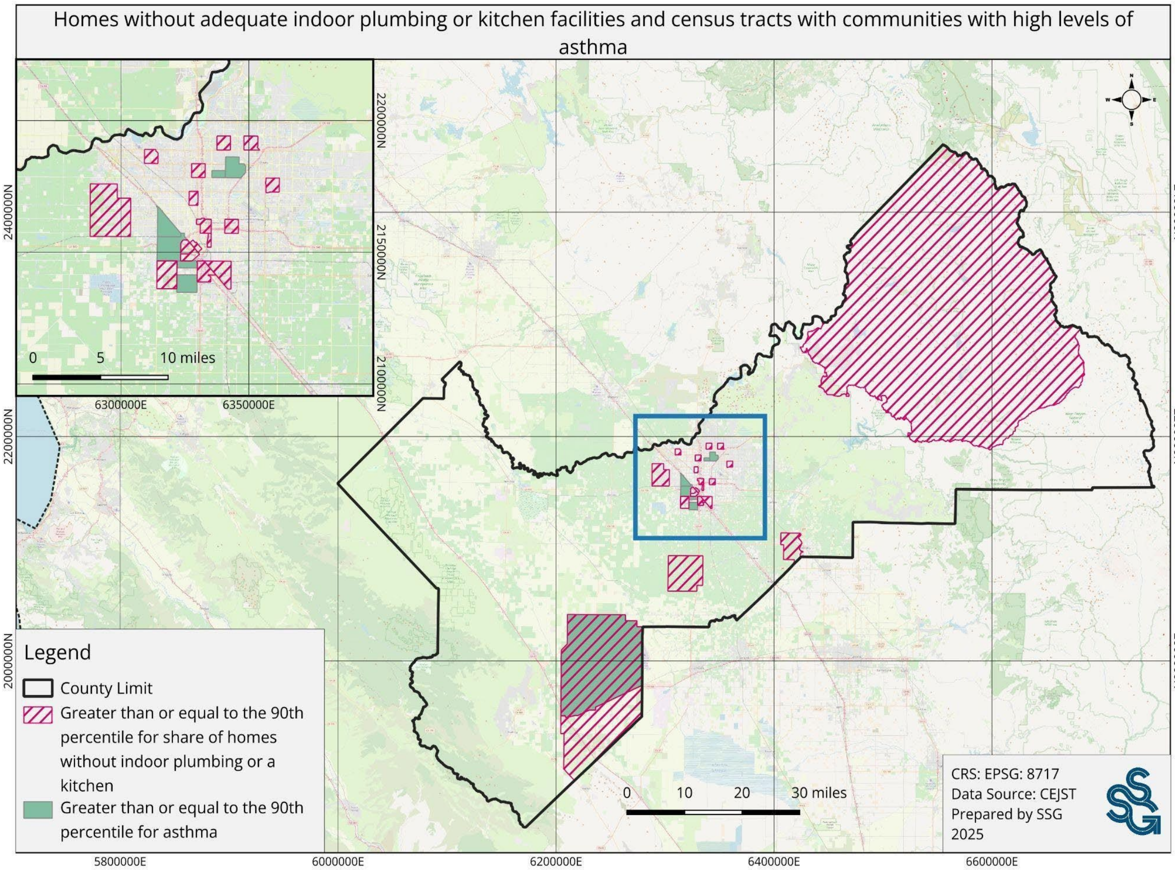
56 Weller, Zachary D., Steven P. Hamburg, and Joseph C. von Fischer. 2020. "A National Estimate of Methane Leakage from Pipeline Mains." Environmental Science & Technology 54, no. 14 (2020): 8958–8967. Website: https://doi.org/10.1021/acs.est.0c00437 (assessed August 2025).

57 Lebel, Eric D., Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson. 2022. "Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes." *Environmental Science & Technology* 56, no. 4: 2529–2539. Website: https://doi.org/10.1021/acs.est.1c04707 (assessed August 2025).

58 Michanowicz et al., "Home Is Where the Pipeline Ends."

59 Seals, Brady, and Krasner, Andee. 2020. *Gas Stoves: Health and Air Quality Impacts and Solutions*. RMI. https://rmi.org/insight/gas-stoves-pollution-health (assessed July 2025).

60 "Asthma Emergency Department Visit Rate (Age-Adjusted) per 10,000 – by County, 2023." Public Health Institute. Website: https://trackingcalifornia.org/topics/asthma#gsc.tab=0 (accessed 2025).



Source: SSG (2025).

Figure 6-8: Map of Asthma Prevalence and Housing Inadequacy in Fresno County

6.3.3 Actions That Reduce Indoor Air Pollution and GHG Emissions Simultaneously in Fresno County

Electrifying household appliances and improving building ventilation can reduce exposure to indoor pollutants and deliver climate benefits. Measures (e.g., phasing out gas appliances, offering incentives for heat pumps and induction stoves, and improving weatherization in older homes) can create healthier indoor environments, especially in households with elevated asthma or respiratory risk. Table 6.E lists GHG emissions reduction measures that impact air pollution in the region.

Table 6.E: Overview of GHG Reduction Measures in the CCAP-A that Will Reduce Indoor Air Pollution

Sectors	Measures
Buildings/Electricity Generation	● Bundle Solar + Savings for Fresno Homes ● Green-Up Commercial Buildings ● Building Net Zero New Homes ● Advance Net-Zero New Commercial Buildings
Transportation	● Electrify Commercial & Public Vehicle Fleets

Source: SSG (2025).
CCAP-A = Comprehensive Climate Action Plan Analysis
GHG = greenhouse gas

6.3.3.1 Impacts

Reducing indoor air pollution depends in part on shifting away from fossil fuel-based appliances (e.g., gas stoves and furnaces) that emit harmful pollutants inside buildings. Table 6.F presents the number of residential units using gas versus electric appliances for cooking and drying under each scenario in 2050. In the LC Scenario, a complete shift away from gas appliances is achieved, with 100% electrification for both cooking and clothes drying. Table 6.G illustrates how commercial building energy use is projected to change by 2050 under different implementation scenarios. Under an LC Scenario, energy demand from natural gas falls dramatically and is replaced largely by cleaner electricity. These shifts can lead to significant indoor air quality improvements in public and commercial spaces. Finally, Table 6.H highlights how natural gas use and associated combustion emissions are projected to change in both the residential and commercial building sectors. The dramatic reductions in the LC Scenario reflect the decarbonization of space and water heating across both sectors.

Table 6.F: Number of Dwelling Units with Gas and Electric Appliances in 2050 in the BAU, BAP, and LC Scenarios

Appliances	Business-as-Usual	Business-as-Planned	Low-Carbon
Using gas for cooking	44,656	44,656	0
Using electricity for cooking	327,478	327,478	372,134
Using gas for clothes dryers	18,607	18,607	0
Using electricity for clothes dryers	353,528	353,528	372,134

Source: SSG
BAP = business as planned	LC = low-carbon
BAU = business as usual

Table 6.G: Energy Used by Fuel Source in Commercial Buildings in 2050 in the BAU, BAP, and LC Scenarios

Fuel Type	Business-as-Usual (MMBtu)	Business-as-Planned (MMBtu)	Low-Carbon (MMBtu)
Natural gas or renewable natural gas	5,461,987	5,342,096	31,159
Local and Grid Electricity	13,959,555	12,506,049	7,584,017
Petroleum Products	124,344	121,156	176
Propane	391,751	126,878	996
Solar	11,862	11,082	97
Hydrogen	2,798	2,798	0

Source: SSG
BAP = business as planned
BAU = business as usual
LC = low-carbon
MMBtu = million British thermal units

Table 6.H: Natural Gas Emissions from Residential and Commercial Buildings in 2050 in the BAU, BAP, and LC Scenarios

Sector	Business-as-Usual (tons)	Business-as-Planned (tons)	Low-Carbon (tons)
Residential	8,634,409	8,121,352	2,352
Commercial	5,461,987	5,342,096	31,159

Source: SSG
BAP = business as planned
BAU = business as usual
LC = low-carbon

6.3.4 Physical and Emotional Well-Being

6.3.4.1 Observations

Physical and emotional well-being are critical components of public health that intersect closely with transportation, land use, and climate policy. Regular physical activity improves cardiovascular health, reduces the risk of premature death and chronic illnesses, and contributes to improved mood and happiness and reduced anxiety. [61,62]

Fresno County faces notable challenges in this area. According to the 2024 County Health Rankings, 25% of adults in Fresno County report no leisure-time physical activity, a figure higher than the California state average of 20%. Additionally, 21% of adults in Fresno report being in poor or fair health, compared to 16% statewide and 14% nationally. Mental health indicators also show

61 World Health Organization. 2022. *Physical Activity*. Last modified October 5. Website: https://www.who.int/news-room/fact-sheets/detail/physical-activity.

62 Mayo Clinic Staff. *Exercise: 7 Benefits of Regular Physical Activity*. Mayo Clinic. Website: https://www.mayoclinic.org/healthy-lifestyle/fitness/in-depth/exercise/art-20048389 (accessed June 20, 2025).

disparities: residents report an average of 5.2 poor mental health days per month, above the state and national averages of 4.7 and 5.1 days, respectively.[63]

Chronic health conditions are another important indicator of physical well-being. These include COPD, emphysema or chronic bronchitis, heart disease, diabetes, chronic kidney disease, and high body mass index (BMI). According to data from the Centers for Disease Control and Prevention (CDC), in 2018, the share of residents reporting at least one of these conditions was 41% in the County. Such conditions elevate the risk of serious illness, contribute to higher rates of hospitalization, and often require prolonged recovery periods and increased healthcare support.[64]

Premature death is another area of concern. Fresno County experiences 8,500 years of potential life lost before age 75 per 100,000 people, higher than both the state average (6,400) and the national average (8,000).[65]

Regular physical activity is widely recognized for its benefits to physical and mental health. It can lower the risk of chronic disease, improve fitness, and support emotional well-being by reducing anxiety and increasing happiness. Communities designed with compact urban form and strong public transit networks tend to foster more physical activity and are associated with lower rates of hypertension.[66] Individuals who shift from driving to transit are likely to increase their daily physical activity by 8 to 33 minutes.[67]

Children also benefit from active travel; those who walk or bike to school have been shown to have higher fitness levels than those who are driven.[68] Similarly, adults who commute by walking or cycling are also associated with significantly lower risk of premature mortality. Research indicates

---

63 University of Wisconsin Population Health Institute. 2025. *County Health Rankings & Roadmaps: California – Fresno County.* 2025. Website: https://www.countyhealthrankings.org/health-data/california/fresno?year=2024 (accessed July 2025).

64 ArcGIS Hub. 2020. Selected Chronic Conditions by U.S. County, 2018. Website: https://hub.arcgis.com/apps/cdcarcgis::selected-chronic-conditions-by-u-s-county-2018-1/explore (accessed August 2025).

65 University of Wisconsin Population Health Institute. 2025. *County Health Rankings & Roadmaps: California – Fresno County.* 2025. Website: https://www.countyhealthrankings.org/health-data/california/fresno?year=2024 (accessed July 2025).

66 Ewing, Reid and Richard Kreutzer. 2006. Understanding the Relationship Between Public Health and the Built Environment. Prepared for the LEED-ND Core Committee, May. Website: https://www.usgbc.org/sites/default/files/public-health-built-environment.pdf (accessed July 2025).

67 Chris Rissel, Nada Cura, Mark Greenaway, Adrian Bauman. 2012. "Physical Activity Associated with Public Transport Use—A Review and Modelling of Potential Benefits." International Journal of Environmental Research and Public Health 9, no. 7 (2012): 2454–2478. Website: https://doi.org/10.3390/ijerph9072454 (accessed July 2025)

68 Voss, Christine and Gavin Sandercock. 2010."Aerobic fitness and mode of travel to school in English schoolchildren." Medicine & Science in Sports & Exercise 42, no. 2 (2010):281–7. Website: https://doi.org/10.1249/mss.0b013e3181b11bdc (accessed July 2025).

that people who regularly engage in active commuting have a 30–40% lower risk of early death,[69,70] with one study finding a 40% reduction in all-cause mortality among individuals who cycle to work.[71] These health benefits are especially important for populations already living with chronic conditions.[72]

Access to parks and green space further supports physical activity. Residents in neighborhoods with ample green space are up to three times more likely to be physically active and 40% less likely to be overweight compared to those with limited access.[73] Seniors living near walkable green spaces may also experience longer life expectancy.[74]

6.3.4.2 Potential Co-Harms

Although encouraging walking and biking has strong public health benefits, it can introduce potential risks if not paired with safe infrastructure and pollution mitigation strategies. Residents who walk or bike along busy roads may be exposed to elevated levels of air pollution. Additionally, inadequate pedestrian and cycling infrastructure increases the risk of injury.

These risks can be mitigated. Research shows that the health benefits of active transportation far outweigh the risks from air pollution, even in polluted environments.[75] Safety also improves as walking and biking become more common; studies have shown that doubling the number of pedestrians in an area reduces the risk of injury per person by about one-third.[76] As well, planting

---

69 Andersen, Lars Bo, et al. 2000. “All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work.” Archives of Internal Medicine 160 (2000):1621–8. Website: https://doi.org/10.1001/archinte.160.11.1621 (accessed July 2025).

70 Matthews, Charles E., et al. 2007. “Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women.” American Journal of Epidemiology 165 (2007):1343-50. Website: https://doi.org/10.1093/aje/kwm088 (accessed July 2025).

71 Andersen, et al., 2000. “All-Cause Mortality and Physical Activity.”

72 Oregon Health Authority. 2018. “Chronic Diseases among Oregon Adults, by County, 2014-2017.” Public Health Division, Health Promotion and Chronic Disease Prevention section.

73 Commission for Architecture and the Built Environment. n.d. Future Health: Sustainable places for health and well-being. Website: https://www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/future-health-full_1.pdf (accessed August 2025).

74 Bray, R., C. Vakil, and D. Elliot. 2005. Report on Public Health and Urban Sprawl in Ontario: A review of the pertinent literature. Ontario College of Family Physicians.

75 Tainio, Marko, et al. 2016. “Can Air Pollution Negate the Health Benefits of Cycling and Walking?” Preventive Medicine 87 June: 233–36. Website: https://doi.org/10.1016/j.ypmed.2016.02.002 (accessed August 2025).

76 Jacobsen, Paul L. 2003. “Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling.” Injury Prevention 9, no. 3 (2003): 205–209. Website: https://doi.org/10.1136/ip.9.3.205 (accessed August 2025).

vegetation barriers along high-traffic corridors can reduce exposure to air pollution as plants capture air pollution particulates on their leaves.[77,78]

6.3.4.3 Actions That Increase Physical and Emotional Well-Being and Reduce GHG Emissions Simultaneously in Fresno County

The following Table 6.I provides an overview of GHG reduction measures in the CCAP-A that would be expected to support increased physical and emotional well-being for the residents and community members of Fresno County. The corresponding impacts of these measures are further described below.

Table 6.I: Overview of GHG Reduction Measures in the CCAP-A that may Support Increased Physical and Emotional Well-Being

Sectors	Measures
Transportation	• Expand Transit Options across the County • Build out the Bike and Pedestrian Network

6.3.5 Impacts

Residents of Fresno County are projected to experience significant increases in active transportation under the LC Scenario compared to BAU and BAP. By 2050 (Table 6.J), the total number of active miles traveled annually, including both walking and biking, is expected to reach nearly 147.5 million miles, more than double the projected total under BAU. This includes over 57 million hours spent walking and more than 4.3 million hours spent cycling each year, reflecting a 121% increase in active miles from the BAU baseline. These shifts are driven by land use, transit, and infrastructure investments that make walking, biking, and transit more accessible and appealing across the county.

Table 6.J: Indicators of Physical and Emotional Well-Being in the CCAP-A Scenarios

Sectors	Business-as-Usual	Business-as-Planned	Low-Carbon
Yearly active miles (2050)	66,611,992	133,223,983	147,479,246
% Improvement from BAU	NA	100%	121%
Annual number of hours spent walking	26,592,850	53,185,700	57,080,307
Annual number of hours spent cycling[1]	1,162,146	2,324,293	4,369,379

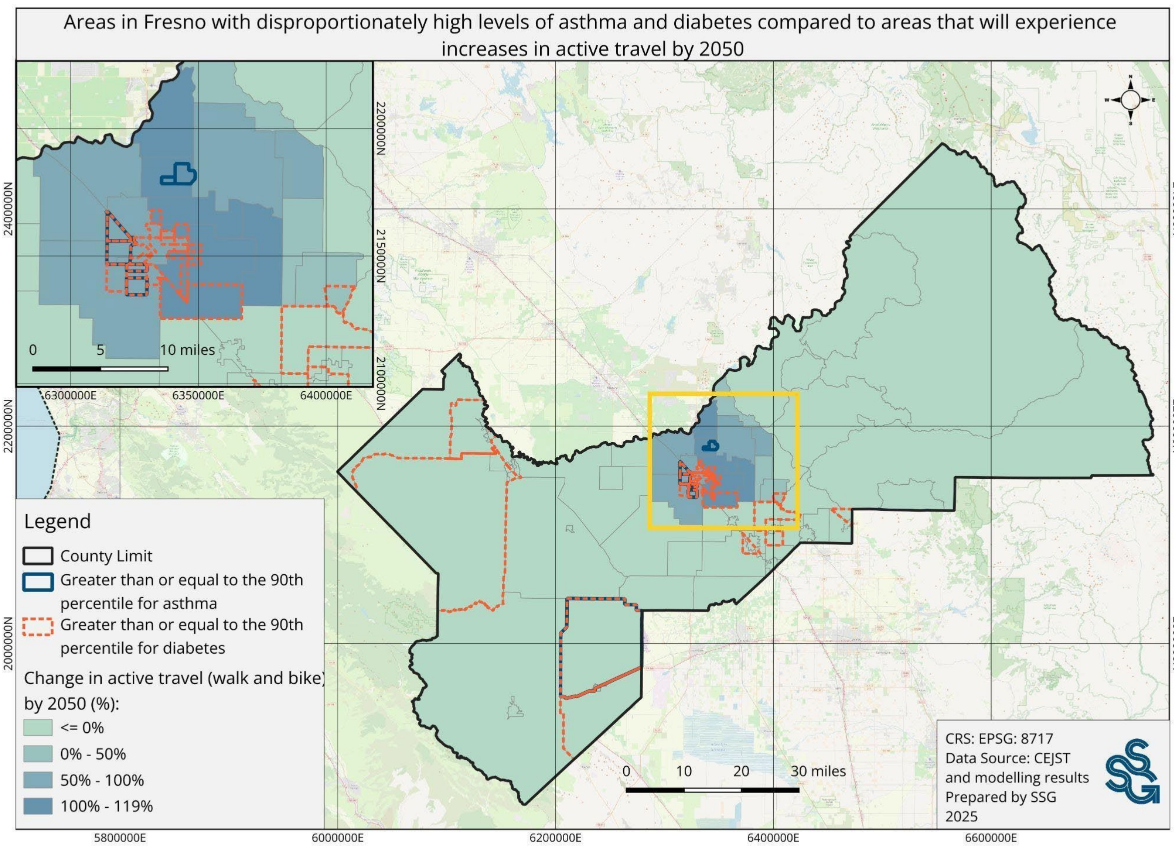
Source: SSG (2025).
[1] This calculation assumes a 2.4 mph (4 km/hr) walking rate and a 9 mph (15 km/hr) cycling rate.
BAU = business as usual
CCAP-A = Comprehensive Climate Action Plan Analysis
km/hr = kilometers per hour
mph = miles per hour

---

[77] Khan, Aysha. 2022. "Plants by School Playgrounds Protect Kids from Road Pollution, Study Finds." NextCity, August. Website: https://nextcity.org/urbanist-news/plants-by-school-playgrounds-protect-kids-from-road-pollution-study-finds (accessed August 2025).

[78] United States Environmental Protection Agency (EPA). 2017. "Living Close to Roadways: Health Concerns and Mitigation Strategies." Last modified January 10, 2017. Website: https://www.epa.gov/science matters/living-close-roadways-health-concerns-and-mitigation-strategies (accessed August 2025).

These benefits are not expected to be distributed evenly across the county. Figure 6-9 maps the projected percentage change in active transportation person-trips (walking and biking) by 2050 under the LC Scenario, relative to the BAP. The map uses travel modeling results (measured in person-trips) to identify where increases or decreases in active travel are likely to occur. Results show that central parts of Fresno County, including areas within the City of Fresno, are expected to experience the largest increases in active travel, in the range of 50% to over 100%. In contrast, some outer and rural areas are projected to see smaller increases or no change. The map also highlights where these changes intersect with existing public health burdens, specifically, census tracts with disproportionately high rates of asthma and diabetes. Understanding where health burdens coincide with projected increases in active travel can help guide investments in walking, biking, and transit infrastructure to support public health benefits where they may be most impactful.



Source: SSG (2025).

Figure 6-9: Projected Change in Active Travel (Walk + Bike) and Overlapping High Rates of Asthma and Diabetes (2050, LC vs. BAP)

6.4 CO-BENEFITS AND CO-HARMS: ECONOMIC PROSPERITY

Actions that reduce emissions can also play a major role in helping revitalize local economies across Fresno County and put the region on a path of economic prosperity for years to come. In addition to direct benefits (e.g., job creation and reduced energy costs) jurisdictions that have a low-emission, low-cost energy supply and supportive policies for reducing GHG emissions will be well positioned to attract new businesses and encourage business expansion.

6.4.1 Employment

6.4.1.1 Observations

Fresno County's economy presents a nuanced picture. The population has shown steady growth, reaching approximately 1,019,900 in 2023, up from 1,017,100 in 2022.[79] However, the region continues to experience persistent economic challenges. As of June 2025, the unemployment rate stood at 8.7%, one of the highest among California counties.[80] Despite this, the local economy has shown signs of resilience. Fresno County's gross domestic product (GDP) increased from $56.2 billion in 2022 to approximately $60.2 billion in 2023.[81] This indicates that while regional economic output is growing, job creation has not kept pace and highlights the importance of climate-aligned investments that can generate high-quality local employment while advancing decarbonization goals.

Fresno County is projected to see continued population growth and economic development over the coming decades, trends that will shape local labor markets and energy needs. As the region transitions toward a low-carbon future, clean energy and climate action investments will create new employment opportunities while also reshaping existing roles. The shift from a fossil fuel-based system to one rooted in electrification and renewable energy will require sustained investments in infrastructure, ranging from building retrofits and grid modernization to public transit expansion and zero-emission vehicle (ZEV) deployment.

These changes are expected to impact the workforce in four main ways:

- **Jobs Created:** New positions will emerge in clean energy generation, energy efficiency services, electric vehicle manufacturing and support, active transportation infrastructure, and utility-scale solar and battery storage installation.

- **Jobs Shifted:** Some workers will move from carbon-intensive sectors (e.g., gas-powered vehicle maintenance, fossil fuel infrastructure) into growing clean sectors like heat pump installation, high-efficiency envelopes, and renewable generation.

- **Jobs Phased Out:** Certain occupations (e.g., internal combustion engine mechanics and fossil fuel distribution workers) may decline as clean technologies become the norm.

---

79 United States Census Bureau. 2025. Resident Population in Fresno County, CA - Population and Housing Unit Estimates. Website: https://www.census.gov/programs-surveys/popest.html (accessed August 2025).

80 California Employment Development Department (EDD). 2025. Fresno County Unemployment Rate and Labor Force Data — June 2025 (Preliminary). Website: https://labormarketinfo.edd.ca.gov/file/lfmonth/frsn$pds.pdf (accessed August 2025).

81 United States Bureau of Economic Analysis (BEA). 2023. Gross Domestic Product (GDP) by County, 2022–2023. Website: https://www.bea.gov/data/gdp/gdp-county-metro-and-other-areas (accessed August 2025).

- **Jobs Transformed:** Many existing roles will adapt to incorporate new skills, tools, and technologies (e.g., electricians working with electric vehicle [EV] chargers or building trades incorporating high-performance envelope standards). It is to be noted that some employment opportunities emerging are not yet possible to anticipate.[82]

Recent analyses of federal climate legislation highlight the scale of job creation enabled by decarbonization. Climate and energy investments integrated into the recently passed Inflation Reduction Act (IRA) could generate more than 9 million person-years of employment across the United States over the next decade, with the majority of those jobs expected in the electricity, transportation, and building sectors.[83]

6.4.1.2 Potential Co-Harms

The transition to a low-carbon economy presents major opportunities for employment, but the benefits will not be evenly distributed without thoughtful design and implementation. Without proactive planning, some workers and industries may experience negative impacts, particularly those in sectors that are expected to phase down, automotive vehicle maintenance and repair, fossil fuel extraction and refinement, and gasoline stations.

LIDACs are particularly vulnerable in this transition. Many frontline workers in emissions-intensive sectors live in areas with long histories of underinvestment and exposure to toxic pollution and hazardous conditions. Without deliberate attention, these communities may not benefit equally from the clean energy transition and could experience further economic insecurity.

Creating well-paying, high-quality jobs should also be a focus to avoid potential economic harms. Currently, approximately one in five utility industry workers are unionized, compared to one in 10 of all American workers.[84] A just transition means investing in jobs that uphold strong labor standards, support union participation and worker organizing, and expand access to training and apprenticeship programs.[85] These efforts should be paired with targeted workforce development and upskilling, short-term transition assistance, and community-based economic development, particularly in regions already experiencing job loss.

---

82 Martínez-Fernández, et al. 2010. Green Jobs and Skills: The Local Labour Market Implications of Addressing Climate Change. Working Document. Paris: OECD. Website: http://www.oecd.org/regional/leed/44683169.pdf (accessed August 2025).

83 Pollin, Robert, et al. 2022. Job Creation Estimates through Proposed Inflation Reduction Act. Amherst, MA: University of Massachusetts Amherst, Political Economy Research Institute (PERI), August.

84 BlueGreen Alliance. “Climate Change & the Clean Economy.” Website: https://www.bluegreenalliance.org/work-issue/climate-change/ (accessed September 2025).

85 BlueGreen Alliance. Solidarity for Climate Action. San Francisco, CA: BlueGreen Alliance, 2019. Website: http://www.bluegreenalliance.org/wp-content/uploads/2019/07/Solidarity-for-Climate-Action-vFINAL.pdf (accessed September 2025).

6.4.1.3 Actions that Increase Employment and Reduce GHG Emissions Simultaneously in Fresno County

Table 6.K below lists GHG emissions reduction measures that have an impact on employment in Fresno County.

Table 6.K: Overview of GHG Reduction Measures in the CCAP-A that Will Increase Employment in Addition to Reducing GHG Emissions

Sectors	Measures
Buildings/Electricity Generation	• Bundle Solar + Savings for Fresno Homes • Green-up Commercial Buildings • Building Net-Zero New Homes • Advancing Net-Zero New Commercial Buildings
Transportation	• Build out the Bike and Pedestrian Network
Waste	• Scale Up Waste Diversion and Circular Economy Programs
Agriculture	• Plow the Way to Zero-Emission Agricultural Equipment
Working and Natural Lands	• Grow the Urban Tree Canopy

6.4.1.4 Impacts

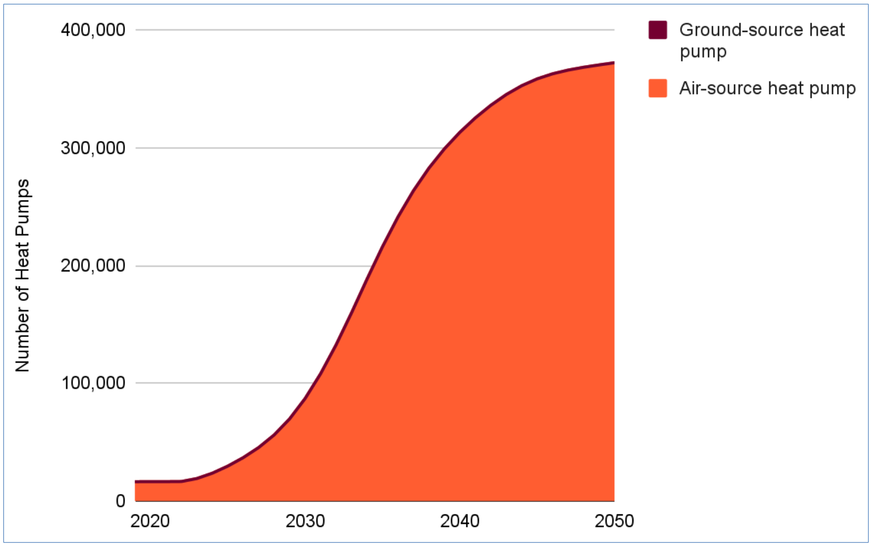
Investments in Fresno County's low-carbon transition are expected to generate new economic opportunities and support local job growth. These include a wide range of primary beneficiaries (e.g., contractors, HVAC suppliers, construction companies, appliance manufacturers, renewable energy developers, car dealerships,[86] and bike shops) and secondary businesses (e.g., banks and credit unions, engineering firms, architects and designers, and insurance companies).

These investments will drive demand across multiple industries, particularly those supporting home upgrades, electrification, and clean transportation. The figures below highlight the scale of transition-related activity through 2050, providing a sense of market opportunity and potential employment demand across key sectors.

As shown on Figure 6-10, nearly 400,000 residential heat pumps are forecast to be installed by 2050, with most of those expected to be air-source models. These numbers effectively represent sales and installation targets for the regional HVAC industry and underscore the need for a robust, well-trained workforce in building electrification.

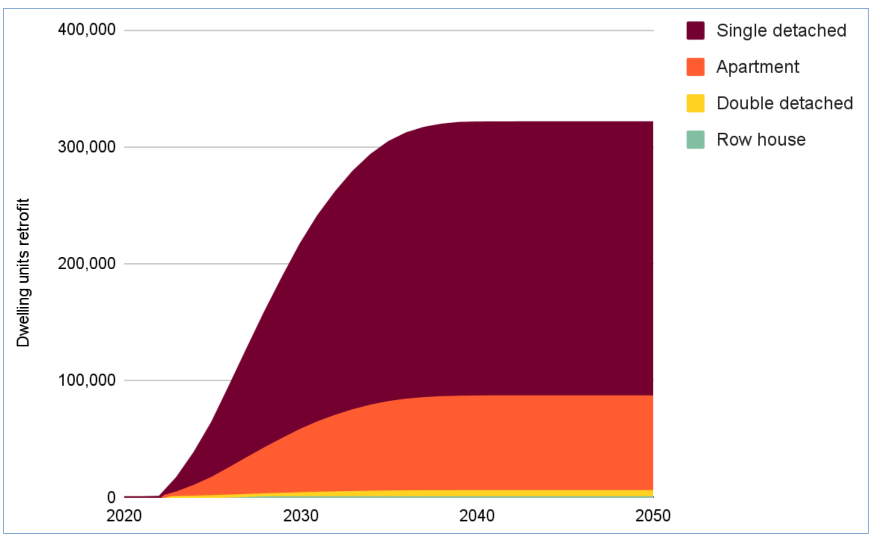
More than 300,000 homes are expected to undergo deep energy retrofits, including upgrades to insulation, windows, lighting, and appliances (Figure 6-11). These projects will fuel ongoing demand for contractors, weatherization crews, electricians, and energy efficiency professionals.

[86] Car dealerships may benefit from increased EV sales but may lose revenue due to decreased maintenance needs of EVs.



Source: SSG (2025).

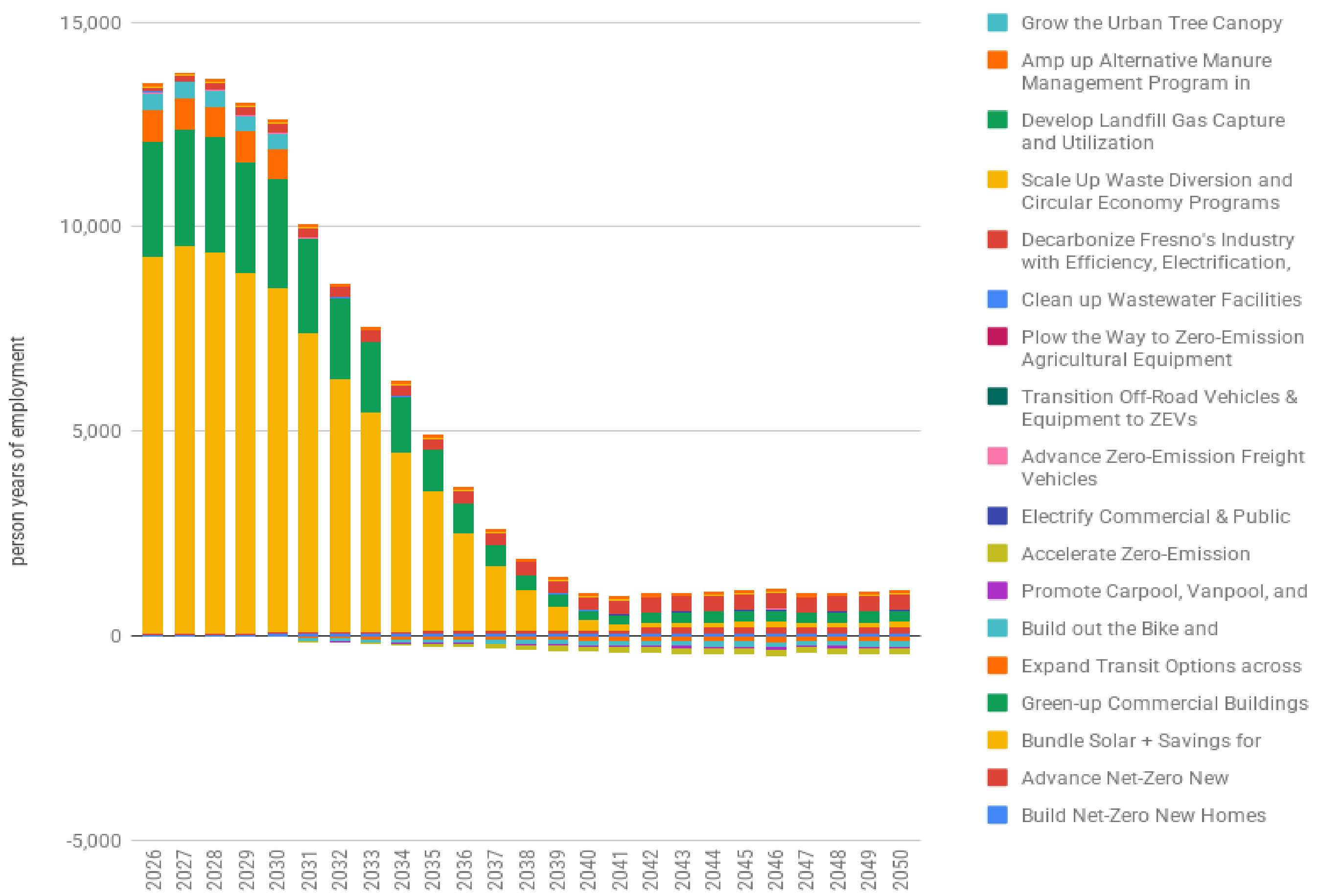
Figure 6-10: Number of Heat Pumps Installed in Residential Buildings in the Low-Carbon Scenario



Source: SSG (2025).

Figure 6-11: Number of Residences (by Unit) Retrofitted in the Low-Carbon Scenario

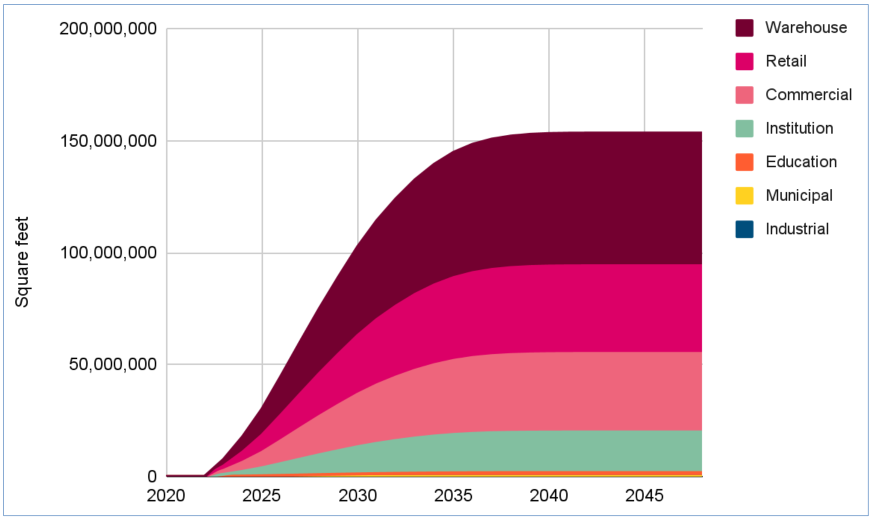
As shown on Figure 6-12, cumulative employment demand spans a wide range of decarbonization measures. The largest job creation opportunities are expected in building retrofits, appliance electrification, solar installation, and industrial efficiency, all of which require long-term investment and skilled labor. Sectors like transportation electrification, waste diversion, and active transit also contribute significantly to job creation over time.



Source: SSG (2025).

Figure 6-12: Person-Years of Employment by GHG Reduction Measure in Fresno County, 2026–2050

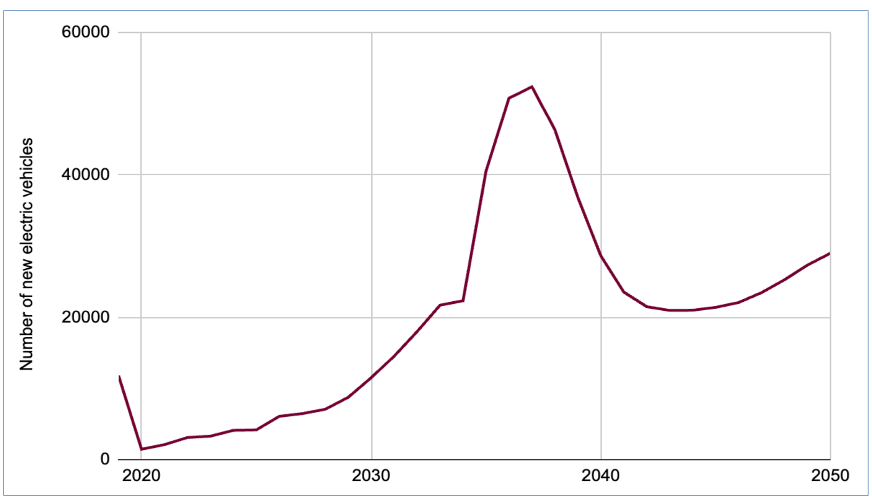
Retrofitting will also expand across commercial, retail, warehouse, and institutional buildings, with projections included in Figure 6-13. These retrofits represent major opportunities for engineering firms, architects, commercial contractors, and facilities teams to help decarbonize Fresno's non-residential building stock.



Source: SSG (2025).

Figure 6-13: Square Footage of Commercial Buildings Retrofitted in the Low-Carbon Scenario

Based on the modelling in the LC scenario, the number of EVs sold in Fresno County is projected to surpass 50,000 new vehicles annually by 2050, representing a dramatic shift in transportation preferences and infrastructure needs (Figure 6-14). This transition will create demand for EV servicing, charging infrastructure development, battery management, utility coordination, and consumer education.



Source: SSG (2025).

Figure 6-14: Number of New EVs in the Low-Carbon Scenario

6.4.2 Financial Energy Savings

6.4.2.1 Observations

A household faces a high energy burden when it spends more than 6% of its income on energy, and a severe burden when spending exceeds 10%.[87] This is a common reality for many lower-income households, particularly those living in older, less-efficient homes. In California, and especially in the Central Valley, energy costs account for a significant share of household budgets due to high temperatures, widespread use of air conditioning, and the prevalence of outdated appliances and poor insulation.[88]

In Fresno County, these pressures are compounded by the region's housing stock, which skews older and less efficient, and by its hot climate, which leads to high cooling loads. Many homes in Fresno County are older or energy-inefficient, contributing to higher energy bills and discomfort for residents. This contributes to elevated energy burdens for many households, particularly renters, seniors, and those living in manufactured or multi-family housing units.[89]

Building out a clean energy system with distributed generation, renewables, microgrids, and storage will not only improve air quality and reduce emissions, it will also increase the economic and energy resilience of Fresno County's communities. By lowering monthly utility costs and reducing dependence on the centralized grid, these improvements allow households to redirect spending to other essential needs, while also helping them better withstand electricity disruptions and extreme weather events.[90]

Fresno County also faces some of the highest household transportation cost burdens in the state, due to long commute distances, sprawl, and limited transit access. Indeed, across the United States, transportation costs often exceed affordable thresholds when housing costs are included, indicating a widespread affordability challenge that Fresno reflects locally.[91] In this context, clean energy and clean transportation solutions can significantly reduce both building- and transportation-related costs for residents.

---

87 United States Department of Energy (DOE). 2022. *How High Are Household Energy Burdens?* Washington, D.C.: Office of Energy Efficiency and Renewable Energy, October.

88 American Council for an Energy-Efficient Economy (ACEEE). 2020. *How High Are Household Energy Burdens?* Washington, D.C.: ACEEE. Website: https://www.aceee.org/research-report/u2006 (accessed July 2025).

89 American Council for an Energy-Efficient Economy (ACEEE). 2016. *Lifting the High Energy Burden in America's Largest Cities: How Energy Effic*iency Can Improve Low-Income and Underserved Communities. Washington D.C.: ACEEE. Website: https://www.aceee.org/sites/default/files/publications/research reports/u1602.pdf (accessed August 2025).

90 Rocky Mountain Institute (RMI). 2021. The Economics of Electrifying Buildings. Boulder, CO: RMI. Website: https://rmi.org/economics-of-electrifying-buildings/ (accessed August 2025).

91 Center for Neighborhood Technology (CNT). n.d. Housing + Transportation (H+T) Affordability Index. Website: https://htaindex.cnt.org (accessed August 2025).

Figure 6-15 illustrates the modeled average household spending on building energy and Figure 6-16 illustrates the modeled average household spending on transportation across the BAP and LC scenarios from 2021 to 2050. In both cases, the LC Scenario demonstrates a steep and sustained drop in household expenditures over time.

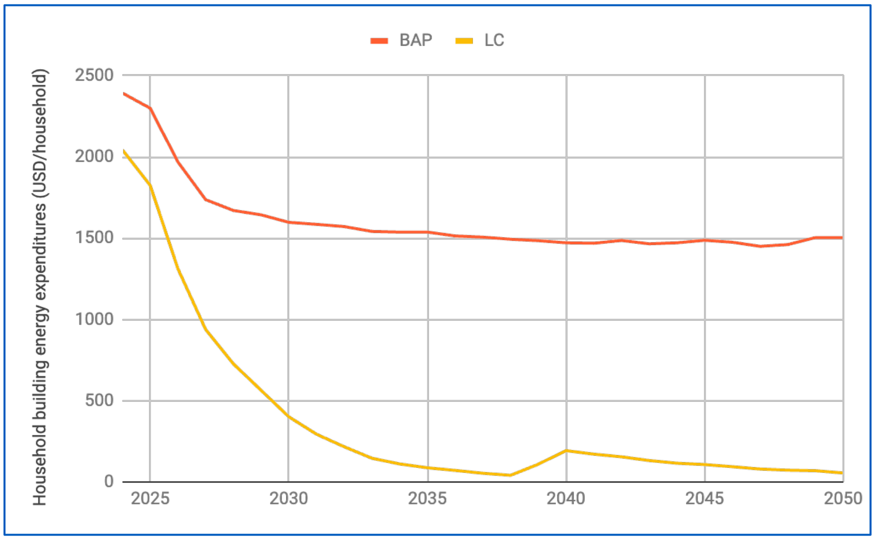
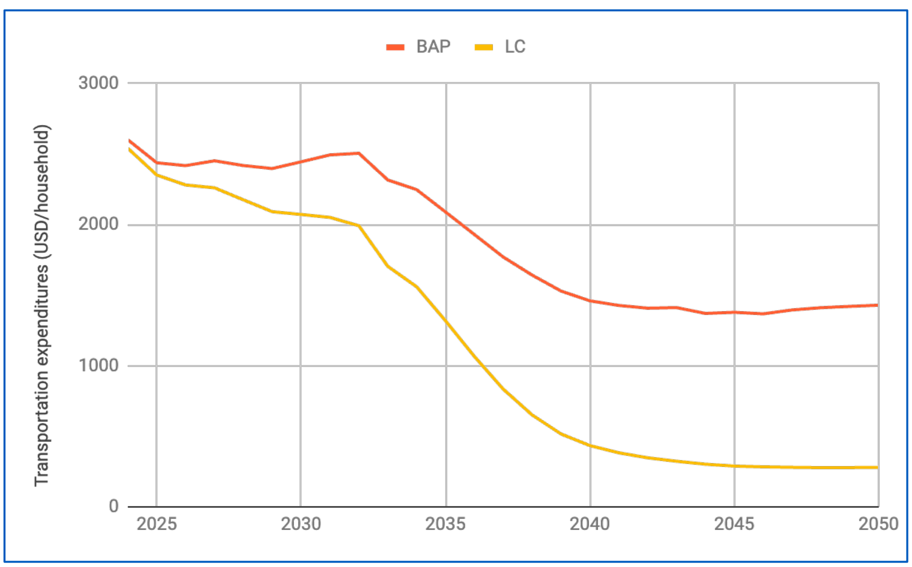


Figure 6-15: Average Annual Household Spending on Household Building Energy in the Scenarios



Source: SSG Analysis.

Figure 6-16: Average Annual Household Spending on Transportation in the Scenarios

6.4.2.2 Potential Co-Harms

Although financial energy savings are a key benefit of many emissions-reducing measures, some strategies can lead to unintended impacts if not designed carefully.

One such impact is the rebound effect, when households reinvest energy savings into other energy-consuming goods or services (e.g., additional appliances or vehicles). This can reduce the net GHG emissions benefits of the original measure, particularly when the new energy use relies on fossil fuels. However, the rebound effect may also support improvements in quality of life or mobility.

Another consideration is that increasing access to transit, walkable communities, or high-performance homes can drive up housing demand in those areas. When this leads to higher housing costs, some residents may be priced out and relocate to more sprawling areas, which are often farther from job centers and essential services. This pattern can result in increased vehicle miles traveled (VMT), longer commutes, and higher household transportation costs, potentially offsetting the financial benefits of local energy improvements. If this type of low-density development occurs on previously undeveloped land, it can also lead to the loss of open space and greenfields, which limits other co-benefits like air quality improvements and stormwater retention.[92]

Finally, while clean energy and efficiency measures often lower long-term costs, they may require upfront investments. LIDACs may be unable to access rebates or tax incentives, or face barriers to participating in retrofit programs. In the absence of targeted design, these efforts may exclude those who would benefit most.

6.4.2.3 Actions That Reduce Energy Poverty and GHG Emissions Simultaneously in Fresno County

The following Table 6.L provides an overview of GHG reduction measures included in the CCAP-A that are expected to reduce energy poverty, in addition to reducing GHG emissions. The associated impacts of each measure are further described below.

Table 6.L: Overview of GHG Reduction Measures in the CCAP-A that will Reduce Energy Poverty in Addition to Reducing GHG Emissions

Sectors	Measures
Buildings/Electricity Generation	• Bundle Solar + Savings for Fresno Homes • Building Net Zero New Homes
Transportation	• Expand Transit Options across the County • Build out the Bike and Pedestrian Network • Promote Carpool, Vanpool, and Shared Mobility Options • Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan
Working and Natural Lands	• Grow the Urban Tree Canopy

92 United States Energy Information Administration (EIA). 2023. 2020 Residential Energy Consumption Survey: Housing Characteristics Tables – Household Energy Insecurity (HC11.1). Washington, D.C.: EIA, 2023. Website: https://www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics#household (accessed August 2025).

6.4.2.4 Impacts

Measures to reduce GHG emissions can reduce household energy costs because they reduce the costs of fuel for transportation, electricity, and heating and cooling buildings.

Table 6.M compares household energy and transportation costs in 2024, 2035, and 2050 across the BAP and LC scenarios. In the LC Scenario, average annual household costs fall from $4,365 in 2024 to just $334 in 2050, a 93% reduction. By comparison, under the BAP Scenario, costs decline more modestly from $4,994 in 2024 to $2,932 by 2050. These savings reflect both reduced utility bills and lower transportation expenditures.

Table 6.M: Comparison of Household Energy and Travel Expenditures in 2050 Across the Scenarios in the CCAP-A

	Business-as-Planned	Low-Carbon
Energy Costs ($/Household)		
Household average annual energy expenditures (2024)	2392.58	1824.6
Household average annual energy expenditures (2035)	1537.54	87.26
Household average annual energy expenditures (2050)	1502.89	55.19
Travel Costs ($/Household)		
Household total annual travel and energy expenditures (2024)	2601.21	2540.66
Household total annual travel and energy expenditures (2035)	2089.67	1065.53
Household total annual travel and energy expenditures (2050)	1428.94	279.06
Total Travel and Energy Costs ($/Household)		
Household total annual travel and energy expenditures (2024)	4993.79	4365.26
Household total annual travel and energy expenditures (2035)	3627.21	1152.79
Household total annual travel and energy expenditures (2050)	2931.83	334.25

Source: SSG (2025).

The financial benefits are driven by the adoption of more efficient, lower-emission technologies. A building retrofit, for instance, can cut energy consumption by half through better insulation and air sealing. When paired with a high-efficiency electric heat pump, which uses just one-third the energy of a typical gas furnace, the combined effect is a six-fold reduction in heating energy use. Similarly, electric vehicles use roughly a quarter of the energy of internal combustion engine vehicles to travel the same distance, as they lose less energy as waste heat.

Together, these improvements translate into significantly lower household expenses over time, as illustrated in Table 6.M and Figure 6-15.

6.5 CO-BENEFITS AND CO-HARMS: CLIMATE ADAPTATION AND RESILIENCE

6.5.1 Passive Survivability

6.5.1.1 Observations

Passive survivability refers to "the ability to maintain safe indoor conditions in the event of extended energy outage or loss of energy supply." According to the United States Department of Energy, it specifically "enables safe indoor thermal conditions, relying on building design measures that require no energy."[93] These design strategies reduce dependency on mechanical systems (e.g., insulation, ventilation, thermal mass, operable windows, or fixed shading). In essence, passive survivability assesses a building's capacity to maintain livable temperatures through design alone, even during power outages or grid disruptions. This concept is increasingly important as climate-driven hazards (e.g., extreme heat, wildfires, and air quality events) become more frequent and severe.

In Fresno County, where summer temperatures regularly exceed 100 degrees Fahrenheit (°F), passive survivability is a critical resilience consideration. It can reduce reliance on energy-intensive cooling and backup power sources during emergencies, offering life-saving protection for medically vulnerable individuals, children, and seniors, especially in LIDACs, where residents may be more exposed to heat and less likely to have access to air conditioning, alternative cooling options, or power backup.[94]

Design features that enhance passive survivability include thermal massing, natural ventilation, advanced insulation, shading, building orientation, reflective or green roofs, and operable windows.[95,96] These strategies not only improve indoor thermal comfort and reduce energy demand, but also strengthen resilience to climate hazards, making passive survivability a valuable co-benefit of GHG reduction.

6.5.1.2 Potential Co-Harms

Although passive survivability offers clear resilience and public health benefits, its implementation may introduce certain tradeoffs, particularly for developers, building owners, and residents in existing structures. One common concern is the increased upfront cost associated with incorporating passive features, especially in older housing stock where retrofits may be more complex or invasive.[97] Additionally, elements like fixed shading, thicker insulation, or thermal mass can sometimes limit layout flexibility or complicate future renovations.[98] Passive strategies form a strong foundation for resilience, but in practical application, particularly in buildings with poor siting, aging infrastructure, or extreme exposure, they may not suffice on their own. Mechanical systems

93 United States Department of Energy. 2025. Energy Resilience. Website: https://www.energycodes.gov/energy-resilience (accessed July 2025).

94 Lawrence Berkeley National Laboratory. 2021. Passive cooling designs to improve heat resilience of homes in vulnerable communities. Website: https://energyanalysis.lbl.gov/sites/default/files/2022-06/passive_cooling_designs_to_improve_heat_resilience_of_homes_in_vulnerable_communities.pdf. (accessed August 2025).

95 National Institute of Building Sciences. 2019. Natural Hazard Mitigation Saves: 2019 Report. Washington, D.C. Website: https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report (accessed August 2025).

96 Sheng, Mengyuan, et al. 2023. "Assessing Thermal Resilience of an Assisted Living Facility during Heat Waves and Cold Snaps with Power Outages." Building and Environment 230 (2023): 110001. https://eta-publications.lbl.gov/publications/assessing-thermal-resilience-assisted

97 American Council for an Energy-Efficient Economy (ACEEE). 2018. The High Cost of Energy in Rural America. 2018. Website: https://www.aceee.org/sites/default/files/publications/researchreports/u1806.pdf (accessed August 2025).

98 United States Green Building Council & University of Michigan. 2011. *Green Building and Climate Resilience: Understanding I*mpacts and Preparing for Changing Conditions. Website: https://www.usgbc.org/sites/default/files/GreenBuildingClimResil.pdf (accessed August 2025).

and backup power are still essential to prevent overheating and ensure thermal safety during extreme heat events.[99]

These challenges are particularly relevant for LIDACs, where buildings are often older, under-resourced, or located in areas with higher exposure to extreme heat, wildfire, or power instability.[100] In Fresno County, where wildfires and heat waves are increasingly frequent, passive survivability strategies (e.g., airtight construction and upgraded building envelopes) not only bolster thermal resilience but also reduce indoor exposure to wildfire smoke by limiting infiltration pathways.[101] Without targeted support or funding mechanisms, there is a risk that these protective measures may remain inaccessible for those who may need them most.

To mitigate these concerns and encourage widespread adoption, passive survivability should be supported by updated building codes, targeted incentives, and performance-based standards that consider both cost-effectiveness and climate resilience. These mechanisms can help make passive design approaches more accessible and scalable across Fresno County.

6.5.1.3 Actions that Increase Passive Survivability and Reduce GHG Emissions Simultaneously in Fresno County

Several measures would be expected to increase passive survivability, as outlined in Table 6.N. The impacts of each of these measures are further discussed in the following section.

Table 6.N: Overview of GHG Reduction Measures in the CCAP-A that Increase Passive Survivability in Addition to Reducing GHG Emissions

Sectors	Measures
Buildings/Electricity Generation	• Bundle Solar + Savings for Fresno Homes • Green-up Commercial Buildings • Build Net-Zero New Homes • Advance Net-Zero New Commercial Buildings
Working and Natural Lands	• Grow the Urban Tree Canopy

99 Sun, Kaiyu, Michael Specian, and Tianzhen Hong. 2020. "Nexus of thermal resilience and energy efficiency in buildings: A case study of a nursing home." Building and Environment, 177 (2020). 106842. Website: https://doi.org/10.1016/j.buildenv.2020.106842 (accessed August 2025).

100 California Energy Commission (CEC). 2016. Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income Customers and Small Businesses. Website: https://ww2.arb.ca.gov/resources/documents/carb-barriers-report-final-guidance-document (accessed August 2025).

101 Passive House Network. Safe at Home: Protecting Indoor Environments from Wildfire Smoke through Passive Building Strategies. 2023. Website: https://passivehousenetwork.org/wp-content/uploads/2023/07/Passive-House-Network-Summer-2023-Report-Safe_at_Home.pdf (accessed August 2025).

These building-sector measures promote improved envelope design, energy efficiency, and resilience to grid outages. Net-zero buildings, in particular, often incorporate airtight construction, high-performance windows, insulation, and shading, which are strategies that improve thermal stability and reduce dependence on active cooling or backup power systems.[102]

In wildfire-prone regions like Fresno County, passive survivability strategies may also offer protective benefits against fire and smoke-related hazards. Although not originally designed for wildfire protection, well-sealed building envelopes, high-performance windows, and filtered ventilation systems can reduce indoor smoke intrusion during wildfire events and extend safe indoor conditions during evacuations or power loss. For example, a modeling study of an assisted-living facility in California found that buildings with passive features (e.g., operable windows and thermal mass) were better able to maintain survivable temperatures during extreme heat events and power outages.[103] Although mechanical systems remained essential for long-term safety, passive design provided critical time for safe sheltering and response. Expanding access to such features can strengthen household resilience to compounding heat, smoke, and outage events.

6.5.1.4 Impacts

Investing in passive survivability offers multiple resilience and public health benefits, particularly in the face of rising temperatures, energy insecurity, and extreme weather events. In Fresno County, where prolonged heat waves and wildfire smoke are increasingly common, passive design features can help maintain safe indoor conditions during power outages, improve indoor air quality, and reduce peak energy demand. These strategies reduce reliance on mechanical cooling and backup power, which may be unavailable or unaffordable for many households.

By extending the amount of time buildings remain habitable without active cooling, passive survivability can prevent heat-related illness, reduce strain on emergency services, and enable safer shelter-in-place conditions during climate emergencies. Vulnerable populations, including older adults, children, people with chronic illnesses, and residents of LIDACs, stand to gain the most from such protections. Additionally, passive strategies (e.g., insulation, shading, and natural ventilation) can reduce household energy bills, offering long-term economic savings alongside climate resilience.

6.5.2 Reduction of Urban Heat Island Effect

6.5.2.1 Observations

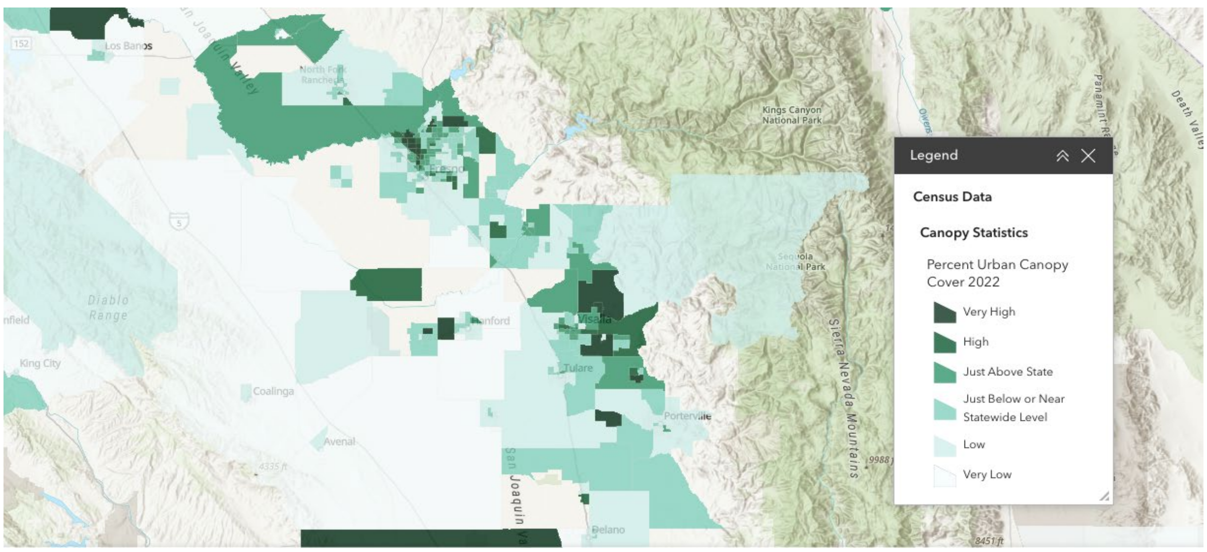
The urban heat island (UHI) effect occurs when built-up areas become significantly hotter than nearby rural areas due to heat-retaining surfaces such as asphalt, concrete, and rooftops, as well as a lack of vegetation and tree canopy. These surfaces absorb solar radiation during the day and slowly release it at night, causing elevated temperatures that can exacerbate heat-related illnesses

[102] Rocky Mountain Institute. 2022. Zero-Energy Homes and Passive Design. Website: https://rmi.org/insight/zero-energy-homes (accessed July 2025).

[103] Sheng, Mengqi, et al. 2023. Assessing Thermal Resilience of an Assisted Living Facility during Heat Waves and Cold Snaps with Power Outages. *Building and Environment* 230 (2023): 110001.Website: https://eta-publications.lbl.gov/publications/assessing-thermal-resilience-assisted (accessed July 2025).

and energy demand.[104] The UHI effect is especially intense in areas with low vegetation, sparse tree cover, and dense impervious land use, all of which are common in historically underserved urban neighborhoods.

Fresno County is highly susceptible to UHI effects due to its combination of high average summer temperatures, sprawling development patterns, and relatively low tree canopy in many areas. As shown on Figure 6-17, urban tree canopy cover is not evenly distributed across Fresno County. These disparities in urban greening contribute to unequal exposure to heat and reduced cooling capacity in certain neighborhoods, compounding existing UHI effects.



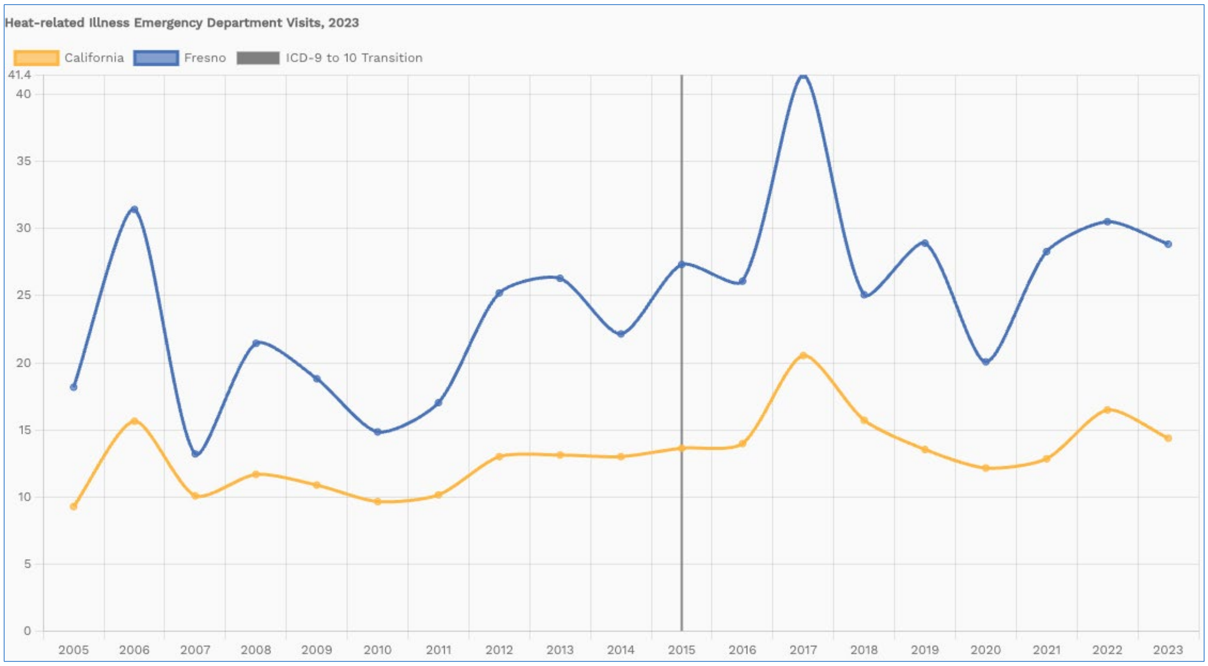
Sources: SSG (2025); United States Department of Agriculture Forest Service (2022).

Figure 6-17: Percent Urban Tree Canopy Cover in Fresno County

Between 2005 and 2023, the rate of heat-related emergency department visits in Fresno County consistently exceeded the statewide average, with recent rates nearly double the California-wide figure (Figure 6-18 below). In 2023, the age-adjusted rate of heat-related emergency department visits in Fresno County was approximately 29 per 100,000 residents, compared to 14 per 100,000 statewide (Figure 6-19 below).[105]

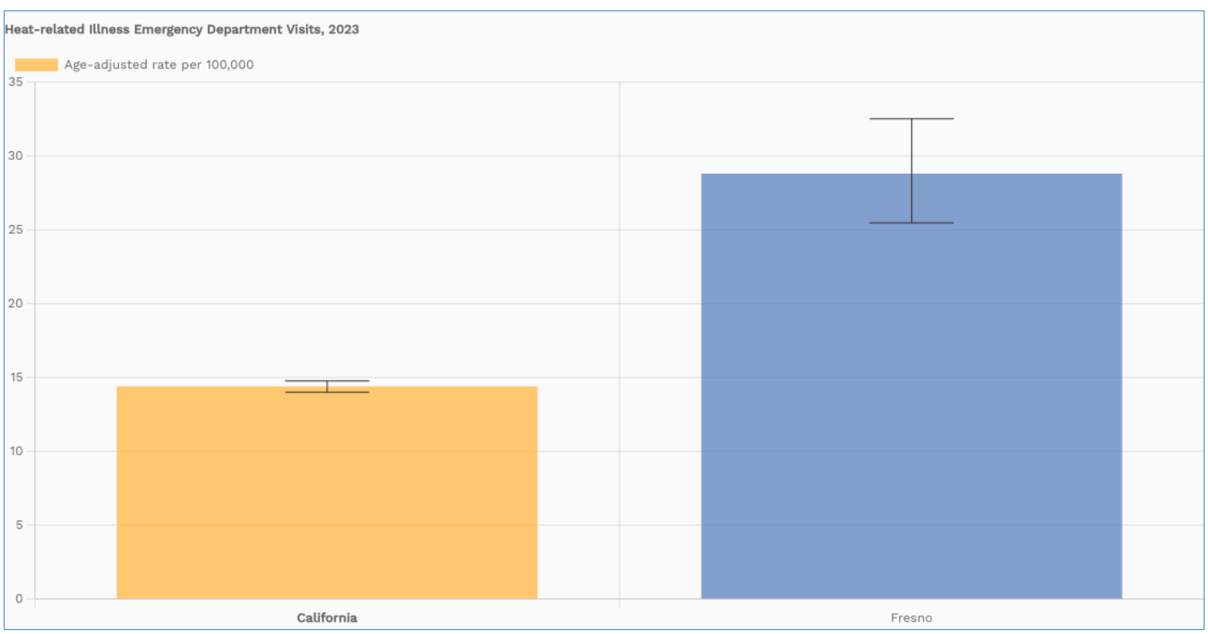
104 United States Environmental Protection Agency (EPA). 2023. What Is the Urban Heat Island Effect? Website: https://www.epa.gov/heatislands (accessed August 2025).

105 Public Health Institute. 2023. *Heat-Related Illness Emergency Department Visits – Data Explorer*. Tracking California. Website: https://trackingcalifornia.org (accessed July 2025).



Source: Tracking California (2023).

Figure 6-18: Trend in Age-Adjusted Heat-Related Emergency Department Visit Rates (2005–2023)



Source: Tracking California (2023).

Figure 6-19: Heat-Related Emergency Department Visit Rate by Location

Outdoor workers, children, older adults, individuals with chronic illness, and other residents in LIDACs face elevated risk. These groups often live in neighborhoods with higher levels of impervious surfaces, less access to green infrastructure, and limited adaptive capacity (e.g., air conditioning or cooling centers).[106]

Strategies to reduce the UHI effect focus on increasing shade, reducing surface heat absorption, and restoring natural cooling processes in the built environment. These strategies include expanding the urban tree canopy and vegetative cover, installing high-albedo or reflective roofing and paving materials, constructing green roofs, and enhancing shaded public spaces and streetscapes. In particular, targeting greening efforts in LIDACs and neighborhoods with high surface temperatures ensures that heat relief is distributed across Fresno County and reaches those most vulnerable. Together, these interventions reduce ambient air and surface temperatures, improve air quality, and offer critical public health benefits, while also supporting GHG reductions by decreasing building cooling demands and mitigating peak energy loads.

6.5.2.2 Potential Co-Harms

Although strategies to reduce the UHI effect offer clear resilience and public health benefits, several implementation challenges or tradeoffs may arise, particularly in areas with constrained resources or existing infrastructure limitations.

Expanding Fresno's urban tree canopy introduces long-term maintenance demands, including pruning, irrigation, and pest or disease management. These responsibilities can strain local public works departments or community-based stewards, especially in neighborhoods already experiencing underinvestment in public infrastructure and basic services. Routine maintenance is a major barrier to sustaining urban greening efforts, particularly in areas without dedicated long-term funding mechanisms.[107]

In water-stressed regions like Fresno County, increasing vegetative cover through tree planting and landscaping may significantly elevate water demand. Although trees offer critical shade and cooling benefits, they also require irrigation to establish and survive, particularly during heatwaves or dry seasons. Without appropriate design features (e.g., xeriscaping, mulch beds, or drip irrigation) and use of drought-tolerant species, urban greening can unintentionally exacerbate water scarcity.

Infrastructure constraints also pose implementation challenges. Tree roots may damage underground utilities, while street tree placements in dense areas can limit parking or interfere with power lines. As well, although high-albedo materials like cool roofs and reflective pavements are

[106] California Office of Environmental Health Hazard Assessment (OEHHA). 2022. Heat-Related Deaths and Illnesses. Website: https://oehha.ca.gov/climate-change/epic-2022/impacts-human-health/heat-related-deaths-and-illnesses (accessed July 2025).

[107] California Urban Forest Council. 2021. State of Urban Forestry in California: Challenges and Opportunities. 2021. Website: https://caufc.org (accessed August 2025).

effective at reducing surface temperatures, improper siting or inappropriate use can cause unintended heat or glare to be reflected into pedestrian zones or nearby facades.[108]

To mitigate these risks, Fresno County should pursue proactive planning, including selecting low-maintenance, drought-resistant species; coordinating tree placement with utility mapping; positioning reflective materials to minimize glare; and concentrating UHI reduction measures in neighborhoods with the highest heat exposure and limited access to cooling infrastructure.

6.5.2.3 Actions that Reduce the Urban Heat Island Effect and Reduce GHG Emissions Simultaneously in Fresno County

The Natural and Working Lands sector measure, Grow the Urban Tree Canopy, would support the reduction of the UHI effect, in addition to reducing GHG emissions.

With the implementation of this measure under the LC Scenario, Fresno County is projected to add approximately 10,667 trees per year between 2026 and 2050, totaling more than 160,000 new urban trees. This investment supports the County's goal to double urban tree canopy cover in priority areas by 2045.

Given that the City of Fresno currently has a canopy coverage rate of just 14.6%, these additions represent a significant step toward mitigating urban heat and enhancing green infrastructure in the community.

[108] Kousis, I., and A.L. Pisello. 2023. "Evaluating the Performance of Cool Pavements for Urban Heat Island Mitigation under Realistic Conditions: A Systematic Review and Meta-Analysis." *Urban Climate* 49 (2023): Article 101470. Website: https://doi.org/10.1016/j.uclim.2023.101470 (accessed July 2025).

7 Workforce Planning Analysis

FRESNO Council of Governments

LSA

7.0 WORKFORCE ANALYSIS AND PLANNING

The transition to a low-carbon, climate-resilient economy presents both a critical challenge and a transformative opportunity for Fresno County. To effectively implement the greenhouse gas (GHG) emissions reduction measures proposed for the county as part of the Comprehensive Climate Action Plan Analysis (CCAP-A), a capable, available and right-sized workforce is needed. This analysis examines the current state of key industries and occupations in the region that are most relevant to mitigation measures considered in the plan. The analysis is a foundational component of the CCAP-A, as it serves to identify current labor market capacities, gaps in workforce readiness, and opportunities to build fair pathways toward plan implementation.

The purpose of the analysis is:

- To assess the current workforce by looking at key sectors impacted by the plan (e.g., energy, transportation, building, waste, and industry); and
- To identify strategies to align workforce development efforts with the implementation goals outlined in the plan.

Thus, this workforce analysis will inform policies and programs that support worker training and career development, paying special attention, when possible, to historically underserved, at-risk, and low-income communities. The analysis directly supports the planning and implementation requirements of the United States Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program and guidelines, and as a result, provides a labor market assessment, outlines strategies to develop and retain a qualified workforce, and identifies mechanisms to ensure fair access to quality employment opportunities.

The first section of this Workforce Analysis and Planning Chapter includes the baseline information needed to characterize the current workforce in Fresno County, and the second part of the Chapter is focused on identifying the solutions and strategies for successfully implementing the GHG emission reduction measures included in the CCAP-A.

7.1 COORDINATION WITH WORKFORCE PARTNERS

7.1.1 Overview of Workforce Stakeholders

Numerous groups have an interest in workforce development in Fresno County. The overall CCAP-A engagement process gathered input from a variety of stakeholders regarding workforce needs and gaps in the region. The input summarized below has been distilled from working groups, focus groups, listening sessions, and outreach to business and industry groups from across Fresno County, as well as nonprofits focused on workforce development. Table 7.A contains this full list of stakeholders.

Efforts to engage stakeholders are ongoing, and broader community engagement has also generated valuable input about workforce issues, as described in Section 7.1.4.

Table 7.A: Stakeholder Engagement List

Organization Name	Organization Type	Location	Sector
Asian Business Institute & Resource Center	Business	Countywide	All
Building Industry Association	Industry	Countywide	Commercial/Residential Buildings
Central California Hispanic Chamber of Commerce	Business	Countywide	All
Clovis Chamber of Commerce	Business	Clovis	All
Coalinga Area Chamber of Commerce	Business	Coalinga	All
Fresno Area Hispanic Foundation	Business	Countywide	All
Fresno Business Council/San Joaquin Valley Manufacturing Alliance	Industry	Fresno/ Countywide	Industry
Fresno Chamber of Commerce	Business	Fresno	All
Fresno County Economic Development Corporation	Business	Countywide	All
Fresno County Farm Bureau	Industry	Countywide	Agriculture
Fresno County Women's Chamber of Commerce	Business	Countywide	All
Fresno Economic Opportunities Commission	Workforce	County	All
Fresno Metro Black Chamber of Commerce	Business	Fresno	All
Fresno Regional Workforce Development Board	Workforce	Countywide	All
Greater Reedley Chamber of Commerce	Business	Reedley	All
Kerman Chamber of Commerce	Business	Kerman	All
Kingsburg District Chamber of Commerce	Business	Kingsburg	All
Sanger Chamber of Commerce	Business	Sanger	All
Selma District Chamber of Commerce	Business	Selma	All

7.1.2 Summary of Workforce Engagement Activities

Public engagement was a key factor in the development of the CCAP-A, with elected representatives, community-based organizations, businesses, industrial representatives, and chambers of commerce having been invited to participate in and informed of the CCAP-A development process. A review of ongoing workforce development efforts and plans was included as a part of the CCAP-A development effort, and the Stakeholder Steering Committee membership also helped to connect the CCAP-A author team with ongoing workforce development activities and contacts in the county. Table 7.B outlines specific engagement meetings that were held to support the workforce analysis.

Table 7.B: Engagement Activities Used in Workforce Analysis and Planning

Engagement Activity	Description	No. of Participants
Focus group with community organizations and city staff	Online presentation on workforce development in Fresno; discussion on priorities, opportunities and challenges faced by community organizations; discussion on programs and initiatives being undertaken	22
Agricultural Stakeholder Meeting	Follow-up meeting to receive specific information regarding the agricultural industry.	10

7.1.3 Key Themes from Engagement Activities

7.1.3.1 What We Heard

Key themes that were raised during the engagement sessions are summarized below.

- **Manufacturing Workforce:** Participants mentioned concern over the need to upscale the workforce to meet future needs in the manufacturing sector.
- **Skills Enhancement and Training:** Participants want to see marginalized workers retrained to enhance their skills in industrial work. They also want to see more training subsidy programs to allow employers to train to their specifications with minimal cost. They have an interest in better utilizing short term vocational training so that the workforce can be trained with industry specific skillsets.
- **Support to Businesses:** In addition to a skilled workforce and assistance with training costs, businesses need greater assistance with pre-employment screening (e.g., background checks).
- **Investment in Staff:** Need to focus on cross training and developing in-house expertise. Workers need training programs to enhance their skills and productivity, as well as access to financial resources for growth and innovation, guidance, counseling, and networking opportunities to connect with industry employers.
- **Funding Limitations:** Need for financial autonomy and less reliance on partners to fund project expansion.
- **Permitting:** Streamlining across jurisdictions needed in order to facilitate the implementation of projects faster.
- **Agriculture:** Participants showed concern about the impacts of the Sustainable Groundwater Management Act (SGMA) and its effects on farmers who are reliant on groundwater.

7.1.3.2 How Input is Used in the CCAP-A

Engagement findings will play a central role in shaping the final recommendations to workforce solutions and partners. Workforce partners' input was considered and incorporated into the CCAP-A to ensure that local businesses, employers, training facilitators, educational institutions, and others are reflected in the priorities, strategies, and implementation pathways.

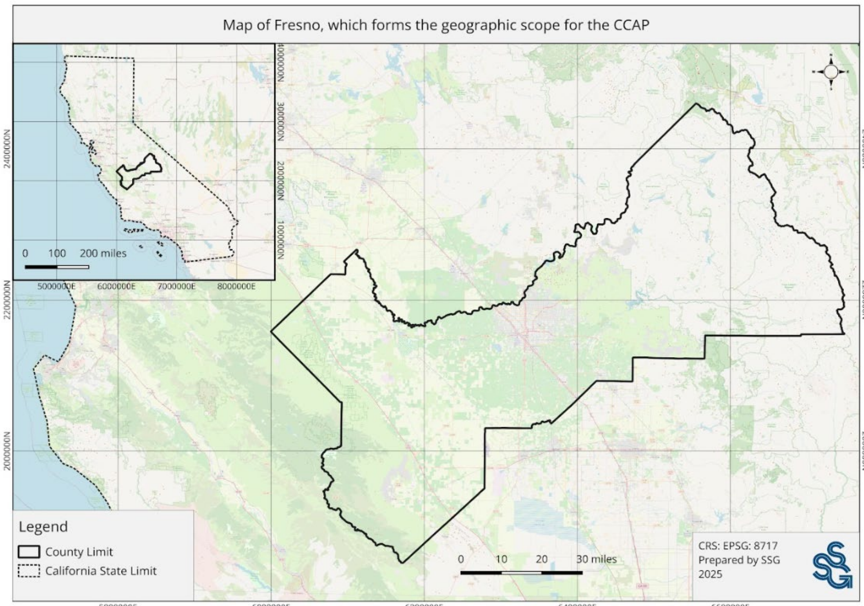
7.2 LABOR MARKET AREA AND CURRENT CHARACTERISTICS

It is important to clearly define the labor market area and geographic area that CCAP-A measures are expected to influence. The Fresno Metropolitan Area, which covers the entire Fresno County, ranks among one of the 67 most populous Metro Areas in the nation. The City of Fresno, the largest municipality in Fresno County, and the San Joaquin Valley Air Pollution Control District (SJVAPCD), make up the Fresno Council of Governments (Fresno COG). Fresno COG is a federally designated Metropolitan Transportation Organization (MPO) and State-designated Regional Transportation Planning Agency (RTPA). Fresno COG includes the 16 jurisdictions in the Fresno Metropolitan Area; these local governments have a joint power agreement that was signed by the membership.[109]

New and growing jobs in the green economy represent a critical shift in workforce demands for Fresno County as it prepares to implement actions to reduce air and carbon pollution. This section

[109] Fresno Council of Governments. 2024. Priority Climate Action Plan (PCAP). Website: https://www.fresnocog.org/wp-content/uploads/2024/07/Fresno-COG-PCAP_030124_-FINAL-reduced-size-file.pdf (accessed September 23, 2025)

provides an overview of the current and future workforce in the county and discusses Fresno County's preparedness to support a renewable energy transition. The analysis covers the geographic area shown on Figure 7-1.



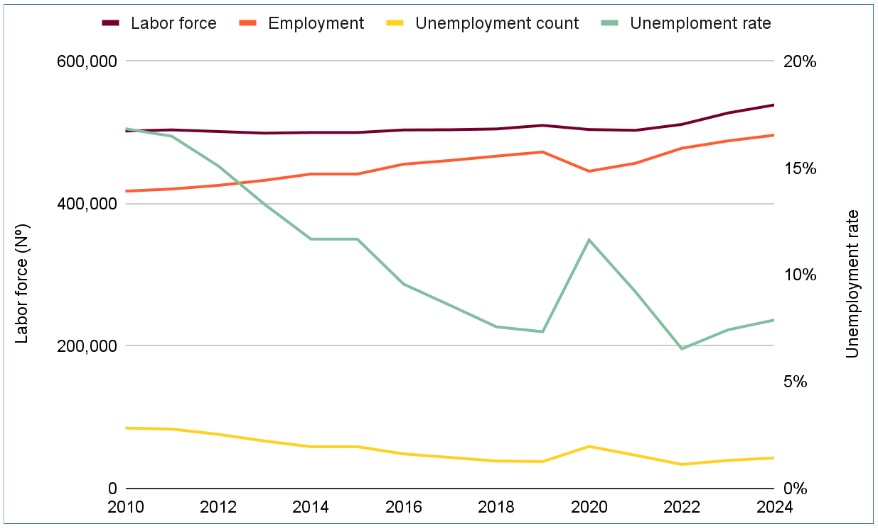
Source: SSG (2025).

Figure 7-1: Fresno County Geographic Area

7.2.1 Current Industries and Workforce

In 2024, Fresno's average employed population was 496,200 (from a total labor force of 538,700), resulting in an unemployment rate of 7.9%. Unemployment rates were particularly high during the COVID-19 pandemic, presenting the highest rates since 2010. In April of 2020, the total unemployment rate in Fresno was 17.5%. By mid-2021, these rates decreased and stabilized to pre-pandemic levels, with a more steady trend into 2024 (Figure 7-2).[110]

110 California Employment Development Department. 2025. *Fresno County — Labor Market Information*. Website: https://labormarketinfo.edd.ca.gov/geography/fresno-county.html (accessed September 23, 2025).



Source: Employment Development Department, State of California.

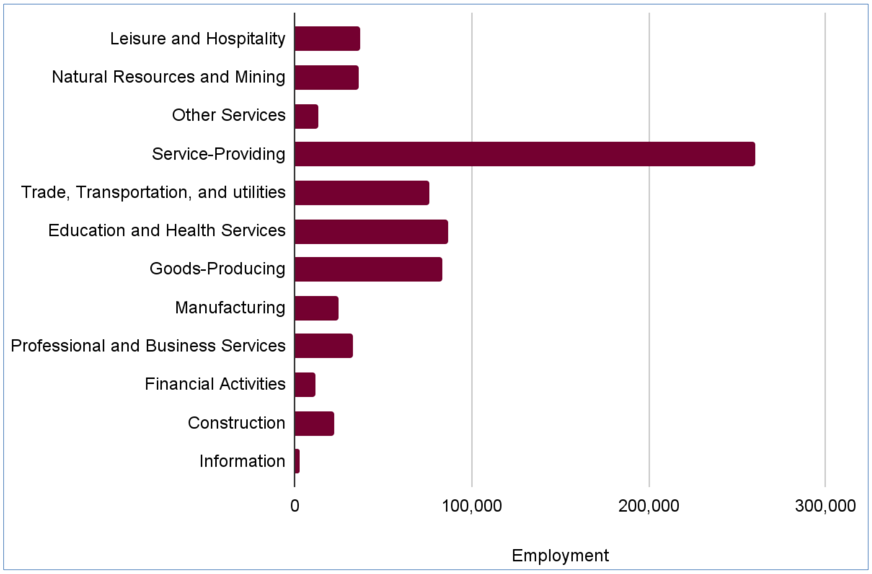
Figure 7-2: Labor Force Breakdown

In 2023–2024, the largest sector for employment by industry was private education and health services (89,600). This was followed by government (80,500), and then trade, transportation, and utilities (76,600). The sectors with the highest wages were semiconductor and related device manufacturing; followed by financial transactions processing, reserve, and clearinghouse activities; and then activities related to credit intermediation.[111] During this time period, the average weekly pay among all industries in Fresno County was $1,403.[112]

As demonstrated in Figure 7-3, which shows the number of jobs by industry type in 2023–2024, service-providing employment was very high in comparison to all others. Education and health services; good-producing; and trade, transportation, and utilities were also industries that offered a high degree of employment. At the lower end were financial activities, construction, the information sector, and other services.

[111] California Employment Development Department. n.d. *Employment by Industry — Labor Market Information*. Website: https://labormarketinfo.edd.ca.gov/data/employment-by-industry.html (accessed September 23, 2025).

[112] California Department of Industrial Relations. n.d. *Quarterly Census of Employment and Wages — Fresno County*. Website: https://data.ca.gov/dataset/quarterly-census-of-employment-and-wages/resource/119eef38-3b59-499f-8f7c-9bea4768469d?filters=Area%20Type%3ACounty%7CArea%20Type%3ACounty%7CArea%20Name%3AFresno%20County (accessed September 23, 2025).

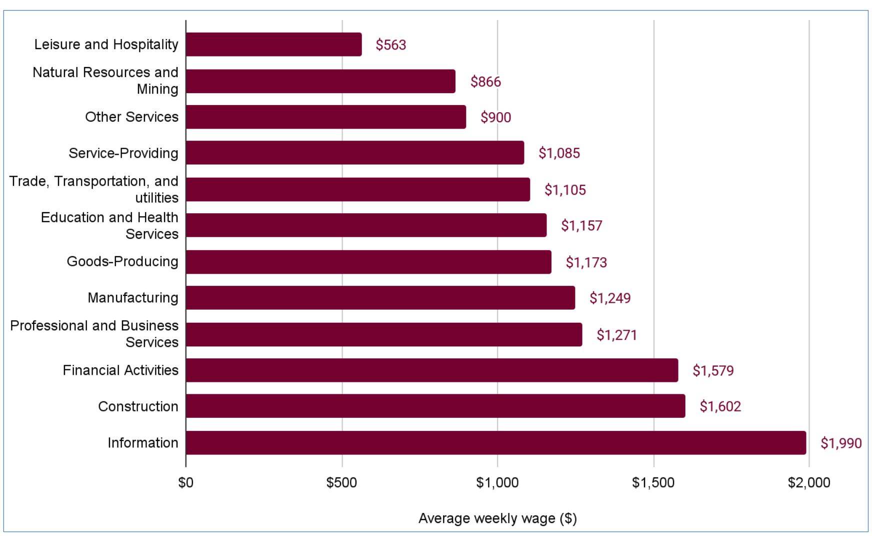


Source: United States Bureau of Labor Statistics (2024).

Figure 7-3: Annual Average Employment by Industry

Figure 7-4 visualizes the average annual pay according to the same industries. Information jobs had the highest weekly wages, followed by construction and financial activities. Leisure and hospitality, natural resources and mining, and other services had the lowest wages.

These figures indicate that both the information and construction industry offered few positions but with high weekly wages. Education and health services; goods-producing; and trade, transportation, and utilities offered a high degree of employment, with medium level wages.

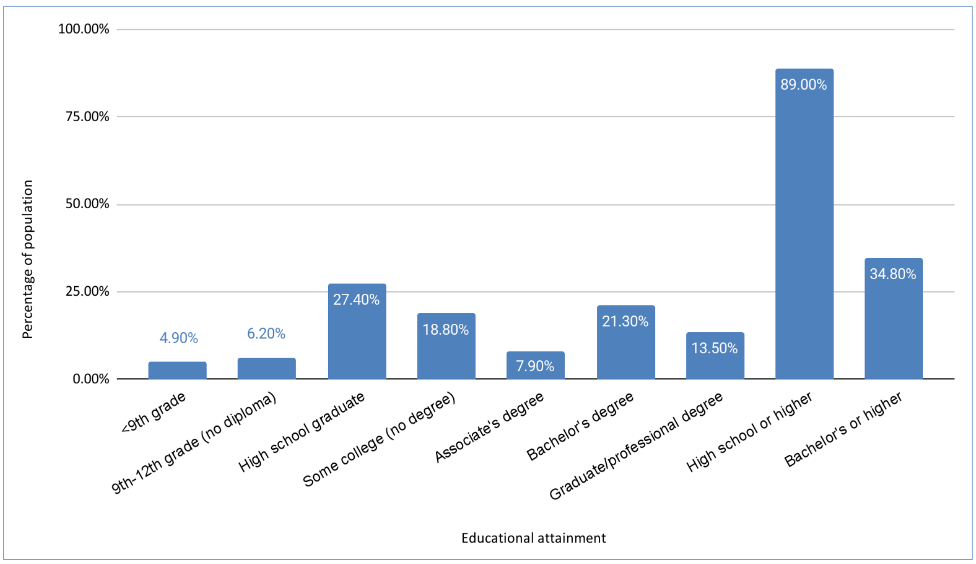


Source: United States Bureau of Labor Statistics (2024).

Figure 7-4: Average Annual Pay by Industry

Educational attainment can play a role in determining readiness and capacity of workers to meet the required technical skills needed for new and emerging industries and jobs. In 2023, 12% of residents (age 18–24) in Fresno County reported an educational attainment less than a high school graduate, while 36% reported being a high school graduate.[113] These are almost the same as the national averages (11% and 37%, accordingly). However, the percentage of 25–34 year olds in Fresno who reported having a bachelor's degree or higher was 28%, which is significantly lower than the national average of 40%. In both cases, the percentage breakdown is almost the same for males and females.

Figure 7-5 shows the rates of educational attainment for the 25 years and over population in Fresno County in 2023.



Source: American Community Survey (2023).

Figure 7-5: Educational Attainment for Population 25 Years and Older in Fresno County, 2023

7.2.2 Key Energy Industries

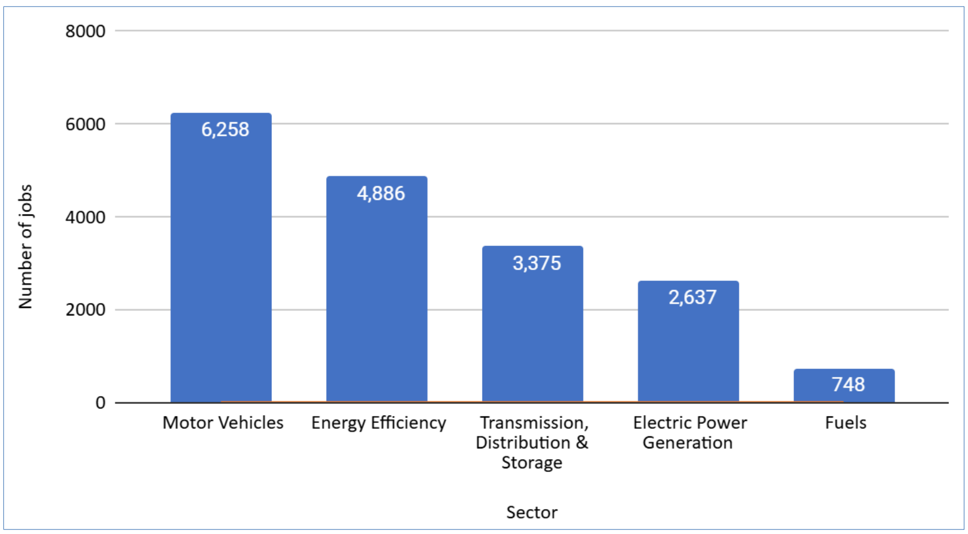
The United States Energy and Employment Report (USEER) places energy employment amongst five technological areas: electric power generation; energy efficiency; fuels; motor vehicles and component parts; and transmissions, distribution, and storage. In 2023, across the country, employment increased in all five of these sectors.[114] California had 932,273 energy workers

113 United States Census Bureau. 2023. *Unemployment by Race and Educational Attainment — 2023*. Website: https://data.census.gov/table?q=unemployment+race&t=Educational+Attainment&g=310XX00US19430&y=2023 (accessed September 23, 2025).

114 United States Department of Energy. 2024. United States Energy and Employment Report (USEER) 2024**.** Website: https://www.energy.gov/sites/default/files/2024-10/USEER%202024_COMPLETE_1002.pdf (accessed September 23, 2025).

statewide in 2023, representing 11.2% of all energy employees in the United States, and 544,604 clean energy jobs.[115] The energy sector in California represents 5.3% of total state employment.[116]

The 2024 USEER County Estimates data found that Fresno County had 17,904 workers in the energy sector,[117] accounting for about 4% of county-wide employment. As visualized in Figure 7-6, of these workers, 6,258 (35%) were in the motor vehicle industry; 4,886 (27%) were in the energy efficiency industry; 3,375 (19%) were in transmission, distribution, and storage; 2,637 (15%) were in electric power generation; and lastly, 748 (4%) were in the fuels sector.[118] Employment in each of these sectors for the year of 2023 is described in more detail below.



Source: USEER (2024).

Figure 7-6: Number of Energy Jobs by Sector in Fresno County, 2023

7.2.2.1 Motor Vehicles

The motor vehicle sector employed 6,258 workers (15% of all energy workers) in Fresno.[119]

---

115 E2. 2025. Clean Jobs America 2025. Website: https://cleanjobsamerica.e2.org/wp-content/uploads/2025/09/E2-2025-Clean-Jobs-America-2025_final.pdf (accessed September 23, 2025).

116 United States Department of Energy. 2024. United States Energy & Employment Report 2024: State Report. Website: https://www.energy.gov/sites/default/files/2024-08/USEER%202024%20States%20Final.pdf (accessed September 23, 2025).

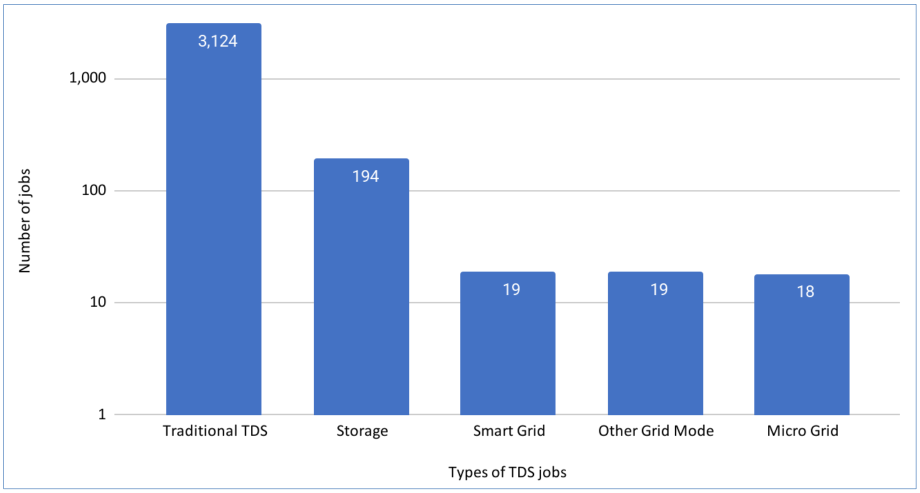
117 United States Department of Energy. 2024. 2024 County Data. Website: https://www.energy.gov/media/330956 (accessed September 23, 2025).

118 United States Department of Energy. 2024. 2024 County Data. Website: https://www.energy.gov/media/330956 (accessed September 23, 2025).

119 United States Department of Energy. 2024. 2024 County Data. Website: https://www.energy.gov/media/330956 (accessed September 23, 2025).

7.2.2.2 Transmission, Distribution, and Storage

The transmission, distribution, and storage (TDS) sector employed 3,375 workers (19% of all energy workers) in Fresno, with the most being in traditional TDS (3,124) and the least in micro grid jobs (18). This is outlined in Figure 7-7.

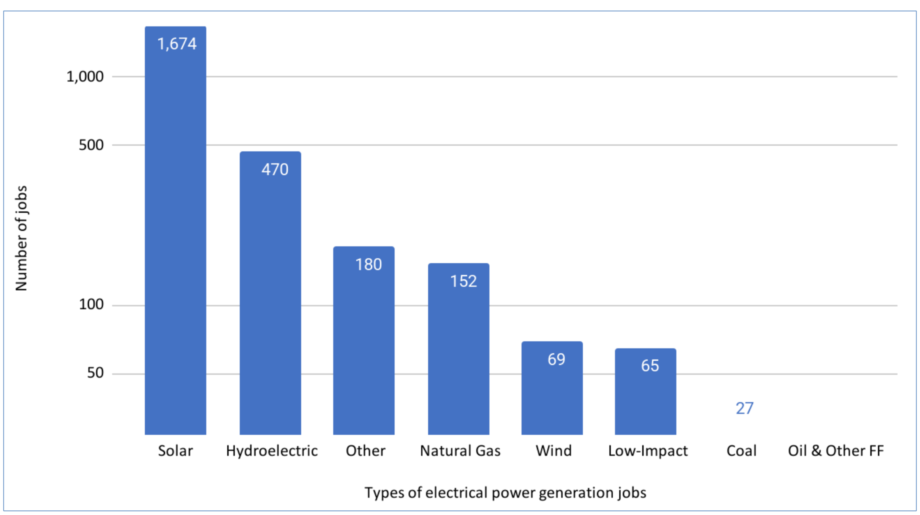


Source: USEER (2024).

Figure 7-7: Transmission, Distribution, and Storage Jobs in Fresno County, 2023

7.2.2.3 Electrical Power Generation

The electric power generation sector employed 2,637 workers (15% of energy workers) in Fresno, with solar-related jobs being the most numerous (1,674) and oil and other fossil fuels being the least (<10). This is visualized in Figure 7-8.

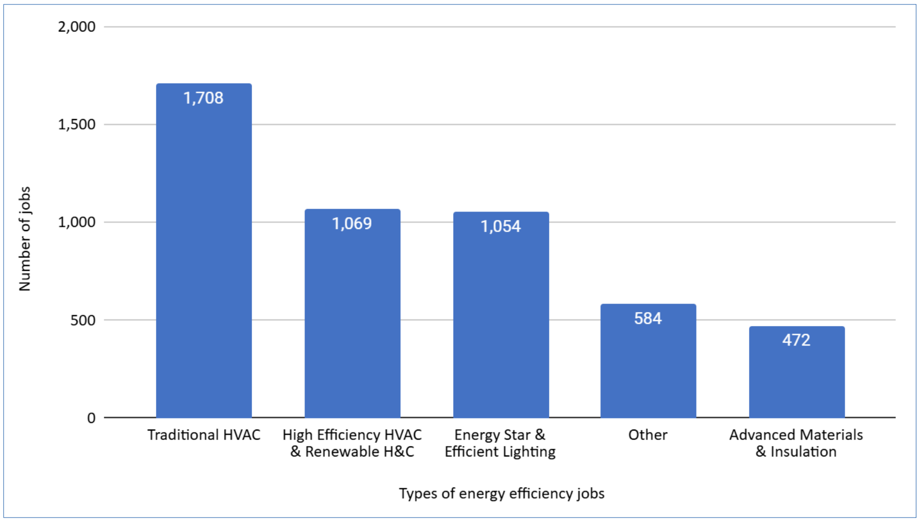


Source: USEER (2024).

Figure 7-8: Electrical Power Generation Jobs in Fresno County, 2023

7.2.2.4 Energy Efficiency

The energy efficiency sector employed 4,886 workers (27% of energy workers) in Fresno, with the most jobs being related to traditional heating, ventilation, and air conditioning (HVAC) (1,708) and the least in advanced materials and insulation (472). This is visualized below, in Figure 7-9.

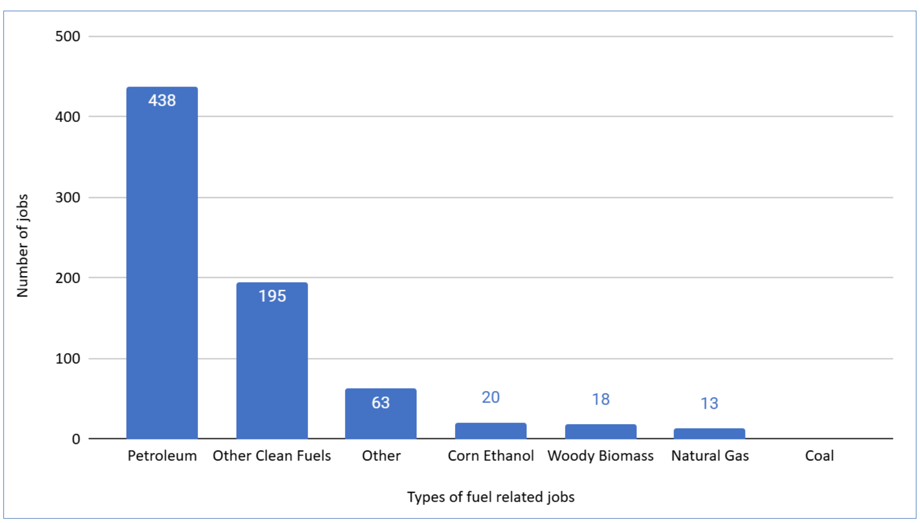


Source: USEER (2024).

Figure 7-9: Energy Efficiency Jobs in Fresno County, 2023

7.2.2.5 Fuels

The fuels sector employed 748 workers (4% of energy workers) in Fresno, with the largest number being attributed to petroleum jobs (438) and the least being coal (<10). This is visualized below, in Figure 7-10.



Source: USEER (2024).

Figure 7-10: Fuel Type Jobs in Fresno County, 2023

7.3 WORKFORCE PROJECTIONS AND FUTURE NEEDS

7.3.1 Key Industries and Priority Occupations by Sector

This section identifies key occupations in each sector: agriculture, buildings and energy generation, transportation, industry, waste, and working and natural lands. The occupations shown in Table 7.C are the priority occupations required to implement the identified climate measures. However, this is not an exhaustive list, and there are likely other occupations not shown that are required for the implementation of climate measures.

Table 7.C: Priority Occupations by Sector

Sector	Description	Priority Occupations
Agriculture	Occupations related to agriculture, farming, crop production, forestry, infrastructure, and related operations	• Agricultural inspectors • Agricultural technicians • First-line supervisors of agricultural crop and horticultural workers • Precision agriculture technicians • Soil and plant scientists
Buildings and Electricity Generation	Occupations related to renewable energy generation and power systems in building design, construction, retrofitting, HVAC, and weatherization	• Construction laborers • Geothermal technicians • Solar photovoltaic installers • Wind turbine service technicians • Civil engineers • Construction and building inspectors • Electricians • Electronics engineers • Electro-mechanical technicians • Heating and air-conditioning mechanics and installers • Weatherization installers and technicians
Transportation	Occupations related to vehicles, public transit, logistics, and infrastructure	• Automotive engineering technicians • Bus and truck mechanics and diesel engine specialists • Locomotive engineers • Logistics analysts • Railroad conductors and yardmasters • Rail-track laying and maintenance equipment operators • Transportation engineers • Transportation managers
Industry	Occupations in manufacturing, engineering, production, and related operations	• Chemical engineers • Commercial and industrial designers • Electrical engineers • Industrial engineers • Machinists • Manufacturing production technicians
Waste	Occupations focused on recycling, waste removal, landfill gas, and wastewater	• Environmental engineers • Recycling and reclamation workers • Water/wastewater engineers
Working and Natural Lands	Occupations related to agriculture, land conservation, forestry, soil and water, and wildlife	• Forest and conservation technicians • Hydrologists • Natural sciences managers • Zoologists and wildlife biologists

Source: O*NET (2024).

Fresno County has a current labor pool of residents employed in the above occupations. Table 7.D (provided on the following page) provides an overview of the current, historic, and projected employment trends for those occupations.

Between 2014 and 2024, Fresno saw a major increase in the number of jobs (>1% growth) in the following occupations: construction and building inspectors, logistics analysts within the transportation sector, transportation managers, and recycling and reclamation workers within the waste sector. To a lesser degree but still demonstrating an increase in the number of jobs (<1% growth) were the following occupations:

- First-line supervisors of agricultural crop and horticultural workers
- Civil engineers
- Constructors laborers within the buildings and electricity generation sector
- Electricians
- Heating and air-conditioning mechanics and installers
- Weatherization installers and technicians
- Electrical engineers
- Automotive engineering technicians
- Bus and truck mechanics and diesel engine specialists
- Transportation engineers
- Environmental engineers
- Water and wastewater engineers
- Natural sciences managers

In contrast, occupations that have been decreasing in number are agricultural inspectors, soil and plant scientists, electronics engineers, and industrial engineers. Jobs as a machinist showed neither an increase or decrease.

It is worth noting that some jobs had no historical employment data, but are projected to offer employment from 2024–2034, reflecting new or emerging professions. These include: precision agriculture technicians, electro-mechanical technicians, commercial and industrial designers, and forest and conservation technicians. The strongest growth in terms of number of jobs is linked to renewable energy (solar, wind, weatherization), logistics and transportation, and recycling and waste sectors.

Jobs with the highest wages (>$100,000) are concentrated in engineering and management roles, including: civil engineers, electrical engineers, industrial engineers, transportation managers, environmental engineers, and natural sciences managers.

Table 7.D: Employment Trends in Priority Energy Occupations

Sector	Occupation	Historical Total Employment (2014)	Total Employment (2024)	Historical Percent Change (%) (2014–2024)	Mean Annual Wage (2024)	Projected Total Employment (2034)	Projected Percent Change (%) (2024–2034)
Agriculture	Agricultural inspectors	300	230	-0.2	$58,279	233	1.5
Agriculture	Agricultural technicians	No data	80		$46,699	83	4.3
Agriculture	First-line supervisors of agricultural crop and horticultural workers	490	800	0.6	$58,710	820	2.5
Agriculture	Precision agriculture technicians	No data	30		$65,448	31	2
Agriculture	Soil and plant scientists	50		-1.0	$92,739	0	5.4
Buildings and Electricity Generation	Civil engineers	870	1060	0.2	$115,270	1113	5
Buildings and Electricity Generation	Construction and building inspectors	120	250	1.1	$83,355	248	-0.8
Buildings and Electricity Generation	Construction laborers	1620	2180	0.3	$58,525	2339	7.3
Buildings and Electricity Generation	Electricians	1050	1820	0.7	$74,582	1993	9.5
Buildings and Electricity Generation	Electro-mechanical technicians	No data	10		$63,821	10	1.1
Buildings and Electricity Generation	Electronics engineers	150	110	-0.3	$110	118	6.9
Buildings and Electricity Generation	Geothermal technicians	90			$48,866	0	1.5
Buildings and Electricity Generation	Heating and air-conditioning mechanics and installers	610	1070	0.8	$64,522	1157	8.1
Buildings and Electricity Generation	Solar photovoltaic installers	490	240		$55,734	341	42.1
Buildings and Electricity Generation	Weatherization installers and technicians	10040	15590	0.6	$69,196	16401	5.2
Buildings & Electricity Generation	Wind turbine service technicians	No data					49.9
Industry	Chemical engineers	140	170		$50,243	174	2.6
Industry	Commercial and industrial designers	No data	40		$72,794	41	3.2
Industry	Electrical engineers	160	310	0.9	$129,837	332	7.2
Industry	Industrial engineers	160	150	-0.1	$103,453	167	11

Table 7.D: Employment Trends in Priority Energy Occupations

Sector	Occupation	Historical Total Employment (2014)	Total Employment (2024)	Historical Percent Change (%) (2014–2024)	Mean Annual Wage (2024)	Projected Total Employment (2034)	Projected Percent Change (%) (2024–2034)
Industry	Machinists	270	260	0.0	$55,469	260	0
Industry	Manufacturing production technicians	16480	20680	0.3	$46,738	20453	-1.1
Transportation	Automotive engineering technicians	1360	1530	0.1	$58,484	1587	3.7
Transportation	Bus and truck mechanics and diesel engine specialists	650	760	0.2	$65,250	778	2.4
Transportation	Locomotive engineers						0.7
Transportation	Logistics analysts	120	320	1.7	$82,969	373	16.7
Transportation	Rail-track laying and maintenance equipment operators						1.6
Transportation	Transportation engineers	25910	40930	0.6	$46,086	42608	4.1
Transportation	Transportation managers	210	560	1.7	$103,056	594	6.1
Waste	Environmental engineers	90	130	0.4	$118,381	135	3.9
Waste	Recycling and reclamation workers	230	480	1.1	$57,124	484	0.9
Waste	Water/wastewater engineers	260	430	0.7	$73,500	402	-6.5
Working and Natural Lands	Forest and conservation technicians	No data	220		$59,649	213	-3.2
Working and Natural Lands	Hydrologists	120				0	-0.1
Working and Natural Lands	Natural sciences managers	70	80	0.1	$147,747	83	3.7

Source: United States Bureau of Labor Statistics, 2024.

7.3.2 Review of Climate Measures and Workforce Implications

This section identifies key occupations needed and the projected workforce demand for the relevant sectors.

Table 7.E includes the approximate number of workers needed by measure, demonstrating the increased need for workers who will be able to deploy solar and low-emission technologies in existing homes (Bundle Solar + Savings for Fresno Homes), as well as the need to upgrade commercial and institutional buildings by installing on-site renewable energy systems (Green-Up Commercial Buildings). It also highlights the need for workers to implement alternative manure management programs in livestock and poultry operations (Amp Up Alternative Manure Management Program in Livestock & Poultry Options). In contrast, for other measures there will be a reduction in the number of workers needed as seen in expanded electric vehicle (EV) charging infrastructure and incentivize EV purchasing (Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan), promote carpooling and other shared mobility options (Promote Carpool, Vanpool, and Shared Mobility Options), and expand protected bike lanes, sidewalks, and multi-use trains (Build Out the Bike and Pedestrian Network).

Table 7.E: Estimated Workforce Needed by Measure

Measure	Number of Workers Needed
Build Net-Zero New Homes	1,202
Advance Net-Zero New Commercial Buildings	2,128
Bundle solar + savings for Fresno homes	79,034
Green-Up Commercial Buildings	26,957
Expand Transit Options Across the County	1,543
Build Out the Bike and Pedestrian Network	-156
Promote Carpool, Vanpool, and Shared Mobility Options	-783
Accelerate Zero-Emission Personal Vehicles and Implement the EV Readiness Plan	-2,079
Electrify Commercial & Public Vehicle Fleets	172
Advance Zero-Emission Freight Vehicles	149
Transition Off-Road Vehicles & Equipment to ZEVs	0
Plow the Way to Zero-Emission Agricultural Equipment	0
Clean Up Wastewater Facilities	168
Decarbonize Fresno's Industry with Efficiency, Electrification, and Clean Fuels	7,171
Scale Up Waste Diversion and Circular Economy Programs	722
Develop Landfill Gas Capture and Utilization	13
Amp Up Alternative Manure Management Program in Livestock & Poultry Options	1,800
Grow the Urban Tree Canopy	14

A more detailed outline of how many new workers in Fresno are needed by occupation type, in order to implement actions, is demonstrated in Table 7.F. It is worth noting that motor vehicle manufacturing will not be needed over time, along with household appliance manufacturing. Conversely, construction, HVAC equipment manufacturing, industrial machinery manufacturing, electric power generation, transmission and distribution, and support activities for agriculture and forestry will all require an increasing workforce.

Table 7.F: Estimated Number of Jobs Created for Each Occupation

Occupation	Number of Workers Needed	
	2026–2050	2026–2032
Construction	98,920	88,876
HVAC equipment manufacturing	5,294	1,596
Household appliance manufacturing	-15	-15
Motor vehicle manufacturing	-2,601	70
Agriculture, construction, and mining machinery manufacturing	0	0
Industrial machinery manufacturing	6591	1,684
Electric power generation, transmission and distribution	7,317	5,266
Waste management and remediation services	735	266
Support activities for agriculture and forestry	1,800	597
Forestry	14	8

Similarly, Figure 7-11 (provided on the following page) gives an overview of how many workers will be needed over time in order to meet the measures outlined in the Low-Carbon Scenario. Two measures (Savings for Fresno Homes and Green-up Commercial Buildings) demonstrate a strong need for related jobs in the immediate future, which can be seen as the largest short-term employment drivers given that they are required for front-loaded construction efforts.

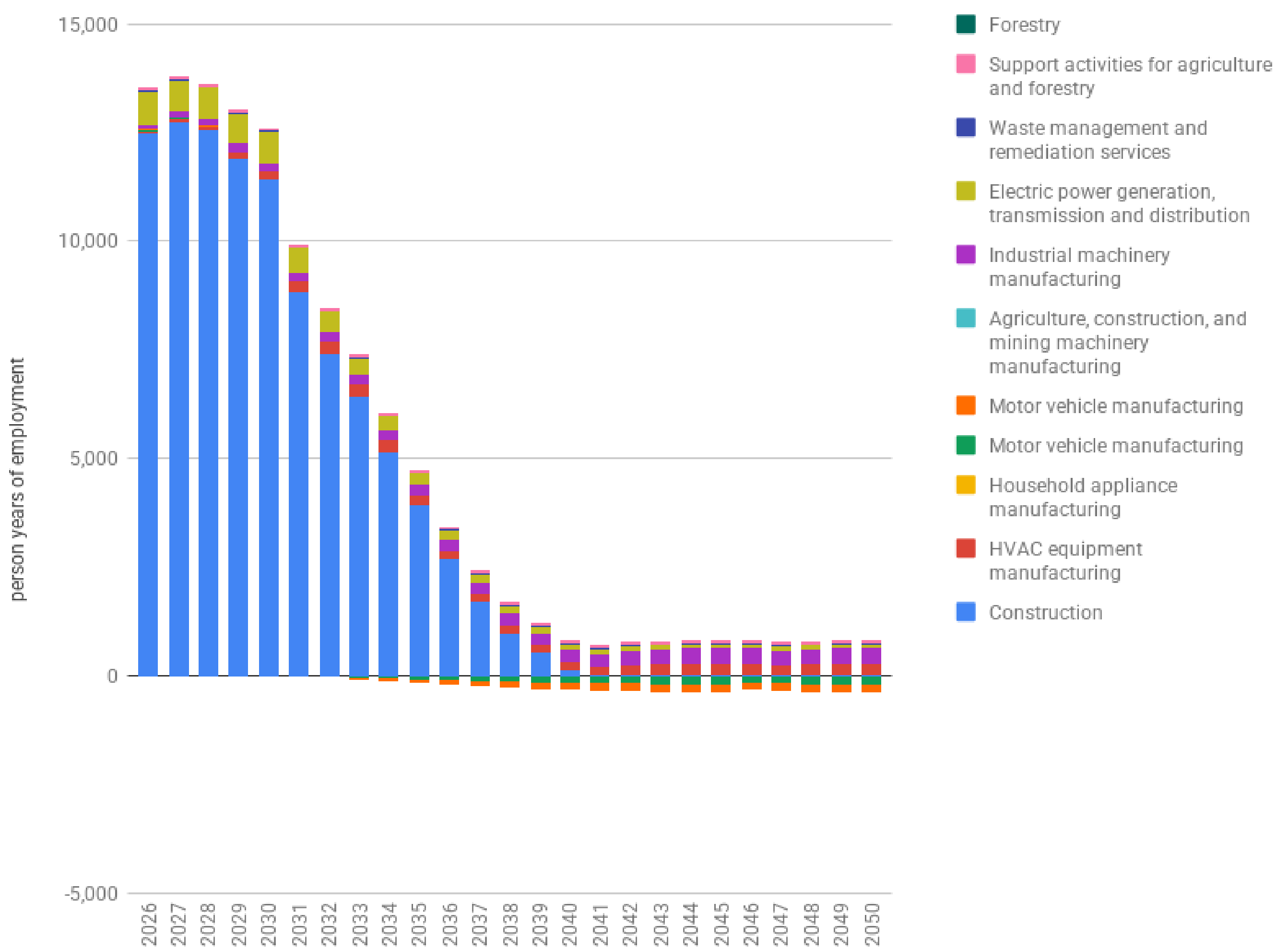
Most other measures (e.g., Build Net Zero New Homes, Advance Net-Zero New Commercial Buildings, Plow the Way to Zero-Emission Agricultural Equipment, Scale Up Waste Diversion and Circular Economy Programs) create only modest employment, generating under 500–700 jobs each. Some peak briefly every few years (e.g., Expand Transit Options Across the County). A few measures (e.g., Build out the Bike and Pedestrian Network, Clean up Wastewater Facilities, Amp up Alternative Manure Management Program) contribute even less, generating around 100–200 jobs each.

After 2040, employment across all measures flattens to very low levels, suggesting that much of the workforce demand is during the initial build-out and transition period to the Low-Carbon Scenario. Those measures that yield high employment are labor-intensive construction and retrofitting, whilst the less required but longer-term jobs are related to maintenance, management, and incremental improvement.

The creation of new industries and jobs provides opportunities to address inequalities related to housing, income and rural-urban disparities without the pressure of excessive growth. For example, jobs created by climate change mitigation strategies could help reduce unemployment for marginalized groups and low-income and disadvantaged communities (LIDAC).

7.3.3 Workforce Shortages and Challenges

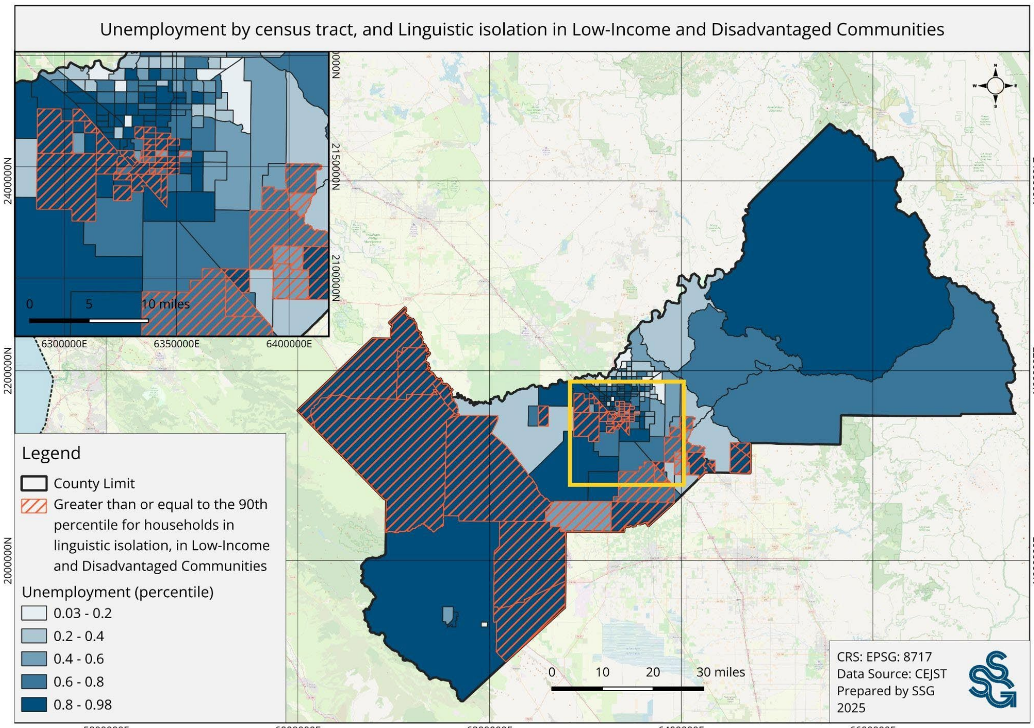
This section highlights LIDAC considerations, focusing on linguistic, racial, and gender disparities, which need to be reflected in workforce planning in Fresno County in order to attain equitable growth across the county.



Source: SSG (2025).

Figure 7-11: Person-Years of Employment Created in the Low-Carbon Scenario, 2026–2050

Figure 7-12 depicts Fresno County, with the City of Fresno highlighted in yellow. It visualizes unemployment levels in terms of percentile, as well as LIDACs which have high rates of linguistic isolation. The map demonstrates that the urban centre has both higher unemployment and higher linguistic isolation, highlighting the density of non-English speaking populations. It also suggests compounded barriers to secure employment: residents in these tracts face both difficulty accessing jobs and language barriers that may limit opportunities.



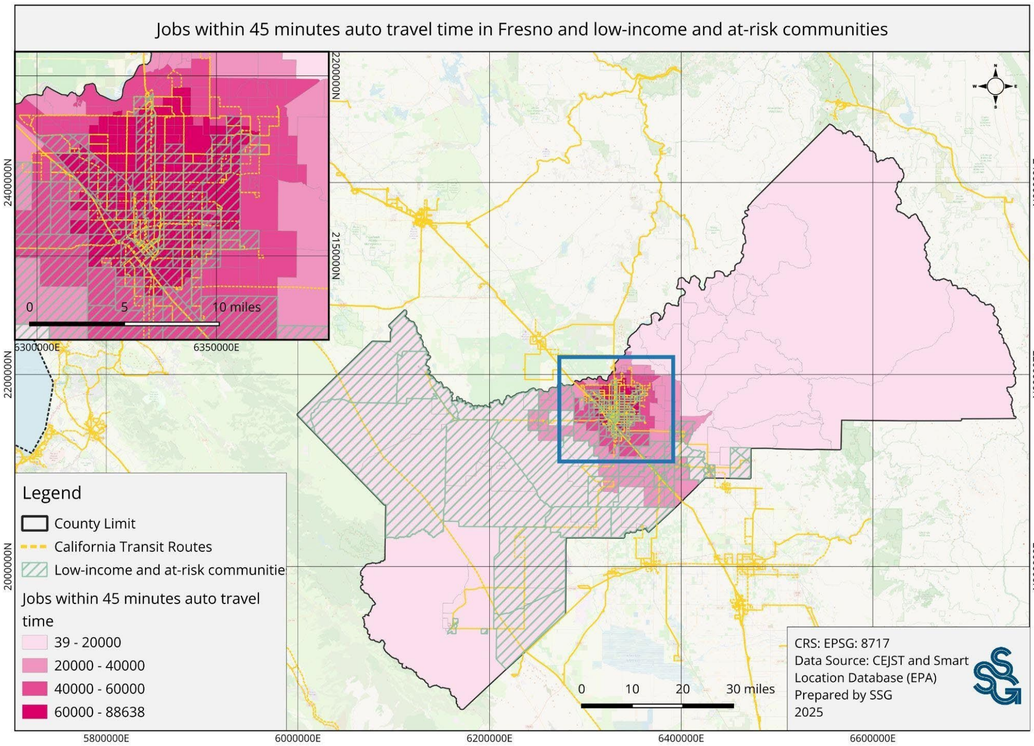
Source: SSG (2025).

Figure 7-12: Unemployment by Census Tract and Linguistic Isolation in Low-Income and Disadvantaged Communities

The highest unemployment and linguistic isolation tracts are concentrated in southwest and southeast Fresno, which are areas which have historically been home to immigrant communities and LIDACs. The rural parts of the county, to the south and east, also have high unemployment rates but less linguistic isolation, which may reflect agricultural areas with seasonal and unstable work patterns. This suggests that rural areas face economic disconnection, as opposed to language barriers, which is the primary concern in the urban core.

Workforce and climate-transition programs targeting both rural and urban areas must consider language access and culturally appropriate outreach. Strategies should be place-based, focusing job training, solar and retrofit opportunities, and transportation programs where both unemployment and linguistic isolation overlap.

Figure 7-13 further outlines the differences in urban and rural workforce and employment access, but also takes into consideration automobile commuting. There is a concentration of jobs in Fresno's urban core, with the number of accessible jobs decreasing as you move outward, toward rural Fresno County.

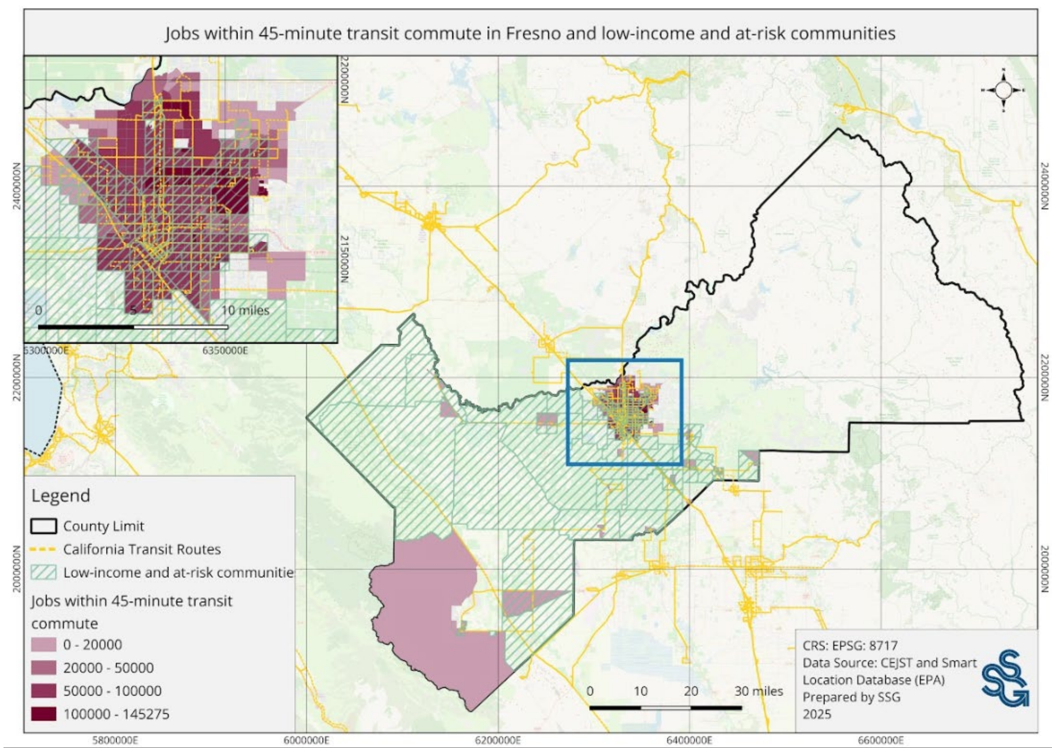


Source: SSG (2025).

Figure 7-13: Jobs Within 45 Minutes Auto Travel Time in Fresno and Low-Income and At-Risk Communities

Rural and peripheral areas face job scarcity, particularly in southern and eastern areas of the county. These areas are also home to many agricultural workers and disadvantaged communities, meaning long commutes or limited employment opportunities are likely. Transit routes connect but may not fully bridge access between potential workers and potential jobs. Contributing factors could also be that major highways and roads are concentrated in and around Fresno city, and rural communities may face transportation inequities if they lack reliable car access, which limits the benefits of a short distance job catchment area.

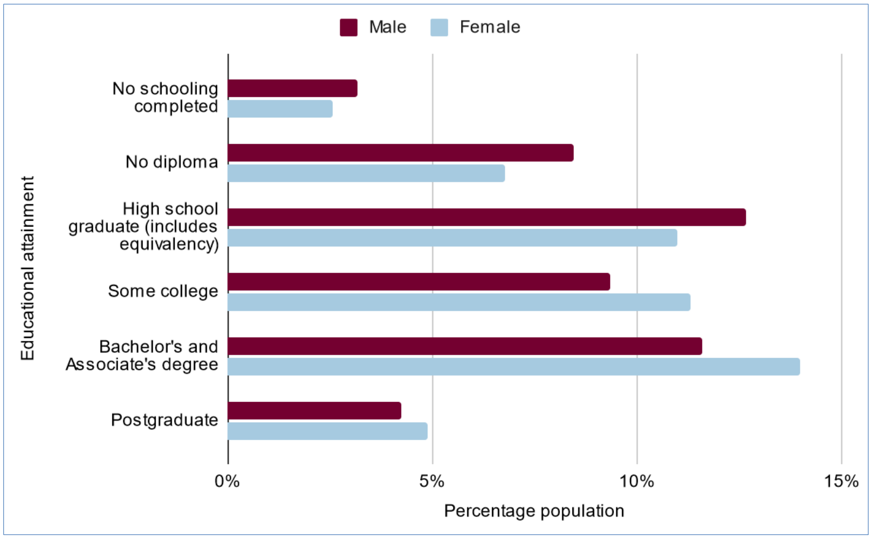
Unlike Figure 7-13, Figure 7-14 indicates that most rural areas in Fresno County show very low job accessibility by transit. This confirms that transit coverage is largely confined to the Fresno metro core. What is worth noting is that at-risk communities may benefit from transit access for employment; this is apparent given that these communities overlap greatly with the job-rich areas on the map. However, proximity does not correlate with equal access. Transportation, affordability and discrimination are all factors which may be barriers. Additionally, and as is visible in several maps later discussed in this section, centrally located, low-income residents may have good access to jobs via transit, but educational attainment and occupational barriers may prevent them from securing high-wage roles.



Source: SSG (2025).

Figure 7-14: Jobs Within 45 Minutes Transit Commute in Fresno and Low-Income and At-Risk Communities

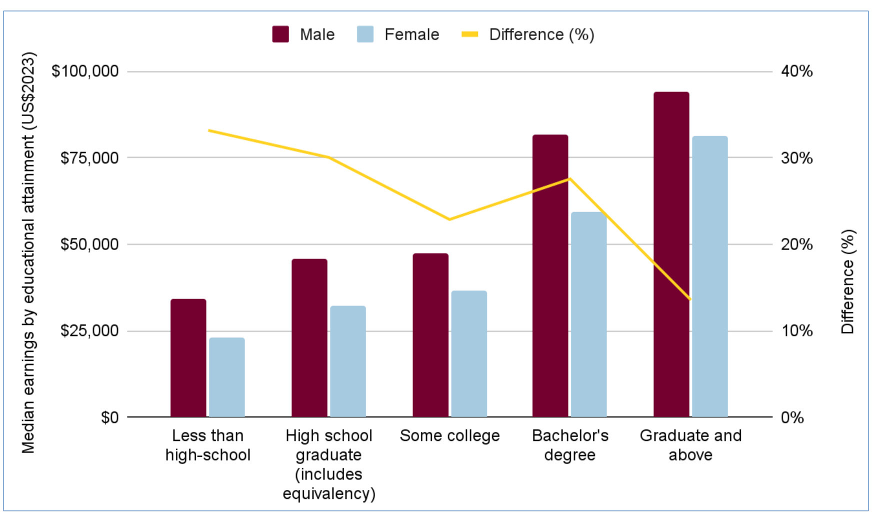
Figure 7-15 shows the percentage of educational attainment by gender in Fresno in 2023. At lower levels of education, males have slightly less schooling levels. There is also a larger share of males than females that have no diploma, suggesting that men are more likely to leave school before completing college. This is also supported by the fact that there are more high school graduates that are male than female, but a greater number of females who have some college education, a bachelor’s degree, or postgraduate education than men, indicating that many men in Fresno stop their education after high school. The biggest gap between men and women is at the bachelor and associate degree level, with women far surpassing men.



Source: Adapted from Census Reporter (2024).

Figure 7-15: Percentage of Educational Attainment by Gender in Fresno, 2023

Figure 7-16 below gives further detail to educational attainment by gender, by presenting an earnings difference between males and females. Key findings include that earnings increase strongly with education for both genders; however, men earn more than women at every education level. The largest gender gap (approximately 30%) is at the bachelor's degree level. At the graduate level, the gender gap narrows slightly, but men still lead in earnings. At lower levels of education, including less than high school or some college, the wage gap is smaller in terms of percentage but still apparent.

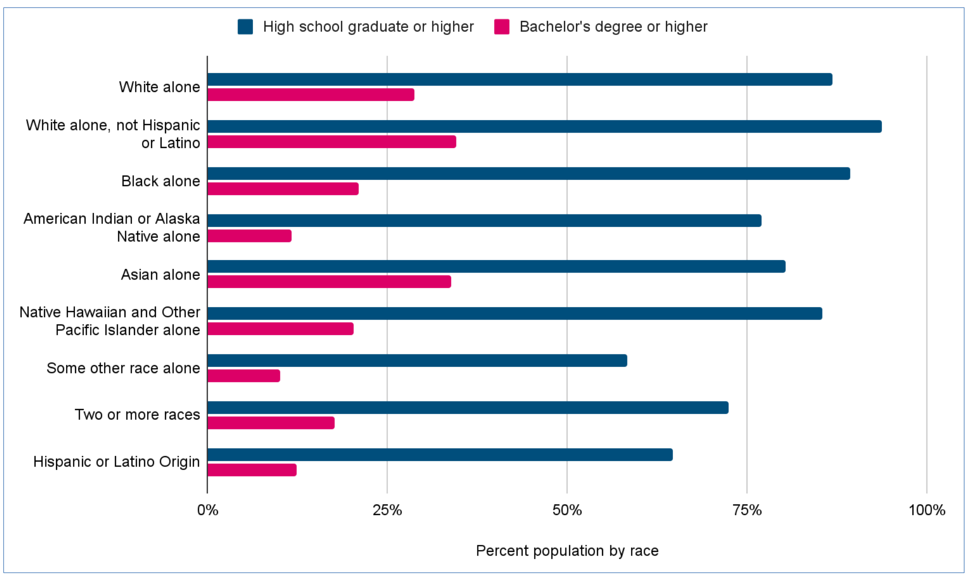


Source: Adapted from Census Reporter (2024).

Figure 7-16: Median Earning by Educational Attainment by Gender in Fresno, 2023

Given that women are advancing in education levels but not seeing equal returns in the labor market, this suggests a structural wage inequality, whereby women may be concentrated in lower-paying fields (e.g., education or healthcare support), while men may dominate in high-paying industries (e.g., construction, engineering, trades, and management) even when they have less education.

According to Figure 7-17, there are trends between racial identity and rates of education, which make it important to understand who is graduating from high school and/or higher education. [120] Those with the highest attainment, in terms of high school graduation or higher, are White alone. This means that, from those accounted for in Fresno in the 2024 Census, approximately 95% of those identified as White alone were a high school graduate or higher. Those identified as Asian alone and Black alone also had high levels of high school attainment or higher (approximately 85% to 90%). The lowest attainment were those of Hispanic or Latino origin (approximately 65%), other races (approximately 60%), and American Indian/Alaska Native alone (approximately 75%).



Source: SSG (2025). Adapted from Census Reporter (2024).

Figure 7-17: Educational Attainment by Race in Fresno, 2023

[120] Note that "High school graduate or higher" includes individuals whose highest level of education is a high school diploma, General Educational Development (GED), some college, associate degree, bachelor's degree, or graduate/professional degree. "Bachelor's degree or higher" is a subset of this group and includes only those with a bachelor's, graduate, or professional degree. Categories are based on the highest level of educational attainment reported in the ACS and are mutually exclusive.

In terms of attaining a bachelor's degree or higher, those who identified as Asian alone had the highest levels (approximately 40%). A moderate level of attainment were from White alone, not Hispanic/Latino (approximately 35%), Black alone (approximately 25%), and two or more races (approximately 25%). Those with the lowest levels of attainment were Hispanic or Latino (approximately 15%), some other races (approximately 10%), and American Indian/Alaska Native (approximately 10%).

What this indicates is that firstly, Hispanic/Latino and Other Race groups are much less likely to graduate high school or earn a bachelor's degree compared to White and Asian groups. Secondly, Black and American Indian/Alaska Native groups have mixed results whereby there are strong levels of completion of high school, but bachelor's degree attainment lags compared to White and Asian groups.

When reviewing educational attainment disparities in Fresno, as discussed above, alongside Table 7.G (provided on the following page), which indicates education needed by occupation, there are several components to workforce planning that are worth taking into consideration. For those with a high school education or less, on-the-job training and apprenticeships would be needed for the following positions: construction laborers, electricians, machinists, bus/truck mechanics, locomotive engineers, solar photovoltaic (PV) installers, wind turbine technicians, and rail-track operators. These positions may attract more men than women given that there are more men who stop their educational attainment at high school.

The following jobs require an associate or post-secondary certificate: agricultural technicians, electro-mechanical technicians, geothermal technicians, weatherization technicians, manufacturing technicians, automotive engineering technicians, and forest/conservation technicians. Women are more likely to hold associate degrees; however, men could be drawn to these positions if applicable workforce training programs are available.

There are a number of jobs that require a bachelor's degree or higher. These include soil and plant scientists, hydrologists, natural sciences managers, logistics analysts, and designers and civil, electrical, chemical, industrial, environmental, transportation, and water and wastewater engineers. Given that there are more women than men receiving higher education in Fresno, they may be better positioned for these roles.

Table 7.G: Typical Education Needed for Entry by Occupation

Occupation	No Formal Educational Credential	High School Diploma or Equivalent	Post-Secondary Non-Degree Award	Associate's Degree	Bachelor's Degree	Typical on-the-Job Training Needed to Attain Competency in the Occupation
Agricultural inspectors					●	Moderate-term on-the-job training
Agricultural technicians				●		Moderate-term on-the-job training
First-line supervisors of agricultural crop and horticultural workers		●				None
Precision agriculture technicians		●				Long-term on-the-job training
Soil and plant scientists					●	None
Civil engineers					●	None
Construction and building inspectors		●				Moderate-term on-the-job training
Construction laborers	●					Short-term on-the-job training
Electricians		●				Apprenticeship
Electro-mechanical technicians				●		None
Electronics engineers						—
Geothermal technicians				●		Moderate-term on-the-job training
Heating and air-conditioning mechanics and installers			●			Long-term on-the-job training
Solar photovoltaic installers		●				Moderate-term on-the-job training
Weatherization installers and technicians						—
Wind turbine service technicians			●			Long-term on-the-job training
Chemical engineers					●	None
Commercial and industrial designers					●	None
Electrical engineers					●	None
Industrial engineers					●	None
Machinists		●				Long-term on-the-job training
Manufacturing production technicians						—
Automotive engineering technicians						—
Bus and truck mechanics and diesel engine specialists		●				Long-term on-the-job training
Locomotive engineers		●				Moderate-term on-the-job training
Logistics analysts					●	None

Table 7.G: Typical Education Needed for Entry by Occupation

Occupation	No Formal Educational Credential	High School Diploma or Equivalent	Post-Secondary Non-Degree Award	Associate's Degree	Bachelor's Degree	Typical on-the-Job Training Needed to Attain Competency in the Occupation
Rail-track laying and maintenance equipment operators		●				Moderate-term on-the-job training
Transportation engineers						—
Transportation managers		●				None
Environmental engineers					●	None
Recycling and reclamation workers	●					Short-term on-the-job training
Water/wastewater engineers		●				Long-term on-the-job training
Forest and conservation technicians				●		None
Hydrologists					●	None
Natural sciences managers					●	None

Source: SSG (2025). Adapted from BLS, Occupational Employment Projections Data (2024).

7.4 SOLUTIONS AND PARTNERSHIPS

7.4.1 Workforce Needs by Climate Sector

Table 7.H outlines potential workforce needs by sector, indicating where there is a need for training, staffing, certification, transitional workforce, or increased career pathway awareness.

Table 7.H: Potential Workforce Needs by Sector

Sector	Job Training	Additional Staffing	Employees With Specialty Certifications	Support for Transitional Workforce	Career Pathway Awareness and Education
Energy	●	●	●	●	●
Buildings	●	●	●	●	●
Transportation	●			●	
Waste and Industry	●				●
Agriculture and Nature-Based Solutions	●				●

7.4.2 Workforce Development Solutions

To close the gaps in workforce needs for CCAP-A implementation, Fresno County will focus on a workforce development strategy with three key goals:

1. Incorporate Good Jobs Principles to create high-quality jobs
2. Workforce development which benefits all communities and individuals in the region
3. Closing gaps through partnerships and mobilizing funding

7.4.2.1 Good Jobs Principles

During the planning and implementation of climate actions, quality jobs will be built into the project-planning process. High-quality jobs are those that provide stable pay, job security, safe working conditions, and secure benefits to support workers and their families.

Employers will be supported in reducing barriers to accessing high-quality jobs by removing unnecessary hiring requirements, providing reasonable accommodations to individuals with disabilities during the hiring process, recruiting from communities underrepresented in the workforce, and providing transparent pay schedules with equal wages and career ladders.

In 2022, the United States Department of Commerce and Department of Labor partnered to define what makes a good job. The “Good Jobs Principles” provide a framework for employers, workers, and governments for creating stable, secure jobs with livable wages and safe working conditions. The eight principles are outlined below and can be a guide for developing future workforce development programs, training, job support, and recruitment initiatives.

- **Recruitment and Hiring:** Qualified applicants are actively recruited. Applicants are free from discrimination, including unequal treatment or application of selection criteria that are unrelated to job performance. Applicants are evaluated with relevant skills-based requirements. Unnecessary credentials and educational and experience requirements are minimized.

- **Benefits:** Full-time and part-time workers are provided benefits that promote economic security and mobility. These include health insurance; a retirement plan; workers' compensation benefits; work-family benefits, such as paid leave and caregiving supports; and others that may arise from engagement with workers. Workers are empowered and encouraged to use these benefits.

- **Equal Opportunity:** All workers have equal opportunity. Workers are respected, empowered and treated fairly. Individuals from underserved communities do not face systemic barriers in the workplace. Underserved communities are persons adversely affected by persistent poverty, discrimination or inequality, including Black, Indigenous, people of color; LGBTQ+ individuals; women; immigrants; veterans; military spouses; individuals with disabilities; individuals in rural communities; individuals without a college degree; individuals with or recovering from substance use disorder; and justice-involved individuals.

- **Empowerment and Representation:** Workers can form and join unions. Workers can engage in protected, concerted activity without fear of retaliation. Workers contribute to decisions about their work, how it is performed and organizational direction.

- **Job Security and Working Conditions:** Workers have a safe, healthy and accessible workplace, built on input from workers and their representatives. Workers have job security without arbitrary or discriminatory discipline or dismissal. They have adequate hours and predictable schedules. The use of electronic monitoring, data and algorithms is transparent, equitable and carefully deployed with input from workers. Workers are free from harassment, discrimination and retaliation at work. Workers are properly classified under applicable laws. Temporary or contractor labor solutions are minimized.

- **Organizational Culture:** All workers belong, are valued, contribute meaningfully to the organization and are engaged and respected, especially by leadership.

- **Pay:** All workers are paid a stable and predictable living wage before overtime, tips and commissions. Workers' pay is fair, transparent and equitable. Workers' wages increase with increased skills and experience.

- **Skills and Career Advancement:** Workers have equitable opportunities and tools to progress to future good jobs within their organizations or outside them. Workers have transparent promotion or advancement opportunities. Workers have access to quality employer- or labor-management-provided training and education.

7.4.3 Partnerships to Address Gaps

To effectively align the CCAP-A with workforce development, Fresno County will need to leverage existing partnerships and programs while seeking opportunities to expand them. The following sections outline existing and potential partners, cross-sector partnerships, and how these can support workforce development. The focus is on programs and partnerships that can provide training and reskilling programs, apprenticeships, and career awareness programs.

Table 7.I (provided on the following pages) lists existing entities, their level of government, the type of resource their partnership would offer and how it aligns to the CCAP-A action areas.

7.4.3.1 Potential Partnerships and Solutions

Many existing programs are listed in the table above. If these programs are not currently being leveraged, it is worth exploring these options and developing partnerships with the organizations to expand them.

To address workforce gaps, further ideas for consideration are detailed below. These take into consideration the Workforce Shortages and Challenges section outlined previously.

7.4.3.2 Clean Energy Workforce Development

Fresno has high solar potential and an aging housing stock, which will require a workforce trained in solar installation, weatherization technicians, electricians and construction laborers. In order to support solar and building retrofits, a high labor demand in the early years of transition (2026–2040) could focus on populations in Fresno's urban core, promoting entry-level positions and training which is localized. Potential partners to consider include community colleges and technical schools (e.g., Fresno City College or Reedley College), the California Workforce Development Board, the Fresno County Economic Development Corporation (EDC), solar companies (e.g., SunPower, Tesla, and Sunrun), and International Brotherhood of Electrical Workers (IBEW) Local 100 (Fresno Chapter). A "Solar and Trades Training Program" could provide short-term certifications in solar installation, weatherization, electrical work, and green construction. Furthermore, additional apprenticeship-to-hire pipelines could be set up with solar firms for low-income neighborhoods.

7.4.3.3 Transportation, Logistics, and EV Fleet Training

Transportation and logistics related jobs, including bus and truck mechanics, transportation laborers, logistics analysts, and EV fleet technicians, would offer stable, longer-term employment, though may require more advanced training.

Potential partners to consider include local trucking companies and distribution centers (e.g., Amazon, UPS, or local produce distributors). As mentioned in the section above, the California Air Resources Board (CARB) and Fresno County EDC may also have existing opportunities to utilize. Lastly, community colleges or trade schools that offer heavy-duty mechanic training would also be worth considering in partnership. A potential opportunity to consider includes establishing an EV fleet maintenance training program with logistics employers. Funding can also be sought from CARB or CalSTART to incentivize fleet electrification and to train existing mechanics. Lastly, partnering with local transit agencies (e.g., Fresno Area Express [FAX]) could offer an opportunity to train mechanics and technicians for electric bus fleets.

Table 7.I: Existing Initiatives and Potential Partnerships

Entity	Level of Government	Description	Workforce Resource Type	Alignment with Proposed Action Areas
Government & Workforce Boards				
Fresno Regional Workforce Development Board (FRWDB) / Workforce Connection[1]	City, County	The FRWDB is a Joint Powers Authority between the City of Fresno and the County of Fresno. It manages Workforce Innovation and Opportunity Act funding, disbursed by the United States Department of Labor, with the goal of providing services to support participants in finding work and businesses in finding skilled workforce. Fresno Regional Countywide Workforce One-Stop Centers are intended to support clients with job searching, training, retraining, and referrals.	• Funding • Career Awareness and Education Pipelines • Training and Reskilling	Covers various action areas
Fresno County Department of Social Services (California Work Opportunity and Responsibility to Kids [CalWORKs]/ Employment Services)[2]	County	Fresno County Department of Social Services (DSS) funds a welfare program, CalWORKs, which focuses on various services, including employment-related supportive services, for eligible California families in need. New Employment Opportunities Program (NEO) is promoted via Fresno Economic Development Corporation (EDC). DSS can offer assistance with hiring strategies and subsidized employment to employers who hire its clients.	• Funding • Career Awareness and Education Pipelines • Training and Reskilling • Apprenticeship	Covers various action areas
California Climate Action Corps (CCAC)[3]	State	This CCAC fellowship places fellows with dozens of public agency, nonprofit, tribal, and educational institution host partners throughout the state to support State and local climate goals. Individuals can apply to become fellows.	• Apprenticeship	Covers various action areas
California Conservation Corps[4]	State	The California Conservation Corps Training and Workforce Development Program enrolls young adults for a year of service resulting in job skills and work experience to launch meaningful careers. California Conservation Corps members implement forest fuel reduction, habitat restoration, and energy efficiency projects, which reduce greenhouse gas emissions.	• Training and Reskilling Program • Apprenticeship	Focused on: Green Buildings and Energy, Electrification, Urban Tree Canopy
California Energy Commission (CEC)[5]	State	The Inclusive, Diverse, Equitable, Accessible, and Local (IDEAL) Zero-Emission Vehicle (ZEV) Workforce Pilot funds projects that support ZEVs, ZEV infrastructure, and ZEV-related commercial technologies in California, with focus on priority populations	• Funding • Training and Reskilling Program • Apprenticeship	Focused on: Electrification

Table 7.I: Existing Initiatives and Potential Partnerships

Entity	Level of Government	Description	Workforce Resource Type	Alignment with Proposed Action Areas
California Air Resources Board (CARB)[6]	State	CARB's Planning and Capacity Building grants support a variety of community-led planning and capacity-building projects that help increase transportation equity and advance a community's vision. These grants cover capacity building, education and outreach, workforce training, and more. Local governments and community-based organizations are eligible for funding.	• Funding • Training and Reskilling Program • Apprenticeship • Career Awareness	Focused on: Transit and Shared Mobility
Reentry Employment Opportunities (REO) Program through the United States Department of Labor[7]	Federal	The REO program provides funding for justice-involved youth and young adults and adults who were formerly incarcerated.	• Funding • Training and Reskilling Program • Apprenticeship • Career Awareness	Covers various action areas
Workforce Pathways for Youth (WPY) Program through the United States Department of Labor[8]	Federal	The WPY program expands job training and workforce activities for youth, including soft-skill development, career exploration, job readiness and certification, summer jobs, year-round job opportunities, and apprenticeships in out-of-school time organizations nationwide.	• Training and Reskilling Program • Apprenticeship • Career Awareness	Covers various action areas
Youth Connections Community through the United States Department of Labor[9]	Federal	The Youth Connections Community is an online learning destination for public workforce system staff and partners who serve youth in the Workforce Innovation and Opportunity Act Youth Program	• Knowledge Sharing	Covers various action areas
YouthBuild Community through the United States Department of Labor[10]	Federal	The YouthBuild Community is a shared electronic space where grantees can support each other in implementing successful programs, sharing tools and fostering partnerships	• Knowledge Sharing	Covers various action areas
Career Pathways Community through the United States Department of Labor[11]	Federal	The Career Pathways Community helps workforce development leaders, practitioners and policymakers expand State and local career pathways efforts currently underway or being planned.	• Knowledge Sharing	Covers various action areas
Map a Career in Clean Energy through the United States Department of Energy (DOE)[12]	Federal	This interactive mapping tool showcases careers in clean energy based on the user's education and experience. The user can explore opportunities in advanced manufacturing, bioenergy, green buildings, hydrogen and fuel cells, hydropower, marine energy, solar, and wind.	• Career Awareness	Focused on: Green Buildings and Energy, and Electrification
Union & Apprenticeship Pathways				
Valley Apprenticeship Connections (VAC) through Fresno Economic Opportunities Commission (EOC)[13]	County	Fresno EOC Valley Apprenticeship Connections pre-apprenticeship 12-week training program prepares residents for union apprenticeships tied to upcoming infrastructure and climate-related construction.	• Training and Reskilling Program • Apprenticeship • Career Awareness	Focused on: Green Buildings and Energy, Transit and Shared Mobility

Table 7.I: Existing Initiatives and Potential Partnerships

Entity	Level of Government	Description	Workforce Resource Type	Alignment with Proposed Action Areas
Central California Electrical Training Institute (CCETI)[14]	County, State	Located in Fresno, apprenticeship programs through CCETI can support skills development in retrofitting and renewable energy installation.	• Training and Reskilling Program • Apprenticeship • Career Awareness	Focused on: Green Buildings and Energy
Central Valley Training Center through the California High-Speed Rail Authority and the City of Selma[15]	City, County	At the Central Valley Training Center, over a 10-week course, students receive comprehensive and innovative training to help launch their careers. This workforce development center provides pre-apprenticeship classes and hands-on construction industry training for Central Valley residents. This center and its programs are aimed at serving veterans, at-risk young adults, minority and low-income populations.	• Training and Reskilling Program • Apprenticeship	Focused on: Transit and Shared Mobility
Community-Based & Nonprofit Programs				
Proteus Inc. through Fresno EOC	State, County	Proteus Inc. has a Sustainable Energy Efficiency Development (SEED) program in their Energy Services Division that trains Migrant Seasonal Farm Workers for careers outside of agriculture, including in the solar energy and weatherization sectors. The organization uses on-the-job training to reimburse employers as well as a training subsidy program to offer stable employment for Proteus participants through on-site training.	• Training and Reskilling Program	Focused on: Green Buildings and Energy
GRID Alternatives Central Valley[16]	County, City	Offering solar installation workforce training and hands-on experience; Central Valley main office and training lab are in Fresno.	• Training and Reskilling Program • Apprenticeship	Focused on: Green Buildings and Energy
Local Conservation Corps (LCC) through Fresno EOC[17]	County	LCC has paid skill-building vocational training programs. Through the LCC's College and Career Center, LCC members have the opportunity to explore and prepare for postsecondary and career pathways.	• Training and Reskilling Program • Career Awareness	Focused on: Waste and Urban Tree Canopy
Central Valley Community Foundation (CVCF)[18]	State, County	A trusted leader in local philanthropy, leading local community programs, CVCF works on transformative change and has experience with climate initiatives not only in Fresno but the San Joaquin Valley and State. It acted as LIDAC representatives on the Priority Climate Action Plan (PCAP) Stakeholder Steering Committee.	• Various	Covers various action areas
Good Jobs Challenge through Fresno County EDC[19]	County	A regional economic development organization advancing business growth, job creation, and workforce development across Fresno County and the Central Valley. The EDC is implementing the *Good Jobs 4 the Central Valley* initiative through the United States EDA Good Jobs	• Job Training and Employment Program • Economic and Workforce	Supports creation of skilled jobs in clean, diversified, and climate-resilient sectors, including industrial decarbonization,

Table 7.I: Existing Initiatives and Potential Partnerships

Entity	Level of Government	Description	Workforce Resource Type	Alignment with Proposed Action Areas
		Challenge, focused on training and placing residents—particularly from underrepresented communities—into quality jobs that support economic diversification and climate-resilient industries.	Development Resource	green manufacturing, transportation and logistics efficiency.
Leadership Counsel for Justice and Accountability (Leadership Counsel)[20]	State	The Leadership Counsel influences land use and transportation planning and public investment priorities, guides environmental policy, and promotes the provision of basic infrastructure and services through community organizing. Fresno's PCAP project team partnered with the Leadership Council for LIDAC outreach.	• Various	Covers various action areas

1 Fresno Regional Workforce Development Board. n.d. Website: https://frwdb.net/ (accessed September 23, 2025).
2 Fresno County Department of Social Services. n.d. Employment Services. Website: https://www.fresnocountyca.gov/Departments/Social-Services/Assistance-Programs/Employment-Services (accessed September 23, 2025).
3 California Climate Investments. n.d. California Climate Action Corps. Website: https://www.caclimateinvestments.ca.gov/california-climate-action-corps (accessed September 23, 2025).
4 California Climate Investments. n.d. Training and Workforce Development Program. Website: https://www.caclimateinvestments.ca.gov/training-workforce (accessed September 23, 2025).
5 California Climate Investments. n.d. IDEAL ZEV Workforce Pilot Project. Website: https://www.caclimateinvestments.ca.gov/ideal-zev-workforce (accessed September 23, 2025).
6 California Climate Investments. n.d. Planning and Capacity Building Grants. Website: https://www.caclimateinvestments.ca.gov/planning-and-capacity-building-grants (accessed September 23, 2025).
7 United States Department of Labor, Employment and Training Administration. n.d. Reentry Employment Opportunities. Website: https://www.dol.gov/agencies/eta/reentry (accessed September 23, 2025).
8 United States Department of Labor, Employment and Training Administration. n.d. Workforce Pathways for Youth. Website: https://www.dol.gov/agencies/eta/youth/workforce-pathways-for-youth (accessed September 23, 2025).
9 United States Department of Labor, Employment and Training Administration. n.d. Youth Connections Community. Website: https://youth.workforcegps.org/ (accessed September 23, 2025).
10 United States Department of Labor, Employment and Training Administration. n.d. YouthBuild Community of Practice. Website: https://youthbuild.workforcegps.org/ (accessed September 23, 2025).
11 United States Department of Labor, Employment and Training Administration. n.d. Career Pathways Community. Website: https://careerpathways.workforcegps.org/ (accessed September 23, 2025).
12 United States Department of Energy, Office of Energy Efficiency and Renewable Energy. n.d. Map a Career in Energy. Website: https://www.energy.gov/eere/jobs/map-career-energy (accessed September 23, 2025).
13 Fresno Economic Opportunities Commission. n.d. Valley Apprenticeship Connections. Website: https://fresnoeoc.org/valley-apprenticeship-connections/ (accessed September 23, 2025).
14 Central California Electrical Training Institute. n.d. Website: https://www.cceti.org/ (accessed September 23, 2025).
15 Central Valley Training Center. n.d. Website: https://cvtcprogram.com/ (accessed September 23, 2025).
16 GRID Alternatives Central Valley. n.d. Website: https://gridalternatives.org/regions/cv (accessed September 23, 2025).
17 Fresno Economic Opportunities Commission. n.d. Local Conservation Corps. Website: https://fresnoeoc.org/lcc/ (accessed September 23, 2025).
18 Central Valley Community Foundation. n.d. Website: https://centralvalleycf.org/ (accessed September 23, 2025).
19 Fresno County Economic Development Corporation (EDC). n.d. Good Jobs 4 the Central Valley. Website: https://www.fresnoedc.com/goodjobs (accessed November 4, 2025).
20 Leadership Counsel for Justice & Accountability. n.d. Website: https://leadershipcounsel.org/ (accessed September 23, 2025).

7.4.3.4 Circular Economy and Waste Diversion

The growing role of waste diversion, landfill gas capture, and circular economy means that certain jobs (e.g., recycling and reclamation workers and water and wastewater engineers) will offer both urban and rural communities distributed employment, particularly if there are lower-barrier entry roles.

Potential partners include California Department of Resources Recycling and Recovery (CalRecycle), private waste management firms (e.g., Mid Valley Disposal), and water technology firms and researchers (e.g., Fresno State's Center for Irrigation and Technology). These partnerships could be used to launch a "Green Careers Incubator" for entry-level waste diversion, recycling, and landfill methane recovery roles. A series of waste-to-energy pilot projects could also be developed in rural areas with CalRecycle and local farms. Lastly, creating water/wastewater technician pipelines through high school vocational programs could be an opportunity, and would focus especially on rural school districts.

7.4.3.5 *Sustainable Agriculture and Tech Transition*

Given that Fresno's economy is agriculture-driven, emerging roles such as precision agriculture technicians, and zero-emission agricultural equipment operators offer an opportunity to transition farmworkers into tech-enabled sustainable agriculture roles.

Partners worth exploring include University of California Agriculture and Natural Resources (UC ANR); Fresno State's Jordan College of Agricultural Sciences and Technology; agriculture technology companies (e.g., Blue White Robotics and Trimble); and lastly, farmworker unions and advocacy groups, including United Farm Workers. It may be worth considering the creation of a Farmworker-to-AgTech pipeline through training in precision farming, drone monitoring, and electric equipment operation. It is also worth ensuring that State or United States Department of Agriculture (USDA) funding for zero-emission farming equipment pilot programs have been secured. Lastly, Fresno could offer mobile training units to bring upskilling opportunities directly to rural communities.

7.4.3.6 Language Access Support

As an overarching consideration, workforce development initiatives must include robust language access support to ensure equitable participation across Fresno County's diverse communities. The city of Fresno faces an immediate demand for workers in solar installation, building retrofits, recycling, and electric vehicle (EV) fleet maintenance. To meet these needs, training and placement programs should incorporate bilingual instruction and translation services that allow non-English-speaking residents to fully engage in these rapidly growing sectors.

In contrast, rural areas of Fresno County may be better positioned for workforce growth in sustainable agriculture, water management, and logistics. These communities would benefit from targeted training that bridges existing agricultural experience with emerging technology-based roles, such as precision agriculture, irrigation efficiency, and clean fleet operations.

Cross-cutting support systems—such as English as a Second Language (ESL) programs integrated with job training and registered apprenticeships—can strengthen career mobility and access to union pathways in construction, retrofits, and clean energy trades. Partnerships with community-based organizations (CBOs) such as the Fresno County EDC, Fresno Economic Opportunities Commission (EOC), Fresno Metro Black Chamber of Commerce, and local labor unions can play a critical role in delivering culturally and linguistically accessible training and connecting participants to stable, well-paying green jobs.

7.5 TRACKING AND MEASURING WORKFORCE PROGRESS

To ensure that workforce initiatives are meeting their intended audience, providing successful career and training outcomes, and meeting the Good Jobs Principles, program progress will need to be measured and tracked consistently over time. The types of metrics tracked will depend upon the types of workforce initiatives, the availability of data and the frequency with which data can be tracked and updated. These metrics can also be supported through the collection of qualitative data from regular meetings with industry leaders, community organizations, policy makers and workers in green industries. This can provide additional insight into workforce initiatives and ensure alignment with workforce goals and needs.

Key performance metrics will need to be refined during the program design and planning process. Metrics will be developed in partnership with workforce development partners to determine what can feasibly be tracked and who will be responsible for tracking, maintaining, and sharing the metrics, as needed. Potential key performance metrics are included in Table 7.J.

Table 7.J: Potential Key Performance Metrics for Workforce Initiative Evaluation

Metric Type	Example Key Performance Metrics
Workforce Initiatives	• Number of new workforce initiatives • Number of expanded workforce initiatives • Total number of workforce initiatives
Job Creation	• Number of jobs created annually by sector
Transitional Workforce	• Number of participants with full-time employment completing green job training programs • Number of workers transitioning to clean energy industries • Demographic breakdown of displaced and retrained workers
Job Quality	• Proportion of full-time versus part-time or contract positions • Retention rates within green industries • Availability of career advancement pathways and wage growth potential • Access to professional development and training • Availability of benefits such as healthcare, retirement plans and paid leave • Median annual wages in green sectors compared to the overall median wage

APPENDIX A

OUTREACH SURVEY – SUMMARY OF RESULTS

Fresno COG – Comprehensive Climate Action Plan

Survey Response Full Report

Table of Contents

Overview

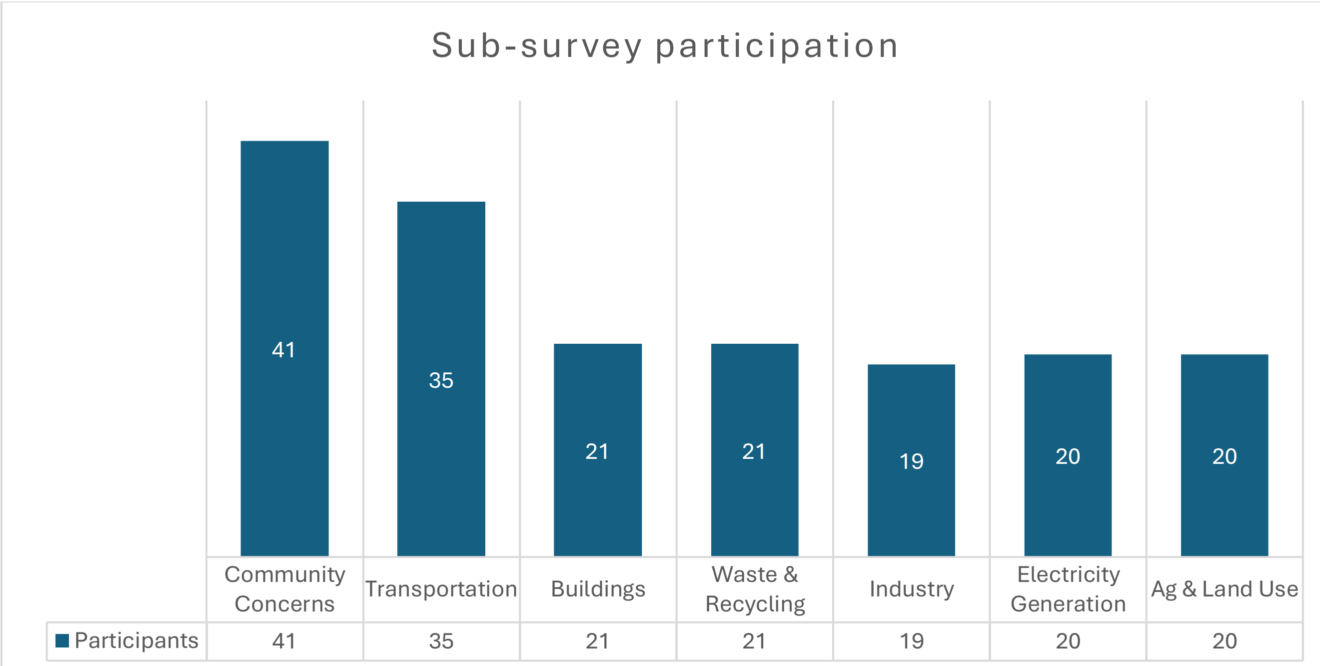
The following is a summary of the Fresno COG Comprehensive Climate Action Plan survey. The survey was live from January 31, 2025, to May 7, 2025. It was promoted on social media; via flyers, eblasts and news stories; and through pop-up booths at events in Fresno, Reedley, Kerman and Tranquility. Metrics for the social media and eblasts are shown in the tables below.

Social Media:

Post Name	Impressions	Reach	Engagement
CCAP Kick Off	111	58	17
CCAP Post 1	276	86	17
CCAP Post 2	245	41	12
CCAP Post 3	132	42	10
CCAP Post 4	120	64	5
CCAP Post 5	127	48	5
CCAP Post 6	133	48	5
CCAP Post 7	189	76	13
CCAP Post 8	155	78	7

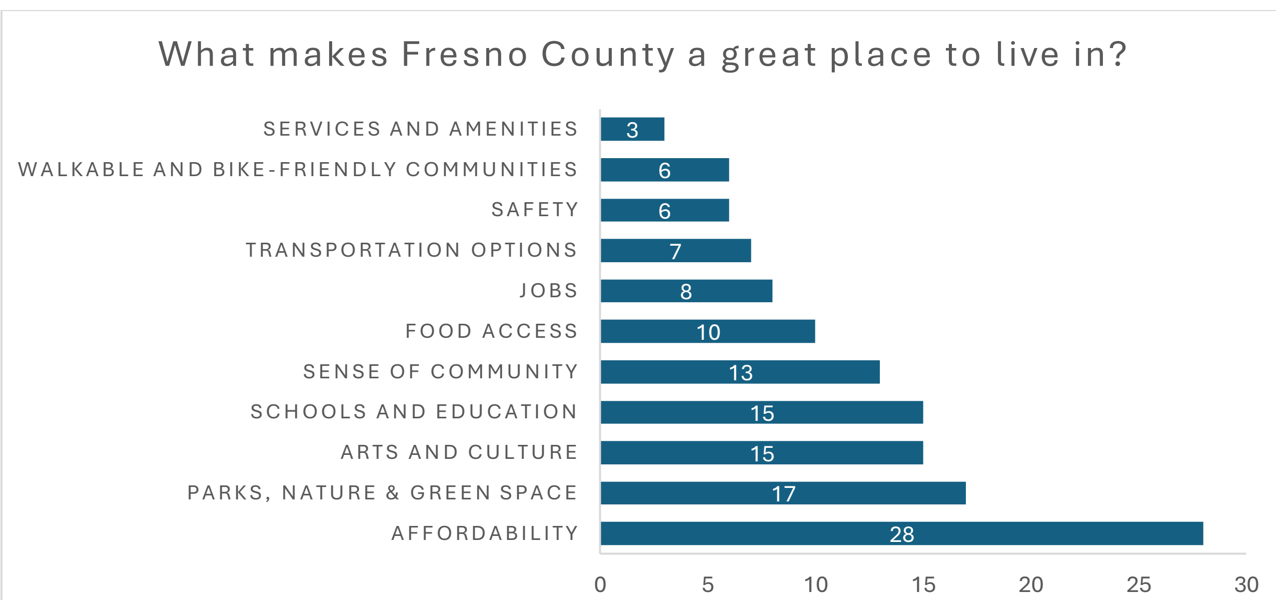
Eblasts:

Name	Sends	Opens	Clicks	Bounces	Unsubscribes
Survey Email	1,873	603	51	92	2
Follow Up Email	1,822	625	69	92	0

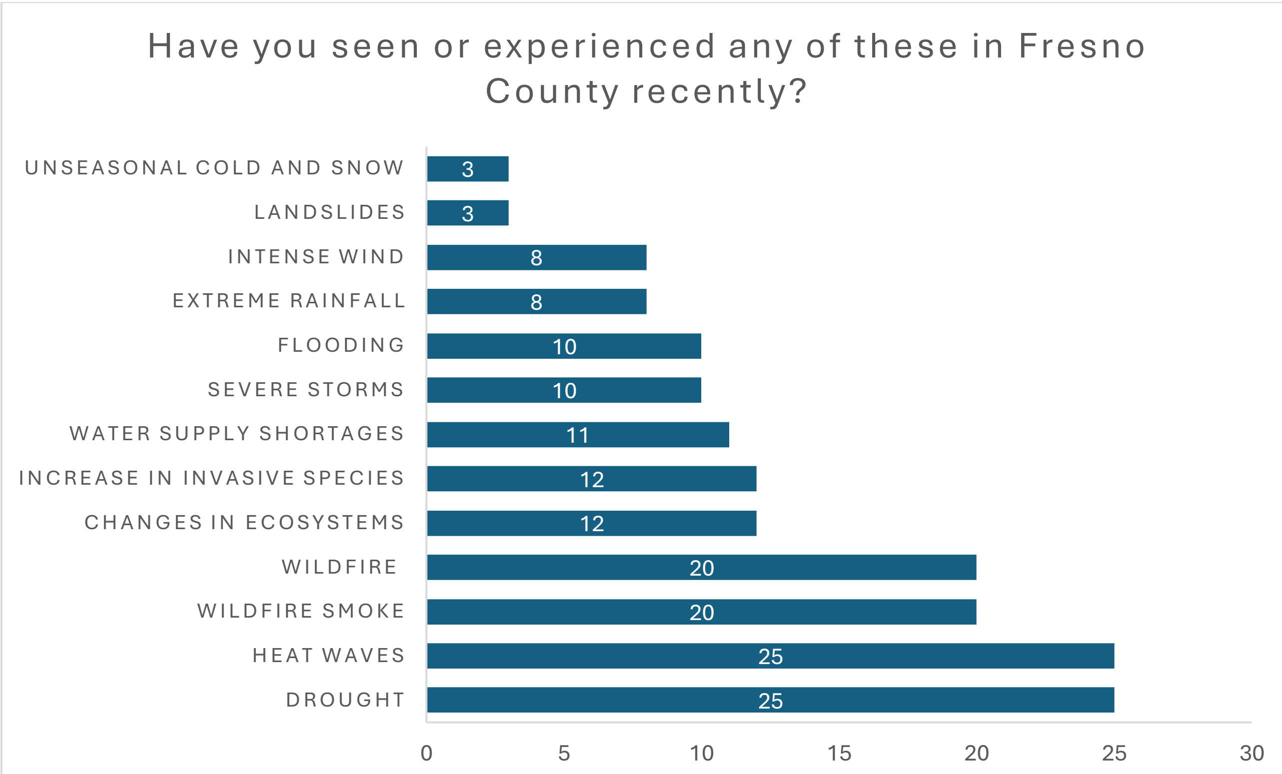


After filling out demographic questions, participants were given a list of surveys and asked to fill out the ones they wanted to give feedback on. Community concerns and transportation were the most popular surveys. It should be noted that the disparity could be attributed to the fact that the community concerns and transportation surveys were linked at the top of the list.

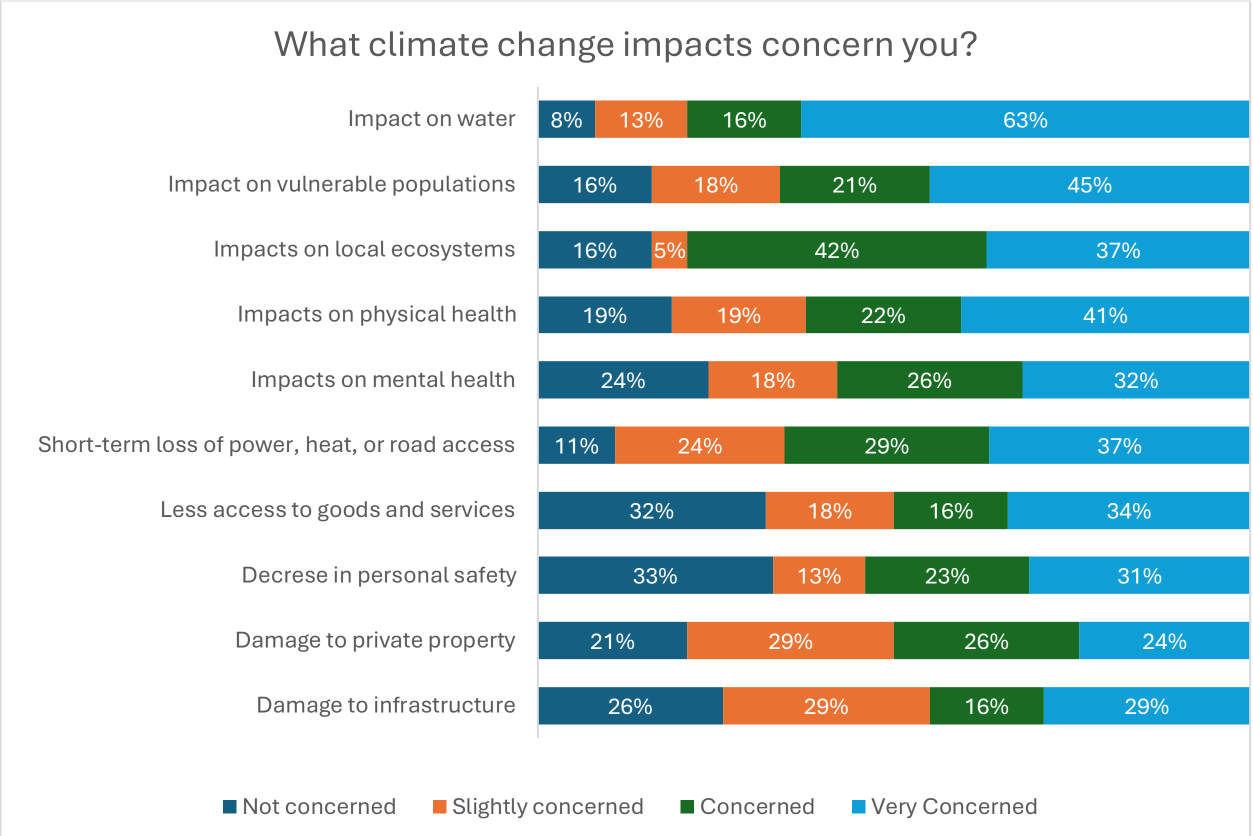
Community Concerns



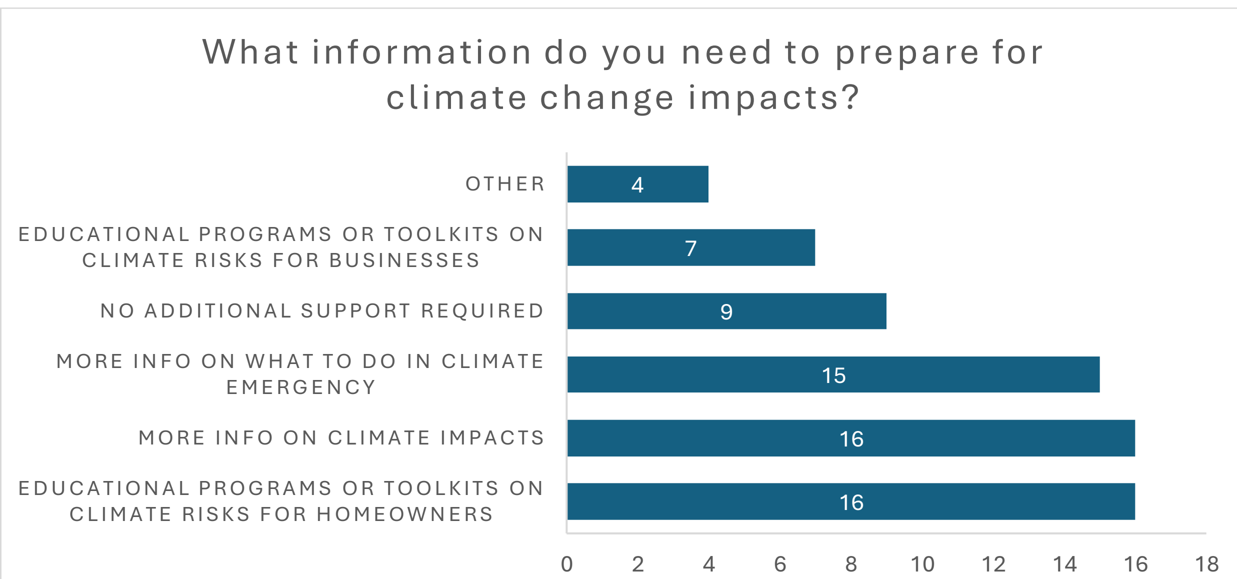
The result of this question signals a trend you will see across all sub surveys: the primary concern for participants in most, if not all, categories is affordability. Whenever a question mentions cost, a vast majority of participants will favor the answer that saves them money.



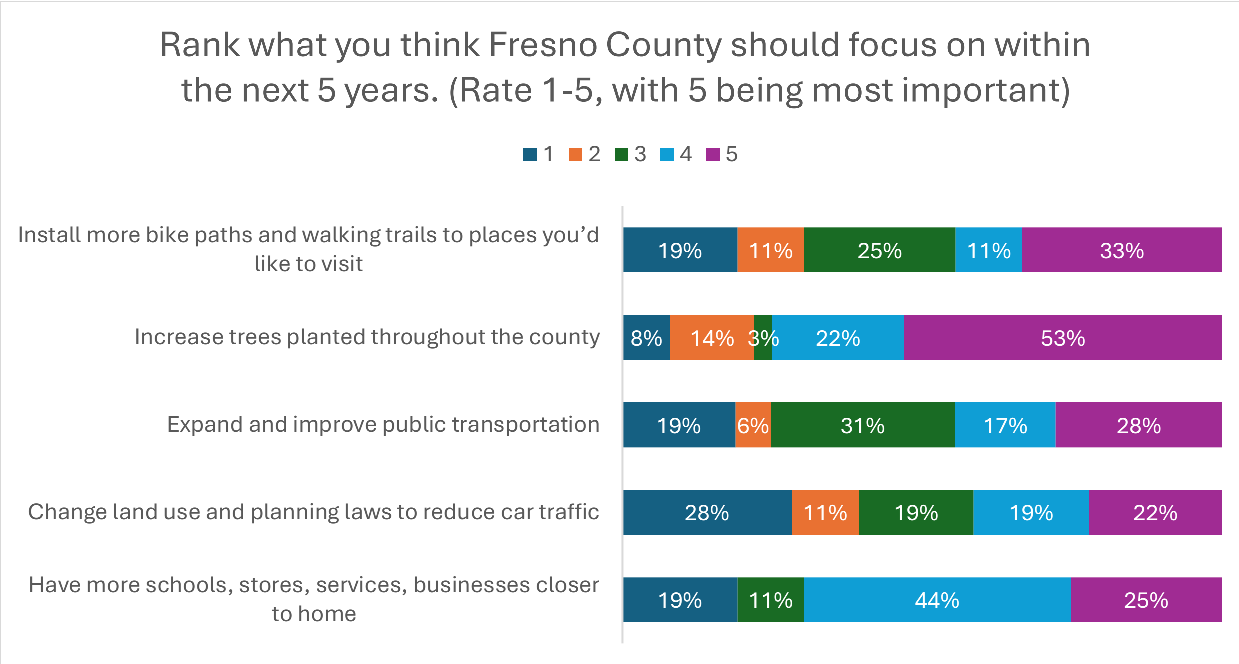
Unsurprisingly, participants have experienced wildfire, heatwaves and drought the most.



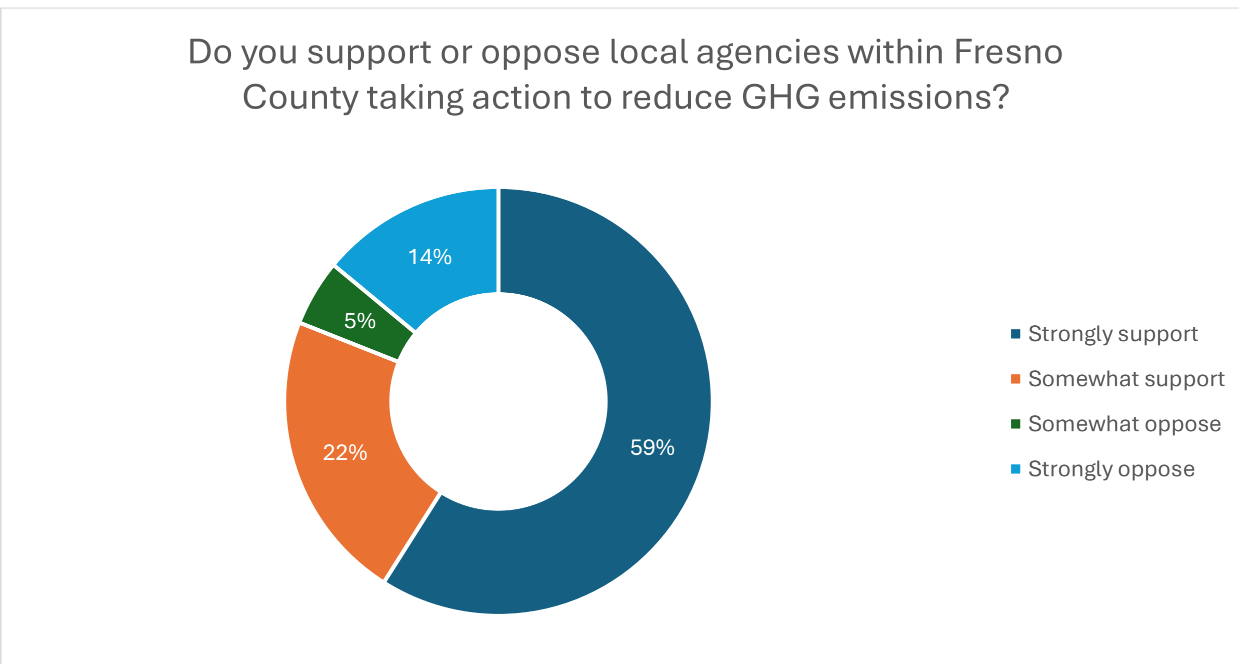
They also rank impacts on water and local ecosystems as their top concerns, with 79% of participants concerned or very concerned.



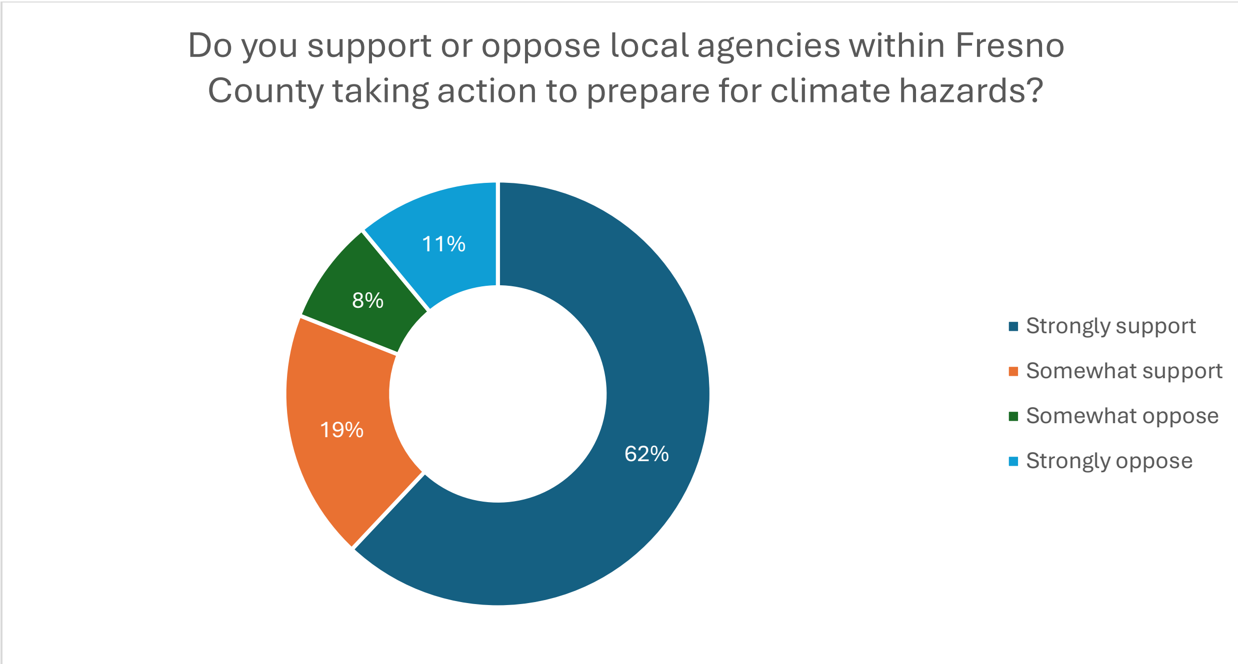
There is little consensus on the best information to prepare for climate change impacts. However, programs or toolkits for businesses garnered the least support.



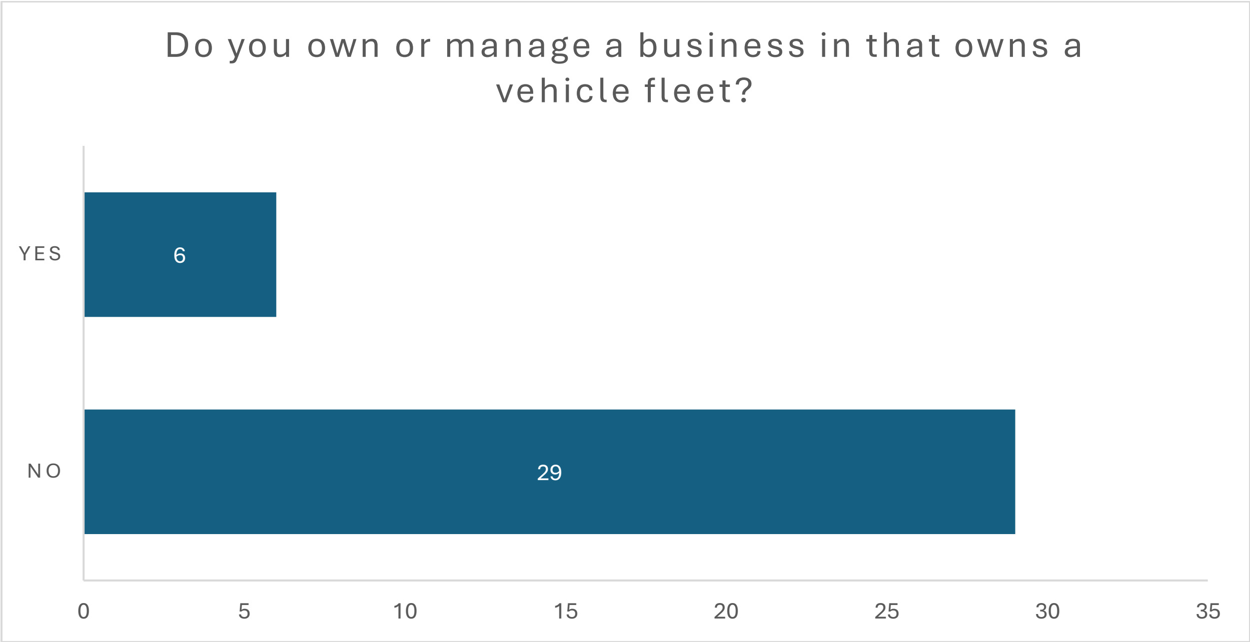
Of the options given to participants, two actions were the given priority. The first is planting more trees. The second was to decrease the gap between homes and schools, businesses, and services.



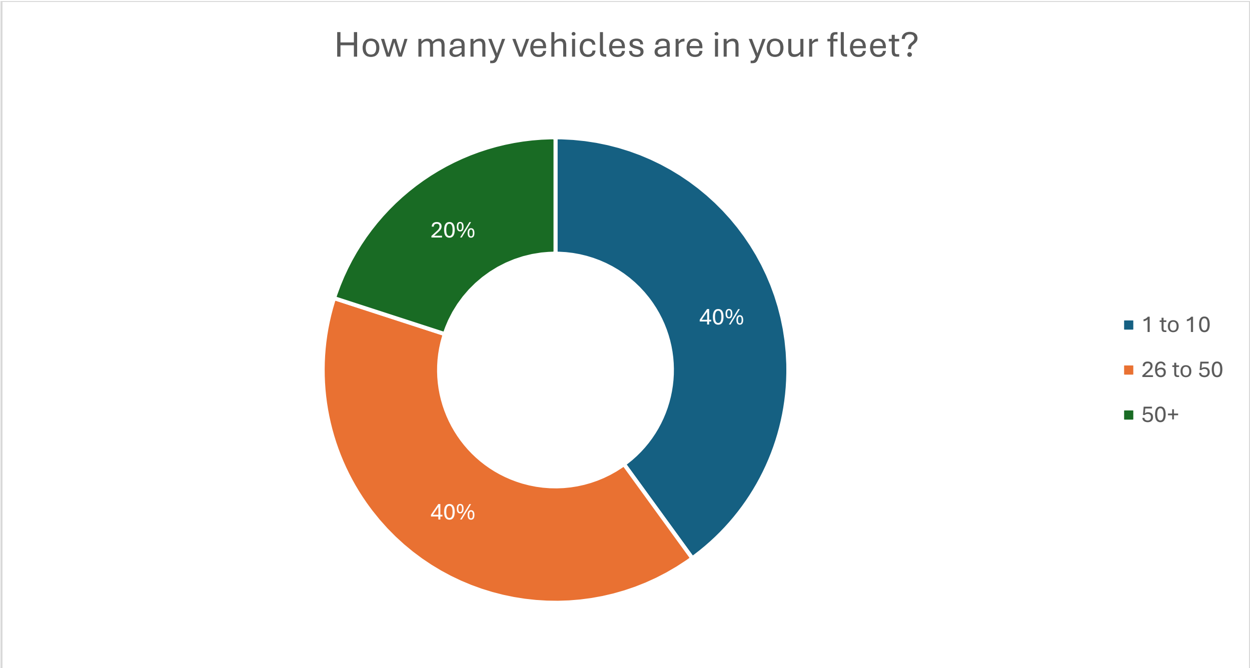
Another interesting takeaway is that the overwhelming majority of participants support local agencies within Fresno County taking action to reduce emissions and prepare for climate hazards, with over 80% expressing some amount of support.

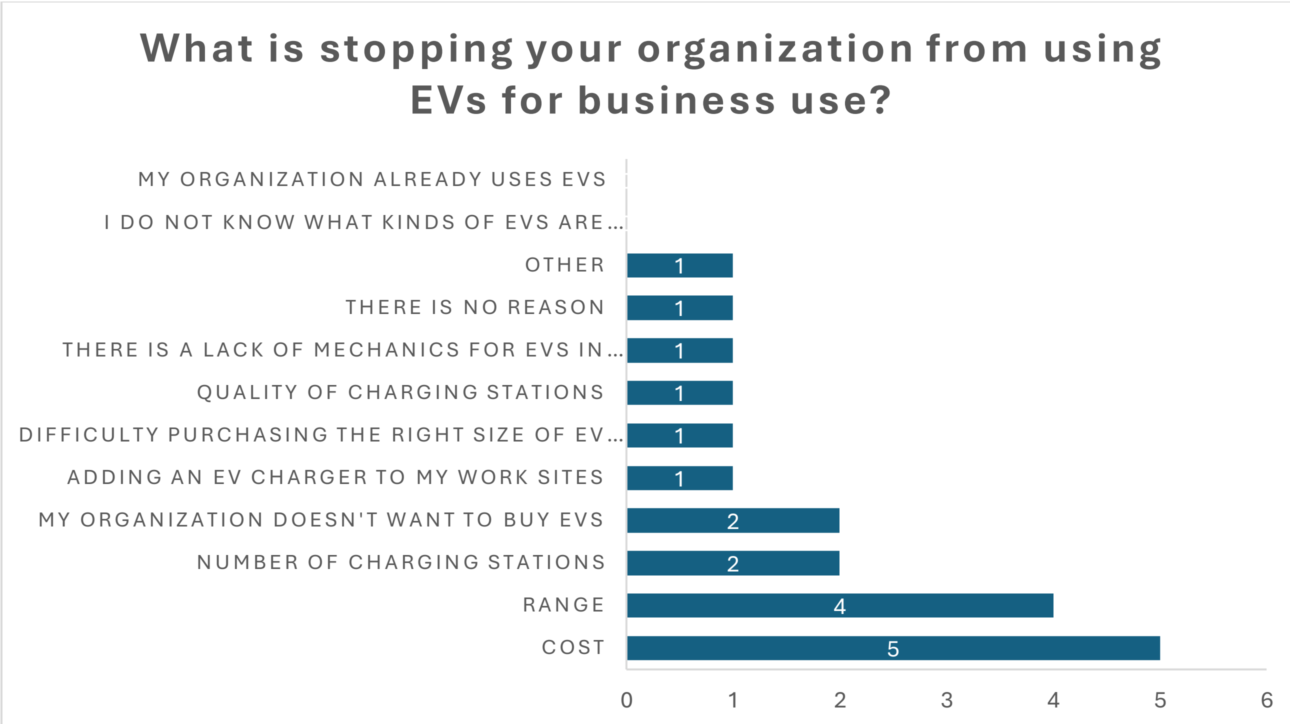

Do you support or oppose local agencies within Fresno County taking action to prepare for climate hazards?
11%
8%
19%
62%
Strongly support
Somewhat support
Somewhat oppose
Strongly oppose

Transportation

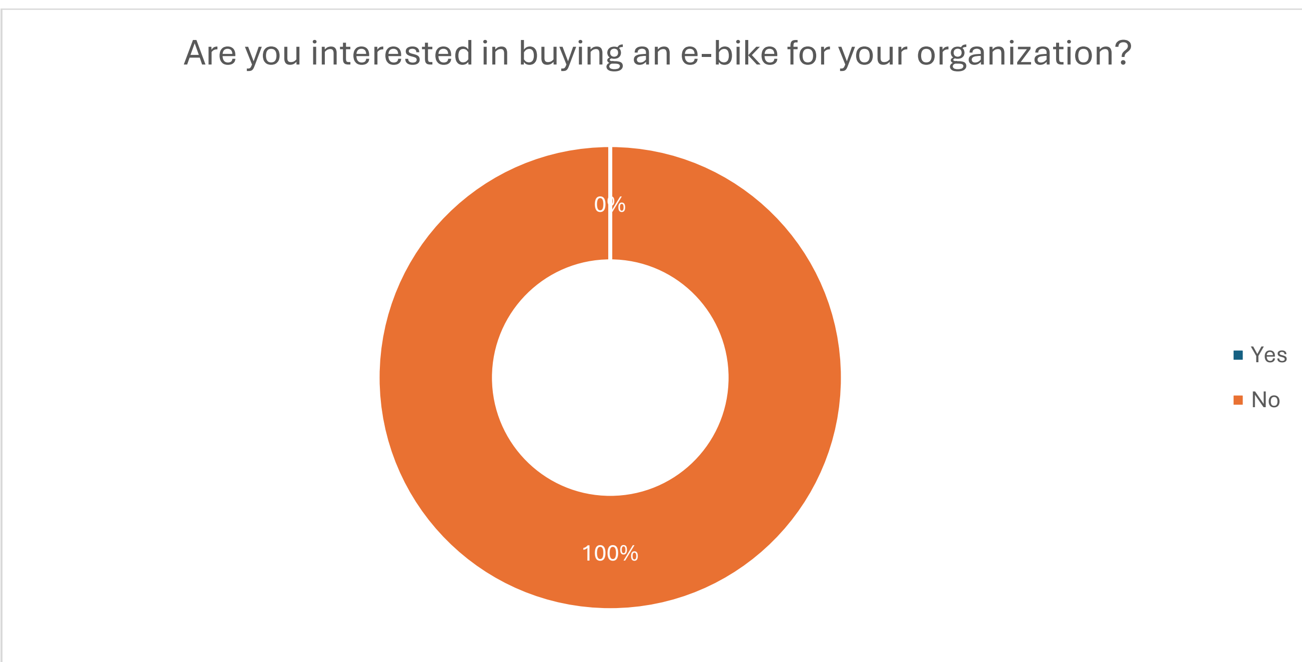


Transportation (Commercial)

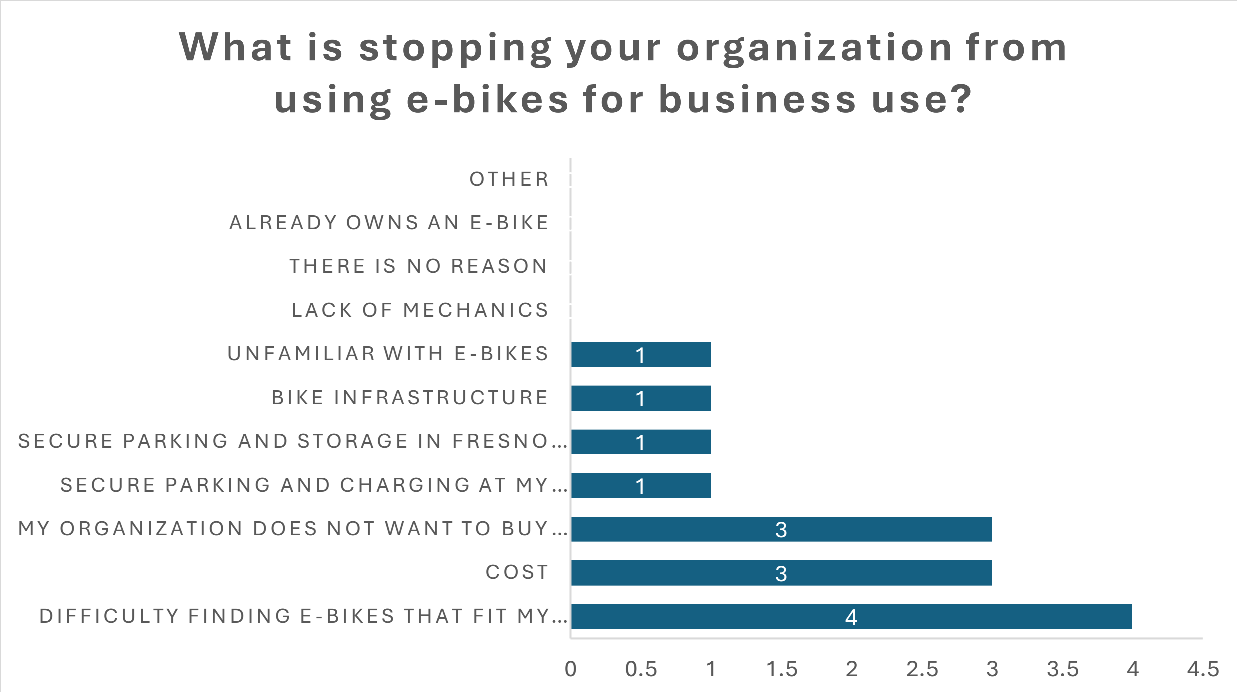




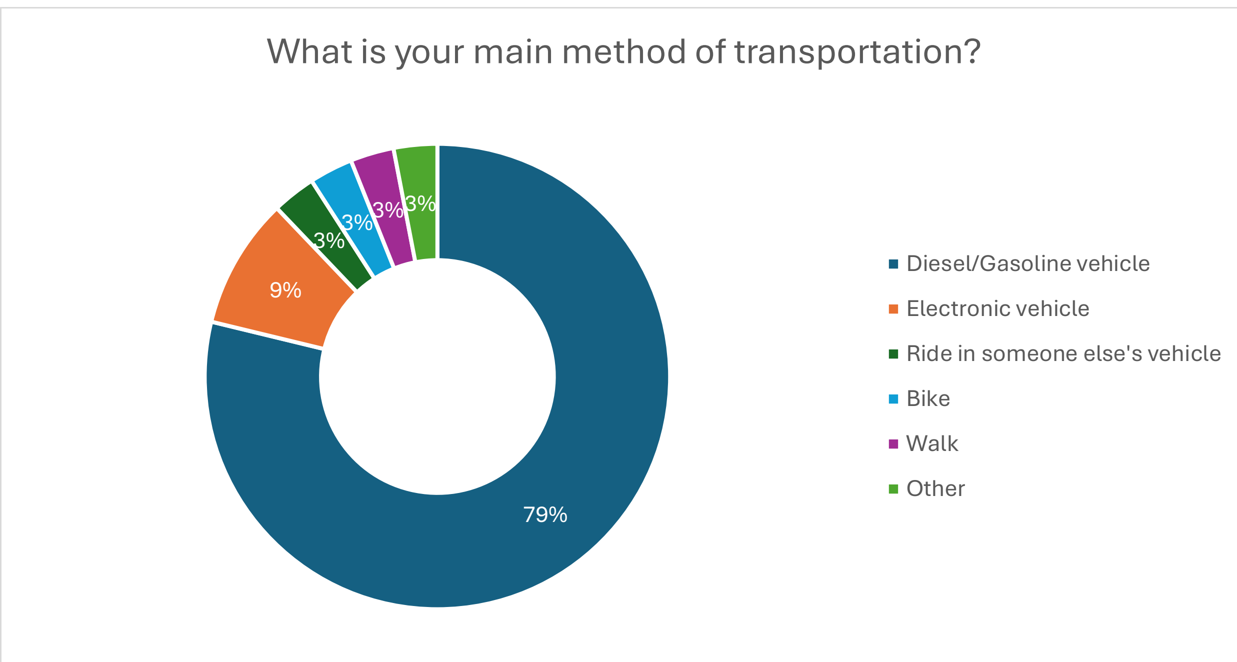
The commercial transportation participants reflected the ongoing theme that cost is a primary concern.



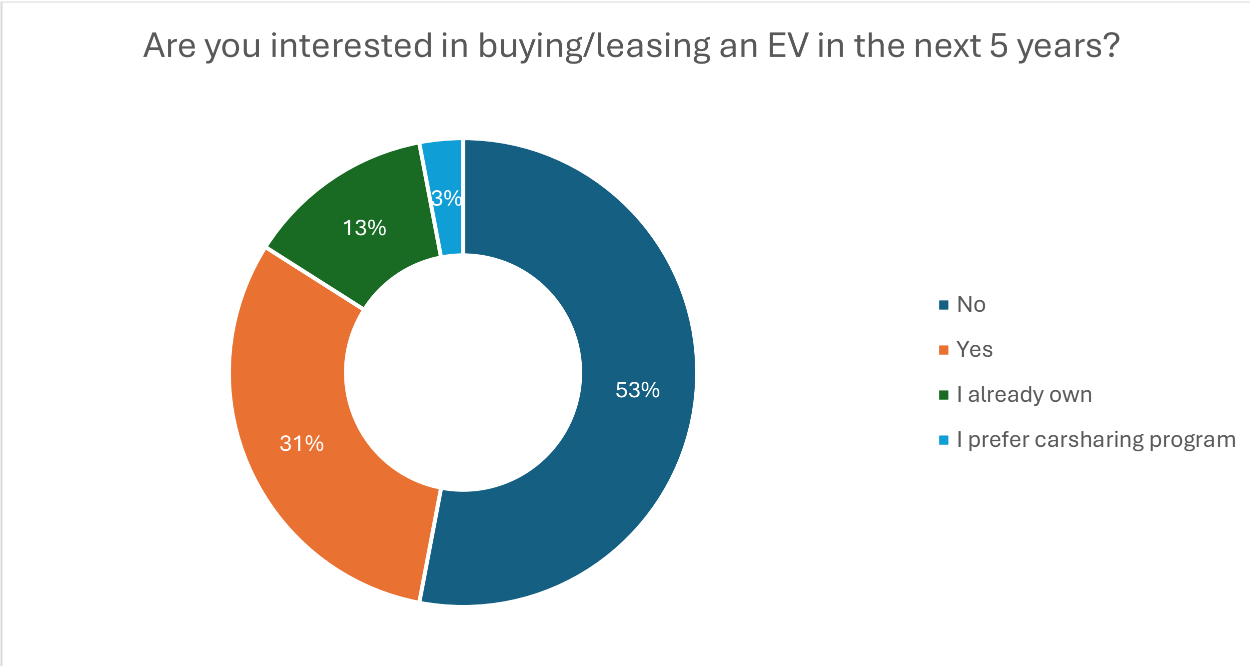
They also expressed no interest in EVs and e-bikes, saying they don't meet the needs of their organizations.

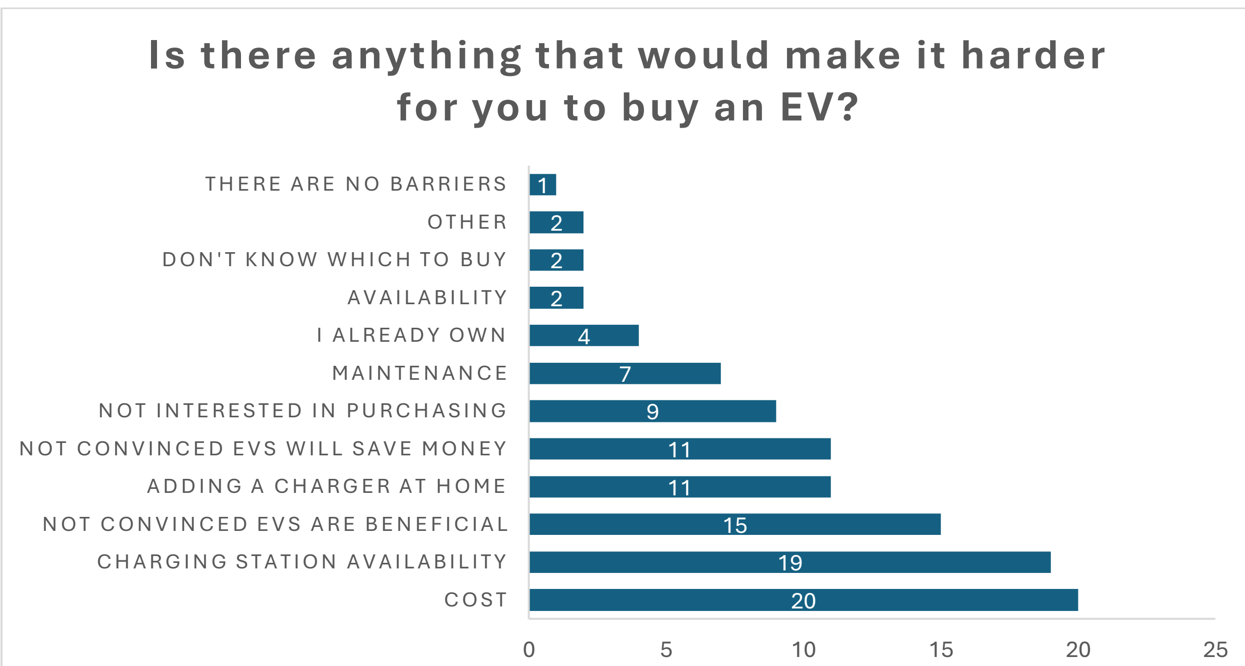


Transportation (Residential)

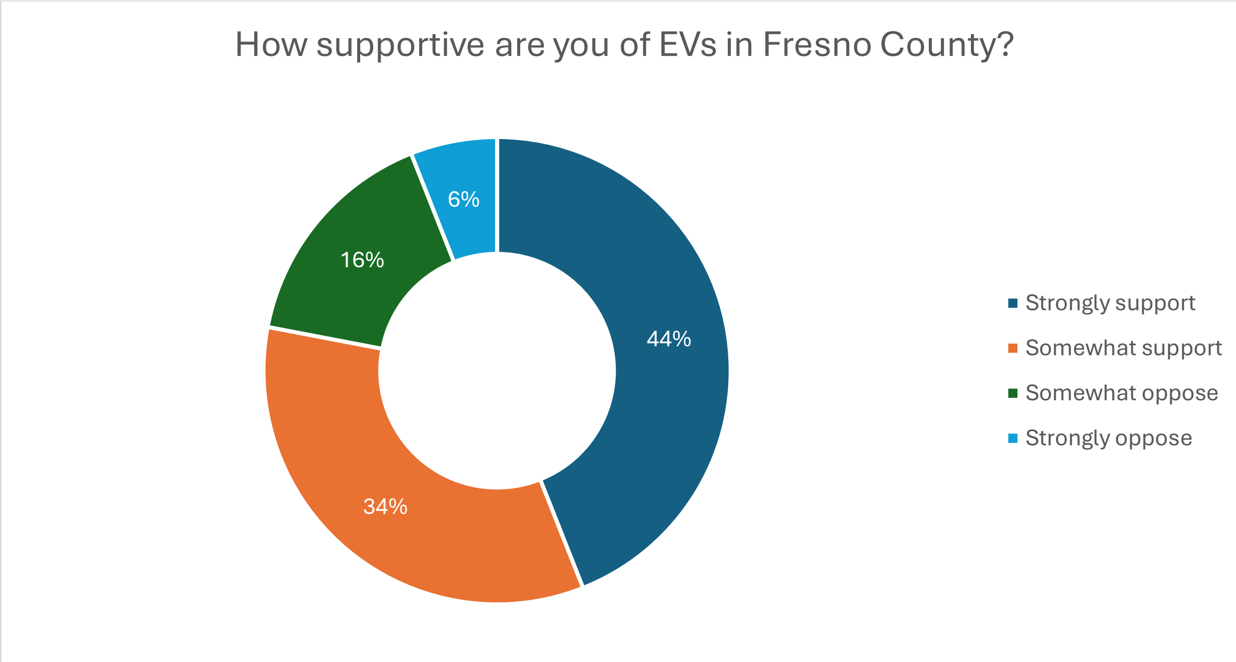


There is an interesting find within the residential transportation participants. While 91% of participants don't drive an EV and a slim majority (53%) of participants aren't interested in purchasing or leasing an EV in the next 5 years, 78% are supportive of EVs in Fresno County.

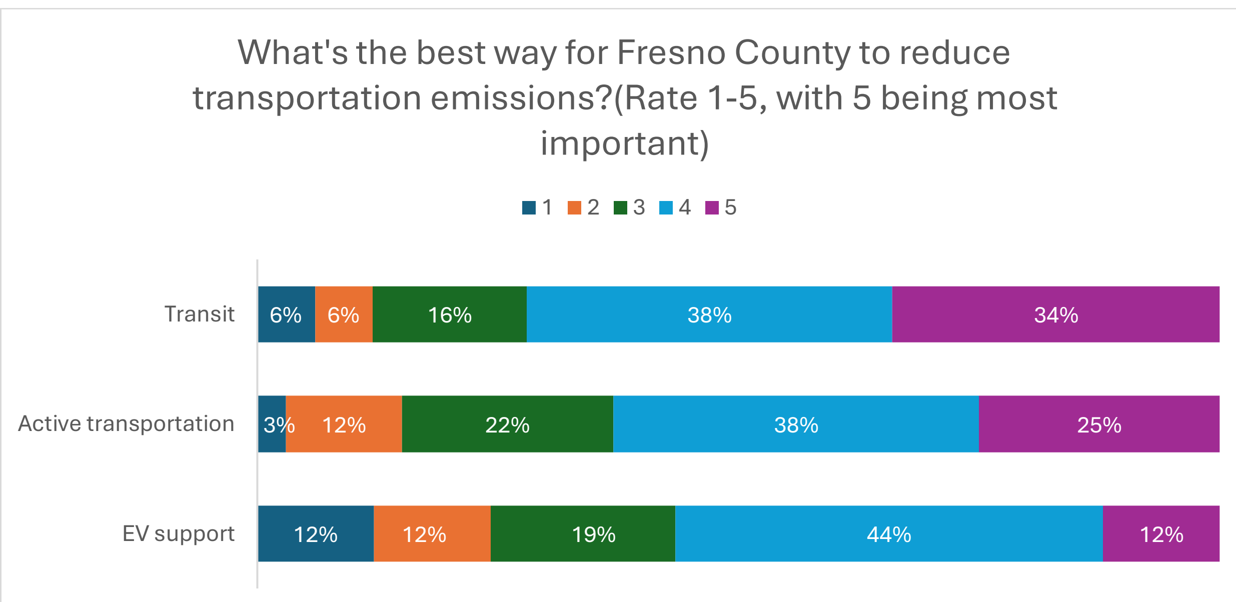




This may be explained by the barriers to EVs. 63% cite cost and 59% cite a lack of charging stations. Another 47% of participants aren't convinced that EVs are better for the environment.



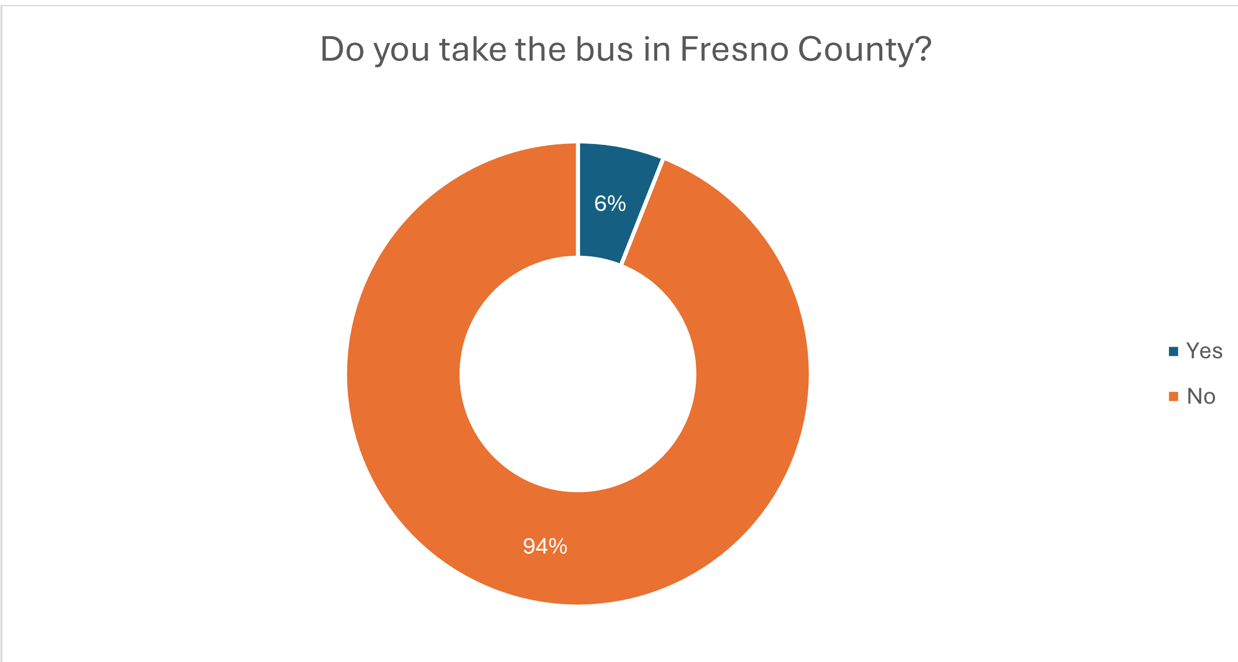
Public transportation is also the exception to the ongoing trend of affordability in the County.

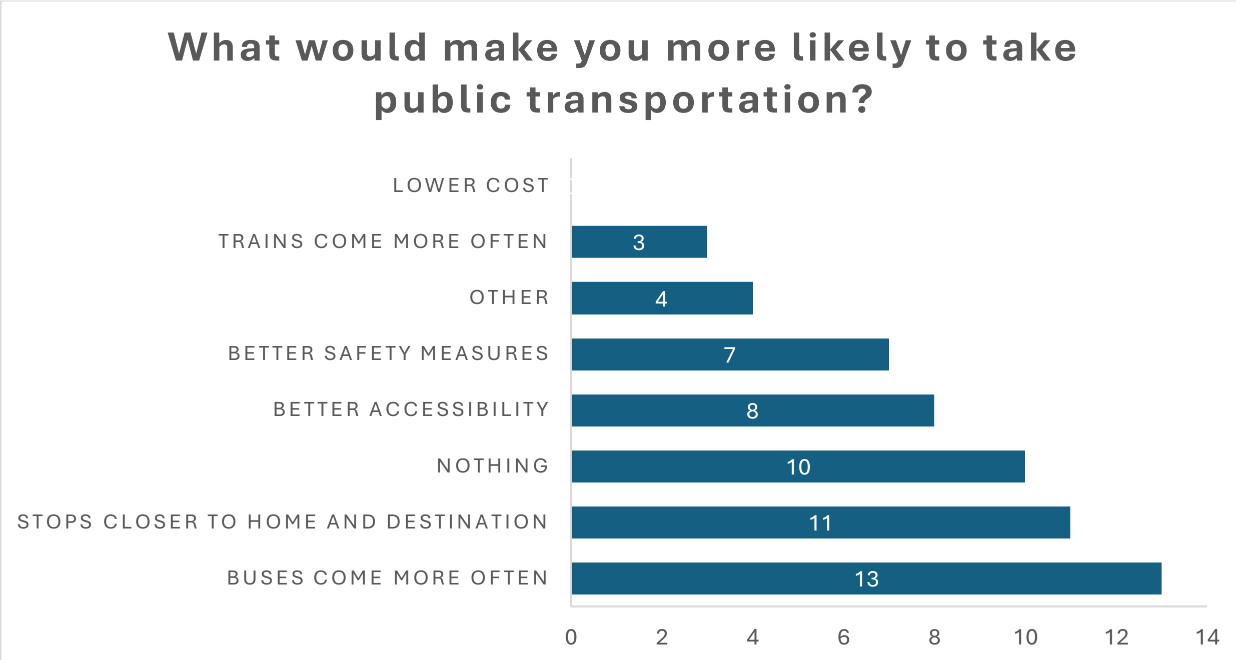


What are other ways Fresno County may reduce transportation emissions?	
Comments	**Similar Comments**
Telework	4
Make cities more walkable	3
De-emphasize road building and promote better public transit	2
Replace traffic lights and stop signs with more traffic circles	2
Bike-friendly infrastructure	2

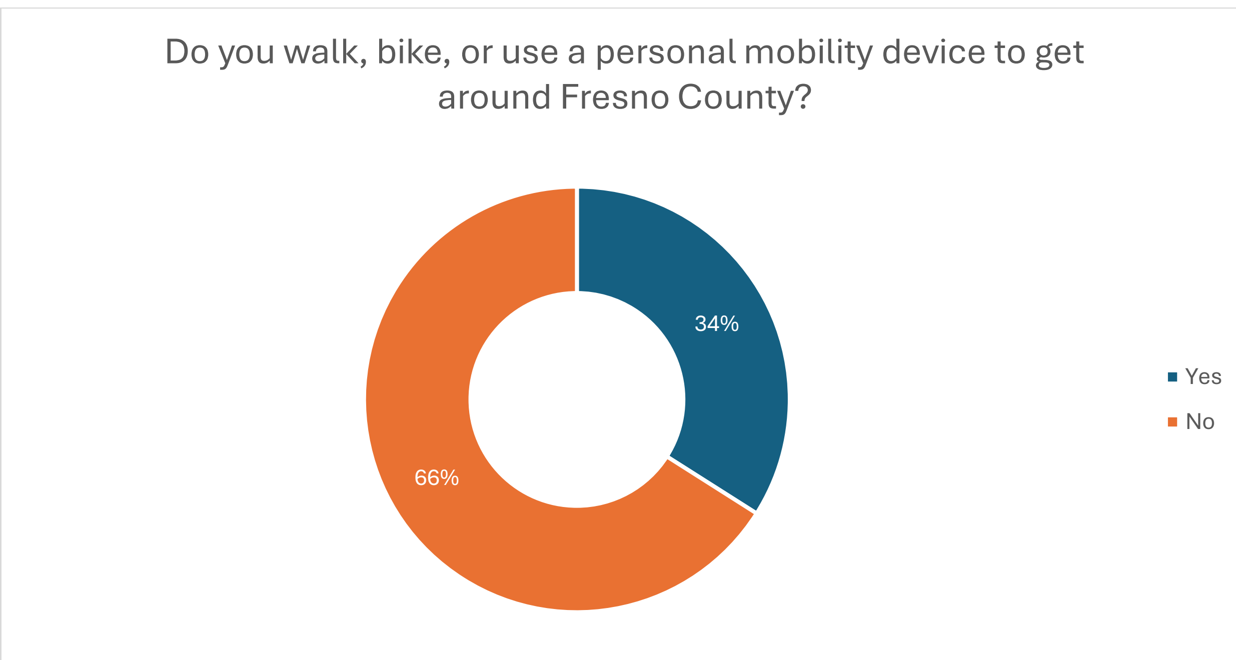
Improve mass transit load balance	0
Develop and promote employer commute plans	0
Minimize congestion and build more freeways or expressways	0
Provide more information on public transit to senior citizens	0
E-bike incentives	0
More pedestrian friendly infrastructure	0
More consistency between county and cities	0

Public transportation has yielded some interesting findings. Transit was rated as the most important method of reducing emissions, with 72% of participants rating it with some importance. Yet only 6% of participants take the bus.

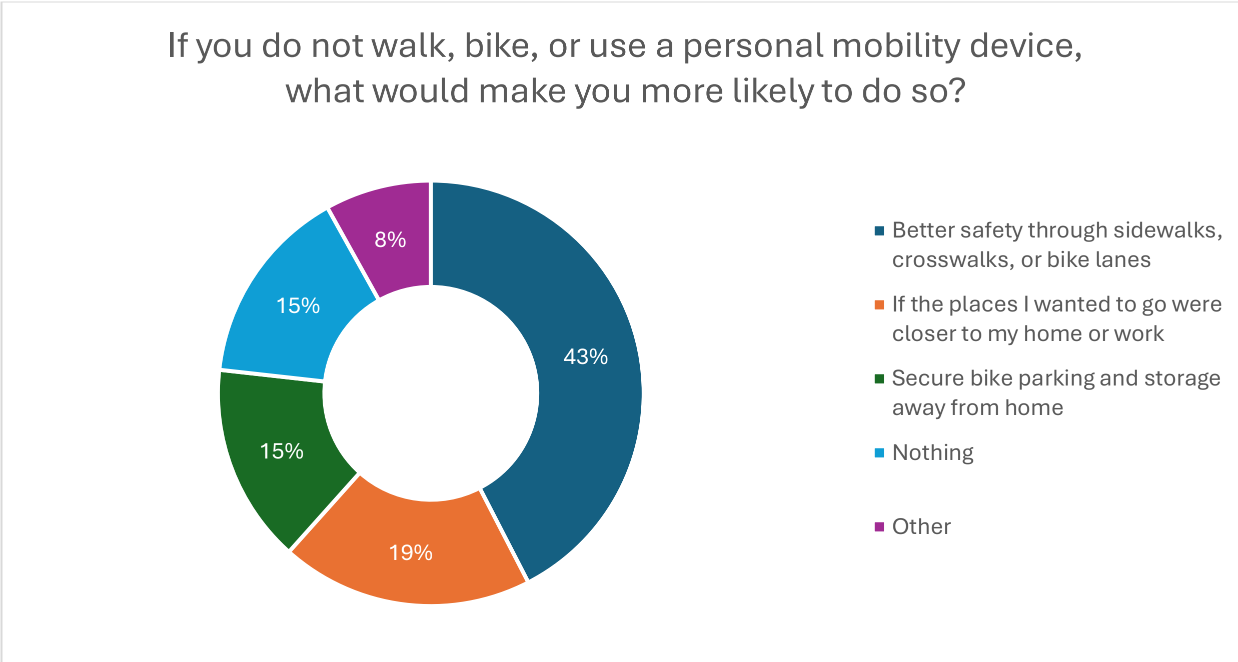




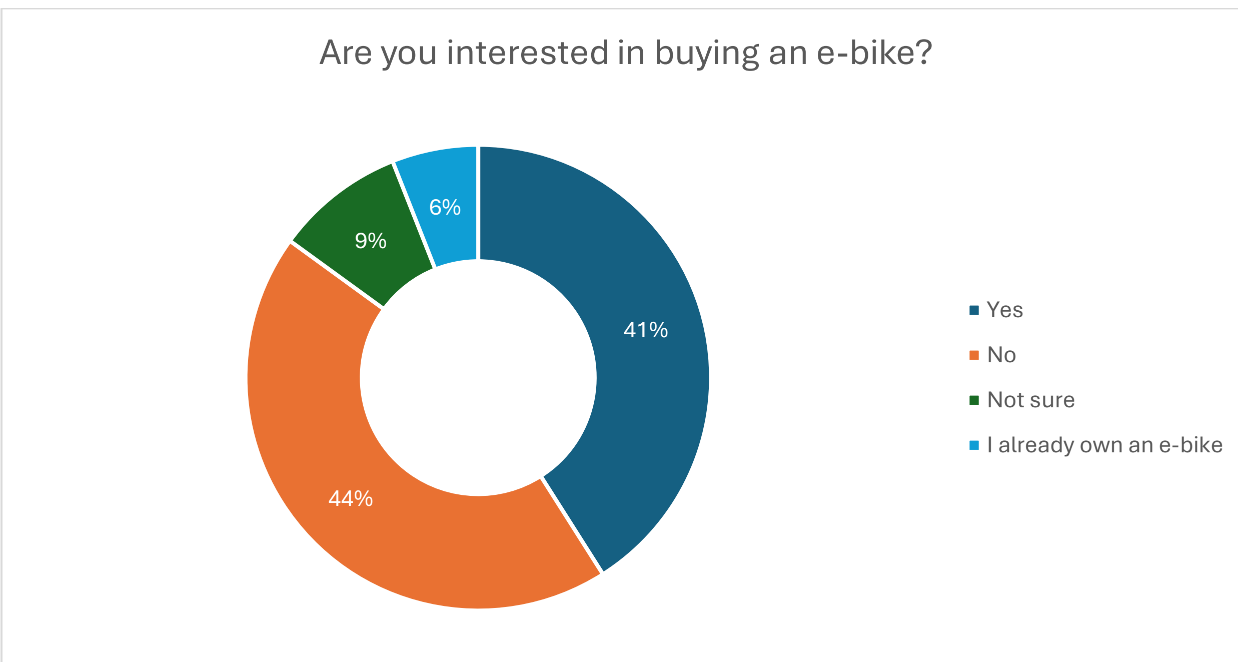
None of the participants rated lower cost as a way to take public transportation more often. Rather, participants would prefer if public transportation was improved, with closer stops and more frequent buses as the top answers.



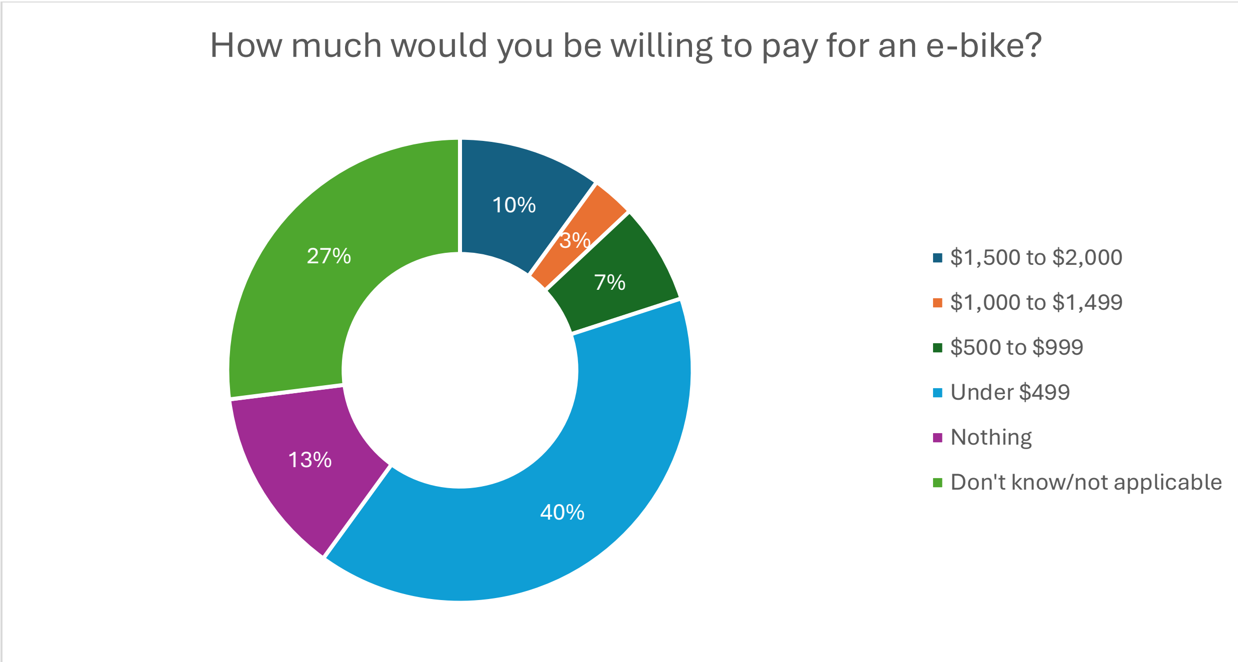
Another interesting finding is that while only 34% of participants walk, bike or use a personal mobility device, 85% are not against doing so.



The primary concern among interested participants is safety, with 43% saying better safety would make them more likely to walk, bike or use a personal mobility device.

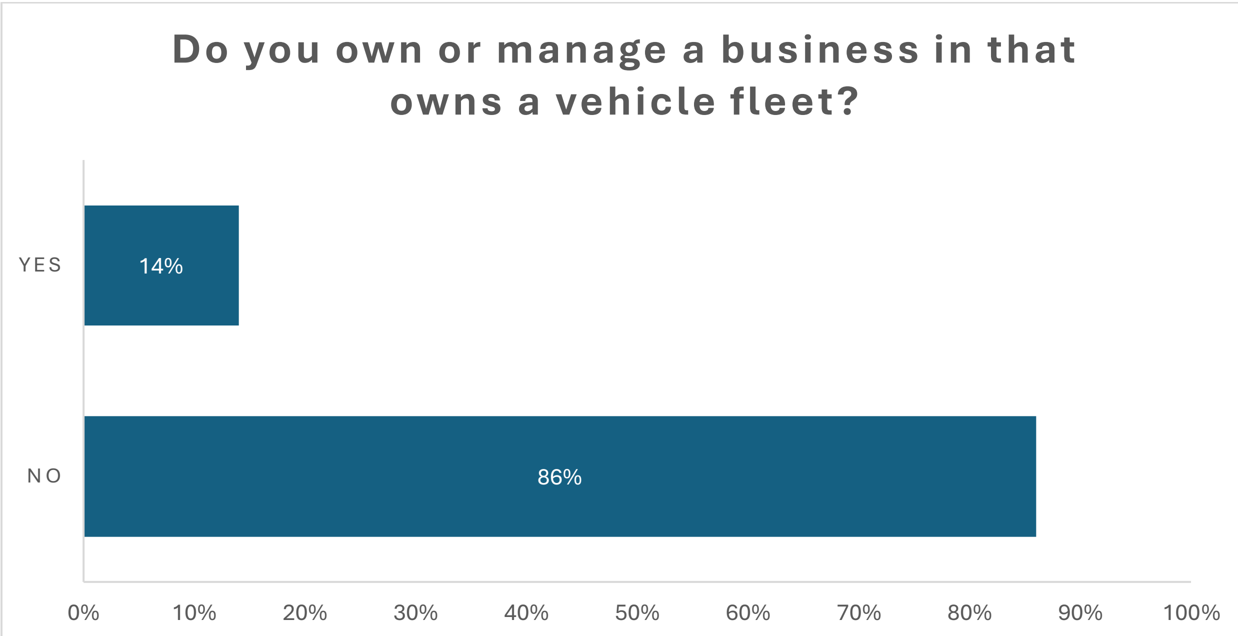


Participants are divided on purchasing E-bikes, with 47% expressing interest in or already owning one while 44% aren't interested at all.

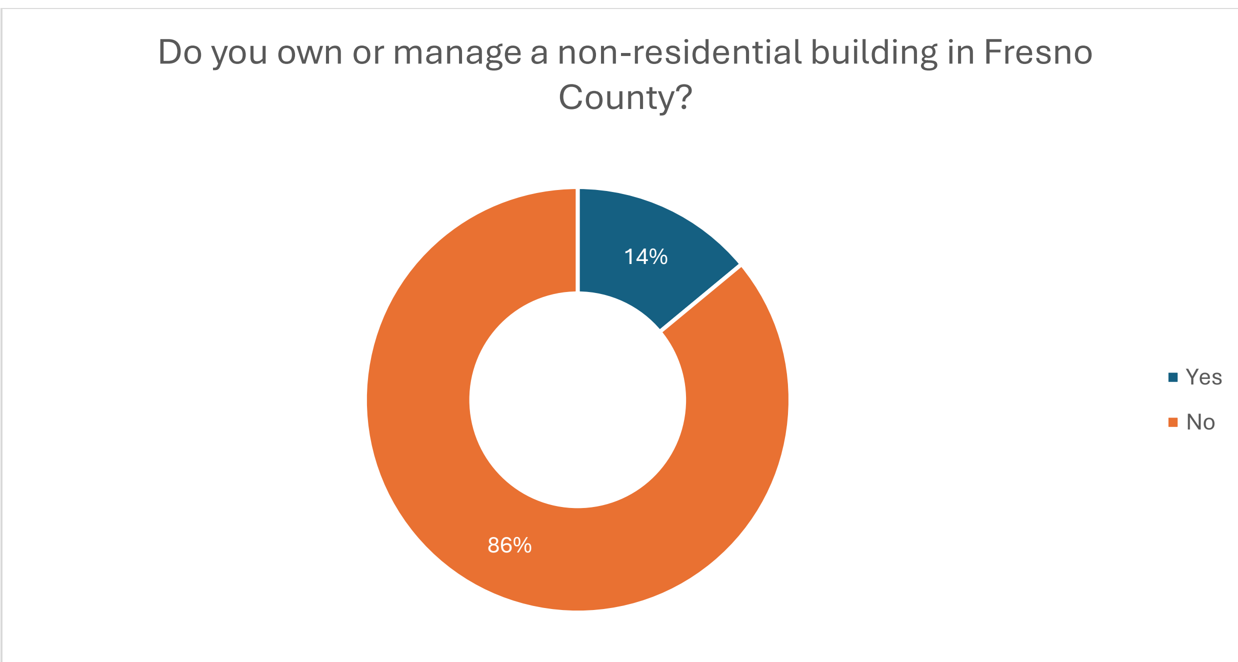


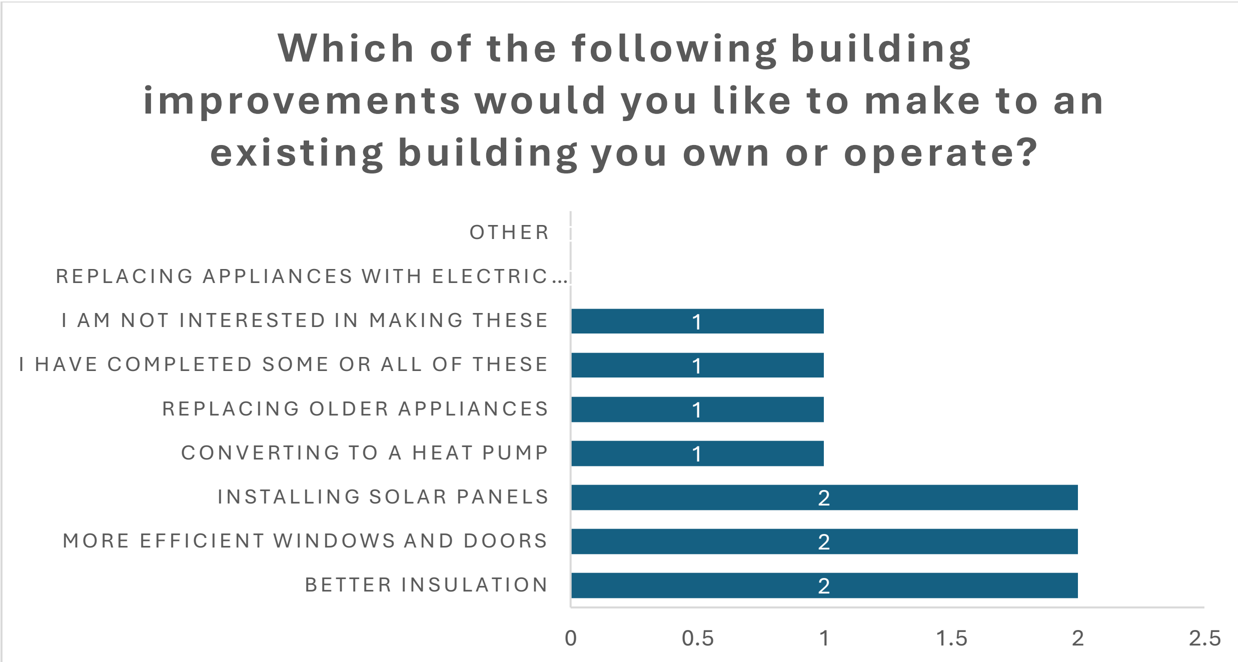
Again, cost is the primary concern, with only 20% of participants willing to pay over $500.

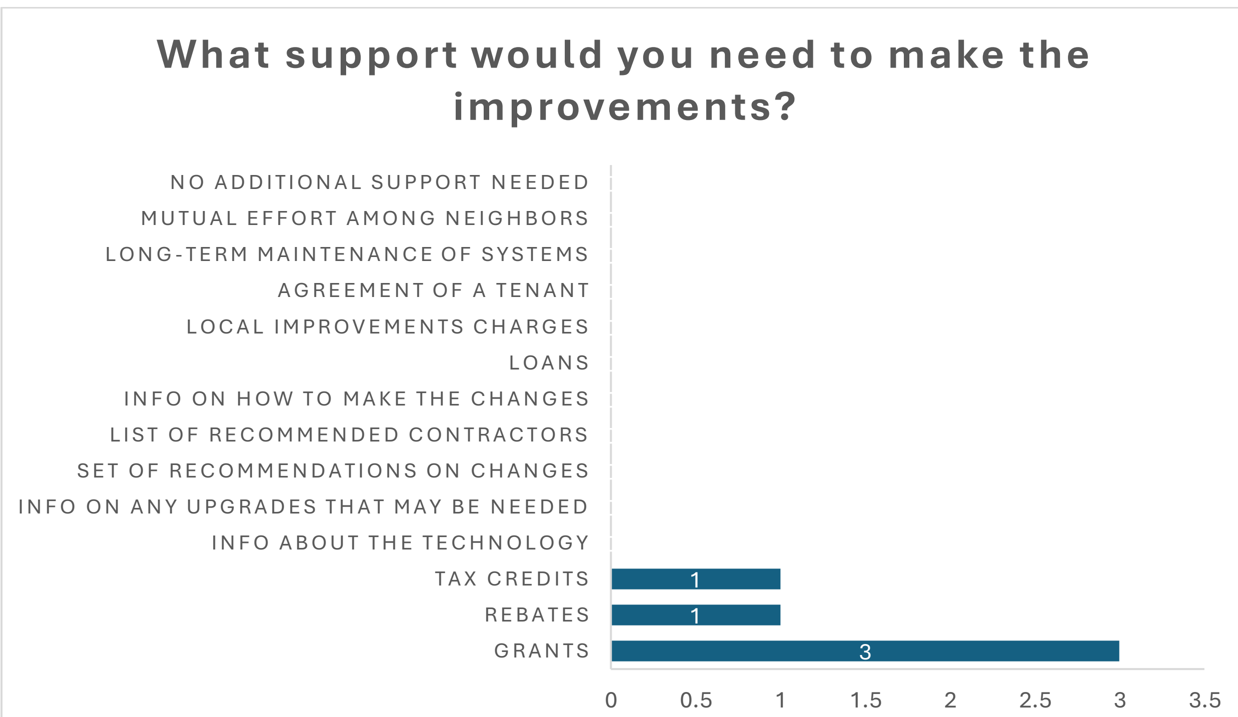
Buildings



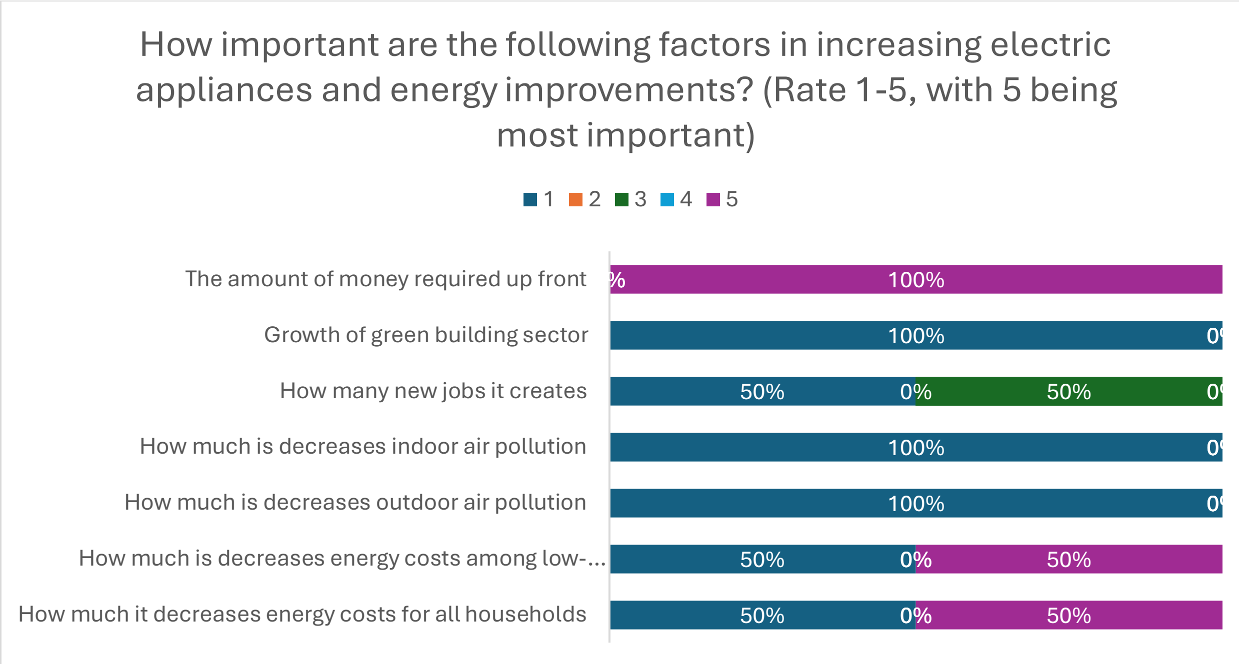
Buildings (Commercial)



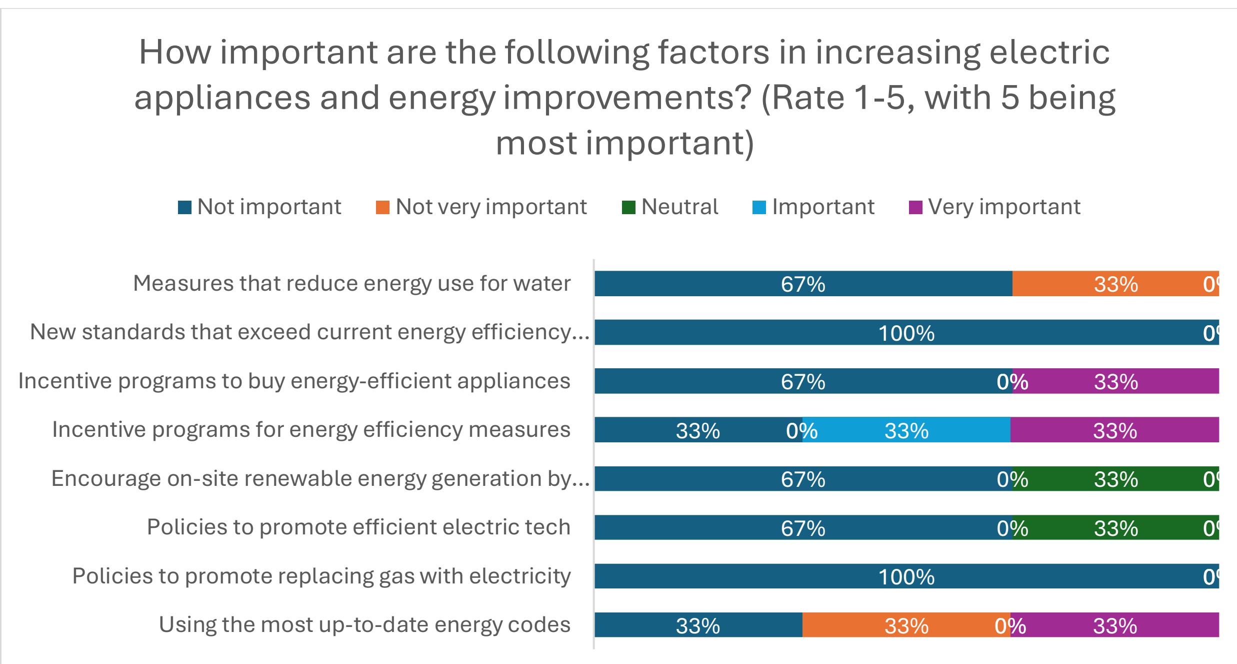




Commercial owners are interested in financial incentives to make energy improvements to their buildings.

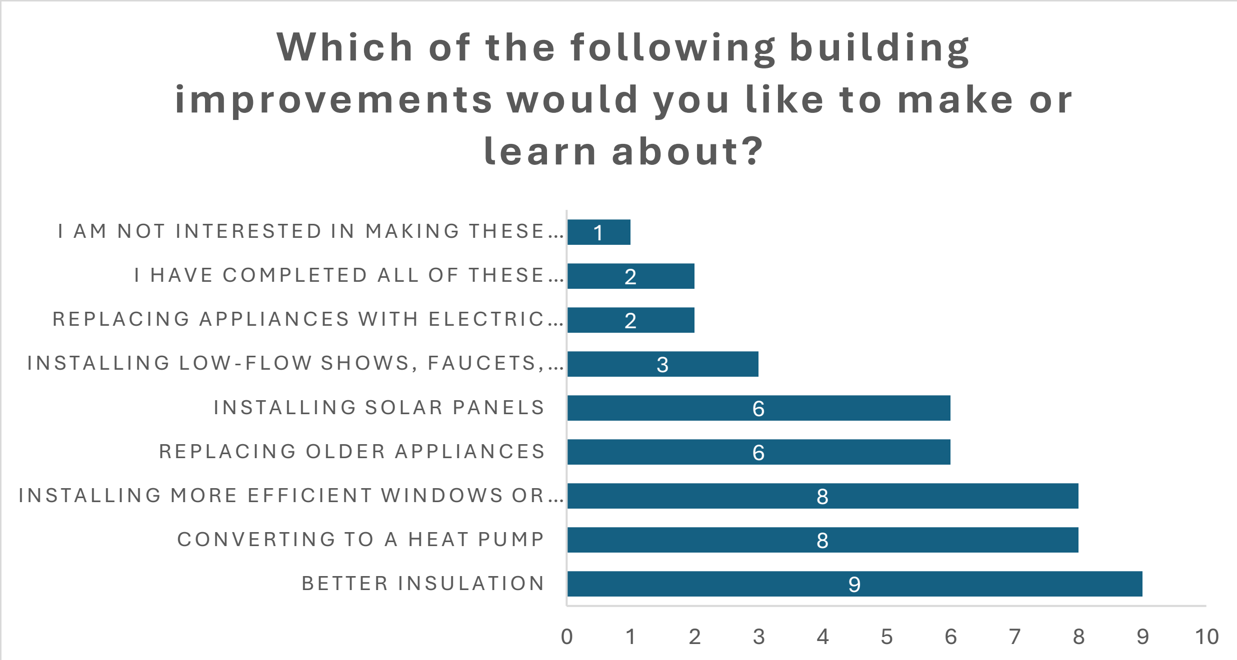


100% of the commercial building participants answered that money required is the most important factor in making those upgrades, with about half agreeing that decreasing energy costs is also important. They also unanimously agree that decreasing pollution and growing the green building sector are unimportant.

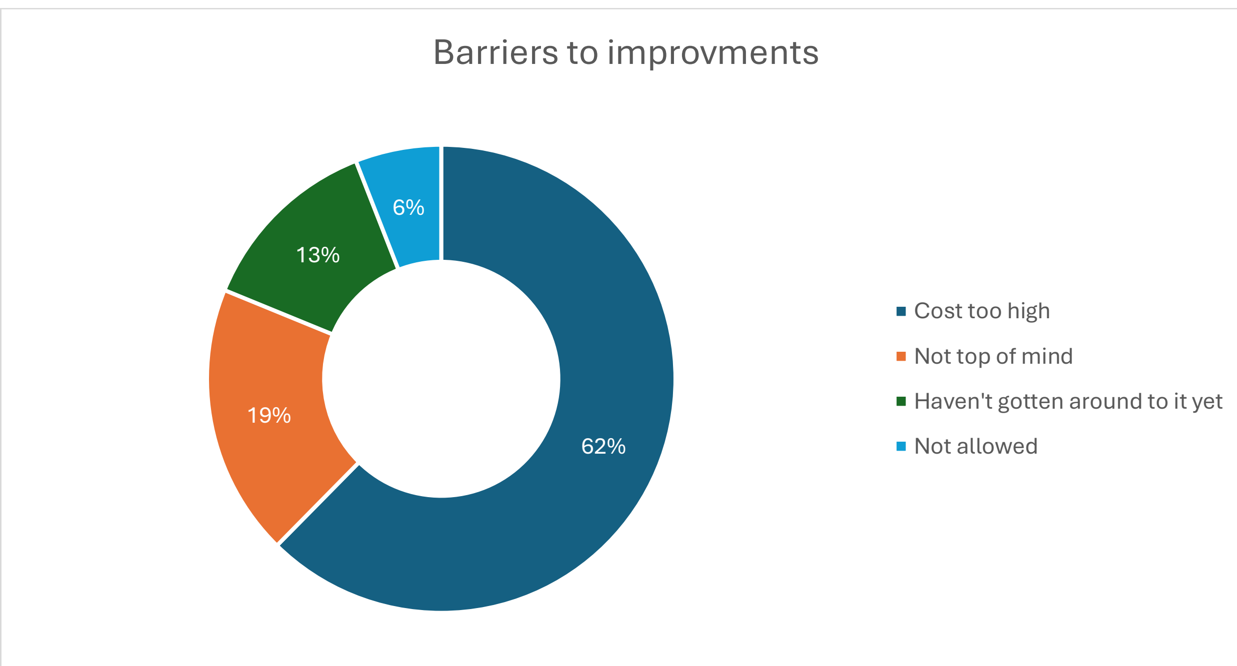


Again, commercial owners only believe financial incentives or energy codes have some amount of importance to making energy improvements to their buildings.

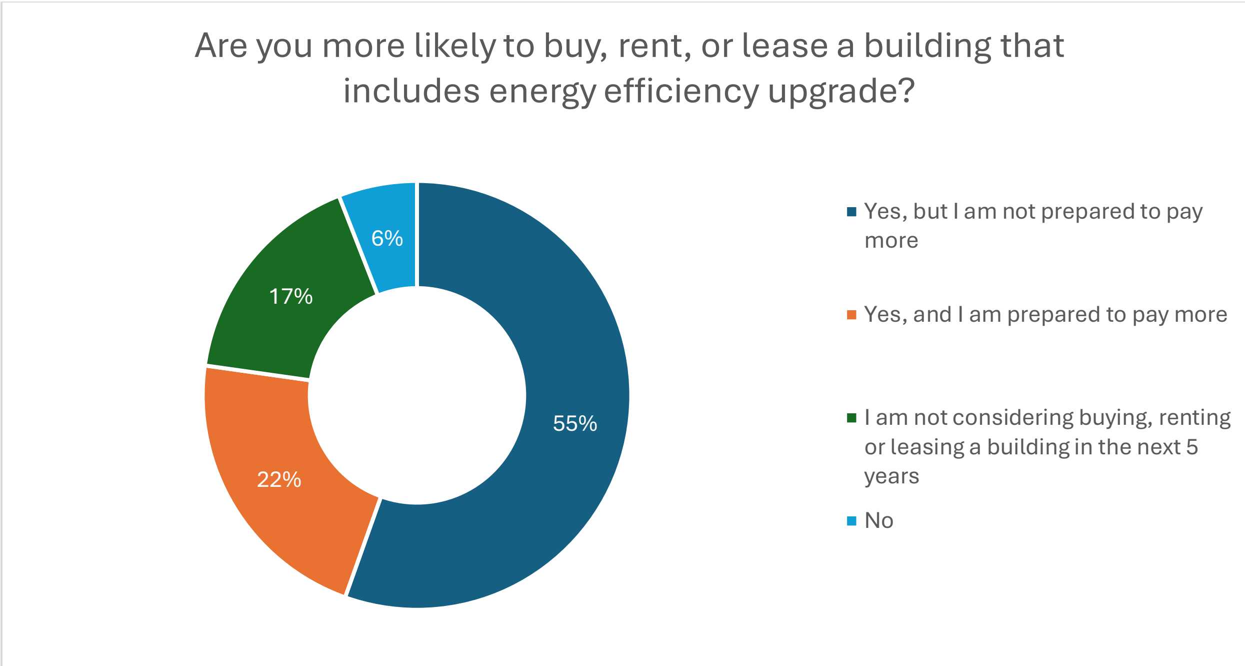
Buildings (Residential)



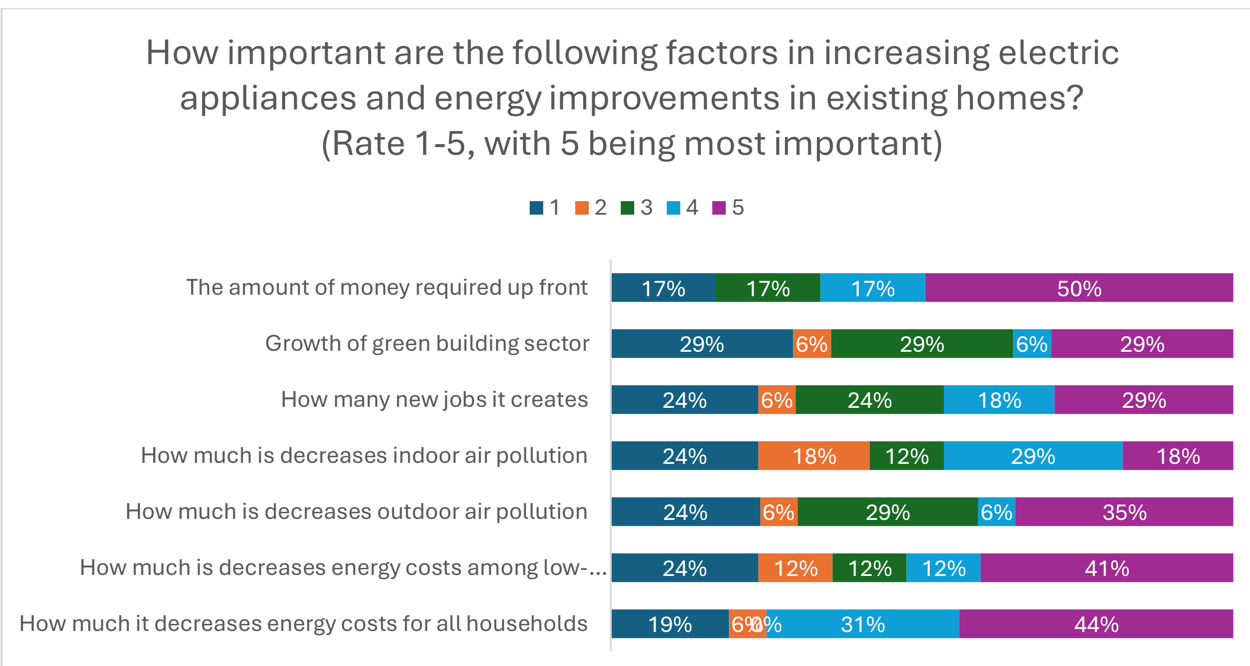
Of the upgrades listed, participants are most interested in efficient windows or doors, heat pumps, and better insulation but only by a slim majority.



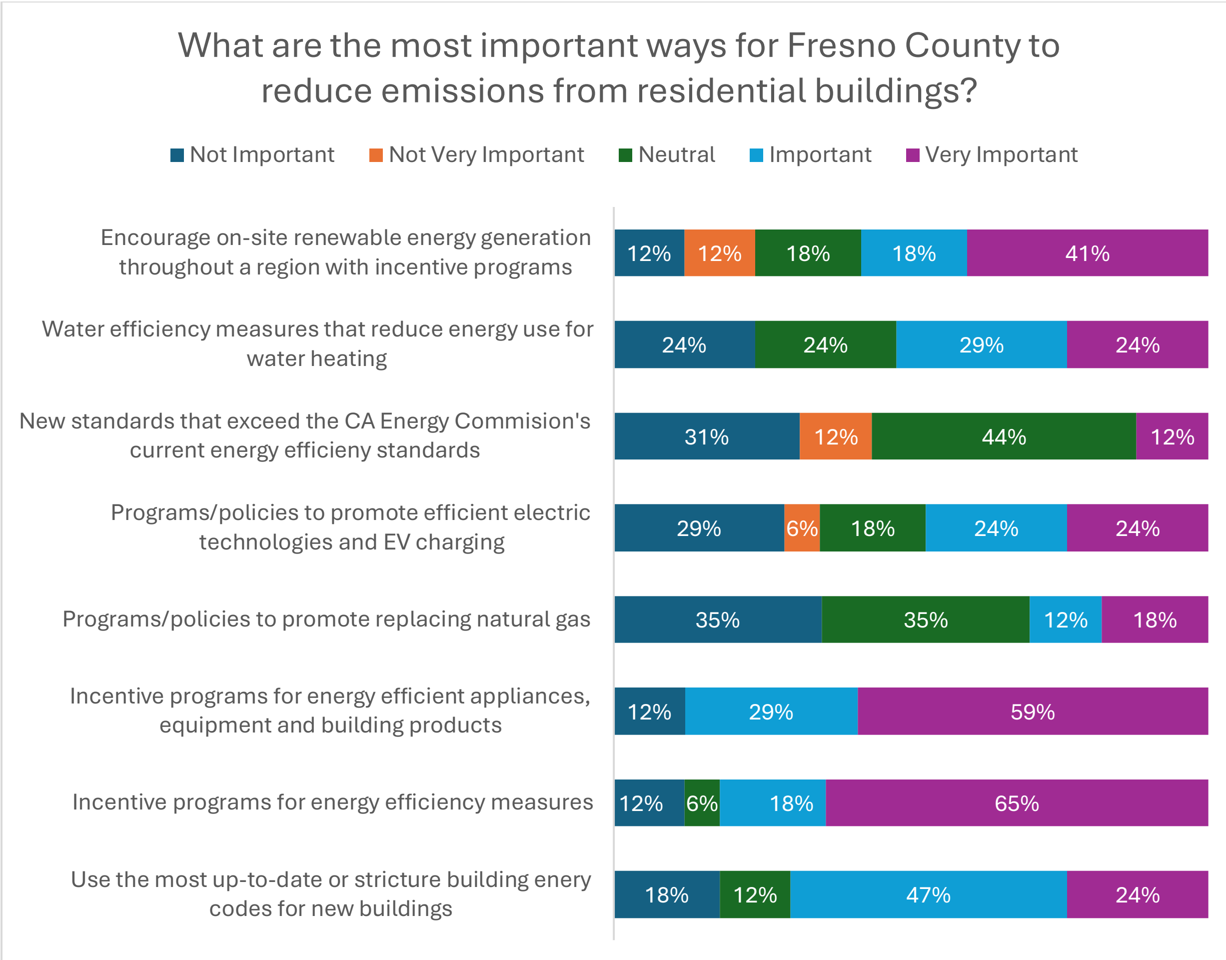
Keeping with the affordability trend, 62% of participants say the main barrier to making these improvements is cost.



Sticking with that trend, only 22% of participants would be willing to pay more when buying, renting, or leasing a building with energy efficiency upgrades.

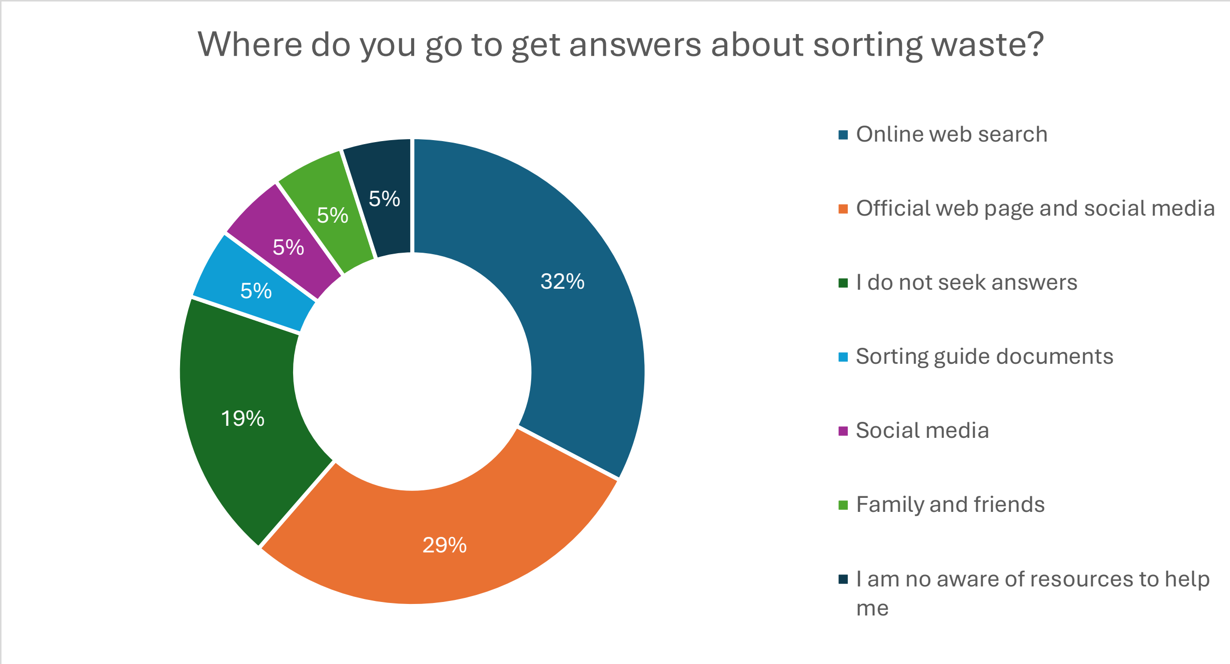


When asked the most important factors in making these improvements, participants ranked immediate cost (67%) and decrease in energy costs (75%) as important.

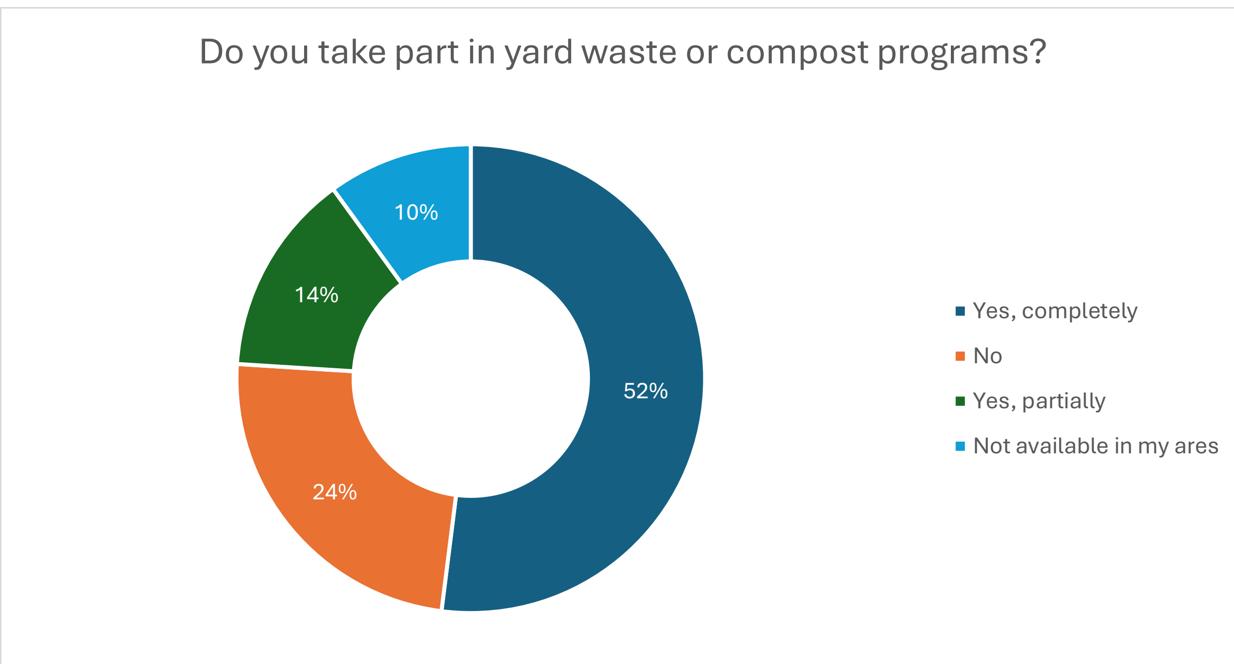


This trend continues with an average of 86% ranking incentive programs as important methods for reducing emissions from buildings.

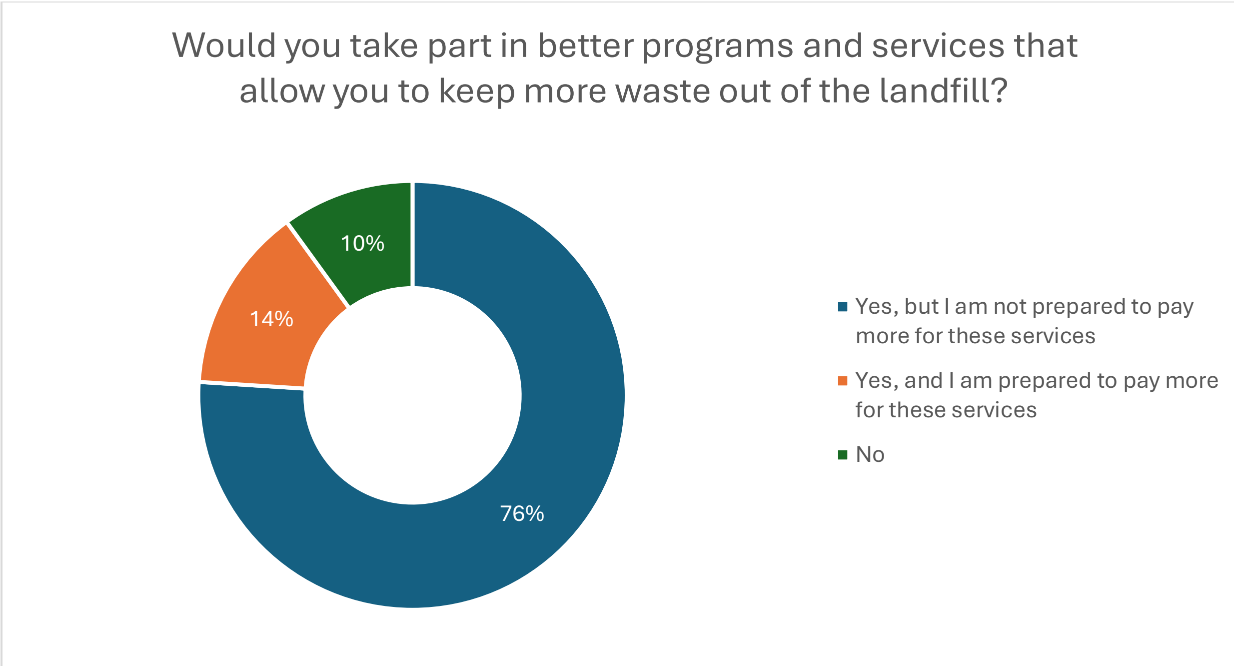
Waste and Recycling



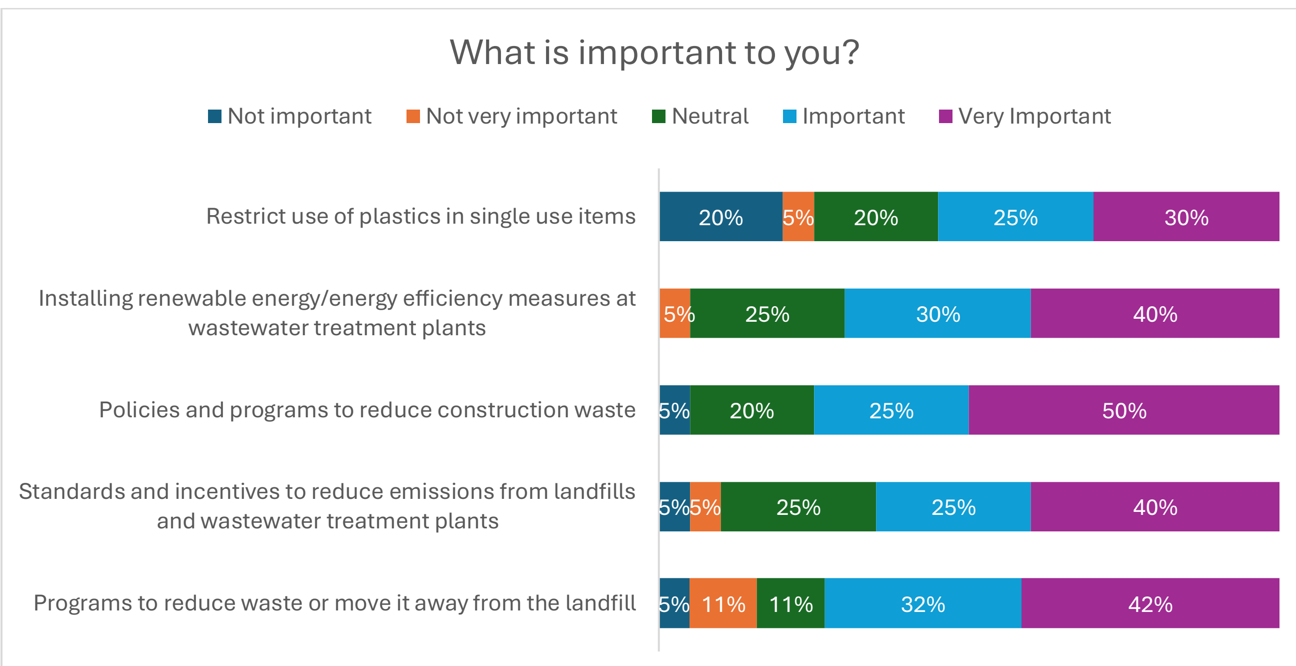
When seeking answers regarding waste sorting, the two top answers are online web searches and official information sources. 19% of participants don't seek answers at all. The rest of the options only receive 5% of the votes.



66% already participate in at least one program to reduce landfill waste.



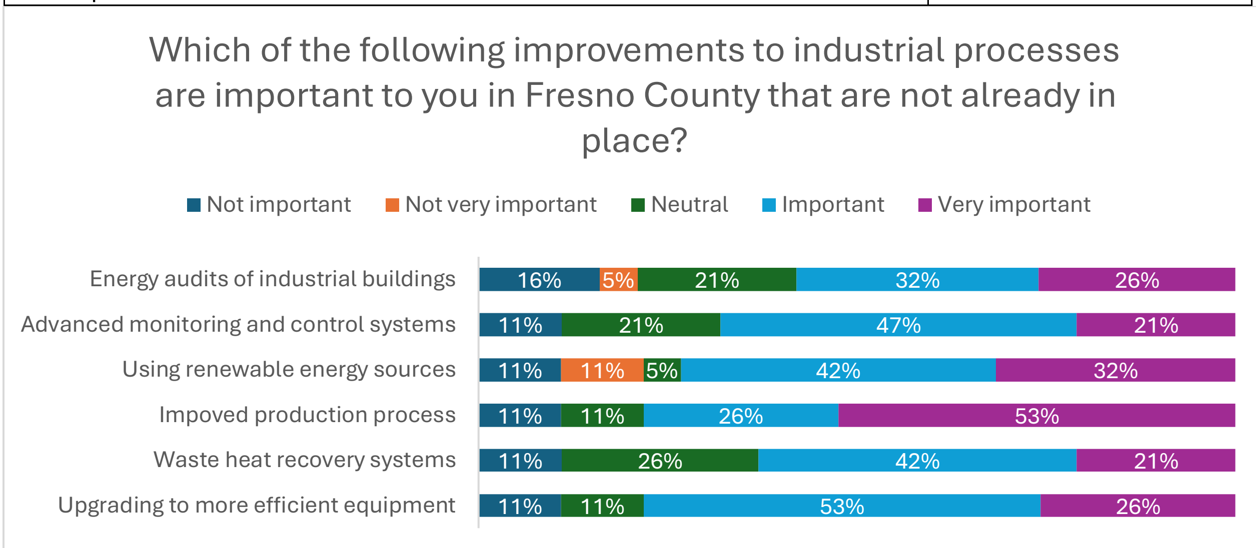
79% of participants would be willing to take part in better recycling/composting programs and services if they did not have to pay more for the services.



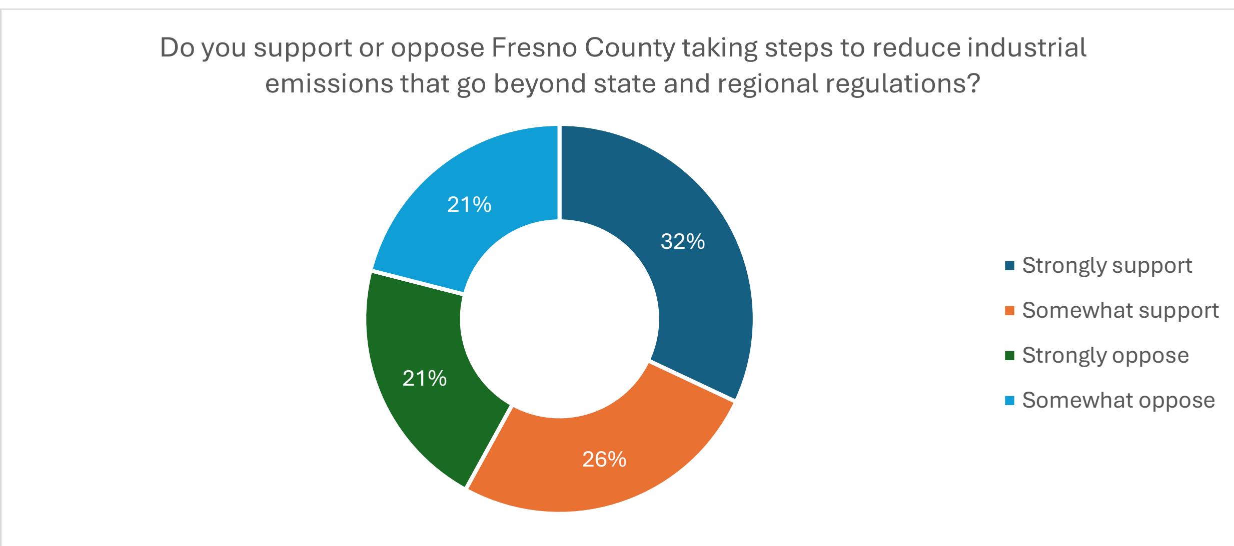
When it comes to participants' priorities, there is no clear winner. However, policies and programs on construction waste earns a slim majority, with 75% of participants ranking it with some amount of importance.

Industry

Are there industrial processes or specific facilities you are concerned about in your area?	
Comments	**Similar Comments**
The cemex expansion project	3
The continued operation and growth of high pollution industries	2
Republic Services emits a strong odor next to the Lewis S. Eaton Trail and the Vulcan Mining company shouldn't be allowed to blast mine near the river	0
The expansion of industrial zones in south Fresno	0

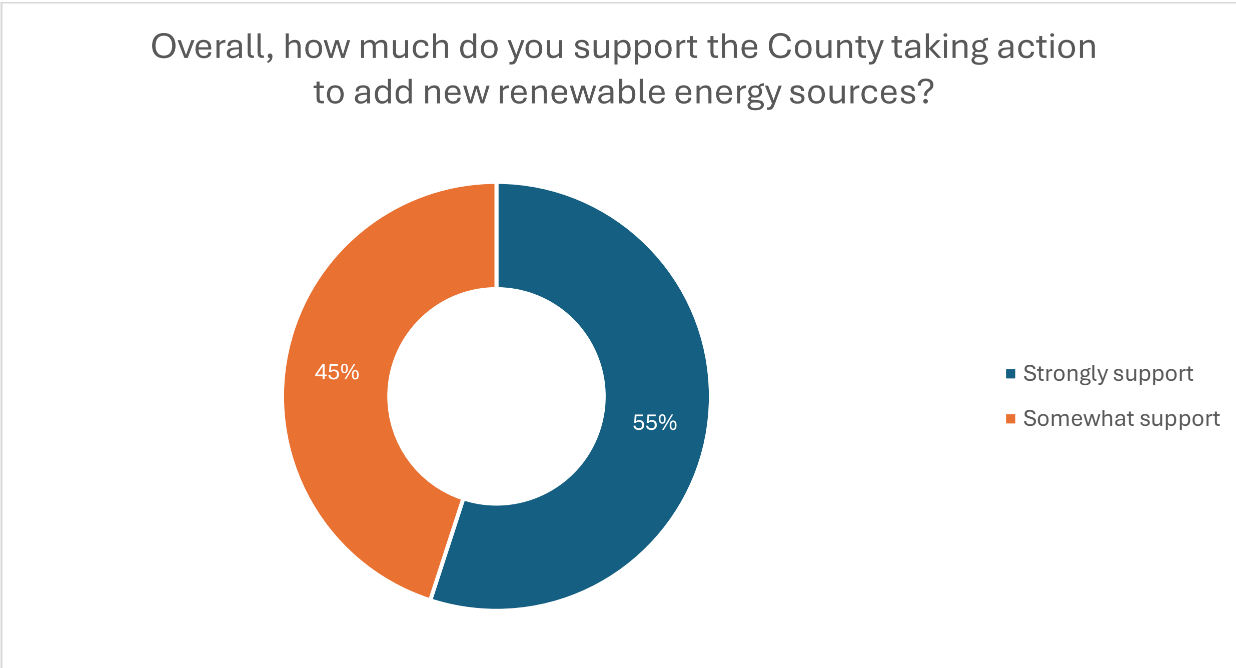


No industrial improvement fell below 50% importance among participants, with efficiency upgrades and improved production taking the top answers at 78% importance.

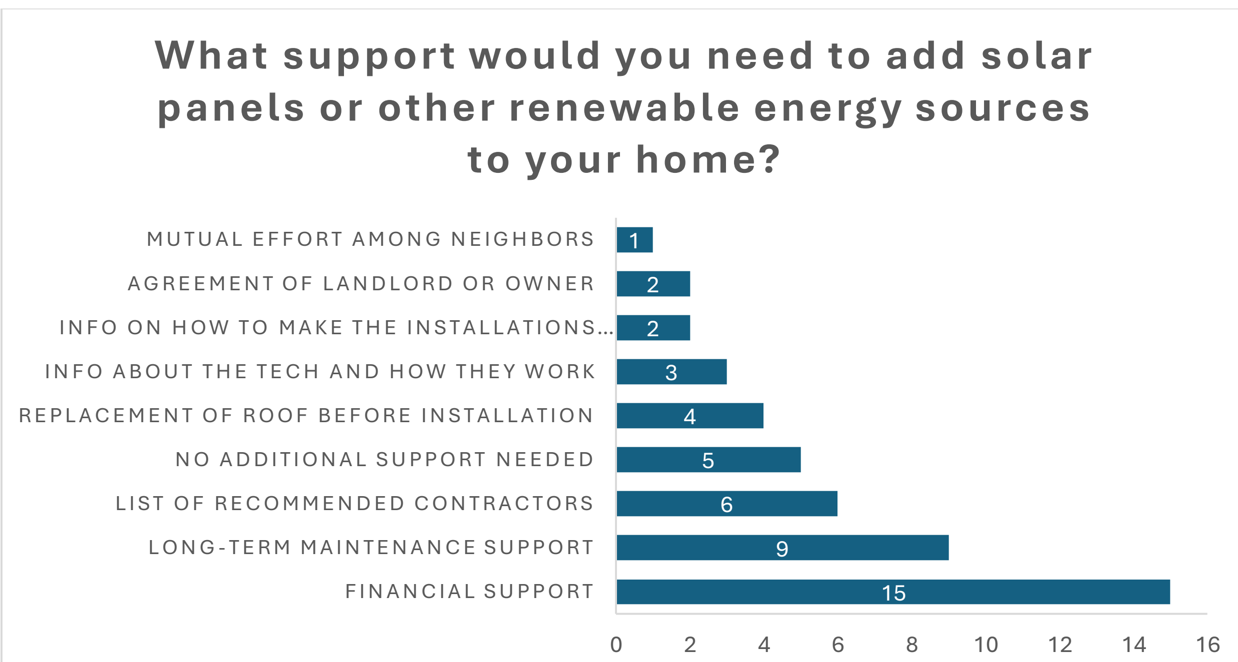


Despite this, participants are divided on the matter of industry, with a narrow 57% majority supporting Fresno County taking steps to reduce industrial emissions that go beyond state and regional regulations.

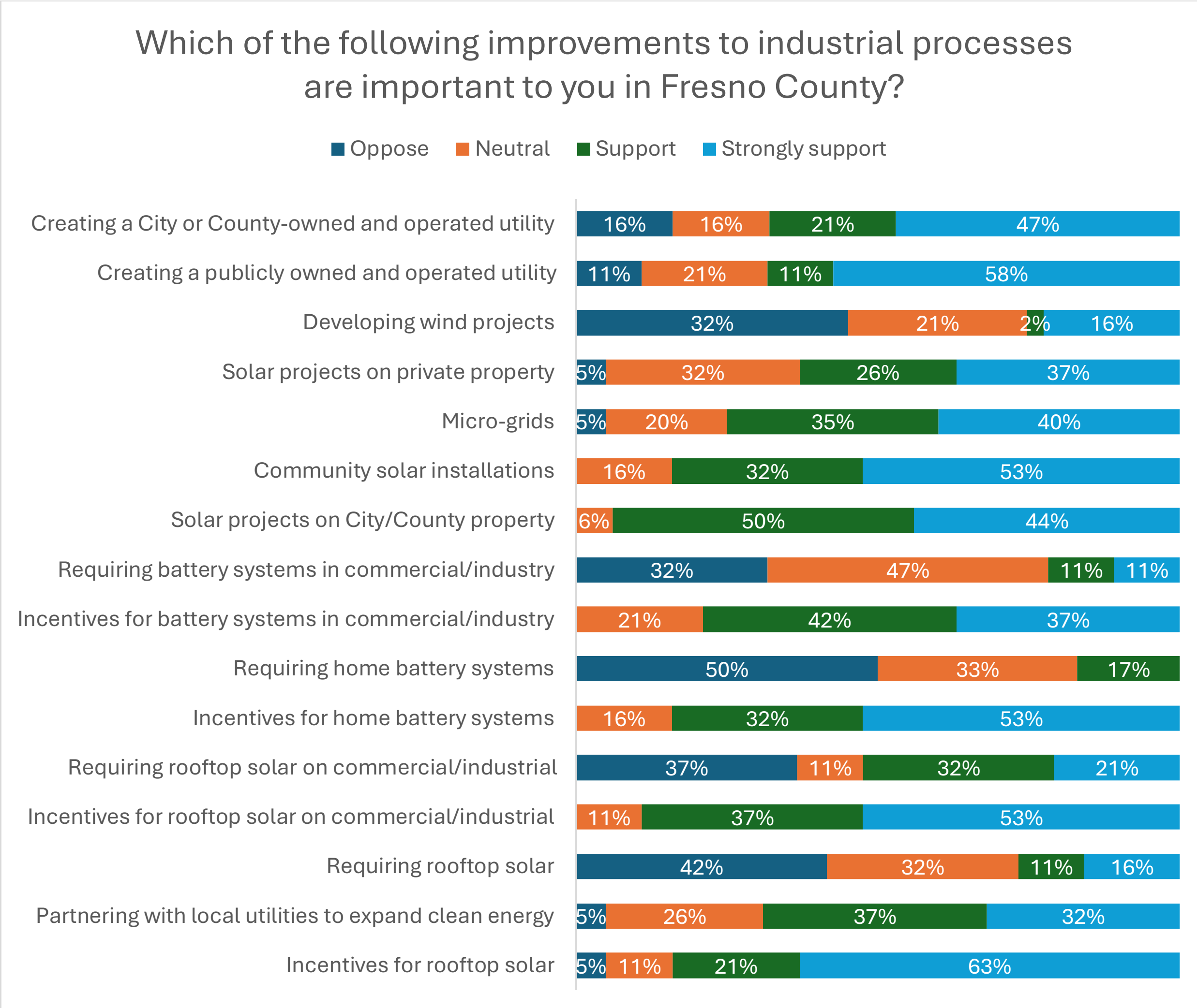
Electricity Generation



Unanimously, 100% of participants give some support to Fresno County adding new renewable energy sources in Fresno County.



However, 74% of participants require financial support to add solar panels or other renewable energy sources. 43% also require long-term maintenance support.

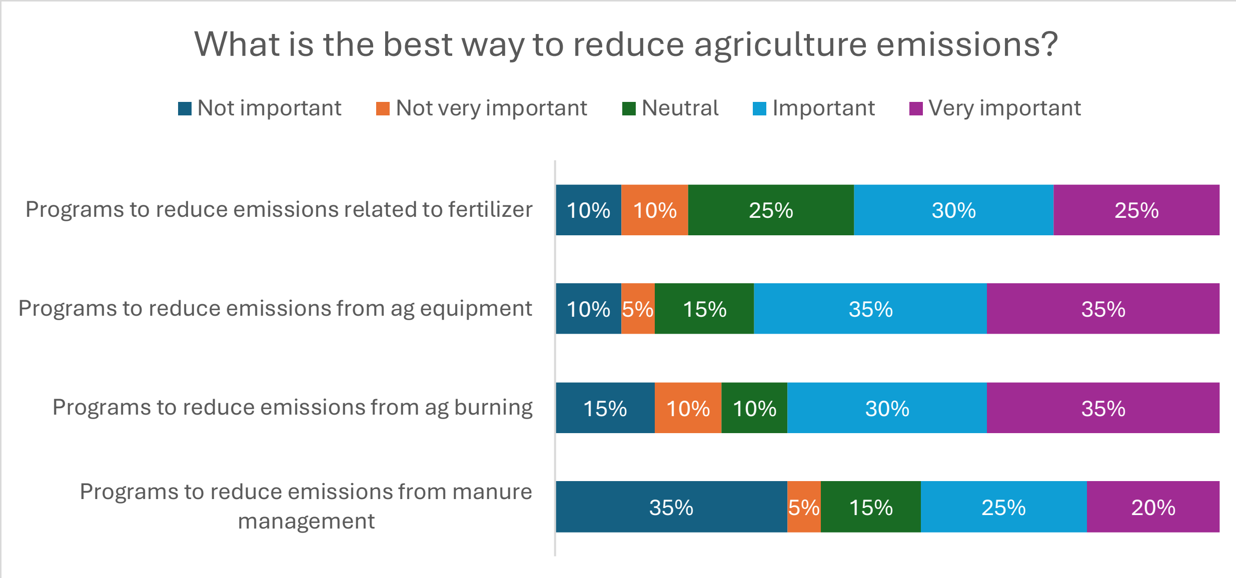


Comments
Solar programs are important and could provide significant long-term reduction in energy costs, but the Public Utilities Commission must work with utility companies to make solar a worthwhile investment.
Solid State Solar operations should be in developed areas on roofs instead of solar farms. We should be promoting a viable bio-circular economy that include urban areas. This includes renewable natural gas, biodiesel, and solid-state fuel cells.
I don’t trust the solar industry, nor do I trust the incentive programs to last. I would rather focus on other upgrades like more energy efficient roofs, windows, and insulation.
Renewable energy savings should be passed back to the consumer instead of the utilities.
Oppose PG&E attempts to cancel NEM 1& 2 contracts

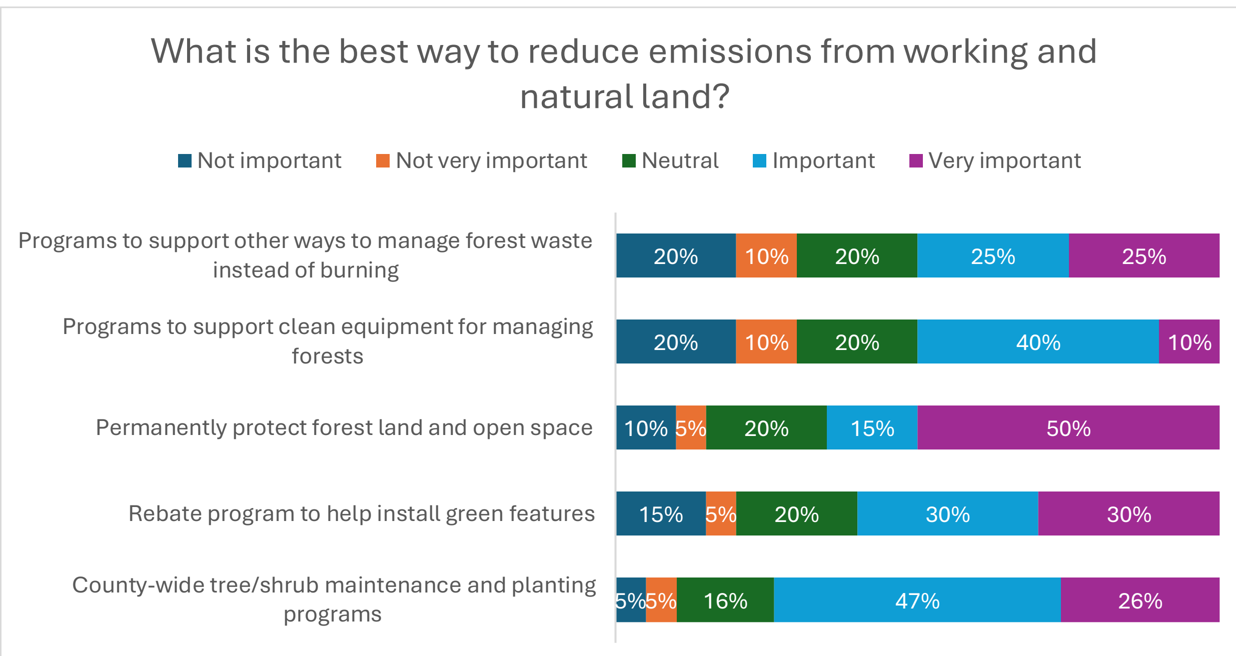
The majority of participants generally support programs that offer incentives to increase renewable energy, with each incentive option garnering over 70% of participants’ support. This is contrasted by the majority of participants opposing programs that make it a requirement.

Another interesting finding is that 68% of participants support publicly owned and operated utilities.

Agriculture and Land Use

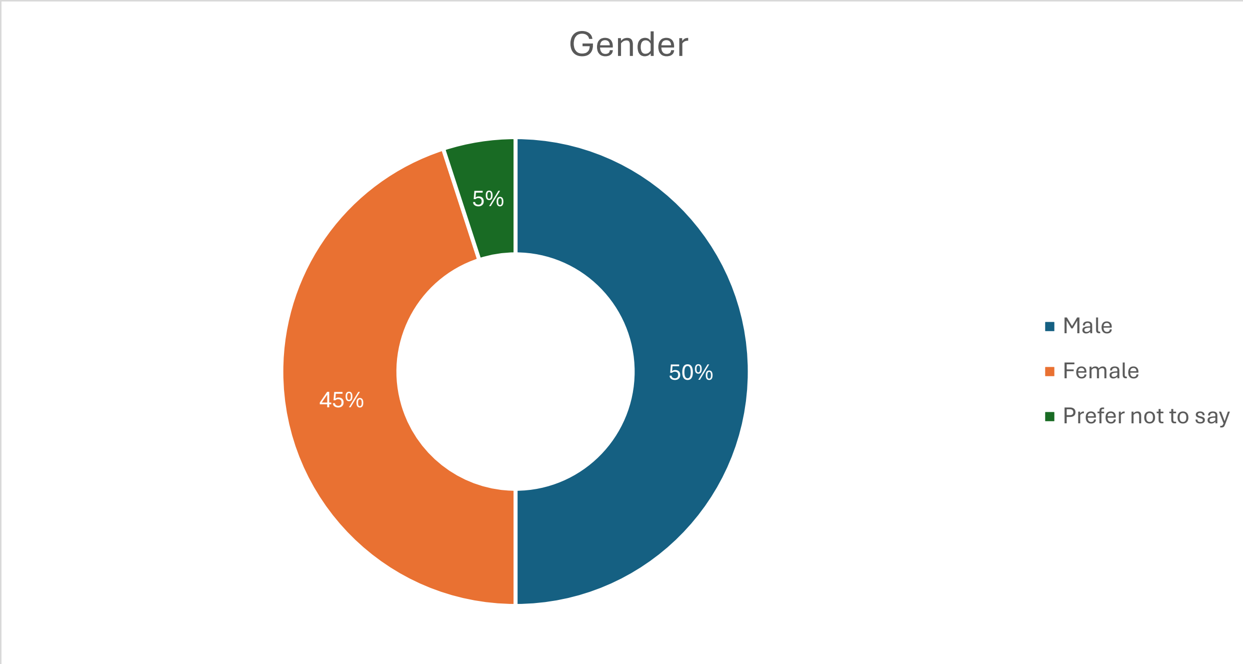


While programs to reduce emissions from fertilizer, equipment, and burning are all ranked as important by at least 50% of participants, programs to reduce manure emissions fall short with only 45% ranking it important and 35% ranking it not important at all.

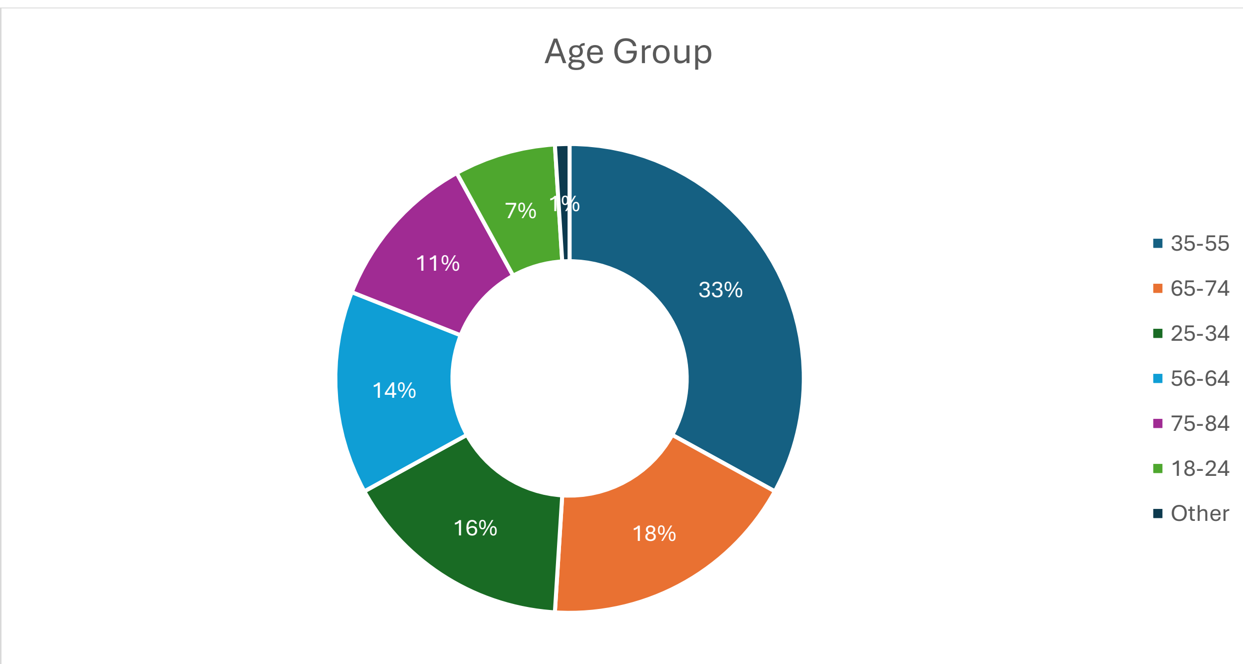


When asked the best way to reduce emissions from working and natural land, results fall in line with the general question from the Community Concerns sub-survey. The standout method was a program to plant more trees and shrubs, with 73% of participants ranking it important.

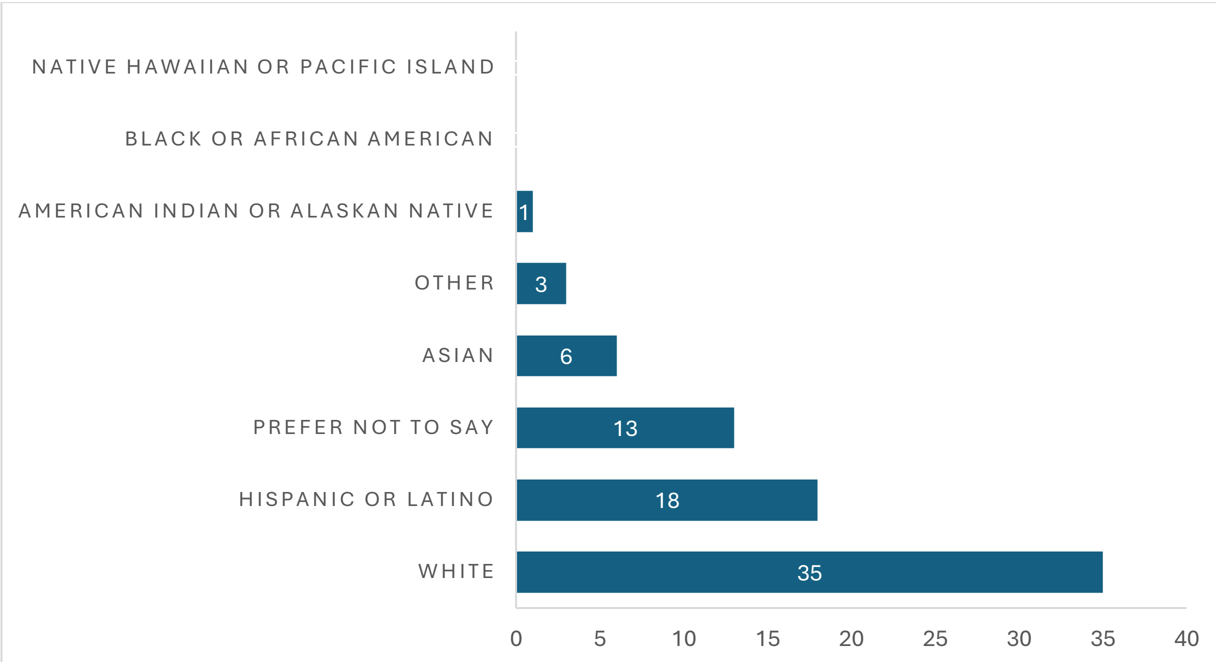
Demographics



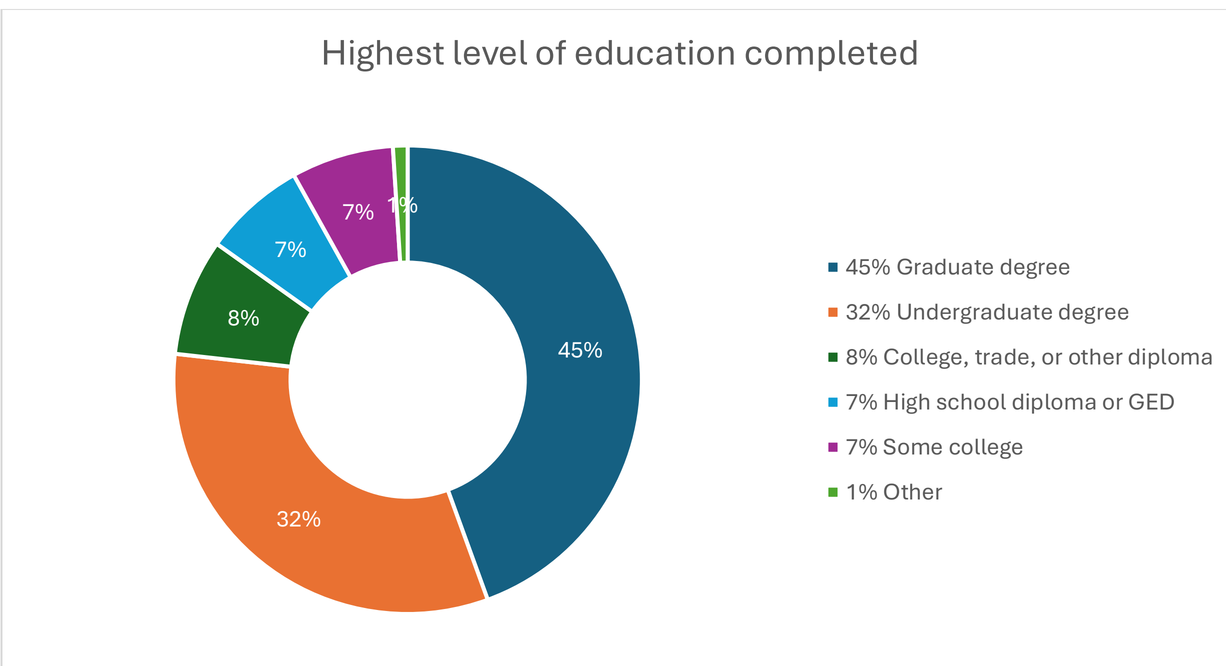
In terms of demographics, the survey received a fairly even split of male and female participants.



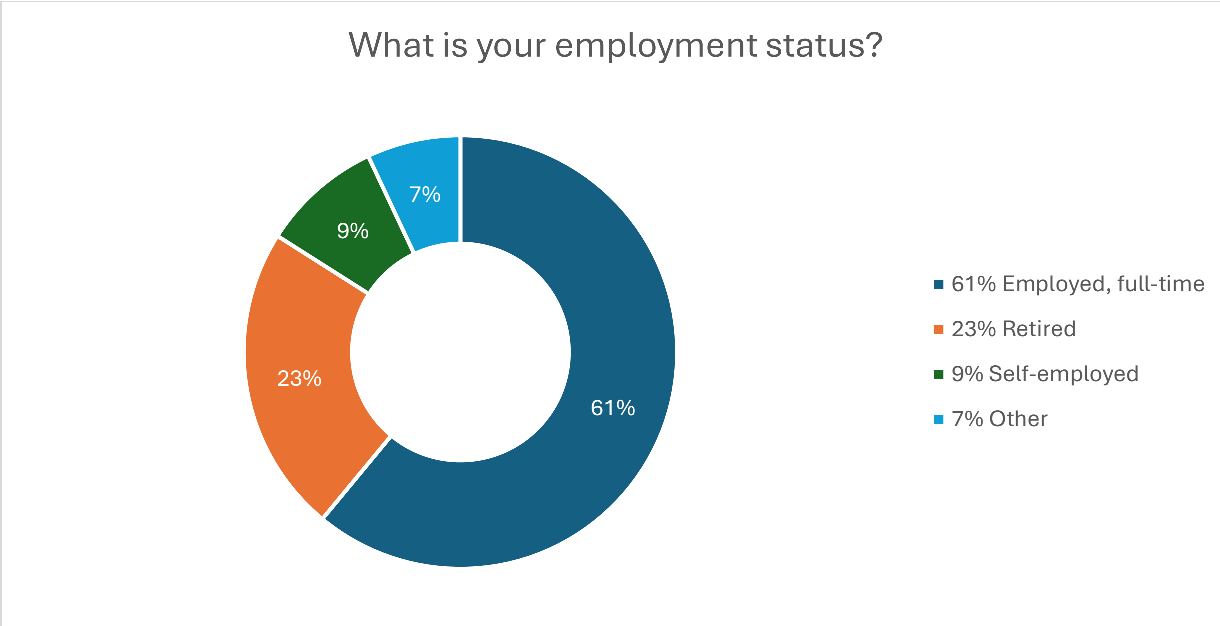
The 35-55 age group has a small majority of the participants with 33% while 18-24 are the smallest group with 7% of participants. The rest of the age groups have a fairly even spread.



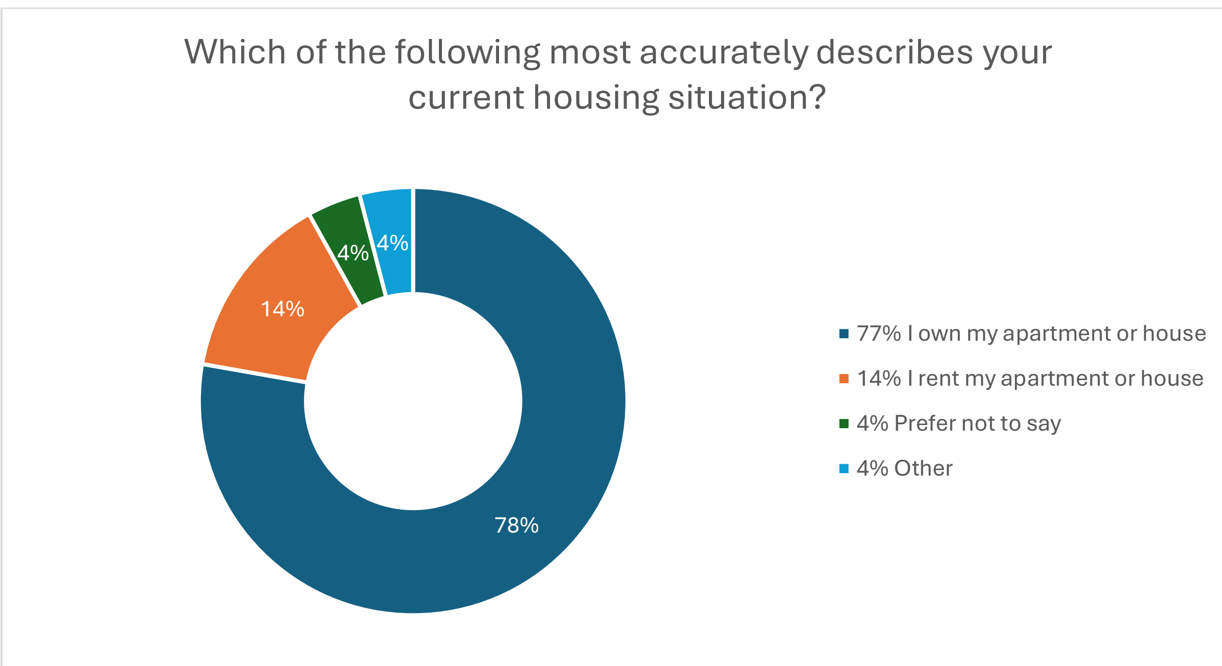
White participants take a clear majority with Hispanic or Latino participants as the second largest group.



Most participants have graduated college, with 45% of participants even having a graduate degree.



Full-time employees take the majority with 61% with retired people taking up 23% of participants.



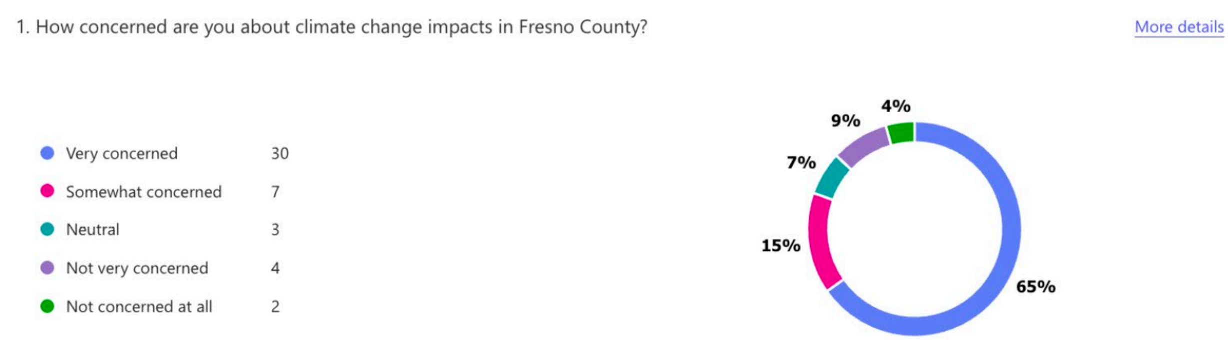
Homeowners take the majority with 77% of participants owning their own apartment or house.

Fresno Council of Governments
Comprehensive Climate Action Plan
Survey #2 Report

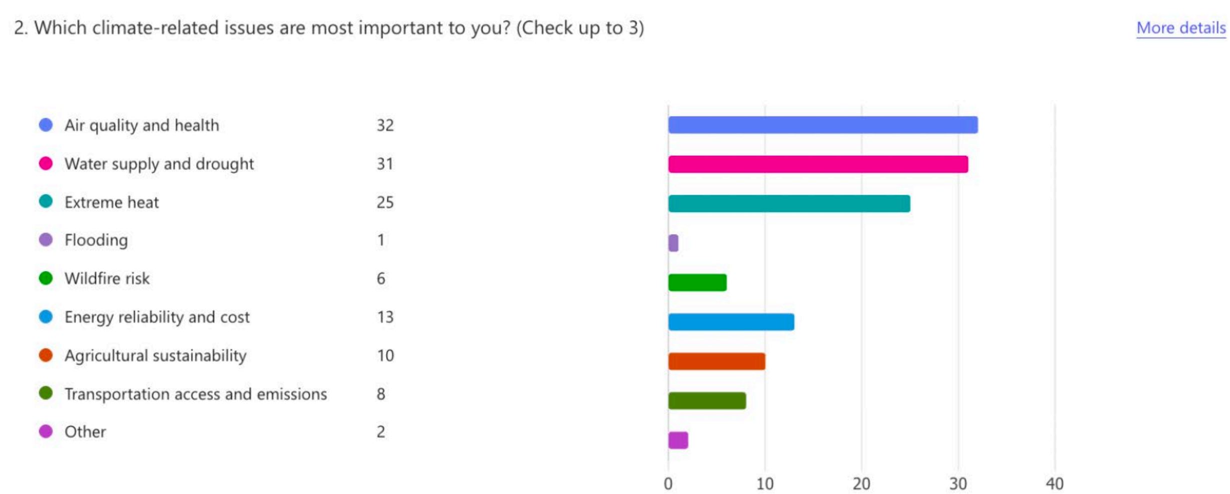
Overview

The following is a summary of the Fresno Council of Governments' (COG) second Comprehensive Climate Action Plan survey. The survey was live from July 21, 2025, to September 8, 2025. It was promoted on social media, via eblasts, and through a pop-up booth at the farmer's market in Clovis. A total of 46 people completed the survey, which is summarized below.

Key Findings

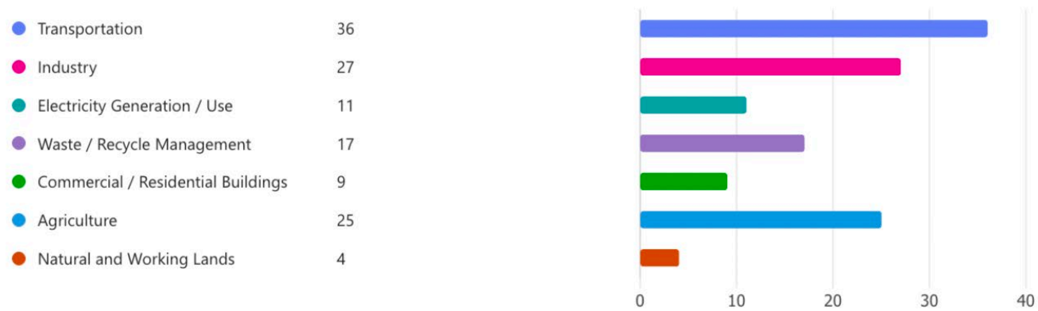


The majority of respondents – 80% – indicated that they are somewhat or very concerned about climate change impacts in Fresno County, with sentiment heavily leaning toward "very concerned." Only two participants said they are not concerned at all.



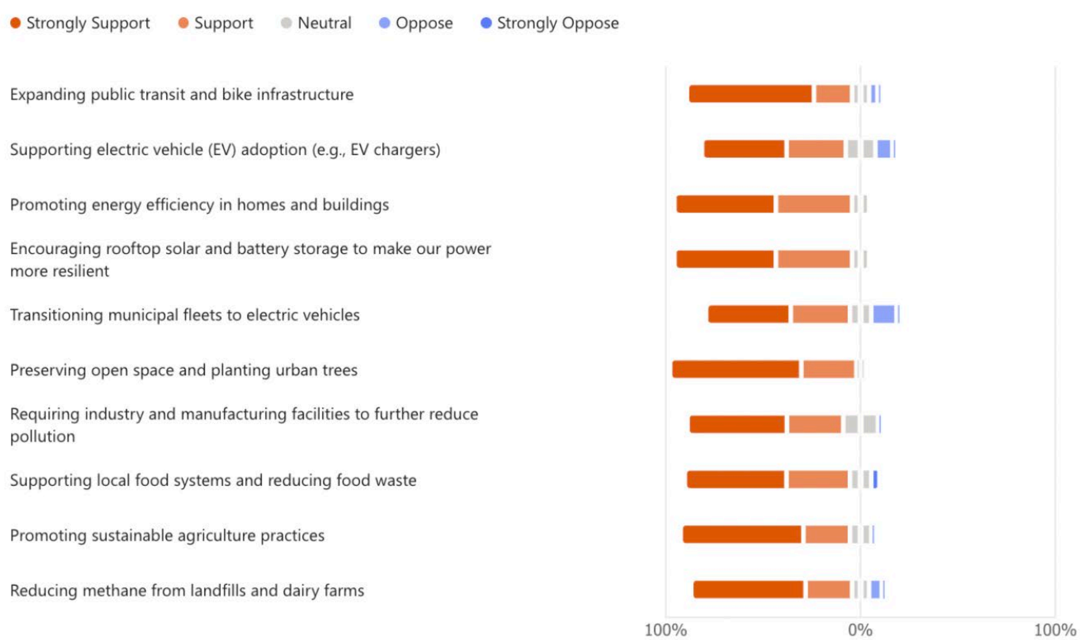
Air quality, water supply and drought, and extreme heat were the top three concerns by a wide margin. Energy reliability and cost, agricultural sustainability, and transportation access and emissions were also important, but a lower priority.

3. The CCAP will include strategies for reducing GHG emissions across the sectors below. Please select three sectors that you would consider to be the most important to reduce emissions from in Fresno County: More details



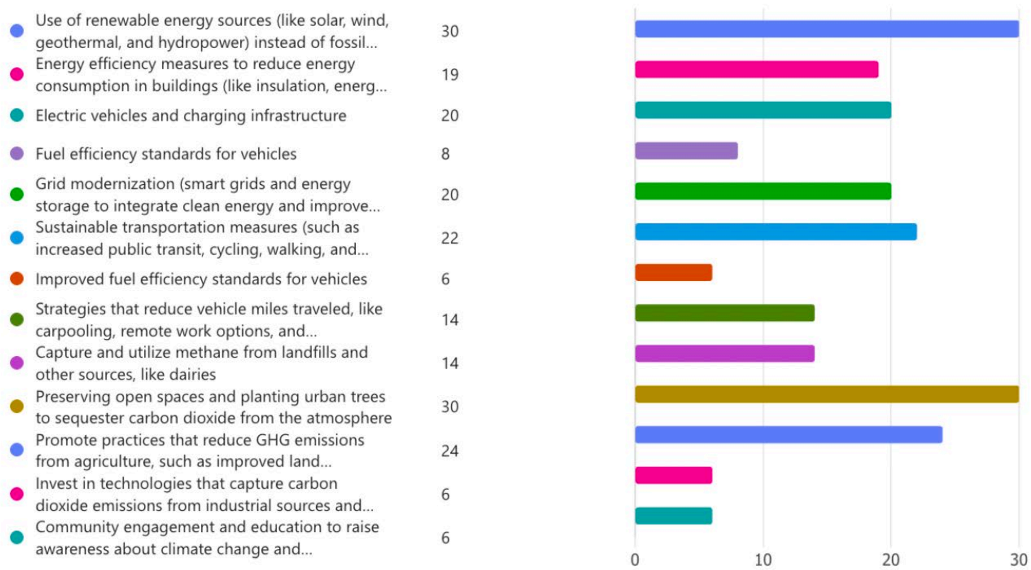
Transportation was considered the most important sector for reducing emissions, with industry and agriculture ranking second and third. Waste/recycle management came in fourth with 17 votes.

4. How supportive are you of implementing the following types of GHG reduction strategies in Fresno County? (Rate each: Strongly Support / Support / Neutral / Oppose / Strongly Oppose) More details



Preserving open space and planting urban trees, expanding public transit and bike infrastructure, and promoting sustainable agriculture practices received the strongest support, while transitioning municipal fleets to electric vehicles received the most opposition.

5. What measures to reduce GHG emissions would you most like to see in your community? Please select the five measures that are most important to you. More details



Two responses received 30 votes – the highest number – on this question: Use of renewable energy sources and preserving open spaces and planting urban trees. Promoting practices that reduce GHG emissions from agriculture received 24 votes, and electric vehicles/charging infrastructure and grid modernization each received 20 votes.

6. Are there other climate actions you would like to see in Fresno County? More details

16 Latest Responses

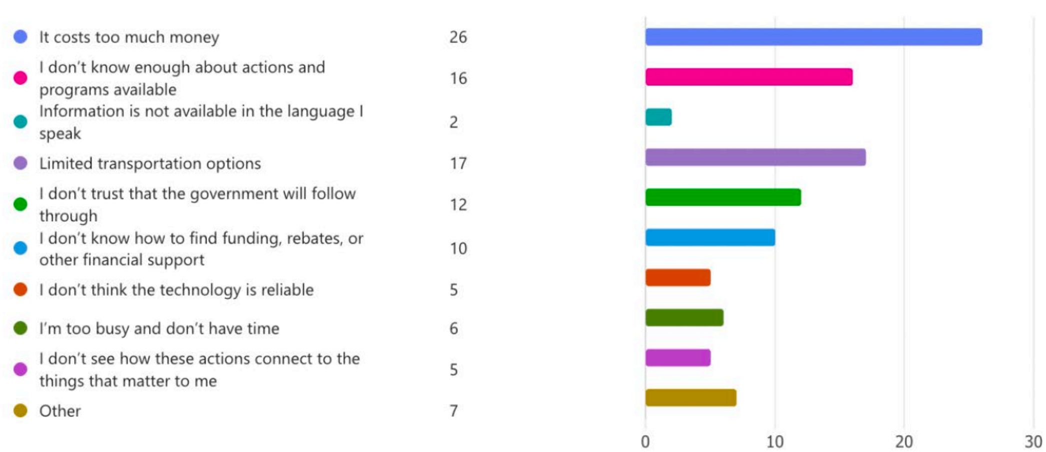
Verbatim responses to this question included:

- More LEED certified infrastructure.
- I'd like to see county and city climate action plans
- Practice regenerative organic agriculture and use organic fertilizer made from food waste. Help cities fund local campaigns to create awareness with families on how to reduce waste, save energy and grow their own food.
- Making sure the citizenry is involved much more in decision-making, rather than the usual 'powers-that-be.'
- Expand mass transit, build carpool lanes.
- Implementation of biomass utilization technologies for Ag and Urban "wastes".
- not at this time
- Leave it alone

- "On #2, above, I was not able to enter my ""other"" climate-related issue, which is electrification
- I would like to see current, science-based and user-friendly climate change information on every municipal and county website and social media outlet, and regular updates provided to governing bodies and officials.
- Common sense, acknowledge that climate change is a naturally-occurring phenomenon not initiated or controlled by humans.
- Limit housing in Ag areas , promote infill construction , the valley is car dependent and that is ok but building commuter locations is counter intuitive to our health goals.
- Not so much lumbering in parks. Automatic shut offs on electric wires in fire-prone areas
- For Fresno County, the development of a repository for the collection and dissemination of information related to key local indicators of climate change. (The database shall include all of the climate action strategies adopted by a governmental and quasi-governmental agency operating with Fresno County.) Also, the establishment of a citizen task force (comprised of civil servants, county residents and experts in the field of climate change) which shall analyze and report annually the degree of success of each of the adopted climate action strategies.
- Increased bus service network coverage and increased frequency including in rural areas. To make it easier, create a countywide transit district merging all county transit agencies into one in order to reduce duplication and increase efficient spending of dollars.
- Exposing as misguided political leaders who ignore climate change

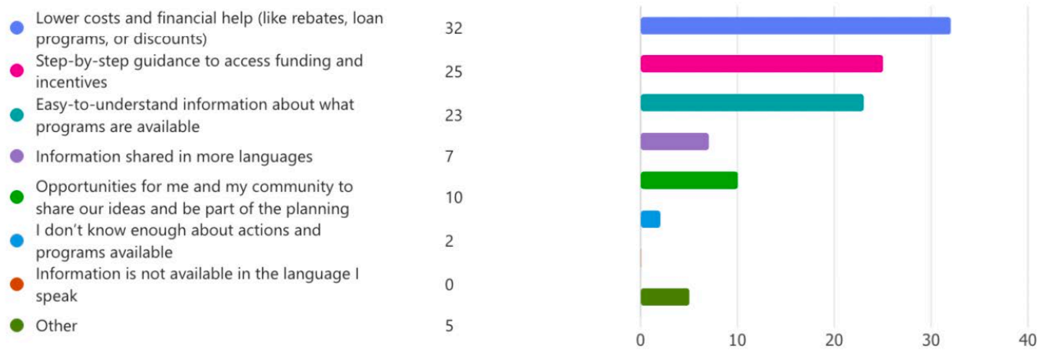
7. What challenges might prevent you or your community from supporting or participating in climate actions? (Check all that apply)

More details



High costs were identified as the biggest challenge preventing communities from participating in climate actions. Limited transportation options and a lack of knowledge about actions and programs available were the second and third most common responses.

8. What would make it easier for you or your community to take climate action? More details



Lower costs and financial assistance were the most frequently cited way to make it easier to take climate action, followed by step-by-step guidance to access funding and incentives and easy-to-understand information about what programs are available.

9. Do you have concerns about how climate policies may affect any specific communities (e.g., low-income, rural, or communities of color)? If so, please explain. More details

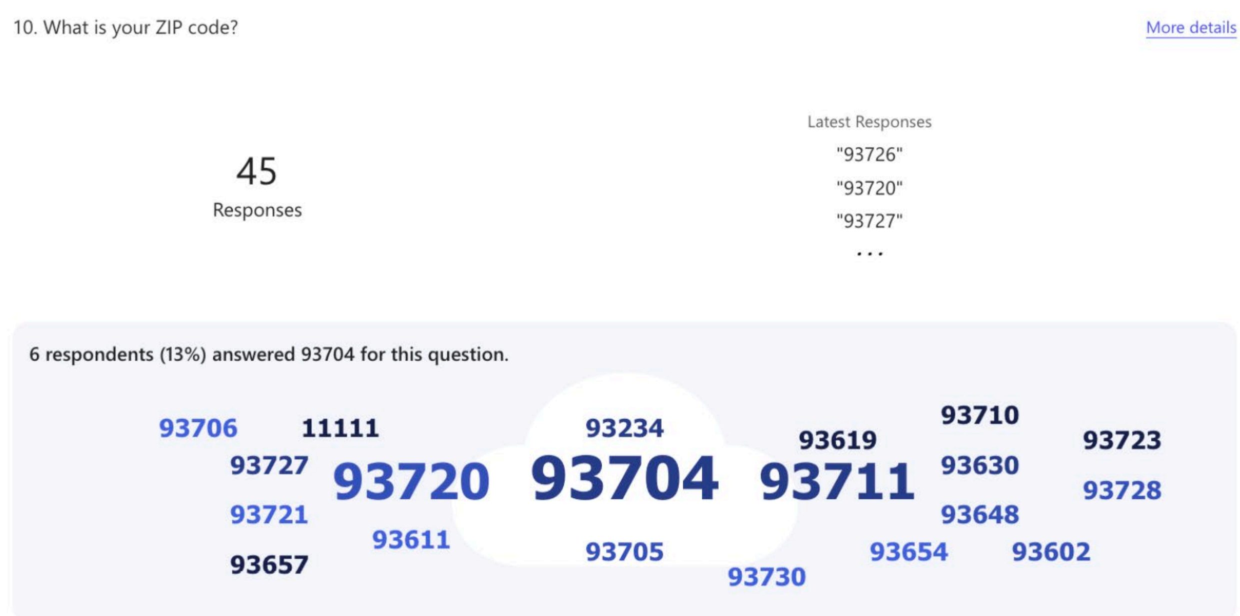
13
Responses

Latest Responses
...

Verbatim responses to this question included:

- The lack of action on climate will impact us all, more so low-income families, more so low-income farmworker families and Latinos.
- We're all in trouble but trouble as you know finds those less able to avoid it. Low income and other less well connected groups will suffer more than the wealthy and powerful.
- Government policies ALWAYS reflect the north parts of Fresno and little concern for the south.
- I have no concerns. I see great opportunity!
- Current energy efficiencies still favor those that can afford the measures. my opinion is the public utilities should underwrite the cost of implementation since they benefit from the increased energy entering the grid
- Extreme heat that affects neighborhoods with out tree canopies
- Low income, rural and some people of color who make up many in low income areas can't afford solar on their homes, electric or hybrid vehicles, energy efficient appliances and probably don't know about or how to access help. There's not enough programs to fill the needs of these communities.
- Rural and low income get the regulations but not money to sustain ideas

- Yes. Marginalized communities that may be affected should be included in the planning process.
- Yes. Climate policies are being used for social engineering and financial gain. Climate change is used as a fear tactic. It has been occurring for the entire life cycle of earth.
- None
- I am concerned that the perception may lead to members of the public not supporting them on the grounds of stymying economic development. In reality, these policies need to be pursued in order to maintain our standard of living, that needs to be communicated to the public effectively.
- Simply having fossil fuel operations near poor people whose lives are too harassed to object to the pollution may reduce some complaint problems, but is unfair to those citizens who breathe and drink the emissions.



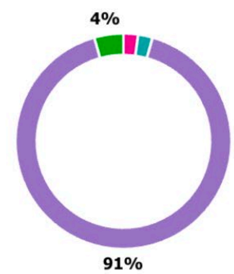
Respondents came from numerous zip codes, with 93704 receiving the most responses.

Zip Code	**Responses**
93704	6
93720	5
93711	5
93630	2
93611	2
93654	2
93721	2
93619	2
93648	2
93705	2

93727	2
93726	2
93234	1
93728	1
93706	1
93730	1
93602	1
93723	1
93710	1
93657	1
93612	1
93722	1

11. How long have you lived in Fresno County? More details

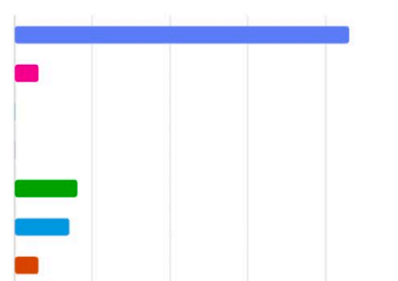
- Less than 1 year 0
- 1–5 years 1
- 6–10 years 1
- More than 10 years 42
- I don't live in Fresno County 2



Most respondents have lived in Fresno County for more than 10 years. Only two have lived in Fresno County for fewer than 10 years. Two participants indicated they do not live in Fresno County.

12. What is your relationship to Fresno County? (Check all that apply) More details

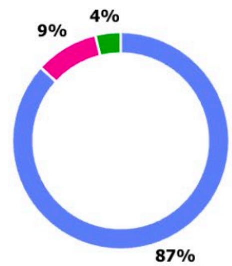
- Resident 43
- Business owner 3
- Farmer/agricultural producer 0
- Student 0
- Local government employee 8
- Community organization representative 7
- Other 3



The vast majority of participants are Fresno County residents. Three are business owners, eight work for local governments, and seven are community organization representatives.

13. What language(s) do you speak at home? More details

English	46
Spanish	5
Hmong	0
Punjabi	0
Other	2



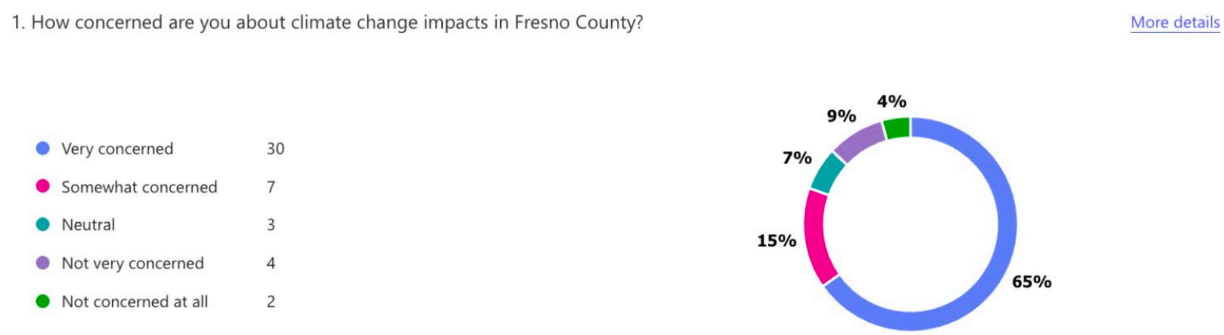
More than 85% of participants speak English at home, with five speaking Spanish.

Fresno Council of Governments
Comprehensive Climate Action Plan
Survey #2 Report

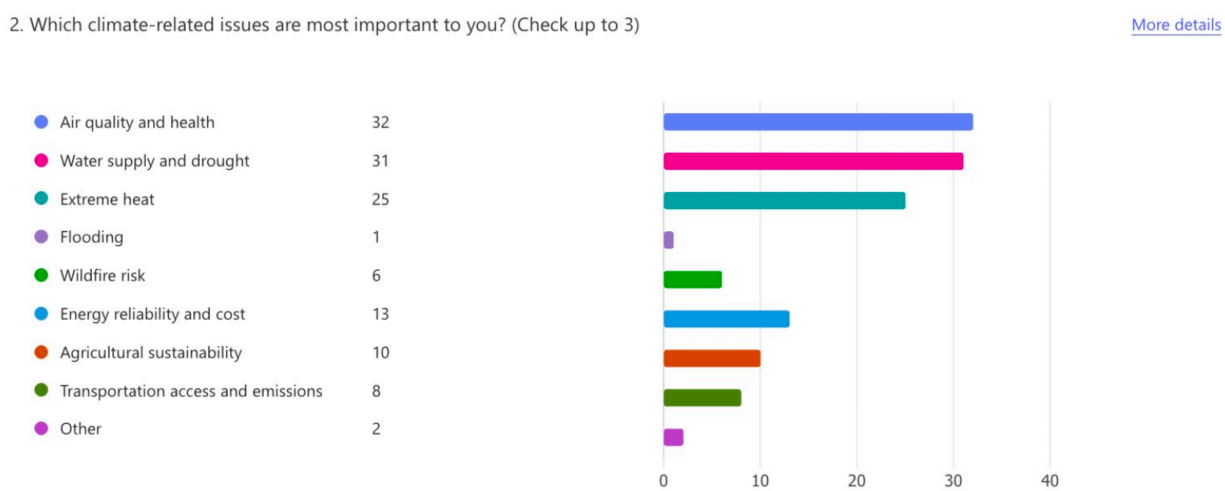
Overview

The following is a summary of the Fresno Council of Governments' (COG) second Comprehensive Climate Action Plan survey. The survey was live from July 21, 2025, to September 8, 2025. It was promoted on social media, via eblasts, and through a pop-up booth at the farmer's market in Clovis. A total of 46 people completed the survey, which is summarized below.

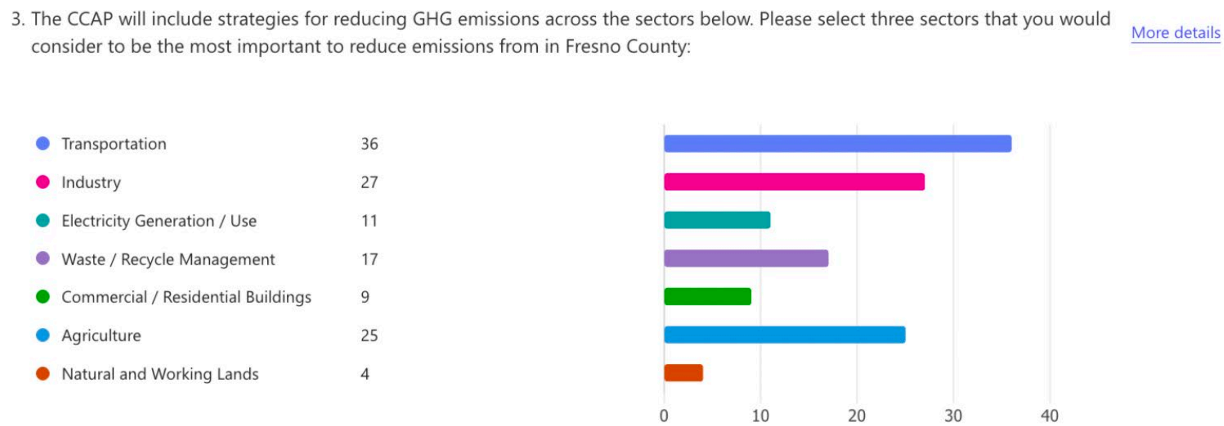
Key Findings



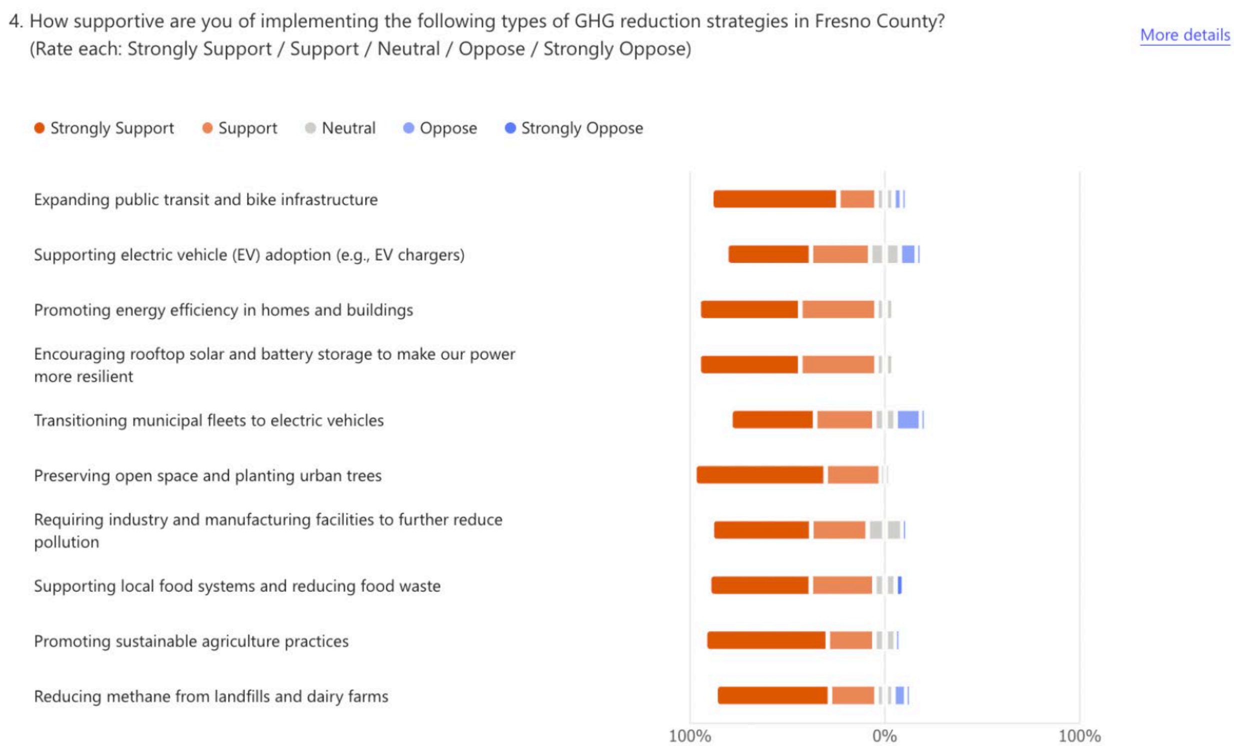
The majority of respondents – 80% – indicated that they are somewhat or very concerned about climate change impacts in Fresno County, with sentiment heavily leaning toward "very concerned." Only two participants said they are not concerned at all.



Air quality, water supply and drought, and extreme heat were the top three concerns by a wide margin. Energy reliability and cost, agricultural sustainability, and transportation access and emissions were also important, but a lower priority.

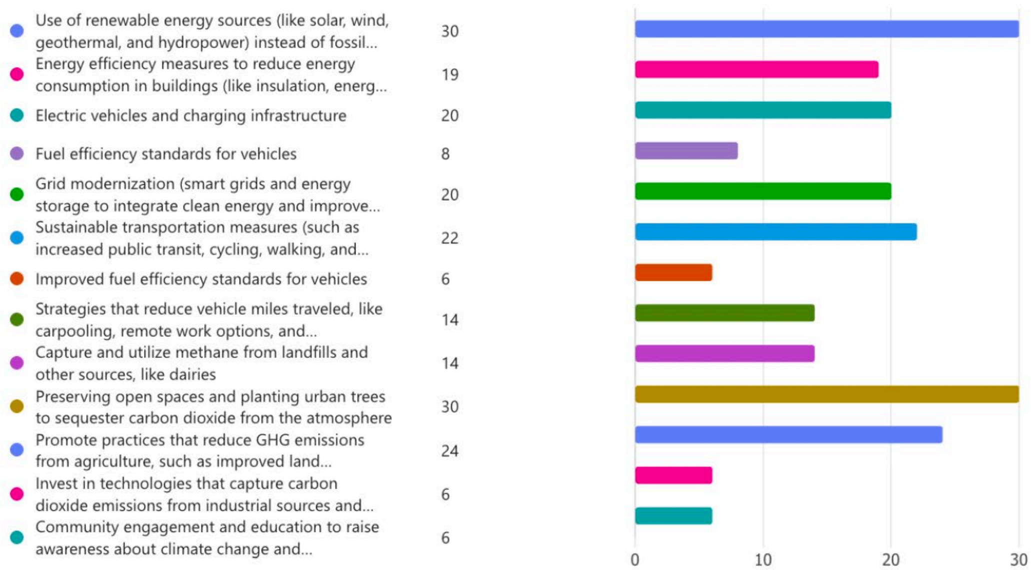


Transportation was considered the most important sector for reducing emissions, with industry and agriculture ranking second and third. Waste/recycle management came in fourth with 17 votes.



Preserving open space and planting urban trees, expanding public transit and bike infrastructure, and promoting sustainable agriculture practices received the strongest support, while transitioning municipal fleets to electric vehicles received the most opposition.

5. What measures to reduce GHG emissions would you most like to see in your community? Please select the five measures that are most important to you. More details



Two responses received 30 votes – the highest number – on this question: Use of renewable energy sources and preserving open spaces and planting urban trees. Promoting practices that reduce GHG emissions from agriculture received 24 votes, and electric vehicles/charging infrastructure and grid modernization each received 20 votes.

6. Are there other climate actions you would like to see in Fresno County? More details

16 Latest Responses

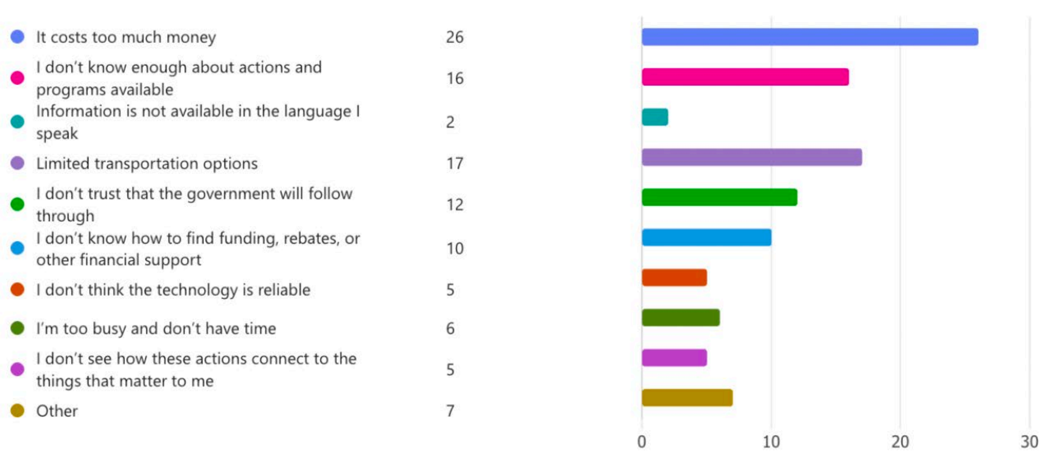
Verbatim responses to this question included:

- More LEED certified infrastructure.
- I'd like to see county and city climate action plans
- Practice regenerative organic agriculture and use organic fertilizer made from food waste. Help cities fund local campaigns to create awareness with families on how to reduce waste, save energy and grow their own food.
- Making sure the citizenry is involved much more in decision-making, rather than the usual 'powers-that-be.'
- Expand mass transit, build carpool lanes.
- Implementation of biomass utilization technologies for Ag and Urban "wastes".
- not at this time
- Leave it alone

- "On #2, above, I was not able to enter my ""other"" climate-related issue, which is electrification
- I would like to see current, science-based and user-friendly climate change information on every municipal and county website and social media outlet, and regular updates provided to governing bodies and officials.
- Common sense, acknowledge that climate change is a naturally-occurring phenomenon not initiated or controlled by humans.
- Limit housing in Ag areas , promote infill construction , the valley is car dependent and that is ok but building commuter locations is counter intuitive to our health goals.
- Not so much lumbering in parks. Automatic shut offs on electric wires in fire-prone areas
- For Fresno County, the development of a repository for the collection and dissemination of information related to key local indicators of climate change. (The database shall include all of the climate action strategies adopted by a governmental and quasi-governmental agency operating with Fresno County.) Also, the establishment of a citizen task force (comprised of civil servants, county residents and experts in the field of climate change) which shall analyze and report annually the degree of success of each of the adopted climate action strategies.
- Increased bus service network coverage and increased frequency including in rural areas. To make it easier, create a countywide transit district merging all county transit agencies into one in order to reduce duplication and increase efficient spending of dollars.
- Exposing as misguided political leaders who ignore climate change

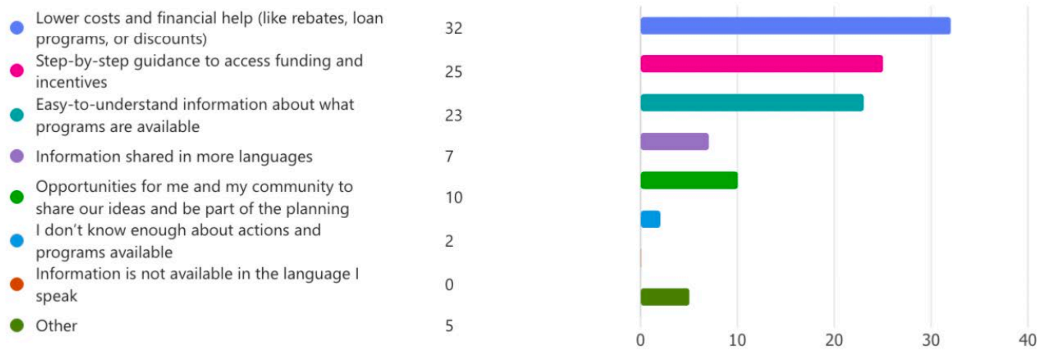
7. What challenges might prevent you or your community from supporting or participating in climate actions? (Check all that apply)

More details



High costs were identified as the biggest challenge preventing communities from participating in climate actions. Limited transportation options and a lack of knowledge about actions and programs available were the second and third most common responses.

8. What would make it easier for you or your community to take climate action? More details



Lower costs and financial assistance were the most frequently cited way to make it easier to take climate action, followed by step-by-step guidance to access funding and incentives and easy-to-understand information about what programs are available.

9. Do you have concerns about how climate policies may affect any specific communities (e.g., low-income, rural, or communities of color)? If so, please explain. More details

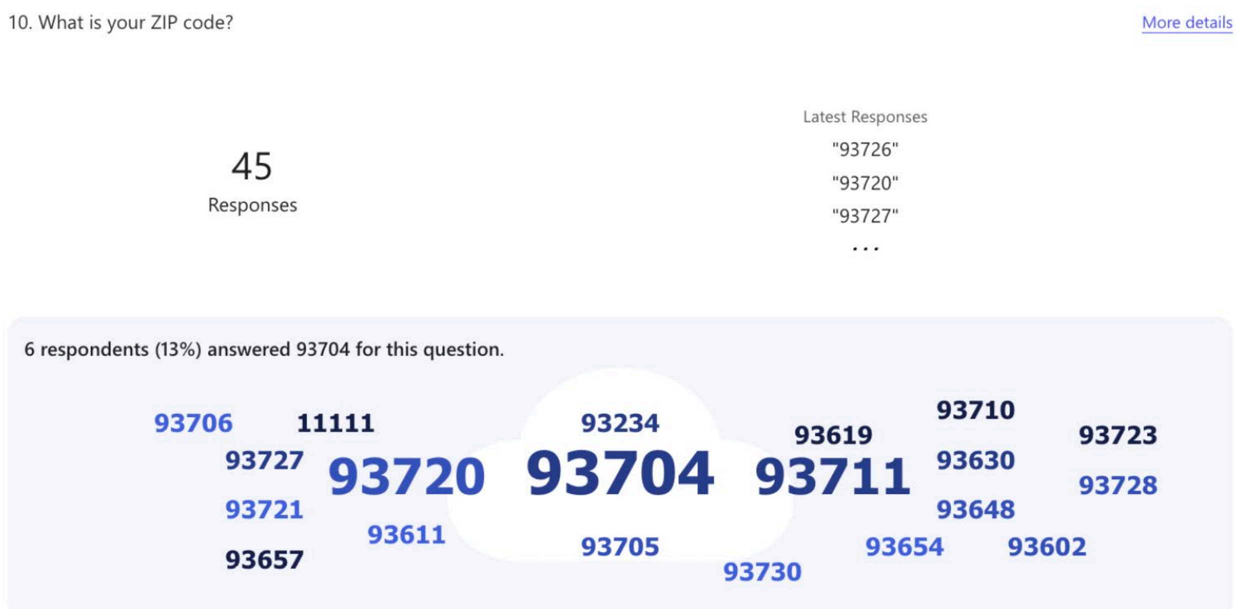
13
Responses

Latest Responses
...

Verbatim responses to this question included:

- The lack of action on climate will impact us all, more so low-income families, more so low-income farmworker families and Latinos.
- We're all in trouble but trouble as you know finds those less able to avoid it. Low income and other less well connected groups will suffer more than the wealthy and powerful.
- Government policies ALWAYS reflect the north parts of Fresno and little concern for the south.
- I have no concerns. I see great opportunity!
- Current energy efficiencies still favor those that can afford the measures. my opinion is the public utilities should underwrite the cost of implementation since they benefit from the increased energy entering the grid
- Extreme heat that affects neighborhoods with out tree canopies
- Low income, rural and some people of color who make up many in low income areas can't afford solar on their homes, electric or hybrid vehicles, energy efficient appliances and probably don't know about or how to access help. There's not enough programs to fill the needs of these communities.
- Rural and low income get the regulations but not money to sustain ideas

- Yes. Marginalized communities that may be affected should be included in the planning process.
- Yes. Climate policies are being used for social engineering and financial gain. Climate change is used as a fear tactic. It has been occurring for the entire life cycle of earth.
- None
- I am concerned that the perception may lead to members of the public not supporting them on the grounds of stymying economic development. In reality, these policies need to be pursued in order to maintain our standard of living, that needs to be communicated to the public effectively.
- Simply having fossil fuel operations near poor people whose lives are too harassed to object to the pollution may reduce some complaint problems, but is unfair to those citizens who breathe and drink the emissions.

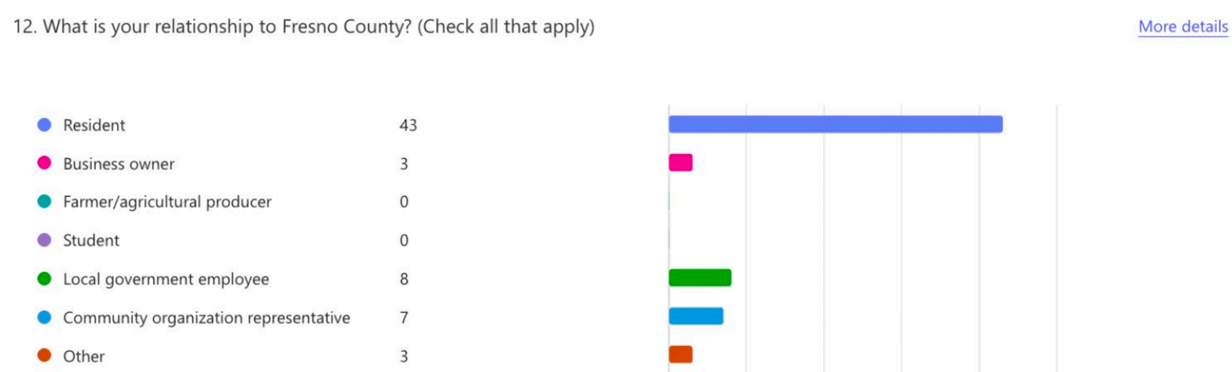


Respondents came from numerous zip codes, with 93704 receiving the most responses.

Zip Code	**Responses**
93704	6
93720	5
93711	5
93630	2
93611	2
93654	2
93721	2
93619	2
93648	2
93705	2

93727	2
93726	2
93234	1
93728	1
93706	1
93730	1
93602	1
93723	1
93710	1
93657	1
93612	1
93722	1

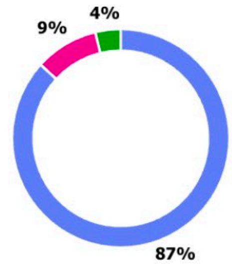
Most respondents have lived in Fresno County for more than 10 years. Only two have lived in Fresno County for fewer than 10 years. Two participants indicated they do not live in Fresno County.



The vast majority of participants are Fresno County residents. Three are business owners, eight work for local governments, and seven are community organization representatives.

13. What language(s) do you speak at home? More details

English	46
Spanish	5
Hmong	0
Punjabi	0
Other	2



More than 85% of participants speak English at home, with five speaking Spanish.

APPENDIX B

GHG EMISSIONS INVENTORY

APPENDIX B: GHG INVENTORIES

B.1. Fresno County GHG Inventory

The following table presents the complete greenhouse gas (GHG) inventory results for Fresno County, summarizing emissions by sector for the 2019 base year as described in Chapter 2. This inventory was developed using an activity-based approach aligned with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).

Table B.1. GHG Inventory for Fresno County, 2019, aligned with Global Protocol for Community-Scale Greenhouse Gas Emission Inventories

					in metric tons				
GPC ref No.	Scope	GHG Emissions Source	Inclusion	Reason for exclusion (if applicable)	CO2	CH4	N2O	Total CO2e	
I		STATIONARY ENERGY SOURCES							3,193,322
I.1		**Residential buildings**							
I.1.1	1	Emissions from fuel combustion within the county boundary	**Yes**		569,173	1,246	389	570,808	
I.1.2	2	Emissions from grid-supplied energy consumed within the county boundary	**Yes**		505,727	99	1,043	506,869	
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		16,295	3	34	16,331	**1,094,008**
I.2		**Commercial and institutional buildings/facilities**							
I.2.1	1	Emissions from fuel combustion within the county boundary	**Yes**		259,252	148	159	259,559	
I.2.2	2	Emissions from grid-supplied energy	**Yes**		500,892	98	1,033	502,023	

		consumed within the county boundary							
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		16,139	3	33	16,175	**777,757**
I.3		**Manufacturing industry and construction**							
I.3.1	1	Emissions from fuel combustion within the county boundary	**Yes**		1,064,232	575	557	1,065,363	
I.3.2	2	Emissions from grid-supplied energy consumed within the county boundary	**Yes**		227,204	45	468	227,717	
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		7,321	1	15	7,337	**1,300,417**
I.4		**Energy industries[1]**							
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the county boundary	**No**	NR	0	0	0	0	
I.4.2	2	Emissions from grid-supplied energy consumed in power plant auxiliary operations within the county boundary	**No**	NR	0	0	0	0	
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption in power plant auxiliary operations	**No**	NR	0	0	0	0	

[1] Emissions from Energy Industries are not quantified in this analysis. Instead, electricity-related emissions are represented using the eGRID regional emissions factor for grid-supplied electricity consumption. This approach excludes emissions from energy used in power plant auxiliary operations, grid-supplied energy consumed in those operations, and transmission and distribution losses associated with grid-supplied energy used in power plant auxiliary systems

I.4.4	1	Emissions from energy generation supplied to the grid	**No**	NR	0	0	0	0	**0**
I.5		**Agriculture, forestry and fishing activities**							
I.5.1	1	Emissions from fuel combustion within the county boundary	**Yes**		1,384	1	1	1,386	
I.5.2	2	Emissions from grid-supplied energy consumed within the county boundary	**Yes**		4,911	1	10	4,922	
I.5.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		158	0	0	159	**6,467**
I.6		**Non-specified sources**							
I.6.1	1	Emissions from fuel combustion within the county boundary	**No**	NR	0	0	0	0	
I.6.2	2	Emissions from grid-supplied energy consumed within the county boundary	**No**	NR	0	0	0	0	
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**No**	NR	0	0	0	0	**0**
I.7		**Fugitive emissions from mining, processing, storage, and transportation of coal**							
I.7.1	1	Emissions from fugitive emissions within the county boundary	**No**	NR	0	0	0	0	
I.8		**Fugitive emissions from oil and natural gas systems**							

I.8.1	1	Emissions from fugitive emissions within the county boundary	**Yes**		50	14,623	0	14,673	**14,673**
II		**TRANSPORTATION**							**6,769,971**
II.1		**On-road transportation**							
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the county boundary	**Yes**		5,303,891	8,030	55,842	5,367,763	
II.1.2	2	Emissions from grid-supplied energy consumed within the county boundary for on-road transportation	**Yes**		4,494	1	9	4,504	
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the county boundary, and transmission and distribution losses from grid-supplied energy consumption	**Yes**		145	0	0	145	**5,372,267**
II.2		**Railways**							
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the county boundary	**No**	NR	0	0	0	0	
II.2.2	2	Emissions from grid-supplied energy consumed within the county boundary for railways	**No**	NR	0	0	0	0	
II.2.3	3	Emissions from portion of transboundary journeys occurring outside the county boundary, and transmission and distribution losses from grid-supplied energy consumption	**No**	NR	0	0	0	0	**0**

II.3		**Water-borne navigation**							
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the county boundary	**No**	N/A	0	0	0	0	
II.3.2	2	Emissions from grid-supplied energy consumed within the county boundary for waterborne navigation	**No**	N/A	0	0	0	0	
II.3.3	3	Emissions from portion of transboundary journeys occurring outside the county boundary, and transmission and distribution losses from grid-supplied energy consumption	**No**		0	0	0	0	**0**
II.4		**Aviation**							
II.4.1	1	Emissions from fuel combustion for aviation occurring within the county boundary	**No**	N/A	0	0	0	0	
II.4.2	2	Emissions from grid-supplied energy consumed within the county boundary for aviation	**No**	N/A	0	0	0	0	
II.4.3	3	Emissions from portion of transboundary journeys occurring outside the county boundary, and transmission and distribution losses from grid-supplied energy consumption	**Yes**		571,958	0	0	571,958	**571,958**
II.5		**Off-road**							
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring	**Yes**		794,121	16,144	15,335	825,600	

		within the county boundary							
II.5.2	2	Emissions from grid-supplied energy consumed within the county boundary for off-road transportation	**No**	NR	0	0	0	0	**825,600**
III		**WASTE**							**468,391**
III.1		**Solid waste disposal**							
III.1.1	1	Emissions from solid waste generated within the county boundary and disposed in landfills or open dumps within the county boundary	**Yes**		0	158,859	0	158,859	
III.1.2	3	Emissions from solid waste generated within the county boundary but disposed in landfills or open dumps outside the county boundary	**No**	N/A	0	0	0	0	
III.1.3	1	Emissions from waste generated outside the county boundary and disposed in landfills or open dumps within the county boundary	**No**	N/A	0	0	0	0	**158,859**
III.2		**Biological treatment of waste**							
III.2.1	1	Emissions from solid waste generated within the county boundary that is treated biologically within the county boundary	**Yes**		0	24,462	17,363	41,825	
III.2.2	3	Emissions from solid waste generated within the county boundary but treated biologically outside of the county boundary	**No**	N/A	0	0	0	0	

III.2.3	1	Emissions from waste generated outside the county boundary but treated biologically within the county boundary	**No**	N/A	0	0	0	0	**41,825**
III.3		**Incineration and open burning**							
III.3.1	1	Emissions from solid waste generated and treated within the county boundary	**No**	N/A	0	0	0	0	
III.3.2	3	Emissions from solid waste generated within the county boundary but treated outside of the county boundary	**No**	N/A	0	0	0	0	
III.3.3	1	Emissions from waste generated outside the county boundary but treated within the county boundary	**No**	N/A	0	0	0	0	**0**
III.4		**Wastewater treatment and discharge**							
III.4.1	1	Emissions from wastewater generated and treated within the county boundary	**Yes**		0	0	267,708	267,708	
III.4.2	3	Emissions from wastewater generated within the county boundary but treated outside of the county boundary	**No**	N/A	0	0	0	0	
III.4.3	1	Emissions from wastewater generated outside the county boundary	**No**	N/A	0	0	0	0	**267,708**
IV		**INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)**							**4,073**

IV.1	1	Emissions from industrial processes occurring within the county boundary	**Yes**		0	0	4,073	4,073	
IV.2	1	Emissions from product use occurring within the county boundary	**No**	NR	0	0	0	0	
V		**AGRICULTURE, FORESTRY AND LAND USE (AFOLU)**							**2,808,639**
V.1	1	Emissions from livestock within the county boundary	**Yes**		0	1,277,428	37,734	1,315,162	
V.2	1	Emissions from land within the county boundary	**No**	NR	0	0	0	0	
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the county boundary	**Yes**		0	1,493,477	0	1,493,477	
VI		**OTHER SCOPE 3**							
VI.1	3	Other Scope 3	**No**	N/A	0	0	0	0	
						Gross	**TOTAL**	**13,244,396**	
						Sequestration		-708,300	
						Nest	**TOTAL**	**12,536,096**	

B.2. Municipal Inventories and Projections

Fresno County’s energy use and emissions data were downscaled to develop municipal-level inventories and projections using city boundaries, parcel data, transportation modeling, and other available datasets described in Data, Methods, and Assumptions Manual in Appendix C.

Building energy use was allocated spatially using parcel data to estimate residential, commercial, and industrial floor area within each jurisdiction and building energy use assumptions were made based on EIA’s Residential Energy Consumption Survey and Commercial Buildings Energy Consumption Survey (CBECS).

Transportation emissions were distributed based on modeled vehicle miles traveled (VMT) from the FresnoCOG’s regional transportation model, and population and employment projections guided were allocated across other end-use sectors.

This spatial downscaling approach allows for a more localized understanding of emission sources and trends across Fresno County’s municipalities. However, the results due have limitations and cannot fully capture all the factors that influence local conditions. Certain sectors, such as natural lands (or carbon sequestration) and agriculture, were not included in the municipal downscaling due to a lack of detailed, spatially explicit data at that scale. As a result, the municipal inventories should be interpreted as indicative rather than exact estimates of local emissions.

In the following section, a summary table presents GHG projections for all cities under the Business-as-Usual (BAU), Business-as-Planned (BAP), and Low-Carbon (LC) scenarios from 2019 through 2050. This is followed by individual city profiles, each containing a 2019 inventory, BAU, BAP, and LC projections charts by sector, and a table presenting emissions by sector in milestone years, illustrating how sectoral trends evolve under different scenarios.

Table B.2. Emissions projections for the Business-as-Usual (BAU), Business-as-Planned (BAP), and Low-Carbon (LC) Scenarios for all municipalities, 2019 - 2050, MTCO2e.

BAU	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
City of Fresno	5,486,049	5,227,124	5,477,525	5,533,764	5,599,081	5,654,210	5,703,417	5,773,514	5,834,011	5,883,410	5,949,990	6,026,624	6,106,570	6,185,491	6,219,542	6,285,879	6,329,585	6,381,515	6,417,661	6,466,721	6,520,939	6,584,117	6,644,746	6,708,123	6,774,341	6,841,374	6,913,120	6,970,156	7,037,764	7,106,140	7,181,484	7,246,536
Clovis	1,737,110	1,704,732	1,698,359	1,677,196	1,673,856	1,676,939	1,679,448	1,732,158	1,777,059	1,791,796	1,821,895	1,873,187	1,925,828	1,975,460	1,959,312	1,973,668	1,968,142	1,958,201	1,948,698	1,947,526	1,955,104	1,970,764	1,988,959	2,011,854	2,038,572	2,066,775	2,095,373	2,119,542	2,143,763	2,168,766	2,190,618	2,205,223
Coalinga	62,105	61,237	67,565	67,477	67,387	67,658	68,549	69,238	69,777	70,472	71,311	72,114	72,895	73,692	74,331	75,279	76,044	76,961	77,586	78,349	79,111	79,976	80,728	81,497	82,233	82,987	83,869	84,448	85,176	85,947	86,892	87,733
Firebaugh	103,288	113,673	133,886	135,790	137,580	139,461	141,928	144,294	146,613	148,977	151,462	153,615	155,835	158,056	160,156	162,469	164,677	167,070	169,192	171,443	173,695	175,909	178,077	180,225	182,422	184,597	186,721	188,698	190,827	192,918	195,139	196,253
Fowler	165,974	165,657	182,626	186,044	189,339	192,665	195,337	198,020	200,662	203,241	206,150	209,403	212,819	216,234	219,314	222,889	226,089	229,859	232,938	236,374	239,826	243,205	246,537	249,770	253,250	256,621	260,020	263,208	266,808	270,188	273,855	275,908
Huron	17,902	16,479	17,222	17,098	16,974	17,018	17,289	17,500	17,660	17,878	18,135	18,419	18,694	18,976	19,201	19,526	19,793	20,088	20,312	20,571	20,833	21,142	21,414	21,702	21,963	22,238	22,561	22,776	23,029	23,314	23,654	23,933
Kerman	107,001	108,094	119,424	120,837	122,257	124,105	126,249	128,287	130,165	132,141	134,339	136,535	138,742	140,961	142,862	145,211	147,287	149,598	151,500	153,615	155,745	157,969	160,062	162,167	164,280	166,397	168,487	170,196	172,143	174,103	176,296	177,747
Kingsburg	237,669	242,023	262,343	265,363	268,236	270,741	273,491	276,217	279,004	281,594	284,529	287,655	290,895	294,137	297,116	300,443	303,496	307,057	309,944	313,173	316,415	319,584	322,656	325,566	328,840	331,944	334,852	337,643	340,806	343,625	346,639	348,527
Mendota	40,111	41,167	46,078	46,418	46,782	47,204	48,061	48,802	49,439	50,189	51,035	51,770	52,485	53,210	53,822	54,650	55,340	56,141	56,743	57,440	58,137	58,889	59,563	60,250	60,914	61,589	62,337	62,869	63,508	64,174	64,964	65,535
Orange Cove	50,238	50,937	55,969	56,341	56,720	57,161	57,772	58,267	58,665	59,173	59,761	60,390	61,019	61,658	62,196	62,926	63,539	64,234	64,773	65,388	66,004	66,684	67,304	67,946	68,550	69,175	69,823	70,287	70,832	71,424	72,123	72,654
Parlier	72,269	69,840	73,375	73,570	73,774	74,121	74,901	75,565	76,110	76,774	77,542	78,368	79,195	80,035	80,713	81,638	82,429	83,295	83,985	84,769	85,560	86,443	87,248	88,084	88,876	89,695	90,631	91,338	92,147	93,013	93,999	94,703
Reedley	207,042	205,186	223,283	225,491	227,761	230,366	232,575	234,773	236,685	238,639	241,030	243,852	246,752	249,660	251,856	254,883	257,356	260,264	262,475	265,081	267,738	270,563	273,219	275,893	278,624	281,352	284,211	286,515	289,276	292,036	295,154	297,558
San Joaquin	23,144	22,642	24,505	24,815	25,143	25,458	25,724	25,951	26,123	26,349	26,636	26,893	27,157	27,424	27,621	27,942	28,164	28,473	28,662	28,911	29,162	29,440	29,694	29,952	30,208	30,466	30,754	30,952	31,214	31,482	31,815	32,090
Sanger	182,610	190,684	214,322	215,246	216,239	217,774	220,303	222,839	225,116	227,390	230,036	232,673	235,328	237,985	239,934	242,609	244,866	247,406	249,390	251,699	254,064	256,631	259,024	261,447	263,906	266,372	269,006	271,125	273,567	276,025	278,766	280,737
Selma	137,632	134,837	147,217	152,780	158,406	164,438	167,423	170,335	173,089	175,883	178,981	182,322	185,725	189,137	192,118	195,662	197,666	200,019	201,806	203,885	205,982	208,228	210,333	212,419	214,582	216,715	218,940	220,766	222,921	225,028	227,403	229,388

BAP	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
City of Fresno	5,486,049	4,885,114	5,187,596	5,266,870	5,205,972	5,152,459	5,080,288	5,030,369	4,970,195	4,900,349	4,852,686	4,806,150	4,785,812	4,408,532	4,332,582	4,303,198	4,234,228	4,180,771	4,106,656	4,050,135	4,006,485	3,965,639	3,918,427	3,876,602	3,848,278	3,819,023	3,777,015	3,794,757	3,828,604	3,849,608	3,881,810	3,906,486
Clovis	1,737,110	1,641,143	1,639,275	1,629,373	1,600,827	1,585,231	1,565,927	1,589,776	1,606,169	1,592,898	1,590,935	1,608,079	1,629,258	1,599,113	1,523,616	1,497,518	1,437,883	1,370,936	1,304,935	1,253,706	1,220,198	1,202,009	1,190,592	1,185,446	1,187,586	1,192,245	1,194,944	1,203,257	1,214,271	1,222,921	1,231,465	1,235,549
Coalinga	62,105	55,171	61,740	63,093	61,075	59,959	59,223	58,430	57,491	56,715	56,260	55,546	55,349	51,205	50,955	51,129	50,938	51,103	50,870	50,817	50,868	50,784	50,578	50,366	50,342	50,320	50,054	50,210	50,619	50,797	51,214	51,518
Firebaugh	103,288	107,639	127,716	129,176	128,911	129,030	129,607	130,095	130,476	130,894	131,486	131,663	132,368	126,637	127,267	128,133	128,798	129,693	130,260	130,929	131,603	132,109	132,402	132,752	133,204	133,597	133,756	134,926	136,279	137,491	138,851	139,318
Fowler	165,974	159,647	176,621	177,835	177,017	176,697	175,680	174,665	173,518	172,328	171,544	170,935	171,083	159,191	158,998	159,308	159,090	159,423	158,990	158,829	158,656	158,243	157,436	156,700	156,225	155,566	154,630	156,127	158,049	159,634	161,506	162,372
Huron	17,902	14,510	15,296	15,516	15,277	15,339	15,253	15,187	15,115	15,010	15,012	14,969	15,051	14,036	14,080	14,230	14,233	14,350	14,340	14,388	14,470	14,516	14,528	14,531	14,592	14,657	14,642	14,713	14,852	14,930	15,082	15,180
Kerman	107,001	101,453	112,698	113,785	111,467	110,680	109,969	109,281	108,429	107,696	107,370	106,788	106,899	100,645	100,530	101,030	101,053	101,515	101,486	101,717	102,105	102,331	102,390	102,494	102,851	103,221	103,194	103,940	105,020	105,814	106,916	107,484
Kingsburg	237,669	206,840	224,725	225,958	226,937	227,702	228,441	229,227	229,980	230,557	231,609	232,621	234,487	225,355	226,968	229,052	230,597	232,700	234,095	235,777	237,536	238,947	240,017	241,155	242,585	243,918	244,772	246,498	248,608	250,400	252,516	253,322
Mendota	40,111	38,080	43,290	43,741	42,367	41,593	41,059	40,502	39,854	39,326	39,009	38,460	38,234	35,872	35,630	35,688	35,510	35,583	35,414	35,381	35,436	35,407	35,329	35,252	35,314	35,400	35,329	35,534	35,903	36,120	36,498	36,711
Orange Cove	50,238	48,862	54,626	54,964	53,901	53,190	52,500	51,769	50,943	50,230	49,691	49,062	48,715	45,781	45,390	45,240	44,877	44,688	44,296	43,993	43,744	43,422	43,020	42,632	42,324	42,024	41,559	41,736	42,037	42,233	42,553	42,748
Parlier	72,269	66,755	70,923	71,305	69,699	68,634	67,824	66,996	66,052	65,234	64,643	63,940	63,604	59,613	59,171	59,059	58,671	58,486	58,060	57,749	57,520	57,206	56,785	56,396	56,108	55,837	55,405	55,697	56,147	56,470	56,951	57,214
Reedley	207,042	194,660	213,771	216,176	212,948	211,042	208,376	205,876	203,068	200,349	198,358	196,361	195,518	181,721	180,176	179,736	178,354	177,694	176,147	175,058	174,205	173,131	171,697	170,362	169,440	168,457	166,940	167,782	169,231	170,203	171,650	172,588
San Joaquin	23,144	21,382	23,620	23,850	23,491	23,235	22,869	22,494	22,067	21,697	21,429	21,088	20,891	19,204	18,961	18,863	18,628	18,527	18,277	18,098	17,943	17,761	17,535	17,311	17,155	16,985	16,746	16,804	16,952	17,019	17,156	17,263
Sanger	182,610	182,159	207,452	209,067	204,961	202,340	200,250	198,330	196,112	193,904	192,307	190,313	189,383	178,361	176,682	176,022	174,546	173,609	171,970	170,712	169,713	168,534	167,087	165,727	164,691	163,653	162,157	163,012	164,326	165,266	166,613	167,365
Selma	137,632	124,639	136,943	142,791	143,426	145,364	144,296	143,259	142,010	140,813	140,106	139,428	139,720	129,970	129,844	130,448	129,530	129,208	128,209	127,566	127,096	126,485	125,609	124,822	124,381	123,910	123,060	123,709	124,812	125,536	126,633	127,435
LC	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
City of Fresno	5,486,049	4,834,330	5,102,577	5,130,219	4,959,002	4,799,975	4,602,046	4,363,915	4,130,123	3,902,460	3,699,683	3,511,275	3,383,797	2,950,979	2,792,764	2,693,126	2,576,328	2,461,609	2,350,665	2,255,155	2,140,310	2,038,985	1,980,624	1,934,468	1,892,122	1,852,925	1,816,310	1,585,440	1,349,421	1,107,346	858,757	602,814

Clovis	1,737,110	1,669,152	1,663,758	1,644,338	1,599,799	1,559,187	1,507,890	1,479,603	1,445,268	1,385,079	1,330,697	1,295,636	1,268,268	1,193,902	1,057,447	982,693	869,909	745,375	631,376	538,430	468,501	420,260	385,884	359,826	338,458	320,715	305,989	270,352	235,302	200,690	166,357	131,620
Coalinga	62,105	60,201	67,039	68,221	65,479	63,067	60,072	55,995	52,038	48,516	45,421	42,314	40,300	35,016	33,533	32,530	31,654	30,948	30,229	29,583	28,340	27,102	26,536	26,090	25,673	25,290	24,928	22,395	19,793	17,114	14,354	11,508
Firebaugh	103,288	111,012	130,517	131,479	129,900	128,446	123,823	118,130	112,605	105,689	98,541	91,893	86,568	75,772	71,316	67,557	64,209	61,082	57,987	54,980	44,190	34,308	32,976	31,914	30,914	30,039	29,250	25,177	20,983	16,660	12,203	7,605
Fowler	165,974	159,079	175,025	175,545	172,151	169,037	162,206	153,183	144,391	135,310	126,608	118,725	112,749	96,648	91,865	88,345	85,338	82,518	79,657	76,887	66,953	57,154	55,260	53,748	52,303	50,986	49,758	42,145	34,313	26,247	17,933	9,357
Huron	17,902	17,773	19,085	19,477	18,752	18,138	17,286	16,119	14,990	13,993	13,129	12,290	11,752	10,319	9,915	9,648	9,393	9,176	8,950	8,747	8,335	7,929	7,764	7,634	7,513	7,404	7,303	6,606	5,891	5,156	4,399	3,618
Kerman	107,001	106,298	118,236	119,923	117,005	114,536	109,762	103,203	96,774	90,383	84,420	78,857	74,872	65,637	62,379	60,060	57,969	56,034	54,075	52,239	46,085	40,056	38,871	37,934	37,062	36,292	35,594	31,552	27,398	23,122	18,716	14,172
Kingsburg	237,669	228,567	250,404	252,232	248,103	244,343	235,787	225,505	215,652	203,800	191,802	180,960	172,252	154,223	146,820	140,668	135,091	129,909	124,778	119,848	103,477	88,665	86,459	84,701	83,055	81,610	80,304	73,346	66,188	58,816	51,217	43,380
Mendota	40,111	38,193	43,319	43,937	42,256	40,814	39,010	36,431	33,893	31,547	29,426	27,302	25,875	22,707	21,635	20,908	20,279	19,752	19,215	18,724	17,338	15,966	15,596	15,305	15,037	14,799	14,584	13,218	11,815	10,370	8,880	7,343
Orange Cove	50,238	48,242	53,633	53,813	52,009	50,490	48,059	44,816	41,695	38,683	35,931	33,426	31,615	27,710	26,343	25,344	24,460	23,654	22,834	22,056	19,394	16,801	16,309	15,919	15,556	15,237	14,948	13,295	11,595	9,845	8,041	6,181
Parlier	72,269	67,678	71,895	72,120	69,666	67,577	64,433	60,307	56,342	52,492	48,984	45,809	43,510	38,216	36,380	35,047	33,815	32,668	31,510	30,424	26,947	23,575	22,900	22,363	21,864	21,420	21,015	18,672	16,267	13,792	11,243	8,615
Reedley	207,042	195,655	213,917	215,405	209,271	203,837	194,552	182,643	171,111	159,824	149,499	140,085	133,348	115,794	109,971	105,861	101,975	98,369	94,783	91,490	82,537	73,889	71,757	70,073	68,500	67,075	65,753	57,490	49,002	40,270	31,277	22,005
San Joaquin	23,144	20,712	22,695	22,788	21,997	21,283	20,282	18,940	17,636	16,450	15,393	14,358	13,639	11,684	11,137	10,763	10,428	10,147	9,860	9,600	9,041	8,492	8,282	8,115	7,959	7,813	7,677	6,725	5,747	4,741	3,705	2,636
Sanger	182,610	181,486	205,336	206,365	199,804	194,150	185,361	173,910	162,813	151,669	141,341	131,873	124,966	109,794	103,741	99,444	95,420	91,584	87,799	84,304	73,726	63,549	61,508	59,894	58,405	57,093	55,906	49,451	42,824	36,011	28,998	21,768
Selma	137,632	127,320	139,742	144,901	143,625	142,469	136,734	128,765	120,878	113,280	106,203	99,487	94,989	82,057	78,274	75,640	73,048	70,690	68,364	66,244	60,986	55,890	54,394	53,227	52,124	51,115	50,166	43,806	37,265	30,531	23,591	16,434

City of Fresno

Figure B.1. Emissions inventory by sector for the City of Fresno, 2019

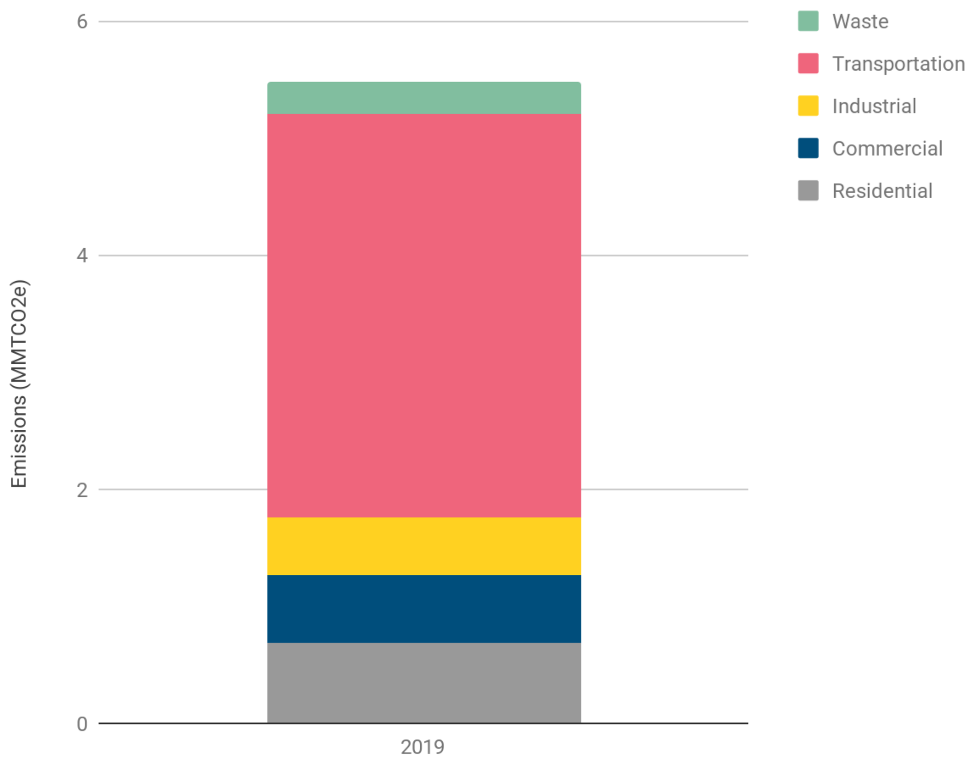


Figure B.2. Business as Usual (BAU) Emissions projections for the City of Fresno, 2019 - 2050

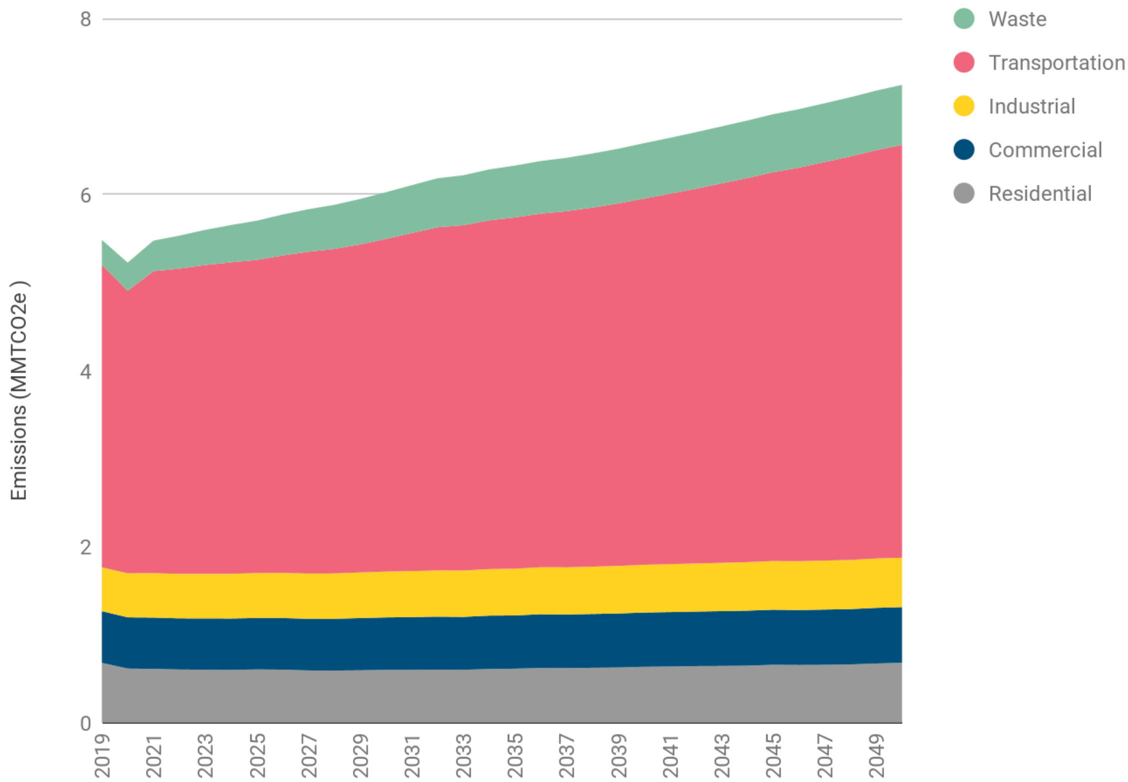


Figure B.3. Business-as-Planned (BAP) Emissions projections for the City of Fresno, 2019 - 2050

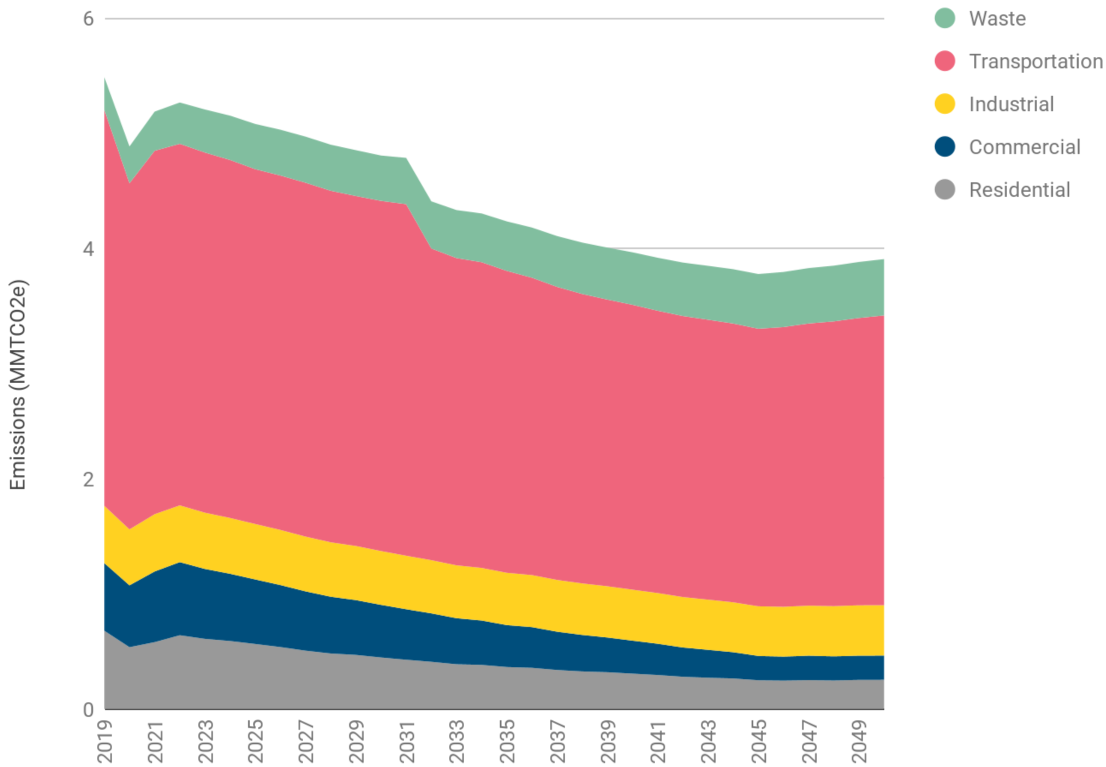


Figure B.4. Low Carbon Scenario (LCS) Emissions projections for the City of Fresno, 2019 - 2050

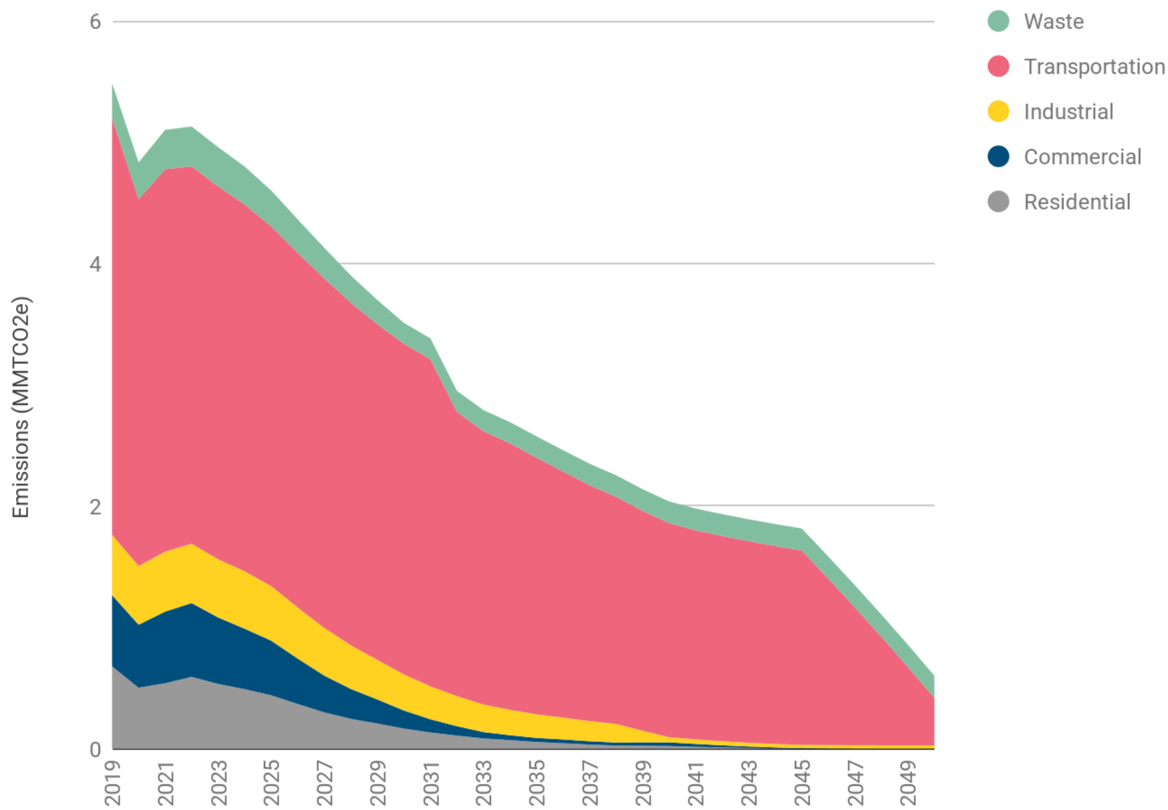


Table B.3. Emissions Projections for each Scenario in the City of Fresno, MTCO2e

Fresno	**2019**	**2030**	**2045**
BAU	5,485,706	6,026,262	6,912,733
BAP	5,485,706	4,805,870	3,776,930
LC	5,485,706	3,511,163	1,816,289
BAU	**2019**	**2030**	**2045**
Residential	679,904	600,199	657,917
Commercial	587,033	595,960	625,580
Industrial	497,479	520,497	553,047
Transportation	3,437,162	3,779,144	4,417,409
Waste	284,127	530,461	658,780
BAP	**2019**	**2030**	**2045**
Residential	679,904	447,669	250,068
Commercial	587,033	456,811	210,822
Industrial	497,479	467,315	431,046
Transportation	3,437,162	3,040,387	2,409,987
Waste	284,127	393,688	475,007
LC	**2019**	**2030**	**2045**
Residential	679,904	167,008	1,418
Commercial	587,033	148,907	4,289
Industrial	497,479	297,627	26,589
Transportation	3,437,162	2,725,881	1,602,450
Waste	284,127	171,740	181,543

Clovis

Figure B.5. Emissions Inventory by Sector for Clovis, 2019

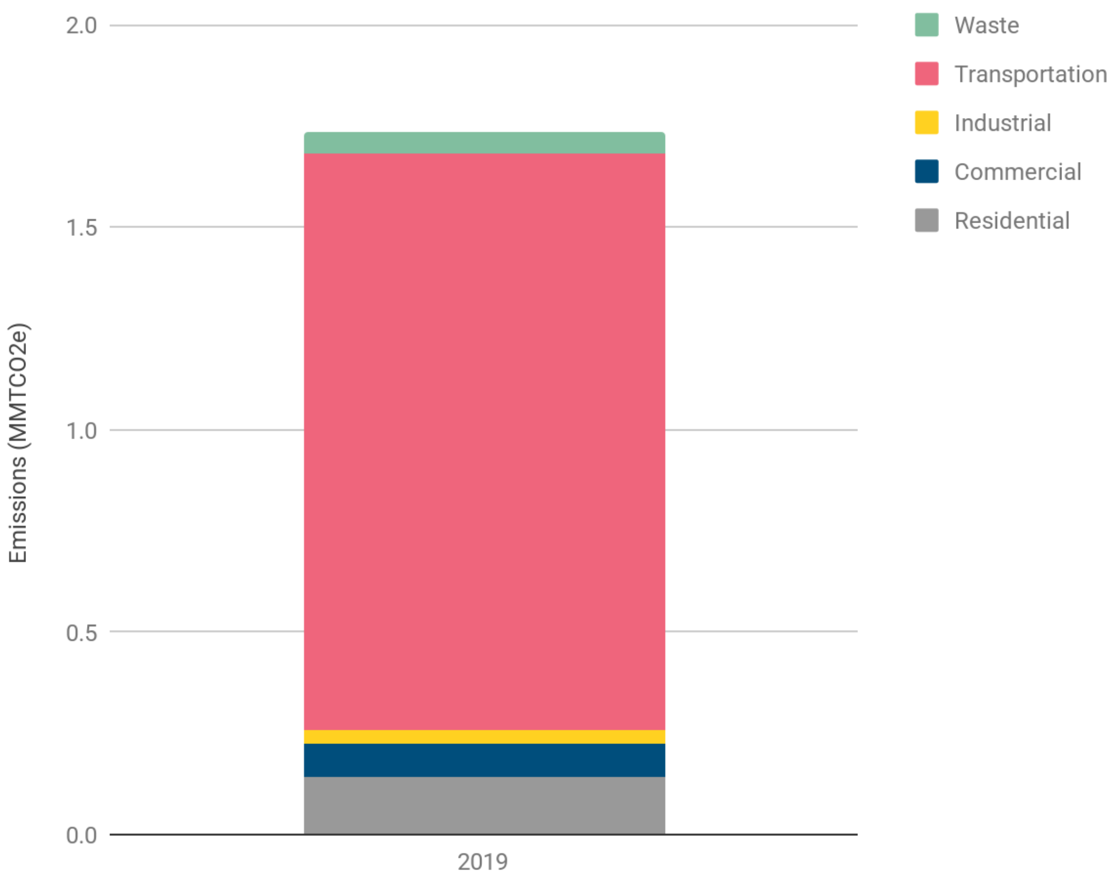


Figure B.6. Business as Usual (BAU) Emissions Projections for Clovis, 2019 - 2050

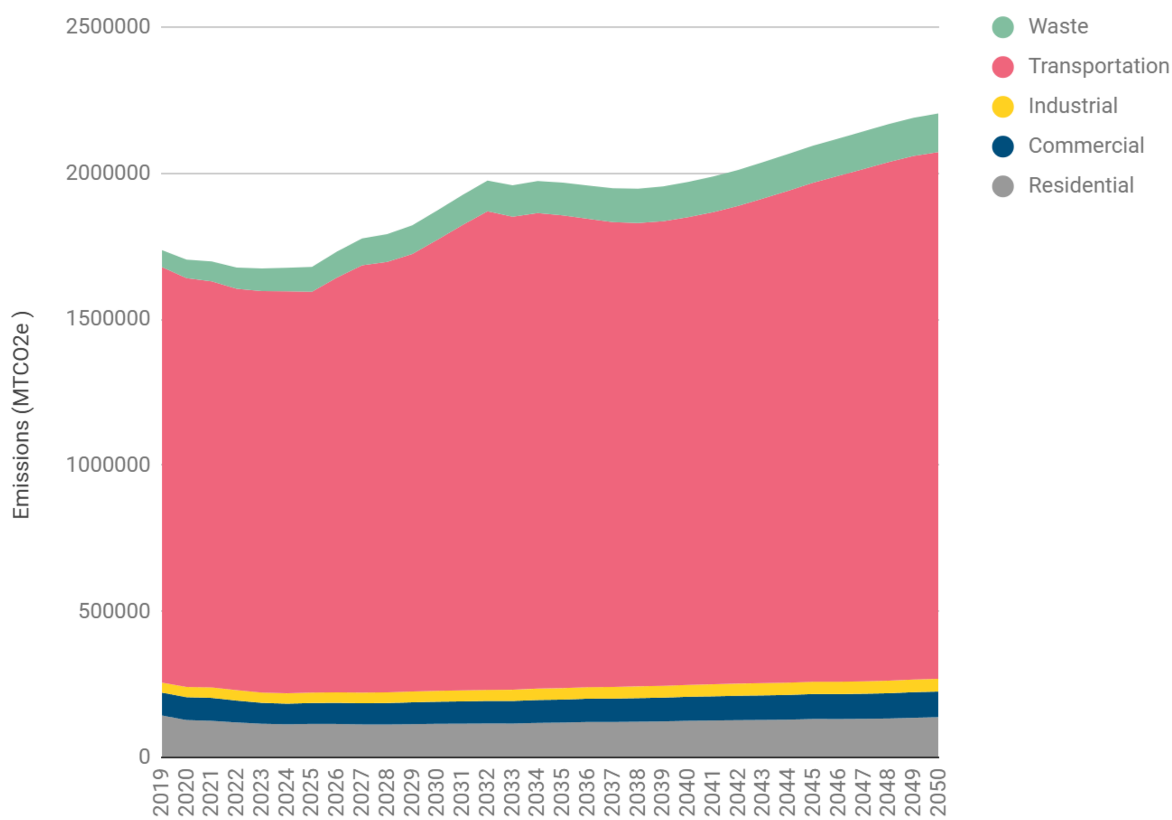


Figure B.7. Business-as-Planned (BAP) Emissions Projections for Clovis, 2019 - 2050

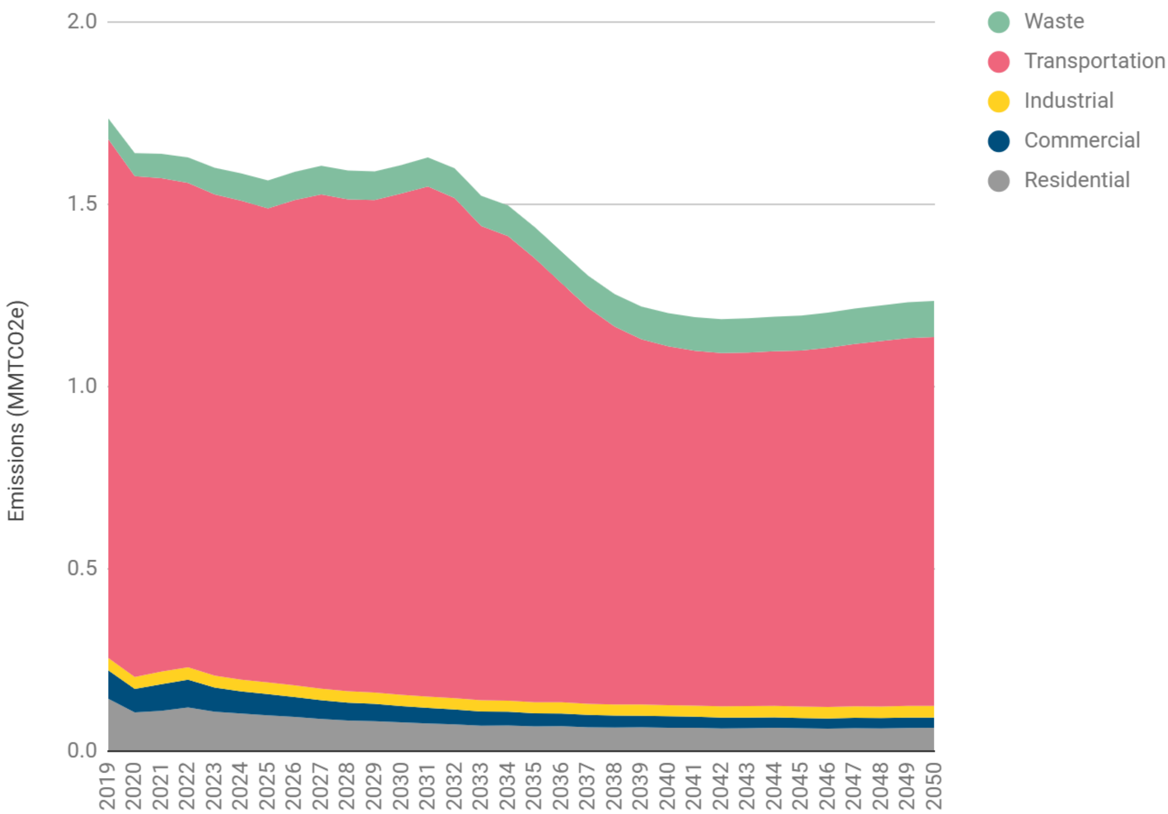


Figure B.8. Low Carbon Scenario (LCS) Emissions Projections for Clovis, 2019 - 2050

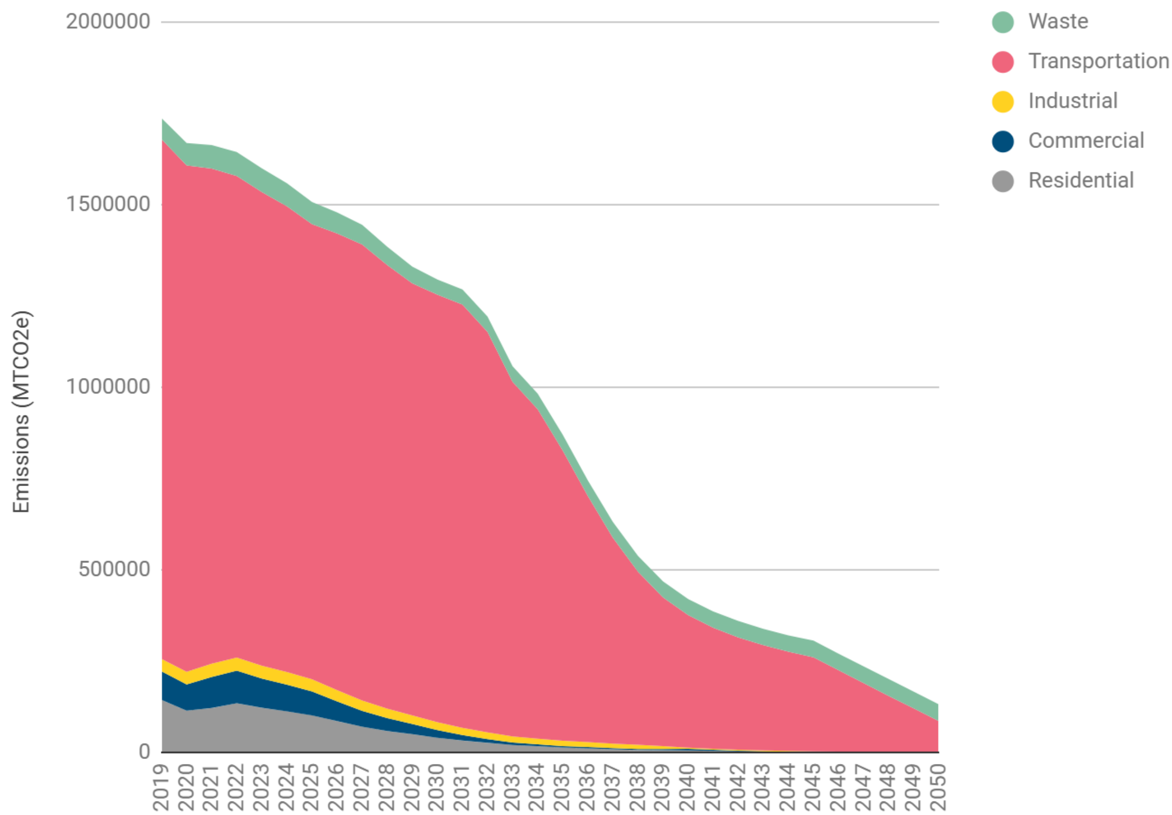


Table B.4. Emissions Projections for each Scenario in Clovis, MTCO2e

Clovis	**2019**	**2030**	**2045**
BAU	1,737,066	1,873,144	2,095,323
BAP	1,737,066	1,608,053	1,194,929
LC	1,737,066	1,295,618	305,985
BAU	**2019**	**2030**	**2045**
Residential	143,760	114,964	131,565
Commercial	78,196	75,470	85,281
Industrial	33,991	37,605	42,408
Transportation	1,423,882	1,544,420	1,708,849
Waste	57,237	100,685	127,219
BAP	**2019**	**2030**	**2045**
Residential	143,760	78,706	62,650
Commercial	78,196	44,887	28,186
Industrial	33,991	31,202	31,320
Transportation	1,423,882	1,375,098	977,067
Waste	57,237	78,160	95,706
LC	**2019**	**2030**	**2045**
Residential	143,760	40,076	366
Commercial	78,196	20,818	290
Industrial	33,991	21,521	1,948
Transportation	1,423,882	1,171,597	257,996
Waste	57,237	41,607	45,385

COALINGA

Figure B.9. Emissions Inventory by Sector for Coalinga, 2019

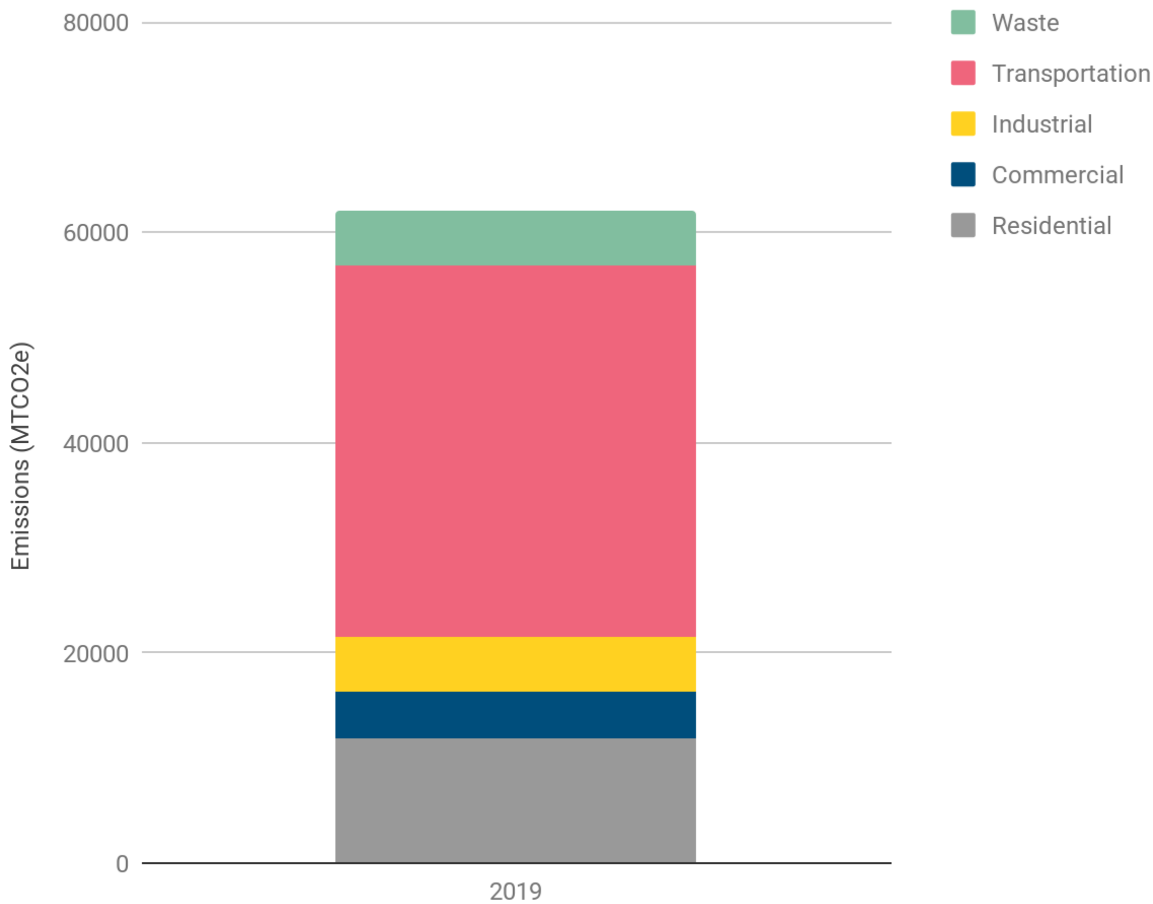


Figure B.10. Business as Usual (BAU) Emissions Projections for Coalinga, 2019 - 2050

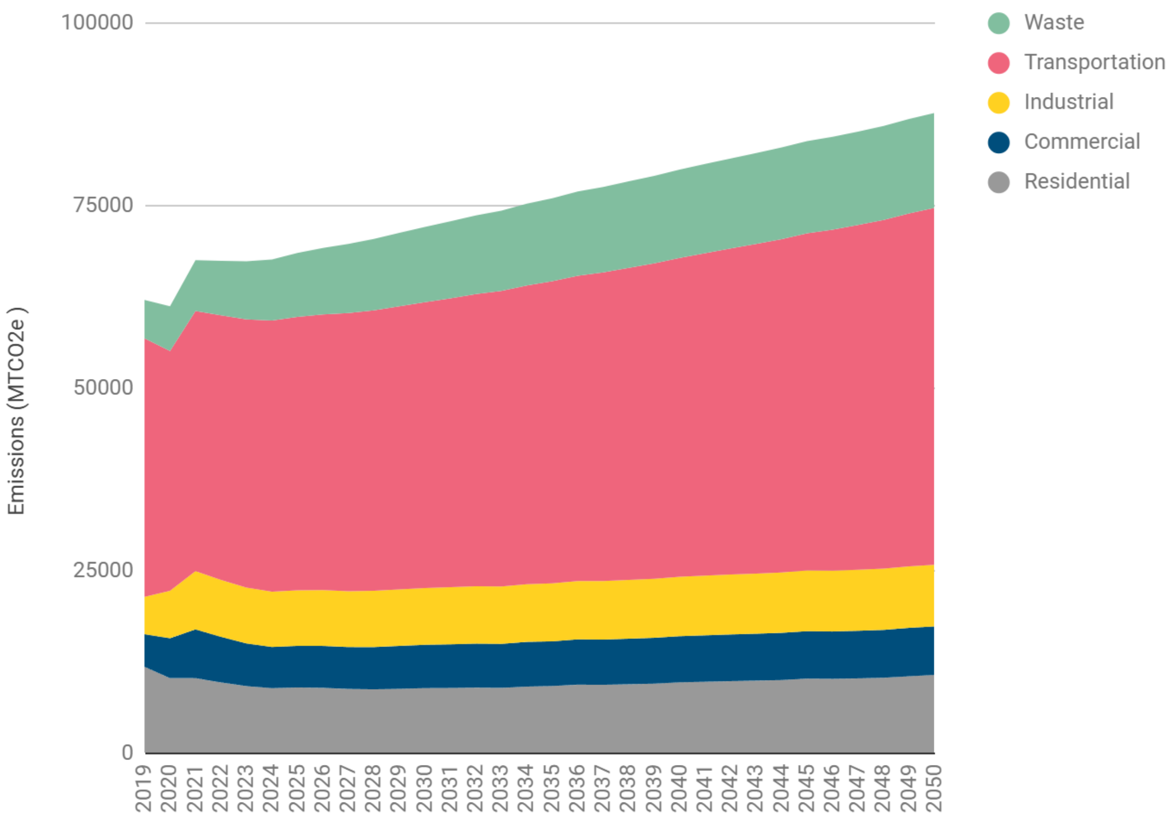


Figure B.11. Business-as-Planned (BAP) Emissions Projections for Coalinga, 2019 - 2050

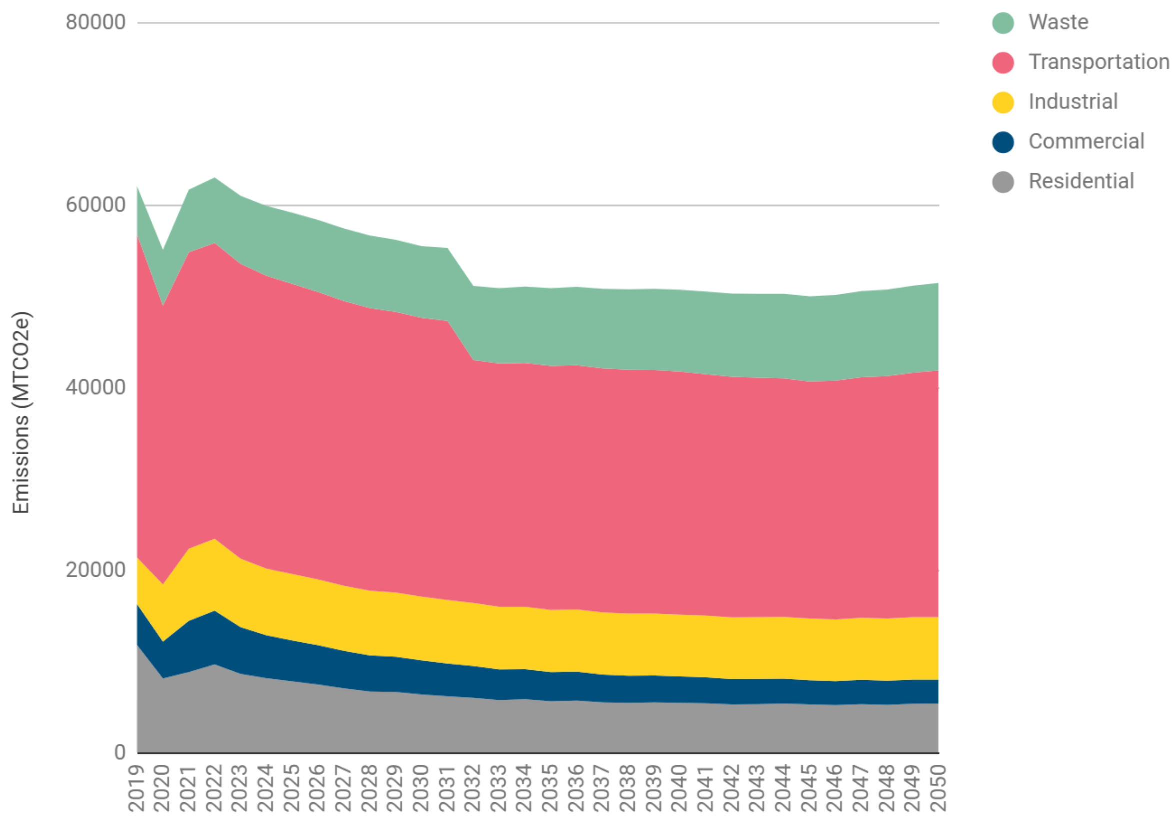


Figure B.12. Low Carbon Scenario (LCS) Emissions Projections for Coalinga, 2019 - 2050

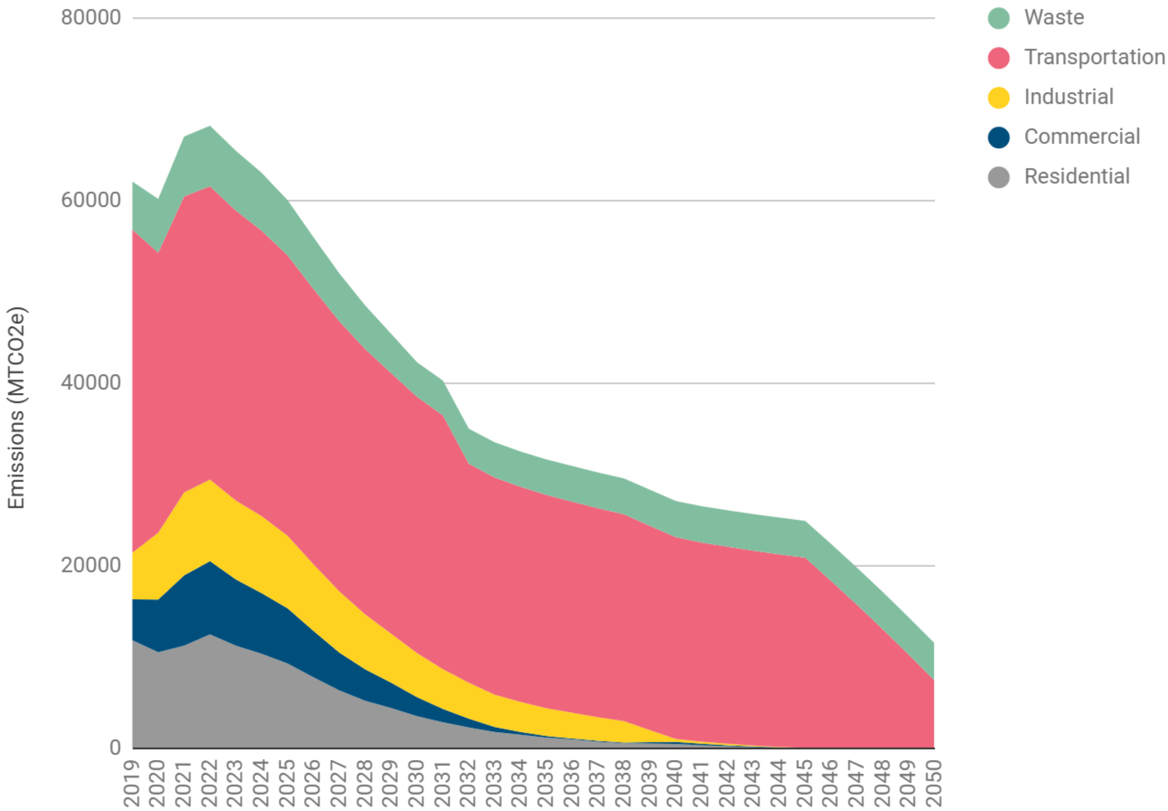


Table B.5: Emissions Projections for each Scenario in Coalinga, MTCO2e

Coalinga	**2019**	**2030**	**2045**
BAU	62,105	72,114	83,869
BAP	62,105	55,546	50,054
LC	62,105	42,314	24,928
BAU	**2019**	**2030**	**2045**
Residential	11,860	8,936	10,241
Commercial	4,463	5,932	6,500
Industrial	5,120	7,784	8,307
Transportation	35,411	39,140	46,190
Waste	5,251	10,322	12,632
BAP	**2019**	**2030**	**2045**
Residential	11,860	6,435	5,331
Commercial	4,463	3,724	2,653
Industrial	5,120	7,000	6,760
Transportation	35,411	30,549	25,986
Waste	5,251	7,837	9,324
LC	**2019**	**2030**	**2045**
Residential	11,860	3,537	28
Commercial	4,463	2,066	3
Industrial	5,120	4,839	20
Transportation	35,411	28,068	20,835
Waste	5,251	3,805	4,042

FIREBAUGH

Figure B.13. Emissions Inventory by Sector for Firebaugh, 2019

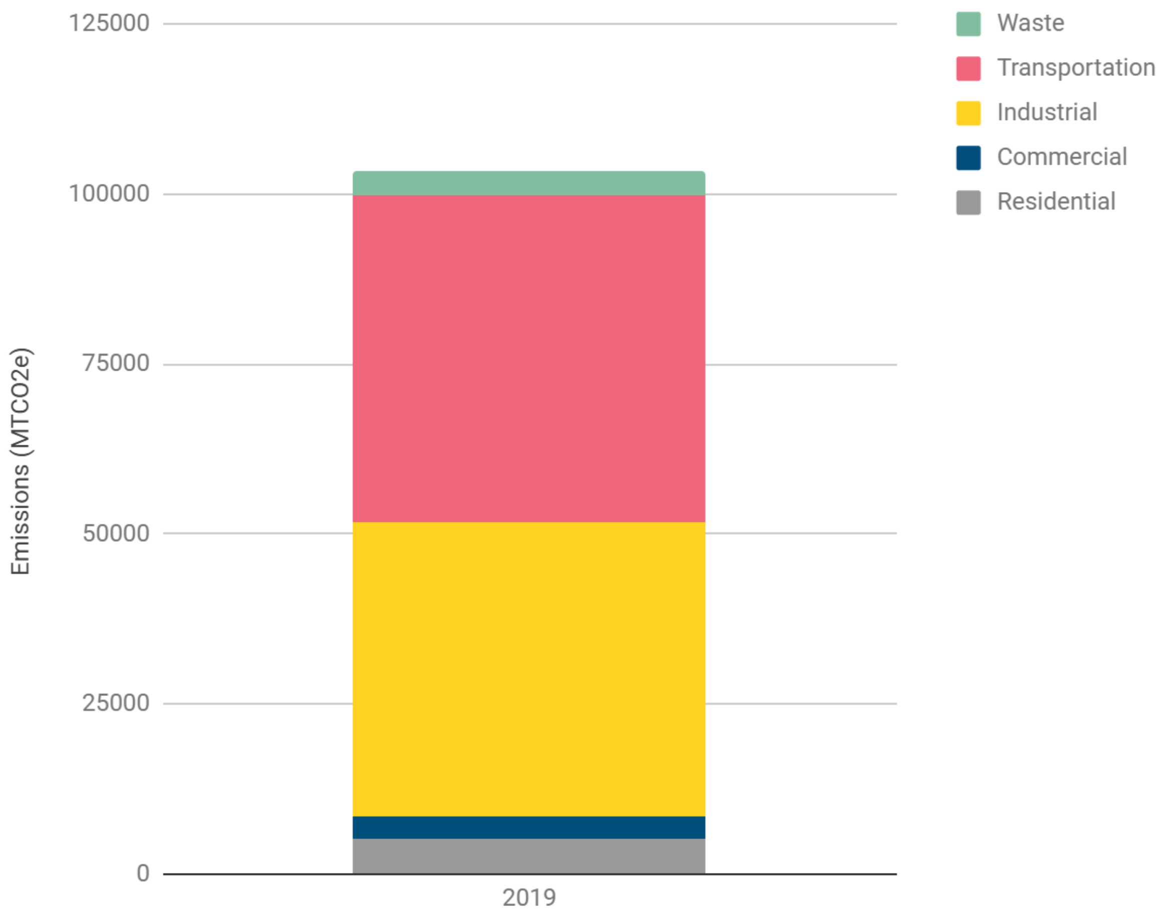


Figure B.14: Business as Usual (BAU) Emissions Projections for Firebaugh, 2019 - 2050

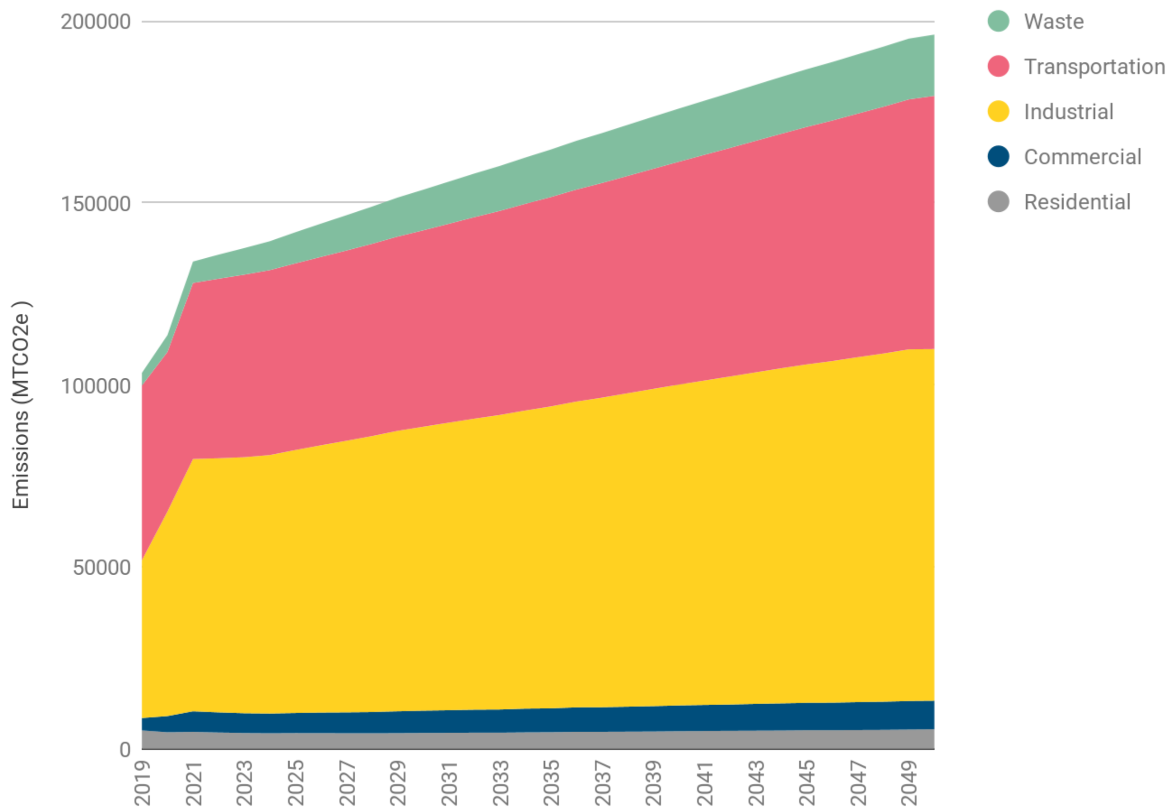


Figure B.15: Business-as-Planned (BAP) Emissions Projections for Firebaugh, 2019 - 2050

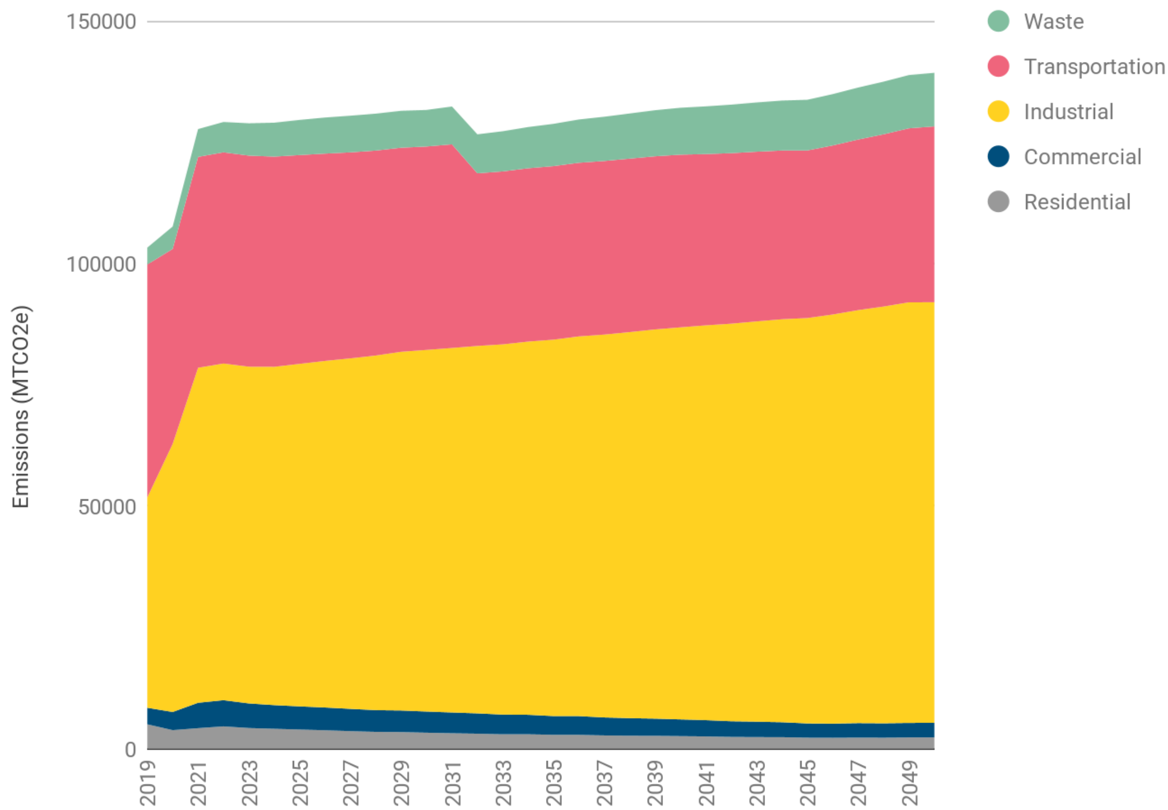


Figure B.16. Low Carbon Scenario (LCS) Emissions Projections for Firebaugh, 2019 - 2050

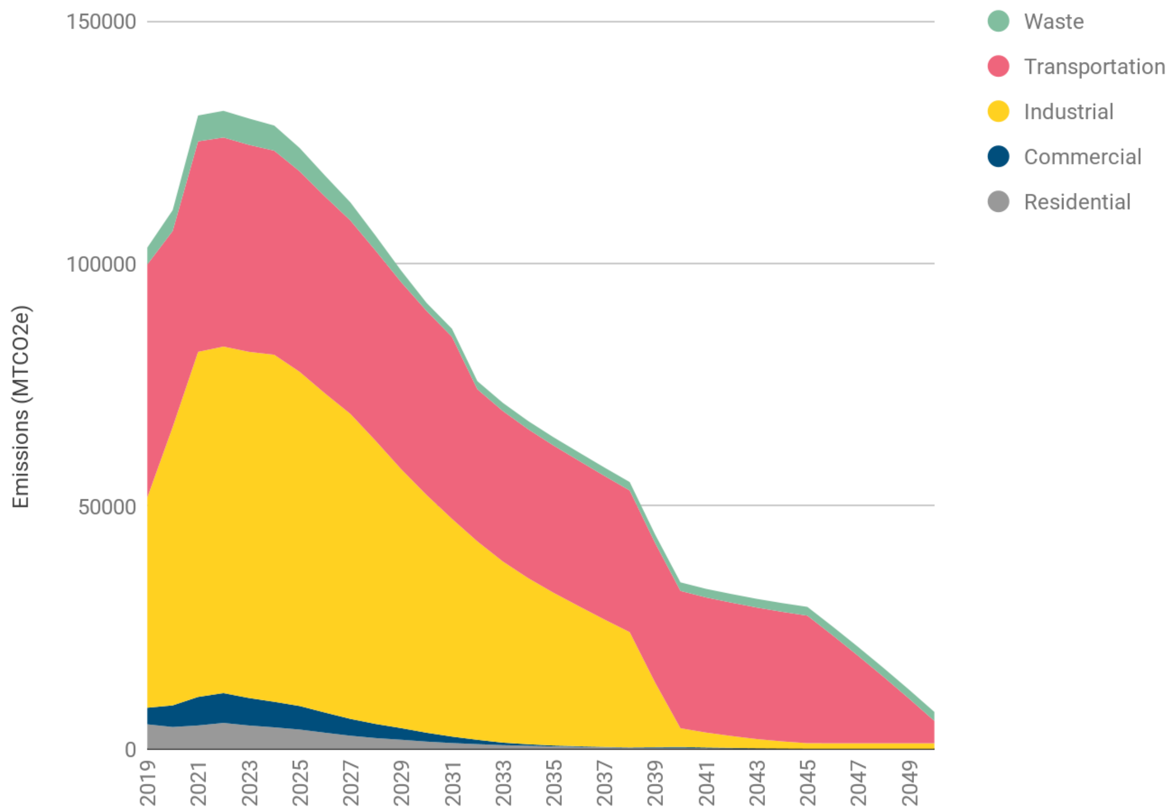


Table B.6. Emissions Projections for each Scenario in Firebaugh, MTCO2e

Firebaugh	**2019**	**2030**	**2045**
BAU	103,288	153,615	186,721
BAP	103,288	131,663	133,756
LC	103,288	91,893	29,250
BAU	**2019**	**2030**	**2045**
Residential	5,058	4,378	5,125
Commercial	3,405	6,110	7,520
Industrial	43,344	78,020	92,984
Transportation	48,006	53,943	65,239
Waste	3,475	11,164	15,853
BAP	**2019**	**2030**	**2045**
Residential	5,058	3,329	2,300
Commercial	3,405	4,358	2,934
Industrial	43,344	74,521	83,540
Transportation	48,006	41,920	34,537
Waste	3,475	7,536	10,445
LC	**2019**	**2030**	**2045**
Residential	5,058	1,490	11
Commercial	3,405	1,829	2
Industrial	43,344	49,000	1,150
Transportation	48,006	37,924	26,277
Waste	3,475	1,649	1,810

FOWLER

Figure B.17. Emissions Inventory by Sector for Fowler, 2019

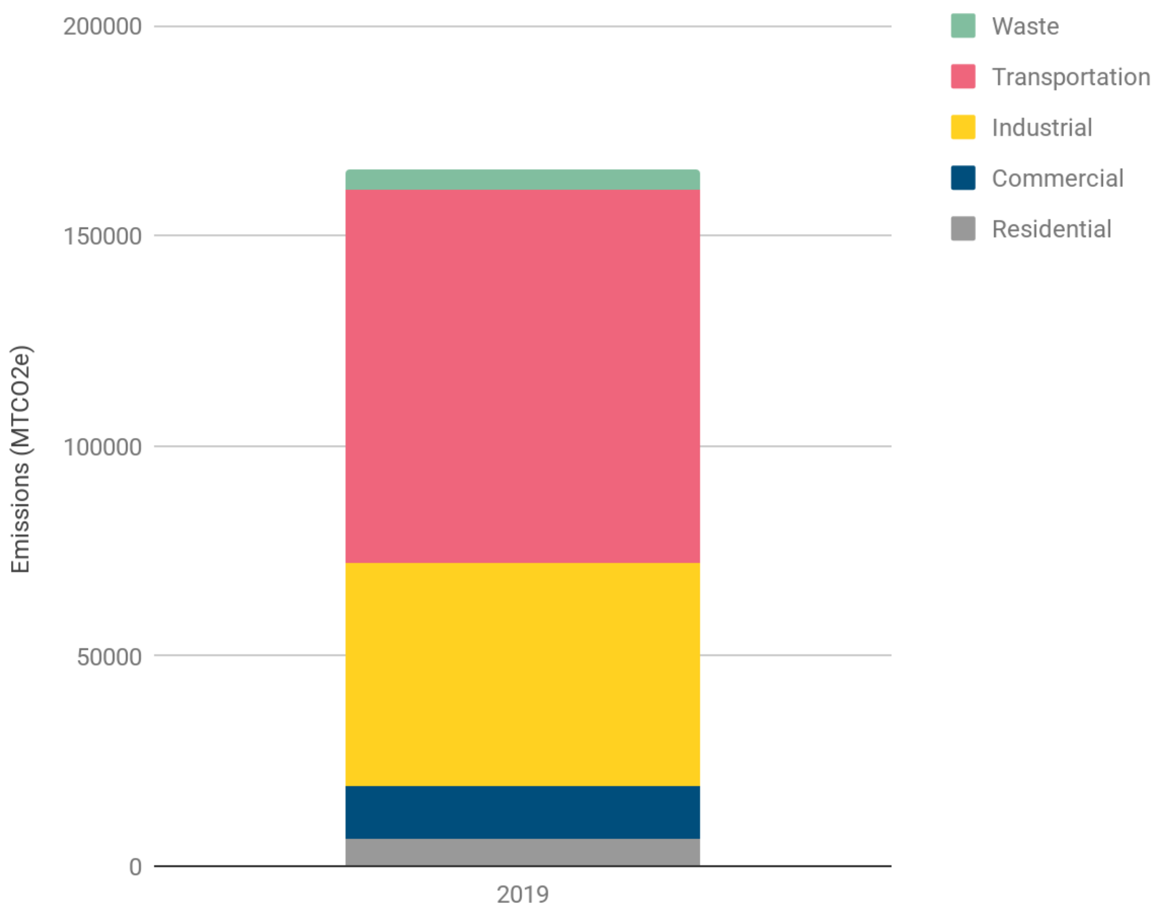


Figure B.18. Business as Usual (BAU) Emissions Projections for Fowler, 2019 – 2050

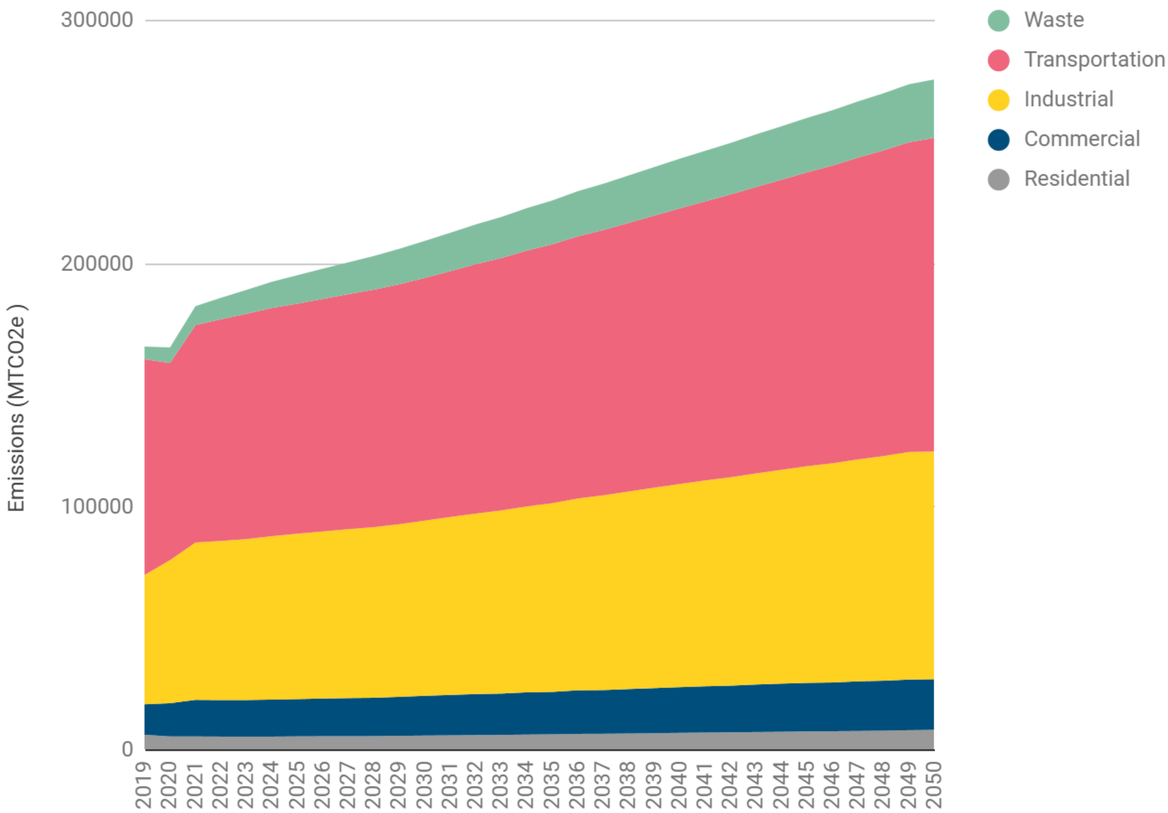


Figure B.19. Business-as-Planned (BAP) Emissions Projections for Fowler, 2019 - 2050

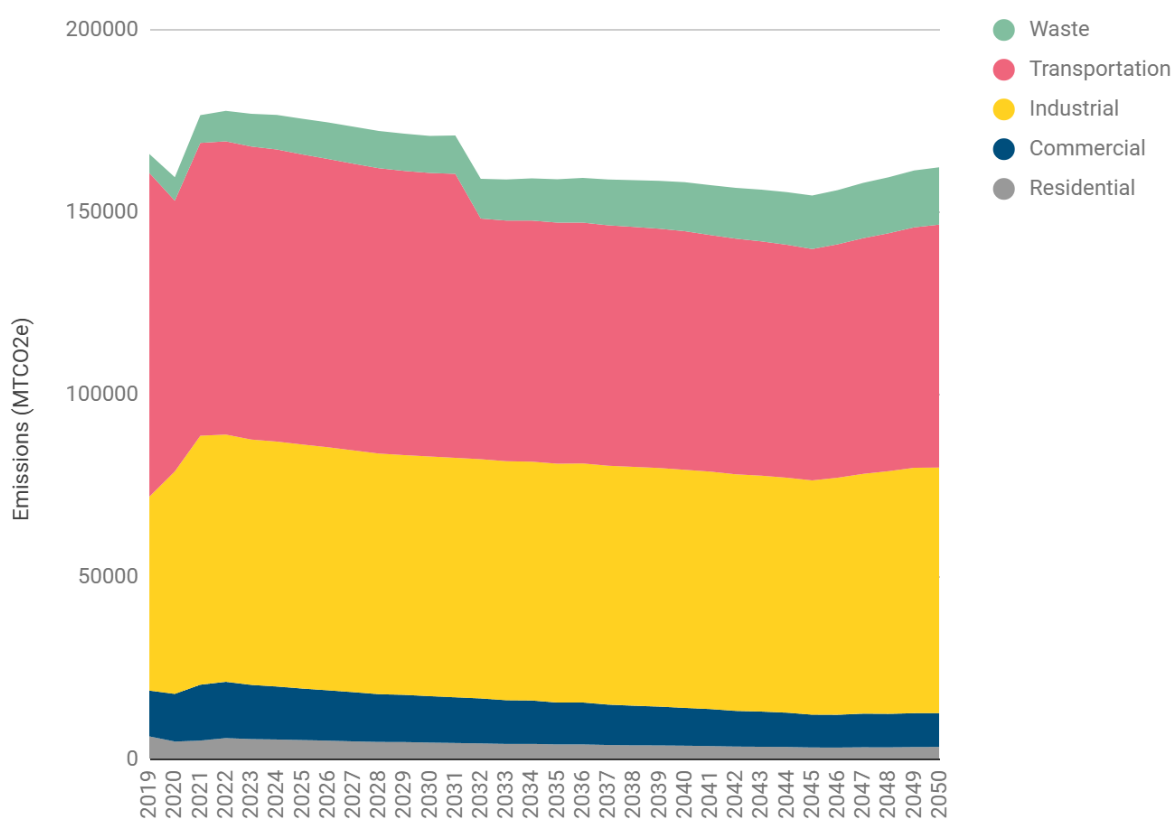


Figure B.20. Low Carbon Scenario (LCS) Emissions Projections for Fowler, 2019 - 2050

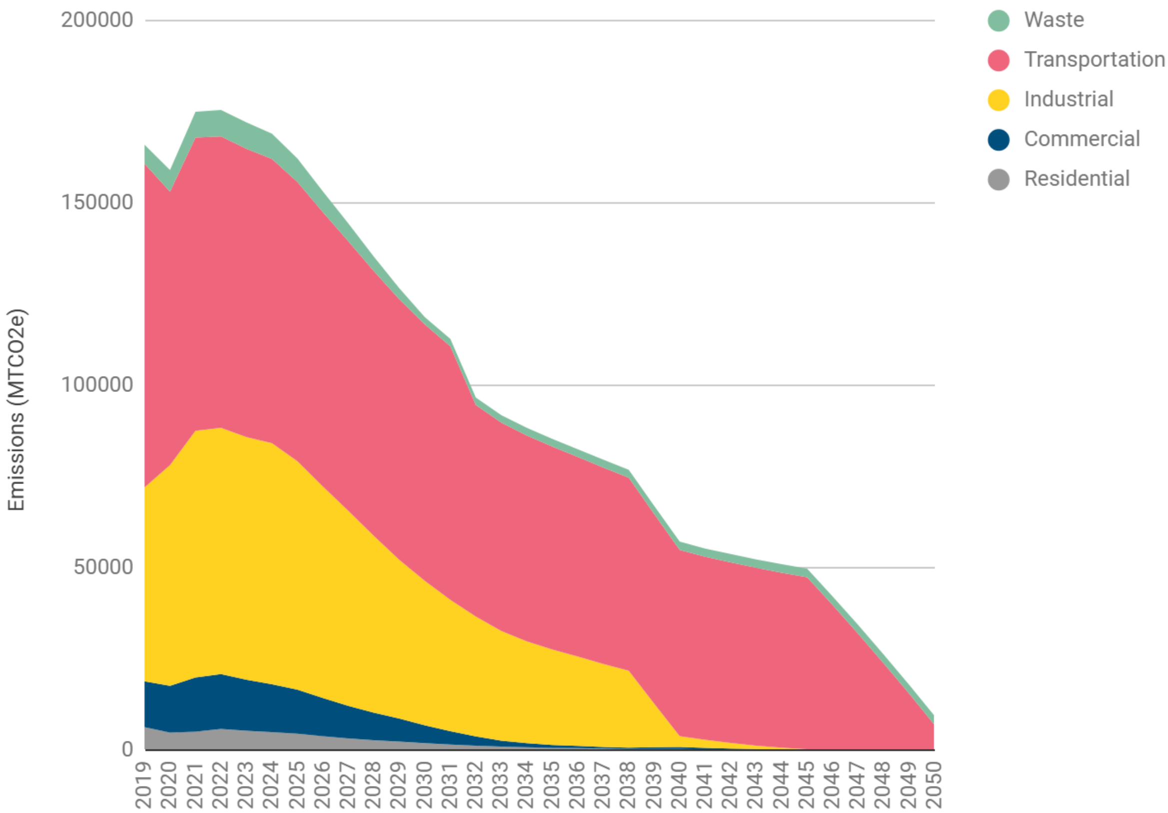


Table B.7. Emissions Projections for each Scenario in Fowler, MTCO2e

Fowler	**2019**	**2030**	**2045**
BAU	165,974	209,403	260,020
BAP	165,974	170,935	154,630
LC	165,974	118,725	49,758
BAU	**2019**	**2030**	**2045**
Residential	6,297	5,983	7,718
Commercial	12,547	16,329	19,924
Industrial	53,192	72,099	89,096
Transportation	88,746	99,837	120,891
Waste	5,193	15,155	22,391
BAP	**2019**	**2030**	**2045**
Residential	6,297	4,594	3,245
Commercial	12,547	12,737	9,012
Industrial	53,192	65,703	64,240
Transportation	88,746	77,764	63,457
Waste	5,193	10,136	14,676
LC	**2019**	**2030**	**2045**
Residential	6,297	1,870	17
Commercial	12,547	4,933	22
Industrial	53,192	39,577	190
Transportation	88,746	70,353	47,172
Waste	5,193	1,992	2,356

HURON

Figure B.21. Emissions Inventory by Sector for Huron, 2019

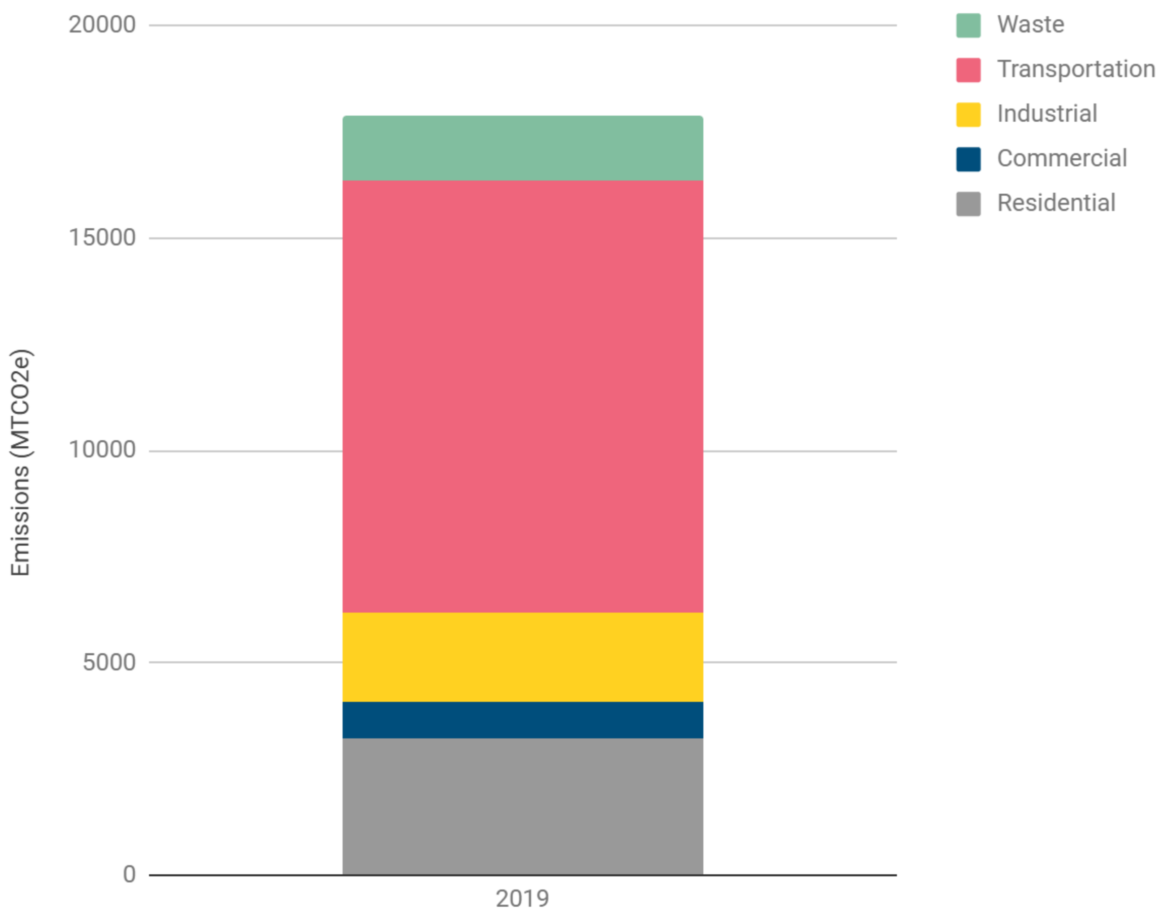


Figure B.22. Business as Usual (BAU) Emissions Projections for Huron, 2019 – 2050

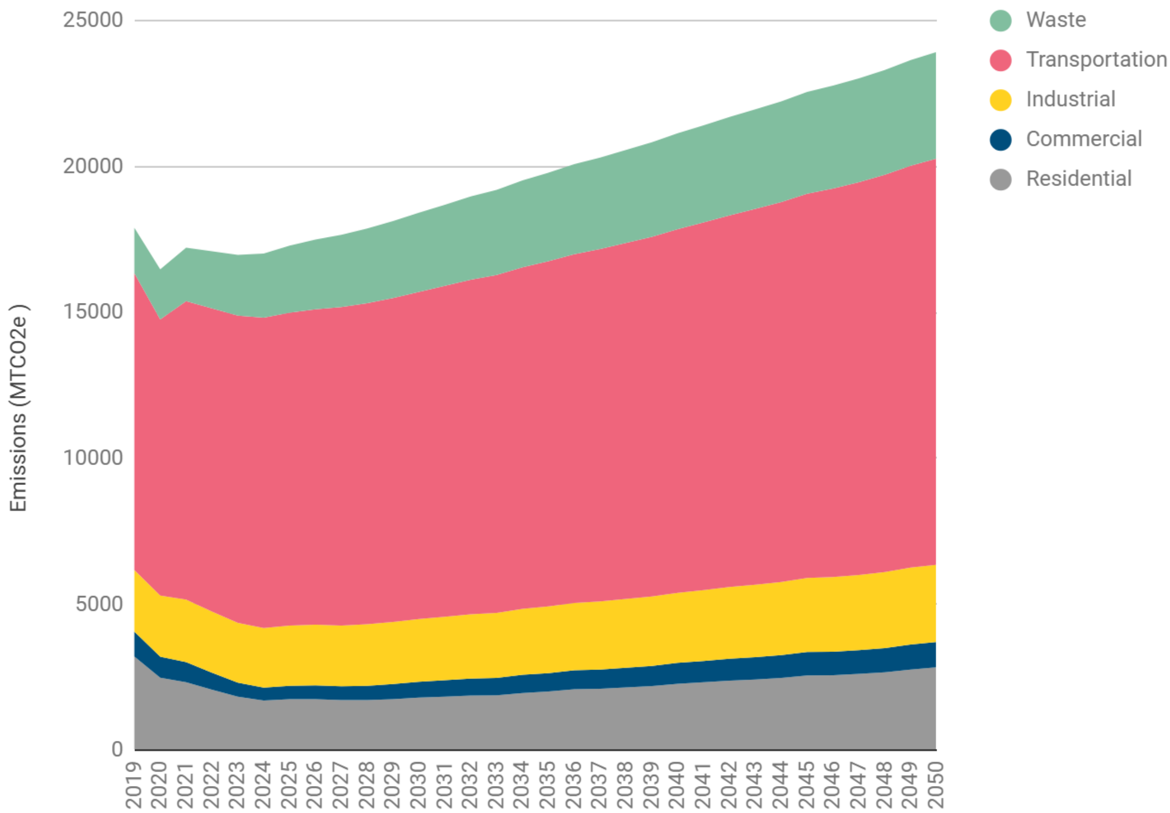


Figure B.23. Business-as-Planned (BAP) Emissions Projections for Huron, 2019 – 2050

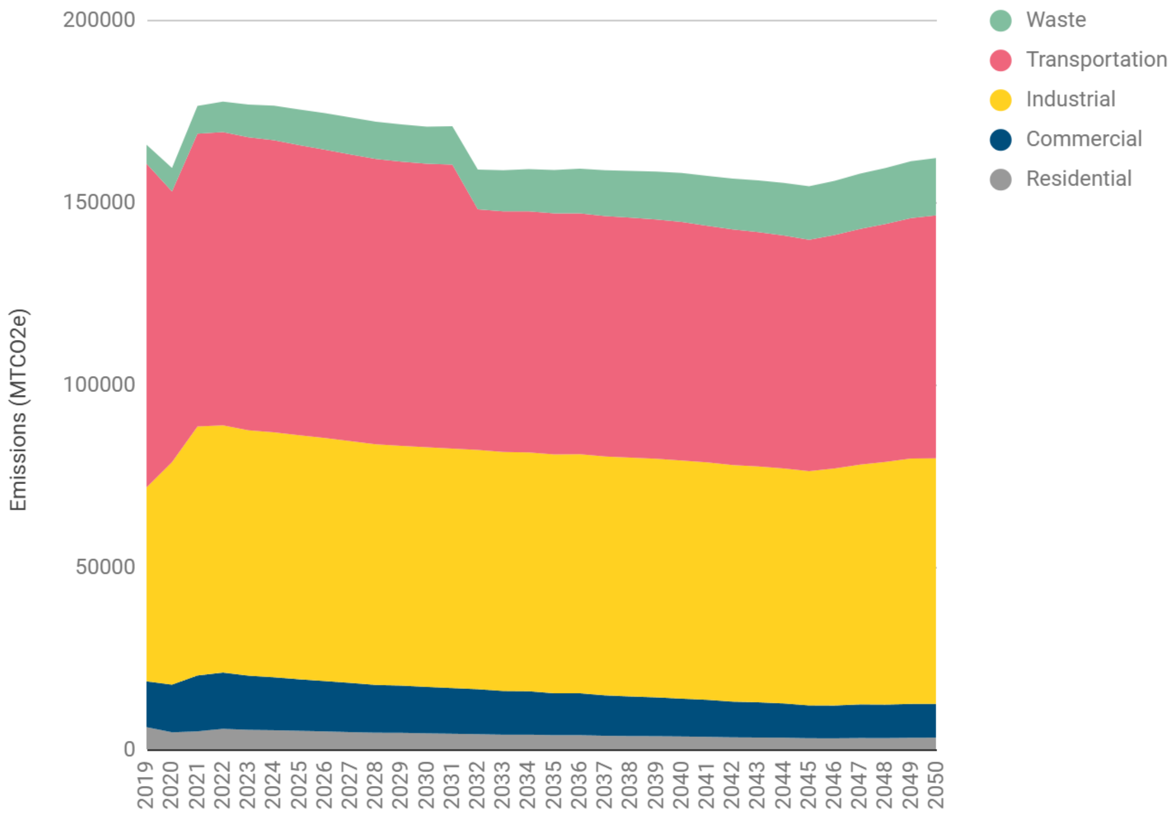


Figure B.24. Low Carbon Scenario (LCS) Emissions Projections for Huron, 2019 – 2050

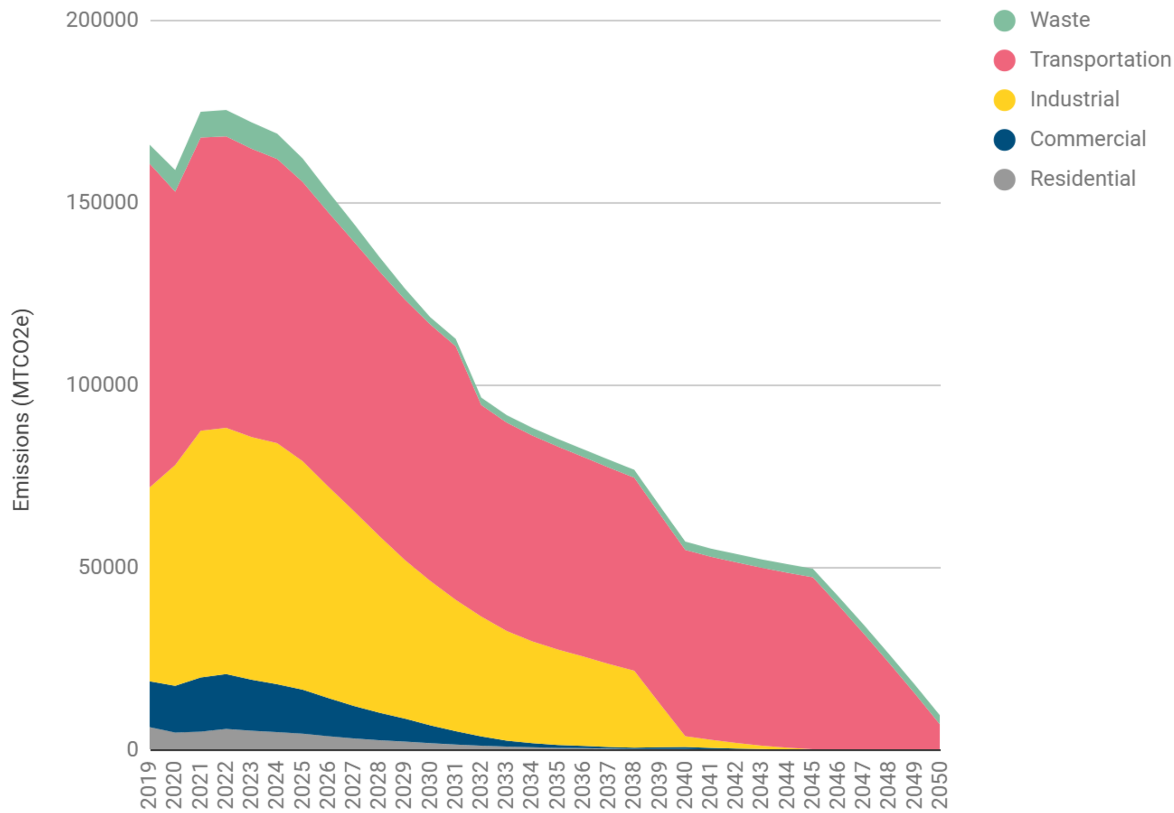


Table B.8. Emissions Projections for each Scenario in Huron, MTCO2e

Huron	2019	2030	2045
BAU	17,902	18,419	22,561
BAP	17,902	14,969	14,642
LC	17,902	12,290	7,303
BAU	**2019**	**2030**	**2045**
Residential	3,208	1,800	2,559
Commercial	847	540	800
Industrial	2,118	2,154	2,541
Transportation	10,177	11,212	13,168
Waste	1,552	2,712	3,493
BAP	**2019**	**2030**	**2045**
Residential	3,208	1,531	1,713
Commercial	847	434	481
Industrial	2,118	2,082	2,323
Transportation	10,177	8,786	7,450
Waste	1,552	2,136	2,675
LC	**2019**	**2030**	**2045**
Residential	3,208	1,094	7
Commercial	847	353	11
Industrial	2,118	1,565	7
Transportation	10,177	8,077	5,910
Waste	1,552	1,201	1,368

Kerman

Figure B.25. Emissions Inventory by Sector for Kerman, 2019

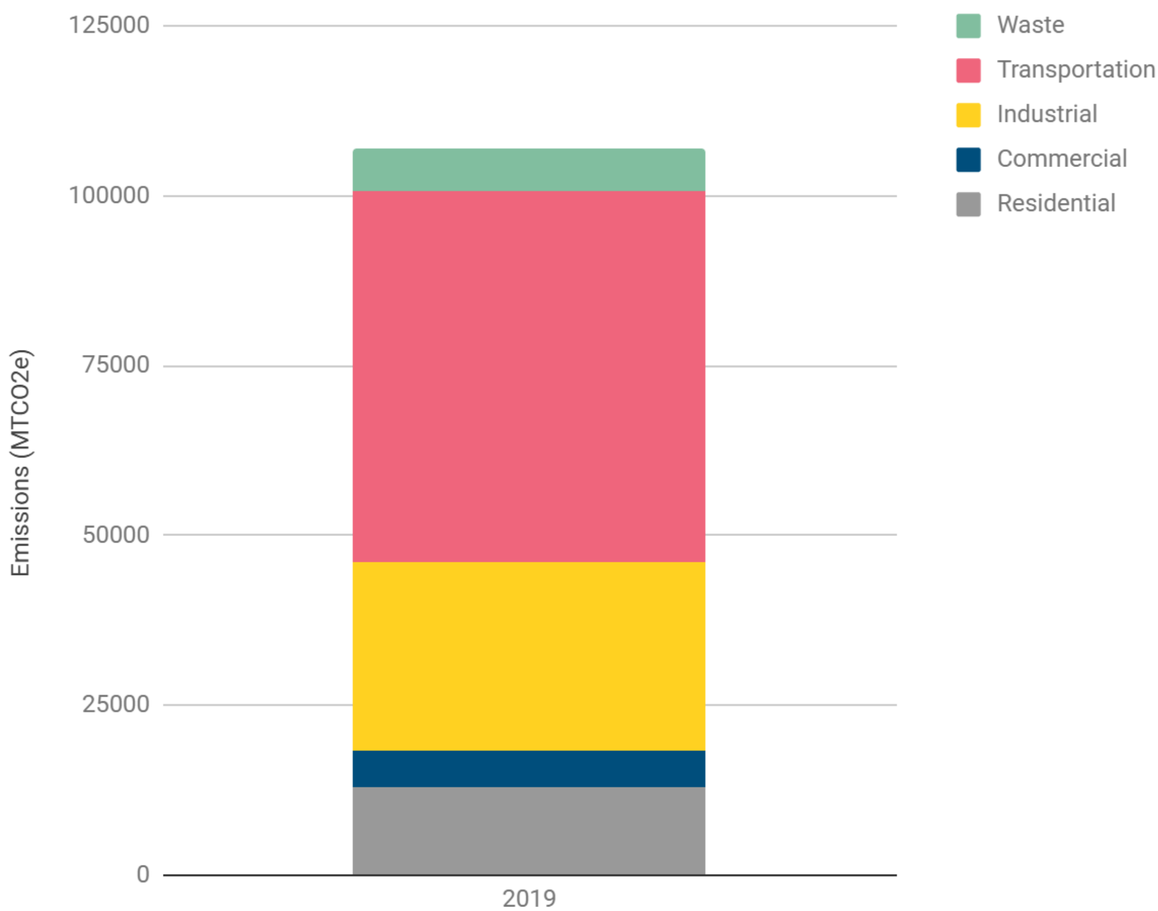


Figure B.26. Business as Usual (BAU) Emissions Projections for Kerman, 2019 – 2050

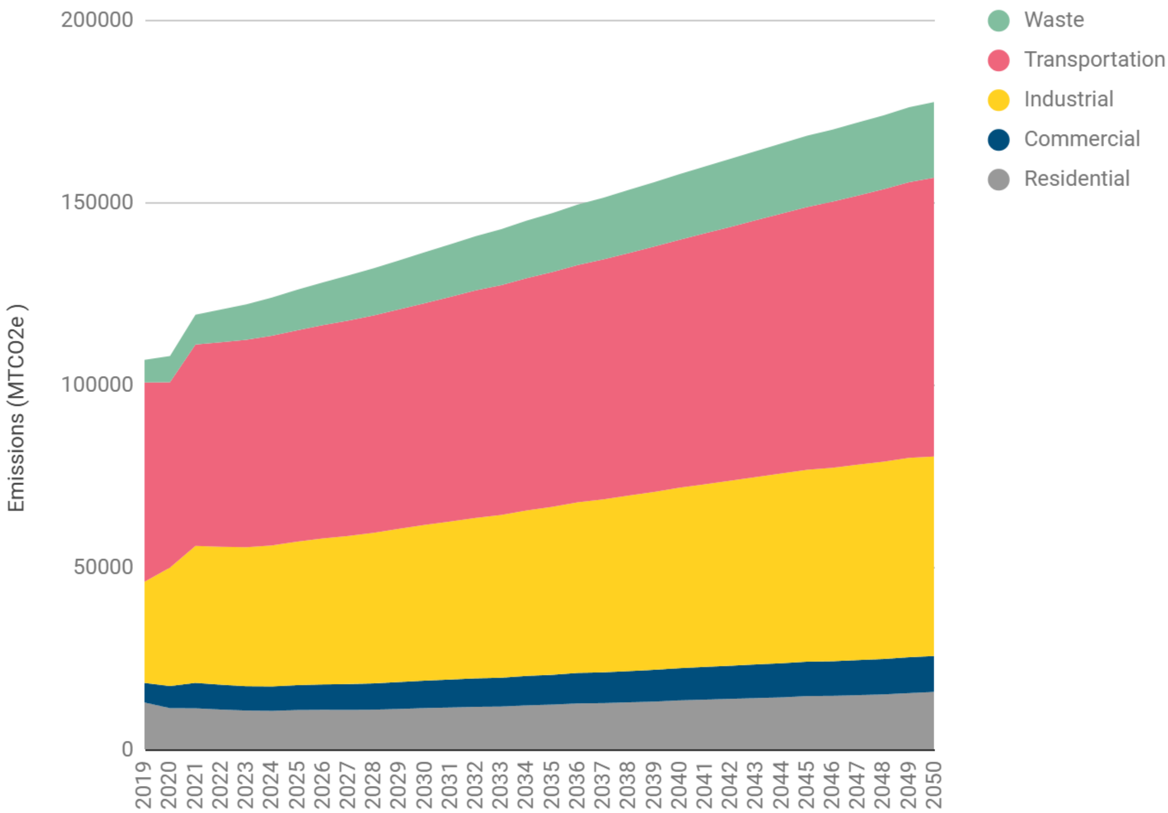


Figure B.27. Business-as-Planned (BAP) Emissions Projections for Kerman, 2019 – 2050

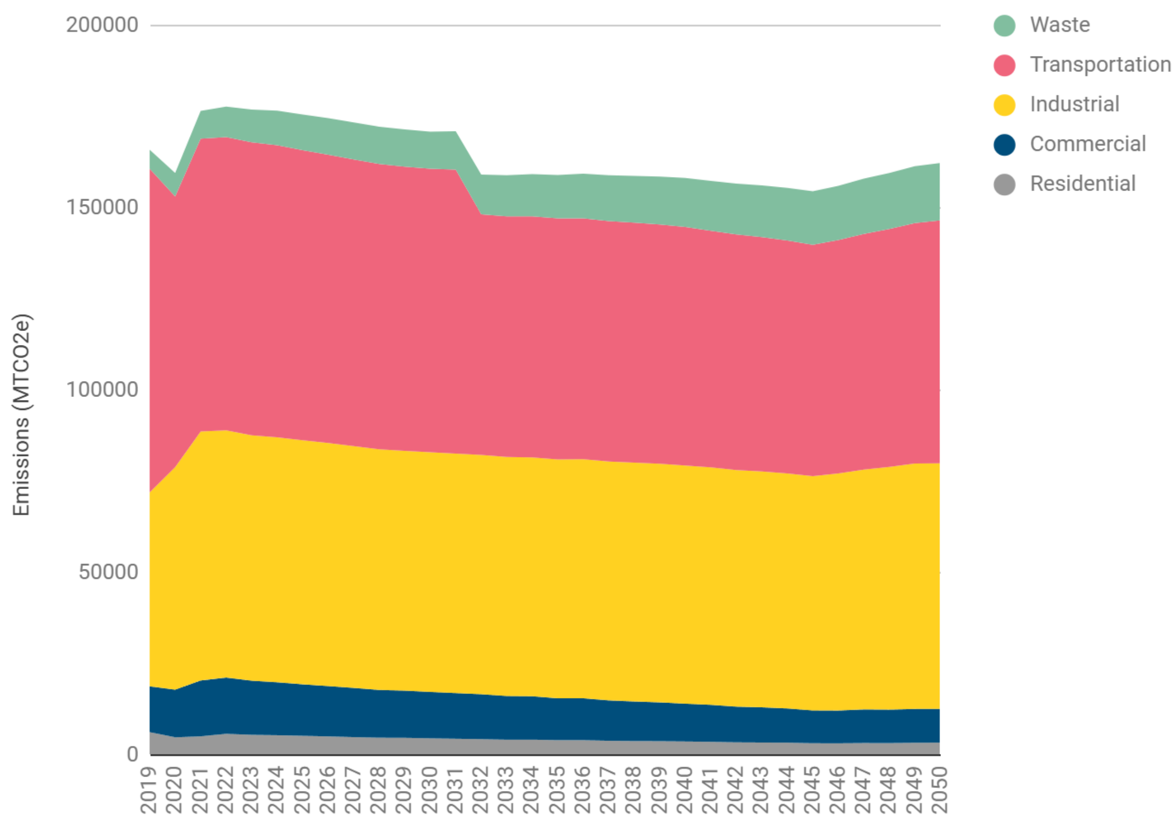


Figure B.28. Low Carbon Scenario (LCS) Emissions Projections for Kerman, 2019 – 2050

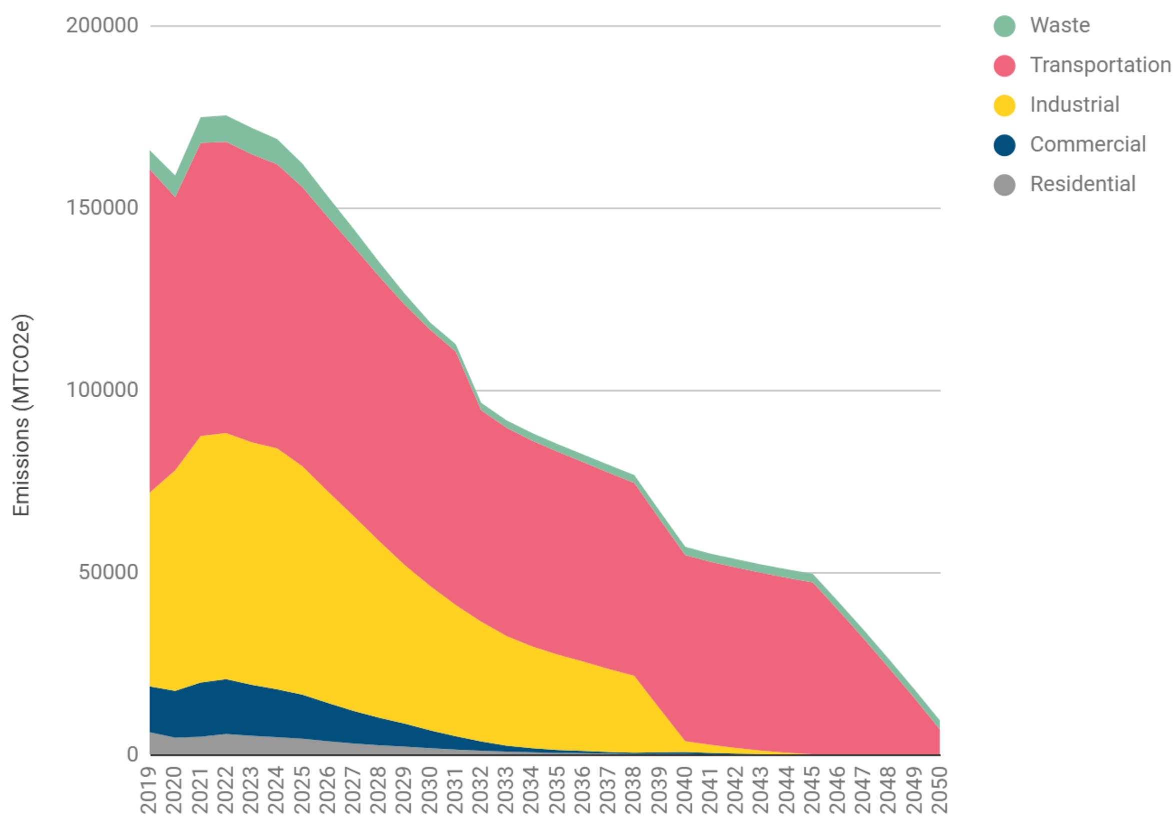


Table B.9. Emissions Projections for each Scenario in Kerman, MTCO2e

Kerman	**2019**	**2030**	**2045**
BAU	106,988	136,517	168,463
BAP	106,988	106,778	103,187
LC	106,988	78,849	35,592
BAU	**2019**	**2030**	**2045**
Residential	13,049	11,521	14,804
Commercial	5,360	7,523	9,441
Industrial	27,718	42,708	52,597
Transportation	54,691	60,823	72,091
Waste	6,169	13,942	19,531
BAP	**2019**	**2030**	**2045**
Residential	13,049	7,631	6,613
Commercial	5,360	4,283	3,092
Industrial	27,718	36,853	39,831
Transportation	54,691	47,701	39,619
Waste	6,169	10,310	14,031
LC	**2019**	**2030**	**2045**
Residential	13,049	3,897	31
Commercial	5,360	2,073	5
Industrial	27,718	24,893	118
Transportation	54,691	43,572	30,190
Waste	6,169	4,415	5,249

Kingsburg

Figure B.29. Emissions Inventory by Sector for Kingsburg, 2019

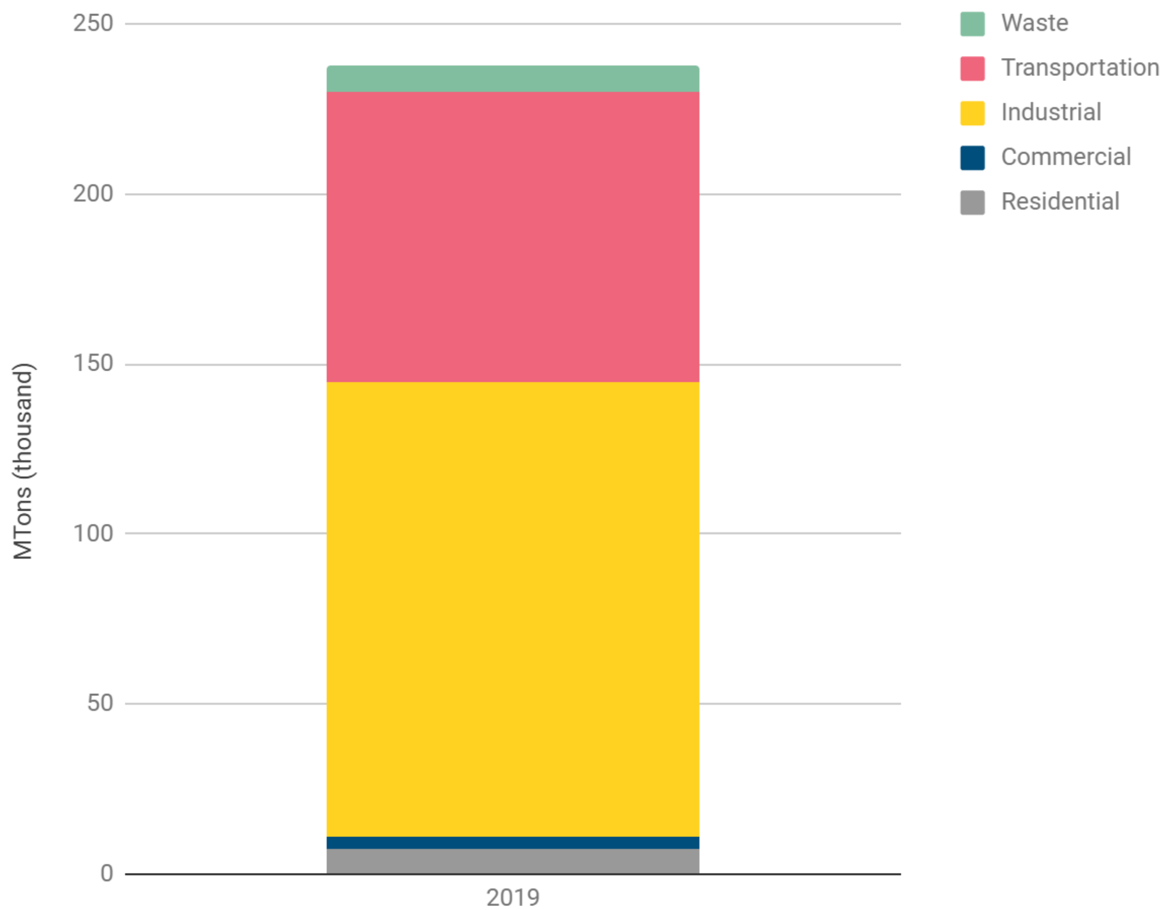


Figure B.30. Business as Usual (BAU) Emissions Projections for Kingsburg, 2019 – 2050

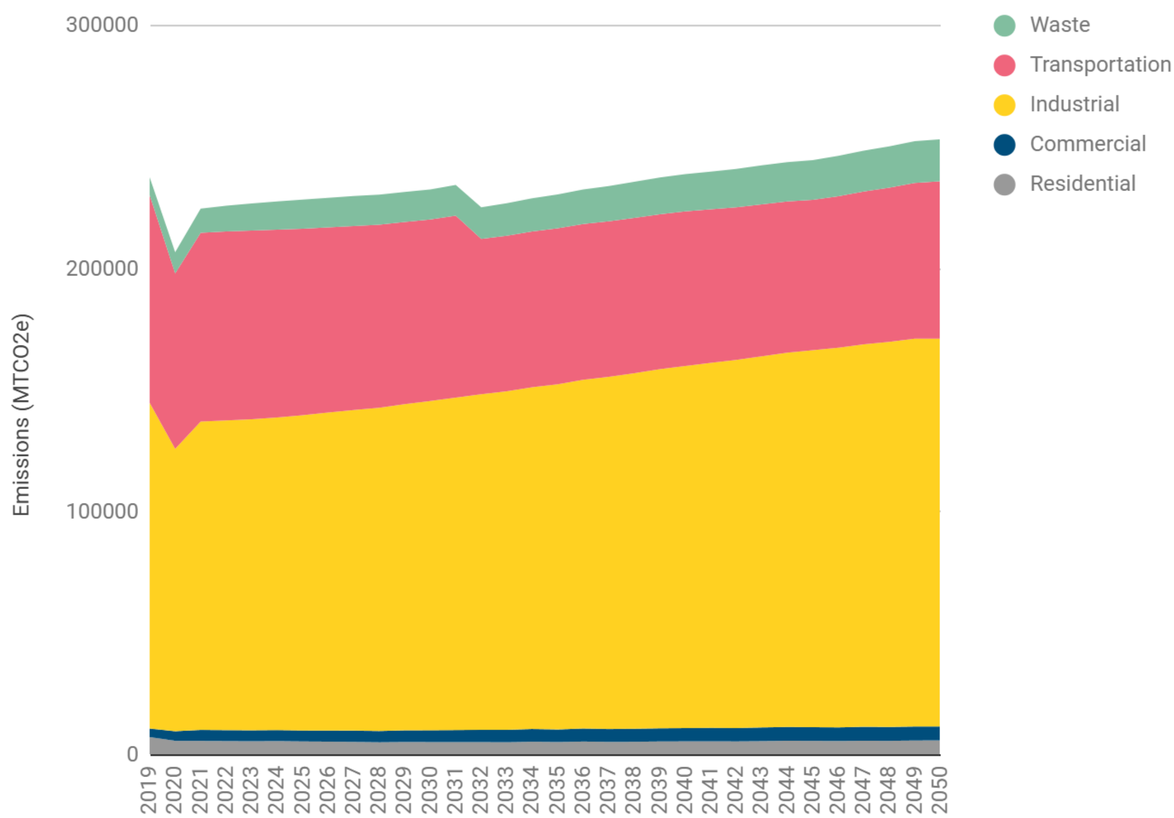


Figure B.31. Business-as-Planned (BAP) Emissions Projections for Kingsburg, 2019 – 2050

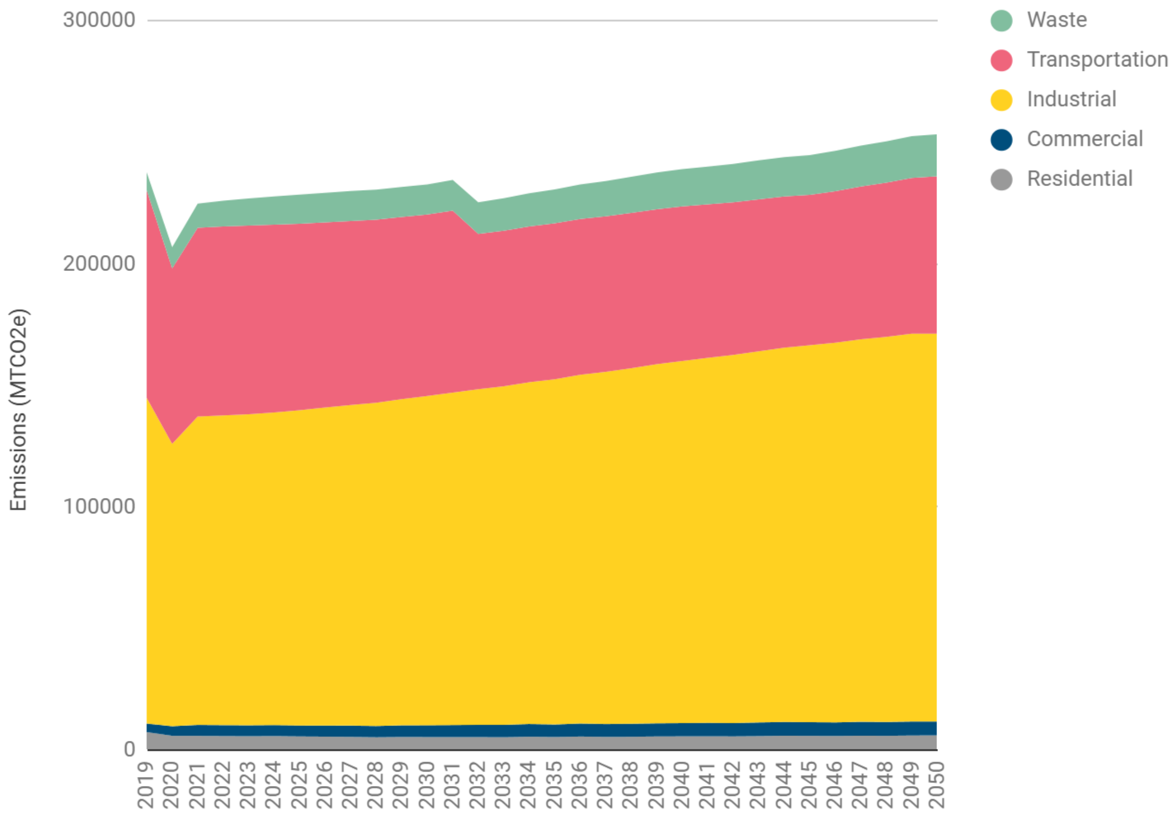


Figure B.32. Low Carbon Scenario (LCS) Emissions Projections for Kingsburg, 2019 – 2050

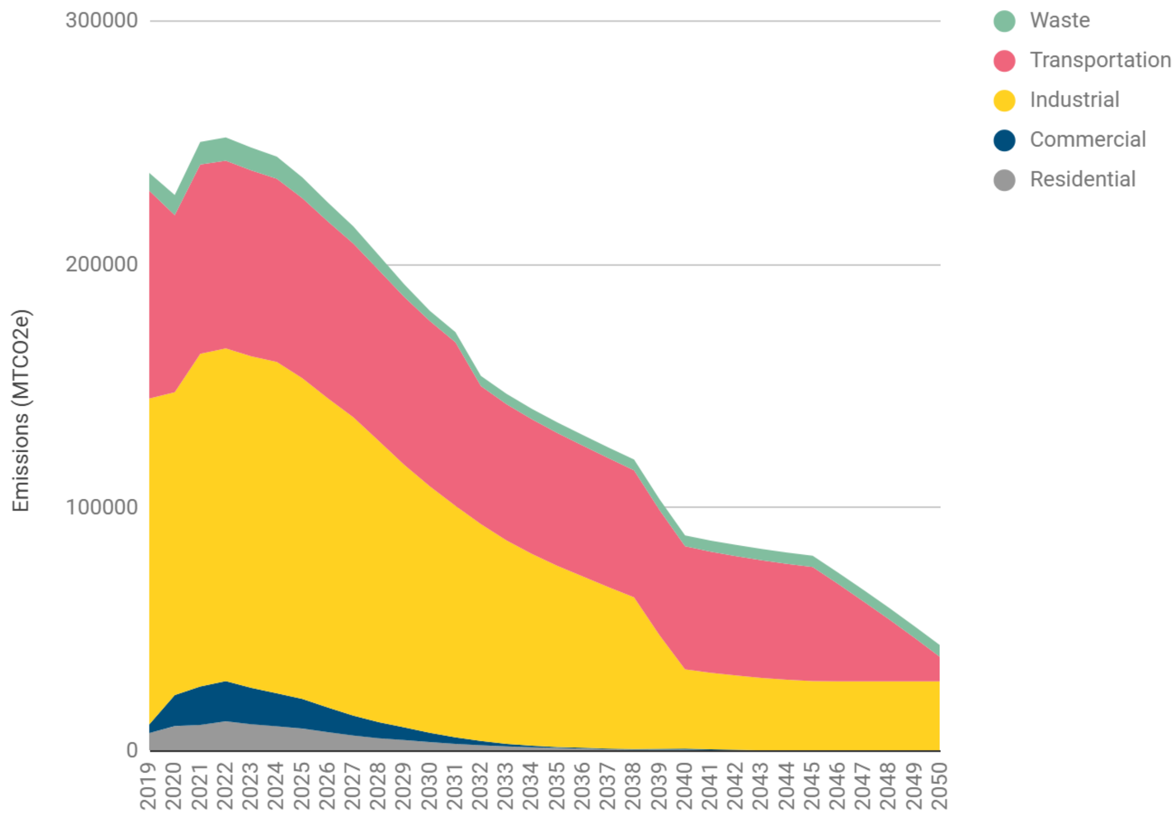


Table B.10. Emissions Projections for each Scenario in Kingsburg, MTCO2e

Kingsburg	**2019**	**2030**	**2045**
BAU	237,669	287,655	334,852
BAP	237,669	232,621	244,772
LC	237,669	180,960	80,304
BAU	**2019**	**2030**	**2045**
Residential	7,410	5,521	6,196
Commercial	3,465	5,050	5,964
Industrial	134,074	164,030	183,631
Transportation	85,380	95,790	115,267
Waste	7,341	17,264	23,794
BAP	**2019**	**2030**	**2045**
Residential	7,410	5,359	5,853
Commercial	3,465	4,855	5,625
Industrial	134,074	135,453	155,054
Transportation	85,380	74,681	61,814
Waste	7,341	12,273	16,426
LC	**2019**	**2030**	**2045**
Residential	7,410	3,641	31
Commercial	3,465	3,831	10
Industrial	134,074	101,334	28,661
Transportation	85,380	67,981	46,942
Waste	7,341	4,174	4,661

MENDOTA

Figure B.33. Emissions Inventory by Sector for Mendota, 2019

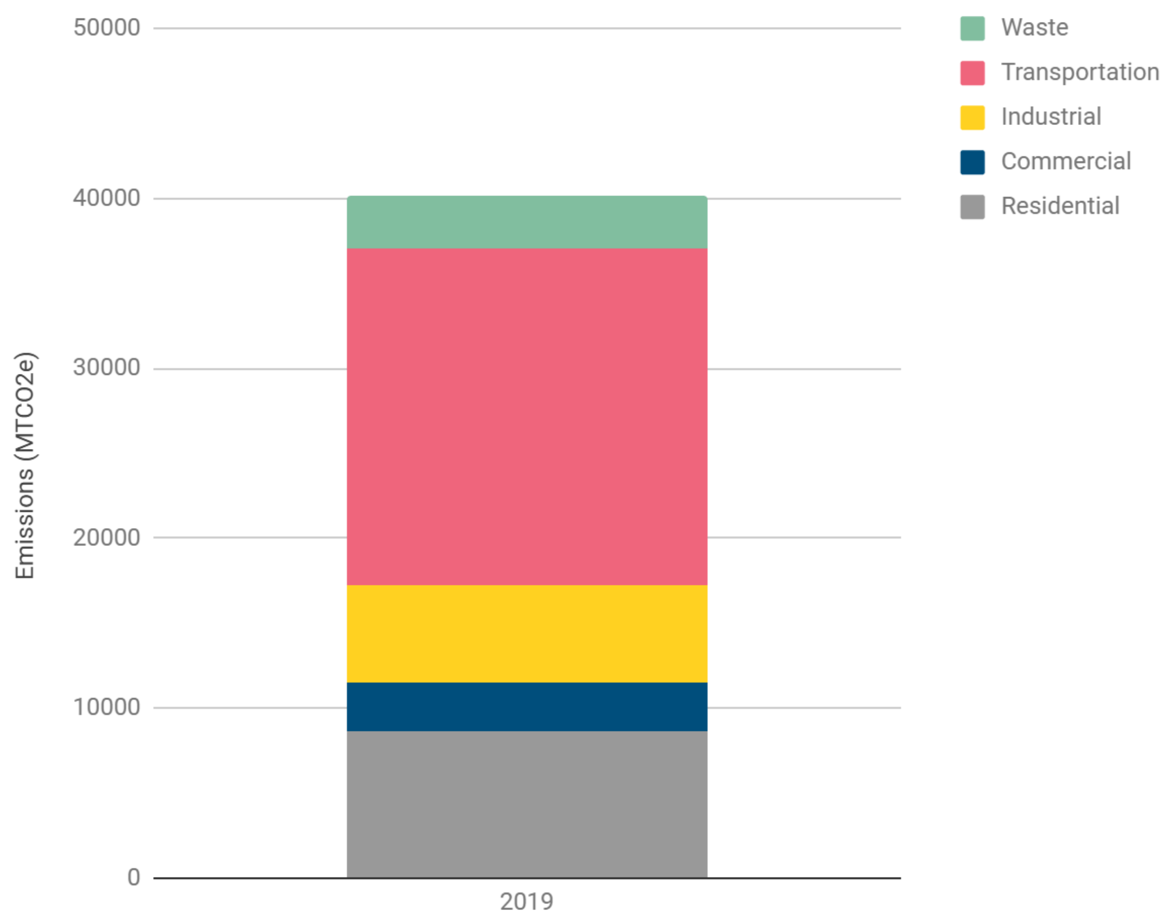


Figure B.34. Business as Usual (BAU) Emissions Projections for Mendota, 2019 – 2050

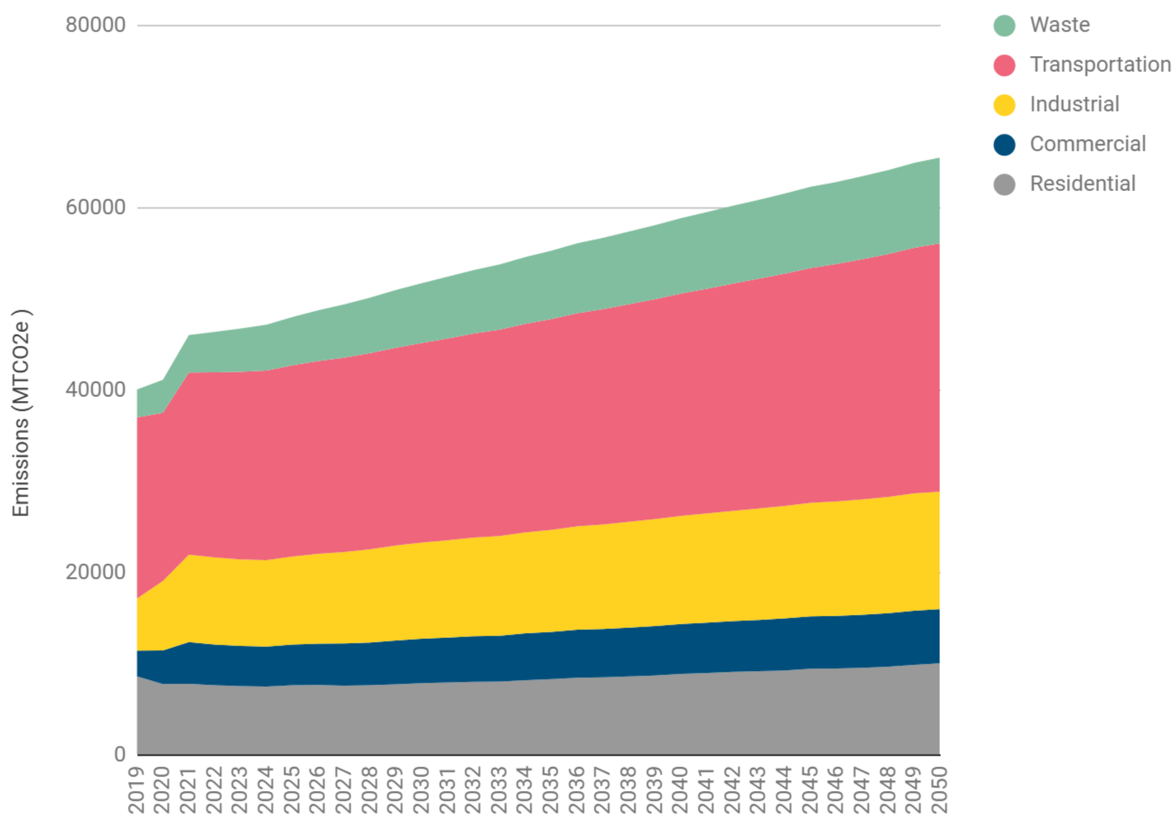


Figure B.35. Business-as-Planned (BAP) Emissions Projections for Mendota, 2019 – 2050

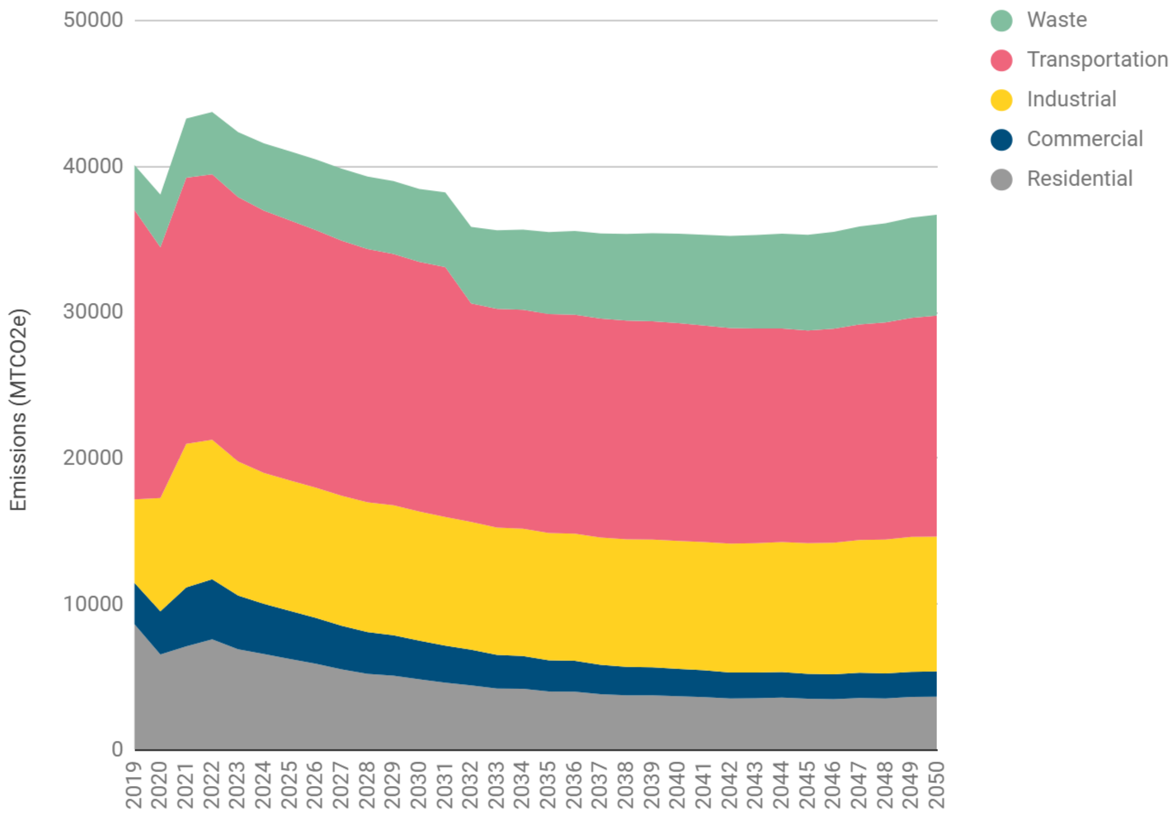


Figure B.36. Low Carbon Scenario (LCS) Emissions Projections for Mendota, 2019 – 2050

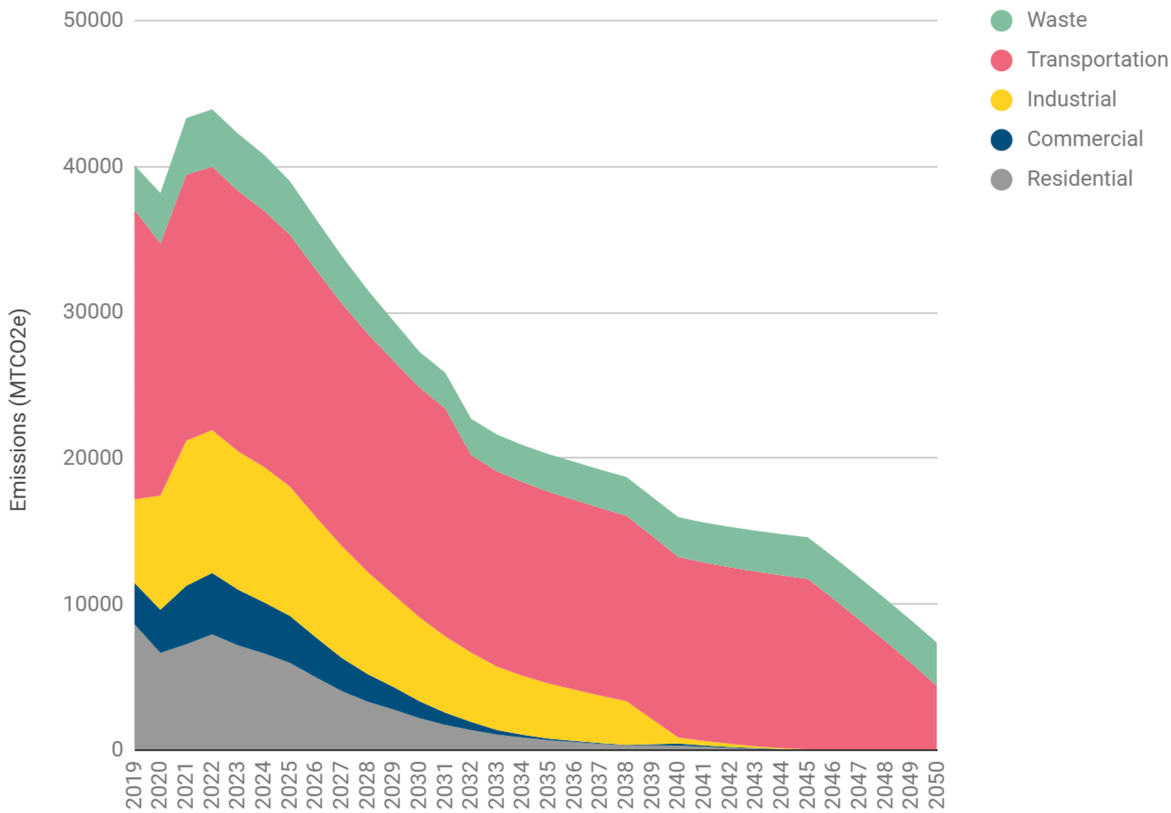


Table B.11. Emissions Projections for each Scenario in Mendota, MTCO2e

Mendota	**2019**	**2030**	**2045**
BAU	40,111	51,770	62,337
BAP	40,111	38,460	35,329
LC	40,111	27,302	14,584
BAU	**2019**	**2030**	**2045**
Residential	8,621	7,885	9,486
Commercial	2,838	4,875	5,740
Industrial	5,727	10,545	12,450
Transportation	19,848	21,897	25,763
Waste	3,076	6,567	8,899
BAP	**2019**	**2030**	**2045**
Residential	8,621	4,846	3,525
Commercial	2,838	2,650	1,706
Industrial	5,727	8,852	8,951
Transportation	19,848	17,119	14,576
Waste	3,076	4,992	6,571
LC	**2019**	**2030**	**2045**
Residential	8,621	2,189	16
Commercial	2,838	1,165	2
Industrial	5,727	5,754	26
Transportation	19,848	15,758	11,686
Waste	3,076	2,436	2,854

ORANGE COVE

Figure B.37. Emissions Inventory by Sector for Orange Cove, 2019

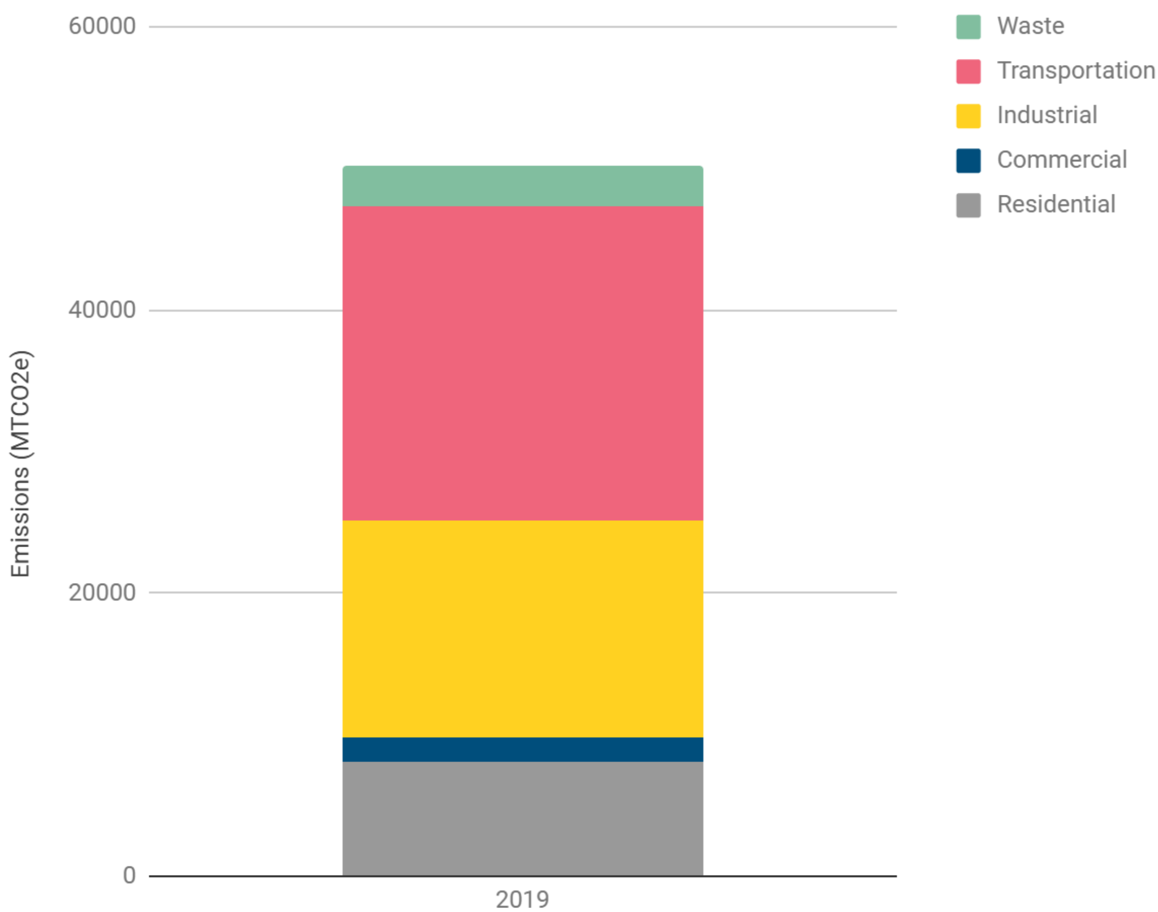


Figure B.38. Business as Usual (BAU) Emissions Projections for Orange Cove, 2019 – 2050

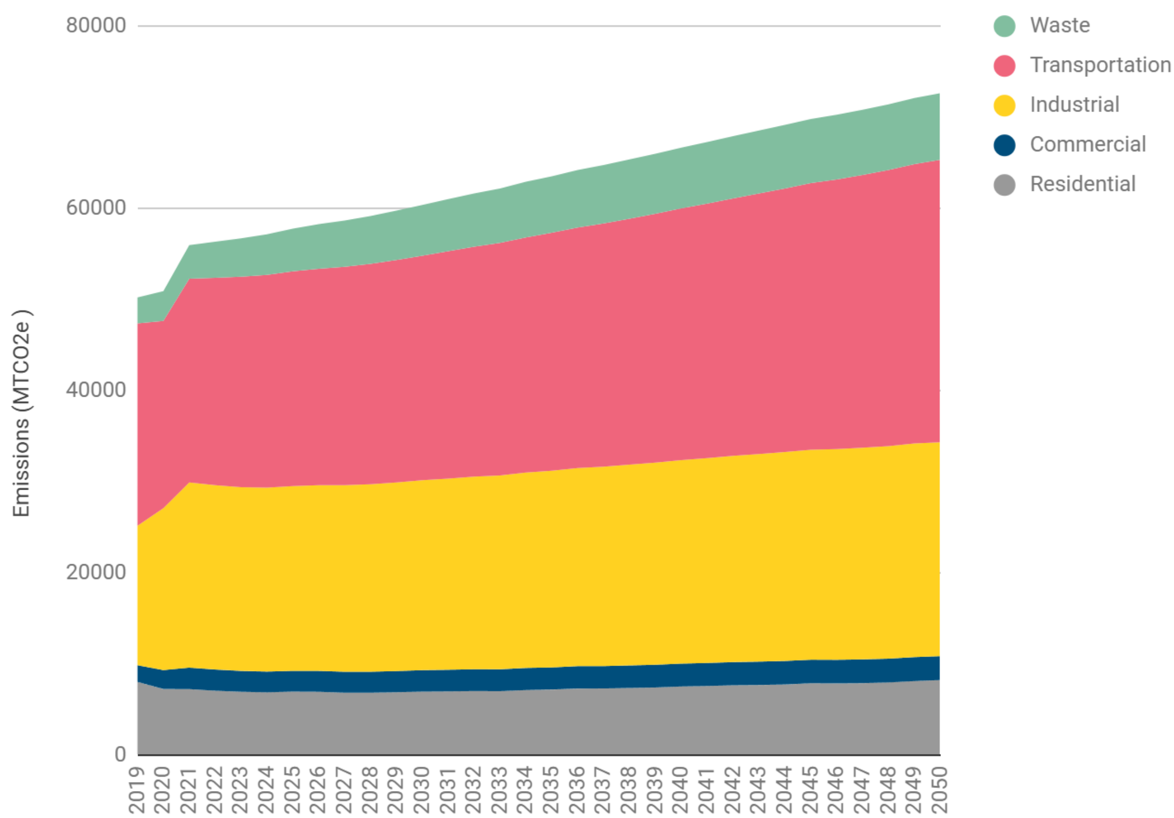


Figure B.39. Business-as-Planned (BAP) Emissions Projections for Orange Cove, 2019 – 2050

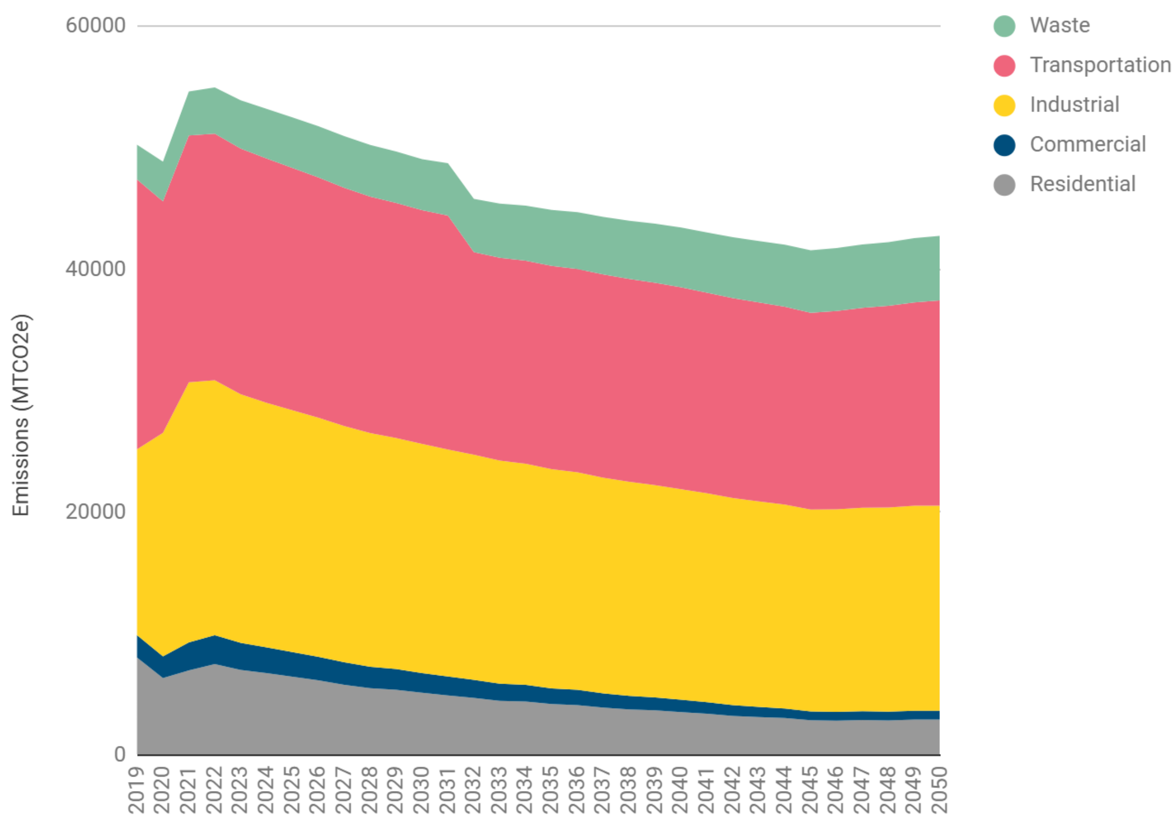


Figure B.40. Low Carbon Scenario (LCS) Emissions Projections for Orange Cove, 2019 – 2050

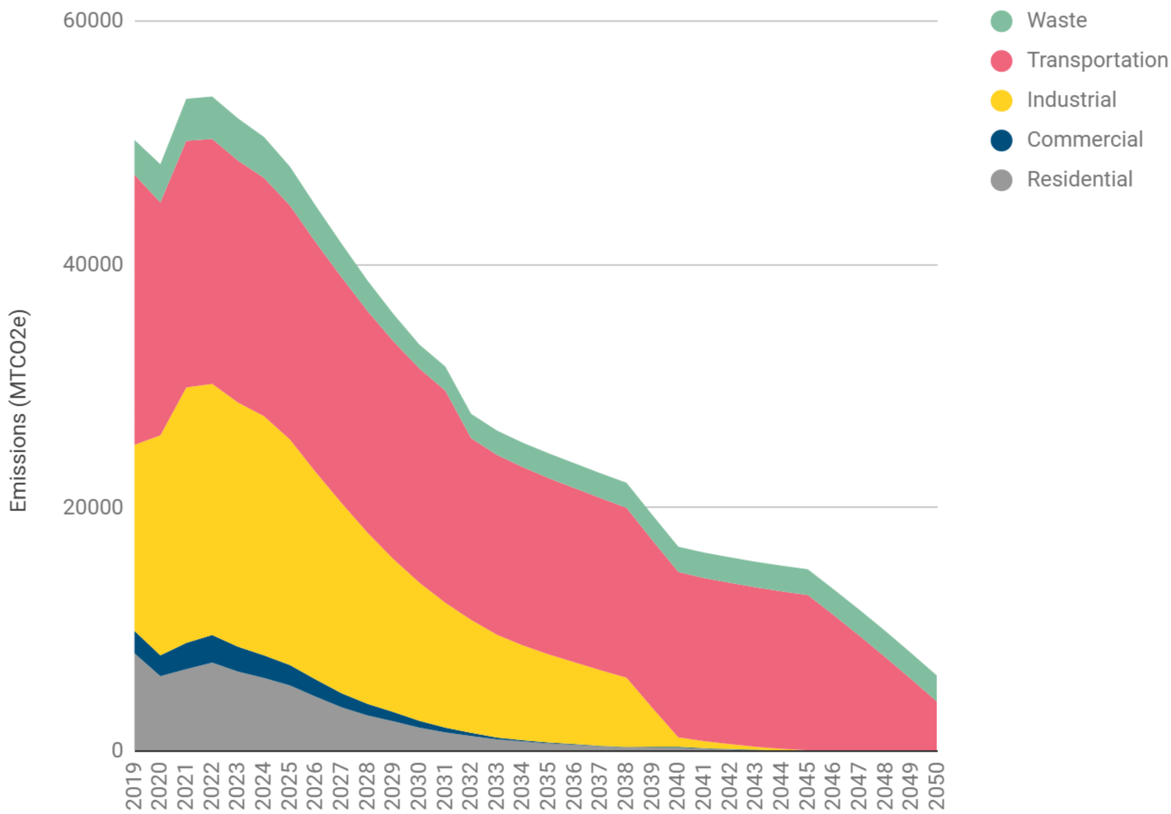


Table B.12. Emissions Projections for each Scenario in Orange Cove, MTCO2e

Orange Cove	**2019**	**2030**	**2045**
BAU	50,238	60,390	69,823
BAP	50,238	49,062	41,559
LC	50,238	33,426	14,948
BAU	**2019**	**2030**	**2045**
Residential	8,038	6,970	7,889
Commercial	1,825	2,350	2,585
Industrial	15,303	20,846	23,052
Transportation	22,226	24,654	29,254
Waste	2,846	5,571	7,043
BAP	**2019**	**2030**	**2045**
Residential	8,038	5,128	2,867
Commercial	1,825	1,633	729
Industrial	15,303	18,858	16,613
Transportation	22,226	19,243	16,202
Waste	2,846	4,199	5,148
LC	**2019**	**2030**	**2045**
Residential	8,038	1,927	13
Commercial	1,825	559	2
Industrial	15,303	11,362	49
Transportation	22,226	17,605	12,763
Waste	2,846	1,973	2,122

Parlier

Figure B.41. Emissions Inventory by Sector for Parlier, 2019

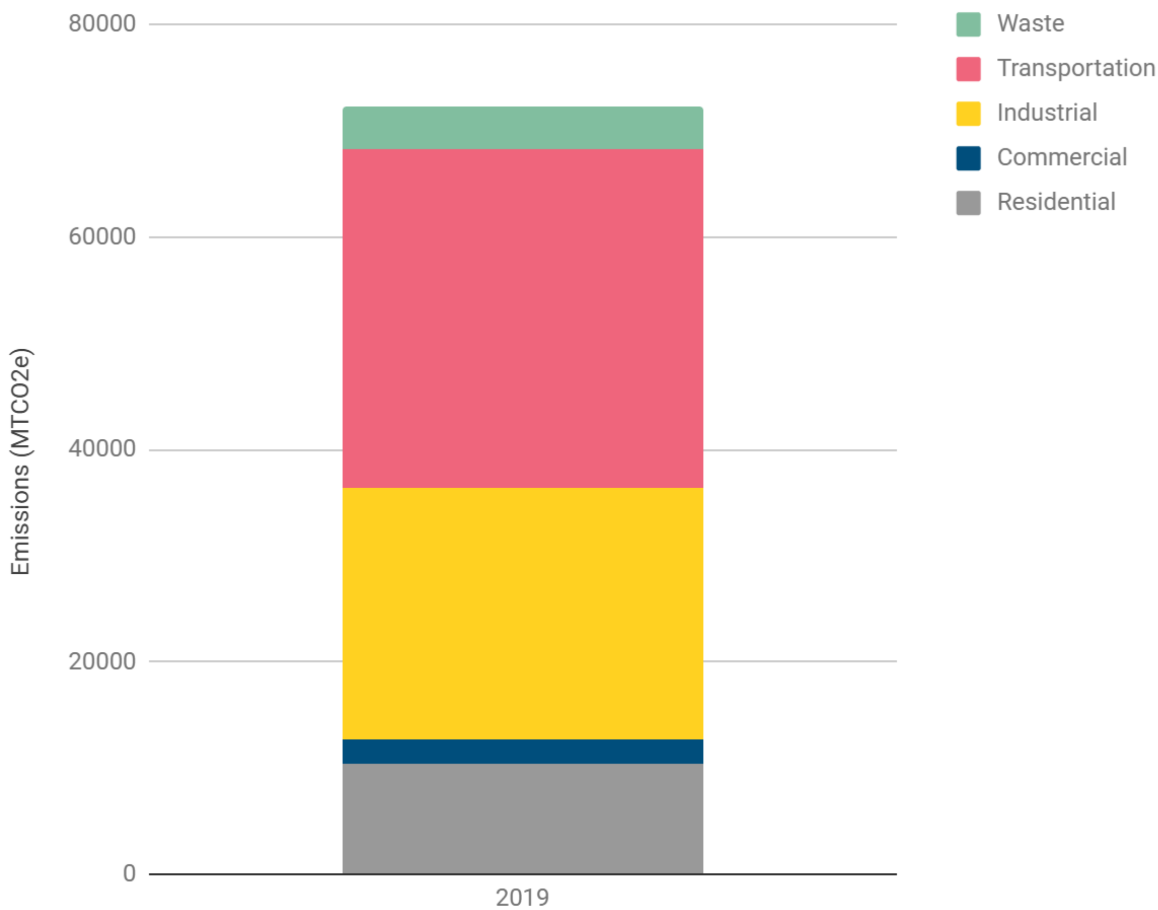


Figure B.42. Business as Usual (BAU) Emissions Projections for Parlier, 2019 – 2050

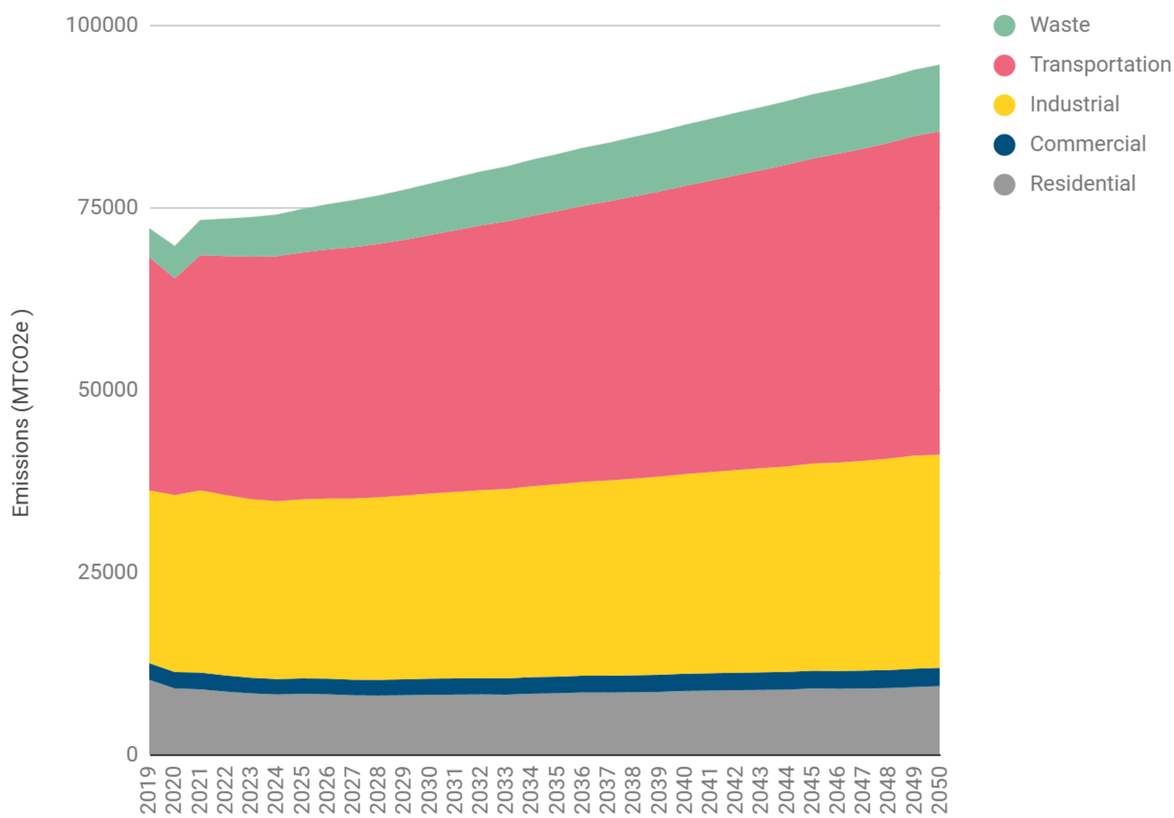


Figure B.43. Business-as-Planned (BAP) Emissions Projections for Parlier, 2019 – 2050

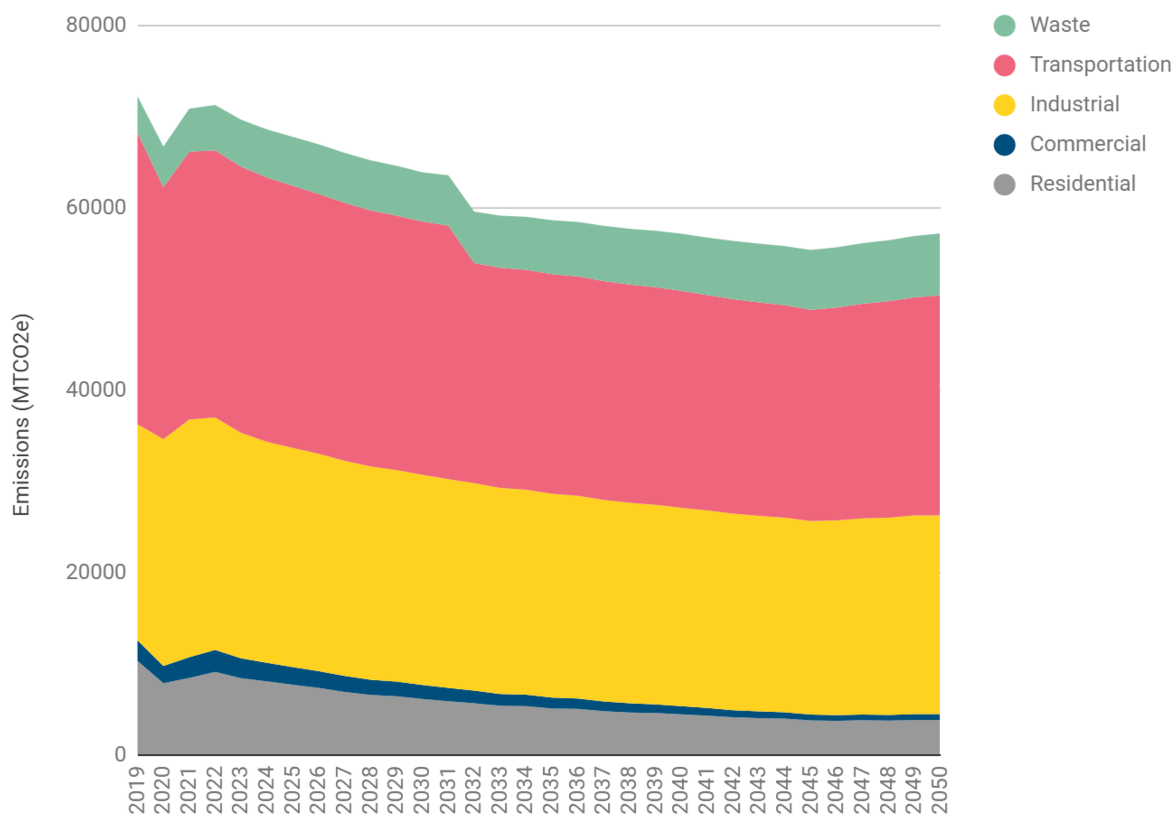


Figure B.44. Low Carbon Scenario (LCS) Emissions Projections for Parlier, 2019 – 2050

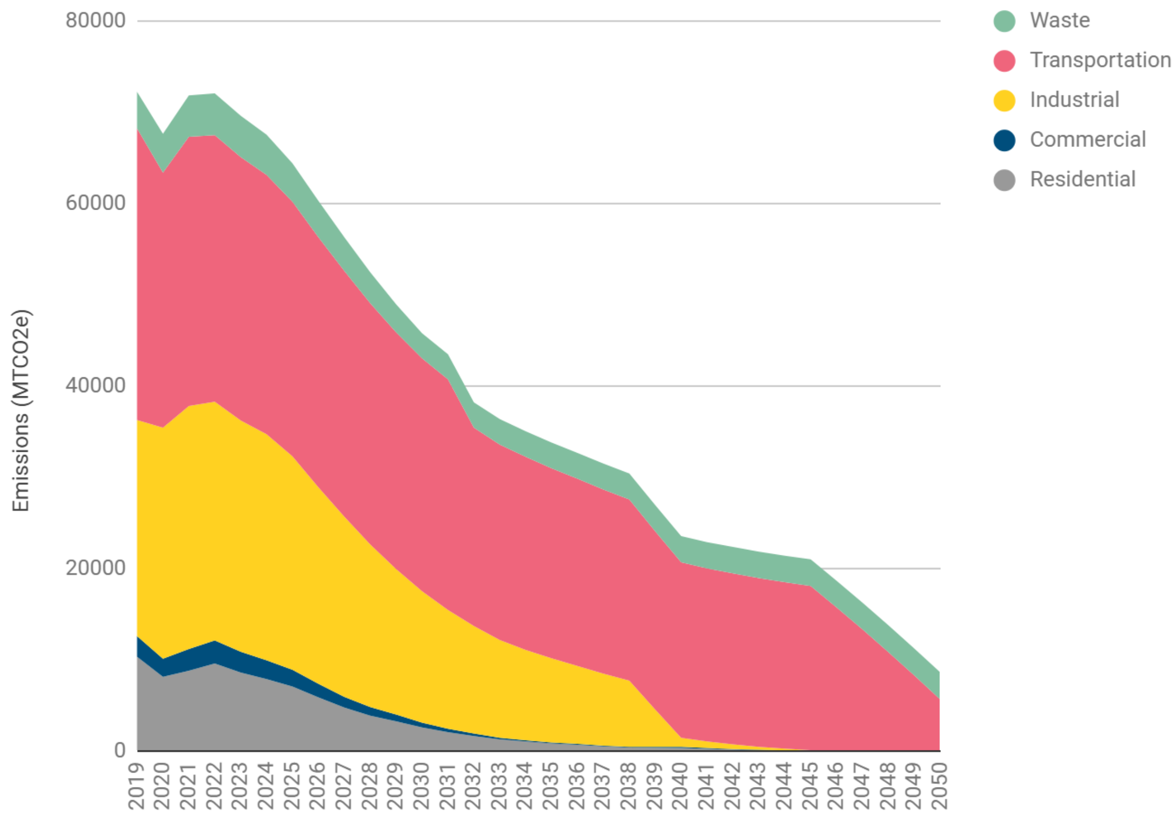


Table B.13. Emissions Projections for each Scenario in Parlier, MTCO2e

Parlier	**2019**	**2030**	**2045**
BAU	72,258	78,358	90,619
BAP	72,258	63,932	55,402
LC	72,258	45,805	21,014
BAU	**2019**	**2030**	**2045**
Residential	10,330	8,279	9,125
Commercial	2,274	2,198	2,443
Industrial	23,677	25,382	28,397
Transportation	31,976	35,437	41,833
Waste	4,001	7,062	8,821
BAP	**2019**	**2030**	**2045**
Residential	10,330	6,162	3,807
Commercial	2,274	1,523	629
Industrial	23,677	23,061	21,237
Transportation	31,976	27,768	23,179
Waste	4,001	5,417	6,550
LC	**2019**	**2030**	**2045**
Residential	10,330	2,581	19
Commercial	2,274	531	9
Industrial	23,677	14,407	63
Transportation	31,976	25,537	17,999
Waste	4,001	2,749	2,924

REEDLEY

Figure B.45. Emissions Inventory by Sector for Reedley, 2019

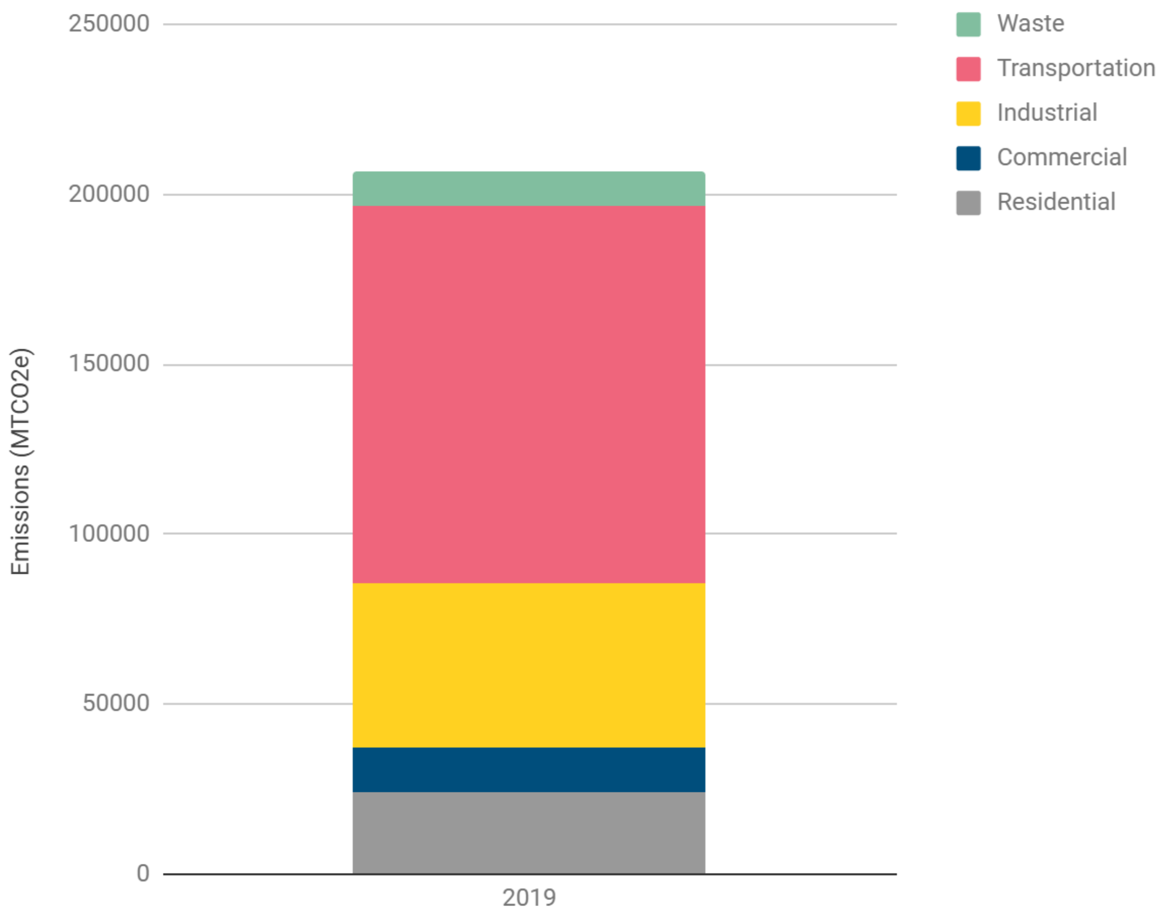


Figure B.46. Business as Usual (BAU) Emissions Projections for Reedley, 2019 – 2050

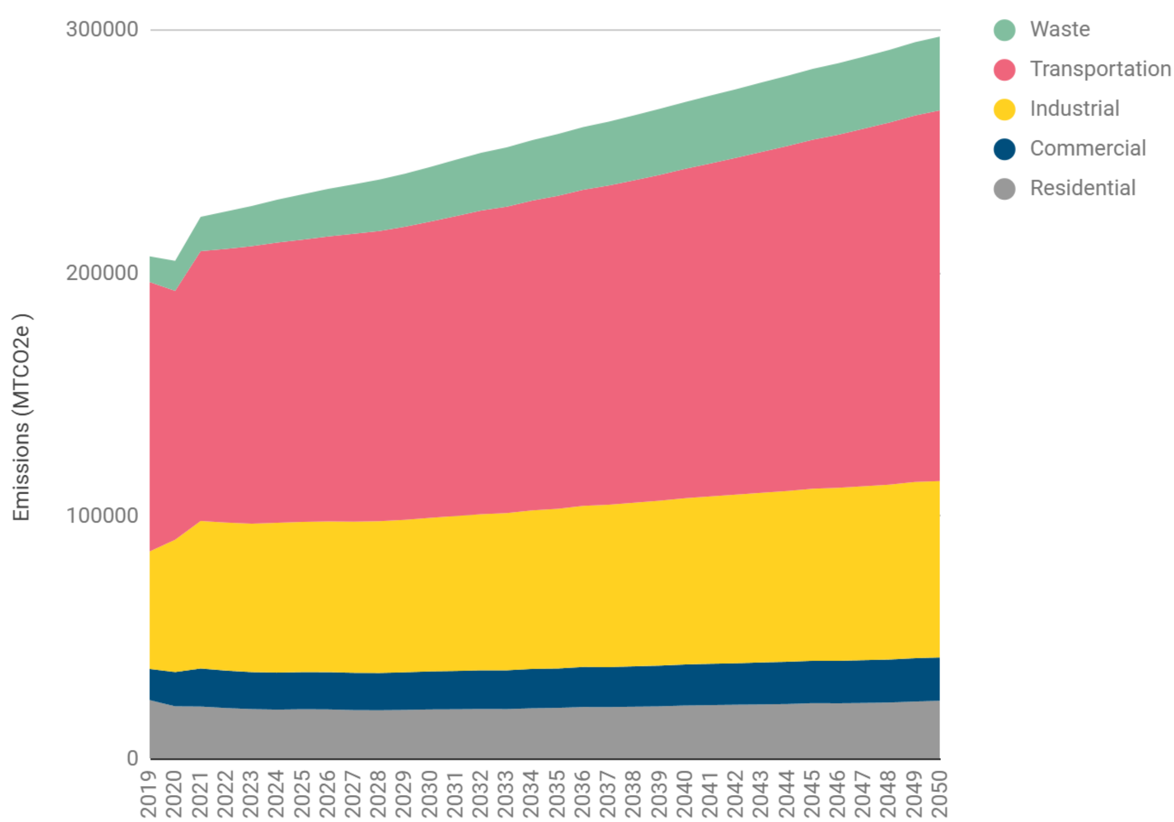


Figure B.47. Business-as-Planned (BAP) Emissions Projections for Reedley, 2019 – 2050

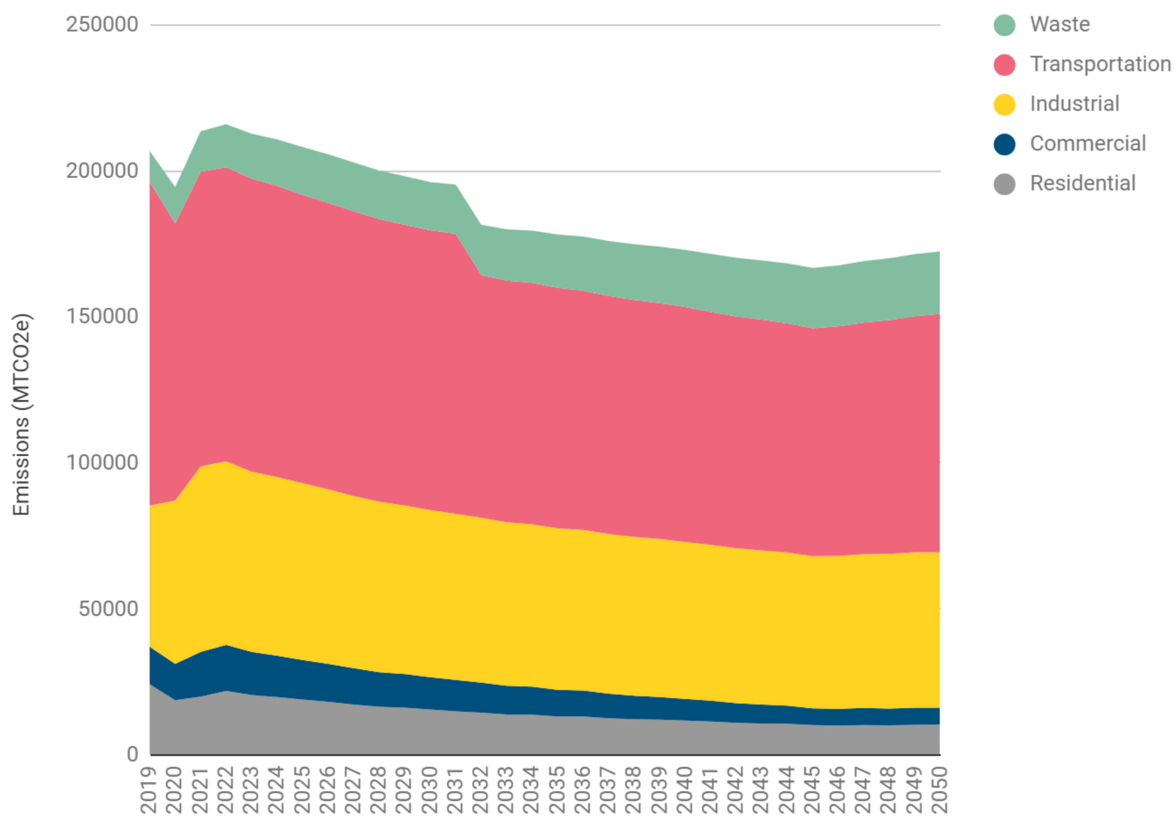


Figure B.48. Low Carbon Scenario (LCS) Emissions Projections for Reedley, 2019 – 2050

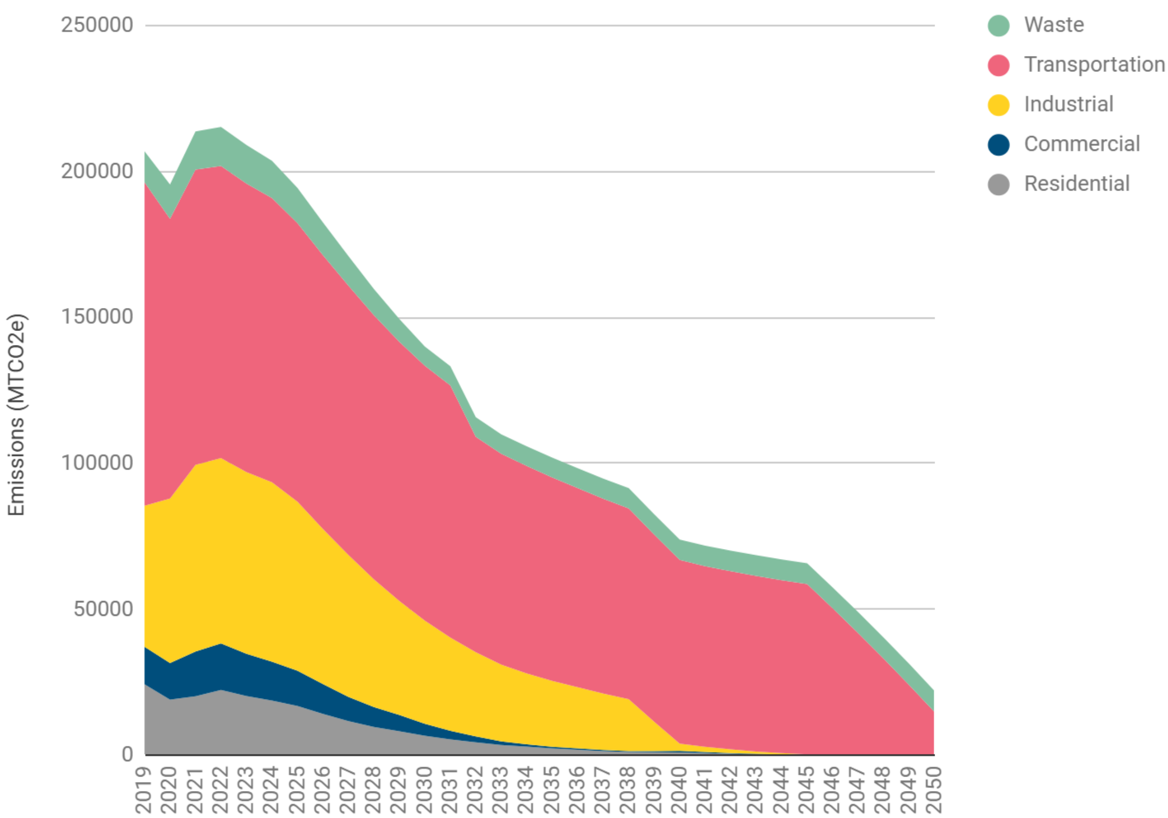


Table B.14. Emissions Projections for each Scenario in Reedley, MTCO2e

Reedley	**2019**	**2030**	**2045**
BAU	206,960	243,750	284,095
BAP	206,960	196,286	166,910
LC	206,960	140,047	65,746
BAU	**2019**	**2030**	**2045**
Residential	24,278	20,453	23,053
Commercial	12,843	15,644	17,440
Industrial	48,331	63,265	70,796
Transportation	110,907	121,843	143,654
Waste	10,601	22,544	29,152
BAP	**2019**	**2030**	**2045**
Residential	24,278	15,562	10,225
Commercial	12,843	11,108	5,796
Industrial	48,331	57,286	52,096
Transportation	110,907	95,867	78,116
Waste	10,601	16,463	20,676
LC	**2019**	**2030**	**2045**
Residential	24,278	6,618	57
Commercial	12,843	4,135	16
Industrial	48,331	35,311	154
Transportation	110,907	87,388	58,377
Waste	10,601	6,595	7,142

SAN JOAQUIN

Figure B.49. Emissions Inventory by Sector for San Joaquin, 2019

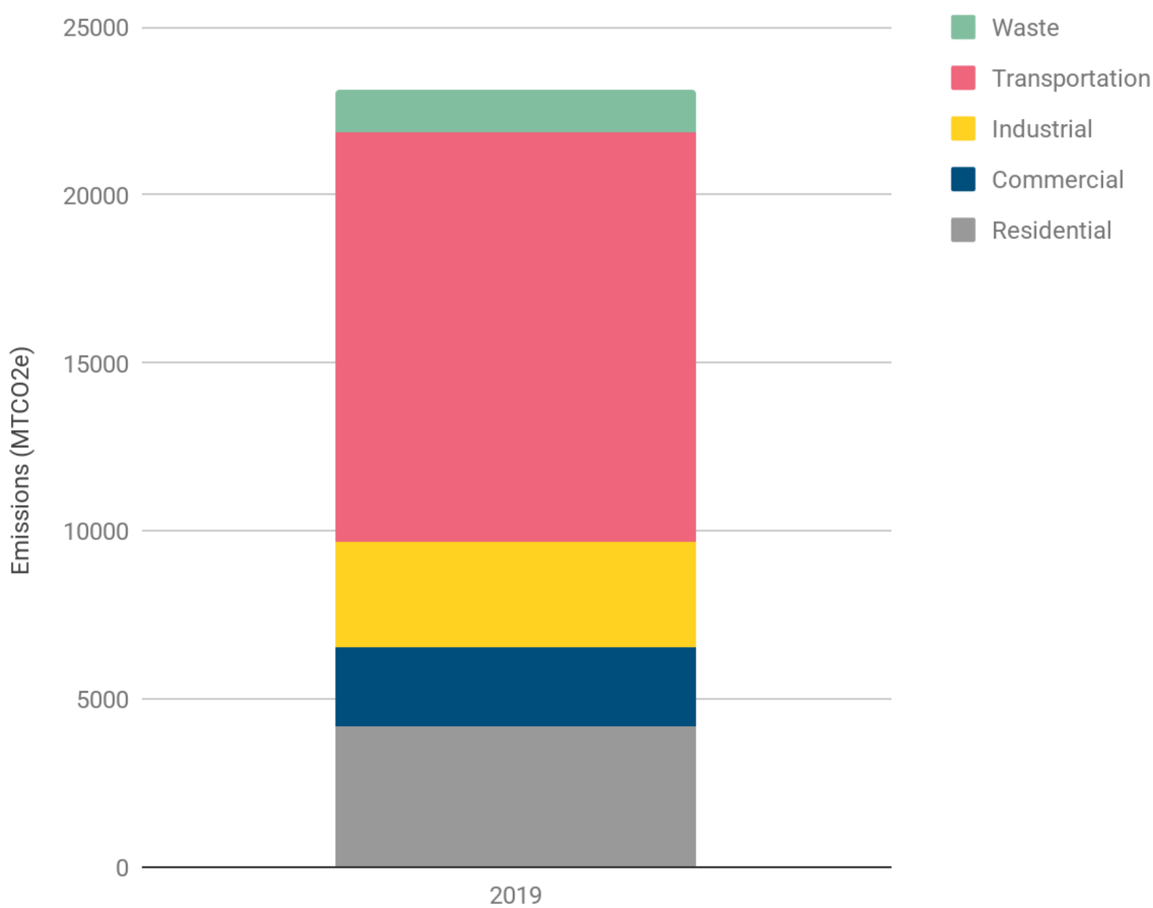


Figure B.50. Business as Usual (BAU) Emissions Projections for San Joaquin, 2019 – 2050

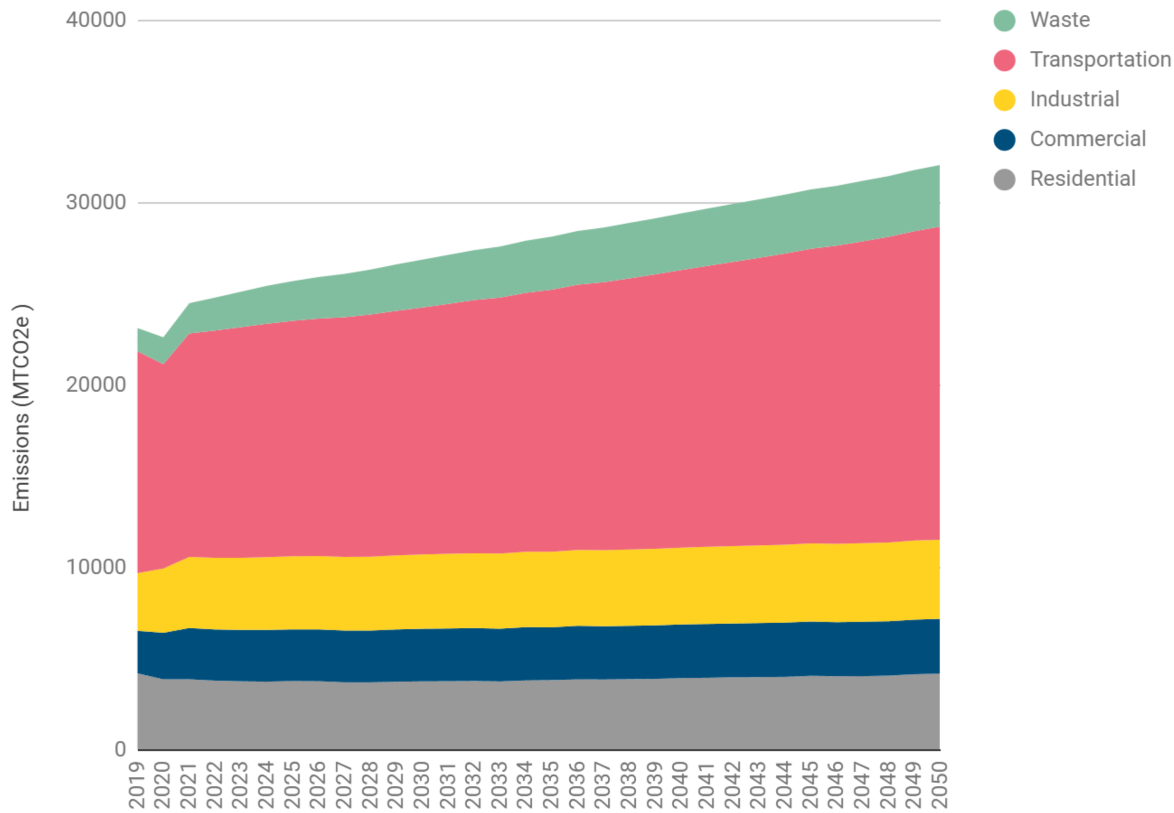


Figure B.51. Business-as-Planned (BAP) Emissions Projections for San Joaquin, 2019 – 2050

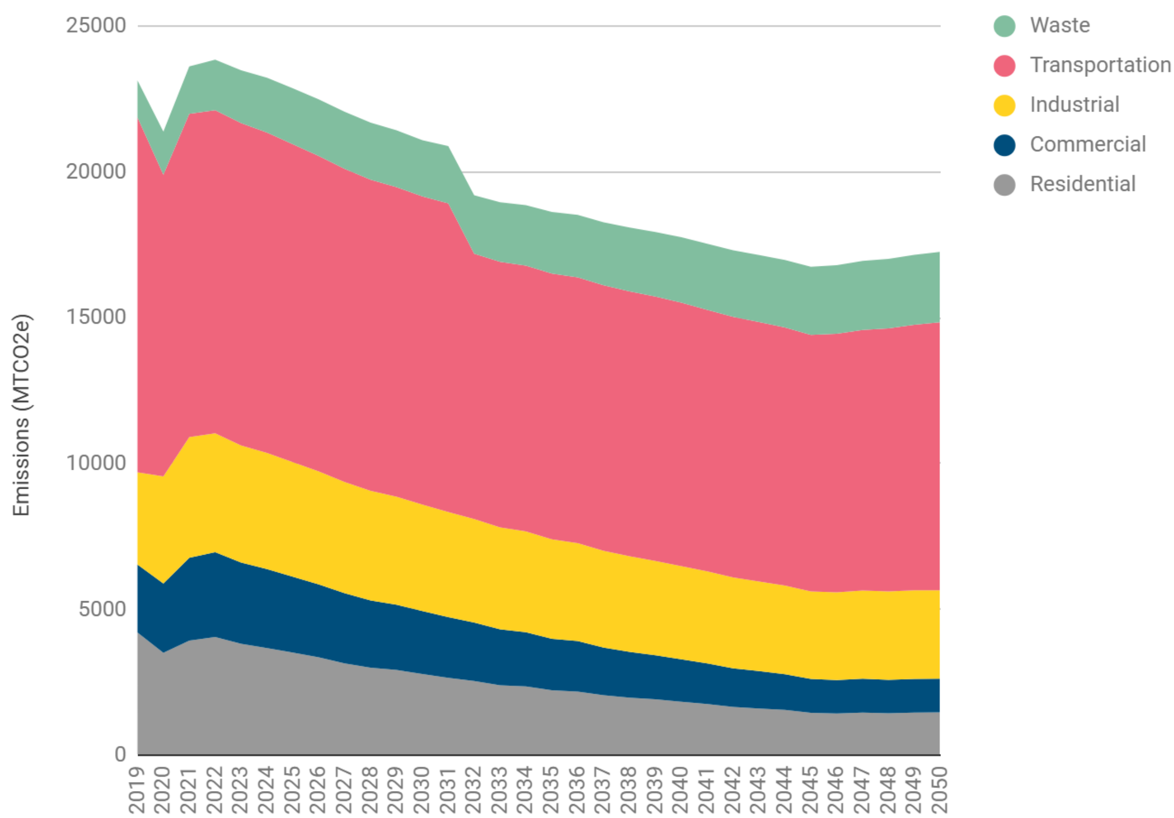


Figure B.52. Low Carbon Scenario (LCS) Emissions Projections for San Joaquin, 2019 – 2050

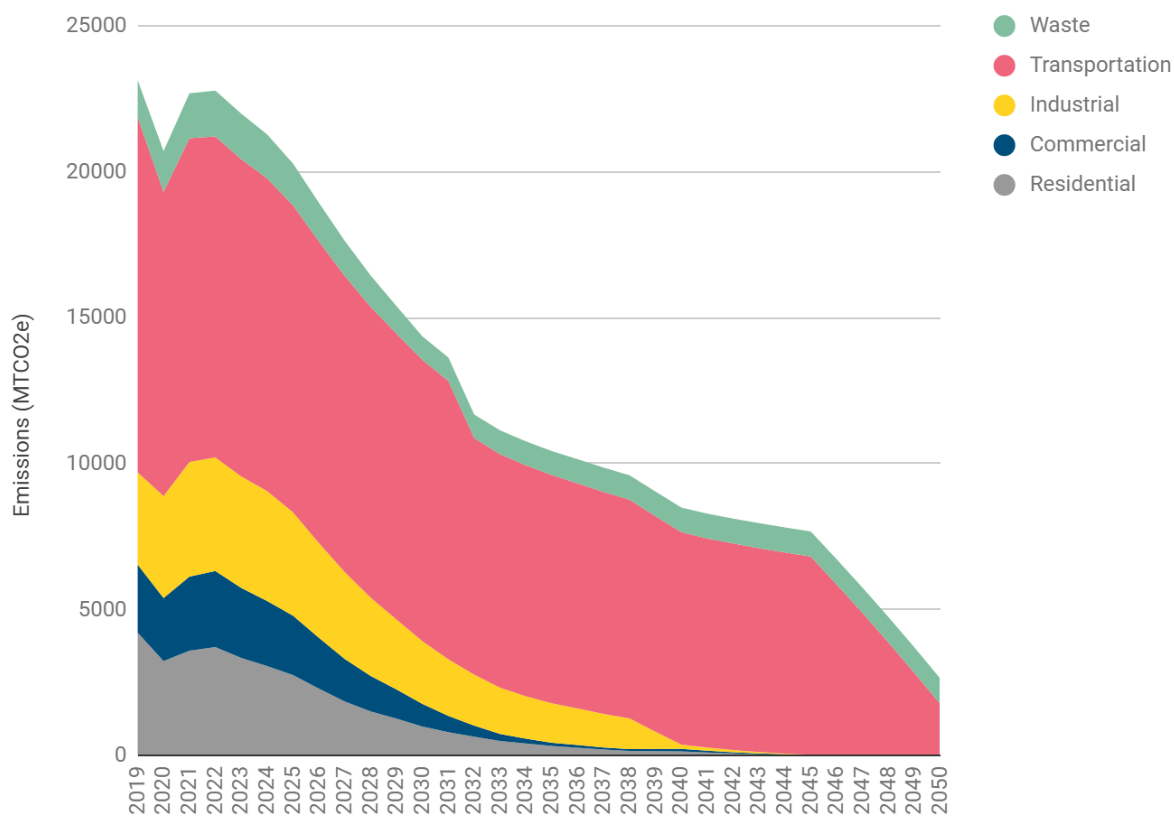


Table B.15. Emissions Projections for each Scenario in San Joaquin, MTCO2e

San Joaquin	**2019**	**2030**	**2045**
BAU	23,144	26,893	30,754
BAP	23,144	21,088	16,746
LC	23,144	14,358	7,677
BAU	**2019**	**2030**	**2045**
Residential	4,208	3,771	4,072
Commercial	2,331	2,881	2,976
Industrial	3,161	4,079	4,282
Transportation	12,174	13,545	16,164
Waste	1,270	2,617	3,259
BAP	**2019**	**2030**	**2045**
Residential	4,208	2,780	1,451
Commercial	2,331	2,158	1,158
Industrial	3,161	3,656	3,003
Transportation	12,174	10,570	8,797
Waste	1,270	1,925	2,337
LC	**2019**	**2030**	**2045**
Residential	4,208	991	7
Commercial	2,331	771	4
Industrial	3,161	2,153	9
Transportation	12,174	9,642	6,793
Waste	1,270	801	864

Sanger

Figure B.53. Emissions Inventory by Sector for Sanger, 2019

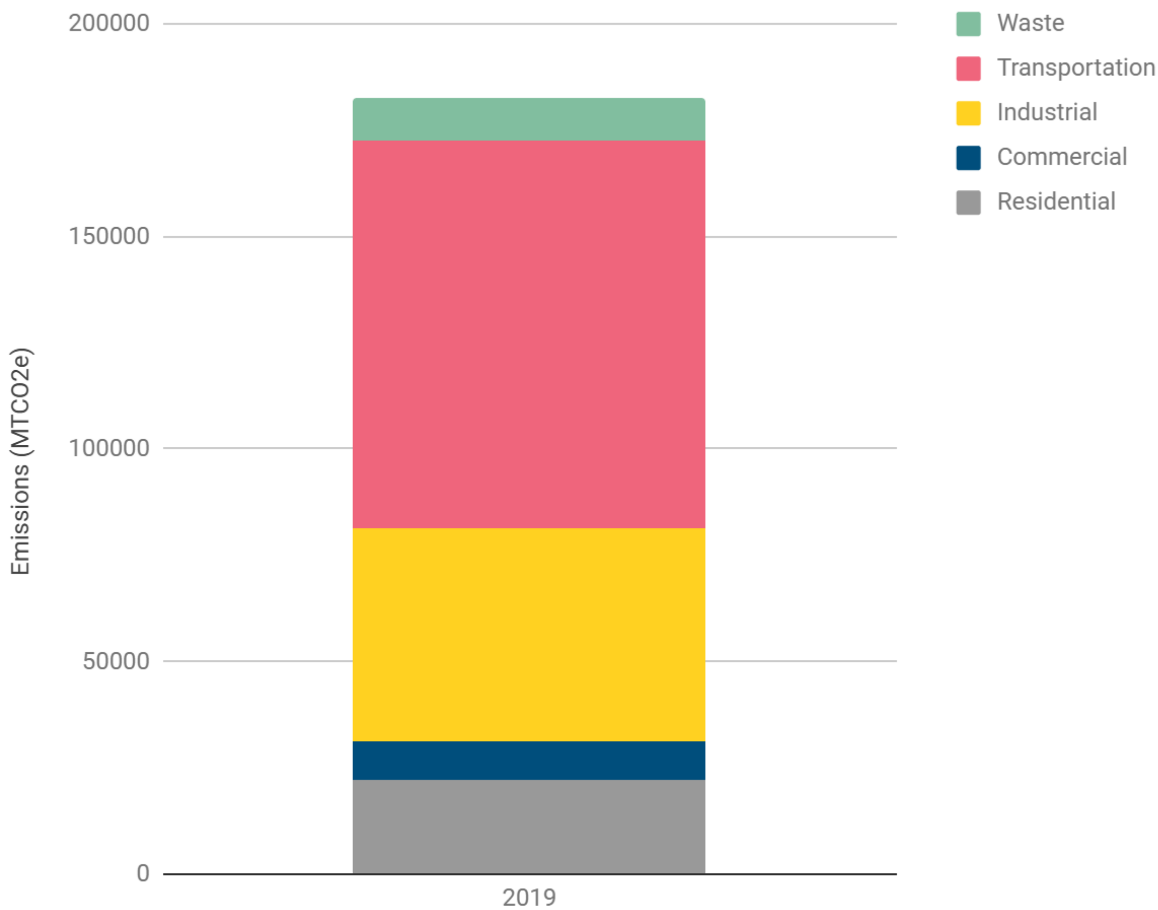


Figure B.54. Business as Usual (BAU) Emissions Projections for Sanger, 2019 – 2050

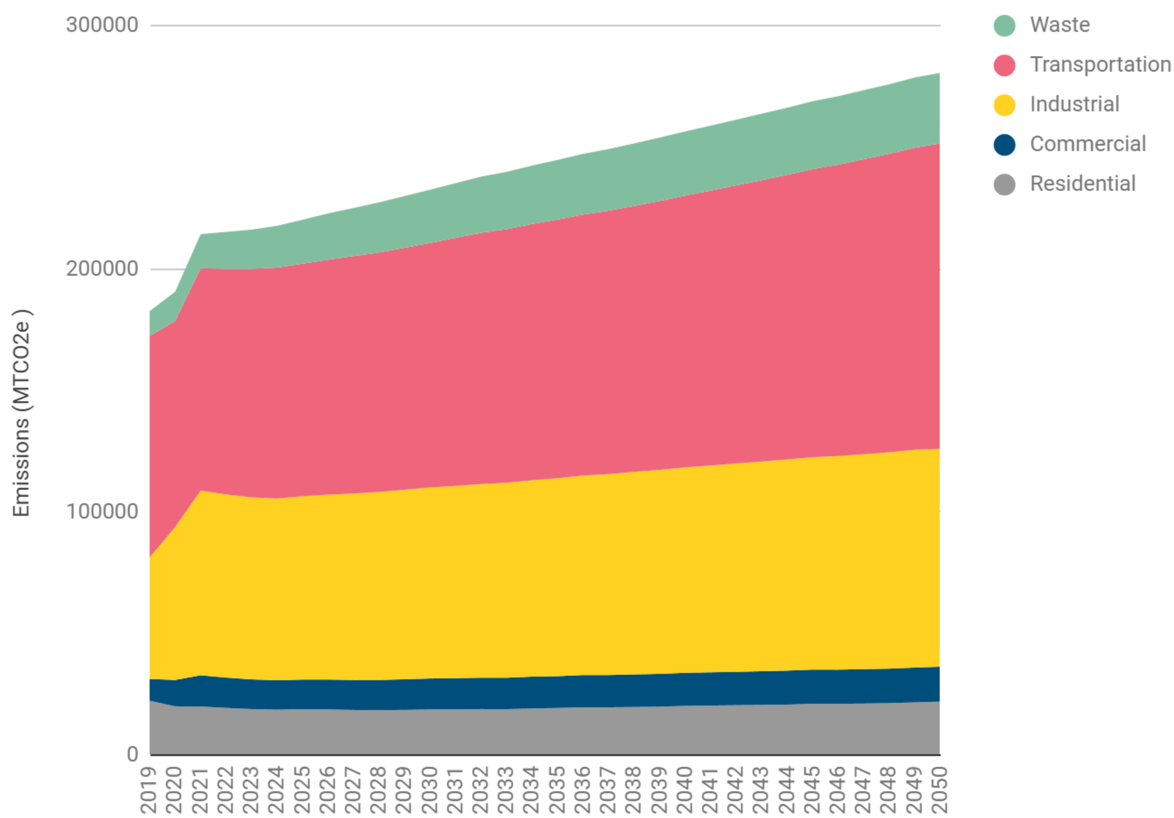


Figure B.55. Business-as-Planned (BAP) Emissions Projections for Sanger, 2019 – 2050

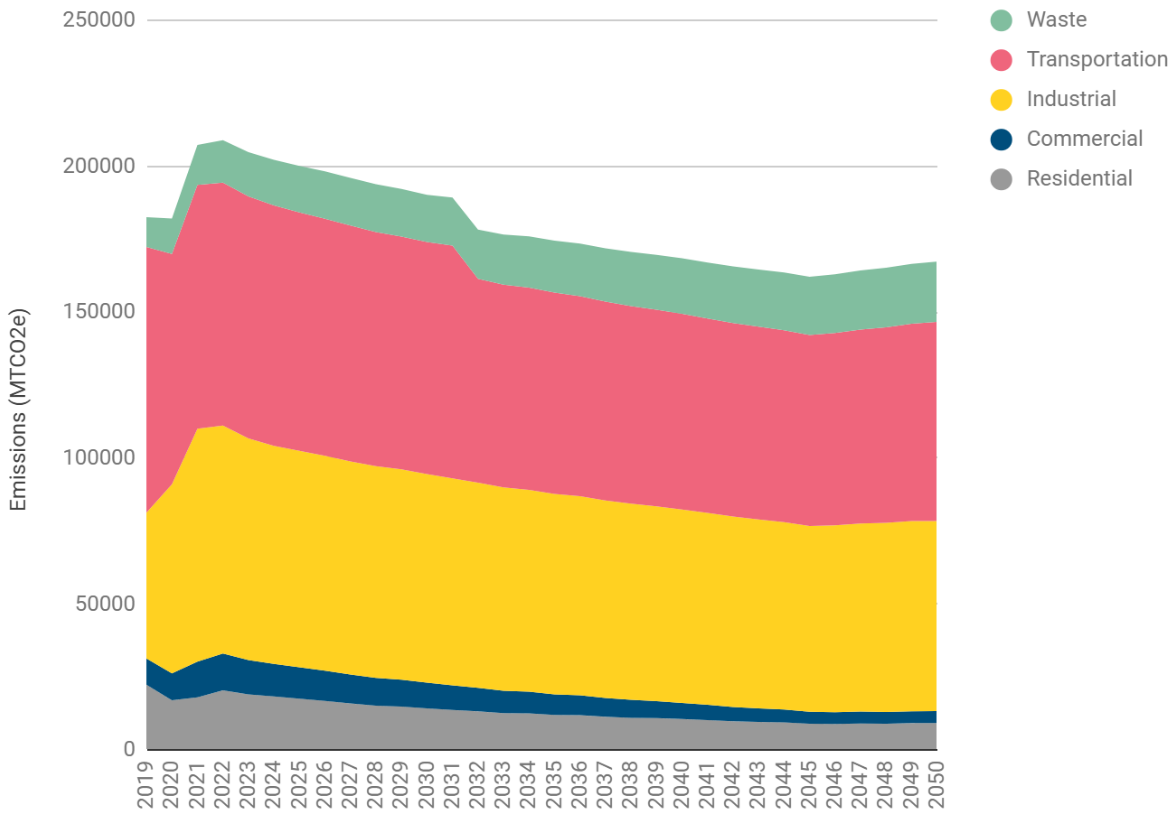


Figure B.56. Low Carbon Scenario (LCS) Emissions Projections for Sanger, 2019 – 2050

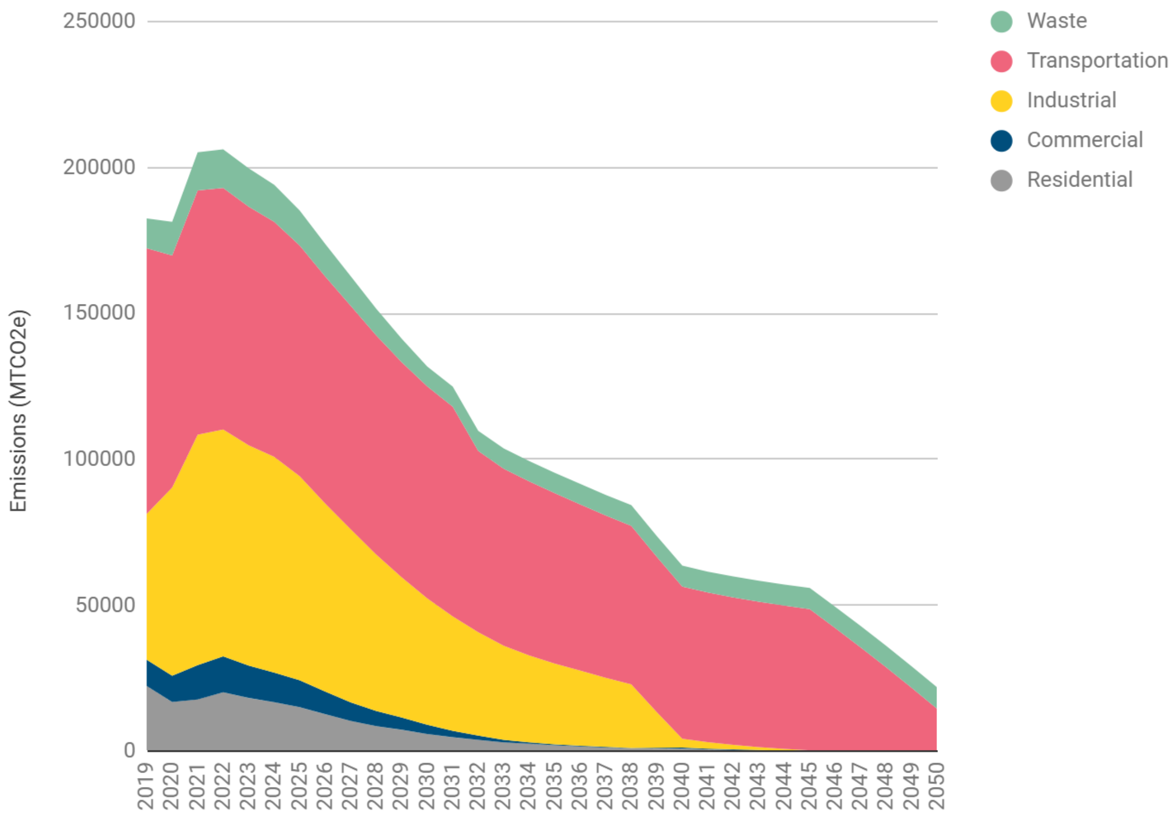


Table B.16. Emissions Projections for each Scenario in Sanger, MTCO2e

Sanger	**2019**	**2030**	**2045**
BAU	182,564	232,604	268,928
BAP	182,564	190,261	162,137
LC	182,564	131,848	55,901
BAU	**2019**	**2030**	**2045**
Residential	22,364	18,783	21,122
Commercial	8,958	12,703	14,026
Industrial	49,946	78,567	87,392
Transportation	91,097	100,643	118,477
Waste	10,199	21,907	27,910
BAP	**2019**	**2030**	**2045**
Residential	22,364	14,224	8,981
Commercial	8,958	8,808	4,045
Industrial	49,946	71,499	63,723
Transportation	91,097	79,569	65,425
Waste	10,199	16,161	19,963
LC	**2019**	**2030**	**2045**
Residential	22,364	5,857	51
Commercial	8,958	3,145	9
Industrial	49,946	43,381	189
Transportation	91,097	72,630	48,378
Waste	10,199	6,835	7,273

SELMA

Figure B.57. Emissions Inventory by Sector for Selma, 2019

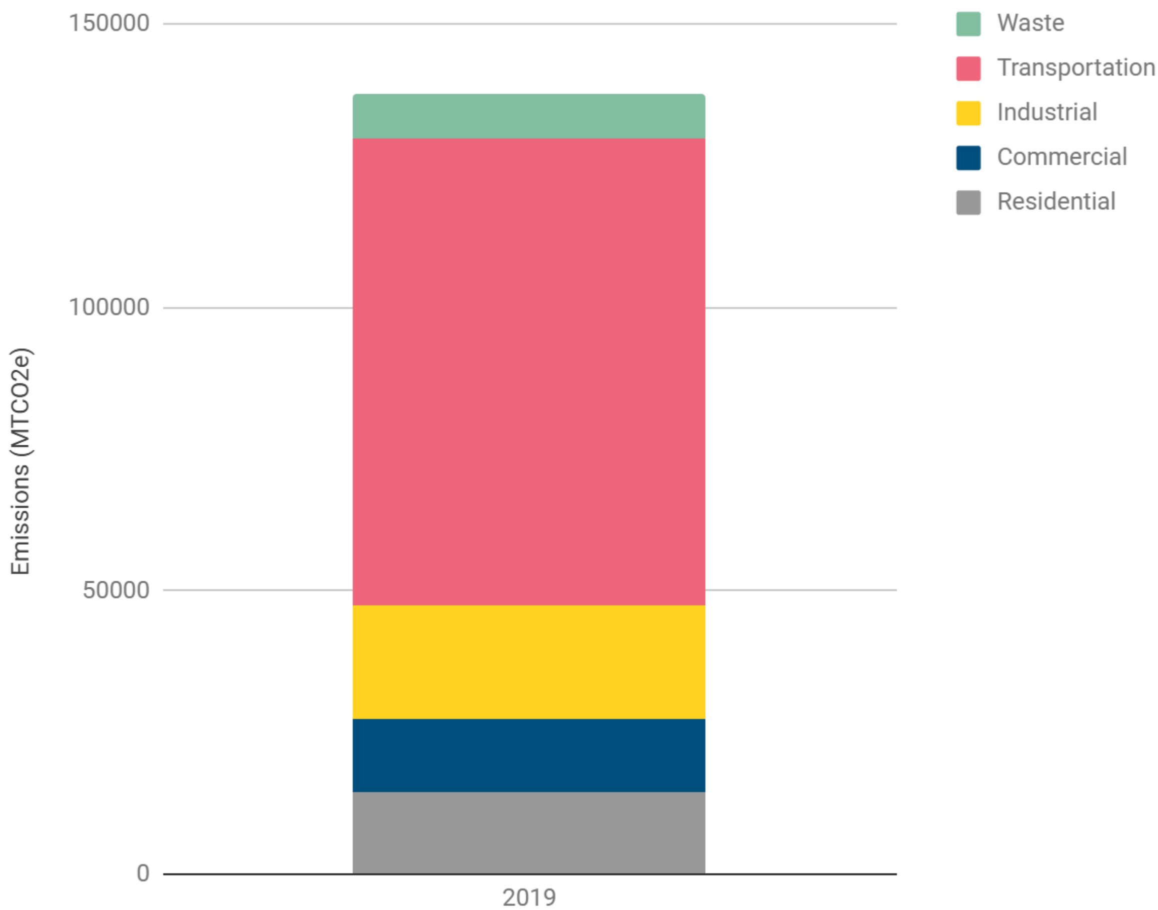


Figure B.58. Business as Usual (BAU) Emissions Projections for Selma, 2019 – 2050

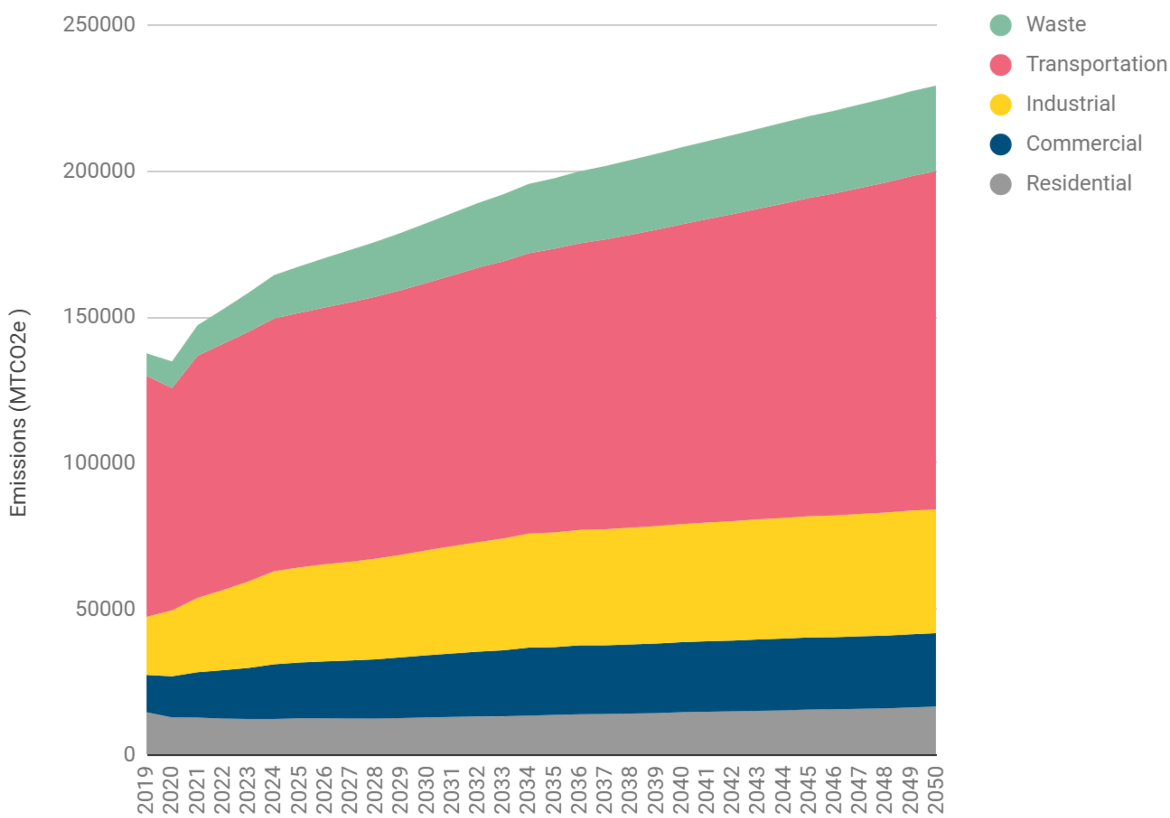


Figure B.59. Business-as-Planned (BAP) Emissions Projections for Selma, 2019 – 2050

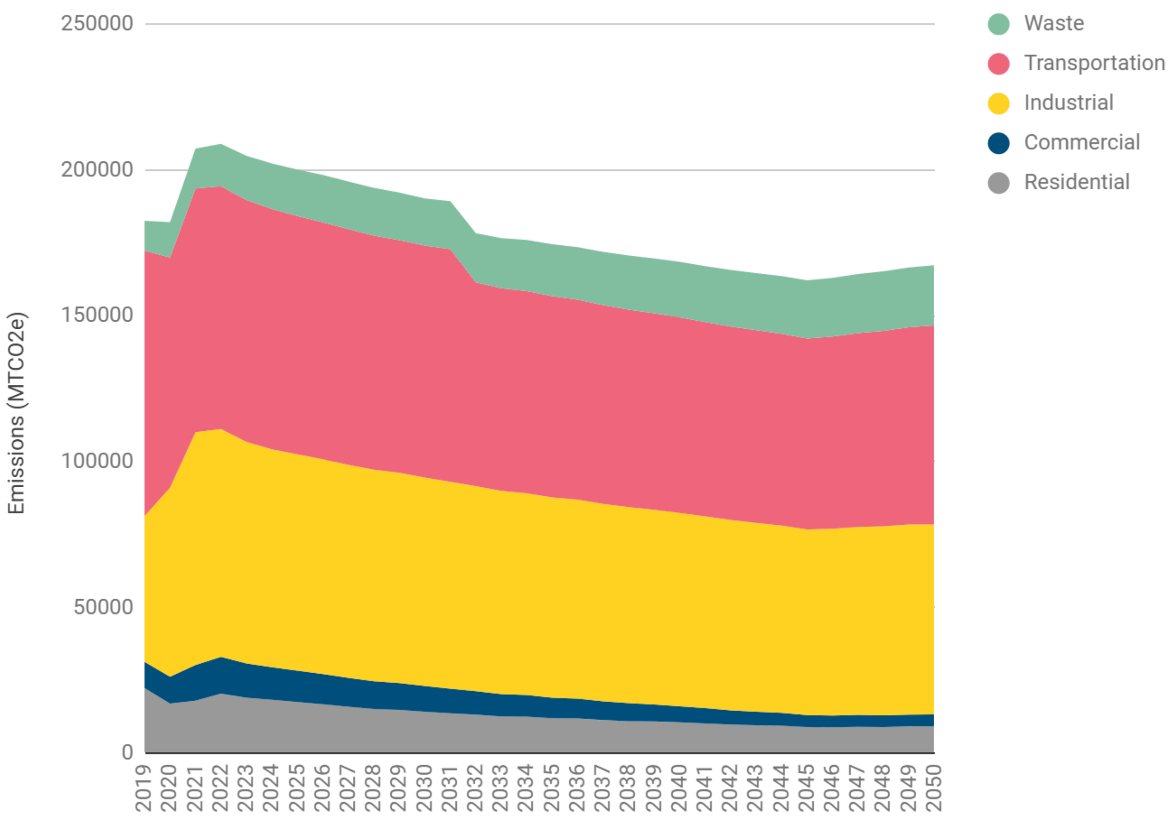


Figure B.60. Low Carbon Scenario (LCS) Emissions Projections for Selma, 2019 – 2050

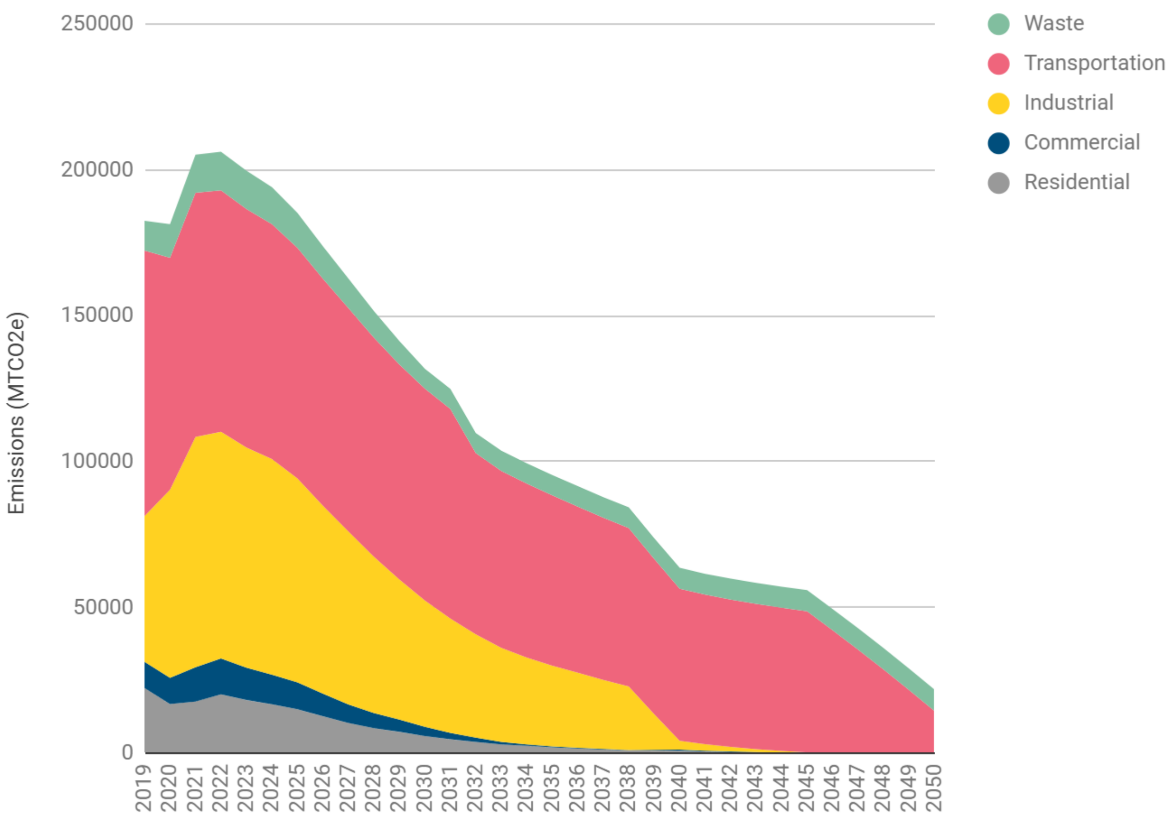


Table B.17. Emissions Projections for each Scenario in Selma, MTCO2e

Selma	**2019**	**2030**	**2045**
BAU	137,613	182,288	218,900
BAP	137,613	139,407	123,050
LC	137,613	99,474	50,164
BAU	**2019**	**2030**	**2045**
Residential	14,648	12,902	15,630
Commercial	12,758	21,272	24,656
Industrial	19,924	35,947	41,583
Transportation	82,573	91,619	109,003
Waste	7,709	20,548	28,028
BAP	**2019**	**2030**	**2045**
Residential	14,648	8,857	6,600
Commercial	12,758	12,835	7,593
Industrial	19,924	31,360	30,472
Transportation	82,573	71,788	58,995
Waste	7,709	14,567	19,389
LC	**2019**	**2030**	**2045**
Residential	14,648	3,986	31
Commercial	12,758	5,241	9
Industrial	19,924	20,025	90
Transportation	82,573	65,362	44,439
Waste	7,709	4,861	5,595

APPENDIX C

DATA, METHODS, AND ASSUMPTIONS MANUAL

Fresno COG

Comprehensive Climate Action Plan

Data, Methods, and Assumptions Manual

Prepared by
Sustainability Solutions Group

Prepared for
Fresno Council of Governments

UPDATED: September 2025

Sustainability Solutions Group

Contents

Glossary

Base Year: the starting year for energy or emissions projections.

Business-As-Usual (BAU): a scenario illustrating energy use and GHG emissions if no additional plans, policies, programs, or projects are implemented.

Business-As-Planned (BAP): a scenario illustrating energy use and GHG emissions if additional plans, policies, programs, and projects which have already been passed or are currently underway continue to be implemented.

Carbon sequestration: The process of storing carbon in a carbon pool.

Commercial Buildings Energy Consumption Survey (CBECS): Developed by the EIA, the CBECS provides information on the estimated 5.9 million commercial buildings in the U.S., including the number of workers, ownership and occupancy, structural characteristics, energy sources and uses, and other energy-related features..

Combined heat and power (CHP): the simultaneous production of two or more useful forms of energy, typically electricity and heat, by a single device (also known as co-generation).

Energy Demand and Simulator for the U.S. (EDSSUS): A model and data dictionary developed by SSG and whatIf? Technologies that can be used to simulate energy demand for states, regions, and municipalities within the United States.

Energy Information Administration (EIA): An agency of the U.S. Federal Government that collects, analyzes, and disseminates information on energy and its interaction with the economy and the environment, including production, stocks, demand, imports, exports, and prices.

Environmental Protection Agency (EPA): An agency of the U.S. Federal Government that studies environmental issues, develops and enforces regulations to protect the environment, and provides grants to various entities to promote environmental conservation and human health.

Greenhouse gases (GHG): gases that trap heat in the atmosphere by absorbing and emitting solar radiation, causing a greenhouse effect. The main GHGs are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Geographic information system (GIS): a type of a computer program or system that analyzes and displays geographically referenced data.

Heating Degree Day (HDD): a measurement designed to quantify the demand for energy needed to heat a building, consisting of the number of degrees that a given day's average temperature is below 18°C, thus requiring heating.

National Renewable Energy Laboratory (NREL): The National Renewable Energy Laboratory is a federally funded research and development center sponsored by the Department of Energy and operated by the Alliance for Sustainable Energy, specializing in the research and development of renewable energy, energy efficiency, energy systems integration, and sustainable transportation.

Residential Energy Consumption Survey (RECS): Developed by the EIA, the RECS provides an estimate of residential energy costs and usage for heating, cooling, appliances, and other end uses, developed using a nationally representative sample of housing units and their energy characteristics combined with data from energy suppliers..

Intergovernmental Panel on Climate Change (IPCC): a United Nations body that assesses the science related to climate change via regular reports and analyses about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions.

Vehicle Miles Traveled (VMT): distance traveled by vehicles within a defined region over a specified time period.

Purpose of this Document

This Data, Methods, and Assumptions (DMA) manual presents the modeling approach used to provide energy and emission benchmarks and projections, as well as a summary of the data and assumptions used in scenario modeling. The DMA makes the modeling elements fully transparent and illustrates the scope of data required for future modeling efforts using the same methodology.

Accounting and Reporting Principles

SSG's greenhouse gas (GHG) inventory development and scenario modeling approach correlate with Intergovernmental Panel on Climate Change (IPCC)-derived accounting methods for developing fair and true accounts of national, state, and county-level emissions. The GHG inventory includes calculations of emissions for the following sectors: transportation, energy, residential, commercial, industry, agriculture, and natural and working lands.

The GHG emission and removal estimates contained in Fresno County GHG inventory are developed using methodologies consistent with guidelines for National Greenhouse Gas Inventories developed by IPCC in the Fifth Assessment Report, which incorporates carbon feedback into its Global Warming Potential (GWP) values.

SSG has developed the following principles for GHG accounting and reporting, based on decades of research and experience working with municipal, state, and national governments:

Relevance: The reported GHG emissions appropriately reflect emissions occurring as a result of activities and consumption within the jurisdiction. The inventory is meant to serve the decision-making needs of the Government Agencies, Commissions, and Offices, taking into consideration relevant local, state, and national regulations. Relevance applies when selecting data sources and determining and prioritizing data collection improvements.

Completeness: All emission sources within the inventory boundary are accounted for, and any exclusions of sources are justified and explained.

Consistency: Emissions calculations are consistent in their approach, boundaries, and methodology.

Transparency: Activity data, emissions sources, emissions factors, and accounting methodologies require adequate documentation and disclosure to enable verification.

Accuracy: The calculation of GHG emissions should not systematically overstate or understate actual GHG emissions, and should be accurate enough to give decision makers and the public reasonable assurance regarding the integrity of the reported information. Uncertainties in the quantification process should be reduced to the extent possible and practical.

Scope

Scope of this Manual

The DMA Manual contains methods and assumptions for model calibration as well as the business-as-usual, and business-as-planned. Eventually this manual will include methods and assumptions for any possible low carbon future scenarios.

Project Scope

The Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant (CPRG) program funds the development of city, regional, and state plans to curtail GHG emissions through the Inflation Reduction Act (IRA). Fresno Council of Governments (Fresno COG) is a recipient of CPRG funding and is currently developing a county-level Comprehensive Climate Action Plan (CCAP) to be completed by December 2025. The CCAP will identify actions for Fresno County to reduce GHG emissions and achieve other community related objectives. Community engagement will help shape emission reduction pathways proposed in the CCAP to reflect local priorities and challenges. Through both technical analysis and community-driven insight, the CCAP will assess GHG emissions reductions opportunities and define a pathway for Fresno County to reach net-zero.

Geographic Boundary

The geographic scope of this project is Fresno County, and includes 15 municipalities: Clovis, Coalinga, Firebaugh, Fowler, Fresno, Huron, Kerman, Kingsburg, Mendota, Orange Cove, Parlier, Reedley, San Joaquin, Sanger, and Selma. Figure 1 shows the geographic boundary, the 69 zones and 15 municipalities.

SSG completed energy and emissions inventories for Fresno County as a whole and for each municipality. Annual energy demand is analyzed at the county level and for each municipality, providing a comprehensive understanding of energy use and emissions across the region.

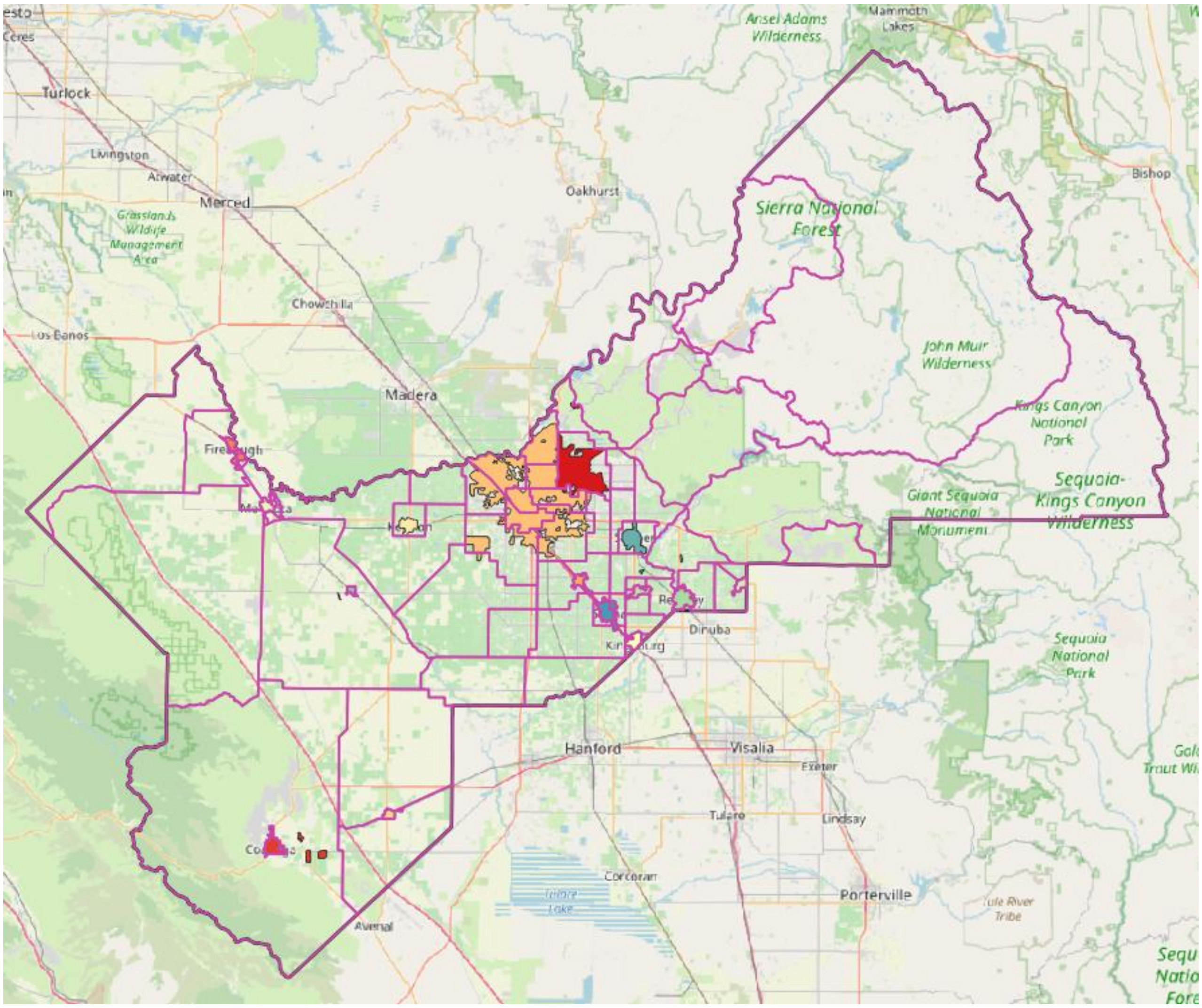


Figure 1. Geographic scope and sub-scopes (municipalities are in color) of this study.

Time Frame of Assessment

The modeling time frame includes years 2019-2050. The year 2019 was selected as the base year by the client since it is the most recent year with current and complete data available for calibration and modeling. Model calibration for the base year uses as much locally observed data as possible, supplemented by data collected at the state and federal levels. The modeling for this project simulates energy demand in annual time steps aligned with near- and long-term goals set by California and the federal government.

Energy and Emissions Structure

Energy

The total energy consumption for the County is defined as the sum of the following aspects:

$Energy_{County} = Energy_{transport} + Energy_{buildings} + Energy_{localEnergyProduction}$

Where:

$Energy_{transport}$ is the movement of goods and people on foot, in vehicles, and using trucks, planes, and trains, etc.

$Energy_{buildings}$ is the use of energy to provide services such as heating and cooling, and other stationary energy use in buildings such as appliances and plugs.

$Energy_{LocalEnergyProduction}$ is energy used within the County of Fresno to generate other energy currencies such as steam, electricity, etc.

GHG Emissions

GHG emissions from anthropogenic activities within the county are defined as the sum of all in-scope emissions sources:

$GHG_{County} = GHG_{transport} + GHG_{buildings} + GHG_{energyGen} + GHG_{fugitive} + GHG_{AFOLU} + GHG_{process}$

Where:

$GHG_{transport}$ are emissions generated by the movement of goods and people (e.g. cars, buses, trucks), rail, marine, aviation, and non-road vehicles (e.g. construction vehicles, tractors, ATVs, logging trucks).

$GHG_{buildings}$ are emissions generated by energy use (lighting, appliances, heating, cooling, etc.) in buildings (both residential and commercial), including industrial facilities such as refineries.

$GHG_{energyGen}$ are emissions generated by the in-county generation of heat and electricity, the transmission of natural gas through pipelines within the county, and in-county alternative fuel production.

$GHG_{fugitive}$ are emissions caused by leaks from distribution pipelines, regulating equipment, and transfer stations in the county's pipeline network.

GHG_{AFOLU} are emissions from Agriculture, Forestry, and Other Land Use activities.

$GHG_{process}$ are emissions generated from industrial processes that emit GHGs (such as cement manufacturing or iron and steel production) or the decomposition of materials in landfills.

Refer to Appendix 1 for a detailed list of included GHG emissions sources by scope.

Models

The modeling for this project integrates the following component models which are used to analyze different temporal scales and sectors:

- Energy Systems Simulator (Annual Energy and Electricity Demand)

Each component model is described in the following sections.

Energy Systems Simulator

The Energy Systems Simulator (ESS) is an energy, emissions, and finance accounting tool developed by Sustainability Solutions Group. The model integrates fuels, sectors, and land-use in order to enable bottom-up accounting for energy supply and demand, including:

- renewable resources (e.g. hydro, solar, wind, geothermal, renewable natural gas, biofuels),
- fossil fuels (e.g. gasoline, diesel, fossil natural gas, coal),
- energy-consuming technology stocks (e.g. vehicles, appliances, dwellings, buildings), and;
- all intermediate energy flows (e.g. electricity and heat).

Energy and GHG emissions values are derived from a series of connected stock and flow models, evolving based on current and future geographic and technology decisions/assumptions (e.g. electric vehicle uptake rates). The model accounts for physical flows (e.g. energy use, new vehicles by technology, vehicle miles traveled) as determined by stocks (buildings, vehicles, heating equipment, etc.).

The model incorporates and adapts concepts from the system dynamics approach to complex systems analysis. For any given year, the model traces the flows and transformations of energy from sources through energy currencies (e.g. gasoline, electricity, hydrogen) and end uses (e.g. personal vehicle use, space heating) to energy costs and GHG emissions. An energy balance is achieved by accounting for efficiencies, technology conversion, and trading losses at each stage of the journey from source to end use.

Table. 1 Model characteristics.

Characteristic	Rationale
Integrated	The tool models and accounts for all energy and emissions in relevant sectors and captures relationships between sectors. The demand for energy services is modeled independently of the fuels and technologies that provide the energy services. This decoupling enables exploration of fuel-switching scenarios. Viable scenarios are established when energy demand and supply are balanced.
Scenario-based	Once calibrated with historical data, the model enables the creation of dozens of scenarios to explore different possible futures. Each scenario can consist of either one or a combination of policies, actions, and strategies. Historical calibration ensures that scenario projections are rooted in observed data.
Spatial	The model includes spatial dimensions that can include as many zones (the smallest areas of geographic analysis) as deemed appropriate; in this case, they are census tracts and grouped census tracts. The spatial components can be integrated with Geographic Information Systems (GIS) and land-use projections.
Sector-based	The model is designed to report emissions according to categories based on sectors (residential, industry, etc.).
Economic impacts	The model incorporates a high-level financial analysis of costs related to energy (expenditures on energy) and emissions (carbon pricing, social cost of carbon), as well as operating and capital costs for policies, strategies, and actions. This allows for the generation of marginal abatement costs. Assumptions for Economic Impacts will be included after the Low Carbon Future Scenario is developed.

ESS Model Structure

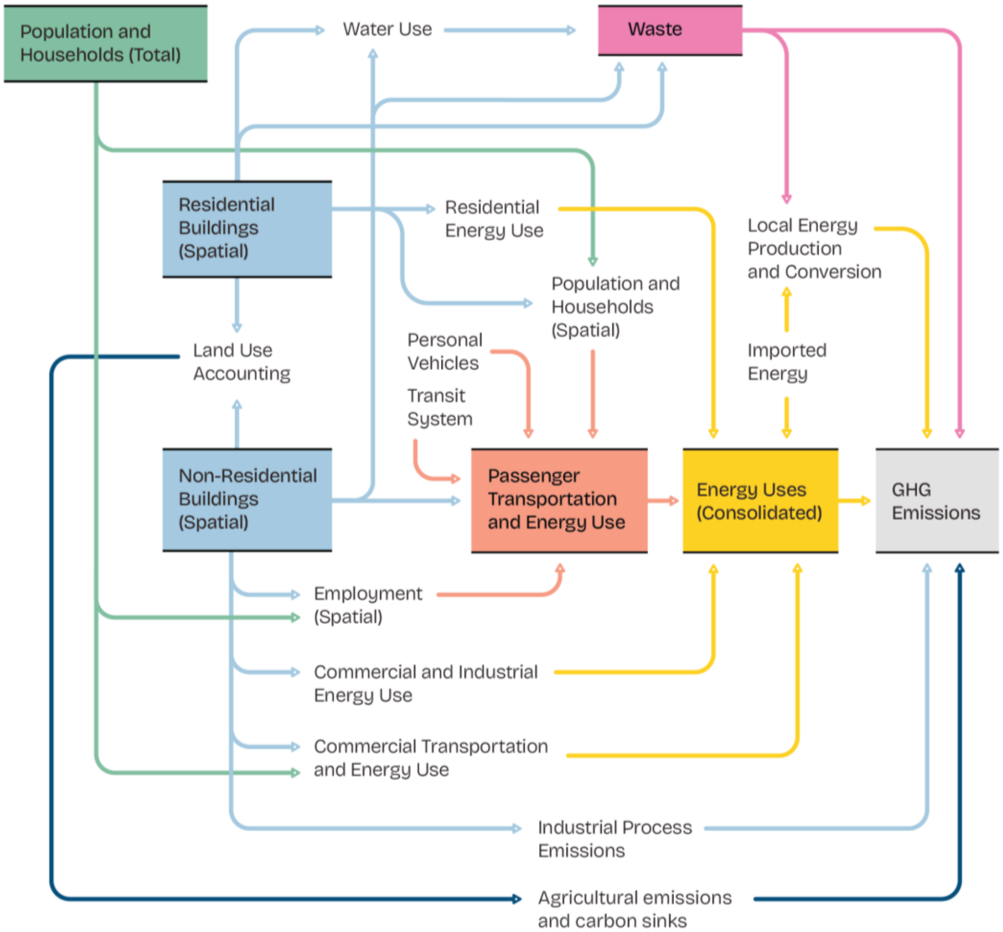
The major components of the ESS model and the first level of their modeled relationships (or influences) are represented by the arrows in Figure 2. Additional relationships may be modeled by modifying inputs and assumptions—specified either directly by users, or in an automated fashion by code or scripts running “on top of” the base model structure. Integrated modeling generates a total picture of the overall impact of inputs and assumptions, including the emissions or sequestration intensity of other inputs within the model.

The model is also spatially explicit. All buildings, transportation, and land-use data are tracked within the model through a GIS platform, and by varying degrees of spatial resolution. Fresno County was divided into 69 zones. Census tracts were grouped for consistent data and each municipality has at least one zone. Larger municipalities have more zones to reflect their main neighborhoods. LIDAC and non-LIDAC areas, defined at the census tract level, are kept separate to enable targeted analysis.

In any given year, various factors shape the picture of energy and emissions flows, including: the population and the energy services it requires; commercial floorspace; energy production and trade; technologies deployed to deliver energy services (service technologies) and to transform energy sources to currencies (harvesting technologies). The model is based on an explicit mathematical relationship between these factors—some contextual and some being part of the energy consuming or producing infrastructure—and the energy flow picture.

Some factors are modeled as stocks—counts of similar things, classified by various properties. For example, population is modeled as a stock of people classified by age and gender. Population change over time is projected by accounting for: the natural aging process, inflows (births, immigration), and outflows (deaths, emigration). The fleet of personal use vehicles—an example of a service technology—is modeled as a stock of vehicles classified by size, engine type and model year, with a similarly classified fuel consumption intensity. As with population, projecting change in the vehicle stock involves aging vehicles and accounting for major inflows (new vehicle sales) and outflows (vehicle discards). This stock-turnover approach is applied to other service technologies (e.g. furnaces, water heaters) and harvesting technologies (e.g. electricity generating capacity).

Figure 2. Representation of the ESS model structure.



Sub-Models and Local Context Calibration

The overall model operates based on the interactions within and between factors of various sub-models, as described in this section. To develop the business-as-usual, business-as-planned, and eventually the decarbonization scenarios, we calibrate the model with local data, building the model from the ground up.

Data Request and Collection

The data we used to calibrate the model was supplied by Fresno COG, and agencies such as California Air Resources Board (CARB), and California Energy Commission. The complete list of data and sources is provided in Appendix 4. To supplement any gaps in the observed data, we developed assumptions which are described below. We applied the data and assumptions using the modeling processes described below.

Zone System

The model is spatially explicit: population, employment, residential, and non-residential floorspace are allocated and tracked spatially across Fresno County's 69 predefined zones, which encompass its 15 municipalities and their principal neighborhoods in the main cities (see Figure 3). These elements drive stationary energy demand. The passenger transportation sub-model also operates within the same zone system.

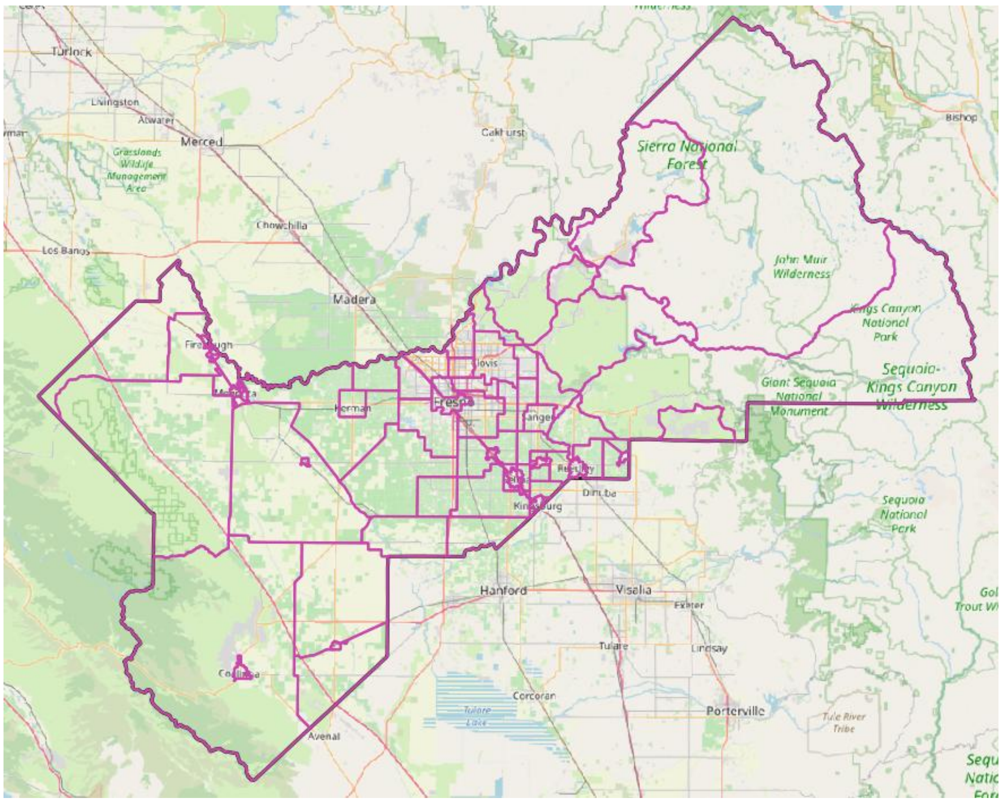


Figure 3. Zone system Fresno County used in ESS modeling.

Population and Employment

How the Sub-model Works

County-wide population is modeled using the standard population cohort-survival method, disaggregated by single year of age and gender. It accounts for typical components of change: births, deaths, immigration, and emigration. The age-structured population is important for analysis of demographic trends, generational differences and implications for shifting energy use patterns. These numbers are calibrated against base year data and existing projections from Fresno COG.

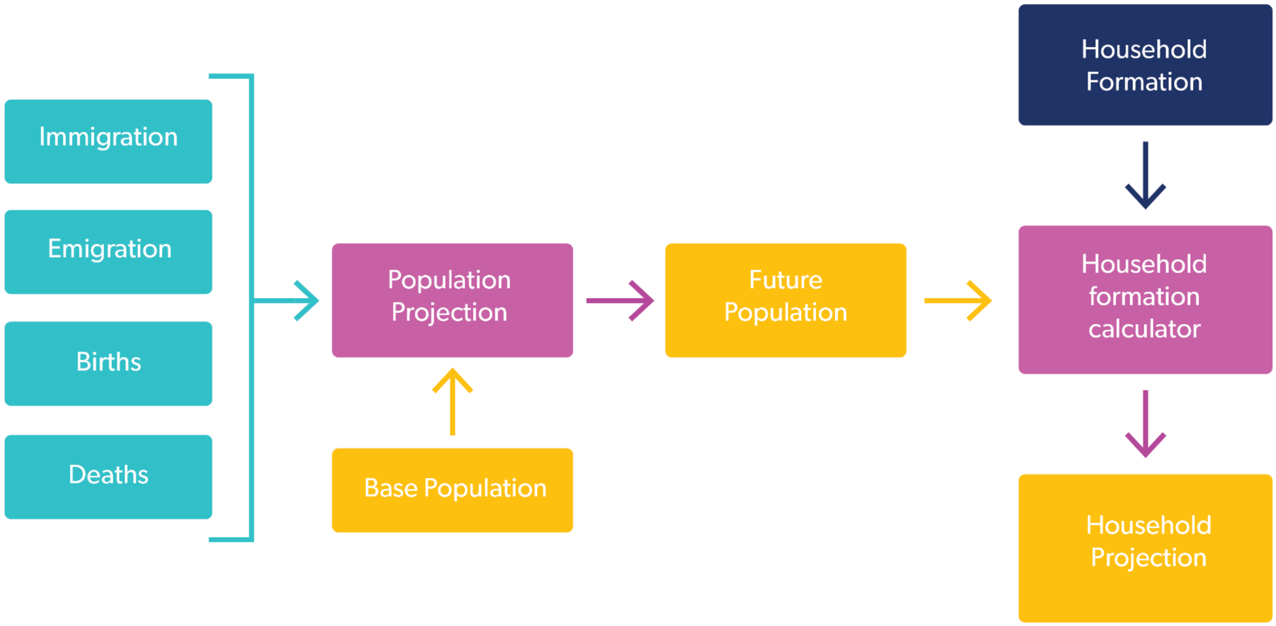


Figure 4. Population and employment submodel design flow. Light blue rectangles represent flows, fuchsia rectangles represent model calculations, yellow rectangles represent stocks, and dark blue rectangle represent model parameters

US Census population and Fresno COG employment data is spatially allocated to the residential (population) and non-residential (employment) buildings. This enables indicators to be derived from the model, such as emissions per household, and drives the business-as-usual (BAU) energy and emissions projections for buildings and transportation.

An additional layer of model logic (not shown explicitly in Figure 4) captures energy-related financial flows and employment impacts. Calculated financial flows include the capital, operating, and maintenance costs of energy-consuming and energy-producing stocks, as well as fuel costs. We also model employment related to the construction of new buildings, retrofit activities and energy infrastructure; assess the financial impact on businesses and households of implementing the strategies, and apply various local economic multipliers (depending on the geographic and economic variability of the calculation and anticipated output) to investments.

How We Calibrate the Sub-model

We distributed the 2019 population to residential buildings in space, using initial assumptions about persons-per-unit (PPU) by dwelling type, and adjusting them so that the total population in the model (which is driven by the number of residential units by type multiplied by PPU by type) matches the total population from census/regional data.

Employment in 2019 is spatially allocated to non-residential buildings, using intensities (e.g. square feet per retail employees). As with population, the model adjusts these initial ratios so that the derived total employment matches total employment data from Fresno County 2019-2050 Growth Projections.

Buildings

How the Sub-model Works

Residential buildings are spatially located and classified using a detailed set of 12 building archetypes (see Appendix 2) capturing footprint, height, and type (single-family, duplex, semi-attached, row-housing, apartment high-rise, apartment low-rise, etc.) and year of construction. The archetypes are used to generate a "box" model that helps to estimate the floor area and energy use, and then is used to simulate the impact of energy efficiency measures.

Using assumptions on thermal envelope performance and heating and cooling degree days, the model calculates space-conditioning energy demand independent of space heating or cooling technologies. First, the model multiplies the residential building floorspace area by an estimated thermal conductance (heat flow per unit of surface area per degree day) and the number of degree days (heating and cooling) to derive the energy transferred out of the building during winter months and into the building during summer months. The energy transferred through the building envelope, the solar gain through the building windows, and the heat gains from equipment inside the building constitute the net space-conditioning load required to be provided by the heating and air-conditioning systems (as shown in Figure 5).

This space conditioning demand is satisfied by stocks of energy service technologies, including heating systems, air conditioners, and water heaters. These stocks are modeled with a stock-turnover approach, capturing equipment age, retirements, and additions—exposing opportunities for efficiency gains and fuel-switching, but also constraining the rate of technology adoption.

Residential building archetypes are also characterized by the number of dwelling units they contain, allowing the model to not only capture the energy effects of shared walls, but also the urban form and transportation implications of population density.

Non-residential buildings, commercial and otherwise (see Appendix 2) are located in space and mapped to a set of 40+ archetypes. The floorspace of these archetypes varies by location. Non-residential floorspace generates demand for energy and water, and provides an anchor point for locating employment of various types.

The model calculates the space-conditioning load for non-residential buildings as it does for residential buildings, with two distinctions: the thermal conductance parameter for non-residential buildings is based on floor area instead of surface area. Using assumptions for thermal envelope performance for each building type, the model calculates total energy demand for all buildings, independent of any space heating or cooling technology and fuel.

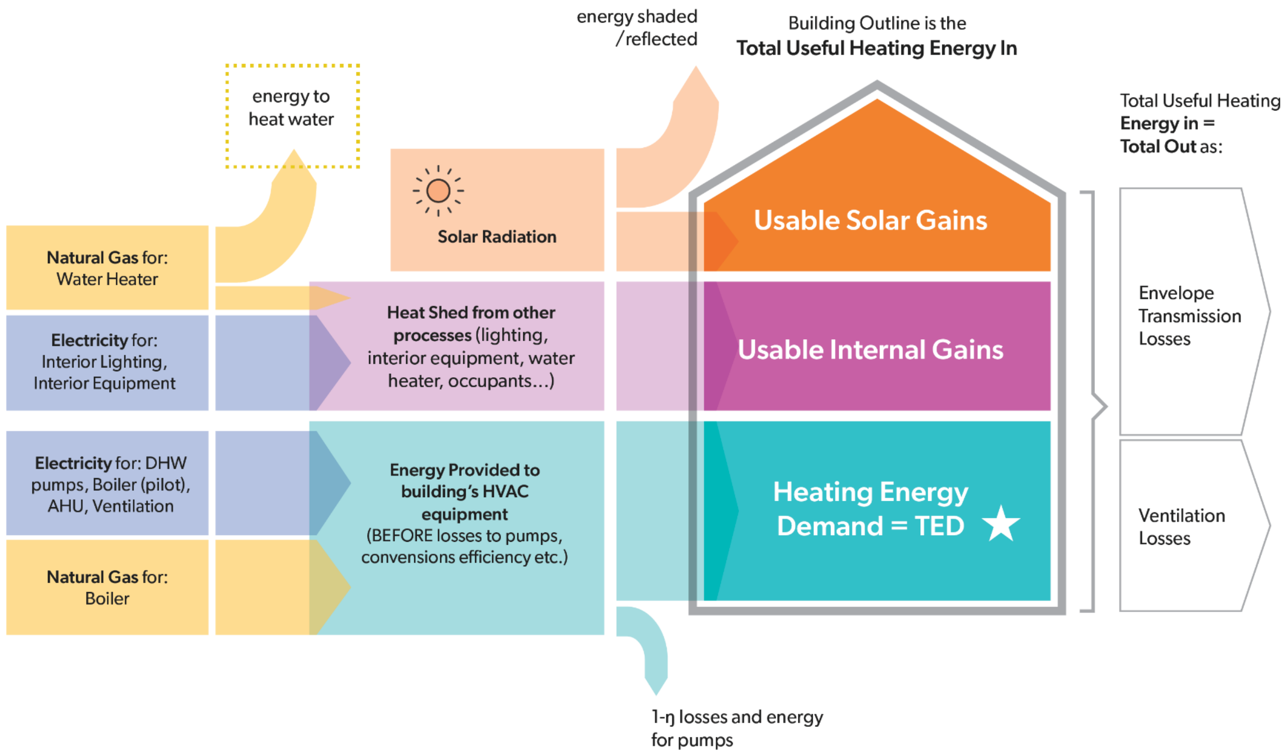


Figure 5. A diagram showing the considerations in the model for energy and emissions related to buildings.

How We Calibrate the Sub-model: Residential Buildings

For each zone in Fresno County, building data (including building type, number of stories, number of units, and year built) was sourced from Fresno County Assessor's Office including data for residential, commercial and industrial buildings.

The initial estimates for thermal conductance and output energy use intensity by end use and equipment efficiency assumptions are regional averages by dwelling type from the Residential Energy Consumption Survey (RECS) by the EIA for the Pacific Census Division. The assumed distribution of residential heat system types is derived from RECS for the Pacific Census Division, complemented by data from the ResStock model by NREL specific to Fresno County.

The initial thermal conductance and output energy use intensity estimates are adjusted through the calibration process until natural gas use in residential buildings aligns with natural gas consumption reported by the California Energy Commission for Fresno County, and residential electricity use matches electricity consumption data reported by the Commission for the same region for the base year.

How We Calibrate the Sub-model: Non-residential Buildings

Starting values for output energy intensities and equipment efficiencies for non-residential end uses are taken from the 2018 Commercial Buildings Energy Consumption Survey (CBECS) complemented by the EPA's Portfolio Manager Technical Reference that provides Energy Use Intensity by Property Type for some additional building types. All parameter estimates are further adjusted during the calibration process. The calibration target for non-residential building energy use is based on observed commercial and industrial fuel consumption in the base year, as reported by the California Energy Commission for Fresno County. Additionally, the split between commercial and industrial energy consumption was estimated using the SLOPE (State and Local Planning for Energy) model developed by NREL for Fresno County.

Passenger Transportation

How the Sub-model Works

The model captures personal transportation energy use by modeling household travel. Families make trips for various purposes (work, school, socializing, errands, drop-offs, shopping), and these trips are shared out over the various modes of transportation (e.g. walk, bike, car, transit). The energy use and emissions associated with various types of personal vehicles are calculated by assigning vehicle miles traveled (VMT) to a stock-turnover personal vehicle model. The induced approach is used to track emissions. See Figure 6.

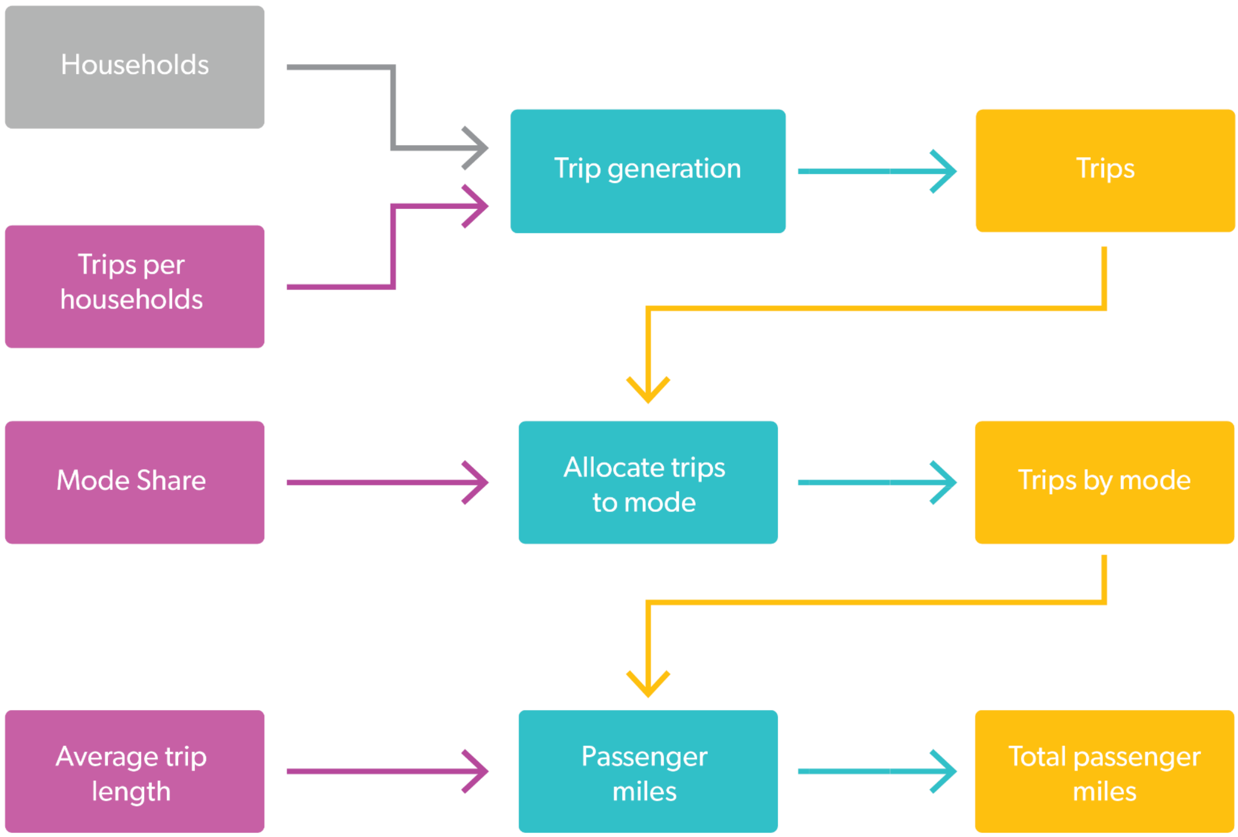


Figure 6. Conceptual diagram of how the model generates trips, trips by mode, and total miles traveled, per a given year. Gray rectangles represent stocks, fuchsia rectangles represent model parameters, light blue rectangles represent calculations made in the model, and yellow rectangles represent model outputs. All the outputs in this case represent flows.

How We Calibrate the Sub-model

The model is calibrated using data from Fresno COG's Transportation Model, in conjunction with the EMFAC emissions model developed and used by CARB, to estimate and calibrate VMT. The stock of personal-use vehicles is coupled with the VMT data to calculate energy consumption for personal vehicle use. Transit VMT and fuel consumption are also modeled based on data provided by EMFAC and Fresno COG. Off-road fuel use is derived from CARB's Off-Road Emissions Inventory for the base year in Fresno County.

The modeled stock of personal vehicles—categorized by size, fuel type, efficiency, and vintage—is also informed by the EMFAC emissions model. The total number of personal-use vehicles is proportional to the projected number of households in the BAU scenario.

Local Electricity Production

How the Sub-model Works

The model simulates in-county production of electricity and combined heat and power (CHP). Production capacity is represented as a stock while generation is modeled as a flow resulting from the use of that capacity. Energy produced from primary sources (e.g. solar, wind) is modeled alongside energy converted from imported fuels (e.g. electricity generation, CHP). The model applies a conversion efficiency to calculate fuel use.

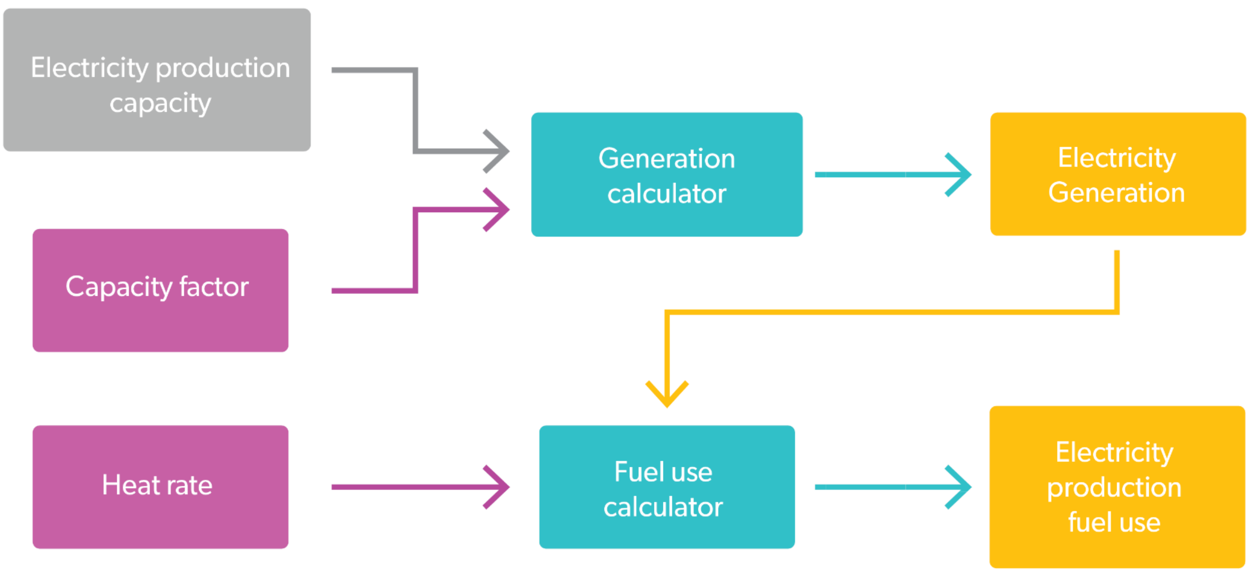


Figure 8: Conceptual diagram of how the model derives electricity production generation and fuel use.

How We Calibrate the Sub-model

The allocation of grid generation to meet demand in Fresno County is based on data from the U.S. Department of Energy's Combined Heat and Power (CHP) Installation Database, maintained by ICF Inc. This database provides comprehensive information on CHP installations across the United States, including those in Fresno County. The data includes details such as site names, locations, capacity, application, operating year, prime mover, and fuel type. Additionally, data on distributed solar generation was calibrated using information from California Distributed Generation Statistics, which offers detailed insights into net energy metering (NEM) installations, including capacity, location, and adoption trends across the state.

Fugitive Emissions

How the Sub-model Works

Fugitive emissions from natural gas pipelines are modeled as an emissions rate applied to total natural gas sales within Fresno County. Natural gas data is from the California Energy Commission.

How We Calibrate the Sub-model

The fugitive emissions rate is calibrated so that the modeled fugitive emissions match the emissions caused by leaks from distribution pipelines reported by local natural gas distribution companies under Subpart W of the EPA Greenhouse Gas Reporting Program (GHGRP).

AFOLU

How the Sub-model Works

The model receives inputs on emissions by type of gas originating from land crops, livestock, and forestry activities. For agriculture, the model processes this data to calculate the total emissions associated with activities such as crop production and livestock management. For forestry, the model processes inputs on GHG emissions and estimates the net emissions and carbon sequestration balance associated with forested areas in Fresno County.

How We Calibrate the Sub-model

For land crops, emissions are calibrated by calculating the total pounds of crops produced by type, using data provided by the County of Fresno Department of Agriculture. To quantify these emissions, the production figures are multiplied by crop-specific carbon footprint values sourced from CarbonCloud Platform.

For forestry, emissions are calibrated using data from Global Forest Watch to estimate the area of stable forests within Fresno County. This area is combined with carbon sequestration rates per unit area, sourced from a report from the California Department of Forestry and Fire Protection and the California Board of Forestry and Fire Protection, to quantify the total carbon sequestration.

It is important to note that the sub-model does not include emissions from farm and forestry machinery, as those are accounted for under the off-road emissions category.

Data and Assumptions

Scenario Development

Scenarios are alternative descriptions of different possible futures that help interested parties consider the implications of these future possibilities for planning and decision-making today. Scenarios are not predictions or forecasts. Rather, they are stories about how the world could change over a specified time in the future.

A scenario is distinguishable from a vision and forecast in two ways:

- a scenario is a possible future – it need not be desirable to everyone, thus it is not a vision, and,
- it need not be likely, thus it is not a forecast; a scenario emphasizes a process of change, not just a point in the future.

Many people assume that the future will closely resemble the present; however, scenarios are not grounded principally in a continuation of past trends or data. Rather, they involve plausible visions of the ways that relevant uncertainties might evolve in the future.

Characteristics of Scenarios

- Plausible: The scenario must be believable.
- Relevant to the key strategic issues and decisions at hand: If the scenario would not cause a decision-maker to act differently compared to another scenario, there is little use in considering it.
- Challenging today's conventional wisdom: It should make one think about different possibilities and options.
- Divergent from each other: Together, the scenarios should “stretch” the thinking about the future environment, so that the decisions take account of a wider range of issues.
- Balanced: It is useful to ensure that a group of scenarios strike a good psychological balance between challenges and opportunities, and between risks and potential benefits.

Reference scenarios provide a baseline from which the impacts of the decarbonization actions can be explored. Two reference scenarios are used in the analysis: Business-as-Usual (BAU) and Business-as-Planned (BAP).

Business-As-Usual Scenario

The Business-As-Usual (BAU) scenario estimates energy use and emissions volumes from the base year (2019) to the year 2050. It can be considered a projection of what would happen if nothing changes, except for the anticipated population and economic growth since it does not include any policy measures. This scenario provides a reference against which to assess the impacts of currently planned rules, bills, legislation, and climate action programs. Detailed assumptions for the BAU scenario can be found in Table 2.

Methodology

1. Calibrate model and develop a 2019 base year data for the county using observed data and filling in gaps with assumptions where necessary.
2. Input existing projected quantitative data to 2050 where available, such as:
    - Population, employment, and housing projections by municipality
    - Build out (buildings) projections by municipality
    - Transportation modeling from the county
    - Economic growth projections
    - Heating and cooling degree days projections
3. Where quantitative projections are not carried through to 2050, extrapolate what the projected trend would be to 2050.
4. Where specific quantitative projections are not available, develop projections through:
    - Analyzing current, on-the-ground action (reviewing action plans, engagement with staff, etc.), and where possible, quantifying the action.

Table 2. Business as usual assumptions

Action	Details	Sources
Population Growth	0.98 million people in 2019 1.07 million people by 2035 (avg of 0.82% per year) 1.13 million people by 2050 (avg of 0.64% per year) Average rate of growth 4,548 people per year	Fresno County 2023-2060 Growth Projections *Not publicly available as of January 2025.
Employment Growth	0.44 million jobs in 2019 0.50 million jobs by 2035 (avg of 0.5% per year) 0.53 million jobs by 2050 (avg of 0.7% per year) Average rate of growth 2,802 jobs per year	Fresno County 2023-2060 Growth Projections Not publicly available as of January 2025.
Heating and Cooling Degree Days	Projections of Heating and Cooling degree days for the county - Climate Explorer (nemac.org)	Climate Explorer (nemac.org) Statistically downscaled global climate models for the county
Energy Use by Building	Baseline building equipment types/stocks held from 2019-2050.	Residential Energy Consumption Survey (RECS) for baseline building equipment types Commercial Building Energy Consumption Survey (CBECS) for building equipment efficiencies
New Residential Building Growth	Residential buildings: 69,470 new residential units are added between 2022 - 2060. Of this 49,900 (72%) will be single-family and 19,560 (28%) will be multi-family.	Fresno County 2023-2060 Growth Projections *Not publicly available as of January 2025.
New non Residential Building Growth	Non-residential buildings: Growth based on projected growth in employment; building types added based on building mix of county where job growth is happening.	Fresno County 2023-2060 Growth Projections Not publicly available as of January 2025.
Agricultural Projections	Agricultural projections are based on historical averages (2009–2023) from the Annual Crop & Livestock Report, combined with REMI's Farm Output forecasts for 2023–2050.	Fresno County Annual Crop & Livestock Report REMI, economic impact model

Action	Details	Sources
Transportation Projection	Transportation projections use EMFAC data and Fresno COG's Transportation Model to estimate trends for vehicle miles traveled (VMT), vehicle stock by type, and trip counts	Fresno COG Transportation Model EMFAC - California Air Resources Board

Business-As-Planned Scenario

The Business-As-Planned (BAP) scenario estimates energy use and emissions volumes from the 2019 base year to the year 2050, incorporating assumptions associated with existing and adopted policies and programs. Assumptions for the BAP scenario can be found in Table 3.

Methodology

1. Create BAU (see steps above)
2. Create demand-side BAP
    - Add additional assumptions to the BAU to capture known policies and plans that are or will be implemented in the coming years. Key programs and pieces of legislation reflected in the BAP. Policies and programs include:
        - Senate Bill 100
        - Title 24 Building Energy Efficiency Standards
        - Senate Bill 350
        - 2022 Appliance Efficiency Standards
        - Advanced Clean Cars II
        - Low Carbon Fuel Standard
        - Corporate Average Fuel Economy standards
        - Assembly Bill 1322
        - California Sustainable Freight Action Plan
        - In-Use Off-Road Diesel-Fueled Fleets Regulation
        - Innovative Clean Transit Regulation
        - Senate Bill 1016
        - Assembly Bill 341
        - Assembly Bill 939

        - Senate Bill 1383
        - Alternative Manure Management Program
        - Healthy Soils Initiative
        - State Water Efficiency and Enhancement Program
    - In all cases: Where quantitative projections are not carried through to 2050, historical trends are extrapolated to 2050.

3. Where specific quantitative projections are not available, assumptions are identified by:
    - Analyzing current, on-the-ground action (reviewing action plans, engagement with staff, etc.), and where possible, quantifying the action.
    - Analyzing existing policy that has potential impact and, where possible, quantifying the potential impact.

Table 3. Business as planned scenario assumptions.

Action	Details	Sources
New dwelling Energy Use Intensity (EUI) improvement	Assume residential buildings built after 2020 use 7% less energy than baseline due to 2019 Building Energy Efficiency Standards.	Building Energy Efficiency Standards
Residential heat pumps for space heating in new builds	After 2023, assume 25% of new residential homes install heat pumps due to the 2022 California Energy Code update.	2022 Building Energy Efficiency Standards for Residentials and Nonresidential Buildings
Rooftop PV - new residential buildings	2019/2022 Title 24 Building Energy Efficiency Standards include the Solar Mandate, which requires that all new residential buildings under three stories be built with solar PV systems. Requirements are based on the home's energy consumption, climate zone, and other factors. Assume new homes will install a 2 kW system starting in 2020. Assume new multifamily residences will install a 10kW system starting in 2023.	2022 Building Energy Efficiency Standards for Residentials and Nonresidential Buildings

Action	Details	Sources
New non-residential building EUI	Assume nonresidential buildings built after 2020 use 30% less energy than baseline due to 2019 Building Energy Efficiency Standards - electricity, not heating.	2019 Building Energy Efficiency Standards
Rooftop PV - new non-residential buildings	2022 Title 24 Building Energy Efficiency Standards include the Solar Mandate, which requires that all new nonresidential buildings and major additions and alterations install solar PV systems. Requirements are based on the building's energy consumption, climate zone, and other factors. Assume new nonresidential buildings will install 30kW system starting in 2023. Buildings affected: ● Hotel-motel ● Tenant space ● Office, medical office, and clinics ● Retail and grocery stores ● Restaurants ● Schools ● Civic (theaters, auditoriums, and convention centers)	2022 Building Energy Efficiency Standards for Residentials and Nonresidential Buildings
Residential retrofits	Assume 380 homes are weatherized annually, reducing energy use by 30%.	Energy Services Impact Report 2023
Rooftop PV - existing residential buildings	Assume solar installations on existing residential buildings remain constant at 47.2 MW per year from 2024 to 2050, between 2020 and 2023 using data from CaliforniaDGStats	California Distributed Generation Statistics
Appliance efficiency	All appliances must comply with the 2022 Appliance Efficiency Standards as summarized in Section 110 of the California Energy Code Assume appliances are replaced with ones adhering to the Title 20 Appliance efficiency standards.	Appliance Efficiency Proceedings -Title 20
Clean electricity grid	Assume 60% of energy is from renewable energy sources by 2031 Assume 100% of energy is from renewable energy sources by 2045	2021 SB 100 Joint Agency Report, Achieving 100 Percent Clean Electricity in California: An Initial Assessment
Electrify personal vehicles	Rate of PUV electrification based on on EMFAC CARB	EMFAC California Air Resources Board
Electrify commercial vehicles	Rate of commercial vehicle electrification based on EMFAC CARB	EMFAC California Air Resources Board

Action	Details	Sources
Electrify transit vehicles	Rate of transit electrification based on this EMFAC CARB FAX (metro): Fully transition its bus fleet to zero-emission by 2040. FCRTA(rural): Plans for full electrification by 2025	EMFAC California Air Resources Board
Electrify publicly-owned vehicles	General Plans commit the following jurisdictions to EV fleets: ● Coalinga ● Firebaugh ● Fresno ● Huron ● Kerman ● Mendota ● Reedley ● San Joaquin ● Selma ● Fresno County	Fresno Council of Governments Electric VehicleReadiness Plan
Aviation fuel	AB-1322: Sustainable fuels target for the aviation sector of at least 20% by 2030	AB-1322 California Global Warming Solutions Act of 2006: aviation greenhouse gas emissions reduction plan
CAFE standards	CAFE Fuel standards: Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles, and Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles.	2024 Corporate Average Fuel Economy - NHTSA
Off road projections	Off road fuel consumption projections based on EMFAC	Off-Road Emissions Inventory - Air Resources Board
Landfill gas capture	Target California State: 40 percent reduction in total methane emissions (SB1383) or GHG emissions reductions of 40 percent below 1990 emission levels by 2030	Senate Bill No. 1383
SGMA projections	Incorporate SGMA reductions in irrigated agricultural land by removing 124,327 acres from production by 2040 and extrapolating this reduction to 2050. Reductions are distributed across crop types as follows: Hay & Pasture (6%), Tree Nuts (33%), Tree Fruits (13%), Vines (22%), Corn (4%), Vegetables (13%), and Field Crops & Grains (8%).	Managing Water and Farmland Transitions in the San Joaquin Valley Blueprint Economic Impact Analysis: Phase One Results

Action	Details	Sources
Alternative Manure Management Program (AMMP)	Assume 5,091MTCO2e is reduced annually from the AMMP program. Starting in 2027, 7,305 MTCO2e is reduced annually from the AMMP program. Increase MTCO2e reductions by 2,200 every 5 years	AMMP - California Climate & Agriculture Network California Department of Food and Agriculture AMMP - Incentive Project Level Data
State Water Efficiency & Enhancement Program (SWEEP)	Assume Fresno County is saving 4303.8 MTCO2e annually and this number grows exponentially annually due to the SWEEP program.	State Water Efficiency & Enhancement Program - California Department of Food and Agriculture
Healthy Soils Initiative	Assume CA Healthy Soils Initiative reduces 6,344.6 MTCO2e/year and additional 15,86.15 MTCO2e are reduced annually. 15,86.15 MTCO2e is an average of annual emission reductions between 2017 - 2020.	Healthy Soils Program - California Department of Food and Agriculture

Low-Carbon Scenario

One Low Carbon scenario was modeled in Fresno which offered an opportunity to explore alternative futures to the BAU and BAP Scenarios. Changes to energy flow and emissions profiles are illustrated by modeling potential changes in the context (e.g., population, development patterns) and by projecting energy services demand intensities, waste production, diversion rates, industrial processes and composition of the energy system infrastructure.

Alternative behaviors of elements actors (e.g., households, various levels of government, industry, etc.) can be reflected by adjusting input variables. Varying the inputs creates "what if"-type scenarios, enabling a flexible mix-and-match approach that connects behavioral assumptions to the physical model. A wide variety of policies, actions and strategies can be explored in this way, and the scenarios are highly flexible. The resolution of the model enables the user to apply scenarios to specific counties, technologies, building or vehicle types or eras and configurations of the built environment. Assumptions for the LC scenario can be found in Table 4.

Methodology for Low-Carbon Scenario

Actions are identified using three sources:

- Interviews with County agencies
- Interviews and workshops
- SSG's internal catalogue of actions based on climate action experience and market research

In conjunction with these sources, the following steps are taken to translate ideas into actions to model:

1. Identify the technological potential of each action or group of actions to reduce energy and emissions by quantifying the actions:
    a. Verify if the action or strategy specifically incorporates a projection or target. If there is a stated intention or goal, review best practices and literature to quantify that goal.
    b. Identify any actions that are overlapping and/or include dependencies on other actions.
2. Translate the actions into quantified assumptions over time ("parameterization").
3. Apply the assumptions to relevant sectors in the model to develop a low-carbon scenario (i.e., apply the technological potential of the actions to the model), incorporating the same quantified assumptions of the common principles for all low-carbon scenarios for this project.
4. Analyze results of the low-carbon scenario against the overall target.
5. If the target is not achieved, identify variables to scale up and provide a rationale for doing so.
6. Iteratively adjust variables to identify a pathway to the target.
7. Develop a marginal abatement cost curve for the low-carbon scenario.

Addressing Uncertainty

All modeling involves some level of uncertainty. Even with data that accurately reflects local conditions, it is difficult to project how conditions and behaviors will respond to broader societal changes and what those changes will be.

The SSG modeling approach uses four strategies for managing uncertainty applicable to community energy and emissions modeling:

1. **Sensitivity analysis:** One of the most basic ways of studying complex systems is sensitivity analysis, which helps quantify uncertainty in a model's output. To perform this assessment, each of the model's input parameters is drawn from a statistical distribution in order to capture the uncertainty in the parameter's true value.[1]

   Approach: Selected variables are modified by ±10-20% to illustrate the impact that an error of that magnitude has on the overall total.

2. **Calibration:** One way to challenge untested assumptions is the use of "back-casting" to ensure that the model can "forecast the past" accurately. The model can then be calibrated to generate historical outcomes in order to better replicate observed data.

   Approach: Variables are calibrated in the model by using two independent sources of data. For example, the model calibrates building energy use (derived from building data) against actual electricity data from the electricity distributor.

3. **Scenario analysis:** Scenarios are used to demonstrate that a range of future outcomes is possible given the current conditions and that no one scenario is more likely than another.

   Approach: Scenarios are conceptualized in close collaboration with local experts and interested parties.

4. **Transparency:** The provision of detailed sources for all assumptions is critical to enabling policy-makers to understand the uncertainty intrinsic in a model.

   Approach: Modeling assumptions and inputs are presented in this document.

Table 4. Low Carbon scenario assumptions.

Action	Details
Solar installation in Existing Residential	1,814 MW of installed capacity on residences by 2030 3,113 MW of installed capacity on residences by 2050
Retrofits in Existing Residential	Increase deep retrofits to reduce EUI by 50%. 25% of homes are retrofitted by 2032 50% by 2038 100% by 2045 80% of heating and water heating systems sales are heatpumps/electric by 2030, and 100% by 2035.

[1] James Keirstead, Mark Jennings, and Aruna Sivakumar, "A review of urban energy system models: Approaches, challenges and opportunities," *Renewable and Sustainable Energy Reviews* 16, no. 6 (2012): 3847. https://doi.org/10.1016/j.rser.2012.02.047

Action	Details
Electric Appliances	80% of new appliance (range stoves and dryers) sales are electric by 2030, and 100% by 2035.
Solar installation in Existing Commercial	1,373 MW of installed capacity on commercial buildings by 2030 2,139 MW of installed capacity on commercial buildings by 2030
Retrofits in Existing Commercial	Increase deep retrofits to reduce EUI by 50%. 35% of commercial buildings are retrofit by 2035 70% by 2040 100% by 2045 80% of heating and water heating systems sales are heatpumps/electric by 2030, and 100% by 2035.
Net-zero New Homes	100% of new residential buildings are net zero by 2030 100% of buildings are electric (no new natural gas), Add heat pumps for space heating, cooling, and water heating EUI improves 5% every 3 years aligned with IECC efficiency increases.
Net-zero New Commercial Buildings	100% of new commercial buildings are net zero by 2030 100% of buildings are electric (no new natural gas) Add heat pumps for space heating, cooling, and water heating EUI improves 5% every 3 years, aligned with IECC efficiency increases
Public Transit	Increase transit mode share to 8% by 2050 Assume all public transit transitions to ZEVs by 2040
Active Transit	County-wide mode share by 2045: Walking: 7% Biking: 5%
Carpooling	According to the Census 12.4% of Means of Transportation to Work was Carpooling, increasing carpooling to 20% by 2045.
Personal Use ZEVs	Assume 170,000 EVs on the road by 2030 (increasing in alignment with ACII - Fresno Country EV Roadmap) Assume all new passenger vehicles to be zero-emission by 2035
Commercial ZEVs	Assume all new commercial light duty vehicles to be zero-emission by 2035. Assume 100% of medium- and heavy-duty vehicle sales will be zero-emissions by 2040. Assume all municipal fleet vehicles are converted to ZEV by 2030
Freight ZEVs	Assume 100% of heavy-duty vehicle sales will be zero-emissions by 2040.
Offroad ZEVs	Assume 100% of off-road equipment purchases are ZEVs in 2040 Assume 25% are hydrogen and 75% are electric.
Waste diversion	Divert 75% of organic waste from landfills by 2027.
Landfill Gas Capture	Increase landfill methane capture (assume 100% is captured)
Wastewater efficiency	Assume the wastewater facilities increase energy efficiency 25% by 2030 and increase efficiency 10% every 5 years.
Wastewater Renewables	23 MW of new installed capacity on wastewater facilities by 2026

Action	Details
Industrial Efficiency	Assume the industry increases energy efficiency 25% by 2030 and increases efficiency 10% every 5 years.
Electrify Industrial Processes	Assume the Electrification of the process increases by 15% in 2032, 35% in 2038, 50% in 2045
Green Hydrogen in Industry	Assume hydrogen use increases 25% by 2045 in industrial processes
Industrial Renewables	Assume on-site renewables provide at least 50% of the energy required for industrial processes by 2045.
Manure Management and Dairy Digester Expansion	Increase dairy digester methane capture. Implement 50 projects from 2026 to 2050. Increase the alternative manure management program. Implement 124 projects from 2026 to 2050.
Agriculture ZEVs	Assume 100% of off-road equipment purchases are ZEVs in 2040 Assume 25% are hydrogen and 75% are electric.
Tree Canopy	Double tree canopy cover in urban areas by 2045. City of Fresno, currently has a canopy coverage of 14.6%.

Benefits Analysis

The IPCC defines co-benefits as "the positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare."[2] The term co-benefits and its corollary, co-harms, have a variety of synonyms, including "ancillary effects" and "ancillary benefits and costs," and an equal variety of definitions. In this analysis, co-benefits are assumed to be any potential or anticipated benefits of the action in addition to its impact on GHG emissions. The following table describes the benefits analyzed, relevant indicators and the method of analysis applied.

Table 5 Overview of co-benefits and co-harms categories, specific impacts and indicators and the analytical method used.

Category	Impact Overview	Indicators	Analytical Method
Co-Benefit and Co-Harms: Health			
Outdoor air quality	Improvement in outdoor air quality	Avoided mortality and incidence of disease Dollar value of total health benefits	Calculated using air pollutants from modeling inputted into EPA's Co-Benefits Risk Assessment (COBRA) tool
Indoor air quality	Improvement in air quality inside homes and businesses	Number of homes using electric appliances Total square footage of non-residential buildings using electric appliances	Correlation between use of gas appliances in the home and indoor air quality
Co-Benefit and Co-Harms: Economic Prosperity			

[2] IPCC. (2014). Annex II: Glossary [Agard, J., E.L.F. Schipper, J. Birkmann, M. Campos, C. Dubeux, Y. Nojiri, L. Olsson, B. Osman-Elasha, M. Pelling, M.J. Prather, M.G. Rivera-Ferre, O.C. Ruppel, A. Sallenger, K.R. Smith, A.L. St. Clair, K.J. Mach, M.D. Mastrandrea, and T.E. Bilir (eds.)]. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757-1776. p. 1762.

Category	Impact Overview	Indicators	Analytical Method
Employment	New employment opportunities are created. Existing employment opportunities are lost.	Jobs created/lost by sector	Employment multipliers for every dollar spent on decarbonization
Financial Energy Savings	Energy efficiency will reduce household building and transportation costs	Household energy and travel expenditures	Calculated in the ScenaCommunity model (change in expenditures on transportation and housing)[3]
Co-Benefit and Co-Harms: Climate adaptation and resilience			
Passive survivability	Populations are able to withstand extreme weather events and power outages	Number of buildings with deep retrofits Number of batteries installed alongside renewable energy systems Electricity provided within micro-grids or district energy systems	Calculated in the ScenaCommunity model
Reduction of urban heat island effect	Planting trees for shade and expanding green infrastructure reduces local temperatures	Number of trees planted or acres of landscape restored	Calculated in the ScenaCommunity model and correlated with reductions in local temperature

[3] See the Data, Methods, and Assumptions (DMA) Manual for more information about SSG's ScenaCommunity model.

Low-Income and Disadvantaged Communities

Low-income and disadvantaged communities (LIDACs) within the jurisdiction are identified through the U.S. EPA's Environmental Justice Screening and Mapping Tool (EJScreen) Version 2.2 and the Climate and Economic Justice Screening Tool (CEJST). These tools provide information at a census-tract level according to different categories and thresholds. The categories, thresholds and descriptions are provided below (Table 6).

LIDACs face socioeconomic disparities in addition to environmental, climate, health and other burdens. According to the CEJST, census tracts are considered disadvantaged if they are at or above the 65th percentile for the number of low-income households and at or above the 90th percentile for one of the data indicators described in Table 6.[4] A census tract that is surrounded by LIDACs and is at or above the 50th percentile for low income is also considered disadvantaged. Federally recognized Tribes are also considered disadvantaged communities.

EJScreen complements insights from the CEJST and enables a comparison of the social, environmental and public health burdens faced by individual communities in the jurisdiction with state and national averages. EJScreen contains environmental and demographic indicators, with similarities to those described above in the CEJST (Table 6). EJScreen combines two demographic indexes[5] with data on 13 environmental indicators to generate indices identifying areas that have higher pollution burdens and vulnerable populations present. The indicators include particulate matter 2.5, ozone, diesel particulate matter, air toxics cancer risk, air toxics respiratory hazard index, toxic releases to air, traffic proximity and volume, lead paint, RMP facility proximity, hazardous waste proximity, superfund proximity, underground storage tanks and wastewater discharge.

The EJScreen tool categorizes communities as disadvantaged in a way that is slightly different from the CEJST. In EJScreen, census tracts and block groups are disadvantaged if they are at or above the 90th percentile for any of EJScreen's supplemental indexes when compared to the nation or the state, if they are within Tribal lands or if they are classified as disadvantaged by the CEJST.

[4] Except in the categories of workforce development, for which a community is classified as disadvantaged when one of the described burdens is exceeded (90th percentile for each indicator) and when more than 10% of people ages 25 years or older have less educational attainment than a high school diploma.

[5] The EJ index is based on the percentage of low-income households and people of color within the geography, and the supplemental EJ index is based on the percentage of low-income households, unemployment, limited English speakers, adults with less than a high school education and populations with low life expectancy.

Table 6. Categories and data indicators in the EJScreen[6] and CEJST tools.[7]

Indicator or Threshold	Included in EJScreen	Included in CEJST	Definition
Public Health			
Air toxics cancer risk	X		Lifetime cancer risk from inhalation of air toxics
Air toxics respiratory hazard index	X		Ratio of exposure concentration to health-based reference concentration
Asthma		X	Share of people who answer "yes" to both of these questions: Have you ever been told by a health professional that you have asthma? Do you still have asthma?
Cardiovascular disease		X	Share of people ages 18 years and older who have been told by a health professional that they had angina or coronary heart disease
Diabetes		X	Share of people ages 18 years and older who have been told by a health professional that they have diabetes other than diabetes during pregnancy
Food desert	X		Low-income and low-access tract measured at 1 mile for urban areas and 10 miles for rural areas, according to the USDA
Lead paint	X	X	Share of homes built before 1960, which indicates potential lead paint exposure
Low life expectancy		X	Average number of years people have left in their lives
Economic Burdens			
Energy cost		X	Average household annual energy cost in dollars divided by the average household income
Historic underinvestment		X	Census tracts that experienced historic underinvestment based on redlining maps between 1935 and 1940
Housing burden		X	Share of households that are both earning less than 80% of Housing and Urban Development's Area Median Family Income and are spending more than 30% of their income on housing costs
Lack of green space		X	Share of land with developed surfaces covered with artificial materials like concrete or pavement, excluding crop land used for agricultural purposes

[6] U.S. Environmental Protection Agency (EPA), 2019. EJSCREEN Technical Documentation.
[7] National Academies of Sciences, Engineering, and Medicine. 2024. Constructing Valid Geospatial Tools for Environmental Justice. Washington, DC: The National Academies Press. https://doi.org/10.17226/27317.

Indicator or Threshold	Included in EJScreen	Included in CEJST	Definition
Lack of indoor plumbing		X	Housing without indoor kitchen facilities or complete plumbing facilities
Less than high school education	X		Percent of the population over age 25 with less than a high school education
Low income	X	X	Low median income calculated as a share of the area's median income
Poverty		X	Share of people living at or below 100% of the federal poverty level
Transportation barriers		X	Average relative cost and time spent on transportation relative to all other tracts
Unemployment	X	X	Number of unemployed people as a share of the labor force
Vulnerable Populations			
Linguistic isolation	X	X	Share of households where no one over age 14 speaks English very well
Over age 64	X		Percent of people over the age of 64
People of color	X		The percent of individuals who list their racial status as anything other than non-Hispanic white-alone (non-multiracial) individuals
Under age 5	X		Percent of people under the age of 5
Air pollution			
Diesel particulate matter	X	X	Mixture of particles in diesel exhaust in the air, measured as micrograms per cubic meter
Ozone	X		Average of the annual top 10 daily maximum eight-hour ozone concentrations in air for 2017-2019
Particulate matter 2.5	X	X	Fine inhalable particles with 2.5 or smaller micrometer diameters
Toxic releases from facilities	X		Modeled toxicity-weighted concentrations in air of EPA Toxic Release Inventory listed chemicals
Traffic impact	X	X	Number of vehicles (average annual daily traffic) at major roads within 500 meters
Land and Water Pollution			
Abandoned mine land		X	Presence of an abandoned mine left by legacy coal mining operations
Clean-up sites	X	X	Number of proposed or listed Superfund or National Priorities List (NPL) sites within 5 kilometers
Formerly Used Defense Sites (FUDS)		X	Properties that were owned, leased or possessed by the United States, under the jurisdiction of the Secretary of Defense prior to October 1986

Indicator or Threshold	Included in EJScreen	Included in CEJST	Definition
Groundwater threats	X	X	Weighted formula of the density of leaking underground storage tanks and the number of all active underground storage tanks within 1,500 feet of the census tract boundaries
Hazardous waste	X	X	Number of hazardous waste facilities (treatment, storage and disposal facilities and large quantity generators) within 5 kilometers
Impaired waters/ wastewater discharge	X	X	Risk-Screening Environmental Indicators (RSEI) modeled toxic concentrations at stream segments within 500 meters
Proximity to Risk Management Plan (RMP) facilities	X	X	Count of RMP facilities within 5 kilometers
Climate Risks			
Expected agriculture loss rate		X	Expected agricultural value at risk from losses due to natural hazards
Expected building loss rate		X	Expected building value at risk from losses due to natural hazards
Expected population loss rate		X	Expected fatalities and injuries due to natural hazards
Projected flood risk		X	Number of properties at risk of floods occurring in the next 30 years
Projected wildfire risk		X	Calculated from inputs associated with fire fuels, weather, human influence and fire movement

Co-Pollutant Reductions

The model generates air pollutants for each of the scenarios modelled. The air pollutants are then uploaded to EPA's CO–Benefits Risk Assessment (COBRA).[8]

Table 7. Air pollutants evaluated in COBRA.

Air pollutants	Formula	Relevant sectors
Nitrous oxides	NO_2	Transportation, industry, stationary energy consumption, electricity generation

[8] EPA (2025), User's Manual for the Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). Retrieved from: https://www.epa.gov/system/files/documents/2025-03/cobra-user-manual-v5.2.pdf

Air pollutants	Formula	Relevant sectors
Sulphur dioxide	SO_2	Transportation, industry, stationary energy consumption, electricity generation
Particulate matter	$PM_{2.5}$	Transportation, industry, stationary energy consumption, electricity generation
Volatile organic compounds	VOC	Transportation, industry, stationary energy consumption, electricity generation

COBRA quantifies changes in air quality using a simple air quality model to estimate the effects on ambient particulate matter and ozone, which are then linked to epidemiological studies to calculate avoided illnesses and deaths and the related economic value. COBRA estimates the following health incidences:

- Adult and infant mortality,
- Non-fatal heart attacks,
- Respiratory and cardiovascular-related hospital admissions,
- Respiratory, cardiovascular, and asthma-related emergency room
- visits,
- Asthma incidences,
- Lung cancer incidences,
- Hospitalizations from Alzheimer's and Parkinson's disease,
- Stroke incidences,
- Hay fever/rhinitis incidences,
- Minor restricted activity days, and
- Work and school loss days

The COBRA analysis is conducted on a per county basis for the years 2028 and 2050, as these are the years available in the tool, with the intervening years calculated as an extrapolation of the data for the preceding calculated year.

Appendix 1: Detailed Emissions Scope Table

Table 1-1. Detailed emissions scope.

GHG Emissions Sources & GHG Types			
Transportation	**CO2**	**CH4**	**N2O**
On-road transportation, railways, water-borne navigation, aviation, off-road transportation	Motor gasoline, distillate fuel, natural gas, residual fuel, lubricants, aviation gasoline, liquefied petroleum gas (LPG), light rail electricity use, Naphtha		
Residential Buildings	**CO2**	**CH4**	**N2O**
Emissions from fuel combustion and grid-supplied energy consumed by residential buildings	Residential electricity use, natural gas consumption, petroleum consumption, coal consumption		
Commercial Buildings	**CO2**	**CH4**	**N2O**
Emissions from fuel combustion and grid-supplied energy consumed by commercial buildings	Commercial electricity use, natural gas combustion, petroleum combustion, and coal combustion		
Industrial Emissions	**CO2**	**CH4**	**N2O**
Emissions from on-site stationary combustion and industrial processes that emit	Industrial electricity use, natural gas combustion, petroleum combustion, cement manufacture, coal combustion, ammonia production, urea consumption, iron and steel production, soda ash		

GHG Emissions Sources & GHG Types			
GHGs (such as cement manufacturing, semiconductor manufacturing, or aluminum production)	production and consumption, limestone and dolomite use, lime manufacture		
Energy and Electricity Production	**CO2**	**CH4**	**N2O**
Emissions from in-county electricity generation and distribution of fuels	Generation of steam, generation of electricity from non-renewables, natural gas pipeline transmission, fugitive emissions from pipelines		

Appendix 2: Building Types

Table 2-1. Building types in the model.

Residential Building Types	Non-residential Building Types	
Single_detached_small	school	surface_infrastructure
Single_detached_medium	hospital	water_pumping_or_treatment_station
Single_detached_large	hotel_motel_inn	industrial_generic
Double_detached_small	recreation	pulp_paper
Double_detached_large	community_centre	cement
Row_house_small	museums_art_gallery	chemicals
Row_house_large	retail	iron_steel_aluminum
Apt_1To3Storey	restaurant	mining
Apt_4To6Storey	commercial	agriculture
Apt_7To12Storey		pipelines
Apt_13AndUpStorey		
inMultiUseBldg		

Appendix 3: Emissions Factors

Table 3-1. Emissions factors used in the model.

Category	Value	Comment
Natural gas	CO_2: 53.06 kg/MMBtu CH_4: 0.001 kg/MMBtu N_2O: 0.0001kg/MMBtu	Sourced from the EPA Center for Corporate Climate Leadership's GHG Emission Factors Hub https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_mar2020.pdf (2020)
Renewable natural gas	CH_4: 0.001 kg/MMBtu N_2O: 0.0001kg/MMBtu	Sourced from the EPA Center for Corporate Climate Leadership's GHG Emission Factors Hub https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_mar2020.pdf (2020)
Electricity	State wide composite plant-specific emission rates (2019) CO_2e: 385.59 lbs CO_2e per MWh	eGRID2019 Data File (https://www.epa.gov/egrid/download-data)
Gasoline	CO_2: 69.55 kg/MMBtu CH_4: 4.22 g/MMBTU N_2O: 0.66 g/MMBTU	National inventory report 1990-2019 : Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6.1–14 This source was used because the units are compatible with SSG's model structure, which uses emission factors per energy unit instead of per mile.
Diesel	Light Duty Vehicles CO_2: 73.84 kg/MMBtu CH_4: 1.88 g/MMBTUmile N_2O: 6.06 g/MMBTU Medium/Heavy Duty Vehicles CO_2: 73.84 kg/MMBtu CH_4: 3.03 g/MMBTU N_2O: 4.16 g/MMBTU	National inventory report 1990-2019 : Greenhouse Gas Sources and Sinks in Canada. Part 2 Table A6.1–14 This source was used because the units are compatible with SSG's model structure, which uses emission factors per energy unit instead of per mile.

Category	Value	Comment
Fuel oil	CO_2: 73.9 kg per MMBtu CH_4: 0.003 kg per MMBtu N_2O: 0.0006 kg per MMBtu	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." Stationary Combustion Emission Factors," US Environmental Protection Agency, available: https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf (2014) Table 1 Stationary Combustion Emission Factor, Fuel Oil No. 2
Wood	CO_2: 93.80 kg per MMBtu CH_4: 0.0072 kg per MMBtu N_2O: 0.0036 kg per MMBtu	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." Stationary Combustion Emission Factors," US Environmental Protection Agency, available: https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_mar2020.pdf (2020) Table 1 Stationary Combustion Emission Factor, Biomass fuels: Wood and Wood Residuals
Propane	CO_2: 62.87 kg per MMBtu CH_4 : 0.003 kg per MMBtu N_2O: 0.0006 kg per MMBtu For mobile combustion: CO_2: 5.7 kg per gallon	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." Stationary Combustion Emission Factors," US Environmental Protection Agency, available: https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_mar2020.pdf (2020) Table 1 Stationary Combustion Emission Factor, Petroleum Products: Propane Table 2 Mobile Combustion CO2 Emission Factors: Propane
GHGs	Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are included. GWP CO_2 = 1 CH_4 = 28 N_2O = 265	Global warming potential (GWP) assumptions are sourced from the Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report.

Appendix 4: Data Sources & Uses

Table 4-1. Input assumptions and calibration targets.

Data	Source	Use
Population by county, age, sex	US Census - 2019 ACS	Calibration target
Residential buildings by county, type, and year built	Fresno County Assessor	Input assumption
Residential floor space per unit by county and type	Fresno County Assessor	Input assumption
Employment by county and sector	Fresno COG	Calibration target
Non-residential buildings by type and year built	Fresno County Assessor	Input assumption
Non-residential floor space by county and type	Fresno County Assessor	Input assumption
Non-residential floor space by type and year built	Fresno County Assessor	Input assumption
Natural gas deliveries by sector and county	California Energy Commission	Calibration target
Electricity sales by utility and customer sector	California Energy Commission	Calibration target
End use equipment fuel shares	RECS EIA CBECS EIA	Input assumption
Industrial emissions from large emitting facilities	EPA GHGRP	Calibration target
Personal use vehicles	EMFAC CARBS Fresno COG	Calibration target
Transit miles and fuel use	EMFAC CARBS Fresno COG	Input assumption
Electricity production capacity, generation, and fuel use	EPA eGRID	Input assumption

Data	Source	Use
Net metering capacity and generation by utility, sector, and technology	EIA Form 861	Input assumption
Heating and cooling degree days by county	U.S. Climate Resilience Toolkit Climate Explore	Input assumption
CHP facilities	U.S. Department of Energy Combined Heat and Power and Microgrid Installation Databases	Input assumption
Crop production by type in pounds and livestock heads by type.	Annual Crop & Livestock Report from The Fresno County Department of Agriculture	Input assumption

FRESNO
Council of Governments

LSA
www.lsa.net