SAC METRO AIR DISTRICT

DECEMBER 2025

COMPREHENSIVE CAPITAL REGION CLIMATE PRIORITIES PLAN

RAMBOLL ICF CivicSpark valley vision AECOM

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Acknowledgements and Disclaimer

The *Comprehensive Capital Region Climate Priorities Plan* (Plan) would not have been possible without collaboration between community members, public agencies, Tribal partners, community groups, and nonprofit organizations. The Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) is grateful for the participation, support, and cooperation of the following contributors.

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Steering Committee

- City of Auburn
- City of Citrus Heights
- City of Davis
- City of Elk Grove
- City of Folsom
- City of Grass Valley
- City of Rancho Cordova
- City of Roseville
- City of Sacramento
- City of South Lake Tahoe
- City of Woodland
- El Dorado County Air Quality Management District
- El Dorado County
- Nevada County
- Nevada County Transportation Commission
- Placer County Air Pollution Control District
- Placer County
- Placer County Transportation Planning Agency
- Roseville Electric Utility
- Sacramento Area Council of Governments (SACOG)
- Sacramento County
- Sacramento Municipal Utility District (SMUD)
- Sacramento Regional Transit District (SacRT)
- Sutter County
- Town of Truckee
- Yocha Dehe Wintun Nation
- Yolo County
- Yolo-Solano Air Quality Management District
- Yuba County

Special Thanks

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Disclaimer

The emission projections and calculations in this document are based on the regulatory environment that existed in March 2024, when the Capital Region Climate Priorities Plan was published. At the time of publication of this document (December 2025), business-as-usual emissions will likely increase over those stated. In addition, current regulations and programs listed in the Plan may no longer be applicable or achieve their reduction targets. Considering these changes, Appendix H was added to this Plan to focus on implementing measures within the control of the Capital Region.

Abbreviations, Acronyms, and Definitions

AB	Assembly Bill
AB 617	Assembly Bill 617 (C. Garcia, Chapter 136, Statutes of 2017) directs the California Air Resources Board and all local Air Districts to protect communities disproportionately impacted by air pollution
ACC	Advanced Clean Cars
AGR	Annual Growth Rate or Compound Annual Growth Rate (CAGR) refers to average growth of any value over a specific period
AHSC	Affordable Housing and Sustainable Communities program
ATIIP	Active Transportation Infrastructure Investment Program
ATP	Active Transportation Program
Ava	Ava Community Energy
BAU	Business-as-usual
BE	Built Environment measure category
BEV	Battery Electric Vehicle
BRT	Bus Rapid Transit
BTU	British Thermal Unit
BUILD	Building Initiative for Low-Emissions Development program
CalEEMod	California Emissions Estimator Model
CalEnviroScreen	California Communities Environmental Health Screening Tool
CalEPA	California Environmental Protection Agency
CAL FIRE	California Department of Forestry and Fire Protection
CALGreen	California Green Building Standards Code (Part 11, Title 24, California Code of Regulations)
CalRecycle	California Department of Resources Recycling and Recovery
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutant
CAPCOA	California Air Pollution Control Officers Association
CAPCOA Handbook	California Air Pollution Control Officers Association Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity
CARB	California Air Resources Board

Carbon Sequestration	The process of capturing and storing carbon dioxide from the atmosphere
Carbon Sink	A process or mechanism, natural or otherwise, that absorbs more carbon from the atmosphere than it releases
CBG	Census Block Group
CBO	Community-Based Organization
CCA	Community Choice Aggregation
CCAP	Comprehensive Climate Action Plan
CCS	Carbon Capture and Storage
CC4A	Clean Cars 4 All
CDBG-MIT	Community Development Block Grant - Mitigation
CDFA	California Department of Food and Agriculture
CDR	Carbon Dioxide Removal
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CES	Clean Energy Surcharge
CFIP	California Forest Improvement Program
CFWR	Composting and Food Waste Reduction
CH_4	Methane
CJF	California Jobs First
CLEEN	California Lending for Energy and Environmental Needs program
CNRA	California Natural Resources Agency
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COVID-19	Coronavirus Disease 2019
CPRG	Climate Pollution Reduction Grants
CSD	California Department of Community Services and Development
CTR	Commute Trip Reduction
CVRP	Clean Vehicle Rebate Project
CWSRF	Clean Water State Revolving Fund
DERA	Diesel Emissions Reduction Act
DOE	Department of Energy

DOT	Department of Transportation
DPM	Diesel Particulate Matter
DWR	California Department of Water Resources
E	Energy measure category
EDA	US Economic Development Administration
EDD	State of California Economic Development Department
EIB	Environmental Impact Bond
EJ	Environmental Justice
EMFAC	The Emissions Factor Model was developed by the California Air Resources Board to assess emissions from on-road vehicles including passenger cars, trucks, motorcycles, and buses
EPA	Environmental Protection Agency
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contracting
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	Greenhouse Gas
GHG Reduction Measure	Any action to reduce risks from climate change by reducing greenhouse gas emissions or removing greenhouse gases from the atmosphere
GO	General Obligation bond
GRIP	Grid Resilience and Innovation Partnerships program
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HCD	California Department of Housing and Community Development
HFC	Hydrofluorocarbon
HSP	Healthy Soils Incentives Program
HUD	US Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
INDIGO	Industrial Decarbonization and Improvements to Grid Operations program
IRA	Inflation Reduction Act
IRS	Internal Revenue Service
ISRF	Infrastructure State Revolving Fund

LCTOP	Low Carbon Transit Operations Program
LGGIT	U.S. EPA Local GHG Inventory Tool
LEAP	Local Energy Action Program
LED	Light Emitting Diode
LQ	A location quotient (LQ) is a ratio used to measure the concentration of economic activity in one geographic area compared to a larger geographic unit
MMT CO_2e	Million Metric Tons of Carbon Dioxide Equivalent
MPO	Metropolitan Planning Organization
MRR	CARB Mandatory Reporting GHG Report
MT CO_2e	Metric Tons of Carbon Dioxide Equivalent
MWh	Megawatt Hour
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NASS	National Agriculture Statistics Service
NEI	National Emissions Inventory
NOx	Nitrogen Oxides
NWL	Natural and Working Lands measure category
OAC	Outreach Advisory Committee
ODS	Ozone Depleting Substances
OEHHA	Office of Environmental Health Hazard Assessment
OEWS	Occupational Employment and Wage Statistics
OJT	On-the-job Training
P3	Public Private Partnership
PCAP	Priority Climate Action Plan
PCE	Peninsula Clean Energy
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
PWEAA	Public Works and Economic Adjustment Assistance
RAISE	Rebuilding American Infrastructure with Sustainability & Equity grant program
RDRS	Recycling and Disposal Reporting System
REAP	Regional Early Action Planning grants

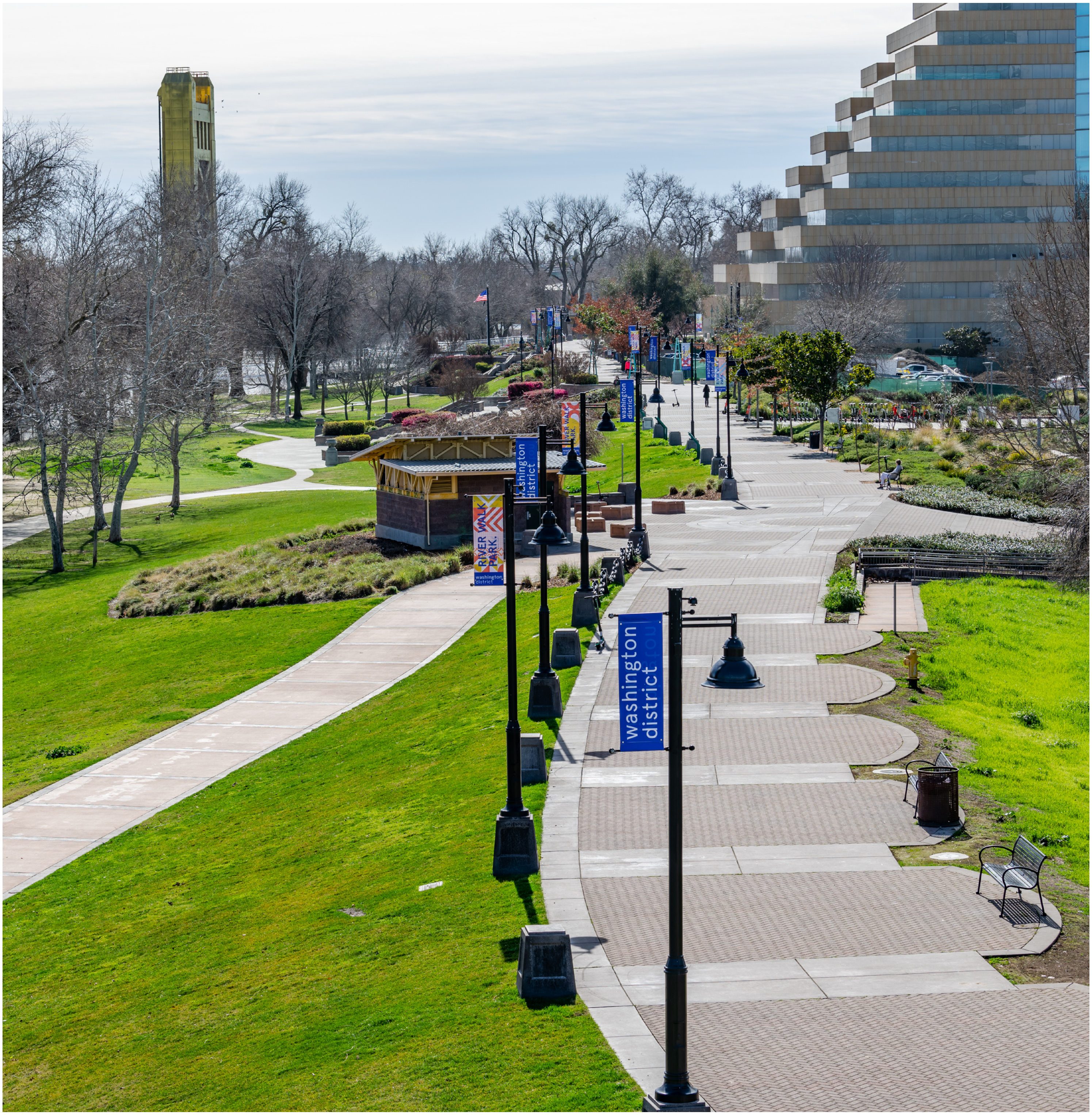
RTPA	Regional Transportation Planning Agency
Sac Metro Air District	Sacramento Metropolitan Air Quality Management District
SACOG	Sacramento Area Council of Governments
SacRT	Sacramento Regional Transit District
Sacramento-Roseville CSA	Sacramento-Roseville, California, Combined Statistical Area
SALC	Sustainable Agricultural Lands Conservation program
SB	Senate Bill
Short Ton	A US ton, equivalent to 2,000 pounds. Criteria air pollutants are often reported in short tons, while GHG emissions are reported in metric tons (1,000 kilograms)
SMART	Strengthening Mobility and Revolutionizing Transportation program
SMUD	Sacramento Municipal Utility District
SO_2	Sulfur Dioxide
SS4A	Safe Streets and Roads for All grant program
SWEEP	Statewide Energy Efficiency Program
SWEEP	State Water Efficiency and Enhancement Program
TDM	Transportation Demand Management
UHI	The Urban Heat Island Effect describes the higher day and night temperatures experienced in urban and suburban areas compared to the temperatures of their natural and rural surroundings
USDA	US Department of Agriculture
UUT	Utility User Tax
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
ZEV	Zero-Emission Vehicle

Chapter 1. Introduction

The greater Capital Region is already feeling the effects of climate change resulting from anthropogenic greenhouse gas (GHG) emissions. These effects include more frequent and extreme weather events, including atmospheric rivers and extreme heat, higher flood risk, reduced snowpack, droughts, and wildfires. These events impact the life and livelihoods of the region's residents by deteriorating human health, decreasing the longevity of transportation and electrical infrastructure, and reducing crop yields. Air pollution from wildfires and exposure to more frequent and extreme heat events is threatening public health, especially for those who are most vulnerable including children, older adults, the unhoused, and those with preexisting health conditions such as asthma and chronic lung and heart disease. Recognizing the need for climate action, the United States Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program aims to create regional and statewide plans to combat the effects of climate change by reducing GHG emissions and associated co-pollutants that compromise air quality.

As a national and global leader in climate research and planning, other states and countries look to California to lead the way in planning for the future. Assembly Bill (AB) 1279, the California Climate Crisis Act of 2022, calls for statewide net-zero GHG emissions by no later than 2045 and directs the California Air Resources Board (CARB) to coordinate with local agencies to reach the target. As the local agency with the primary responsibility to help the Capital Region reach its air quality and climate goals, the Sacramento Metropolitan Air Quality Management District (Sac Metro Air District), in coordination with local jurisdictions, agencies, and Tribal partners, led development of a climate action plan for the Capital Region, defined for this report as El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba counties, which make up the CPRG planning area.

All CPRG Phase I Planning Grant participants must submit a Priority Climate Action Plan (PCAP), a Comprehensive Climate Action Plan (CCAP), and status reports. As a grantee, the Sac Metro Air District developed a PCAP titled the Capital Region Climate Priorities Plan in 2024 that identified the region's emission sources, quantified GHG reduction measures, reviewed community engagement, and identified low-income community impacts.[1] The Comprehensive Capital Region Climate Priorities Plan (the Plan) builds from the PCAP and serves as the CCAP deliverable required for the CPRG program.



The Capital Region already deals with significant air quality challenges from transportation emissions which are exacerbated by certain geographical features. These geographic characteristics expose the region to a diverse range of climate risks over its dense urban areas, valley farmland and agricultural fields, rolling foothills, and high Sierra Nevada mountains. Each of these distinct environments has its own set of issues and opportunities. Fortunately, the CPRG program is facilitating a collaborative process that enables several local agencies to identify commonalities in each jurisdiction's respective climate goals and formulate a set of regional priorities that can be scoped and funded to deliver benefits throughout the Capital Region. These strategies will be shared with others in the country who face similar environmental challenges.

Through this climate action planning process, the Sac Metro Air District engaged residents, local agencies, multiple cities, and seven counties to build the relationships necessary to implement local climate actions. A steering committee (Table 1) consisting of staff from El Dorado, Placer, Nevada, Sacramento, Sutter, Yolo, and Yuba counties, cities within these counties, the Yocha Dehe Wintun Nation, the Sacramento Area Council of Governments (SACOG), the Sacramento Regional Transit District (SacRT), and the Sacramento Municipal Utility District (SMUD) was formed to guide the development of the initial Sacramento- Roseville, California, Combined Statistical Area (Sacramento-Roseville CSA) Capital Region Climate Priorities Plan. This steering committee continued to guide the development of this Plan and provided input on the development of GHG reduction targets for the region, the co-pollutant inventory, and the identification of priority measures. To signify the importance of regional collaboration, on November 9, 2023, more than 50 elected officials from around the region attended a joint meeting of the Boards of Directors for the Sac Metro Air District, SMUD, SacRT, and SACOG, where executive approval was given to execute a joint resolution in support of continued collaboration on regional priority projects.

Cooperation ensures greater efficiencies and swifter attainment of mutual goals, which leads to improved wellness and quality of life for the region's residents. Regional priorities identified by the Sac Metro Air District Board and its partners relate to mobility and the reduction of vehicle miles traveled (VMT), grid resiliency, infill development, wildfire reduction, biomass energy, hydrogen production, and energy efficiency. The CPRG program is accelerating work to decarbonize the transportation, industry, electric power, and natural and working lands sectors and address injustice by supporting grant recipients in enacting solutions that are community driven.

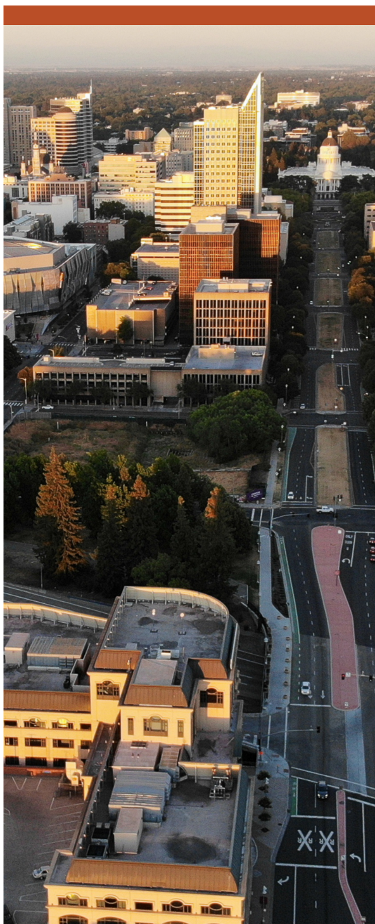
Table 1. Capital Region CPRG Steering Committee

CAPITAL REGION CPRG STEERING COMMITTEE Lead Agency/Chair – Sac Metro Air District	
City of Auburn	Placer County Air Pollution Control District
City of Citrus Heights	Placer County
City of Davis	Placer County Transportation Planning Agency
City of Elk Grove	Roseville Electric Utility
City of Folsom	Sacramento Area Council of Governments (SACOG)
City of Grass Valley	Sacramento County
City of Rancho Cordova	Sacramento Municipal Utility District (SMUD)
City of Roseville	Sacramento Regional Transit District (SacRT)
City of Sacramento	Sutter County
City of South Lake Tahoe	Town of Truckee
City of Woodland	Yocha Dehe Wintun Nation
El Dorado County Air Quality Management District	Yolo County
El Dorado County	Yolo-Solano Air Quality Management District
Nevada County	Yuba County
Nevada County Transportation Commission	

To engage residents in the planning process, and with help from the CPRG steering committee, the Sac Metro Air District invited community-based organizations (CBOs), nonprofits, and other community groups to participate in an Outreach Advisory Committee (OAC) and influence the creation of a fair community engagement strategy. Key themes from outreach conducted by the CPRG planning team pertain to fair implementation of this climate action plan and the importance of continued stakeholder engagement. During development of the Plan, staff conducted in-depth interviews with individuals from CBOs, governmental agencies, workforce development organizations, and a local university to solicit input on Plan measures, regional priorities, and implementation barriers and opportunities. The Sac Metro Air District distributed a survey based on community priorities that garnered 850 responses. When asked how residents would prioritize the benefits of air pollution reduction in their communities, improving public health and lowering energy bills were among the two greatest priorities. When asked what sources of air pollution most impact their communities, over 50% of respondents selected wildfires and emissions from passenger vehicles and trucks.

Useful tools that keep planners and decision makers accountable to their communities and aid in meeting local climate goals are the *California Air Pollution Control Officers Association Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity* (CAPCOA Handbook); and the associated California Emissions Estimator Model (CalEEMod). Efforts to develop and implement the CAPCOA Handbook and CalEEMod were led by the Sac Metro Air District on behalf of the air districts of California, and both are considered cutting-edge tools. These planning resources help decision makers evaluate GHG reduction measures and climate vulnerabilities to support sustainable, resilient, and fair land use and transportation planning. Some local actions were not quantified within the CAPCOA Handbook, and the CPRG planning team worked to incorporate these actions as quantified measures within the CAPCOA Handbook (CAPCOA Handbook Update) through the development of this climate action plan, ensuring their implementation not only in the Capital Region, but across California.

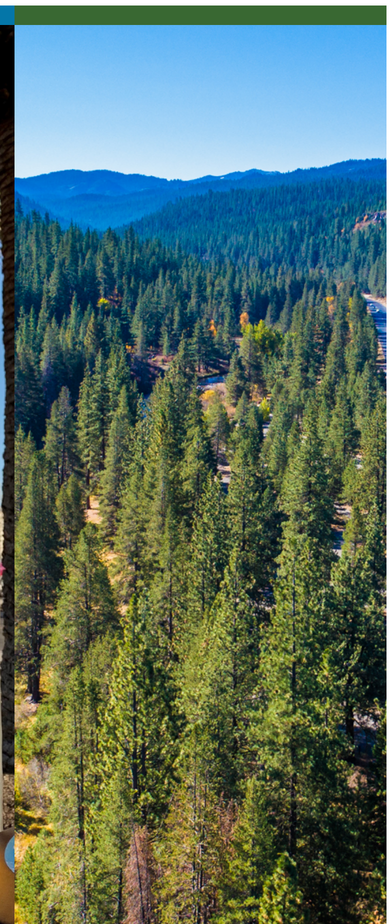
The geography, climate risks, and local factors within the seven counties covered by this climate action plan led to the selection of a distinct set of GHG reduction measures. The measures selected for the Plan speak to the most concerning set of climate risks in the region, and no single climate solution will address the multitude of climate related impacts. The GHG mitigation measures in the Plan are represented within four categories – built environment, energy, transportation, and natural and working lands.



Built Environment

Energy

Transportation



Natural and Working Lands

Overview

To guide climate action development, the Sac Metro Air District first developed a Sacramento-Roseville CSA 2019 GHG emission inventory and forecast emissions to 2045. The Sac Metro Air District then established regional 2030 and 2045 GHG reduction targets for the Plan, including a 2045 carbon neutrality target. After reviewing the existing climate action plans in the region and conducting a GHG inventory for all seven counties, the Sac Metro Air District worked with the steering committee and community partners to generate a list of measures for inclusion in the Capital Region Climate Priorities Plan. Two additional measures were added during development of the Comprehensive Capital Region Climate Priorities Plan: E-1A: Onsite Solar Canopies and E-1B: Battery Storage-Supported Microgrids. The Plan measures encourage infill development, building electrification and vehicle decarbonization, active modes of transportation, energy resiliency, carbon sequestration, and forest and ecosystem health. Each measure's GHG mitigation potential is provided in metric tons of carbon dioxide equivalent (MT CO_2e) per year for the reduction target years of 2030 and 2045. Additionally, each measure's co-pollutant reductions are provided in short tons per year for 2030 and 2045. The Plan discusses scale of implementation, authority to implement, benefits to low-income communities, cost considerations, and funding recommendations for each measure. The Plan also includes a community engagement summary, funding and financing analysis, and workforce planning analysis. Implementation of the Plan's GHG reduction measures will move the region closer to carbon neutrality by 2045. To meet our emissions reduction goals, the Capital Region will continue to advance electric power sector improvements, paying particular attention to renewable energy deployments and battery storage.

In the future, new and strengthened partnerships will allow for continued capacity to apply for funding opportunities to implement necessary energy, built environment, transportation, and natural and working lands measures. New climate actions would require appropriate approvals from environmental review to consultation with community members.

The investment of future climate funding in a region as multifaceted as Sacramento encourages other regions throughout the nation to strengthen their climate plans and solidify their climate and sustainability goals. In many ways, the Capital Region is one of the most culturally and geographically diverse places in the country, and it will continue to be an example to the rest of the country.

REFERENCES

[1] *https://www.airquality.org/residents/climate-change/climate-pollution-reduction-grants*

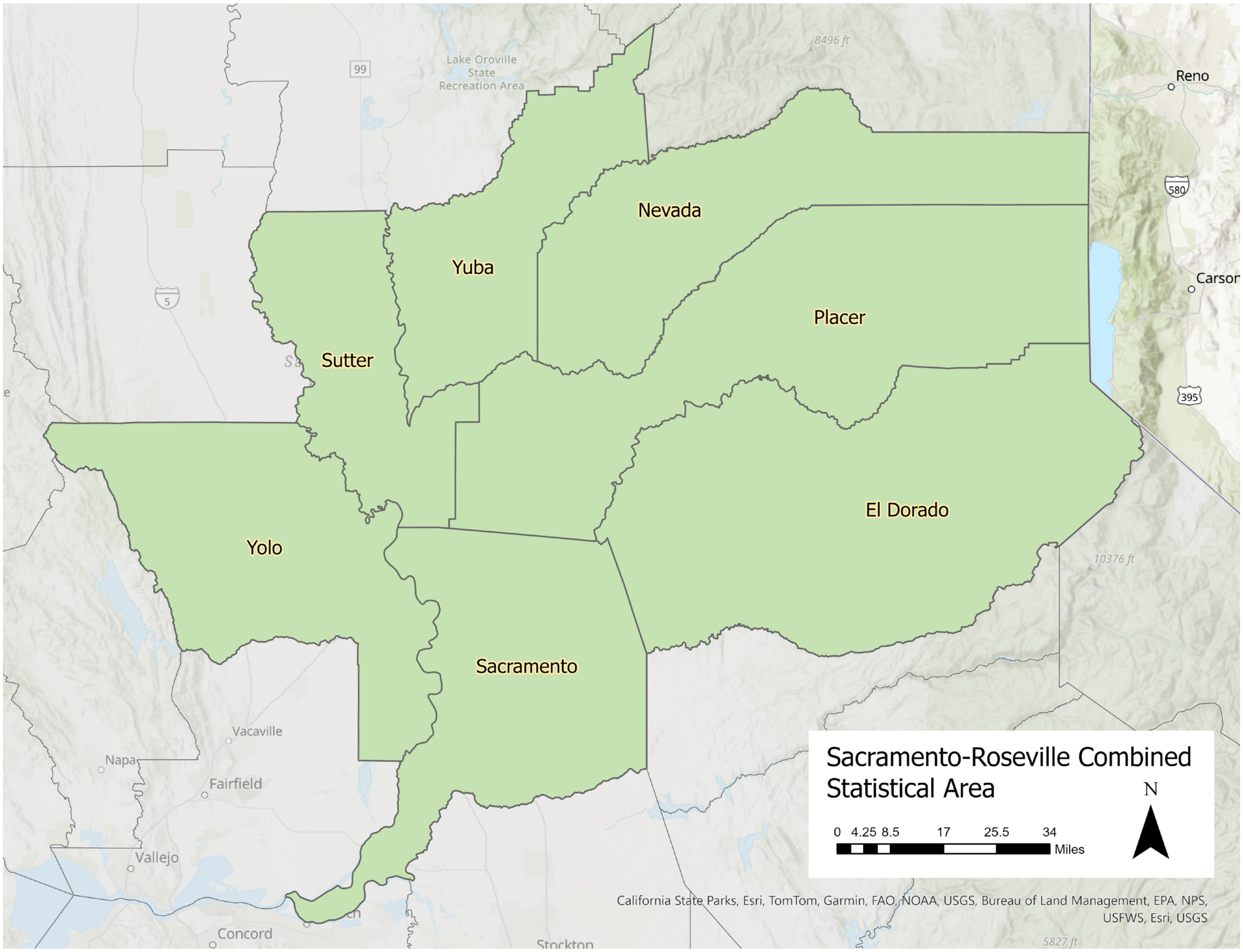
Chapter 2. Greenhouse Gas Emissions Inventory

Developing a Baseline Greenhouse Gas Inventory

A crucial first step in developing a climate action plan is to understand the current state of GHG emissions in the region, including key emissions sources by sector and by geography. GHG inventories help track progress in reducing emissions and achieving targets. This GHG inventory serves as a tool to evaluate emissions by source and economic sector for the region in order to develop and prioritize GHG reduction measures. It will be used as a baseline for comparison when calculating the impact of proposed GHG emissions reduction measures and carbon sinks.

The Sacramento–Roseville CSA emissions inventory was developed with sector, subsector, and county-level details. The Sacramento–Roseville CSA, shown in Figure 1, includes the counties of El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

Figure 1. Sacramento-Roseville CSA[1]

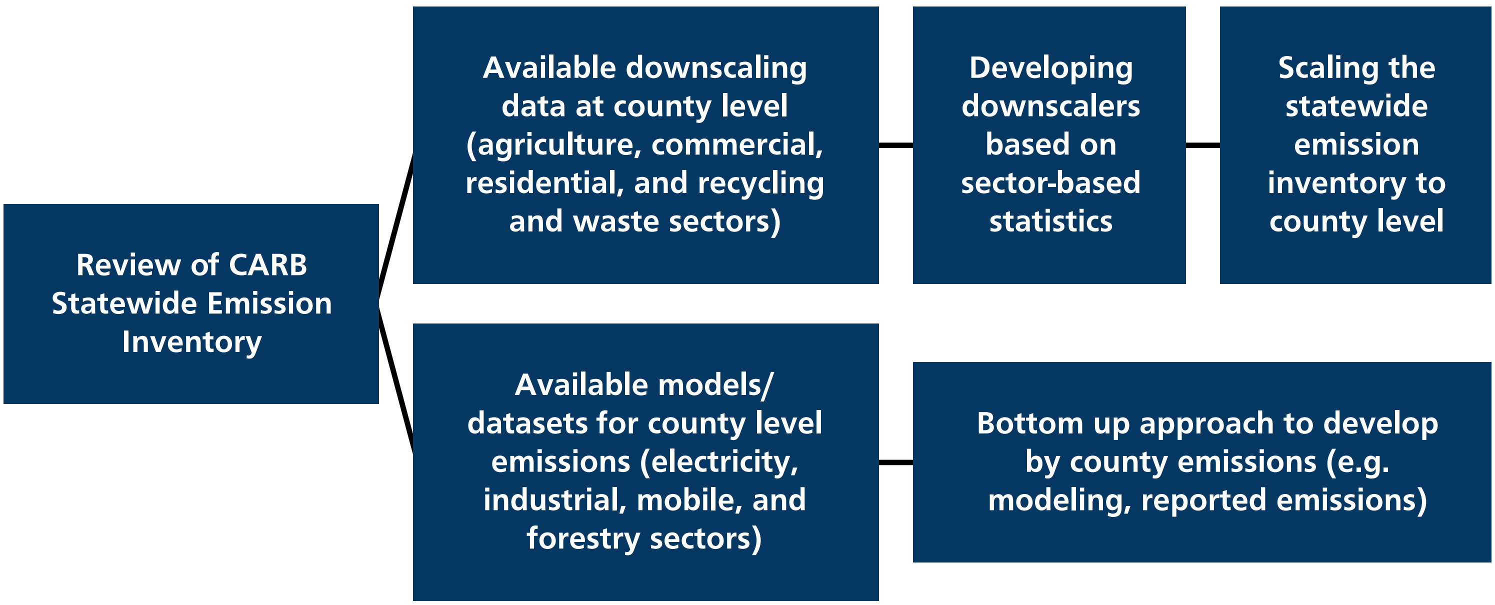


The inventory captures emissions generated by the region's broad range of sources including agriculture and forestry, industrial sectors, the operation of commercial and residential buildings, and from vehicles and machinery including off-road equipment, on-road vehicles, rail, and waterborne sources.

Developing a comprehensive regional inventory using a bottom-up approach is challenging and resource intensive. For the purposes of this Plan, existing emission inventories such as the CARB California Annual Statewide Inventory were leveraged to estimate the emissions for each subsector. For several sectors, relevant analytical data was used to downscale the state emissions to Sacramento–Roseville CSA counties.

Emissions were estimated based on available CARB tools and data, activity data, and emission factors. This methodology was applied to the industrial, electricity and mobile sectors, which includes on-road, off-road, rail and marine sources. For the remaining sectors, emissions were estimated by downscaling from CARB's statewide emissions inventory to Sacramento–Roseville CSA counties based on publicly available sector-specific activity such as natural gas consumption, cropland acreage, population, and landfill tonnage.

Figure 2. Overview of GHG Inventory Approach



Historical year 2019 was selected as the GHG inventory baseline year. To select the inventory year, the CPRG planning team considered available emissions data and the timing of the COVID-19 pandemic. Due to the unique conditions of 2020 as a result of COVID-19, historical year 2020 was not selected as the baseline. The Plan uses 2019 as the GHG inventory baseline year due to an availability of data and the alignment with existing and expected trends that represent business as usual prior to the disruption caused by the COVID-19 pandemic.[2]

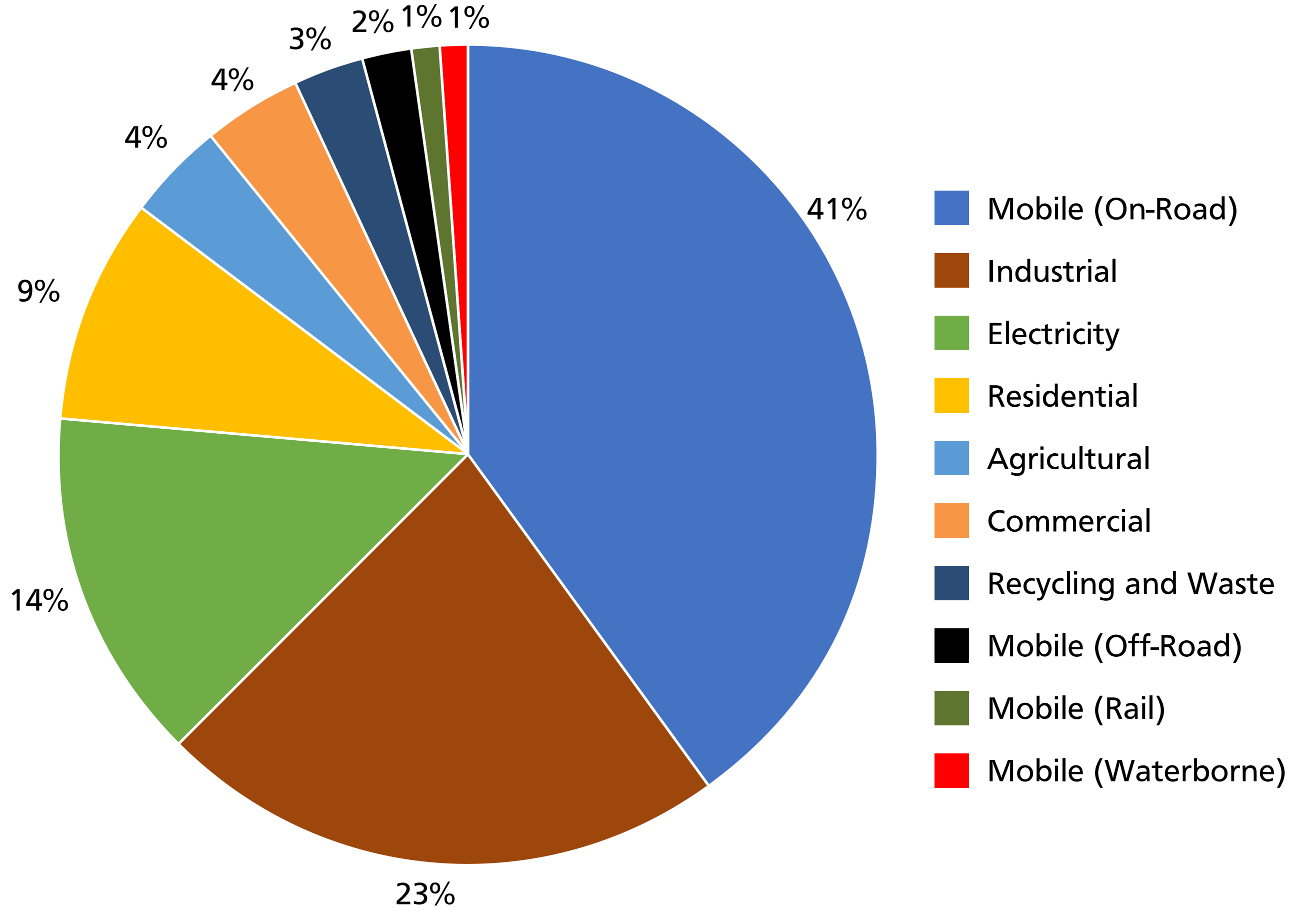
Greenhouse Gas Inventory Results

GHG Emissions by Sector

To inform the development of a climate action plan, it is important to understand the key sources of emissions across the region to help prioritize emissions reduction actions and strategies in the future. The complete 2019 GHG emissions inventory for the Capital Region is summarized in tables and figures below.[3]

Figure 3 displays emissions across the entire Sacramento-Roseville CSA by sector and mobile subsectors. On-road vehicle emissions are the largest sector, contributing 41% of emissions. Industrial is the second largest sector, contributing 23% of emissions, and includes petroleum marketing facilities such as fuel bulk stations, pipeline transportation systems for natural gas, and other types of industrial facilities. Electricity is the third largest sector, contributing 14% of emissions, and includes electricity consumption across all sectors (no other sectors include electricity-related emissions). The next most significant sector is residential, primarily reflecting emissions generated from natural gas use.

Figure 3. 2019 Sacramento-Roseville CSA Gross GHG Emissions by Sector and Mobile Subsectors



Total GHG emissions can be represented in two ways:

- **Gross Emissions:** Total emissions **without** removals (e.g., excluding CO_2 removals from forests or trees)
- **Net Emissions:** Total emissions **with** removals (e.g., including CO_2 removals from forests or trees)

Table 1 below displays the emission breakdown by sector and mobile subsectors. Aircraft activity for the Sacramento-Roseville CSA (e.g., fuel consumption, flight-miles) was not readily available, therefore, aircraft emissions were excluded. Mobile (on-road) produces the most emissions in all counties. Only Sacramento, Placer, and Yolo counties are reported to produce industrial emissions.

Table 1. 2019 Regional Greenhouse Gas Emissions by Sector and Mobile Subsectors

Sector	2019	% of Gross Total
Mobile (On-Road)	10,713,128	41.1%
Industrial	5,907,051	22.7%
Electricity*	3,616,254	13.9%
Residential	2,231,851	8.6%
Agricultural	1,100,837	4.2%
Commercial	988,062	3.8%
Recycling and Waste	716,684	2.8%
Mobile (Off-Road)	546,763	2.1%
Mobile (Rail)	135,349	0.5%
Mobile (Waterborne)	78,819	0.3%
Forestry	(3,029,766)	NA
Gross Total (Excluding Forestry Removals)*	**26,034,798**	**100%**
Net Total (Including Forestry Removals)*	**23,005,032**	**NA**

Electricity emissions have been updated since the **2024 Capital Region Climate Priorities Plan, which also impacts total emissions*

GHG Emissions by Geography

As the most highly populated counties, Sacramento, Yolo, and Placer counties generate the most GHG emissions in the Sacramento-Roseville CSA. Consistent with their lower population size, Yuba and Nevada counties have the smallest emissions. Figure 4 maps emission magnitudes by county, with darker colors indicating greater emission values.

Figure 4. 2019 Sacramento-Roseville CSA GHG Emissions

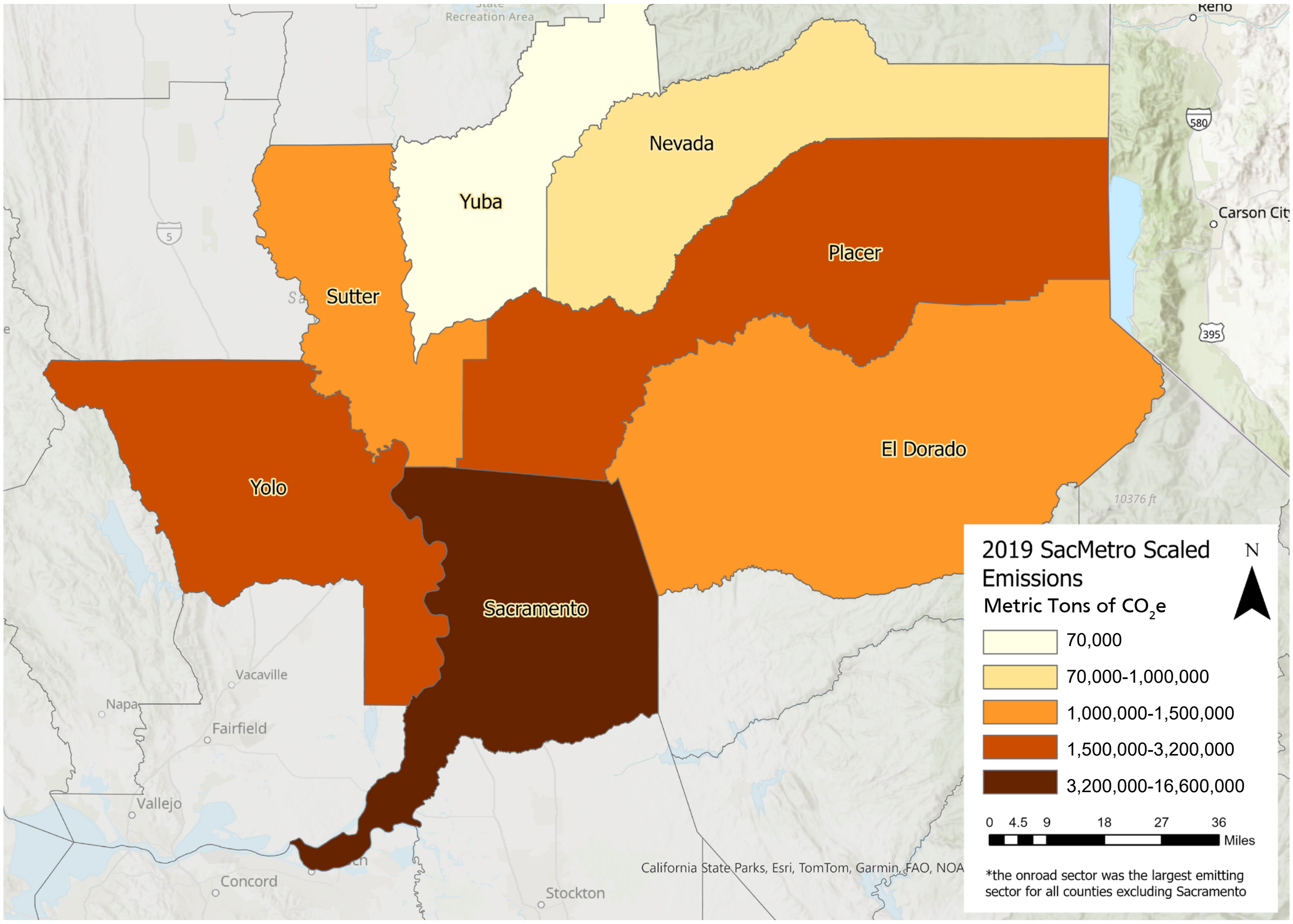
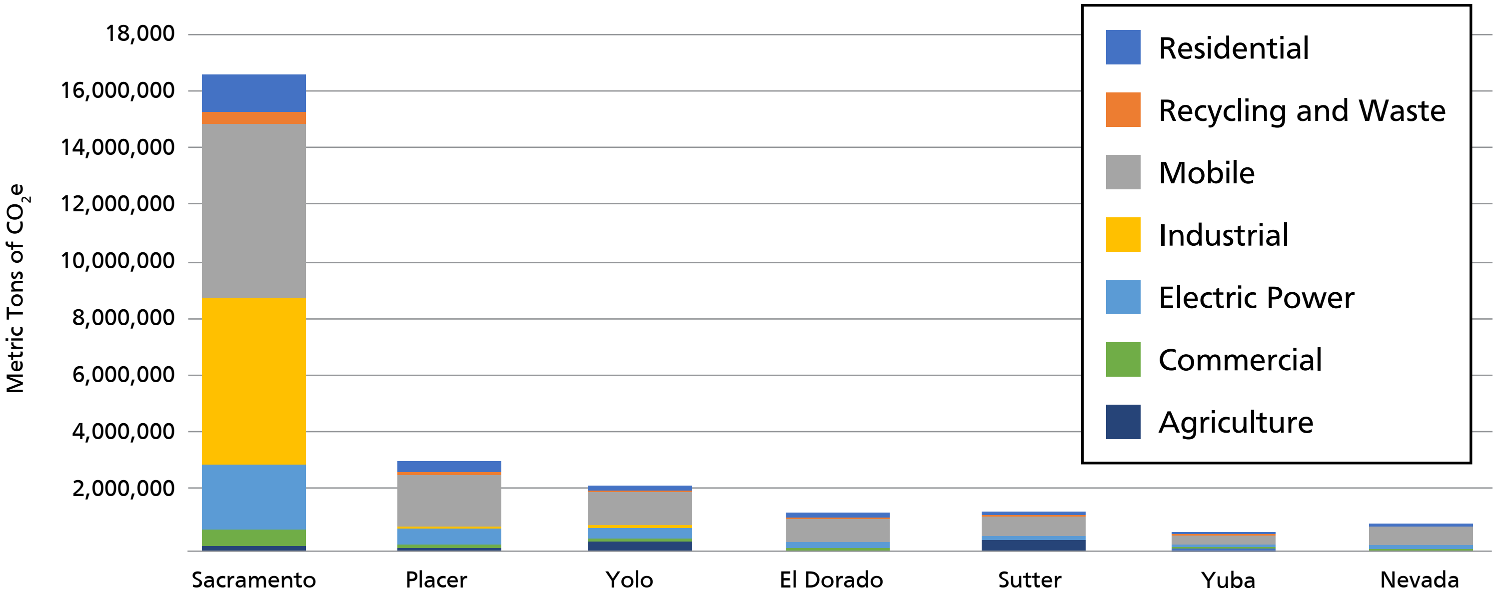


Figure 5 displays the emissions by county, stacked by sector. Across all counties, the mobile source sector was the greatest contributor to overall emissions with the largest contributions from on-road vehicles. However, in Sacramento County the industrial sector's contribution was close to the mobile sector's contribution.

Figure 5. Sacramento-Roseville CSA Annual 2019 GHG Emissions by County and Sector*



**The mobile sector includes the On-Road, Off-Road, Rail, and Waterborne subsectors*

Table 2 displays per capita gross emissions by county for the entire Sacramento-Roseville CSA. Sutter County has the highest per capita emissions, roughly double the emissions of El Dorado County. Sacramento County has the second highest per capita emissions while Nevada County has the third highest. While Sacramento County clearly presents the greatest opportunity for emissions reductions, exploring the sources of higher per capita emissions in Sutter and Nevada counties may present additional opportunities for emissions reductions.

Table 2. 2019 Regional Greenhouse Gas Emissions per Capita

County	2019 Regional GHGs (Metric Tons of CO_2e capita)
Sutter	12.53
Sacramento	10.49
Nevada	9.92
Yolo	9.48
Placer	8.67
Yuba	8.31
El Dorado	7.83
Sacramento-Roseville CSA Average Per Capita Emissions	**9.93**

This 2019 inventory provides a solid basis from which to develop an emissions reduction strategy across sectors and geographies. Guidelines for ongoing emissions tracking and inventory refinement can be found in Appendix A.

Overview by Sector

The next section provides an overview of GHG emissions by sector. Methodologies and details for each sector can be found in Appendix B.

Residential Sector

The residential sector includes emissions generated from on-site fuel combustion for space heating, water heating, cooking, and other fuel combustion in residential homes as well as fertilizer usage, and fugitive emissions related to refrigerants and other ozone depleting substances (ODS). The residential sector includes the following subsectors:

- Household Fuel Use: mainly natural gas combustion
- Landscape: residential use of nitrogen fertilizer on turf and other landscaping
- Fugitives of Transmission and Distribution: pipeline system leaks
- ODS: refrigerants, foams, aerosols and fire protection

Emissions in the residential sector are mainly generated by household fuel use (81%) for heating and cooking, and ODS (14%), which result from leaks from refrigerants in refrigerators and air conditioning units. Emissions for each county are displayed by subsector in Figure 6. Emissions per capita for each county are displayed in Figure 7.

Figure 6. 2019 Residential CO_2e[4] Emissions by County and Subsector

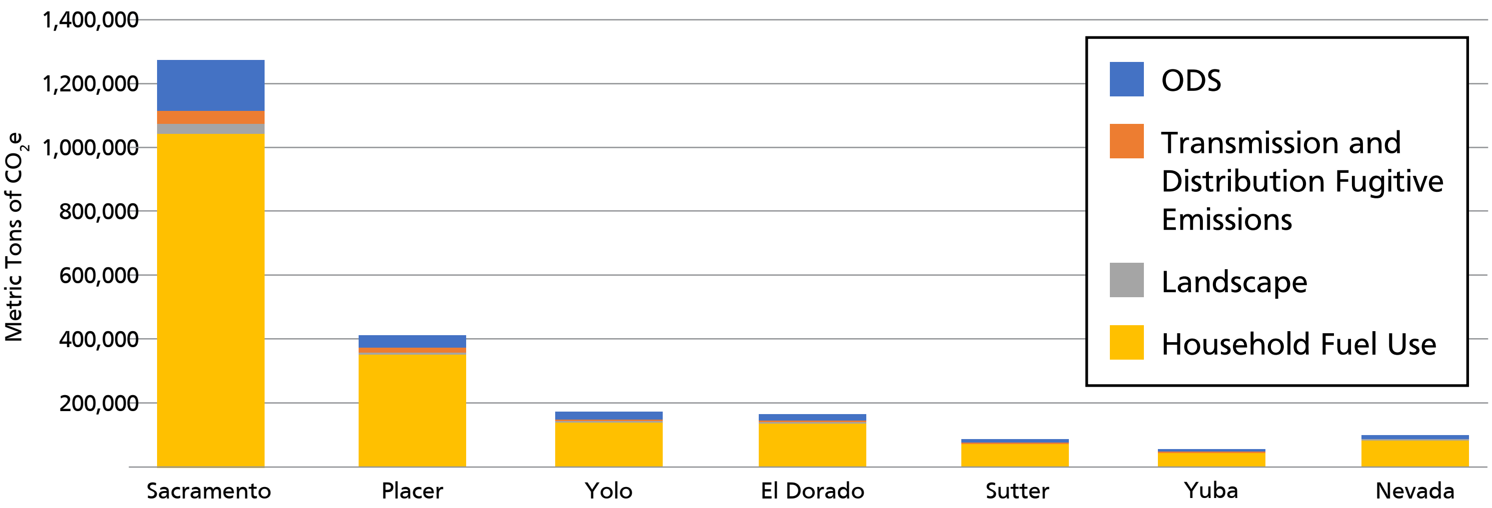
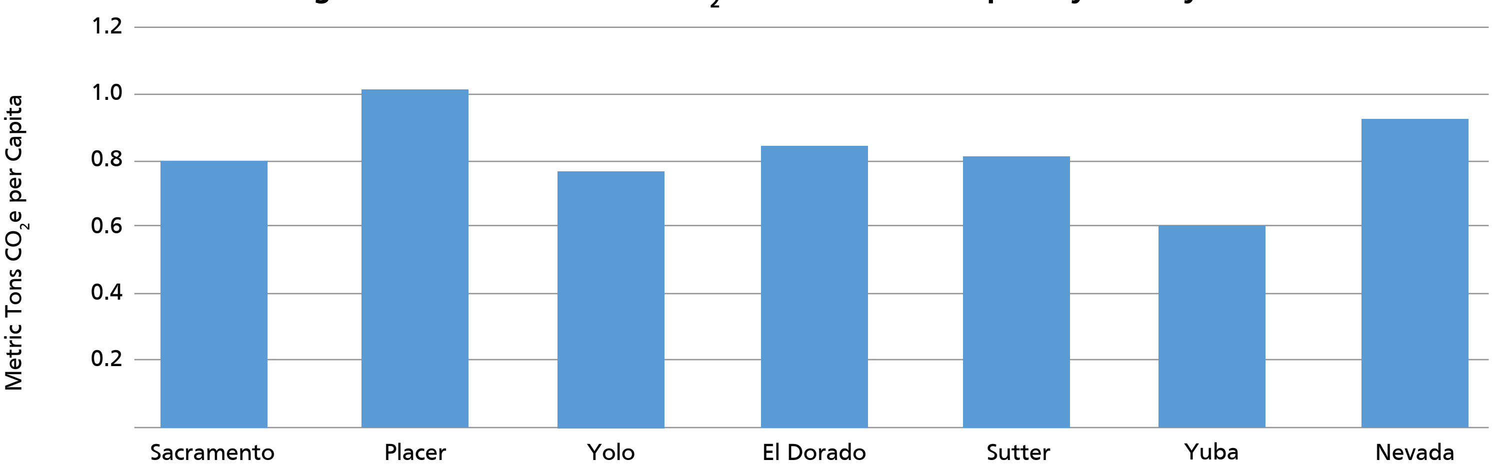


Figure 7. 2019 Residential CO_2e Emissions Per Capita by County



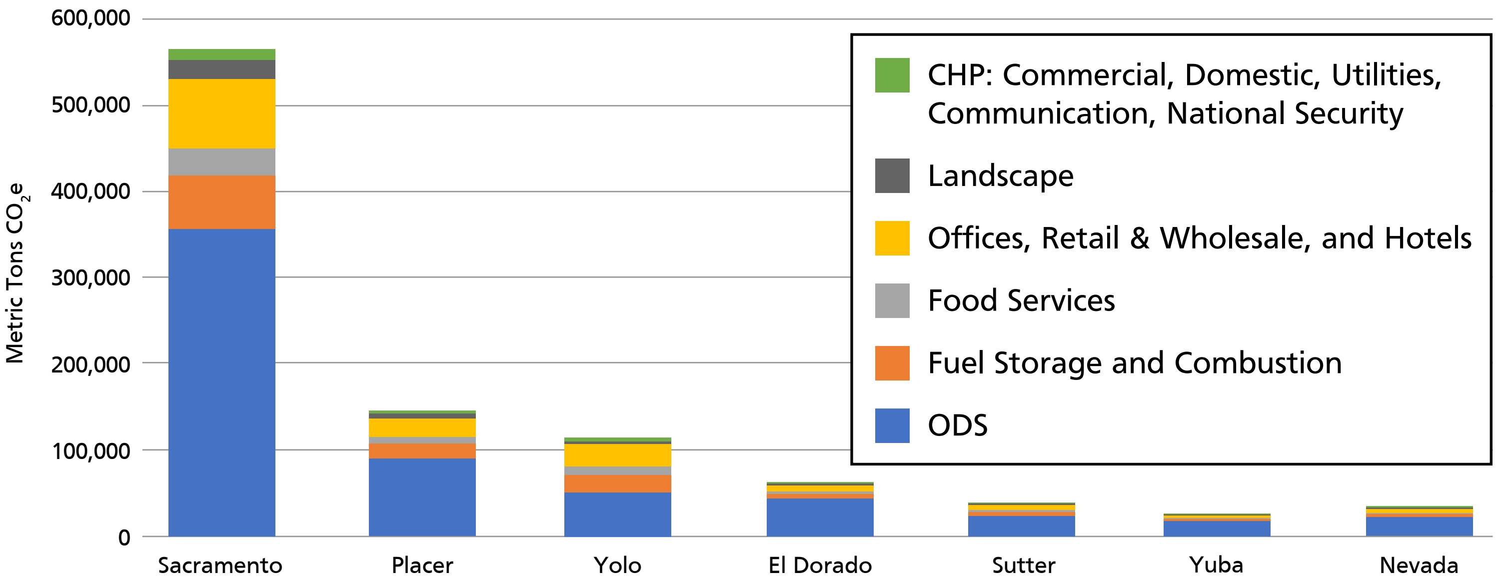
Commercial Sector

The commercial sector includes emissions from on-site fuel combustion for commercial heating, fuel storage, fertilizer use, and fugitive emissions of refrigerants and ODS. Most commercial sector emissions are generated through ODS fugitive emissions due to their high global warming potential (GWP), but there are also key contributors from commercial fuel combustion and fertilizer use.

Primary Commercial Emission Sources	Primary Sources of 2019 Regional GHGs
Fuel Combustion	Food Services, Offices, Health Care, Retail & Wholesale, Education, Hotels, Transportation Services, Combined Heat and Power (CHP): Commercial, Domestic, Utilities, Communication, National Security
Commercial Use of Nitrogen Fertilizer on Turf	Landscape
Fugitives	ODS

Commercial sector emissions are mainly generated by ODS (40%) and fuel combustion (17%). Emissions for each county are displayed by subsector in Figure 8.

Figure 8. Scaled 2019 Commercial CO_2e Emissions by County and Subsector



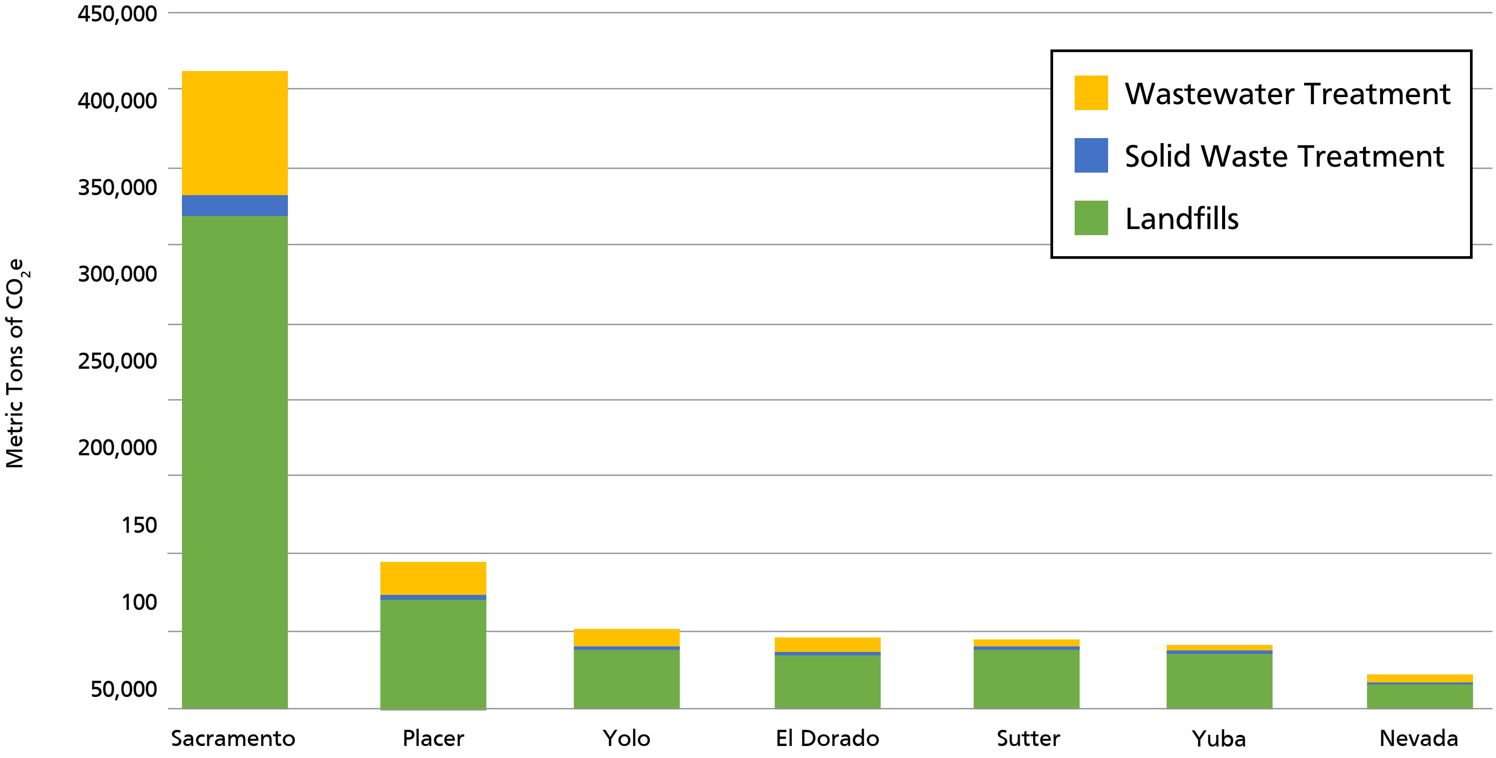
Recycling and Waste Sector

The recycling and waste sector includes emissions related to landfills and waste treatment. The following subsectors make up the recycling and waste sector:

- Landfills: emissions related to landfill gas (methane) generation
- Solid Waste Treatment: emissions related to composting
- Wastewater Treatment: emissions related to methane (CH_4) gas produced through anaerobic digestion used in wastewater treatment

Recycling and waste sector emissions are mainly generated by landfills (78%) and wastewater treatment (19%). Emissions for each county are displayed by subsector in Figure 9.

Figure 9. Scaled 2019 Recycling and Waste CO_2e emissions by County and Subsector



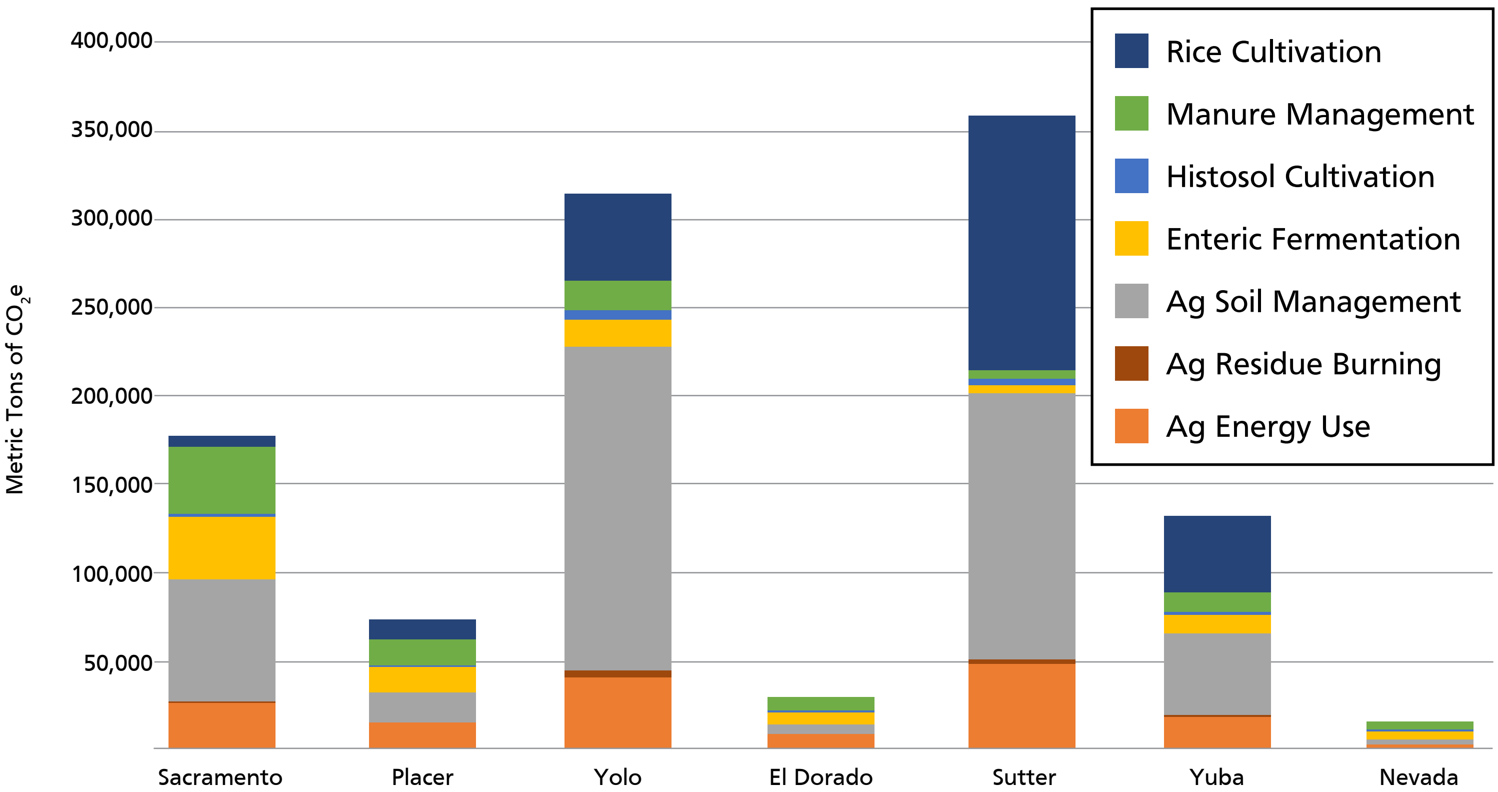
Agricultural Sector

The agricultural sector includes emissions related to energy use, crop residue and soil management, manure management, and crop cultivation. The following subsectors make up the agricultural sector:

- Agriculture Energy Use: energy consumption from off-road field equipment
- Agriculture Residue Burning: combustion emissions from crop residue burning
- Agriculture Soil Management: emissions related to nitrous oxide (N_2O) released during fertilizer and manure applications
- Enteric Fermentation: emissions from ruminant livestock (e.g., cattle & sheep) digestion
- Histosol Cultivation: N_2O emissions from agricultural soils
- Manure Management: methane emissions related to digesters or processes used in livestock waste management
- Rice Cultivation: emissions from methane-producing bacteria in the soil of rice cultivation

Agricultural sector emissions are mainly generated by soil management (43%) and rice cultivation (23%). There is substantial rice cultivation in the region, particularly in Yolo and Sutter counties. Emissions for each county are displayed by subsector in Figure 10.

Figure 10. Scaled 2019 Agriculture CO_2e Emissions by County and Subsector



Industrial Sector

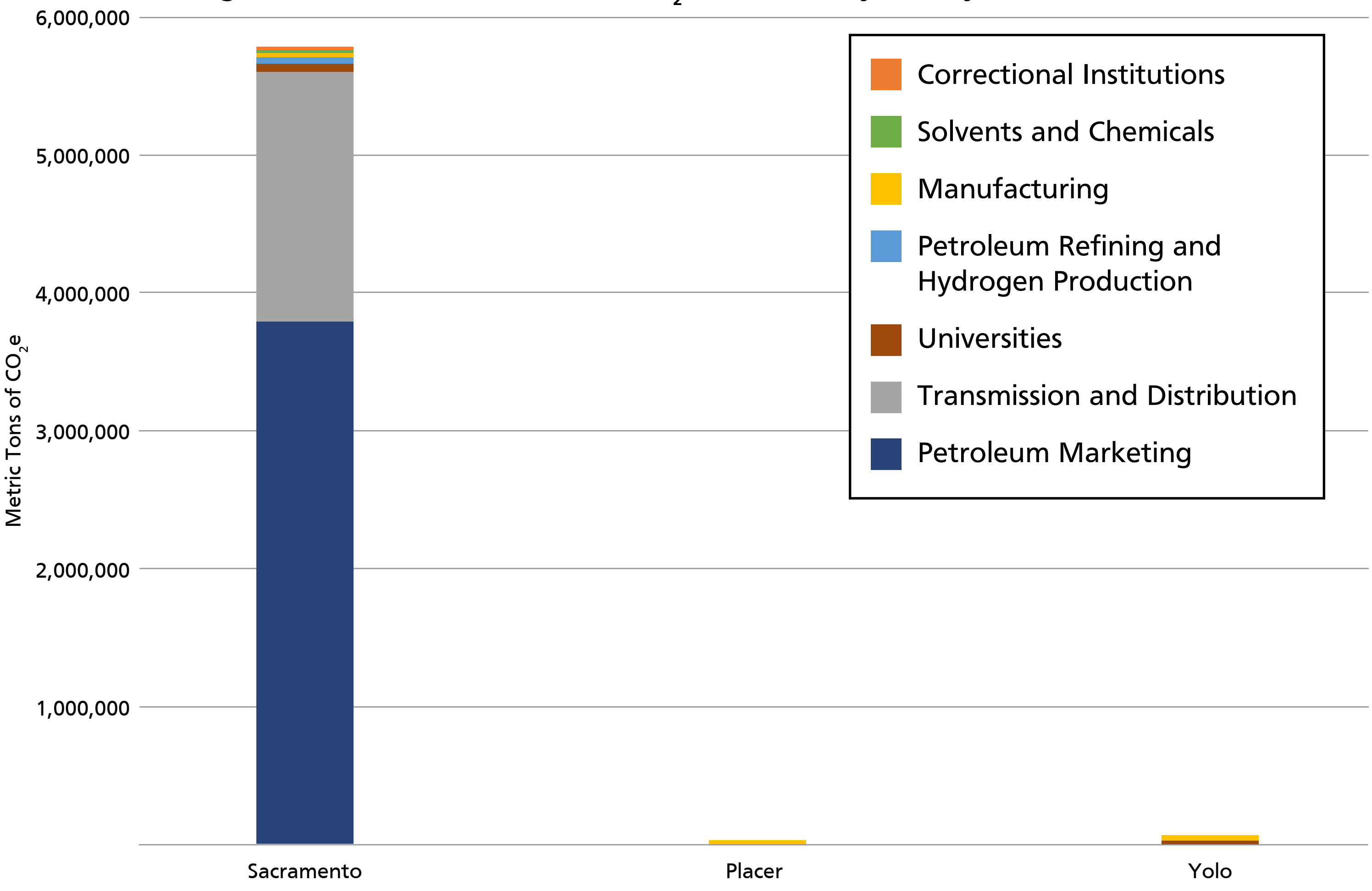
The industrial sector includes emissions related to factory, heavy industrial, and large facility operations. The following subsectors comprise the industrial sector:

- Petroleum Marketing: emissions from fuel bulk stations
- Transmission and Distribution: emissions from pipeline transportation systems for natural gas
- Correctional Facilities: emissions related to on-site steam generation and fuel combustion
- Petroleum Refining and Hydrogen Production: emissions related to petroleum refining and hydrogen production operations
- Manufacturing: emissions related to fuel combustion on-site
- Solvents and Chemicals: emissions related to fuel combustion on-site
- Universities: emissions related to on-site steam generation and fuel combustion

The industrial sector inventory focuses on major emitting facilities. The warehousing industry, which has a relatively low GHG emissions intensity and comprises 75% of the zoned industrial square footage in the region, is excluded from the industrial sector.

Emissions in the industrial sector are mainly generated by petroleum marketing (64%) and transmission and distribution of natural gas (17%). Industrial emissions in Sacramento County are the largest in the Sacramento-Roseville CSA, which is consistent with its greater density of industrial facilities countywide. Emissions for each county are displayed by subsector in Figure 11.

Figure 11. Scaled 2019 Industrial CO_2e Emissions by County and Subsector



Electricity Sector

The electricity sector includes emissions related to electricity usage within each of the Sacramento-Roseville CSA counties. While electricity is used across sectors, it is calculated separately for the purposes of a GHG inventory. Electrical sector emissions were based solely on local energy consumption and utility-specific emissions factors. Emissions for each county are displayed in Figure 12 and per capita emissions are showin Table 3.

Figure 12. Scaled 2019 Electricity Consumption CO_2e Emissions by County

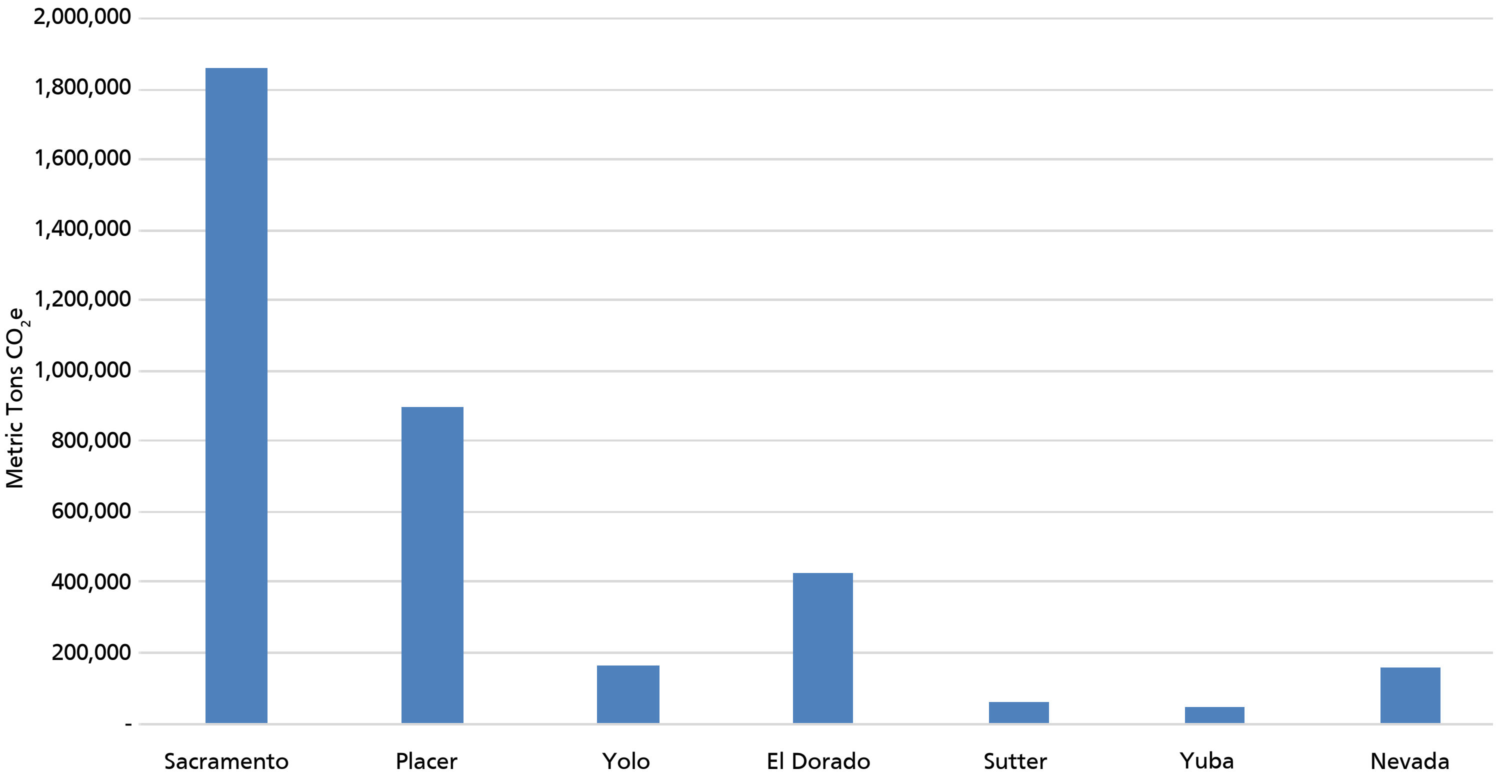


Table 3. 2019 Electricity Sector Greenhouse Gas Emissions Per Capita

County	2019 Electricity Sector GHG Emissions	MT CO_2e Per Capita
Sacramento	1,862,404	1.21
Placer	900,681	2.28
Yolo	162,113	0.74
El Dorado	426,534	2.25
Sutter	59,484	0.58
Yuba	47,868	0.62
Nevada	157,169	1.61

Mobile Sector

The mobile sector includes emissions generated from vehicle fleets, local rail trips, boats, and mobile off-road equipment. The following subsectors make up the mobile sector:

- On-Road Vehicles: light-duty vehicles (including passenger cars), heavy-duty vehicles, motorcycles and buses
- Off-Road Equipment: equipment across industries like construction, lawn and garden, industrial/cargo, agricultural, oil and gas, etc.
- Rail: freight and passenger locomotives traveling within the region
- Waterborne: pleasure craft and harbor craft

Mobile sector emissions are mostly generated by on-road vehicles (93%), with significant contributions from passenger cars and heavy-duty trucks. Emissions for each county are displayed by subsector in Figure 13 and per capita emissions are shown in Table 4.

Figure 13. Scaled 2019 Mobile CO_2e Emissions by County and Subsector

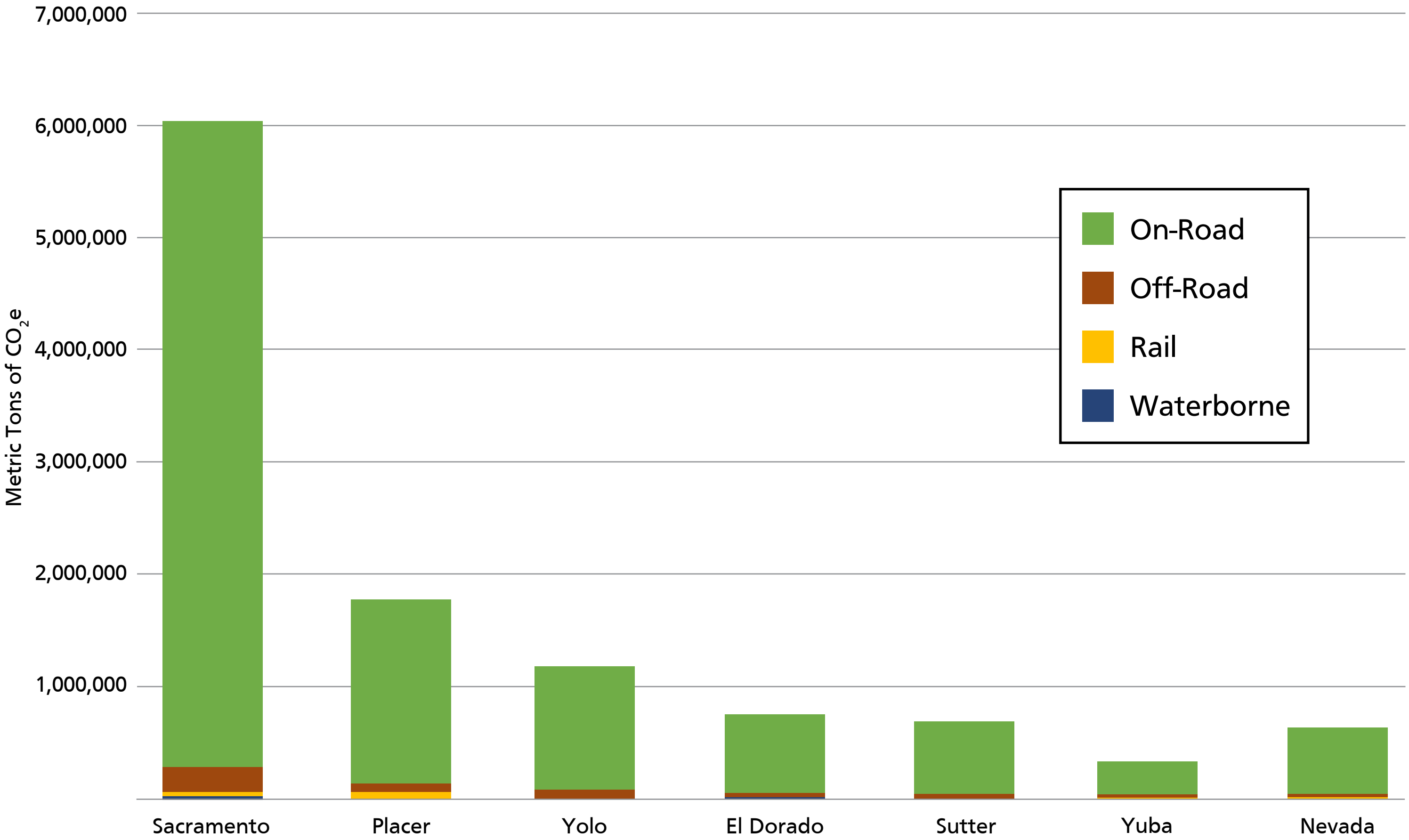


Table 4. 2019 Mobile Sector Greenhouse Emissions Per Capita

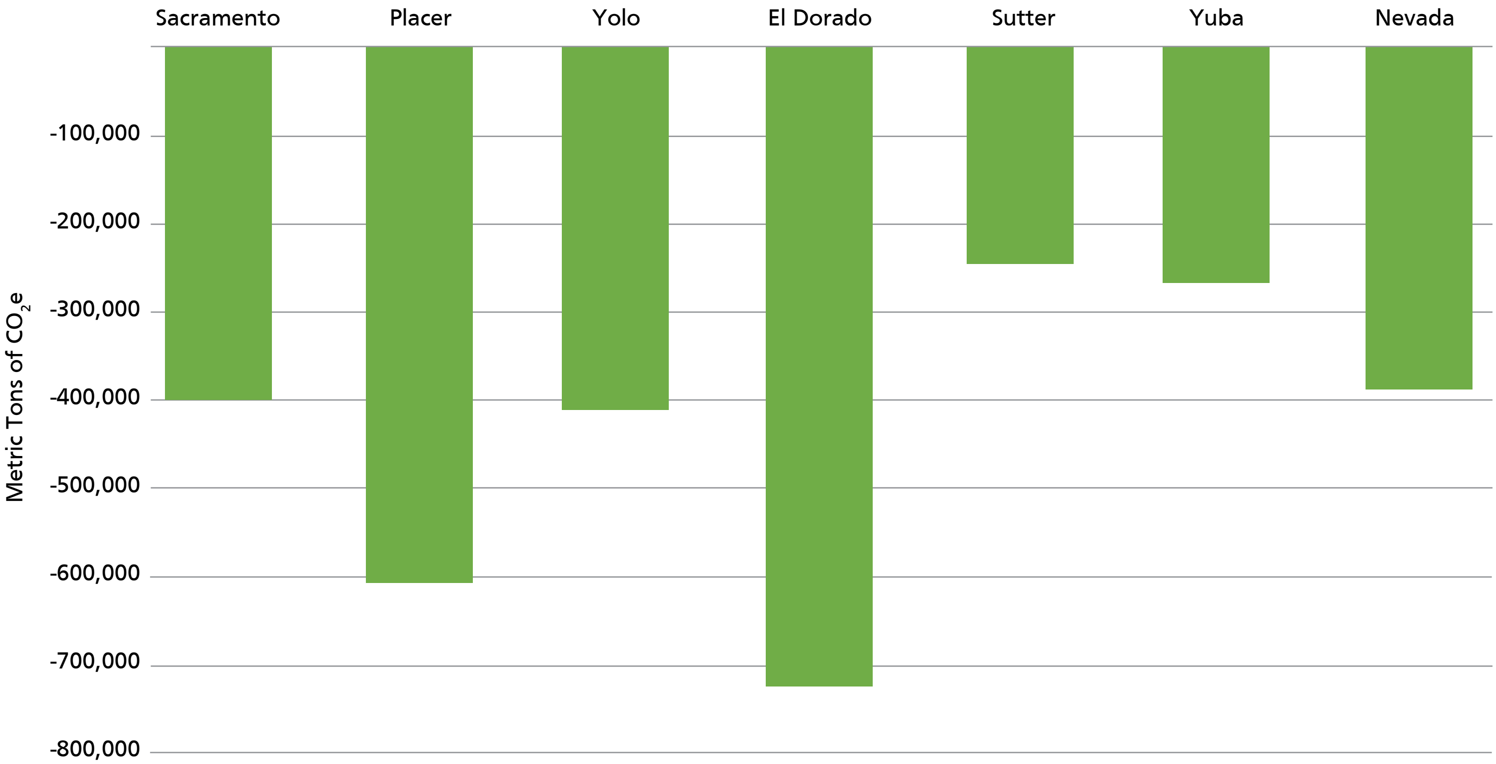
County	2019 Electricity Sector GHG Emissions	MT CO_2e Per Capita
Sacramento	6,046,037	3.93
Placer	1,787,4.52	4.52
Yolo	1,188,073	5.39
Sutter	702,371	6.84
El Dorado	760,206	4.01
Nevada	645,684	6.61
Yuba	344,439	4.46

Forestry

The forestry sector represents carbon dioxide (CO_2) emissions sequestered by trees and represented by tree coverage; therefore, this sector, is an estimate of a carbon sink in the region. A carbon sink is a process or mechanism, natural or otherwise, that absorbs carbon from the atmosphere.

Forestry sequestered emissions are shown in Figure 14. Carbon sink emissions in El Dorado County are the largest in the Sacramento-Roseville CSA area based on the significant amount of forestland in the region. El Dorado County is the most forested county in the Sacramento-Roseville CSA.

Figure 14. Scaled 2019 Forestry Sequestered CO_2e by County



GHG Emissions Forecast and Target-Setting

Sacramento-Roseville CSA's 2019 GHG emissions were forecast to 2030 and 2045 under a "business-as-usual" (BAU) scenario. This scenario considers the potential emissions impact of existing California and federal regulations and programs but assumes the Capital Region will not take further action to reduce emissions. Legislation integrated into the forecasts includes SB 100, Advanced Clean Cars (ACC) I, Advanced Clean Trucks, Heavy-Duty Omnibus, Heavy-duty Emission Warranty Phase 1, Innovative Clean Transit, and Safer Affordable Fuel-Efficient Vehicles Rules. The forecast indicators listed in Table 3 were used to forecast emissions in each sector.

Table 5. GHG Forecast Indicators

Sector	Forecast Indicator
Agriculture	No change
Residential Energy	Population growth
Commercial Energy	Service population growth (population and jobs)
Electric Power	Electricity use: service population growth Electricity emissions factor: utility-specific carbon-free electricity generation goals and SB 100 regulation (all utilities without carbon-free electricity goals are assumed to reach 100% clean electricity by 2045)
Industrial	Industrial job growth
Mobile (On-road)	CARB EMFAC vehicle miles traveled projections (based on socio-economic indicators and the California Statewide Travel Demand Model) and emissions projections (based on various state and national factors)
Mobile (Off-road)	CARB Off-road Web Tool emissions projections
Mobile (Rail)	Service population growth
Mobile (Waterborne)	Population growth
Recycling and Waste	Service population growth
Forestry	No Change

The mobile (on-road) sector emissions forecast was completed using the CARB EMFAC2021 tool[6]. The Emissions Factor Model (EMFAC) integrates the impact of certain California regulations on vehicle types and miles traveled, such as from ACC 1, Advanced Clean Trucks, and Heavy-Duty Omnibus. However, at the time of emissions forecasting, the California ACC II regulation, which requires 35% light-duty zero-emissions vehicle (ZEV) sales in 2026 and 100% in 2035, had not been integrated into the EMFAC model. Therefore, business-as-usual mobile (on-road) emissions will most likely be lower than expected and the current forecasts represent a conservative estimate. Emissions in the agriculture and forestry sectors were held constant from 2019 levels. While agriculture is likely to remain an important economic contributor in the region, expected population and employment growth will continue to exert pressure on the region's agricultural lands, potentially leading to decreasing agricultural acreage and corresponding GHG emissions over the long-term. Forestry sector emission forecasts are dependent upon numerous variables, including long-term impacts from climate change. The role of forestry sector carbon sequestration in the context of the region's 2045 carbon neutrality goal will require additional analysis to better understand its long-term potential. Therefore, forestry emission forecasts were kept constant from 2019 levels.

The business-as-usual 2019-2045 emissions forecast results by sector are shown in Figure 15 and Table 4. The forecasts show that if the region does not take any further climate action, regional gross emissions (excluding forestry removals) could decrease 14% and net emissions (including forestry removals) could decrease 15% by 2045.

Figure 15. Region-wide GHG Emissions Forecasts by Sector – BAU Scenario

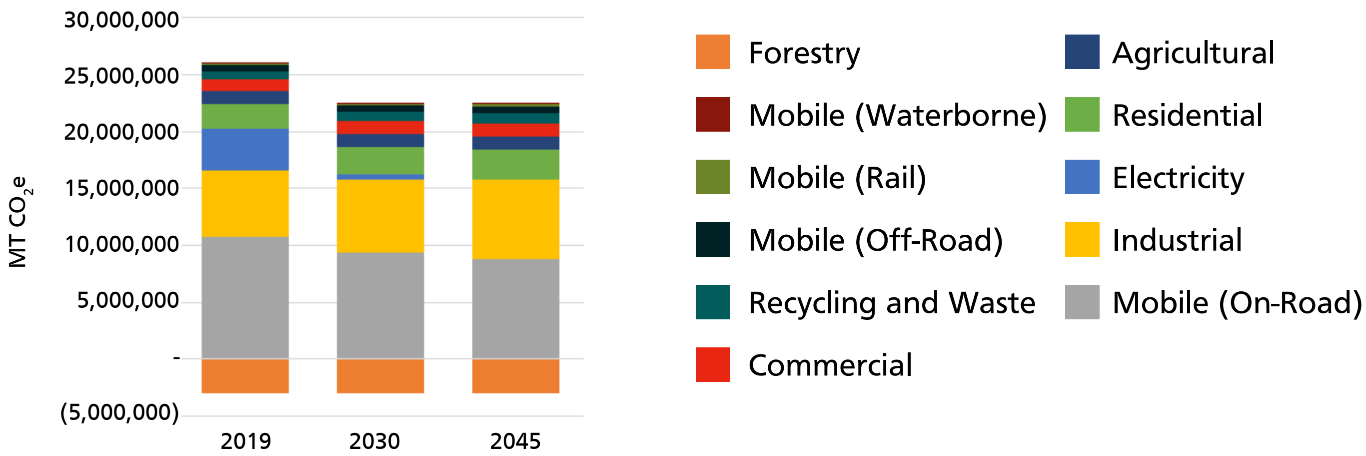


Table 6. Region-wide GHG Emissions (MT CO_2e) Forecasts by Sector– BAU Scenario

Sector	2019	2030	2045	Percent Change 2019-2045
Mobile (On-Road)	10,713,128	9,347,158	8,804,307	-18%
Industrial	5,907,051	6,389,523	6,953,552	18%
Electricity	3,616,254	507,265	0	-100%
Residential	2,231,851	2,451,593	2,693,669	21%
Agricultural	1,100,837	1,100,837	1,100,837	0%
Commercial	988,062	1,089,300	1,200,240	21%
Recycling and Waste	716,684	790,117	870,586	21%
Mobile (Off-Road)	546,763	568,820	605,024	11%
Mobile (Rail)	135,349	149,217	164,414	21%
Mobile (Waterborne)	78,819	86,895	95,745	21%
Forestry	(3,029,766)	(3,029,766)	(3,029,766)	0%
Gross Total (Excluding Forestry Removals)	**26,034,798**	**22,480,725**	**22,488,373**	**-14%**
Net Total (Including Forestry Removals)	**23,005,032**	**19,450,960**	**19,458,608**	**-15%**

The drop in emissions from 2019 to 2045 is primarily due to reductions in the mobile (on-road) and electricity sectors. As the CARB EMFAC model predicts that regional VMT will increase from 2019 to 2045, the 18% decrease in mobile (on-road) emissions is primarily due the increase in low- and zero-emissions vehicles in California and in new vehicle fuel efficiency. Electricity-related emissions are fully reduced by 2045 due to Senate Bill (SB) 100 (De León, 2018) requirements, meaning that any electricity used in the region will produce no emissions by 2045. The forestry sector is expected to reduce gross emissions by approximately 13% annually in 2030 and 2045.

Figure 16 shows the 2045 forecast emissions by sector. By 2045, the majority of the region's GHG emissions are estimated to come from the mobile on-road (39%), industrial (31%), and residential (12%) sectors.

Figure 16. 2045 Region-wide BAU GHG Emissions (MT CO_2e) Forecasts by Sector

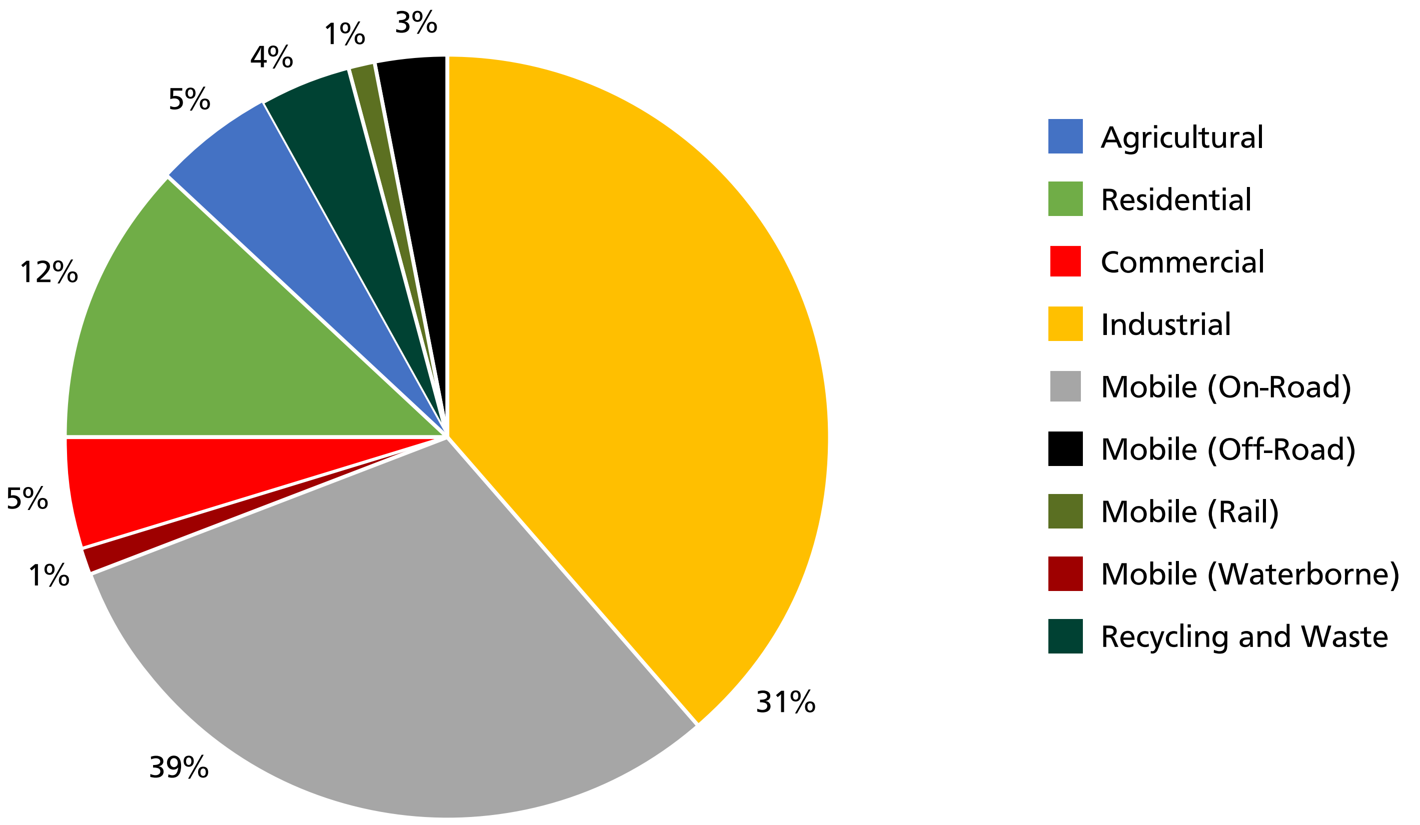
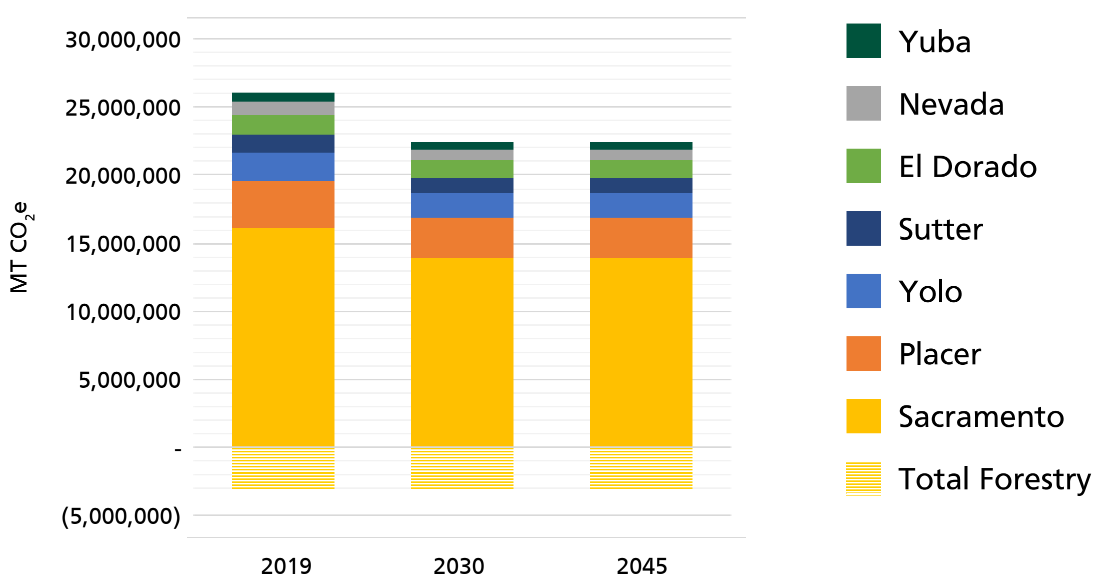


Figure 17 shows forecast GHG emissions by county (note that the forestry sector is not disaggregated by county). Of all counties in the region, Sacramento County will continue to produce the most emissions from 2019 to 2045.

Figure 17. BAU Forecast GHG Emissions by County



GHG Reduction Targets

As part of the Plan development process, the Sacramento-Roseville CSA set economy-wide and sector-based near-term (2030) and long-term (2045) GHG emissions targets for the region. These targets are not meant to replace any existing community GHG reduction targets but can act as initial targets for communities that have not yet established official targets.

There are two ways to lower GHG emissions in pursuit of the GHG targets:

- **GHG Reductions**: Reduce the amount of GHGs released into the atmosphere through strategies like energy efficiency, renewable energy, etc.
- **GHG Removals:** Directly remove GHGs from the atmosphere through strategies like biogenic carbon sequestration or direct air capture.

GHG targets can be set on a net or gross GHG emissions basis, which account for GHG removals differently:

- **Gross Emissions:** Total emissions without removals (e.g., excluding CO_2 removals from forests or trees)
- **Net Emissions:** Total emissions with removals (e.g., including CO_2 removals from forests or trees)

A gross emissions target can only be met through emissions reductions while a net emissions target can be met through emissions reductions and removals. The state of California has set both gross and net GHG reduction targets in line with scientific best practice as outlined in Table 5.

Table 7. State of California GHG Targets

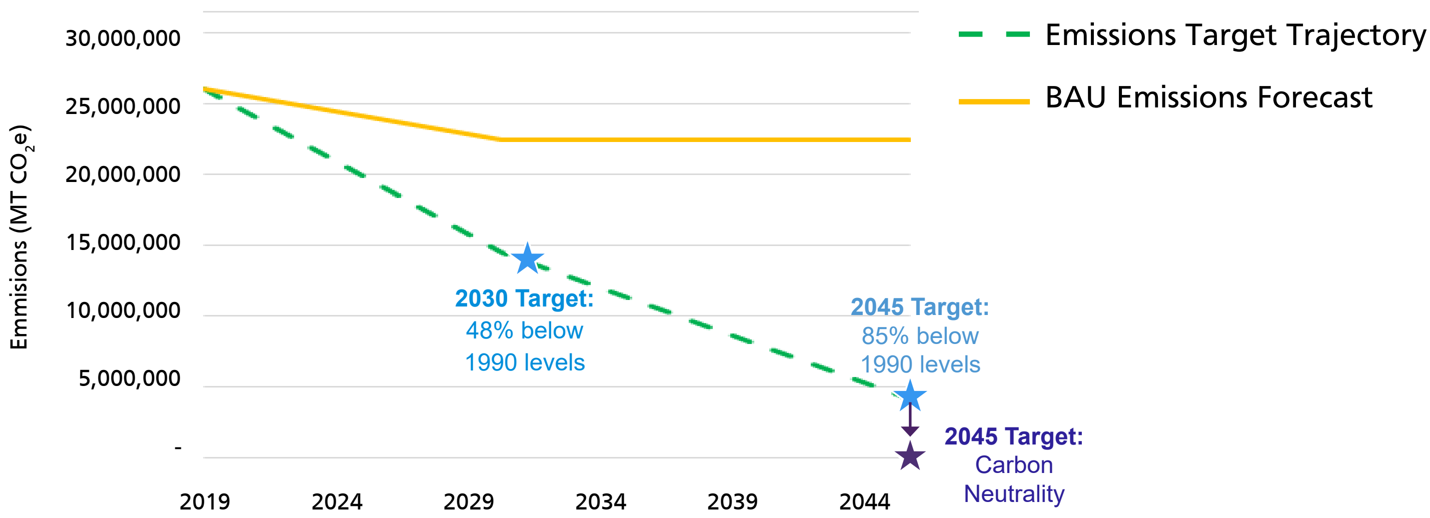
Target Type	2030	2045
Gross Emissions Targets	40% below 1990 levels (SB 32)	85% below 1990 levels (AB 1279, Muratsuchi, 2022)
Net Emissions Targets	NA	Carbon neutral (AB 1279)

The CARB Scoping Plan lays out a roadmap to meeting these emissions goals. In the 2022 Scoping Plan, CARB adopted a more ambitious GHG reduction goal of 48% below 1990 levels by 2030, which exceeds the 2030 goal adopted through SB 32 (i.e., 40% below 1990 levels).[7] The 2022 Scoping Plan also recognizes the importance of local governments in supporting the state's GHG reduction goals. Therefore, with the input of the steering committee and other stakeholders, the Sacramento-Roseville CSA aligned its Plan with the state's GHG targets, including the more aggressive 48% reduction by 2030 target (see Table 6).

Table 8. Sacramento-Roseville CSA GHG Targets

Target Type	2030	2045
Gross Emissions Targets	48% below 1990 levels (14,503,022 MT CO_2e)	85% below 1990 levels (4,205,669 MT CO_2e)
Net Emissions Targets	NA	Carbon neutral

Figure 18. Sacramento-Roseville CSA GHG Targets



To estimate the region's total target emissions levels in 2030 and 2045, regional 1990 emissions were approximated using the region's 2019 inventory, assuming the region's historic emissions trends paralleled California's emissions trends. For example, in 1990, the state of California's gross emissions were 7% higher than 2019 statewide levels. Therefore, it was assumed that the Sacramento-Roseville CSA's 1990 emissions were also 7% higher than the region's 2019 levels, or roughly 28,037,795 MT CO_2e in 1990. The emissions reduction targets of 48% and 85% below 1990 levels were then applied to the region's 1990 emissions to estimate the targeted emissions in 2030 and 2045 (see Table 6).

The regional emissions forecast estimates 20% reductions below 1990 levels by 2030, approximately maintaining that level of reductions through 2045. Therefore, the region will not meet the emissions reduction targets of 48% below 1990 levels by 2030 or 85% by 2045 under the business-as-usual scenario, and additional GHG reduction measures will be needed. The Plan developed sector-specific GHG reduction

Table 9. Sector-Specific 2030 and 2045 GHG Reduction Targets

Sector (% 2045 emissions)	Recommended 2030 Target (% reduction from 2019 levels)	Recommended 2045 Target (% reduction from 2019 levels)
Transportation – on-road, off-road, waterborne, rail (43%)	35%	80%
Electricity (0%)*	86%	100%
Industrial (31%)	47%	85%
Residential and Commercial (17%)	30%	95%
Agriculture (5%)	40%	65%
Waste (4%)	7%	19%
Total Region-wide Reduction Targets	48% below 1990 levels	85% below 1990 levels/Carbon Neutral

*In the business-as-usual emissions forecast, it is assumed utilities either meet their own carbon-free electricity targets or SB 100, whichever comes first (SB 100 requires 100% of retail electricity sales to be carbon-free by 2045). Therefore, the Electric Power sector goals align with utility goals/SB 100 instead of the California Scoping Plan Scenario goals of a 35% reduction by 2030 and 86% reduction by 2045.

targets to illustrate what it will take to meet these economy-wide targets. While it is not necessary to achieve the exact sector-specific targets to meet the economy-wide targets, the sectoral targets in Table 7 can act as guideposts for the relative level of effort needed to meet regional reduction targets. The sectoral targets were informed by the California Scoping Plan Scenario sector-specific reductions outlined in the AB 32 GHG Inventory Sectors Modeling Data Spreadsheet, California's Renewables Portfolio Standard of 100% clean electricity by 2045, and steering committee input.[8] Sector-specific targets are presented as reductions from 2019 levels instead of 1990 because 1990 sector-specific emissions were not estimated.

Remaining Emissions

To achieve the 2045 carbon neutral target, the region must reduce at least 85% of emissions through reduction strategies, such as energy efficiency and clean energy, and address the remaining emissions through removal strategies, such as carbon removal from forests. If the region meets its 85% reduction goal by 2045, the remaining 15% of emissions equates to approximately 4.2 MMT CO_2e. The emissions forecast assumes forestry removals remain constant from 2019-2045, so forests would remove approximately 3.0 MMT CO_2e/year in 2045 to help the region reach a 96% reduction by 2045. The remaining 4% of emissions (approximately 1.2 MMT CO_2e) would then have to be addressed with additional carbon dioxide removal (CDR) strategies.

Conventional CDR methods (i.e., those that are well established, already deployed at scale, and are widely reported), include afforestation/reforestation and forest management, peatland and coastal wetland restoration, and soil carbon sequestration. Novel CDR methods include ocean fertilization, direct air carbon capture and storage, bioenergy with carbon capture and storage, biochar, ocean alkalinity enhancement, and enhanced rock weathering. Carbon capture and storage (CCS) is a set of industrial methods for the chemical capture and geological storage of CO_2. The Scoping Plan focuses on direct air carbon capture and storage, bioenergy with carbon capture and storage, and natural and working lands strategies. The Scoping Plan notes that the state's natural and working lands sector will likely be a net source of emissions in the coming decade, so other forms of mechanical CDR such as direct air capture will be needed to meet the carbon neutral target.

REFERENCES

[1] Census, 2023. Accessed online at https://www2.census.gov/geo/maps/econ/ec2012/csa/EC2012_330M200US472M.pdf

[2] Even though a more recent year (2022) of forecasted emissions is available in the 2022 Final Scoping Plan, it was not leveraged for this effort because: 1) the level of subsector granularity in CARB's Annual Statewide Inventory is higher and allows more flexibility for scaling emissions and leveraging the inventory during the analysis of measures; 2) the Scoping Plan documentation focuses on describing methodologies for years affected by the Plan (2023 and beyond); hence, limited information is available for 2022 emissions; 3) differences are minor in overall emissions between the CARB Annual Statewide Inventory historical year 2020 and the Scoping Plan forecasted year 2022.

[3] Figures and tables in this summary do not include sequestered carbon emissions from the Forestry sector.

[4] Carbon dioxide equivalent measured in the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another greenhouse gas.

[5] Warehousing emissions associated with electricity use are included under the electricity sector; warehousing emissions associated with natural gas use are included under the commercial sector; and warehousing emissions associated with vehicles and equipment are included under the mobile sector.

[6] EMFAC2025 was not available at the time of GHG forecast development.

[7] 2022 Scoping Plan

[8] AB 32 GHG Inventory Sectors Modeling Data Spreadsheet

Chapter 3. Co-Pollutant Inventory and Projections

Co-pollutants include criteria air pollutants (CAPs) and hazardous air pollutants (HAPs).[1] The Clean Air Act (CAA) requires the EPA to set National Ambient Air Quality Standards (NAAQS) for CAPs which include carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide. These pollutants are found all over the U.S. and can harm public health, the environment, and cause property damage. HAPs are other pollutants beyond the six CAPs that are known or suspected to cause cancer and other health effects, as well as adverse environmental effects. There are almost 200 HAPs, including benzene, formaldehyde, and methylene chloride.

Co-pollutant emissions generated within the Sacramento-Roseville CSA region were gathered from the EPA's 2017 National Emissions Inventory (NEI). The NEI is based primarily upon data provided by State, local, and Tribal air agencies for sources in their jurisdictions and supplemented by data developed by the EPA. These 2017 activities serve as a proxy for 2019 base year activities as it is the latest year prior to 2019 for which data is available. The co-pollutants quantified in the NEI also include CAP precursors such as volatile organic compounds — a precursor to ozone — and ammonia — a precursor to particulate matter (levels of ozone and lead are not included in the NEI). Co-pollutant emissions from NEI were gathered from the following sectors: agriculture, dust, fires (agricultural field burning, prescribed fires, and wildfires), fuel combustion, industrial processes, mobile, solvents, miscellaneous (non-industrial not classified elsewhere sources), and other (vegetation and soil, bulk gasoline terminals, commercial cooking, gas stations, waste disposal). A summary of the Sacramento-Roseville CSA region 2019 co-pollutant emissions are included in Table 1 while the following tables show 2019 co-pollutant emissions by sector for each pollutant.[*] The major source varies by co-pollutant, but generally, most co-pollutant emissions are generated by activities associated with the mobile, fuel combustion, agriculture, and fires (wildfires) sectors.

It is important to note that the seven-county region experienced 526 wildfires, burning approximately 15,482 acres in 2017 compared to 531 wildfires burning 13,386 acres in 2016 (2017 wildfire data was assessed as the co-pollutant 2019 inventory is based on 2017 EPA NEI data). On a statewide basis, during 2017, wildfire firefighting agencies responded to 9,270 fires that burned 1,548,429 acres, a 12% increase in the number of fires and a 76% increase in acres burned from 2016. The Clean Air Act Section 319(b) recognizes that using air monitoring data influenced by an exceptional event, like wildfires, may not be appropriate when making certain regulatory decisions. For air monitoring data influenced by an exceptional event that causes one or more exceedances of the NAAQS, CAA Section 319(b) establishes a mechanism to exclude this air monitoring data from regulatory determinations. However, these wildfire-related emissions are included in the NEI.

** Carbon monoxide (CO) and particulate matter 10 (PM10) were also quantified but not included in the 2019 co-pollutant inventory results as they were not as significant as other co-pollutants. However, each measure quantifies potential CO and PM10 reductions.*

Table 1. Sacramento-Roseville CSA 2019 Co-Pollutant Emissions by County (short tons)

Co-Pollutants	El Dorado	Nevada	Placer	Sacramento	Sutter	Yolo	Yuba
Ammonia	1,255	984	1,425	5,593	1,504	3,300	1,299
HAPs	1,439	1,254	1,210	2,746	411	649	505
Nitogen Oxides	1,968	2,076	4,802	10,626	2,798	3,255	1,269
$PM_{2.5}$	3,147	2,638	1,969	3,792	943	1,661	893
Sulfur Dioxide	224	306	132	336	35	111	78
Volatile Organic Compounds	9,241	7,340	6,535	16,126	2,673	4,837	2,871

Figure 1. Total Ammonia Emissions by Sector

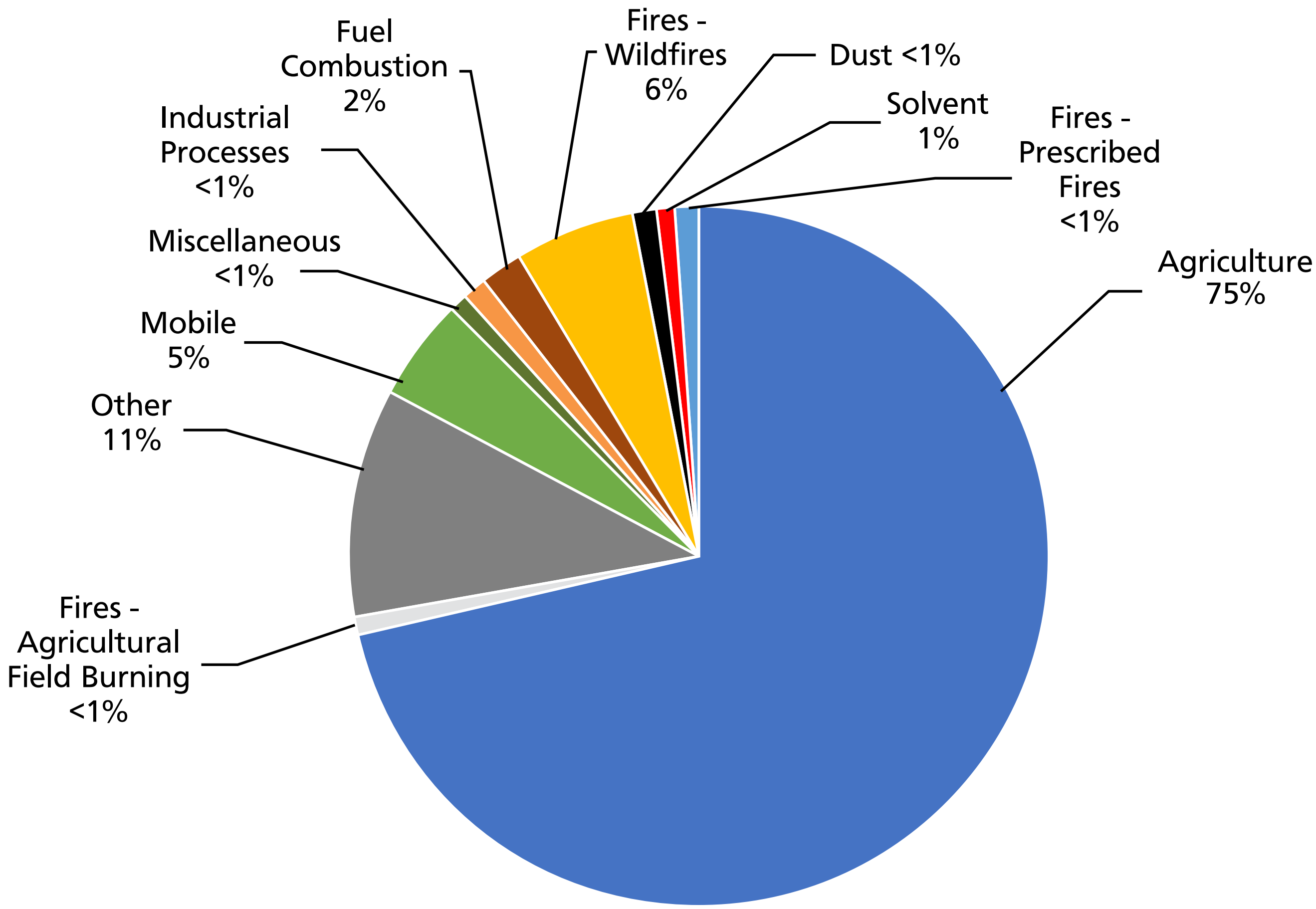


Figure 2. Total HAPs Emissions by Sector

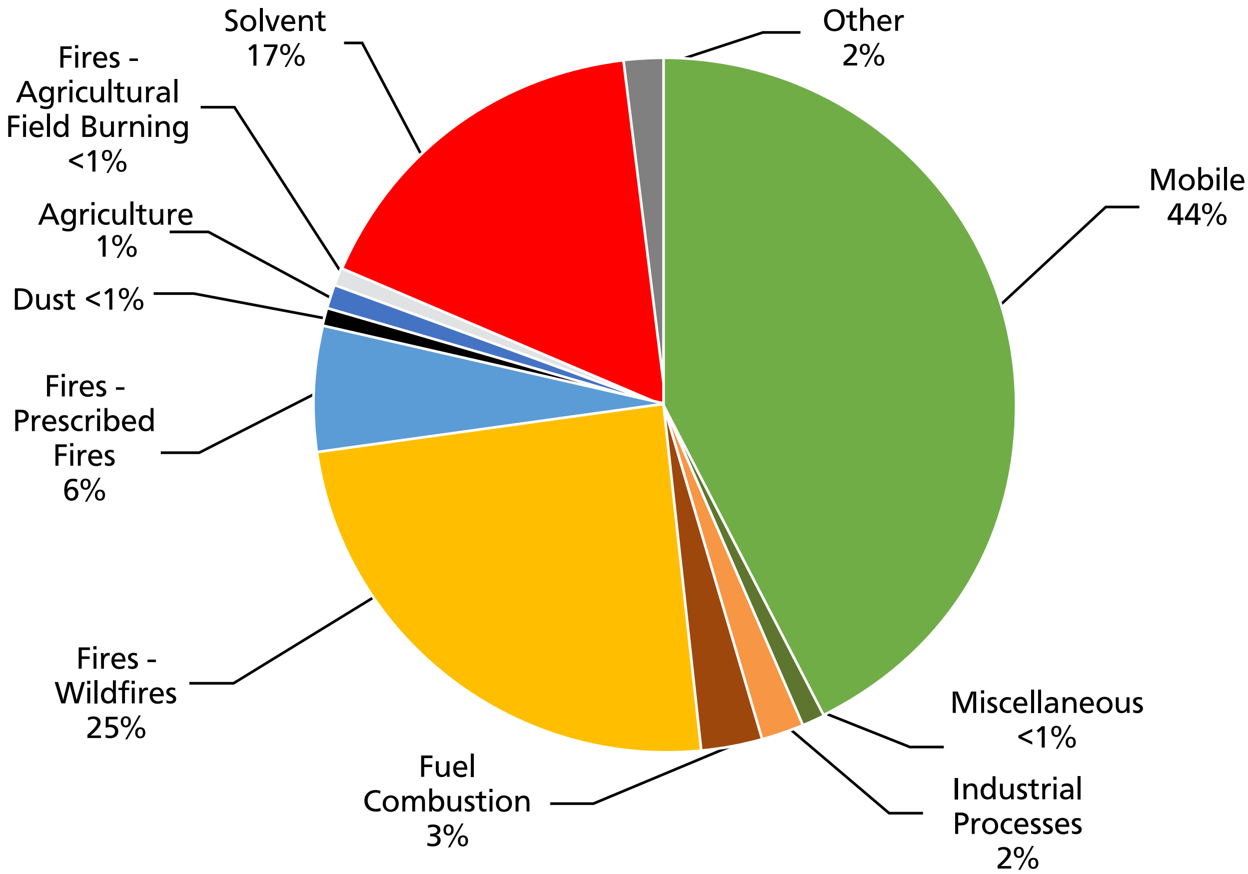


Figure 3. Total Nitrogen Oxides Emissions by Sector

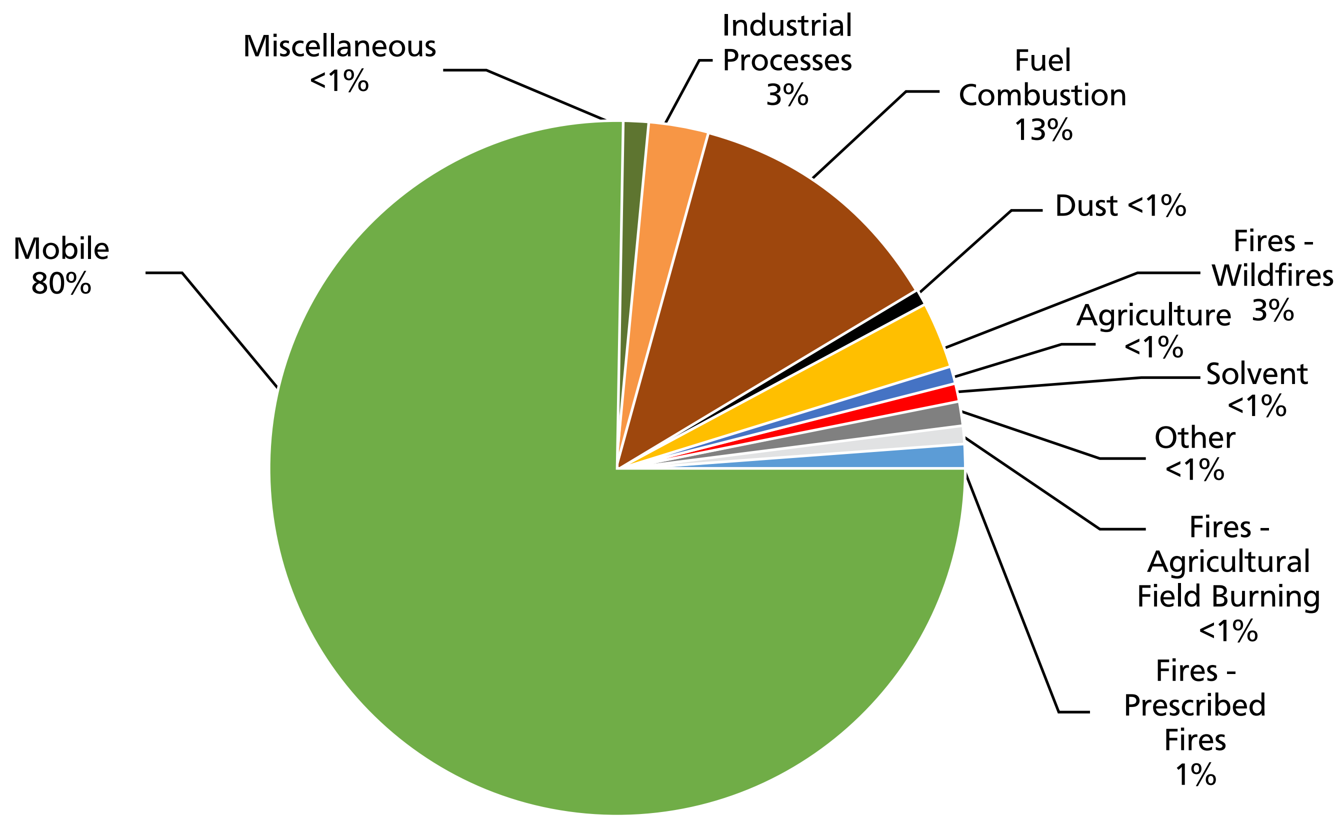


Figure 4. Total $PM_{2.5}$ Emissions by Sector

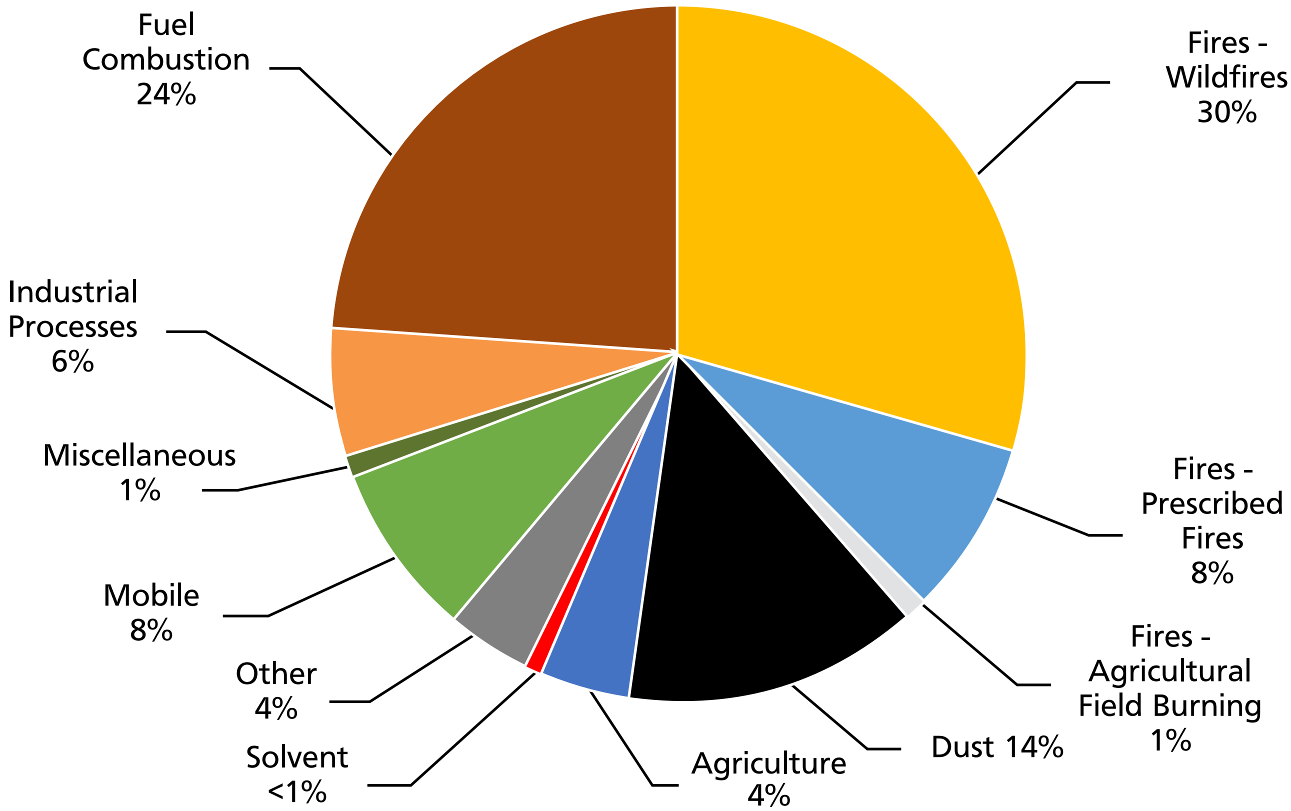


Figure 5. Total Sulfur Dioxide Emissions by Sector

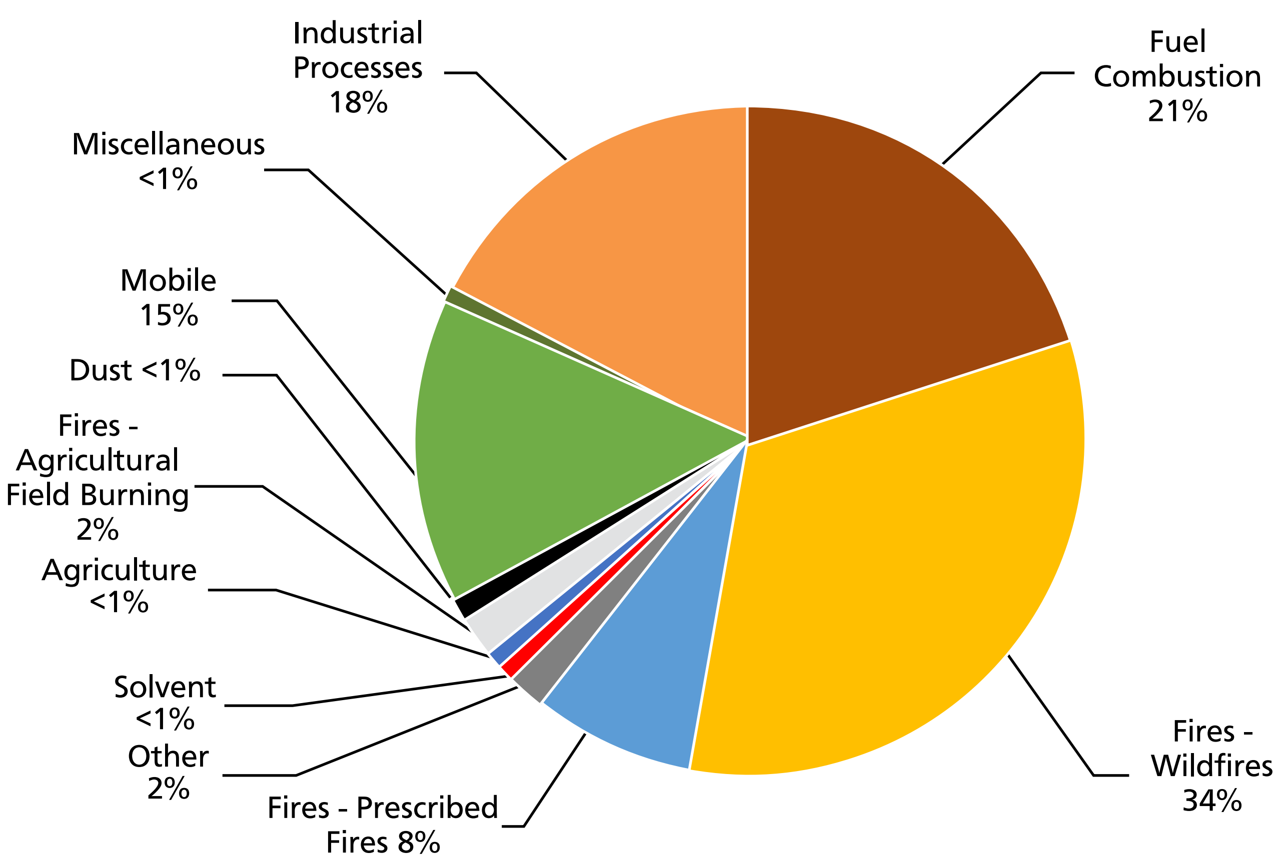
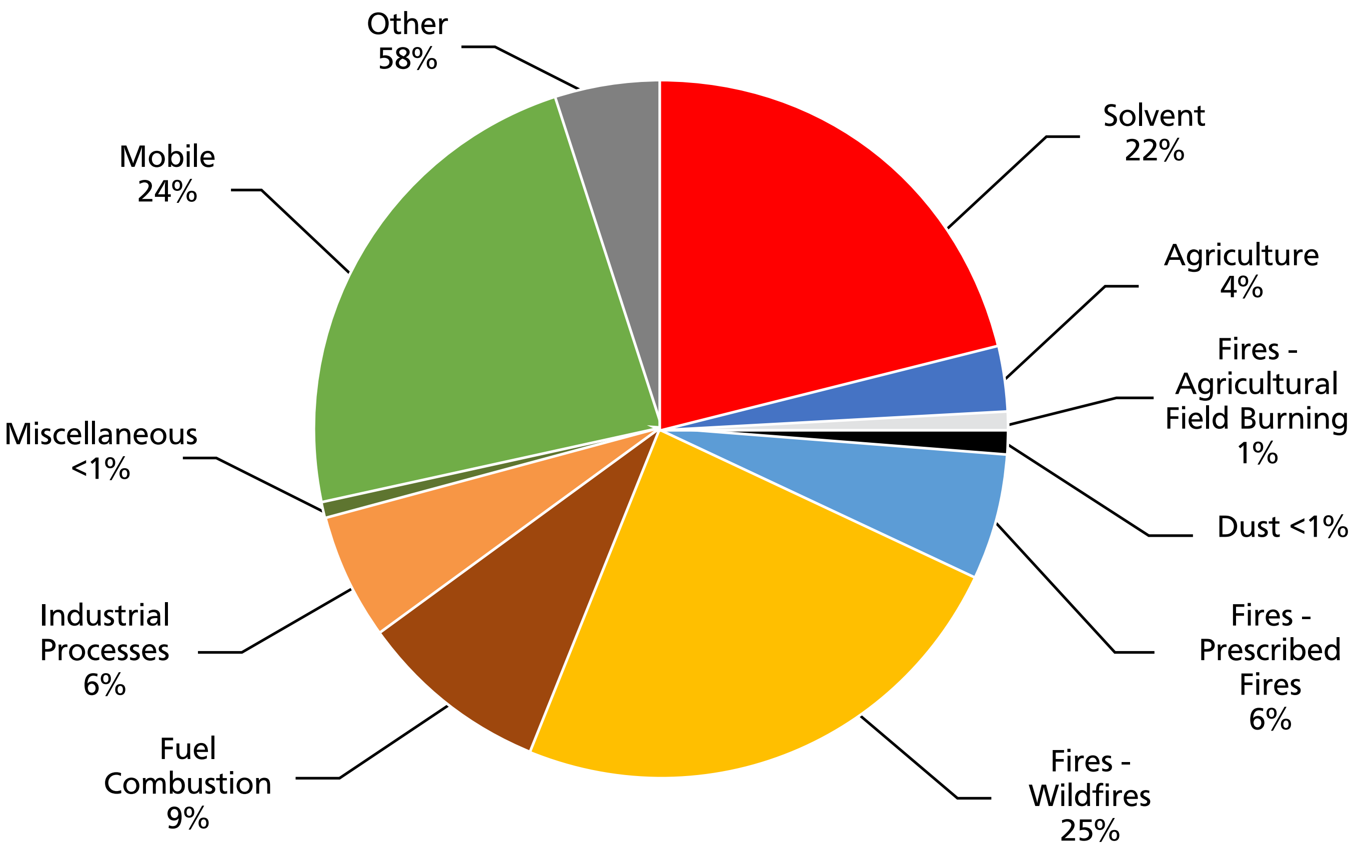


Figure 6. Total Volatile Organic Compounds Emissions by Sector



Business-as-usual co-pollutant projections are based on the forecasted change in activity associated with the source of the co-pollutant or a proxy for that activity (e.g., change in vehicle miles traveled, population, etc.). The co-pollutant activities and growth indicators sources are detailed in Table 2. The co-pollutant activities that have "No Change" as their growth indicator, such as industrial activities, are not expected to change significantly or applicable growth indicators were not available.

Table 2. Co-Pollutant Activities and Growth Rates

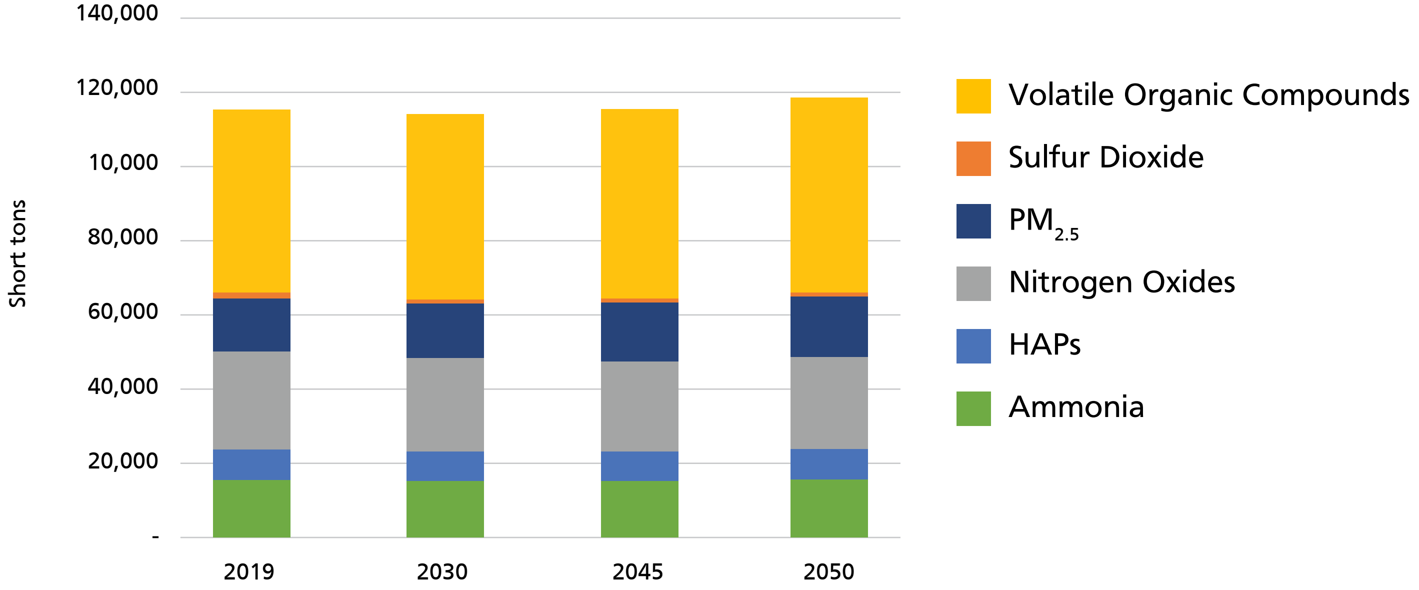
Activity	Growth Indicators
Agriculture	No Change
Dust	Total Vehicle Miles Traveled
Fires	No Change
Fuel Combustion	Service Population
Industrial Processes	Industrial Jobs
Miscellaneous	No Change
Mobile	On-Road Emissions
Other	Service Population
Solvent	Service Population

Using the growth indicators in Table 2, co-pollutant emissions were forecast from 2019 to 2030, 2045, and 2050 in Table 3. Figure 7 summarizes the total co-pollutant forecasts showing that regional co-pollutants are generally expected to increase over time.

Table 3. SMAQMD Co-Pollutant Forecasts (short tons)

Co-Pollutants	El Dorado	Nevada	Placer	Sacramento	Sutter	Yolo	Yuba
2019							
Ammonia	1,255	984	1,425	5,593	1,504	3,300	1,299
HAPs	1,439	1,254	1,210	2,746	411	649	505
Nitrogen Oxides	1,968	2,076	4,802	10,626	2,798	3,255	1,269
$PM_{2.5}$	3,147	2,638	1,969	3,792	943	1,661	893
Sulfur Dioxide	224	306	132	336	35	111	78
Volatile Organic Compounds	9,241	7,340	6,535	16,126	2,673	4,837	2,871
2030							
Ammonia	1,290	1,003	1,450	5,622	1,507	3,304	1,312
HAPs	1,406	1,237	1,159	2,618	405	631	496
Nitrogen Oxides	1,795	1,896	4,359	9,618	2,651	3,023	1,165
$PM_{2.5}$	3,218	2,686	2,079	4,026	988	1,761	919
Sulfur Dioxide	226	315	138	334	36	116	81
Volatile Organic Compounds	9,247	7,345	6,556	16,317	2,774	5,023	2,902
2045							
Ammonia	1,334	1,029	1,488	5,688	1,511	3,312	1,328
HAPs	1,403	1,237	1,164	2,626	415	641	501
Nitrogen Oxides	1,738	1,837	4,233	9,322	2,654	2,986	1,138
$PM_{2.5}$	3,304	2,744	2,217	4,326	1,047	1,881	952
Sulfur Dioxide	228	326	146	345	37	124	85
Volatile Organic Compounds	9,363	7,419	6,779	17,037	2,935	5,318	2,984
2050							
Ammonia	1,349	1,038	1,503	5,724	1,514	3,317	1,334
HAPs	1,418	1,247	1,195	2,701	426	656	509
Nitrogen Oxides	1,785	1,886	4,370	9,625	2,733	3,079	1,172
$PM_{2.5}$	3,333	2,764	2,267	4,437	1,068	1,923	964
Sulfur Dioxide	229	329	149	354	38	126	86
Volatile Organic Compounds	9,451	7,473	6,941	17,492	3,006	5,448	3,030

Figure 7. Sacramento-Roseville CSA Co-pollutant Forecasts



REFERENCES

[1] US EPA. 2025. Criteria Air Pollutants. Available: https://www.epa.gov/criteria-air-pollutants

Chapter 4. Greenhouse Gas Reduction Measures

After conducting a GHG inventory and community outreach, 26 measures were selected for inclusion in the Plan. Implementation of these measures is anticipated to move the Capital Region closer to carbon neutrality by 2045. The measures span five sectors including transportation, energy, natural and working lands, waste management and water. Implementation could potentially reduce GHG emissions by approximately 3.2 million MT CO_2e per year by 2045. The measures with the greatest potential for GHG reductions are Zero-Emission Vehicle Adoption and Charging Infrastructure, Building Decarbonization/ Electrification, Land Use Improvements, and Transportation Demand Management Program. Within the Plan, each measure's GHG mitigation potential is provided in MT CO_2e per year for the 2030 and 2045 reduction target years. The Plan discusses scale of implementation, co-benefits, climate resiliency, authority to implement, monitoring and reporting, co-pollutant reductions, cost considerations, health outcomes of measure implementation, and other considerations for vulnerable communities. The CAPCOA Handbook was leveraged for established GHG measure quantification methodologies. Nine measures included in the Plan were not initially quantified within the CAPCOA Handbook, and the CPRG planning team worked with CAPCOA to incorporate these actions as quantified measures within the CAPCOA Handbook during the development of the Plan, so all Californian jurisdictions can access the new measure quantification methodologies. See Appendix C for detailed information on the GHG reduction calculation methodologies for each measure.

Table 1. Comprehensive Capital Region Climate Priorities Plan GHG Reduction Measures

Measure Number	Measure Name	Sector	2030 Reductions MT CO_2e/yr	2045 Reductions MT CO_2e/yr
Measure BE-1	Land Use Improvements	Transportation	270,828	302,903
Measure BE-2	Building Energy Efficiency Improvements	Energy	2,377	0
Measure BE-3	Increase Use of Renewable Energy in New and Existing Buildings	Energy	6,170	0
Measure BE-4	Building Decarbonization/ Electrification	Energy	383,884	532,430
Measure BE-5	Construction and Landscape Equipment Emissions Reduction	Energy	121,033	124,223
Measure BE-6	Install Cool Pavement	Energy	0	0
Measure BE-7	Reduce Solid Waste	Waste Management	21,593	29,423
Measure BE-8	Reduce Water Utility Emissions	Water	310	0
Measure BE-9	Reduce Wastewater Emissions	Waste Management	67,198	73,023
Measure BE-10	Require Edible Food Recovery Program Partnerships with Food Generators	Waste Management	1,761	2,607
Measure TR-1	ZEV Adoption and Charging Infrastructure	Transportation	1,286,610	1,309,392
Measure TR-2	Public Transit Improvements	Transportation	30,359	31,710
Measure TR-3	Provide Bus Rapid Transit	Transportation	17,267	20,182
Measure TR-4	Roadway Improvements for Multi-Modal Use and Access	Transportation	42,493	41,245
Measure TR-5	Transportation Demand Management Program	Transportation	212,764	261,697
Measure TR-6	Active Modes of Transportation for Youth	Transportation	35,882	39,601
Measure TR-7	Establish a School Bus Program	Transportation	13,262	53,576
Measure TR-8	Electric Bikeshare	Transportation	657	647
Measure NW-1	Wildfire Resilience and Management	Natural and Working Lands	2,357	2,357
Measure NW-2	Biomass Energy	Energy	846	1,693
Measure NW-3	Increase Tree Canopy	Natural and Working Lands	4,922	4,922
Measure NW-4	Carbon Sequestration Program/ Carbon Farming	Natural and Working Lands	168,014	168,014
Measure NW-5	GHG Local Offset Program	Natural and Working Lands	171,683	171,683
Measure NW-6	Natural and Working Lands Equipment Emissions Reduction	Natural and Working Lands	1,922	1,853
Measure E-1A	Onsite Solar Canopies	Energy	171	0
Measure E-1B	Battery Storage-Supported Microgrids	Energy	209	0

**NW-2 reductions are informational only as they account for lifecycle emissions not included in the regional GHG inventory or GHG reduction targets*

Measure Categories

Relevant climate measures were organized into four main categories – Built Environment (BE), Transportation (TR), Natural and Working Lands (NW), and Energy (E). The suite of measures and sub measures in the Built Environment category support infill development, building electrification, and energy resiliency. Measures in this category improve building energy efficiency, increase small-scale renewable energy use, increase residential density, and reduce waste. The Plan encourages infill housing development programs that allow residents to live closer to downtown areas where there is greater access to jobs and activities. Residents are more likely to walk or bike to destinations when they are located nearby. Living near jobs, schools, supermarkets, and health care centers can reduce vehicle trips and improve air quality, providing fuel savings and enhancing pedestrian and traffic safety. Additionally, by installing cool pavements in place of heat-absorbing pavements, neighborhoods can reduce energy emissions and reduce the effects of extreme heat.

The Energy category promotes the use of large-scale renewable or clean energy sources that feed directly into the electric grid. The measures within this category are essential to maximizing the GHG reduction potential of electrification actions in the Built Environment and Transportation categories.

Based on the GHG inventory conducted for the Sacramento-Roseville CSA, the largest source of emissions in the Capital Region is from the transportation sector, which was selected as a sector for targeted emissions reduction. Within the Transportation category, there is a suite of measures and sub measures to improve public transit, encourage rideshare, and promote the adoption of electric and cleaner-fueled vehicles.

These measures provide alternatives to single-occupancy vehicle trips and reduce emissions from vehicles. Transportation emissions can be reduced by improving the emissions profile of vehicle fleets, or by reducing VMT. The measures presented here will lead to mode shifts from single-occupancy vehicles to shared (e.g., transit) or active modes of transportation (e.g., bicycling, walking).

The Natural and Working Lands category includes measures that conserve land that acts as a carbon sink and promote healthy soils and forests. Measures in this category minimize the likelihood of severe or catastrophic wildfire behavior and improve the sequestering capabilities of natural lands. Implementation of these measures will lead to improved air quality, public health, and ecosystem health.

Figure 1. Comprehensive Capital Region Climate Priorities Plan Measure Categories

BUILT ENVIRONMENT	ENERGY	TRANSPORTATION	NATURAL AND WORKING LANDS
Infill Development	Clean Energy Sources	Reduce Vehicle Miles Traveled	Carbon Sequestration
Building Decarbonization		Vehicle and Equipment Decarbonization	Forest Management
Energy Resiliency			

Co-Benefits

Co-benefits are additional benefits of emissions reduction. Co-benefits are increasingly prevalent in justifying funding, planning, and implementing emissions reduction measures. The co-benefits of each measure included in the Plan are provided to give a full account of the advantages of implementation for a measure. While all measures achieve at least one co-benefit, some measures may also yield a disbenefit. For example, measures that electrify a fossil fuel source will lead to improved air quality and fuel savings but will also increase electricity consumption. Potential disbenefits are discussed within the measure's description.

Table 2. Co-Benefits of GHG Reduction Measures

Icon	Co-Benefit Category	Scope of Benefit
	Improved air quality	Criteria air pollutant (CAP) reductions
	Energy and fuel savings	Electricity, natural gas, refrigerant, propane, gasoline, or diesel reductions
	Vehicle miles traveled reductions	Reductions in VMT
	Water conservation	Water use reductions
	Enhanced pedestrian or traffic safety	Reduced collisions; pedestrian/bicyclist safety
	Improved public health	Toxic air contaminant reductions (including exposure); increased physical activity; improved public safety
	Improved ecosystem health	Improved biological diversity and soil and water quality
	Enhanced energy security	Systemwide load reduction; local energy generation, leveling out peaks
	Enhanced food security	Stability of food systems; improved household access to food
	Social equity	Address existing social inequities (e.g., housing/anti-displacement, community engagement, availability of disposable income)

Beyond these co-benefits, each measure includes "health and other considerations" and how the measure can increase climate resiliency. These considerations should be incorporated into decisions regarding measure implementation.

Co-Pollutants

Along with potential GHG reductions, the measure summaries also present annual co-pollutant reductions in 2030 and 2045. Co-pollutant reductions include estimates of CAPs and CAP precursors such as nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2) along with the HAP diesel particulate matter (DPM). Co-pollutant reduction calculation methodologies are included with each measure.

Costs

Each measure includes an estimate of the cost of implementation, which is based on the components of each measure. The results are presented as rough-order-of-magnitude estimates in high-, medium-, and low-cost categories. Cost estimates are developed as a point-in-time estimates and do not consider phased implementation or the time-value of money.

The cost estimate identifies the primary actor or payer responsible for the implementation of each measure. This analysis considers two categories of payers – public agency payers and private payers. Public agency payers are defined as public institutions such as local, state, federal, or quasi-governmental institutions. Measures primarily supported by taxpayer dollars are defined as public agency payers. Private payers are defined as households or businesses. Implementation cost categories are defined separately for public agency payers and private payers.

Public payer cost estimates are based on the cost to implement measures at the 2045 scale of application defined for each measure. Table 3 describes the cost categories for public agency payers, which were established as a percentage of fiscal year 2022-23 total governmental expenditures for the counties within the Sacramento-Roseville CSA. The low-cost category represents up to approximately 1% of total annual government expenditures in the region, or $5 million. The high-cost category represents costs greater than 5% of total annual government expenditures in the region.[1]

Table 3. Public Agency Payer Cost Categories for Sacramento-Roseville CSA Region GHG Reduction Measures

Cost Category	Definition
Low	Under $5 million. Minimal upfront investment or regulatory policy.
Medium	$5 million to $25 million. Moderate upfront investment or larger programmatic initiative.
High	Greater than $25 million. Large-scale investment or capital-intensive measure.

The cost categories for private payers are described in Table 4. These cost categories were established on a per-consumer (or per-implementing-entity) basis and are not aggregated to a regional cost estimate. Per-consumer cost estimates are marginal (i.e., the cost difference between the GHG reduction measure alternative and existing equipment), and upgrades are assumed to be made at the end of useful life for the existing equipment.

Table 4. Private Payer Cost Categories for Sacramento-Roseville CSA Region GHG Reduction Measures

Cost Category	Definition
Low	Under $10,000. Low upfront investment required.
Medium	$10,000-$50,000. Moderate upfront investment required.
High	Greater than $50,000. Large-scale program or investment.

Authority to Implement, Monitoring, and Reporting

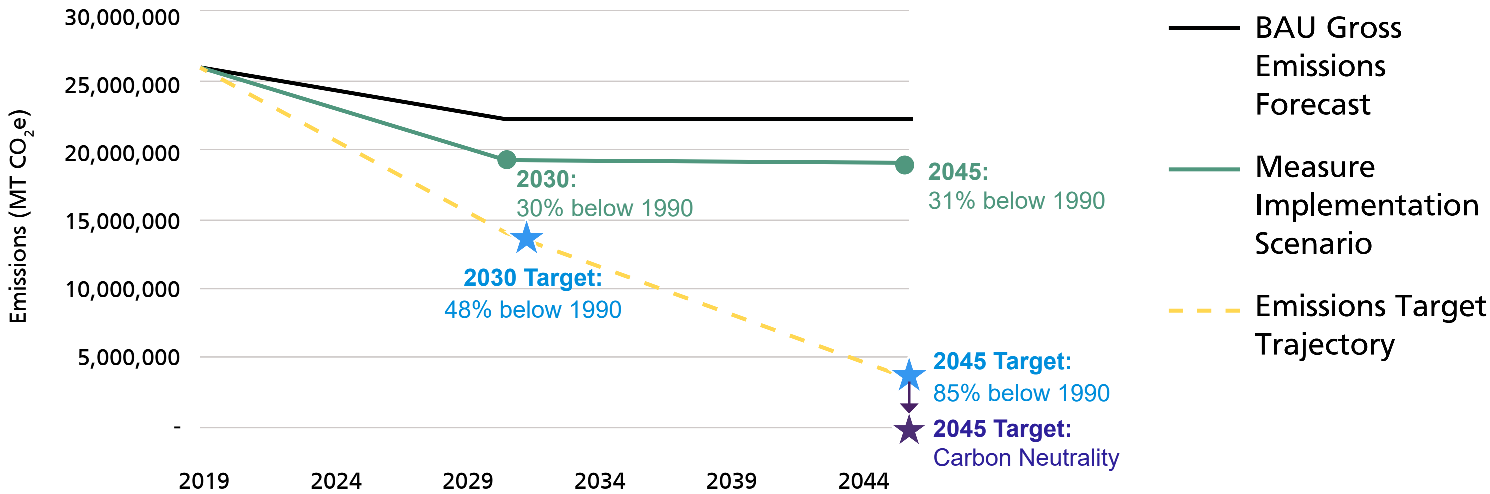
The state of California establishes statewide emissions targets. The California Global Warming Solutions Act of 2006 (AB 32) designates CARB as the state agency responsible for monitoring and regulating sources of GHG emissions. SB 32 of 2016 requires CARB to ensure that statewide GHG emissions are reduced to 40% below 1990 levels by 2030. California aims to be carbon neutral by 2045. To be consistent with state of California emissions targets, the year 2030 and 2045 were selected as the target dates for emission reductions.

While many local jurisdictions in the Capital Region have climate action plans, this Plan will strengthen local action through coordination and implementation at the regional scale. The Plan presents clear actions and incorporates relevant legislation, rules, and policies describing stakeholders' authority to implement each GHG reduction measure. Measures were developed using information available as of June 2025, and implementation authorities may change as new legislation is passed. Each measure description details the monitoring and reporting mechanisms necessary to ensure that the measures are properly implemented, and reductions are achieved by the target date. Where the scale of application are the same values for 2030 and 2045, the region assumes that the maximum potential implementation is achieved by 2030 and held steady through 2045.

Measure Implementation Scenario

After developing BAU emissions forecasts ("where are we headed?"), emissions reduction targets ("where do we want to go?"), and GHG reduction measures ("what can we do?"), the planning team assessed each measure for its 2030 and 2045 GHG reduction potential. The region's GHG emissions trajectory with all Plan measures implemented is called the Measure Implementation Scenario (Figure 2). [2]

Figure 2. Measure Implementation Scenario Emissions Forecast



Under the Measure Implementation Scenario, 2030 BAU gross emissions will be further reduced by approximately 2,680,000 MT CO_2e or 30% below 1990 levels, and 2045 emissions by 2,990,000 MT CO_2e or 31% below 1990 levels. As the emissions reduction targets are 48% by 2030 and 85% by 2045, the Plan measures alone cannot meet the region's GHG targets. This outcome is common in local and regional climate action planning as most major emission sources fall partly or entirely outside the control of local or regional governing bodies. Therefore, the GHG reduction gap between the Measure Implementation Scenario and emissions targets requires additional action from regional, state, and/or federal partners.

Table 5 shows the 2045 Measure Implementation Scenario GHG reductions by sector. Most measure reductions occur in the mobile (on-road) sector, in which measures produce roughly 2.1 MMT CO_2e of reductions in 2045, followed by the residential and commercial measures, which produce approximately 0.5 MMT CO_2e of reductions by 2045. Measures that reduce electricity use or increase clean electricity sources are not expected to produce any additional GHG reductions in 2045 as the electric grid is projected to be 100% carbon free in the BAU scenario. Additionally, no Plan measures address rail or waterborne emission sources in the mobile sector or industrial sector (though some measures may indirectly affect industrial fuel combustion emissions); and accordingly, no GHG reductions are noted in those sectors. However, rail and waterborne emissions are only forecast to produce approximately 1% of total emissions in 2045, and thus they are not a priority focus for climate action in the Capital Region.

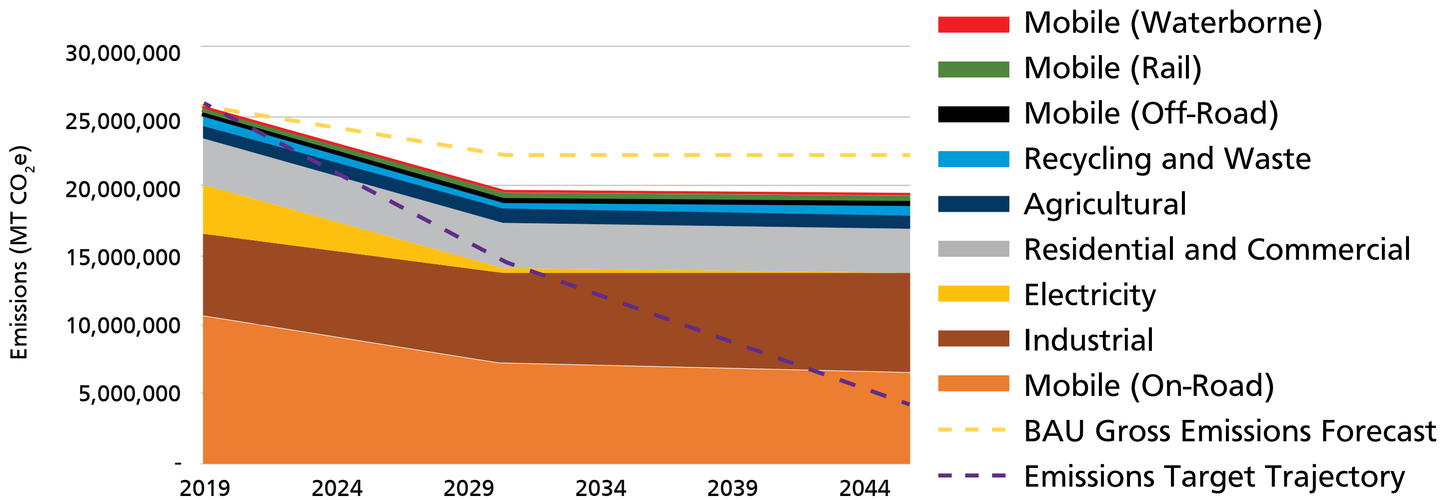
Table 5. 2045 Measure Implementation Emissions Reductions

Sectors	2045 BAU Emissions	2045 Emissions with Measure Implementation	% Reduction in 2045 BAU Emissions
Mobile (On-Road)	8,804,307	6,743,354	-23%
Industrial	6,953,552	6,953,552	No Change
Residential and Commercial	3,893,908	3,361,478	-14%
Agricultural	1,100,837	932,824	-15%
Recycling and Waste	870,586	765,534	-12%
Mobile (Off-Road)	605,024	478,947	-21%
Mobile (Rail)	164,414	164,414	No Change
Mobile (Waterborne)	95,745	95,745	No Change
Electricity	0	0	No Change
Foresty	(3,029,766)	(3,037,045)	<1%
Offsets	NA	(171,683)	NA
Gross Total	**22,488,373**	**19,495,847**	**-13%**
Net Total	**19,458,608**	**16,287,119**	**-16%**

**The residential and commercial sectors have been combined as some measures reduce emissions across both sectors.*

Figure 3 shows the remaining emissions each year in the Measure Implementation Scenario compared to the BAU and reduction target trajectories.

Figure 3. Measure Implementation Scenario Remaining Emissions



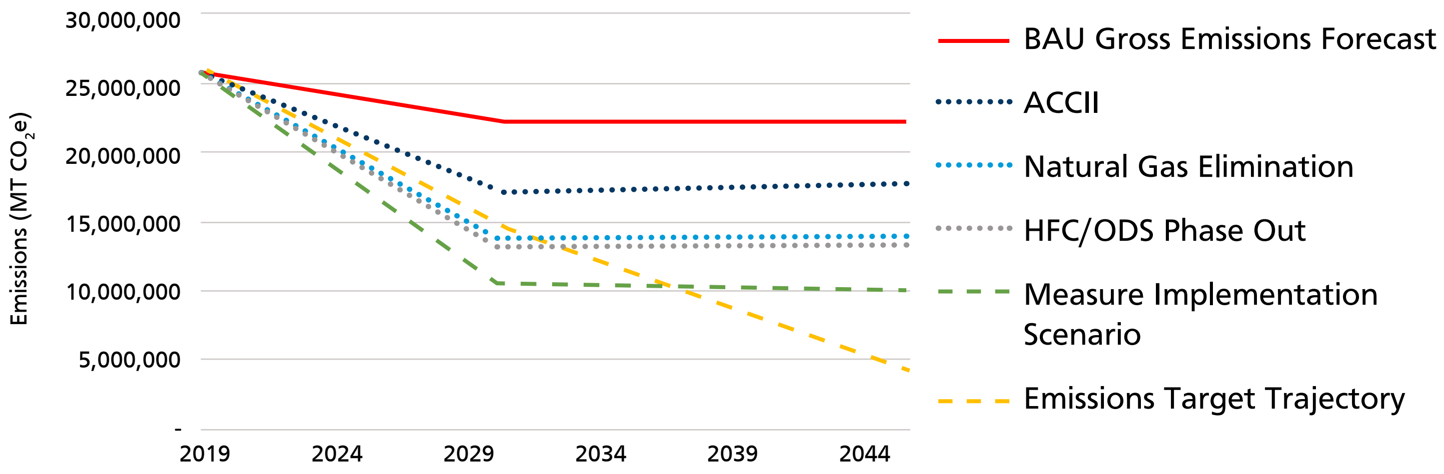
If all Plan measures were implemented, the majority of remaining 2045 emissions would be from the industrial (36%), mobile (on-road) (35%), and residential and commercial (17%) sectors. In the industrial sector, the remaining emissions are primarily from petroleum marketing facilities such as fuel bulk stations (64% of industrial emissions) and natural gas transmission and distribution (17%). In the residential sector, most remaining emissions are from natural gas use (81% of residential emissions), while in the commercial sector the greatest remaining emissions source is ODS fugitive emissions (40% of commercial emissions). To reach the GHG reduction targets, the region will need more ambitious local action within these sectors, as well as additional state and federal support. For each of these primary remaining emissions sectors, Table 6 summarizes the barriers to effective regional action and provides potential state-level action that can further reduce emissions and is not currently reflected in the BAU forecasts or Measure Implementation Scenario.

Table 6. Barriers to Implementation and Examples of State Action

Primary Remaining Emissions Sector	Barrier to Regional Action	State-Level Action Examples
Industrial (primarily from petroleum marketing facilities and natural gas transmission and distribution)	No regulatory authority over decommissioning natural gas infrastructure, fuel bulk station operations, or other industrial processes	• SB 1371 (Leno, 2014) mandates that the California Public Utilities Commission and CARB develop rules and procedures for pipeline facilities to minimize natural gas leaks • Industrial Decarbonization and Improvements to Grid Operations (INDIGO) program
Mobile (On-road)	No regulatory authority over private vehicle purchasing decisions	• Advanced Clean Cars II (ACCII) for light-duty vehicles • Advanced Clean Fleets for state and local government fleets
Residential and Commercial	Reliant on building and equipment turnover rates	• Building and energy codes • SB 1206 (Skinner, 2022) prohibiting high GWP hydrofluorocarbon (HFC) sales • Incentives for electric alternatives • Reduced incentives for natural gas energy efficiency measures

When considering additional state-level actions, California's ACCII, which requires 35% light-duty ZEV sales in 2026 and 100% in 2035, can substantially reduce mobile (on-road) emissions and is not reflected in the current BAU or Measure Implementation Scenario. If ACCII were integrated into the GHG forecasts, this could reduce 2045 emissions by a maximum of 18% compared to 1990 levels. Additionally, if all natural gas use was eliminated in the region in line with state decarbonization goals, 2045 emissions could be reduced by another 13% compared to 1990 levels (natural gas emissions are reflected in the residential, commercial, and industrial sectors). And finally, state legislation prohibiting the sale of high GWP hydrofluorocarbons (HFCs) can further reduce residential and commercial emissions, as the majority of the ODS emissions in these sectors are from HFCs. This could reduce 2045 emissions by a maximum of 3% compared to 1990 levels. Implementing these additional GHG reduction considerations can provide significant progress toward the regional targets, potentially meeting the 2030 GHG reduction target and resulting in a 52% reduction by 2045 compared to 1990 levels as reflected in Figure 4. With the Measure Implementation Scenario reductions included, these additional considerations could help the region reach a maximum of 63% reductions by 2045 compared to 1990 levels.

Figure 4. Emissions with Additional State Action[3]



GHG removals from forestry or carbon offsets can only be counted toward the net GHG reduction target, which is carbon neutrality by 2045. Measures that produce GHG removals can increase 2045 BAU GHG removals by approximately 6% or 0.2 MT CO_2e (2045 BAU GHG removals were 3.0 MMT CO_2e). These removal measures could reduce gross emissions by 1% by 2045 compared to 1990 levels. As the 2045 carbon neutrality target requires an 85% emissions reduction below 1990 levels with the remaining 15% to be addressed by removals, additional removal measures or more ambitious implementation of existing measures would be needed to meet the 2045 carbon neutrality target.

REFERENCES

[1]*California State Controller's Office. 2024. Counties raw data for fiscal year 2022-23. Retrieved from https://bythenumbers.sco.ca.gov/Counties/Counties-Raw-Data-for-Fiscal-Year-2022-23/bmic-m77z/about_data.*

[2]*Measure TR-5 has multiple options for implementation and GHG reductions were calculated for each option. However, all options cannot be implemented simultaneously as it would result in double-counting reductions. Therefore, the implementation option that results in the maximum reductions was included in the Measure Implementation Scenario.*

[3]*The GHG impacts of ACCII, natural gas elimination, and HFC phase out have not been fully integrated into the Measure Implementation Scenario GHG reduction assumptions. Therefore, the Measure Implementation Scenario emissions in this figure overestimate the measure GHG reductions that could be achieved.*

Land Use Improvements

Measure BE-1

GHG Mitigation Potential

270,828 MT CO_2e/yr by 2030

302,903 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Living near jobs, schools, supermarkets, and medical care facilities improves connectivity between destinations and provides greater options for modes of travel, resulting in better air quality from less passenger vehicle use and traffic.

Cost

Payer: Public Agency (e.g., local government)

Cost Level: Low

Measure Description

This measure focuses on reducing VMT by increasing residential density through infill housing and mixed-use development. Reducing the distance that people must travel to access goods and services and reducing the number of trips by single-occupancy vehicles leads to reductions in GHG emissions.

Increase Residential Density: Requires new residential developments to achieve a higher density than the average U.S. residential density. Increased density allows people greater options for modes of travel and results in shorter and fewer vehicle trips.

Infill Development: Encourages infill housing development programs that allow residents to live closer to downtown areas, increasing access to jobs and activities. Developing more housing closer to downtown areas leads to VMT and GHG reductions.

Subsector

Land Use; Transportation

Scale of Application

By 2030:

- Increase residential density by 20% across the region.
- Reduce approximately 150 million VMT per year through infill development.

By 2045:

- Increase residential density by 25% across the region.
- Reduce approximately 132 million VMT per year through infill development.

Authority to Implement

- **Legislation, Rules, and Policy:** California vests land use authority with local jurisdictions, provided state requirements for comprehensive planning and housing needs are met. However, VMT are considered transportation and environmental impacts in California by SB 743 (Steinberg, 2013). Directing growth and investment into communities with high access and low VMT, along with constructing the necessary public infrastructure to support such growth, are actions supported by state housing, transportation, air quality, and climate goals.
- **Incentives:** California regions must achieve VMT reduction targets as required by SB 375 (Steinberg, 2008) or lose access to certain state transportation funding. Regulatory streamlining is also available for projects consistent with qualified climate action plans and certain infill development. Metropolitan planning organizations (MPOs) and regional transportation planning agencies (RTPAs) also have authority to direct flexible funding into projects that support infill development.

Monitoring and Reporting

Annual reporting by local jurisdictions and quadrennial transportation modeling by MPOs and RTPAs will track this measure. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Update zoning codes and local land use ordinances to allow denser housing types. Support backbone utility improvement projects.
- **Year 1-2:** Increase residential density by 10% across the region by designing and building new vertical housing developments with densities exceeding state housing thresholds.
- **Year 2-3:** Increase residential density by 20% across the region by designing and building new vertical housing developments with densities exceeding state housing thresholds.

Potential implementation tracking metrics include:

1. Residential density of project areas
2. Distance to downtown for proposed projects
3. Amount of VMT displaced by infill projects

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure T-1)[1] and the CAPCOA Handbook Update (measure T-55).[2] The majority of the GHG reductions are achieved through the increase in residential density and the associated VMT reductions. Emissions for passenger cars and passenger trucks for the region were modeled using CARB's vehicle Emissions Factor Model (EMFAC)[3] and applying the percentage of GHG reductions estimated as a result of the measure. Calculations for infill development are based on the estimated annual VMT reduction as provided by SACOG from the Green Means Go program.[4] The GHG reductions are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[3] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-1. Potential Emissions Reductions from Measure BE-1 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Increase Residential Density	231,318	270,353
Infill Development	39,510	32,550
Total Reduction	**270,828**	**302,903**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on the guidelines in the CAPCOA Handbook and the CAPCOA Handbook Update. The co-pollutant reductions associated with infill development are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[3] Annual co-pollutant emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA at the scale of application by 2030 and 2045.

Table BE-1.2 Potential Co-Pollutant Reductions (short tons/year) from Measure BE-1 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	9.7	154.9	18.0	2.9	1.0	0.4	<0.1
2045	6.6	114.9	12.0	2.5	0.8	0.4	<0.1

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The cost assumes that the measure is implemented through planning and zoning changes and does not consider infrastructure costs or savings associated with infill and mixed-use development. Additionally, the cost to private actors is not considered as it is assumed that developers would be receiving a return on their investment or would choose not to develop.[5]

Health and Equity Considerations

Building residential units in areas with a mix of shops and businesses within easy walking distance provides substantial population health benefits. People who live in areas with high residential density and access to goods and services are likely to be more physically active than residents of neighborhoods in which homes are separated from commercial areas. Residents tend to have lower rates of obesity, type 2 diabetes, high blood pressure, and other chronic medical problems. Living in compact areas with greater accessibility can also provide better access to health-promoting goods and services.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[2] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023.*

[3] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available: https://arb.ca.gov/emfac/*

[4] *Sacramento Area Council of Governments (SACOG). 2024. Green Means Go Calculation and Methodology. Provided by Sac Metro Air District January 28, 2024.*

[5] *California Community Builders. 2025. The Effects of Upzoning Single Neighborhoods on Supply and Affordability. Available: https://www.ccbuilders.org/research/blog-post-title-two-23scr. Accessed: May 2025.*

ADDITIONAL SOURCES

Creatore, MI et al. 2016. Association of Neighborhood Walkability With Change in Overweight, Obesity, and Diabetes. J Am Med Assoc 315(20):2211-2220. Doi:10.1001/jama.2016.5898. Available: https://jamanetwork.com/journals/jama/fullarticle/2524191. Accessed: December 2024.

Ewing R et al. 2003. Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity. Am J Health Promotion 18(1):47-57. Available: https://pubmed.ncbi.nlm.nih.gov/13677962/. Accessed: January 2024.

Frank L et al. 2006. Many Pathways from Land Use to Health: Associations between Neighborhood Walkability and Active Transportation, Body Mass Index, and Air Quality. J Amer Planning 72(1):75-87. Available: https://www.tandfonline.com/doi abs/10.1080/01944360608976725. Accessed: December 2024.

Fuzhong L et al. 2008 Built Environment, Adiposity, and Physical Activity in Adults Aged 50-75. Am J Prev Med 35(1):38-46. doi: 10.1016/j amepre.2008.03.021. Available: https://pubmed.ncbi.nlm.nih.gov/18541175/. Accessed: January 2024.

Fuzhong L et al. 2009. Built environment and changes in blood pressure in middle-aged and older adults. Prev Med 48(2009):237-241. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2775535/. Accessed: January 2024.

Sturm R and Cohen DA. 2004. Suburban sprawl and physical and mental health. Public Health 118(7)488-496. Available: https://doi org/10.1016/j.puhe.2004.02.007. Accessed: January 2024.

Building Energy Efficiency Improvements

Measure BE-2

GHG Mitigation Potential

2,377 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Energy-efficient buildings increase resiliency to extreme events such as power outages and extreme heat or precipitation.

Cost

Payer: Private (e.g., individual household, property owner)

Cost Level: Low (per implementing entity)

Measure Description

This measure is based on the replacement of existing appliances with energy-efficient models to improve energy consumption in buildings.

Require Energy Efficient Appliances: This measure is based on the adoption of ENERGY STAR-certified appliances that exceed the energy efficiencies of conventional appliances. Appliances applicable to this measure include residential and commercial refrigerators, washing machines, dishwashers, and ceiling fans. Replacing conventional appliances with less energy-intensive alternatives will reduce overall energy consumption, resulting in GHG emission reductions. Despite greater upfront costs, more energy-efficient models would result in lower energy bills in the long term.

Subsector

Energy Efficiency Improvements

Scale of Application

By 2030:

- 20% level of participation across either commercial or residential buildings in the region.
- Application includes upgrading refrigerators, washing machines, dishwashers and ceiling fans.

By 2045:

- 40% level of participation across either commercial or residential buildings in the region.
- Application includes upgrading refrigerators, washing machines, dishwashers and ceiling fans.

Authority to Implement

- **Legislation, Rules, and Policy:** The California Energy Commission (CEC), through the appliance efficiency regulations (Title 20), sets minimum efficiency levels for energy and water consumption in appliances. Energy-efficient appliances may also be required as part of a larger environmental program through the California Environmental Quality Act (CEQA).
- **Incentives:** The Inflation Reduction Act (IRA) of 2022 created two programs to encourage home energy retrofits: Home Efficiency Rebates (HOMES) to fund whole house energy efficiency retrofits and the Home Electrification and Appliance Rebates (HEEHRA) to help low- to moderate-income households "go electric" through qualified appliance rebates.

Monitoring and Reporting

Building energy efficiency improvements will be tracked through rebate program reporting. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Encourage a 10% level of participation across either commercial or residential buildings in the region.
- **Year 2-3:** Encourage a 20% level of participation across either commercial or residential buildings in the region.

Potential implementation tracking metrics include:

1. Rebate program funds allocated per specific technologies
2. Number of homes that replaced existing appliances with energy-efficient models

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure E-2).[1] The GHG reductions are achieved through reductions in energy consumption by replacing conventional electric appliances with more energy-efficient alternatives. This measure applies to electricity as natural gas ENERGY STAR appliances were not evaluated. Electricity consumption by county was forecast from 2019 levels using service population growth rates and the assumption that 40% of countywide electricity consumption comes from buildings.[2] The estimated electricity reduction of ENERGY STAR appliances as compared with conventional appliances was obtained from CAPCOA Table E-2.1.1 For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045. In 2045, the measure does not produce additional GHG reductions as it only reduces electricity use, which produces zero emissions by 2045.

Table BE-2. Potential Emissions Reductions from Measure BE-2 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Require Energy Efficient Appliances	2,377	0
Total Reduction	**2,377**	**0**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use which produces zero emissions by 2045. Co-pollutant reductions by 2030 were not quantified.

Cost Considerations

Measure cost is based on the adoption of ENERGY STAR-certified appliances. ENERGY STAR's Single-Family New Homes Cost Estimates summary estimates incremental unit costs to upgrade to ENERGY STAR-certified measures range from $30 per dishwasher to $178 per heating equipment system.[3]

Health and Equity Considerations

Building energy efficiency retrofits reduce symptoms of respiratory and cardiovascular conditions and allergies. Natural daylight in energy-efficient buildings improves sleep, reduces headaches, and reduces eyestrain. More efficient appliances can potentially result in energy and water savings for households.

The accessibility of rebate programs should be a factor in decision making when considering home weatherization for lower income households. Additionally, incentives should be offered to motivate landlords to pursue residential building energy efficiency upgrades or home weatherization for renter energy savings.

REFERENCES

[1] CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

[2] USEIA. 2023. How much energy is consumed in U.S. buildings? November 2023. Available: https://www.eia.gov/tools/faqs/faq php?id=86&t=1

[3] ENERGY STAR. 2023. ENERGY STAR Version 3.2 cost & savings summary. Retrieved from https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%203.2%20Cost%20%20Savings%20Summary.pdf

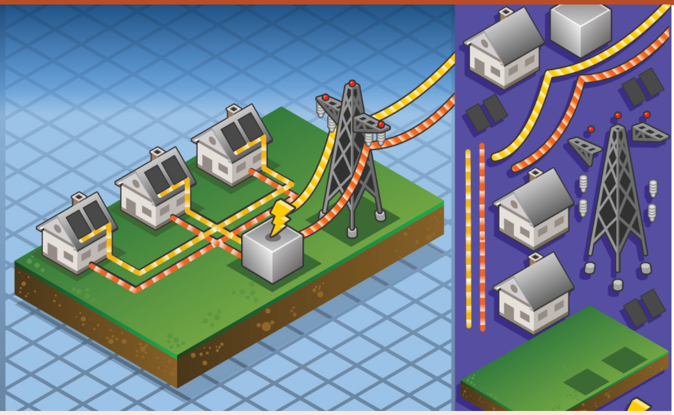
ADDITIONAL SOURCES

International Energy Agency. 2019. Multiple Benefits of Energy Efficiency. Paris. License: CC BY 4.0. Available: https://www.iea.org reports/multiple-benefits-of-energy-efficiency/health-and-wellbeing. Accessed: January 2024

National Renewable Energy Laboratory. 2002. A Literature Review of the Effects of Natural Light on Building Occupants. U.S. Department of Energy Laboratory, Contract No. DE-AC36-99-GO10337. Available: https://www.nrel.gov/docs/fy02osti/30769.pdf. Accessed: January 2024.

Increase Use of Renewable Energy in New and Existing Buildings

Measure BE-3



GHG Mitigation Potential

6,170 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Onsite renewable energy provides redundancy during power outages and surplus energy back to the electric grid, making communities more resilient during extreme events and power outages.

Cost

Payer: Private (e.g., individual household, property owner)

Cost Level: Medium (per implementing entity)

Measure Description

This measure focuses on generating zero-emission renewable energy (such as from solar and wind) in new and existing developments to displace the use of grid electricity, which relies on a more carbon-intensive fossil fuel.

Require Renewable Surplus Buildings: This measure requires installing renewable energy infrastructure and producing surplus renewable energy onsite for new and existing buildings. The surplus renewable energy generated must be sold back to the electric grid. This measure would result in carbon-negative buildings, which reduce more GHG emissions than they generate. Renewable surplus buildings would produce renewable energy that offsets the amount of emissions generated from the development's electricity and onsite fuel consumption.

Subsector

Building Decarbonization

Scale of Application

By 2030:

- Produce 250,000 megawatt hours (MWh) of onsite renewable energy per year in new and existing buildings across the Sacramento-Roseville CSA.

By 2045:

- Produce 475,240 MWh of onsite renewable energy per year in new and existing buildings across the Sacramento-Roseville CSA.

Authority to Implement

- **Legislation, Rules, and Policy:** The California Solar Mandate requires new construction projects to have onsite solar generation or join a community solar farm. There are no provisions for local governments to specifically require more, unless additional renewable energy generation is part of a larger environmental compliance strategy.
- **Incentives:** State and federal incentive programs such as EPA's Solar for All program are available for installation of solar and battery storage systems. Solar systems are also exempt from property tax in California.

Monitoring and Reporting

Building energy efficiency improvements will be tracked through rebate program reporting. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Outreach to relevant stakeholders and pass existing building and new building electrification ordinances in the region.
- **Year 1-2:** Produce 125,000 MWh of onsite renewable energy per year.
- **Year 2-3:** Produce an additional 125,000 MWh of onsite renewable energy per year.

Potential implementation tracking metrics include:

1. Number of renewable energy interconnection applications
2. kW renewable energy installed
3. MWh of renewable energy produced

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures E-17).[1] The GHG reductions are achieved through the surplus production of zero-emission renewable energy onsite for new and existing developments. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for each electric utility. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045. In 2045, the measure does not produce additional GHG reductions as it only reduces electricity use which produces zero emissions by 2045.

Table BE-3. Potential Emissions Reductions from Measure BE-3 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Require Renewable Surplus Buildings	6,170	0
Total Reduction	**6,170**	**0**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use, which produces zero emissions by 2045. Co-pollutant reductions by 2030 were not quantified.

Cost Considerations

On-site renewable energy applications, such as solar panel and small wind turbine installations, can vary significantly by project type. The average capacity-weighted installed cost for new distributed small-wind projects between 2014 and 2023 was $11,410 per kW for turbines with capacities ranging from less than 1kW to 15kW. Typical turnkey installations for onsite solar panels range from $2.50 to $3.50 per watt, but can be as high as $5 per watt depending on location.[2] On-site solar installations range between $18,000 and $43,000 for a typical 10kW system depending on location.[3] This estimate does not account for federal or state tax credits or incentives.

Health and Equity Considerations

On-site renewable energy installations support energy resilience, allowing buildings to continue to provide electricity for cooling and potentially medical devices. Renewable energy installations can decrease energy costs, resulting in savings for building occupants.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[2] *California Distributed Generation Statistics. 2025. Statistics and Charts. Available: https://www.californiadgstats.ca.gov/charts/*

[3] *Consumer Affairs. 2025. How much do solar panels cost in 2025? Available: https://www.consumeraffairs.com/solar-energy/how-much-do-solar-panels-cost.html.*

ADDITIONAL SOURCES

International Energy Agency. 2019. Multiple Benefits of Energy Efficiency. Paris. License: CC BY 4.0. Available: https://www.iea.org reports/multiple-benefits-of-energy-efficiency/health-and-wellbeing. Accessed: January 2024

National Renewable Energy Laboratory. 2002. A Literature Review of the Effects of Natural Light on Building Occupants. U.S. Department of Energy Laboratory, Contract No. DE-AC36-99-GO10337. Available: https://www.nrel.gov/docs/fy02osti/30769.pdf. Accessed: January 2024.

Building Decarbonization/Electrification

Measure BE-4

GHG Mitigation Potential

383,884 MT CO_2e/yr by 2030

532,430 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Limiting wood burning eliminates the need to purchase firewood as fuel and increases carbon sequestration through trees. All-electric developments offer better grid reliability especially as the electric grid integrates more renewable energy.

Cost

Payer: Private (e.g., individual household, property owner)

Cost Level: Medium (per implementing entity)

Measure Description

This measure focuses on decarbonizing existing buildings and new developments by promoting the transition from fossil fuel-powered devices to electric appliances and all-electric end uses. The most common energy end uses are natural gas systems for space heating, water heating, and cooking ranges. Appliances (such as stoves, water heaters and fireplaces) powered by wood, natural gas, or propane are more emissions-intensive than their electric counterparts as electricity from the grid increasingly transitions to renewable sources. The implementation of this measure is made up of two parts:

All-Electric Development: This measure deploys new residential or commercial developments that use all-electric appliances and end uses. Installing electric systems for space heating, water heating, cooking, pool heating, and any other system that would otherwise use natural gas or propane decreases GHG emissions.

Limit Wood-Burning Devices and Natural Gas/Propane Fireplaces in Residential Developments: The most efficient alternatives to wood-burning devices or gas fireplaces are electric fireplace inserts and electric heat pumps. This measure applies to existing and new residential dwelling units.

Subsector

Building Decarbonization

Scale of Application by 2030

By 2030:

- Electrify 50 million square feet of new commercial buildings.
- Electrify 75,000 new residential units.
- Convert from wood-burning to electrified heating in 5,500 existing and new residential units.

By 2045:

- Electrify 75 million square feet of new commercial buildings.
- Electrify 100,000 new residential units.
- Convert from wood-burning to electrified heating in 11,000 existing and new residential units.

Authority to Implement

- **Legislation, Rules, and Policy:** Due to *California Restaurant Association v. City of Berkeley*, Case No. 21-16278 (9th Cir. 2023), local jurisdictions cannot ban specific energy infrastructure (such as natural gas connections) in new construction due to federal preemption inherent in the 1975 Energy Policy and Conservation Act (EPCA). However, the EPCA does not preempt air emission standards. California air district rules regarding air emission standards for appliances and voluntary CEQA compliance pathways would be permissible.
- **Incentives:** CARB's woodsmoke reduction program provides funding for replacement of uncertified wood-burning devices. New construction can use CARB's Building Initiative for Low-Emissions Development Program, while existing buildings can utilize local utility programs to convert from mixed-fuel buildings to all electric. Building electrification incentives such as SMUD's all-electric smart home building incentives and the Home Electrification and Appliance Rebates (HEEHRA) are available as resources.

Monitoring and Reporting

Building energy efficiency improvements will be tracked through rebate program reporting. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Electrify 25 million square feet of new commercial buildings and 37,500 new residential units. Convert 2,750 new and existing residential units from wood-burning to electrified heating.
- **Year 2-3:** Electrify an additional 25 million square feet of new commercial buildings and 37,500 new residential units. Convert an additional 2,750 new and existing residential units from wood-burning to electrified heating.

Potential implementation tracking metrics include:

1. Incentive amount provided for specific technologies
2. Number of all-electric new developments permitted

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures E-14 and E-15).[1] The majority of GHG reductions are achieved through design and implementation of all-electric end uses for new residential and commercial developments. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for each electric utility. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the

Table BE-4. Potential Emissions Reductions from Measure BE-4 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
All-Electric Development	375,574	517,887
Limit Wood Burning	8,310	14,543
Total Reduction	**383,884**	**532,430**

implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on guidelines in the CAPCOA Handbook. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2045. Application of this measure by 2030 was not quantified; therefore, the 2045 estimates below are based on the anticipated all-electric development and limits to wood-burning devices by 2050.

Table BE-4.2 Potential Co-Pollutant Reductions (short tons/year) from Measure BE-4 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2045	512.3	1139.8	719.2	157.2	156.7	4.7	0.0

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The cost of home electrification can vary significantly based on the project pursued. Rewiring America case studies in California suggest that installing a whole-home heat pump averages $19,000.[2] Additionally, panel upgrades (borne by the customer) may be necessary, in addition to permitting costs.

Health and Other Considerations

Conversion from gas stoves to electric reduces air pollutants that increase the risk of development and severity of asthma, chronic lung disease, and respiratory infections. Indoor combustion of wood, natural gas and propane increases risk of respiratory infections, chronic lung disease, lung cancer, heart disease, stroke, type 2 diabetes, and premature mortality. Children, older adults, people with asthma, heart, or lung disease, people from low-income communities, and others who are disproportionately exposed to pollution are most vulnerable to the effects of indoor air pollution. Homes without indoor fuel combustion reduce environmental triggers for these conditions.

Wood burning can be the primary or sole heating source for some residents, and wood burning in some areas may cost less than operating and maintaining a heat pump. Consider programs to assist lower income residents in repairing and replacing non-wood-burning heating devices.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[2] *Rewiring America. 2024. Home electrification cost estimates. Available: https://www.rewiringamerica.org/research/home-electrification-cost-estimates*

ADDITIONAL SOURCES

American Lung Association. 2022. Literature Review on the Impacts of Residential Combustion: Final Report. Available: https://www.lung org/getmedia/2786f983-d971-43ad-962b-8370c950cbd6/ICF_Impacts-of-Residential-Combustion_FINAL_071022.pdf. Accessed: January 2024.

Belanger K and Triche EW. 2008. Indoor Combustion and Asthma. Immunol Allergy Clin North Am. 2008 Aug; 28(3): 507–vii. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760246/ Accessed: January 2024

Gruenwald T et al. 2023. Population Attributable Fraction of Gas Stoves and Childhood Asthma in the United States. Int. J. Environ. Res. Public Health 20(1),75. Available: https://www.mdpi.com/1660-4601/20/1/75. Accessed: January 2024

Saki H et al. 2020.Study of relationship between nitrogen dioxide and chronic obstructive pulmonary disease in Bushehr, Iran. Clinical Epidemiology and Global Health. Vol 8, Issue 2, June 2020, Pages 446-449. Available: https://doi.org/10.1016/j.cegh.2019.10.006 Accessed: January 2024

The White House. 2022. Clean Indoor Air Benefits Everyone. Available: https://www.whitehouse.gov/ostp/news-updates/2022/12/08 clean-indoor-air-benefits-everyone/#:~:text=Cleaner%20indoor%20air%20improves%20cognition,conditions%20like%20asthma%20and%2 allergies. Accessed: January 2024

United States Environmental Protection Agency. 2023. Effects of NO2. Available: https://www.epa.gov/no2-pollution/basic-information about-no2#Effects. Accessed: January 2024

United States Environmental Protection Agency . 1998. Compilation of Air Pollutant Emissions Factors from Stationary Sources (AP-42): Section 1.4 Natural Gas Combustion. Available: https://www.epa.gov/sites/default/files/2020-09/documents/1.4_natural_gas_combustion.pdf

Construction and Landscape Equipment Emissions Reduction

Measure BE-5

GHG Mitigation Potential

121,033 MT CO_2e/yr by 2030

124,223 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

The replacement of conventional gasoline- or diesel-fueled equipment with a low-emissions alternative can lead to long-term cost savings from reduced fuel and maintenance costs.

Cost

Payer: Private (e.g., individual household, business)

Cost Level: Medium (per implementing entity)

Measure Description

This measure focuses on the emission reduction potential of replacing conventional gasoline or diesel-fueled equipment with a low-emission alternative. This measure is made up of several components and is applicable to construction, agricultural, industrial, and landscaping equipment. The implementation of this measure is made up of three parts:

Use Electric or Hybrid Powered Construction Equipment: This sub measure requires the replacement of conventional gasoline- and diesel-fueled construction equipment with electric- or hybrid-powered alternatives. The replacement of heavily polluting equipment types will reduce fossil fuel combustion and result in a net reduction in GHG emissions.

Use of Cleaner-Fuel Construction Equipment: This sub measure requires the transition to cleaner fossil-fueled alternatives for construction equipment in place of conventional diesel-fueled or gasoline-fueled equipment. Specifically, this measure is based on the replacement of construction equipment with compressed natural gas (CNG) alternatives; however, users could expand this use to cover additional fuel types, such as renewable diesel combined with newer equipment with increased fuel efficiency. The use of CNG and renewable diesel alternatives should be limited to instances where electric or hybrid alternatives are unavailable.

Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape Equipment: This sub measure requires the use of zero-emission (electric) landscaping equipment over conventional gasoline-fueled equipment. This measure covers the use of chainsaws, chippers, lawn mowers, leaf blowers/vacuums, riding mowers, tillers, and trimmers. The replacement of heavily polluting equipment with electric equipment will reduce fossil fuel consumption and result in a net reduction in GHG emissions.

Subsector

Construction/Lawn and Landscaping

Scale of Application

By 2030:

- 60% penetration rate of electric-powered construction equipment.
- 40% penetration rate of cleaner-fuel construction equipment.
- 10% penetration rate of electric landscaping equipment.

By 2045:

- 60% penetration rate of electric-powered construction equipment.
- 40% penetration rate of cleaner-fuel construction equipment.
- 90% penetration rate of electric landscaping equipment.

Authority to Implement

- **Legislation, Rules, and Policy:** Construction equipment in California is subject to Off-Road Diesel Regulation, which as of January 1, 2023, requires all new fleet engines be Tier 3 or higher. Construction projects are also subject to CEQA, and jurisdictions and lead agencies may require cleaner equipment. As of January 1, 2024, construction fleets subject to the Off-Road Diesel Regulation must use renewable diesel. Starting with model year 2024, most small off-road engines (those used in landscaping equipment) must be zero emission. Local governments also have the authority to ban certain devices (such as leaf blowers) using their police powers.
- **Incentives:** CARB offers a professional Lawn and Garden Equipment exchange program for small businesses and sole proprietors. Local air districts may use Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) funding for lawn and garden equipment incentive programs.

Monitoring and Reporting

Reductions from construction and landscaping equipment can be tracked through annual reporting from incentive programs and inventory estimates from CARB. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Achieve a 30% penetration rate of electric-powered construction equipment, 20% penetration rate of cleaner-fuel construction equipment, and 5% penetration rate of electric landscaping equipment.
- **Year 2-3:** Achieve a 60% penetration rate of electric-powered construction equipment, 40% penetration rate of cleaner-fuel construction equipment, and 10% penetration rate of electric landscaping equipment.

Potential implementation tracking metrics include:

1. Incentive amounts allocated to specific technologies
2. Number of electric and cleaner-fuel construction and landscaping equipment purchased
3. Number of gasoline- or diesel-fueled construction and landscaping equipment retired

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures C-1-A, C-1-B, and LL-1).[1] Table BE-5 shows the reductions from the different components of this measure. As "Use Electric or Hybrid Powered Construction Equipment" and "Use Clean-Fuel Construction Equipment" apply to the same regional fleet of construction equipment, measure penetration cannot add to over 100% for both components combined. The market availability for electric construction equipment is still nascent, although it is expected to grow in the future.

Emissions for construction and landscaping equipment for the region were modeled using CARB's OFFROAD model.[2] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045 noted above.

Table BE-5. Potential Emissions Reductions from Measure BE-5 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Use Electric or Hybrid Powered Construction Equipment	105,311	107,862
Use Clean-Fuel Construction Equipment	14,657	14,535
Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape	1,065	1,826
Total Reduction	**121,033**	**124,223**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on guidelines in the CAPCOA Handbook. Co-pollutant emissions for construction and landscaping equipment for the region were modeled using CARB's OFFROAD model.[2] For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045 noted above.

Table BE-5.2 Potential Co-Pollutant Reductions (short tons/year) from Measure BE-5 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	450.7	2849.0	168.3	31.8	26.6	2.0	16.7
2045	324.0	2562.4	281.7	24.2	19.7	2.0	9.6

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

Cost varies based on implementation, from under $200 for electric leaf blowers to an average of $175,000 each for electric tractors.[3] The marginal cost to consumers ranges based on the type of equipment purchased. Some equipment, such as electric leaf blowers, have reached price parity or are less expensive than gasoline- or diesel- fueled alternatives, while the price gap remains high for other equipment (e.g., the estimated price premium for an electric tractor compared to a diesel alternative is approximately $50,000).[3,4]

Health and Other Considerations

Exposure to diesel and gas emissions generates systemic inflammation and produces effects in the lungs, heart, blood, blood vessels, and brain. Replacing diesel construction equipment with cleaner-fuel equipment reduces the risk of cardiovascular, lung and respiratory disease, and cancer to workers. Replacement of gas-powered equipment with inherently quieter electric-only equipment reduces both the risk of pollutant-related conditions and the effects related to noise – hearing loss and impacts of noise stress including hypertension, elevated cholesterol, and increased risk of heart disease.

REFERENCES

[1] CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

[2] CARB. 2021. California Air Resources Board's OFFROAD Model (v1.1.0) Emissions Inventory. Available: https://arb.ca.gov/emfac/offroad/

[3] Port Technology International. 2019. Electric yard tractors: Weighing the costs and benefits. Available: https://www.porttechnology.org/wp-content/uploads/2019/05/068-069_Electric_Yard_Tractors_Weighing_the_Costs_and_Benefits.pdf.

[4] Lawn Love. 2025. How much Does an Electric Leaf Blower Cost in 2025?. Available: https://lawnlove.com/blog/leaf-blower-cost/

ADDITIONAL SOURCES

Hammer MS et al. 2014.Environmental Noise Pollution in the United States: Developing an Effective Public Health Response. Environmental Health Perspectives (2014) 122:2. Available: https://ehp.niehs.nih.gov/1307272/. Accessed: January 2024.

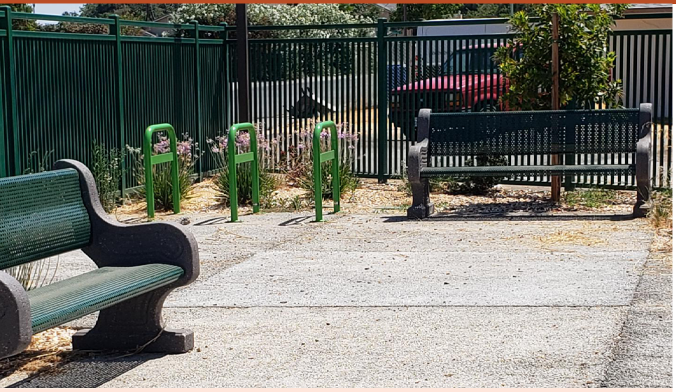
Kerns E et al. 2018. Cardiovascular conditions, hearing difficulty, and occupational noise exposure within US industries and occupations. Am J Ind Med 2018 Jun;61(6):477-491. doi: 10.1002/ajim.22833. Available: https://pubmed.ncbi.nlm.nih.gov/29537072/. Accessed: January 2024.

Koutros S et al. 2020. Diesel exhaust and bladder cancer risk by pathologic stage and grade subtypes. Environment International 135: February 2020, 10534. Available: https://doi.org/10.1016/j.envint.2019.105346. Accessed: January 2024.

U.S. Office of Occupational Safety and Health Administration. 2013. OSHA/MSHA Hazard Alert: Diesel Exhaust/Diesel Particulate Matter. Available: https://www.osha.gov/sites/default/files/publications/OSHA-3590.pdf. Accessed: January 2024.

Install Cool Pavement

Measure BE-6



GHG Mitigation Potential

0 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Cool pavements can reduce the effects of UHI, especially in the evening, improving pedestrian comfort during warmer nights. Cool pavements can also reduce ground-level ozone formation and the temperature of stormwater runoff. UHI mitigation strategies such as cool pavements should be prioritized in paved areas of communities disproportionately impacted by the UHI effect.

Cost

Payer: Public Agency (e.g., local or regional government entity)

Cost Level: High

Measure Description

This measure focuses on emission reductions from the installation of cool pavement in place of conventional dark pavements.

Installing Cool Pavement: This measure would install cool pavement in place of conventional dark-colored, heat-absorbent pavements such as asphalt. By installing cool pavement, electricity consumption for cooling in surrounding buildings would decrease, thus reducing the GHG emissions associated with electricity generation. Cool pavement installation should be prioritized in neighborhoods impacted by urban heat islands (UHI), with significant paved surface area, low tree canopy, or high vulnerability due to age, employment, income, and linguistic isolation, among other sensitivity indicators.

Subsector

Building Energy

Scale of Application

By 2030:

- Install cool pavement for 18,480,000 square feet of paved surfaces across the region.

By 2045:

- Install cool pavement for 18,480,000 square feet of paved surfaces across the region.

Authority to Implement

- **Legislation, Rules, and Policy:** For public pavement, such as roads, trails, sidewalks, alleys, plazas, and publicly owned parking facilities, local jurisdictions and agencies can designate their own standards, which can include cool pavement requirements such as minimum albedo. For new development, jurisdictions may adopt design standards with cool pavement requirements.
- **Incentives:** MPOs and RTPAs can include additional points for projects with cool pavements during competitive or flexible funding rounds.

Monitoring and Reporting

Adoption of cool pavement ordinances and design standards by jurisdictions could be used as a method to track new cool pavement installation projects. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Strategically install 9,240,000 square feet of cool pavements across the region.
- **Year 2-3:** Strategically install an additional 9,240,000 square feet of cool pavements across the region.

Potential implementation tracking metrics include:

1. Number of ordinances and design standards adopted
2. Area of cool pavement installed

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measure E-21).[1] The extent of cool pavement installed by 2030 is assumed to be 18,480,000 square feet for 350 lane-miles and an assumed lane width of 10 feet.[2] The GHG reductions were estimated based on electricity savings for cooling resulting from cool pavement installation offset by the increase in natural gas use for heating. Based on the CAPCOA Handbook methodology, the measure is projected to generate a net increase in 2030 and 2045 emissions, as the reduction in electricity use (which will be low- to zero-emissions by 2030 and 2045) is offset by the increased natural gas use in the winter for heating – known as the winter heating penalty. However, this methodology likely overstates the winter heating penalty, as the reference study relies upon historical winter temperatures and does not account for warmer winters due to climate change. Further, by 2045 a greater share of heating systems is likely to use electricity – which will be 100% zero-emissions – rather than natural gas. Thus, although this measure is likely to generate GHG reductions, they could not be calculated under the CAPCOA method, and emissions reductions are therefore reported as 0.

For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-6. Potential Emissions Reductions from Measure BE-6 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Install Cool Pavement	0	0
Total Reduction	**0**	**0**

Co-Pollutant Reductions Quantification Summary

The methodology for estimating emission reductions for co-pollutants is based on guidelines in the CAPCOA Handbook. As described previously, the measure could decrease cooling/electricity use but increase natural gas use for winter heating, resulting in a slight net increase in co-pollutant emissions. However, for reasons discussed above, this winter heating penalty could be overstated by 2045.

Table BE-6.2. Potential Co-Pollutant Emissions (short tons/year) from Measure BE-6 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	-0.05	-0.04	0.00	0.0	0.00	0.00	0.00
2045	-0.05	-0.04	0.00	0.0	0.00	0.00	0.00

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

Material costs for cool pavements vary depending on material used, ranging from under $4 to approximately $20 per square yard, according to the Smart Surfaces Coalition. To install cool pavement for 18.5 million square feet of paved surfaces, costs may range from $25 million to $125 million.[3] However, cool pavements may require less maintenance, which can reduce maintenance costs for local agencies.

Health and Other Considerations

Cool pavements can reduce the health effects of extreme heat, which include heat rash, heat cramps, fainting and dizziness, muscle breakdown, heat exhaustion, and heat stroke, which can be fatal. Socioeconomic status is a significant determinant of heat vulnerability. Vulnerable and sensitive communities are disproportionately at risk of negative heat effects. A potential disbenefit of cool pavement installation includes reflectivity concerns.

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District on December 22, 2023.*

[2] *California Code of Regulations. 2023. Cal. Code Regs. tit. 14 § 1273.01. Accessed January 2024. Available: https://casetext.com regulation/ california-code-of-regulations/title-14-natural-resources/division-15-department-of-forestry-and-fire-protection/chapter-7-fire protection/ subchapter-2-state-minimum-fire-safe-regulations/article-2-ingress-and-egress/section-127301-width*

[3] *Smart Surfaces Coalition. (n.d.). Cool roadways partnership. Available: https://smartsurfacescoalition.org/cool-roadways-partnership.*

ADDITIONAL SOURCE

Capital Region Climate Readiness Collaborative. 2019. Urban Heat Island Mitigation Plan. Available: https://www.airquality.org LandUseTransportation/Documents/UHI%20Mitigation%20Plan.pdf. Accessed: January 2024.

Reduce Solid Waste

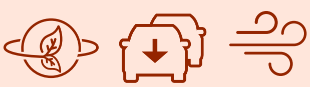
Measure BE-7

GHG Mitigation Potential

21,593 MT CO_2e/yr by 2030

29,423 MT CO_2e/yr by 2045

Co-Benefits



Climate Resilience

Organics diversion programs can provide locally generated compost, which can support soil health, benefiting soil carbon sequestration and water retention. Healthy soils can support agricultural resilience against drought.

Cost

Payer: Public Agency (e.g., municipal solid waste authority)

Cost Level: Low (High cost if requires additional waste management capacity)

Measure Description

This measure will implement or expand waste management services to reduce the volume of landfill waste. Diverting waste from landfills to recycling or composting facilities will reduce the generation of GHG emissions, mainly CH_4, a byproduct of landfill decomposition. This measure is composed of two parts:

Institute or Extend Recycling Services: Expanding recycling services would reduce the volume of waste that is disposed of in landfills, ultimately reducing CH_4 emissions from landfill decomposition. Though specialized waste streams for recycling also produce GHG emissions, they do so at a lower rate. In addition, upstream emissions from production of new raw materials are indirectly reduced by using recycled materials.

Implement Organics Diversion Program: Implementing an organics diversion program will reduce the quantity of organic waste sent to landfills. Organic waste includes both edible and non-edible food waste such as food-soiled paper, yard waste, and non-hazardous wood waste. Diverting these waste products from landfills will reduce the emissions associated with landfill decomposition. Such implementation will require more composting facilities, compost pickup services, compost bins, and community education and outreach.

Subsector

Solid Waste

Scale of Application

By 2030:

- 15% participation in recycling and organics waste diversion programs (either by expanding existing programs or establishing new services).

By 2045:

- 20% participation in recycling and organics waste diversion programs (either by expanding existing programs or establishing new services).

Authority to Implement

- **Legislation, Rules, and Policy:** In the Capital Region, residential solid waste collection and operation of solid waste landfills tend to be municipal operations or franchises, whereas commercial solid waste collection is private. It is within the authority of the local government, in their role as operator, to require recycling or diversion beyond state requirements and to collect fees to cover operational expenses.
- **Incentives:** Integrated waste management fees, imposed on solid waste operators by the California Department of Resources and Recycling and Recovery (CalRecycle), are used for solid waste reduction, recycling and reuse, composting, environmentally safe transformation, and safe land disposal practices. Municipal governments can also have different fee schedules for collection, with smaller fees for smaller waste bins and no fee for recycling and green waste pick up.

Monitoring and Reporting

Annual reporting for recycling and organics diversion is required per the Integrated Waste Management Act, the Per Capita Disposal Measurement System, and SB 1383 (Lara, 2013: short-lived climate pollutants). A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Achieve 7.5% participation in recycling and organics waste diversion programs.
- **Year 2-3:** Achieve 15% participation in recycling and organics waste diversion programs.

Potential implementation tracking metrics include:

1. Weight of waste diverted and treatment type (e.g., recycled or composted)

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures S-1 and S-2).[1] The majority of GHG reductions are achieved by expanding recycling services. EPA's Waste Reduction Model (WARM)[2] was used to estimate emission reductions based on the population participation and estimated disposal rates by location/county. The diversion of edible food to food banks as an alternative to composting is not captured in the methodology for this measure, but is described in Measure BE-10. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-7. Potential Emissions Reductions from Measure BE-7 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Institute or Extend Recycling Services	19,875	27,082
Implement Organics Diversion Program	1,718	2,341
Total Reduction	**21,593**	**29,423**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure.

Cost Considerations

Costs vary significantly based on project pursued. The Institute for Local Government has a suite of case studies based on different California programs.[3] This estimate assumes that existing facilities possess the capacity to implement this measure through instituting or expanding recycling services or implementing an organics diversion program. If the measure does require additional capacity to process waste, this is likely to be a high-cost measure.

Health and Other Considerations

Improved access to recycling facilities can ensure recycling practices in residential communities.

Edible food scraps and food waste donated to food banks or other non-profit organizations can increase community food security and improve the nutritional status of vulnerable populations.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[2] *EPA. 2023. Waste Reduction Model (WARM). Available: https://www.epa.gov/warm/versions-waste-reduction-model*

[3] *Institute for Local Government. 2015. The True Cost of Recycling: California Communities are Financing and Siting Recycling Infrastructure. Available: https://www.ca-ilg.org/sites/main/files/file-attachments/case_story_snapshot_compilation_final_0.pdf.*

ADDITIONAL SOURCE

Sacramento County Environmental Management. 2024. Edible Food Recovery – SB 1383. Available: https://emd.saccounty.gov/EH FoodProtect-RetailFood/Pages/FoodRecovery.aspx#:~:text=Permitted%20food%20facilities%20such%20as,charitable%20organizations%2 or%20 individuals%20directly. Accessed: January 2024.

Reduce Water Utility Emissions

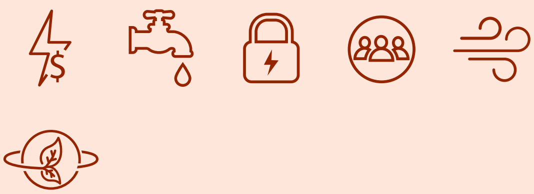
Measure BE-8

GHG Mitigation Potential

310 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits



Climate Resilience

Water conservation improves water availability especially under drought conditions and when California experiences reduced snowpack.

Cost

Payer: Private (e.g., individual household, property owner)

Cost Level: Low (per implementing entity)

Measure Description

This measure focuses on the water conservation resources by requiring low-flow water fixtures in buildings, reducing the amount of water-inefficient turf grass in landscaping, and designing water-efficient landscapes. Electricity is required to source and transport municipal water, and thus reducing water consumption reduces energy use and GHG emissions. The implementation of this measure is made up of three parts:

Require Low-Flow Water Fixtures: Requires the use of low-flow and high-efficiency water fixtures (such as toilets, showerheads, faucets, washing machines, and dishwashers) in residential and non-residential buildings. Low-flow water fixtures use less water than conventional fixtures, thereby reducing the energy associated with municipal water transport and processing, and wastewater treatment after use.

Reduce Turf in Landscapes: Requires removing turf grass, which has higher water demands than most other types of vegetation. Maintaining landscapes without turf reduces water consumption compared to areas with turf.

Design Water-Efficient Landscapes: Requires the design of landscapes that are water efficient and have lower water demands than the California Department of Water Resources (DWR) 2015 Model Water Efficient Landscape Ordinance (MWELO) requirements.[1] Irrigating water-efficient landscapes reduces water consumption compared to conventional landscapes.

Subsector

Water

Scale of Application

By 2030:

- Installing low-flow fixtures in residential dwellings for up to 20% of residential water usage.
- Removing 200,000 square feet of turf.
- Implementing 5,000 residential/commercial landscaping projects that replace traditional landscape areas with landscapes.
  - Projects could be either approximately 1,000 square feet of landscape area, or approximately 500 square feet of special landscape area (with edible plants, recreational area, irrigation with recycled water, or water features with recycled water).

By 2045:

- Installing low-flow fixtures in residential dwellings for up to 20% of residential water usage.
- Removing 200,000 square feet of turf.
- Implementing 5,000 residential/commercial landscaping projects that replace traditional landscape areas with landscapes.
  - Projects could be either approximately 1,000 square feet of landscape area, or approximately 500 square feet of special landscape area (with edible plants, recreational area, irrigation with recycled water, or water features with recycled water).

Authority to Implement

- **Legislation, Rules, and Policy:** The state requires water purveyors achieve conservation targets, typically through rebates and incentives for their customers. End users are also required to have water meters, which encourages conservation. The California Building Code has provisions for water conservation, and structural remodels of a certain size will require upgrades to increase conservation. Jurisdictions may impose outdoor watering restrictions and landscaping requirements for drought-tolerant plants and efficient irrigation.
- **Incentives:** Water conservation rebates are typically provided by water purveyors, and can include fixtures (such as toilets), as well as turf removal subsidies.

Monitoring and Reporting

Reductions in water utility emissions can be tracked by water providers through annual reporting to the California State Water Resources Control Board. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop incentive programs and outreach to relevant stakeholders.
- **Year 1-2:** Install low-flow fixtures in residential dwellings for 10% of residential water usage, remove 100,000 square feet of turf, and implement 2,500 residential/commercial landscaping projects that replace traditional landscape areas with water-efficient landscapes.
- **Year 2-3:** Install low-flow fixtures in residential dwellings for up to 20% of residential water usage, remove an additional 100,000 square feet of turf, and implement an additional 2,500 residential/commercial landscaping projects that replace traditional landscape areas with water-efficient landscapes.

Potential implementation tracking metrics include:

1. Number of low-flow fixtures installed
2. Square footage of turf removed
3. Number of landscaping projects implemented
4. Change in per capita potable water use

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures W-4, W-5, and W-6).[2] The majority of GHG reductions are achieved through the installation and use of low-flow fixtures in residential buildings. The water energy-intensity factor is based on the Sacramento River Hydrologic Region in the CAPCOA Handbook (Table W-1.1). The GHG intensity of electricity is based on the market-based electricity emissions factor projections for each electric utility. In 2045, the measure does not reduce GHG emissions as it only reduces electricity use which generates zero emissions by 2045. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045 noted above.

Table BE-8. Potential Emissions Reductions from Measure BE-8 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Require Low-Flow Water Fixtures	288	0
Reduce Turf in Landscapes and Lawns	22	0
Design Water-Efficient Landscapes	0	0
Total Reduction	**310**	**0**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use, which produces zero emissions by 2045.

Cost Considerations

There are several measure options for conserving water and energy resources. While project costs vary, most interventions represent a low cost for the payer. The cost of installing low-flow fixtures such as shower heads or toilets ranges from $10 to $50 per fixture and can achieve a water savings of 25% to 60%.[3] Outdoor conservation measures such as removing turf grass has an average cost between $0.88 and $1.84 per square foot, typically costing between $760 and $3,300 for the average lawn.[4] Water efficient landscaping such as xeriscaping can be a larger investment for property owners, ranging between $7,000 and $18,300 for a medium yard (between 1,000 and 2,500 square feet).[5] In addition to the benefit of utility savings, some jurisdictions and utilities offer rebate programs to offset the installation of water conservation measures.

Health and Other Considerations

When designing new water-efficient landscapes, selecting low-allergen plants can reduce risk of exacerbation of allergies and asthma. The removal of turf grass can reduce exposure to fertilizers, herbicides, and pesticides, which may trigger irritation of the skin, eyes, nose, and throat.

REFERENCES

[1] *California Department of Water Resources. 2022. Model Water Efficient Landscape Ordinance. Available: https://water.ca.gov/Programs/Water-Use And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance*

[2] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[3] *U.S. Department of Energy. (n.d.). Reduce hot water use for energy savings. Available: https://www.energy.gov/energysaver/reduce-hot-water-use-energy-savings*

[4] *LawnStarter. 2024. Grass removal price. Available: https://www.lawnstarter.com/blog/cost/grass-removal-price/*

ADDITIONAL SOURCES

Cutter's Landscape. 2025. How much does it cost to xeriscape a yard? Available: https://cutterslandscape.com/how-much-does-it-cost-to-xeriscape-a-yard/

Asthma and Allergy Foundation of America. 2018. Smart Gardening: Tips for an Allergy-Friendly Garden Available: https://community.aafa org/blog/smart-gardening-tips-for-a-allergy-friendly-gardening. Accessed: January 2024.

Californians for Pesticide Reform. 2021. Pesticides and Human Health. Available: https://www.pesticidereform.org/pesticides-human health/. Accessed: January 2024.

Healthline. 2021. Symptoms of Plant Food Poisoning. Available: https://www.healthline.com/health/fertilizers-and-household-plant foods#causes. Accessed: January 2024.

Reduce Wastewater Emissions

Measure BE-9

GHG Mitigation Potential

67,198 MT CO_2e/yr by 2030

73,023 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

CH_4 emissions from wastewater treatment can be reduced by recovering emissions via capture technology. CH_4 recovery provides fuel redundancy during extreme events, but CH_4 combustion can increase air pollution. Care should be taken so that combustion emissions have no impact on nearby sensitive or vulnerable populations.

Cost

Payer: Public Agency (e.g., local government, wastewater utility)

Cost Level: High

Measure Description

This measure focuses on reducing GHG emissions from wastewater treatment plants that have anaerobic digestion processes, a common source of CH_4 that is a more potent GHG than CO_2.

Establish CH_4 Recovery in Wastewater Treatment Plants: This measure requires capturing and combusting the CH_4 emissions from existing wastewater treatment plants. The combustion or flaring of CH_4 converts the emissions into CO_2, which has a lower global warming potential than CH_4. Additional reductions (and revenue/savings) may be achieved if the heat from combustion is used to generate electricity for onsite energy use, or alternatively, if the captured CH_4 is processed to be sold as a transportation fuel, or converted into clean hydrogen fuel, under the Low Carbon Fuel Standard. This measure is most applicable for wastewater treatment plants that have anaerobic digestion infrastructure, and may not be appropriate for treatment plants that use lagoons to process wastewater.

Subsector

Methane Recovery

Scale of Application

By 2030:

- Capturing and flaring the CH_4 from 15% of the total wastewater treated in the region.

By 2045:

- Capturing and flaring the CH_4 from 15% of the total wastewater treated in the region.

Authority to Implement

- **Legislation, Rules, and Policy:** Wastewater treatment plants are typically operated by public agencies and subject to regulations by the Central Valley and Lahontan Regional Water Quality Control Boards. It is within the authority of these agencies to upgrade their facilities to capture CH_4 and increase user fees, issue bonds, or receive grants to cover the capital and operational expenses.

Monitoring and Reporting

Reductions in wastewater emissions can be tracked through annual reporting to Regional Water Quality Control Boards. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Identify wastewater treatment plants in the region with anaerobic digestion infrastructure and develop appropriate methane capture programs for each site.
- **Year 1-2:** Install methane capture technology at each site.
- **Year 2-3:** Capture and flare methane from 15% of the total wastewater treated in the region.

Potential implementation tracking metrics include:

1. Quantity of methane captured
2. Quantity of methane flared
3. Electricity generated from captured methane
4. Number of wastewater treatment plants with methane capture programs

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure E-19).[1] Calculations assume that the wastewater is treated at facilities with primary treatment, and the CH_4 emissions are captured and flared. The amount of wastewater treated per day was obtained from sanitation or public works reports for each county and forecast using service population forecasts.[2] Additional GHG reductions may be achieved for this measure, such as using the heat from CH_4 combustion to generate electricity for onsite use or processing the captured CH_4 for use as transportation fuel, were not quantified. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-9. Potential Emissions Reductions from Measure BE-9 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Establish CH_4 Recovery in Wastewater Treatment Plants	67,198	73,023
Total Reduction	**67,198**	**73,023**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure.

Cost Considerations

Wastewater treatment plants that have no current system for capturing methane would face high installation costs for a methane recovery system. Costs would be lower for plants that already have a system for trapping or cleaning captured gases.[3] One program in Roseville costs $8.1 million for anaerobic treatment, waste separation, and biogas upgrading technology.[4] As CH_4 is used to produce renewable electricity and heat, cogeneration plants would generate additional revenue. The Sacramento Area Sewer District's (SacSewer) integrated 13.4 MW cogeneration plant will use fuel cell technology that eventually could produce green hydrogen.

Health and Other Considerations

While odors emitted by wastewater treatment plants are not a direct cause of disease, they can lead to nausea, headaches, and respiratory problems. Reduce odor impacts on the nearby community by implementing all available deodorization methods. During construction of new CH_4 recovery facilities, control dust and noise impacts on the surrounding community to avoid generating the respiratory and cardiovascular effects of exposure to particulate pollution and noise stress.

REFERENCES

[1] CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

[2] SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available: https://www.sacog.org/planning/blueprint

[3] California Air Pollution Control Officers Association. 2021. Handbook for analyzing greenhouse gas emission reductions, assessing climate vulnerabilities, and advancing health and equity. Available: https://caleemod.com/documents/handbook/full_handbook.pdf.

[4] OneWaterNews. 2023. California wastewater agencies pursue codigestion to create renewable energy. Available: https://www.onewaternews.com/california-wastewater-agencies-pursue-codigestion-to-create-renewable-energy

ADDITIONAL SOURCES

Lebrero R et al. 2011. Odor Assessment and Management in Wastewater Treatment Plants: A Review. Critical Reviews in Environmental Science and Technology 41(10)915-950. DOI: 10.1080/10643380903300000. Available: https://www.tandfonline.com/doi abs/10.1080/10643380903300000. Accessed: January 2024.

Lewkowska P et al. 2016. Characteristics of odors emitted from municipal wastewater treatment plant and methods for their identification and deodorization techniques. Environmental Research 151:573-586. Available: https://www.sciencedirect.com/science/article/abs/pii S001393511630487X. Accessed: January 2024.

Require Edible Food Recovery Program Partnerships with Food Generators

Measure BE-10

GHG Mitigation Potential

1,761 MT CO_2e/yr by 2030

2,607 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Salvaging edible food that would otherwise be sent to a landfill provides food security for underserved populations. Food recovery conserves resources, reduces waste, and lowers CH_4 emissions.

Cost

Payer: Private (e.g., business, non-profit organization)

Cost Level: Medium (per implementing entity)

Measure Description

This measure focuses on recovering edible food to reduce the amount of non-diverted organic waste that ends up in the landfill. Reducing food waste reduces GHG emissions associated with landfill decomposition, which produces CH_4.

Require Edible Food Recovery Program Partnerships with Food Generators: Requires food handling organizations (such as food service establishments, wholesale providers, and retail providers of food) to partner with food recovery programs to reduce the amount of food that would be sent to landfills. The extra edible food can be collected and redistributed for consumption by those in need.

Subsector

Solid Waste

Scale of Application

By 2030:

- Recovering 2,500,000 pounds of edible food per year.
- Deployment of 100 distribution centers equipped with one delivery vehicle and one walk-in refrigeration unit per center.

By 2045:

- Recovering 4,000,000 pounds of edible food per year.
- Deployment of 150 distribution centers equipped with one delivery vehicle and one walk-in refrigeration unit per center.

Authority to Implement

- **Legislation, Rules, and Policy:** SB 1383 (Lara, 2016) requires food businesses to donate the maximum amount of edible food they would otherwise dispose of to food recovery organizations. These businesses include wholesale food vendors, food distributors, grocery stores, food service providers, restaurants, institutional cafeterias, venues, and hotels.
- **Incentives:** Recovery from Tier 2 facilities, which typically provide prepared food, is more difficult due to temperature concerns and timing. Providing funding to food recovery organizations for vehicles, equipment, and personnel can increase the successful recovery of edible food.

Monitoring and Reporting

Required edible food recovery will be monitored through SB 1383 (Lara, 2013) reporting by food generators. A measure implementation schedule for key milestones is as follows:

- Year 0-1: Outreach to relevant stakeholders and create partnerships between food handling organizations and food recovery organizations.
- Year 1-2: Deploy 50 distribution centers equipped with one delivery vehicle and one walk-in refrigeration unit per center and recover 1,250,000 pounds of edible food per year.
- Year 2-3: Deploy an additional 50 distribution centers equipped with one delivery vehicle and one walk-in refrigeration unit per center and recover an additional 1,250,000 pounds of edible food per year

Potential implementation tracking metrics include:

1. Amount of edible food recovered
2. Number of food-handling organizations, food service establishments, wholesale providers, and retail sources of edible food waste participating

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measure S-3).[1] Net GHG reductions are achieved through the recovery of edible foods and accounting for the increase in GHG emissions from transportation vehicles and refrigeration equipment used in the food recovery process. Calculations assume the use of gasoline for refrigerated vans, large walk-in commercial refrigerators with solid doors, default refrigerant charge size, and default leak rates based on the CAPCOA Handbook Update. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for each electric utility. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-10. Potential Emissions Reductions from Measure BE-10 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Require Edible Food Recovery Program Partnerships with Food Generators	1,761	2,607
Total Reduction	**1,761**	**2,607**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on the guidelines in the CAPCOA Handbook and the CAPCOA Handbook Update. Net co-pollutant reductions are achieved through the recovery of edible foods associated with the avoided food transportation to a landfill and the reduction in organic waste that would be flared at a local landfill, accounting for the increase in emissions from vehicles used in the food recovery process. The co-pollutant reductions associated with the avoided food waste transportation and landfill flaring are based on the CARB 2020 California Department of Resources Recycling and Recovery Food Waste Prevention and Rescue Program and vehicle emission factors from the increase in vehicles used in the food recovery process from EMFAC2021.[3] Annual co-pollutant emissions below represent the implementation of this measure across the Sacramento-Roseville CSA at the scale of application by 2045. Application of this measure by 2030 was not quantified; therefore, the 2045 estimates below are based on the amount of edible food recovered by 2050. For some pollutants, emissions from transportation of recovered food exceed emissions reduction from the edible food recovery, resulting in a disbenefit for this measure.

Table BE-10.2 Potential Co-Pollutant Reductions (short tons/year) from Measure BE-10 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2045	0.33	-0.01	0.1	0.00	0.01	0.00	0.01

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The costs associated with this measure assume that the costs for food delivery and storage will be borne by program partners. The measure assumes approximately 150 vehicles at $30,000 and 150 refrigerators at $3,000 each.[2]

Health and Other Considerations

Edible foods diverted from landfills and redistributed for consumption can increase community food security and improve the nutritional status of vulnerable populations. Though this measure could decrease landfill gas flaring and waste hauling-related co-pollutant emissions, it could increase food distribution-related co-pollutant emissions. Therefore, ensuring the food distribution vehicles are low- or zero-emission would help mitigate the increase in food distribution co-pollutant emissions.

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District on December 22, 2023.*

[2] *Home Depot. (n.d.). Commercial refrigerators. Retrieved from https://www.homedepot.com/b/Appliances-Refrigerators-Commercial-Refrigerators/N-5yc1vZc3oe.*

[3] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available: https://arb.ca.gov/emfac/*

Onsite Solar Canopies

Measure E-1A

GHG Mitigation Potential

171 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Installing onsite solar energy systems provides backup generation sources that can reduce the risk of power outages. Onsite solar energy systems over parking lots or playgrounds can also reduce the urban heat island effect and provide outdoor shade for students, staff, and visitors. Solar canopies over parking lots can also provide electricity for vehicle charging.

Cost

Payer: Public Agency (e.g., local government, school district)

Cost Level: High

Measure Description

This measure implements shade structure solar energy systems over parking lot areas or adjacent to playgrounds at K-12 schools. This measure would shift each school's electricity consumption from electricity providers to onsite renewable energy and is cost effective in locations with high energy costs. In addition to reducing grid reliance and utility costs, solar shade structures provide valuable secondary benefits such as shaded parking for staff and visitors, reduced heat island effect on school grounds, efficient outdoor lighting opportunities, and improved outdoor comfort and safety for students—particularly in play areas.

Subsector

Renewable Energy Generation/Building Decarbonization

Scale of Application

By 2030:

- Install 27 MW of solar capacity, generating 31,876 MWh of electricity across 77 schools by 2030.

By 2045:

- Install 40.2 MW of solar capacity, generating 51,193 MWh of electricity across 118 schools by 2050.

Authority to Implement

- **Legislation, Rules, and Policy:** School districts may establish onsite solar energy systems at school campuses. School district can pursue third-party financing through a Power Purchase Agreement (PPA), which can reduce upfront costs while locking in predictable electricity rates. The solar energy company can provide the capital to construct the onsite solar energy system, and the school district can pay for the energy produced at a fixed price.

- **Incentives:** The financial viability of this measure is significantly influenced by utility rate structures, particularly under Pacific Gas and Electric's (PG&E) commercial schedules, which affect both the avoided cost of electricity and the net-metering or time-of-use credit value. Escalating utility rates and incentives such as the federal Investment Tax Credit (ITC) and potential local rebates further improve project economics. Typical payback or breakeven periods range from 10 to 15 years, depending on site-specific energy savings and negotiated contract terms.

Monitoring and Reporting

Implementation progress would be monitored via the terms included in the negotiated contract between the solar energy company and the school district. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Initiate contracts between solar energy company and individual school districts.
- **Year 1-2:** Deploy 32 shade structure solar energy systems regionwide.
- **Year 2-3:** Deploy 45 shade structure solar energy systems regionwide.

Potential implementation tracking metrics include:

1. MW of solar systems installed
2. Electricity generated by solar systems
3. Number of schools with solar systems
4. Number of solar canopy installations

GHG Reductions Quantification Summary

The estimated reductions are based on guidelines in the CAPCOA Handbook (Measure E-10-B), electricity generation estimates from the REopt tool, and utility-specific GHG intensity. The GHG reductions are achieved through the shift of energy consumption from grid energy to zero-emission renewable energy at local schools. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for SMUD and PG&E. In 2045, the measure does not reduce GHG emissions as it only reduces electricity use, which generates zero emissions by 2045. For additional details on inputs and assumptions for this specific analysis, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table E-1A. Potential Emissions Reductions from E-1A across the Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Onsite Solar Canopies	171	0
Total Reductions	**171**	**0**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use which produces zero emissions by 2045. Co-pollutant reductions by 2030 were not quantified.

Cost Considerations

The capital cost of installing solar canopies is primarily driven by the size of the system, site-specific construction needs, and structural integration with parking or playground infrastructure. Typical turnkey installation costs range from $2.50 to $3.50 per watt, resulting in a total investment of approximately $100 million to $141 million for full deployment by 2045. Ongoing operations and maintenance costs are modest, generally estimated at $15 to $25 per kW per year.

Health and Other Considerations

Solar canopy installations may interfere with existing tree canopies, which have a range of health and environmental benefits, such as reducing the urban heat island effect and improving air quality. Solar canopy structures can also reduce the urban heat island effect by shading parking lots, but to a smaller degree. New solar canopy projects should consider the tree canopy at each site and replace any trees designated for removal.

ADDITIONAL SOURCES

Anderson, Kate, et al. 2021. REopt Lite User Manual. National Renewable Energy Laboratory. Available: https://www.nrel.gov/docs/fy21osti/79235.pdf.

CAPCOA. 2024. 2024 Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.caleemod.com/documents/handbook/full_handbook.pdf.

Battery Storage-Supported Microgrids

Measure E-1B

GHG Mitigation Potential

209 MT CO_2e/yr by 2030

0 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Battery storage-supported microgrids can increase local energy resilience. Onsite renewable energy systems combined with battery storage act as an alternative to diesel generators in the event of grid power outages. This can enable sites to provide cooling and clean air during outages. The microgrid manager can also use energy storage and the batteries in electric vehicles to balance energy distribution and usage within the microgrid.

Cost

Payer: Public Agency (e.g., school district)

Cost Level: Medium

Measure Description

This measure installs onsite lithium-ion battery storage units to store excess solar energy on K-12 school campuses when paired with Measure E-1A: Onsite Solar Canopies. This measure enables grid-connected and off-grid operation modes for flexibility and reliability. Lithium-ion batteries are an appropriate choice for school campuses due to their compact footprint, high energy recovery rates, and ability to quickly respond to load changes making them ideal for managing peak demand, providing short-term local backup power, and maximizing the value of onsite solar generation. Their maturity in the commercial market and proven safety record also makes them a low-risk, manageable solution for school facility operators.

Subsector

Renewable Energy Generation

Scale of Application

By 2030:

- The project would install 7.4 MW of battery capacity across 77 schools by 2030, with a storage capacity of 29.4 MWh.

By 2045:

- The project would install 10.5 MW of battery capacity across 118 schools by 2050, with a storage capacity of 42 MWh.

Authority to Implement

- **Legislation, Rules, and Policy:** School districts may establish onsite microgrids that can function independently of the grid at school campuses.

- **Incentives:** The financial viability of this measure is enhanced through time-of-use rate optimization, demand charge reduction, and resiliency value in the event of grid outages. School districts may also explore third-party ownership or Energy-as-a-Service (EaaS) models to reduce upfront capital burden. Project payback periods generally range from 8 to 15 years depending on utility rate structures, operational strategies, and available incentives such as the federal ITC for storage charged with solar, and California's Self-Generation Incentive Program (SGIP).

Monitoring and Reporting

Each school district can track progress on the deployment of battery storage-supported microgrids. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Initiate contracts.
- **Year 1-2:** Deploy 32 battery systems regionwide.
- **Year 2-3:** Deploy 45 battery systems regionwide.

Potential implementation tracking metrics include:

1. MW of battery systems installed
2. Number of schools with battery systems
3. Number of lithium-ion battery storage unit installations

GHG Reductions Quantification Summary

The estimated reductions are based on guidelines in the CAPCOA Handbook (Measure E-10-B), electricity storage estimates from the REopt tool, and utility-specific GHG intensity. The GHG reductions are achieved through the shift of energy consumption from grid energy to battery-stored zero-emission renewable energy at local schools. The battery storage captures the surplus electricity generation from an existing onsite solar energy system. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for SMUD and PG&E. In 2045, the measure does not reduce GHG emissions as it only reduces electricity use which generates zero emissions by 2045. For additional details on inputs and assumptions for this specific analysis, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table E-1B. Potential Emissions Reductions from E-1B across the Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Battery Supported Microgrids	209	0
Total Reductions	**209**	**0**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use which produces zero emissions by 2045. Co-pollutant reductions by 2030 were not quantified.

Cost Considerations

The capital cost of lithium-ion battery storage systems for school-based microgrids varies based on system size, configuration, and integration requirements with existing or planned solar infrastructure. According to NREL's Storage Futures Study and recent cost benchmark updates, fully installed commercial-scale battery systems typically range from $1,300 to $1,600 per kWh of storage capacity.

Health and Other Considerations

Reliable electricity is vital for public health, especially for vulnerable populations including children. Storing surplus renewable energy can reduce the risk of power outages, which disproportionately impacts vulnerable communities. Microgrids can enable the site to serve as a resilience center during power outages, providing cooling, clean air, and electricity. Microgrids can also reduce the use of diesel back-up generators, avoiding co-pollutant emissions.

ADDITIONAL SOURCES

Anderson, Kate, et al. 2021. REopt Lite User Manual. National Renewable Energy Laboratory. Available: https://www.nrel.gov/docs/fy21osti/79235.pdf.

CAPCOA. 2024. 2024 Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.caleemod.com/documents/handbook/full_handbook.pdf.

Hand, M.M. et al. 2012. Renewable Electricity Futures Study, National Renewable Energy Laboratory. Available: https://www2.nrel.gov/analysis/re-futures.

ZEV Adoption and Charging Infrastructure

Measure TR-1

GHG Mitigation Potential

1,286,610 MT CO_2e/yr by 2030

1,309,392 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

When compared to traditional internal combustion engine vehicles, ZEVs can reduce the effects of extreme heat by reducing the amount of exhaust heat in the surrounding environment. Charging stations that include shade, solar, or tree canopies can improve battery health and provide respite for passengers as they wait for their vehicles to charge.

Cost

Payer: Public (e.g., local or state government, metropolitan planning organization)

Cost Level: High

Measure Description

This measure focuses on increasing the use of cleaner fuel and ZEVs by replacing conventional combustion vehicles that generate more GHG emissions, and by increasing access to charging infrastructure for ZEVs. The measure covers light-duty vehicles such as passenger cars and light-duty trucks. The implementation of this measure is made up of two parts:

Use of Cleaner-Fuel Vehicles: Requires transitioning conventional gasoline- or diesel-powered vehicles to a combination of cleaner-fuel vehicles that include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). This measure would support fleet transition within the Sacramento-Roseville CSA to cleaner vehicle use and would complement the planned transition to ZEV-only sales required by California's ACCII program. Currently, the ACCII regulation requires that new vehicle sales in California would reach 68% by 2030.[1]

Provide Electric Vehicle (EV) Charging Infrastructure: Requires installing more EV chargers at buildings with designated parking areas (such as commercial, educational, retail, and multi-family buildings). Greater availability of charging infrastructure would increase the share of miles that PHEVs can drive in electric mode instead of gasoline-powered mode, thus reducing GHG emissions from gasoline consumption. In addition, a greater number of electric vehicle chargers will indirectly support the transition to ZEVs.

Subsector

Clean Vehicles and Fuels; Parking or Road Pricing/ Management

Scale of Application

By 2030:

- Converting 30% of the light-duty vehicle fleet to a cleaner vehicle technology (15% to BEVs and 15% to PHEVs).
- Installing 6,500 electric chargers (5,000 in Sacramento County and 1,500 across remaining counties in the CSA).

By 2045:

- Converting 30% of the light-duty vehicle fleet to a cleaner vehicle technology (15% to BEVs and 15% to PHEVs).
- Installing 13,000 electric chargers (10,000 in Sacramento County and 3,000 across remaining counties in the CSA).

Authority to Implement

- **Legislation, Rules, and Policy:** Local jurisdictions have authority to enact building codes beyond state standards. California's Green Building Standards Code (CALGreen) has mandatory measures, Tier 1 measures, and Tier 2 measures. Adopting Tier 2 standards for vehicle charging will ensure appropriate infrastructure for ZEV deployment.
- **Incentives:** Local utilities have rebate programs for charging infrastructure, as well as preferential rates for EV charging. Vehicle deployment can be aided with low-income light duty programs, such as Clean Cars 4 All (CC4A) and medium- and heavy-duty programs through the Carl Moyer Program or the Sacramento Emergency Clean Air Transportation program. The statewide Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) also offers point-of-sale vouchers for medium- and heavy-duty vehicles. The statewide Clean Vehicle Rebate Project (CVRP) which had 532,690 recipients statewide has closed.

Monitoring and Reporting

Progress is measured through annual reporting on programs administered by CARB and local air districts. California EMFAC data will also disclose penetration of ZEVs. Deployment of electric vehicle supply equipment (EVSE) can also be tracked through annual climate action plan reporting by local jurisdictions. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Convert 15% of light-duty vehicle fleet to a cleaner vehicle technology. Install 1,500 EV chargers in less urbanized counties.
- **Year 1-2:** Convert 30% of light-duty vehicle fleet to a cleaner vehicle technology. Install 2,500 EV chargers in Sacramento County.
- **Year 2-3:** Install 2,500 EV chargers in Sacramento County.

Potential implementation tracking metrics include:

1. Number of vehicles replaced
2. EV charger installation permits granted
3. Local BEV/PHEV registrations
4. Number of buildings installing EV chargers and building type

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures T-14 and T-30).[2] The potential GHG reductions from the transition of baseline gasoline vehicle fleet to these cleaner-fuel vehicles varies across the vehicle technology selected. The estimated GHG reductions from converting 15% of the baseline light-duty vehicle fleet to each of these technologies is shown in Table TR-1. The calculation assumes that a total of 30% of baseline light-duty vehicles would transition to these cleaner vehicle options. The maximum GHG reductions are achieved when transitioning conventional fuel vehicles to BEVs. As ZEV technology advances and the market shapes cost and demand for these vehicles in the future, the extent to which these technologies penetrate conventional fuel fleets may vary.

The measure also includes incremental GHG reductions associated with providing EV charging infrastructure for PHEVs. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-1. Potential Emissions Reductions from Measure TR-1 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Use of Cleaner-Fuel Vehicles (15% BEVs)	745,752	752,480
Use of Cleaner-Fuel Vehicles (15% PHEVs)	529,988	544,850
Provide EV Charging Infrastructure	10,871	12,062
Total Reduction	**1,286,610**	**1,309,392**

Co-Pollutant Reductions Quantification Summary

The co-pollutant reductions associated with implementation of this measure are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[3] VMT reductions are estimated using the percent reduction in GHG emissions and percent of vehicles converted to cleaner fuels and the total county miles as reported in EMFAC2021. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual co-pollutant emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA at the scale of application by 2030 and 2045.

Table TR-1.2. Potential Co-Pollutant Reductions (short tons/year) from Measure TR-1 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	286.4	4574.8	532.6	84.6	29.0	12.6	0.2
2045	231.1	4042.6	417.8	90.9	29.6	12.5	0.2

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The measure cost only considers the infrastructure cost associated with the installation of electric vehicle charging infrastructure to facilitate ZEV adoption. The measure assumes 13,000 EV chargers are installed. EV chargers range from $3,000-$7,000 per level 2 charger and $50,000-$100,000 for fast chargers. Installation costs for fast chargers range from $40,000 to $150,000.[4]

Health and Other Considerations

Exposure to gasoline and diesel emissions generates systemic inflammation and produces effects in the lungs, heart, blood vessels, and brain. Children, older adults, people from low-income communities, and others disproportionately affected by pollution are most vulnerable. ZEV use can reduce emissions that cause deficits in lung function, asthma, high blood pressure, cancer, type 2 diabetes, cognitive difficulties, and premature death, among other health outcomes. Drivers of EVs also avoid exposure to gasoline vapors containing toxic air contaminants that increase the risk of cancer.

REFERENCES

[1] CARB. 2022. Advanced Clean Cars II Regulation Adoption. Meeting Workshop Presentation. August 2022. Accessed Jan 2024 at https://ww2.arb ca.gov/sites/default/files/barcu/board/books/2022/082522/22-10-1pres.pdf

[2] CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

[3] CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available: https://arb.ca.gov/emfac/

[4] McKinsey & Company. 2023. Can public EV fast-charging stations be profitable in the United States? Available: https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/can-public-ev-fast-charging-stations-be-profitable-in-the-united-states.

ADDITIONAL SOURCES

World Health Organization. 2019. Health consequences of air pollution on populations. Available: https://www.who.int/news/item/15-11 2019-what-are-health-consequences-of-air-pollution-on-populations#:~:text=It%20increases%20the%20risk%20of,poor%20people%2 are%20 more%20susceptible. Accessed: January 2024

US Environmental Protection Agency. 2023. Research on Near Roadway and Other Near Source Air Pollution. Available: https://www.epa.gov/air-research/research-near-roadway-and-other-near-source-air-pollution. Accessed: January 2024

Public Transit Improvements

Measure TR-2

GHG Mitigation Potential

30,359 MT CO_2e/yr by 2030

31,710 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Extending transit network coverage or hours and providing safety features at transit stations can improve ridership, resulting in less passenger vehicle use and traffic.

Cost

Payer: Public Agency (e.g., local transit agencies)

Cost Level: High

Measure Description

This measure focuses on improving a rider's experience when using public transportation. Improving the rider's experience and enhancing the accessibility of transit services makes it a more viable mode of transportation and facilitates a modal shift away from single-occupancy vehicles. The implementation of this measure is made up of the four parts.

Extend Transit Network Coverage or Hours: Public transportation networks would be expanded by adding or modifying existing transit services through expansion of service into new areas or by additional frequency of service throughout the day. Modifications to local transit services can accommodate various commute times for alternative-shift workers and would encourage the use of public transportation and reduce VMT and associated emissions.

Increase Transit Service Frequency: Increasing the frequency of select service lines will reduce waiting time and overall trip duration to improve the experience and attractiveness of public transportation, encouraging a modal shift away from vehicles and reducing associated emissions.

Provide Transit Shelters (Bus Shelters Only): This measure involves providing additional amenities to make it safer and more comfortable to wait for the bus by installing bus shelters.

Provide Transit Shelters (Bus Shelters and Real-Time Arrival Information): This measure involves providing bus shelters with real-time arrival information displays. Transit ridership research shows that adding these amenities decreases both the real and perceived waiting time, encouraging increased ridership.

Subsector

Transit

Scale of Application

By 2030:

- Increase transit service hours by 85%.
- Increase transit frequency by 30% for 90% of transit routes.
- Add 48 new transit stops with new bus shelters and benches.
- Increase the average number of boardings per day at each transit station with bus shelters and real-time arrival information to 100 boardings.
- Increase the average number of boardings per day across the transit agencies in the region to 26,250 boardings.

By 2045:

- Increase transit service hours by 85%.
- Increase transit frequency by 40% for 90% of transit routes.
- Add 48 new transit stops with new bus shelters and benches.
- Increase the average number of boardings per day at each transit station with bus shelters and real-time arrival information to 150 boardings.
- Increase the average number of boardings per day across the transit agencies in the region to 27,563 boardings.

Authority to Implement

- **Legislation, Rules, and Policy:** Transit providers have the authority to increase service hours and coverage, as long as funding is secured, and service is provided consistent with federal regulations. Improvements to transit shelters may be made by either the transit provider or the local jurisdiction, provided the location has necessary right-of-ways or easements. Transit shelters may also be included as conditions of approval for new developments in some circumstances.
- **Incentives:** As some state funding is only available for regions that achieve their VMT reduction targets, investing in comprehensive public transit improvements will help maintain or increase transit ridership and help ensure continued eligibility for these funds.

Monitoring and Reporting

Public transit improvements can be tracked through annual reporting by transit providers. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Expand transit service hours by 30% and increase transit frequency by 30% for 45% of transit routes.
- **Year 1-2:** Prepare individual sites and install bus shelters with real-time arrival displays and benches at 48 new or existing transit stops.
- **Year 2-3:** Expand transit service hours by 85% and increase transit frequency by 30% for 90% of transit routes.

Potential implementation tracking metrics include:

1. Number of improved transit stops
2. Number of boardings at each improved transit stop
3. Transit service miles and hours
4. Transit ridership
5. Surveys on changes in ridership experience

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measures T-25, T-26, and T-46).[1,2] Table TR-2 shows the individual contributions to emission reductions from each of the measure components. Expansion of transit network coverage or hours generates the greatest emission reductions. Emissions for commuting passenger cars and passenger trucks for the region were modeled using CARB's EMFAC[2] and applying the percent reduction estimated as a result of the measure. The percentage of VMT associated with commuter traffic was derived from the commute share of household generated-VMT in the Sacramento metro area.[3] Two scenarios were modeled to show the possible range of reductions:

- **Scenario A:** Expansion of public transit network, increased transit service frequency, installation of bus shelters and real-time arrival information.
- **Scenario B:** Expansion of public transit network, increased transit service frequency, installation of bus shelters.

In both scenarios, the emission reduction values from the expansion of the transit network and increased transit service frequency are applicable, however the scenarios diverge with the inclusion of real-time arrival information. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-2. Potential Emissions Reductions from Measure TR-2 across the Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Expanded Transit Network Coverage or Hours	23,853	23,614
Increase Transit Service Frequency	5,719	7,073
Provide Transit Shelters (Bus Shelters and Real- Time Arrival Information)	787	1,023
Provide Transit Shelters (Bus Shelters Only)	398	557
Total Reduction	**29,969-30,359**	**31,244-31,710**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on the guidelines in the CAPCOA Handbook. Co-pollutant emissions reductions are based on the estimated bus VMT and light-duty vehicle VMT reductions and the associated emission factors from EMFAC2021.[3] Bus VMT is estimated based on the number of routes in Sacramento and bus operational hours per day. Light-duty vehicle avoided VMT associated with extended transit network coverage or hours and provision of transit shelters is based on the estimated GHG emissions percent reduction and total county mileage as reported in EMFAC2021. Light-duty vehicle avoided VMT associated with increasing transit service frequency is based on the estimated daily person trips in the corridors and average vehicle trip length. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Cost Considerations

Building bus shelters, expanding transit service hours and frequency, and constructing 48 new bus stops represents a significant investment. A 2010 US Department of Transportation (DOT) estimate found that the average cost to build a single bus stop to be minimally ADA compliant is $21,500.[4]

Table BE-TR-2.2 Potential Co-Pollutant Reductions (short tons/year) from Measure TR-2 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	2.4	71.2	11.4	1.6	0.5	0.3	-0.3
2045	3.5	81.6	9.1	1.8	0.6	0.3	-0.2

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Health and Other Considerations

Increased access to efficient public transit promotes walking and results in reductions in obesity, heart disease, hypertension, stroke, type 2 diabetes, osteoporosis, and cancer. Regardless of income, public transit users walk more than non-transit users. Psychological wellbeing is often higher when using transit, as driving is the most stressful commute mode. In communities served by transit, traffic injuries are lower and community security increases from street-level monitoring of city streets and transit waiting areas.

Though this measure could decrease passenger vehicle-related co-pollutant emissions, it could increase diesel particulate matter emissions from the increased use of diesel buses. Therefore, ensuring that the buses are low- or zero-emission vehicles would help mitigate the increase in transit co-pollutants.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf*

[2] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District on December 22, 2023.*

[3] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/*

[4] *U.S. Department of Transportation. (n.d.). Bus stop optimization: Final report. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/Bus_Stop_Optimization_Final_Report.pdf.*

ADDITIONAL SOURCES

SACOG. 2016. Metropolitan Transportation Plan/Sustainable Communities Strategy. Available online at: https://www.sacog.org/sites/main files/file-attachments/mtpscs_complete.pdf

Besser LM and Dannenber AL. 2005. Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations Am J Prev Med 2005;29(4). Doi:10.1016/j.ampre.2005.06.010. Available: https://www.cdc.gov/healthyplaces/articles/besser_dannenberg.pdf. Accessed: January 2024.

Guzman Habinger J et al. 2020. Active Transportation and Obesity Indicators in Adults from Latin America: ELANS Multi-Country Study. Int J Environ Res Public Health. 2020 Oct; 17(19): 6974. 2020 Sep 24. doi: 10.3390/ijerph17196974. Available: https://www.ncbi.nlm.nih.gov/pmc articles/PMC7579005/. Accessed: January 2024.

Legrain A et al. 2015. Am stressed, must travel: The relationship between mode choice and commuting stress. Transportation Research Part F: Traffic Psychology and Behaviour 34. October 2015, Pages 141-151. Available: https://www.sciencedirect.com/science/article/abs/pii S1369847815001370. Accessed: January 2024.

Litman, T. 2020. Evaluating Public Transportation Health Benefits. Victoria Transport Policy Institute, April 2020. Available: https://www.vtpi org/tran_health.pdf. Accessed: December 2023.

Litman, T. 2023. Safer Than You Think! Revising the Transit Safety Narrative. Victoria Transport Policy Institute, May 2023. Available: https:/ www.vtpi.org/safer.pdf. Accessed: January 2024.

Mortin A. 2014. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. Preventive Medicine 69. Dec 2004, 296-303. Available: https://www.sciencedirect.com/science/article/pii S0091743514003144. Accessed: January 2024.

Provide Bus Rapid Transit

Measure TR-3

GHG Mitigation Potential

17,267 MT CO_2e/yr by 2030

20,182 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

BRT improves connectivity between destinations, thus incentivizing transit and results in less passenger vehicle use and traffic.

Cost

Payer: Public Agency (e.g., local transit agencies)

Cost Level: High

Measure Description

This measure focuses on providing more efficient public transportation options to encourage increased ridership and shift away from single-occupancy vehicle use, thereby decreasing transportation GHG emissions.

Provide Bus Rapid Transit: This measure facilitates the conversion of an existing bus route to a bus rapid transit (BRT) system. A BRT system will be equipped with exclusive right-of-way (e.g., busways, queue jumping lanes) at congested intersections, increased limited-stop service (e.g., express service), intelligent transportation technology (e.g., transit signal priority, automatic vehicle location systems), and advanced technology vehicles (e.g., articulated buses, low-floor buses). BRT also includes enhanced station design, efficient fare-payment smart cards or smartphone apps, branding of the system, and use of vehicle guidance systems. The enhanced components of a BRT system and increased frequency of service will improve transit reliability and reduce transit wait times. This will increase ridership and reduce VMT and associated GHG emissions.

Subsector

Transit

Scale of Application

By 2030:

- Increase transit frequency (bus arrivals per hour) due to BRT by 125%.
- 20% level of implementation across all bus routes.

By 2045:

- Increase transit frequency (bus arrivals per hour) due to BRT by 125%.
- 25% level of implementation across all bus routes.

Authority to Implement

- **Legislation, Rules, and Policy:** BRT requires coordination between the transit provider and the local or state jurisdiction with authority over the right-of-way. The transit agency must commit to providing frequent service, and the jurisdiction must commit to right of way dedication, signal priority/preemption, and facility improvements. Failure by either partner can result in a lower level of service for BRT.
- **Incentives:** Funding agencies can require minimum levels of service or maximum travel time through corridors to ensure BRT is implemented.

Monitoring and Reporting

Annual reports from MPOs and RTPAs would track implementation of this measure. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Identify existing bus routes for conversion to a BRT system. Prepare bus stops for conversion.
- **Year 1-2:** Implement BRT systems for 50% of identified bus routes.
- **Year 2-3:** Implement BRT systems for 100% of identified bus routes.

Potential implementation tracking metrics include:

1. Transit frequency
2. Miles of BRT treatments
3. Transit ridership both before and after BRT system implementation

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure T-28).[2] Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045. Emissions for light-duty vehicles for the region were modeled using CARB's EMFAC[3] and applying the percent reduction estimated as a result of the measure. The level of implementation refers to the number of transit routes with BRT systems as a fraction of the total transit routes in the plan/community. Increased transit frequency is estimated as transit frequency with the BRT measure minus existing transit frequency, where frequency is measured as the number of arrivals over a given time (e.g., buses per hour). For additional details on inputs and assumptions for this specific analysis for the Sacramento-Roseville CSA, see Appendix C.

Table TR-3. Potential Emissions Reductions from Measure TR-3 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Provide Bus Rapid Transit	17,267	20,182
Total Reduction	**17,267**	**20,182**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, co-pollutant reductions are estimated using a methodology based on the guidelines in the CAPCOA Handbook. Co-pollutant emissions reductions are based on the estimated bus VMT and light duty vehicle VMT reductions and the associated vehicle emission factors from EMFAC2021.[3] Light-duty vehicle avoided VMT associated with increasing transit service frequency is based on the estimated daily person trips in the corridors and average vehicle trip length. Bus VMT is estimated based on the number of routes in Sacramento and bus operational hours per day. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table BE-TR-3.2 Potential Co-Pollutant Reductions (short tons/year) from Measure TR-3 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	-3.4	-21.5	0.6	-0.1	-0.1	0.0	-0.1
2045	-1.3	-2.0	0.5	-0.1	0.0	0.0	-0.1

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

Measure implementation includes costs associated with intelligent transportation system (ITS) technology, advanced technology vehicles, and enhanced station design. ITS applications for bus rapid transit can vary widely ranging from $100,000 to $1 million per mile.[4] In addition to ITS application costs, the measure includes costs associated with vehicle or station design investments.

Health and Other Considerations

Increased access to efficient public transit promotes walking and results in reductions in obesity, heart disease, hypertension, stroke, type 2 diabetes, osteoporosis, and cancer. Regardless of income, public transit users walk more than non-transit users. Psychological wellbeing is often higher when using transit, as driving is the most stressful commute mode. In communities served by transit, traffic injuries are lower and community security increases from street-level monitoring of city streets and transit waiting areas.

Though this measure could decrease passenger vehicle-related co-pollutant emissions, it could increase transit-related co-pollutants from the increased use of buses. Therefore, ensuring that the buses are low- or zero-emission vehicles would help mitigate the increase in transit co-pollutants.

REFERENCES

*[1] Kingsley, 2021. SacRT Bus. Available online at: https://media.bizj.us/view/img/11445673/sacrt-bus*900xx6720-3780-0-350.jpg*

[2] CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

[3] CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/

[4] U.S. Department of Transportation. 2011. ITS Knowledge Resources: 2011-SC00234. Available: https://www.itskrs.its.dot.gov/2011-sc00234.

ADDITIONAL SOURCES

Besser LM and Dannenber AL. 2005. Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations Am J Prev Med 2005;29(4). Doi:10.1016/j.ampre.2005.06.010. Available: https://www.cdc.gov/healthyplaces/articles/besser_dannenberg.pdf. Accessed: January 2024.

Guzman Habinger J et al. 2020. Active Transportation and Obesity Indicators in Adults from Latin America: ELANS Multi-Country Study. Int J Environ Res Public Health. 2020 Oct; 17(19): 6974. 2020 Sep 24. doi: 10.3390/ijerph17196974. Available: https://www.ncbi.nlm.nih.gov/pmc articles/PMC7579005/. Accessed: January 2024.

Legrain A et al. 2015. Am stressed, must travel: The relationship between mode choice and commuting stress. Transportation Research Part F: Traffic Psychology and Behaviour 34. October 2015, Pages 141-151. Available: https://www.sciencedirect.com/science/article/abs/pii S1369847815001370. Accessed: January 2024.

Litman, T. 2020. Evaluating Public Transportation Health Benefits. Victoria Transport Policy Institute, April 2020. Available: https://www.vtpi org/tran_health.pdf. Accessed: December 2023.

Litman, T. 2023. Safer Than You Think! Revising the Transit Safety Narrative. Victoria Transport Policy Institute, May 2023. Available: https:/ www.vtpi.org/safer.pdf. Accessed: January 2024.

Mortin A. 2014. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. Preventive Medicine 69. Dec 2004, 296-303. Available: https://www.sciencedirect.com/science/article/pii S0091743514003144. Accessed: January 2024.

Roadway Improvements for Multi-Modal Use and Access

Measure TR-4

GHG Mitigation Potential

42,493 MT CO_2e/yr by 2030

41,245 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Bike boulevards and bikeway networks encourage bicycling as a more sustainable mode of transportation. The replacement of vehicle trips with bicycle trips results in less fuel consumption and pollution, leading to healthier air, water, and ecosystems.

Cost

Payer: Public Agency (e.g., local or government entity, metropolitan planning organization)

Cost Level: High

Measure Description

This measure focuses on the improvement and expansion of multi-modal transportation routes to encourage a mode shift from single-occupancy vehicles to active modes of transportation such as bicycling or walking. The implementation of this measure is made up of three parts:

Provide Pedestrian Network Improvements: This measure will expand the sidewalk network to improve connectivity and access. Increasing the number of well-maintained pedestrian sidewalks will enhance the pedestrian experience and encourage people to walk instead of drive. The GHG reductions associated with this measure are based on the displacement of light-duty VMT.

Construct or Improve Bike Boulevards: This measure will construct or improve peripheral Class III bicycle boulevards that connect to the larger bikeway network. These supplementary Class III bikeways create safe, low-stress connections to encourage a mode shift from driving to bicycling, thus displacing VMT and reducing GHGs.

Expand Bikeway Network: This measure will expand bikeway networks. A bicycle network is an interconnected system of bike lanes, boulevards, and paths that improve the bicycling conditions of a community, often redesigning streets to accommodate protective infrastructure, signage, and paint to facilitate a safe and convenient route of travel. Bicycle networks also have the capacity to increase the “catchment area” of existing transit hubs through increased access, ultimately increasing public transit ridership.

Subsector

Neighborhood Design

Scale of Application

By 2030:

- Expand pedestrian sidewalk network by 15%.
- Add accompanying bike boulevards to displace 20% of the community/project area VMT.
- Expand the existing bike network by 45%.

By 2045:

- Expand pedestrian sidewalk network by 15%.
- Add accompanying bike boulevards to displace 25% of the community/project area VMT.
- Expand the existing bike network by 50%.

Authority to Implement

- **Legislation, Rules, and Policy:** Local and state governments have authority to set roadway and pathway design specifications and approve new roadways and active modes facilities through California's Subdivision Map Act and CEQA. Jurisdictions in California also have the right of eminent domain for active modes facilities.
- **Incentives:** State and federal transportation programs offer billions in funding, but program design may not incentivize complete streets or active modes. Reframing competitive grants to give additional points for multi-modal use and access would encourage development of sustainable transportation systems.

Monitoring and Reporting

Annual reporting by public works departments and the California Department of Transportation (Caltrans) would track implementation of this measure. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Update active transportation plans and bikeway master plans and outreach to relevant stakeholders.
- **Year 1-2:** Expand the pedestrian sidewalk network by 15% and add accompanying Class III bicycle boulevards. Expand the existing bicycle network by 20%.
- **Year 2-3:** Expand the existing bicycle network by 45%.

Potential implementation tracking metrics include:

1. Miles of bikeway boulevard and sidewalk improvement projects
2. Miles of bike lanes or bike boulevards installed
3. Active transport commuting mode share

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures T-18, T-19B, and T-20).[1] The majority of GHG reductions are achieved through the improvement and expansion of existing bike and pedestrian networks, which yield the largest reduction of VMT within the measure components. Emissions for passenger cars and passenger trucks for the region were modeled using CARB's EMFAC[2] and applying the percent reduction estimated as a result of the measure. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-4. Potential Emissions Reductions from Measure TR-4 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Provide Pedestrian Network Improvements	40,603	39,131
Construct or Improve Bike Boulevard	963	1,125
Expand Bike Network	927	989
Total Reduction	**42,493**	**41,245**

Co-Pollutant Reductions Quantification Summary

The co-pollutant reductions associated with implementation of this measure are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[2] VMT reductions are estimated using the percent reduction in GHG emissions and the total county miles as reported in EMFAC2021. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-4.2. Potential Co-Pollutant Reductions (short tons/year) from Measure TR-4 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	10.4	165.9	19.3	3.1	1.1	0.5	0.0
2045	8.2	144.0	14.9	3.2	1.1	0.4	0.0

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The City of Elk Grove's Bicycle, Pedestrian, and Trails Master Plan estimates on-street bike lanes cost approximately $75,000 per mile.[3] Measure assumptions include approximately a 50 percent increase in miles of bike lanes.

Health and Other Considerations

Enabling walking and biking can lead to higher rates of physical activity and lower rates of obesity, heart disease, hypertension, stroke, type 2 diabetes, osteoporosis, and cancer. Walkable and bikeable neighborhoods are associated with mental health benefits such as less depression and less cognitive decline. Lower income communities tend to have less safe infrastructure for walking and biking with fewer sidewalks, marked crosswalks, and lighting. Traffic injury rates tend to decline as walking and bicycling increase in communities because drivers become more cautious. Improving conditions for active travel can help neighborhoods by providing better mobility for disadvantaged communities.

REFERENCES

1. *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*
2. *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/.*
3. *City of Elk Grove. 2021. Bicycle, pedestrian, and trails master plan: Complete final draft. Available: https://www.elkgrove.gov/sites/default/files/city-files/Departments/SPI/BPTMP/BPTMP_Complete_FinalDraft.pdf.*

ADDITIONAL SOURCES

Gibbs K et al. 2012. Income Disparities in Street Features that Encourage Walking – A BTG Research Brief. Chicago, IL: Bridging the Gap Program, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago (2012). http://www.bridgingthegapresearch r og/_asset/02fpi3/btg_street_walkability FINAL 03-09-12.pdf.

Gordon-Larsen P et al. 2009. Active commuting and cardiovascular disease risk: the CARDIA study. Archives of Internal Medicine 2009 169(13):1216-1213. doi:10.1001/archinternmed.2009.163 Available: https://jamanetwork.com/journals/jamainternalmedicine fullarticle/773531. Accessed: December 2023.

Jacobsen P. 2003. Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Inj Prev. 2003 Sep; 9(3): 205–209. doi: 10.1136/ip.9.3.205. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1731007/. Accessed: January 2024.

Litman T. 2023. Evaluating Active Transport Benefits and Costs: Guide to Valuing Walking and Cycling Improvements and Encouragement.

Transportation Demand Management Program

Measure TR-5

GHG Mitigation Potential

212,764 MT CO_2e/yr by 2030

261,697 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Sharing commute trips with others improves social cohesion, which could help build resiliency during emergencies or extreme events. Accessible rideshare programs would lower transportation costs for all employees. EV carpooling or vanpooling programs could reduce localized air pollution from exhaust emissions.

Cost

Payer: Private (e.g., employer or business)

Cost Level: High (per implementing entity)

Measure Description

This measure focuses on the emission reductions associated with decreased commuter VMT by encouraging or mandating the shift away from single-occupancy vehicle use to alternative modes of transportation such as public transportation, carpooling, or bicycling. Four potential components of the transportation demand management (TDM) program are described below:

Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring): This sub measure involves the mandated implementation of a commute trip reduction (CTR) program with employers to discourage single occupancy commuting trips from employees. A CTR program requires the implementation of CTR marketing, and a combination of elements such as ridesharing programs, subsidized or discounted transit programs, end-of-trip bicycle facilities, and employer-sponsored vanpool to facilitate participation by employees. This measure could also include mandatory reduction requirements (including penalties for non-compliance) that are monitored and reported to ensure program success.

Implement Commute Trip Reduction Program (Voluntary): This sub measure is a more flexible alternative to the previous component that would implement a voluntary CTR program that leverages employer-provided services, infrastructure, and incentives to encourage the use of alternative forms of transportation such as public transit, ridesharing/vanpooling, and bicycling. In addition, this measure will involve the marketing of such services to educate and inform employees of the alternative transportation services available to them. The voluntary nature of this option translates to smaller potential reductions.

Provide Ridesharing Program: This sub measure would implement a ridesharing program to encourage the displacement of single-occupancy commute trips to carpool/ridesharing alternatives. Actions to promote this program may include providing an app or website for ride coordination and designating premium parking spaces for ridesharing vehicles.

Implement Subsidized or Discounted Transit Program: This measure would provide subsidized, discounted, or free transit passes for qualified individuals. By reducing the cost of public transportation, it makes this mode of transportation more desirable, encouraging a shift away from single-occupancy vehicle trips.

Subsector

Trip Reduction Programs

Scale of Application

By 2030:

- 76% of employees eligible for a CTR program.
- 30% of employees able to opt-into ridesharing program.
- 30% of working individuals eligible for subsidized transit program.
- 75% of fare reduction for subsidized transit program.
- 46% participation rate from regional workforce in TDM programs.

By 2045:

- 76% of employees eligible for a CTR program.
- 35% of employees able to opt-into ridesharing program.
- 30% of working individuals eligible for subsidized transit program.
- 75% of fare reduction for subsidized transit program.
- 60% participation rate from regional workforce in TDM programs.

Authority to Implement

- **Legislation, Rules, and Policy:** New growth areas can create permanent, on-going assessments to fund TDM, such as through a community finance district, assessment, homeowner association dues, or other non-revocable mechanisms. Mandatory membership in a transportation management organization can also be a development condition.
- **Incentives:** TDM programs typically provide incentives for individuals using sustainable modes through prizes, recognition, guaranteed ride homes, or reduced transportation costs.

Monitoring and Reporting

TDM programs can be tracked through annual reporting by transportation management associations and modeling by MPOs and RTPAs. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop outreach plan for commute trip reduction and ridesharing programs.
- **Year 1-2:** Implement commute trip reduction and ridesharing programs.
- **Year 2-3:** Evaluate efficacy of commute trip reduction and ridesharing programs and create an improvement plan.

Potential implementation tracking metrics include:

1. Number of TDM program participants and new commuting methods
2. Usage of transit passes for commuting
3. Usage of onsite parking

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measures T-5, T-6, T-8, and T-9).[1] Table TR-5 shows the individual contributions of emission reductions from all four components of the measure. A mandatory approach for CRT programs generates the largest possible reductions. Since CRT programs could be implemented through either a voluntary or mandatory program and yield different emission reductions, two scenarios were modeled for the TDM program:

- **Option A:** Implement CTR Program (Mandatory Implementation and Monitoring) – includes all remaining programs.
- **Option B:** Implement CTR Program (Voluntary) – includes all remaining programs.

In practicality, this measure could be implemented on both a mandatory and voluntary basis and would vary from employer to employer. All measure components cannot be implemented simultaneously as that would result in the double-counting of GHG reductions. Therefore, GHG reductions from "Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)" are used for the maximum reduction value and have been included in the Measure Implementation Scenario. The GHG reductions from "Provide Ridesharing Program" and "Implement Subsidized or Discounted Transit Program" are included in the minimum reduction value.

Emissions for commuting passenger cars and passenger trucks for the region were modeled using CARB's EMFAC[2] and applying the percent reduction estimated as a result of the measure. The percentage of VMT associated with commuter traffic was derived from the commute share of household-generated VMT in the Sacramento metro area.[3] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-5. Potential Emissions Reductions from Measure TR-5 across Sacramento-Roseville CSA

Scenario	Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Option A	Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	212,764	261,697
Option B	Implement Commute Trip Reduction Program (Voluntary)	32,733	40,261
Remaining Programs	Provide Ridesharing Program	26,013	36,244
	Implement Subsidized or Discounted Transit Program	1,521	1,870
Minimum Reduction (Remaining Programs)		**27,534**	**38,114**
Maximum Reduction (Option A)		**212,764**	**261,697**

Co-Pollutant Reductions Quantification Summary

The co-pollutant reductions associated with implementation of this measure are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[2] VMT reductions are estimated using the percent reduction in GHG emissions and the total county light-duty vehicle fleet milage as reported in EMFAC2021. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of these sub measures across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-5.2. Potential Co-Pollutant Reductions (short tons/year) from Measure TR-5 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	139.2	2223.8	258.9	41.1	14.1	6.1	0.1
2045	114.7	2008.0	207.3	45.2	14.7	6.2	0.1

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

Mandating the shift away from single-occupancy vehicle use and encouraging carpooling incurs minimal costs. To comply with the mandate, programs typically require minimal capital. For example, the cost of the travel demand management program for San Francisco's General Hospital includes marketing ($10,000), "Next Bus" monitors in the lobby ($50,000), and the salary of a TDM Program Manager ($120,000).[4]

Health and Other Considerations

Ridesharing and carpooling provide opportunities to enhance social connections and establish relationships that create a sense of belonging. This social cohesion boosts the physical and mental health, safety, and resilience of individuals and the community. Shifting from car travel to transit, walking or bicycling introduces regular physical movement that reduces systemic inflammation and the risk of cardiovascular disease, type 2 diabetes, chronic obstructive pulmonary disease, and cancer. It strengthens muscles and bones, improving the ability to carry out everyday activities, and reduces depression and anxiety. It also improves the ability to think and learn, reducing the risk of dementia.

REFERENCES

[1] CAPCOA. 2021. *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*

[2] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/.*

[3] *SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint.*

[4] *Zuckerberg San Francisco General Hospital. 2024. Attachment B: Transportation program annual summary 2017 - TDM existing and proposed. Available: https://www.zuckerbergsanfranciscogeneral.org/wpcontent/uploads/2024/05/AttachmentB_TransportationProgAnnSumm2017_TDM_Existing_Proposed.pdf.*

ADDITIONAL SOURCES

Gleeson, M., Bishop, N., Stensel, D. et al. 2011. The anti-inflammatory effects of exercise: mechanisms and implications for the prevention and treatment of disease. Nat Rev Immunol 11, 607–615 (2011). https://doi.org/10.1038/nri3041. Available: https://www.nature.com/articles nri3041. Accessed: January 2024.

U.S. Centers for Disease Control and Prevention. 2023. Benefits of Physical Activity. Available: https://www.cdc.gov/physicalactivity/basics pa-health/index.htm#reducing-disease. Accessed: January 2024.

U.S. Centers for Disease Control and Prevention. 2023. How Does Social Connectedness Affect Health? Available: https://www.cdc.gov emotional-wellbeing/social-connectedness/affect-health.htm. Accessed: January 2024.

Woods, JA et al. 2011. Exercise, Inflammation and Aging. Aging Dis. 2012 Feb; 3(1): 130–140. Available: https://www.ncbi.nlm.nih.gov pmc/articles/PMC3320801/. Accessed: January 2024

World Health Organization. 2022. Physical activity. Available: https://www.who.int/news-room/fact-sheets/detail/physical-activity. Accessed: January 2024.

Active Modes of Transportation for Youth

Measure TR-6

GHG Mitigation Potential

35,882 MT CO_2e/yr by 2030

39,601 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Replacing private vehicle trips with walking, bicycling, or bus trips can help reduce onsite air pollution at schools.

Cost

Payer: Public Agency (e.g., local government entity)

Cost Level: Medium

Measure Description

This measure focuses on providing funding for new sidewalks, bike lanes, off-street pathways, and street crossings to help children and students use active modes of transportation to get to school, thereby shifting trips away from private vehicles. Reducing single-occupancy vehicle VMT related to school commutes will reduce GHG emissions.

The measure builds on the federally funded Safe Routes to Schools Program that funds new projects for sidewalks, bike lanes, and off-street pathways, and street crossings projects to help youth use active modes of transportation to get to school.

Subsector

Trip Reduction Programs, VMT reduction

Scale of Application

By 2030:

- 20% of students within two miles are driven to school after project implementation; or
- 31% decrease in number of students within two miles being driven to school.

By 2045:

- 15% of students within two miles are driven to school after project implementation; or
- 36% decrease in number of students within two miles being driven to school.

Authority to Implement

- **Legislation, Rules, and Policy:** Local jurisdictions can improve rights-of-way to support active modes around schools, parks, youth centers, and other destinations for youth. Active modes programing is typically initiated and operated by local school districts, parent-teacher associations, transportation management associations, or CBOs, and is most successful with an active onsite coordinator.

- **Incentives:** The Federal Safe Routes to School Program and California's Active Transportation Program provide education, best practices, and funding for active modes of transportation. New developments can also include funding for active modes programing as part of a larger environmental compliance strategy.

Monitoring and Reporting

MPOs and RTPAs can monitor funds awarded and program implementation. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Update active transportation plans and bikeway master plans and outreach to relevant stakeholders.
- **Year 1-2:** Prioritize expansion of the pedestrian sidewalk network and add accompanying Class III bicycle boulevards within two miles of schools.
- **Year 2-3:** Prioritize expansion of the existing bicycle network within two miles of schools.

Potential implementation tracking metrics include:

1. Miles of sidewalks or bike lanes constructed or improved
2. Student travel modes
3. Measurement of bicycle network connectivity around schools
4. Number of schools benefiting from pedestrian and bicycle infrastructure improvements

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measure T-56).[1] Potential GHG reductions are due to the modal shift away from single-occupancy commuter trips to alternative active modes of transportation such as bicycling, walking, or using public transit. The analysis assumes any mode shift away from private vehicle trips will lead to a direct reduction in emissions, including bus trips. Emissions for passenger cars and passenger trucks in the region were modeled using CARB's EMFAC[2] and a fraction of emissions associated with school travel reported by the Safe Routes to School program was applied.[3] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-6. Potential Emissions Reductions from Measure TR-6 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Active Modes of Transportation for Youth	35,882	39,601
Total Reduction	**35,882**	**39,601**

Co-Pollutant Reductions Quantification Summary

The co-pollutant reductions associated with implementation of this measure are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[2] VMT reductions are estimated using the percent reduction in GHG emissions and the total county miles as reported in EMFAC2021. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-6.2. Potential Co-Pollutant Reductions (short tons/year) from Measure TR-6 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	139.2	2223.8	258.9	41.1	14.1	6.1	0.1
2045	114.7	2008.0	207.3	45.2	14.7	6.2	0.1

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The City of Elk Grove's Bicycle, Pedestrian, and Trails Master Plan estimates that costs associated with walkability improvements include approximately $3,000 for a pedestrian refuge island, $1,800 for a high visibility marked crosswalk, and $2.6 million per mile of Class I shared use path.[4]

Health and Other Considerations

Shifting children's trips to school from private cars trips to bus, bicycling or walking trips initiates regular physical movement that improves blood pressure and blood sugar levels and reduces risk of chronic diseases such as type 2 diabetes and obesity. Consistent physical activity in children also generates mental and behavioral health benefits such as improved attention and memory, less anxiety and depression, and higher self-confidence and self-esteem. Cooperative active travel such as "walking school buses" can increase social connections that enhance a sense of belonging and boost physical and mental health. Where possible, pedestrian and bicycle infrastructure improvements should be accompanied by tree planting to augment health benefits and provide shade.

REFERENCES

[1] Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District on December 22, 2023.

[2] CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/.

[3] Safe Routes to School National Partnership (SR2S Partnership). 2013. Travel to School in California: Key Findings from the National Household Travel Survey. Accessed December 2023. Available online at: https://saferoutespartnership.org/sites/default/files/pdf/Travel%20to%2School%20in%20California%20Policy%20Brief%20PAGES.pdf.

[4] City of Elk Grove. 2021. Bicycle, pedestrian, and trails master plan: Complete final draft. https://www.elkgrove.gov/sites/default/files/city-files/Departments/SPI/BPTMP/BPTMP_Complete_FinalDraft.pdf.

ADDITIONAL SOURCES

Massachusetts General Hospital. 2021. Physical Activity and Mental Health: What is the Connection? Available: https://www.massgeneral.org children/physical-activity/mental-health. Accessed: February 2024.

U.S. Centers for Disease Control and Prevention. 2023. Health Benefits of Physical Activity for Children, Adults, and Adults 65 and Older. Available: https://www.cdc.gov/physicalactivity/basics/adults/health-benefits-of-physical-activity.html. Accessed: February 2024.

Establish a School Bus Program

Measure TR-7

GHG Mitigation Potential

13,262 MT CO_2e/yr by 2030

53,576 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

A school bus program can help reduce onsite air pollution from exhaust emissions at schools by reducing private vehicle trips, especially if the buses are ZEVs.

Cost

Payer: Public Agency (e.g., school districts)

Cost Level: Medium

Measure Description

This measure focuses on reducing commuter VMT and emissions by establishing a school bus program to replace single-occupancy vehicle trips to and from school. This measure would focus on school bus routes with enough occupancy to offset emissions from operating school buses. Additional reductions would be achieved by implementing an electric school bus program.

Subsector

Trip Reduction Programs, VMT reduction

Scale of Application

By 2030:

- 50% of students in the Sacramento-Roseville CSA participate in the bus service.
- 100% of students are served by a bus system (regardless of whether they ride).

By 2045:

- 50% of students in the Sacramento-Roseville CSA participate in the bus service.
- 100% of students are served by a bus system (regardless of whether they ride).

Authority to Implement

- **Legislation, Rules, and Policy:** School districts and county offices of education may establish and operate school bus programs. Funding can be provided through the California Department of Education Home-to-School Transportation Reimbursement funding, local sources, or fees imposed on riders.
- **Incentives:** The CEC, CARB and local air districts offer funding for zero-emission school buses and charging infrastructure. Establishing charging infrastructure near major field trip destinations such as Sutter's Fort State Historic Park will encourage school districts to use zero- emission school buses when visiting the Sacramento- Roseville CSA.

Monitoring and Reporting

The Capital Region School Bus Consortium, a partnership between air districts and school districts, monitors implementation of this measure. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Develop a school bus program per school district.
- **Year 1-2:** Implement school bus programs.
- **Year 2-3:** Evaluate efficacy of school bus programs and create an improvement plan.

Potential implementation tracking metrics include:

1. Bus ridership and percentage of students participating in the bus program
2. Bus miles traveled
3. Number of bus stops
4. Number of students served by a bus system

GHG Reductions Quantification Summary

The methodology for estimating emission reductions from this measure is based on the guidelines in the CAPCOA Handbook Update (measure T-40).[1] GHG reductions would be achieved by establishing a bus program to bring students to and from school, shifting trips away from single-occupancy vehicles. GHG reductions are based on the light-duty vehicle emission factors from CARB's EMFAC[2] and the light-duty vehicle occupancy rate based on the CAPCOA Handbook[3] offset by the increased school bus emissions from CARB's EMFAC. An average occupancy rate of 25 students per bus was assumed. For additional details on inputs and assumptions for this measure, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the 2030 and 2045 scale of application.

Table TR-7. Potential Emissions Reductions from Measure TR-7 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Establish a School Bus Program	13,252	53,576
Total Reduction	**13,252**	**53,576**

Co-Pollutant Reductions Quantification Summary

The co-pollutant reductions associated with implementation of this measure are calculated based on the estimated VMT reductions and the light-duty vehicle fleet emission factors from EMFAC2021.[2] VMT reductions are estimated using the percent reduction in GHG emissions and the total county miles as reported in EMFAC2021. For additional details on inputs and assumptions for this specific analysis in Sacramento- Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-7.2. Potential Co-Pollutant Reductions (short tons/year) from Measure TR-7 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	3.3	52.0	6.1	1.0	0.3	0.1	0.0
2045	10.1	181.9	18.1	4.3	1.4	0.6	0.0

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

As reported by California Air Resources Board in 2021, the approximate cost of a zero-emission school bus is $262,000.[4]

Health and Other Considerations

Shifting children's trips to school from private cars to bus, bicycle or walking trips initiates regular physical activity that improves blood pressure and blood sugar levels and reduces the risk of chronic diseases such as type 2 diabetes and obesity. Consistent physical activity in children also yields mental and behavioral health benefits such as the improved ability to think and learn, less anxiety and depression, and higher self-confidence and self-esteem. Bus or vanpool programs can enhance social connections that create a sense of belonging and boost physical and mental health.

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District on December 22, 2023.*

[2] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/.*

[3] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*

[4] *California Air Resources Board. 2021. Zero Emission Bus Pilot Commercial Deployment Project. Available: https://ww2.arb.ca.gov/sites/default/files/2021-10/sac%20ze%20school%20bus%20deployment%20project%20final%20report.pdf.*

ADDITIONAL SOURCES

U.S. Centers for Disease Control and Prevention. 2023. Health Benefits of Physical Activity for Children, Adults, and Adults 65 and Older. Available: https://www.cdc.gov/physicalactivity/basics/adults/health-benefits-of-physical-activity.html. Accessed: February 2024.

U.S. Centers for Disease Control and Prevention. 2023. How Does Social Connectedness Affect Health? Available: https://www.cdc.gov emotional-wellbeing/social-connectedness/affect-health.htm. Accessed: January 2024.

Electric Bikeshare

Measure TR-8

Measure Description

This measure focuses on emission reductions associated with shifting trips from single-occupancy vehicles to electric bicycles.

Transition conventional to electric bikeshare: This measure evaluates the emission reduction potential associated with establishing and expanding access to electric bikeshare programs. Research conducted by the state of California found that the establishment of electric bicycle rideshare programs increases ridership at a greater rate than traditional programs. Electric-assist peddling allows riders ease of travel with the capacity to climb hills.

Subsector

VMT reduction

Scale of Application

By 2030:

- 15% of residences in the region have access to electric bikeshare programs.

By 2045:

- 15% of residences in the region have access to electric bikeshare programs.

Authority to Implement

- **Legislation, Rules, and Policy:** As these systems operate in the public right-of-way, local governments have authority over operators, bicycle parking, sidewalk riding, and other operational considerations. In areas with multiple jurisdictions, it is recommended they coordinate to ensure user consistency between destinations.
- **Incentives:** Private operators have historically focused on the city centers of Davis, Sacramento, and West Sacramento. Public subsidies or a public operator will likely be required to serve other locations, such as suburban areas. Subsidies for individual riders, such as mobility wallets or discounted passes, can help expand service into lower income and disadvantaged communities to increase access to programming.

GHG Mitigation Potential

657 MT CO_2e/yr by 2030

647 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Electric bikeshare programs encourage bicycling as a more sustainable mode of transportation. The replacement of vehicle trips with bicycle trips results in less fuel consumption and pollution, leading to healthier air, water, and ecosystems.

Cost

Payer: Public Agency (e.g., local government, metropolitan planning organization)

Cost Level: Medium

Monitoring and Reporting

Deployed vehicles and square miles of service area as reported by local jurisdictions can track electric bikeshare programming. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Review existing electric bikeshare incentive programs in the region and outreach to relevant stakeholders.
- **Year 1-2:** Establish and expand access to electric bikeshare programs.
- **Year 2-3:** Continue to expand programs to ensure 15% of residences in the region have access to electric bikeshare programs.

Potential implementation tracking metrics include:

1. Number of residents with access to bikeshare program
2. Number of electric bikeshare vehicles deployed
3. Electric bikeshare program ridership
4. Bikeshare miles traveled and average trip length

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure T-22-B).[1] By providing electric bikeshare access, individuals are encouraged to shift travel from single-occupancy vehicles to electric bicycles, displacing VMT and reducing GHGs. The GHG reductions are based on the accessibility of the program and other assumptions from the CAPCOA Handbook. Emissions for passenger cars, passenger trucks, and motorcycles were estimated using CARB's EMFAC[2] and the percentage of GHG reductions estimated as a result of the measure were applied. For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table TR-8. Potential Emissions Reductions from Measure TR-8 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Expand Electric Bikeshare Access	657	647
Total Reduction	**657**	**647**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it is anticipated that co-pollutant reductions associated with this measure would be negligible. This is based on the note in the CAPCOA Handbook that co-pollutant VOC emissions can be calculated by multiplying the percent reduction in GHG emissions (0.012%) by an adjustment factor of 87 percent.

Cost Considerations

The measure cost includes the purchase of electric bikes, which cost around $1,000 each, plus program costs.[3] However, costs can be recouped through user fees.

Health and Equity Considerations

Commuters who switch from passenger vehicle use to electric bicycle use initiate regular physical activity that reduces risk of cardiovascular disease, type 2 diabetes, chronic obstructive pulmonary disease, cancer, depression, anxiety, and dementia. Electric bicycle users also avoid exposure to carcinogenic gasoline vapors at filling stations. An electric bikeshare program is a more affordable option than owning a car and can improve access to healthcare and other health-promoting goods and services.

REFERENCES

[1] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*

[2] *CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/.*

[3] *REI. (n.d.). How much do electric bikes cost?. Retrieved from https://www.rei.com/learn/expert-advice/cost-electric-bikes.html.*

ADDITIONAL SOURCES

Gleeson, M., Bishop, N., Stensel, D. et al. 2011. The anti-inflammatory effects of exercise: mechanisms and implications for the prevention and treatment of disease. Nat Rev Immunol 11, 607–615 (2011). https://doi.org/10.1038/nri3041. Available: https://www.nature.com/articles nri3041. Accessed: January 2024.

Litman T. 2023. Evaluating Active Transport Benefits and Costs: Guide to Valuing Walking and Cycling Improvements and Encouragement Programs. Victoria Transport Policy Institute. November 2023. Available: https://vtpi.org/nmt-tdm.pdf. Accessed: January 2024.

U.S. Centers for Disease Control and Prevention. 2023. Benefits of Physical Activity. Available: https://www.cdc.gov/physicalactivity/basics/pa health/index.htm#reducing-disease. Accessed: January 2024.

Woods, JA et al. 2011. Exercise, Inflammation and Aging. Aging Dis. 2012 Feb; 3(1): 130–140. Available: https://www.ncbi.nlm.nih.gov/pmc articles/PMC3320801/. Accessed: January 2024.

World Health Organization. 2022. Physical activity. Available: https://www.who.int/news-room/fact-sheets/detail/physical-activity. Accessed: January 2024.

Wildfire Resilience and Management

Measure NW-1

GHG Mitigation Potential

2,357 MT CO_2e/yr Annual Average for 2025–2075

Co-Benefits

Climate Resilience

Reestablishing forests that were impacted by severe or catastrophic wildfire improves ecosystem resilience and health. Reforestation provides wildlife habitat, water filtration, healthier soil, and promotes carbon sequestration. Using forestry waste to create biochar, a soil additive, also improves carbon sequestration.

Cost

Payer: Public Agency (e.g., local, regional, or state government entity)

Cost Level: Medium

Measure Description

This measure focuses on lowering the intensity of wildfires in forested areas by implementing fuel treatments. During a wildfire event, the majority of GHG emissions are released from the burning of live tree biomass. With fuel treatments, the treated forest stands will have lower fire severity than untreated forest stands, leading to lower GHG emissions from combustion of the overstory canopy.

Wildfire Resilience and Management: Requires the use of fuel treatments to reduce future wildfire intensity. Treated forest stands will result in less severe wildfires and will reduce the amount of stored carbon released during wildfires.

Subsector

Natural and Working Lands

Scale of Application

By 2030:

- Treating 4,000 acres of mixed-conifer forest and 4,000 acres of ponderosa forest annually for 50 years, starting in 2025.

By 2045:

- Treating 4,000 acres of mixed-conifer forest and 4,000 acres of ponderosa forest annually for 50 years, starting in 2025.

Authority to Implement

- **Legislation, Rules, and Policy:** Local jurisdictions have the authority to require private property owners to maintain vegetation around structures to create defensible space for first responders. Local and state governments can also enter into a stewardship agreement with private and federal landowners to treat forestry areas.

- **Incentives:** Funding and rebates for forest fuel treatments such as the federal Forest Health Program can help ensure management of higher-risk lands and continued sequestration of carbon.

Monitoring and Reporting

Prescribed burns can be tracked through burn permits issued by local air districts and fire agencies. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Select areas of regional forest for fuel treatment.
- **Year 1-2:** Treat 4,000 acres of mixed-conifer forest and 4,000 acres of ponderosa forest per year.
- **Year 2-3:** Treat an additional 4,000 acres of mixed-conifer forest and 4,000 acres of ponderosa forest per year.

Potential implementation tracking metrics include:

1. Acres of each forest type treated
2. Age of forest stand
3. Fire incidence in treated areas

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measure N-7)[1] and the calculation spreadsheet provided by the Sac Metro Air District.[2] The calculations estimate carbon balances for untreated and fuel treated scenarios based on the annual burn rate, carbon consumption by fire type, net ecosystem productivity, and other inputs. In the short term, there are increases in carbon emissions from fuel treatments and prescribed burns. In the long term, GHG reductions are achieved through reduced wildfire intensity. The average forest stand age is assumed to be 100 years old, based on research that suggests 100- to 200-year old trees dominate contemporary western mixed-conifer and ponderosa forests.[3] The total additional acres of forests treated are determined based on the Tobacco Gulch Ecological Restoration Project[4] and the Lake Tahoe West Landscape Restoration Strategy[5] and are scaled up for the Capital Region. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Average annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application.

Table NW-1. Potential Emissions Reductions from Measure NW-1 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Wildfire Resilience and Management	2,357	2,357
Total Reduction	**2,357**	**2,357**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure.

Cost Considerations

The cost of treating forests for wildfire resilience averages approximately $1,000 per acre.[6]

Health and Other Considerations

Cultural burns are a form of land management used by Indigenous Tribes for generations to promote sustainable forest growth and make forests more resilient. Expanding cultural burns across federal and Tribal lands could restore the productivity of forestland. SB 332 (Dodd, 2021), effective January 1, 2022, affirms the right to cultural burns.

Minimizing the likelihood of severe wildfires reduces threats to life and safety for residents and first responders and protects against widespread damage to public health from smoke, dust, and stress. Wildfire smoke activates inflammatory pathways and can trigger severe respiratory conditions, heart attacks, strokes, cardiac arrests, early deaths, pregnancy loss, low birth weight, and preterm delivery. Extreme wildfires often have severe mental health effects such as post- traumatic stress disorder, depression, and generalized anxiety in both adults and children, potentially lasting for years after the event.

Programs to reduce wildfire smoke exposure should consider vulnerable populations including outdoor workers and the unhoused who are disproportionately exposed to wildfire smoke.

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023.*

[2] *Sac Metro Air District. 2023. Measure NW-1 Calculation Sheet. Provided by Sac Metro Air District December 26, 2023.*

[3] *Stevens et al. 2015. Average Stand Age from Forest Inventory Plots Does Not Describe Historical Fire Regimes in Ponderosa Pine and Mixed Conifer Forests of Western North America. Available: https://www.fs.usda.gov/research/treesearch/52503.*

[4] *USDA. 2023. Tobacco Gulch Understory Burning on the Georgetown, Ranger District. Available: https://www.fs.usda.gov/detail eldorado/news-events/?cid=FSEPRD1143767.*

[5] *Lake Tahoe West. 2019. Landscape Restoration Strategy. Available: https://www.nationalforests.org/assets/images/LTW Landscape-Restoration-Strategy-02Dec2019-FINAL.pdf.*

[6] *The Nature Conservancy. 2021. Wildfire resilience funding. Available: https://www.nature.org/content/dam/tnc/nature/en/documents/WildfireResilienceFunding_TNC_6-30-21.pdf.*

ADDITIONAL SOURCES

Reuters. 2023. What are the health risks from wildfire smoke? Available: https://www.reuters.com/world/americas/what-are-health-risks wildfire-smoke-2023-06-07/. Accessed: January 2024.

To P, Eboreime E, Agyapong, V.I.O. 2021. The Impact of Wildfires on Mental Health: A Scoping Review. Behav. Sci. 11 (126). https://doi org/10.3390/ bs11090126. Available: https://pubmed.ncbi.nlm.nih.gov/34562964/. Accessed: February 2024.

U.S. Environmental Protection Agency. 2023. Health Effects Attributed to Wildfire Smoke. Available: https://www.epa.gov/wildfire-smoke course/health-effects-attributed-wildfire-smoke. Accessed: January 2024.

Wettstein ZS et al. 2018. Cardiovascular and Cerebrovascular Emergency Department Visits Associated With Wildfire Smoke Exposure in California in 2015. J Am Heart Assoc. 7(8): e007492. Available: 10.1161/JAHA.117.007492. Accessed: January 2024.

Biomass Energy

Measure NW-2

GHG Mitigation Potential

846 MT CO_2e/yr by 2030

1,693 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Using waste from agricultural and forestry practices for biomass can support decarbonization efforts. Biomass energy avoids emissions from agricultural or forestry burns or burns waste more efficiently to create products such as biochar, a soil additive that improves carbon sequestration. However, biomass that is solely grown for fuel can be environmentally disruptive by displacing land for food production and increasing GHG emissions.

Cost

Payer: Public Agency (e.g., local government, utility)

Cost Level: Low

Measure Description

This measure focuses on the local generation of electricity (or cogeneration) with biomass to displace fossil fuel-based electricity generation. Biomass energy has lower lifecycle GHG emissions than conventional fossil fuel energy because of the carbon uptake from plants grown to produce biomass fuel.

Biomass Energy: This measure would support new biomass fuel electricity generation capacity to produce electricity, or electricity and heat (cogeneration). By installing biomass energy generation locally, the carbon intensity of the electricity supply would decrease, reducing GHG emissions from local electricity consumption.

Subsector

Building Energy

Scale of Application

By 2030:

- Generate one megawatt (MW) of biomass energy in the Sacramento-Roseville CSA.

By 2045:

- Generate one megawatt (MW) of biomass energy in the Sacramento-Roseville CSA.

Authority to Implement

- **Legislation, Rules, and Policy:** SB 1109 (Caballero, 2022) requires that investor-owned utilities purchase at least 125 MW of electricity from biomass generating facilities. Additional requirements can make biomass more viable.
- **Incentives:** Community choice aggregators and electric utilities can contract with biomass energy providers to provide a stable revenue stream for the providers and a stable base load for the utilities.

Monitoring and Reporting

Annual reporting of installed biomass capacity and generation can be used to track biomass energy implementation. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Outreach to relevant stakeholders and community members.
- **Year 1-2:** Install new biomass processing facility and initiate long-term feedstock contracting.
- **Year 2-3:** Generate one MW of biomass energy.

Potential implementation tracking metrics include:

1. Electricity generated by biomass fuels
2. Megawatts of peak generation power
3. Number of new biomass facilities
4. Total MW installed

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Update (measure E-26).[1] The amount of biomass electricity generation installed by 2030 is assumed to be one MW. Emissions reduction estimates are based on replacing higher carbon intensity electricity in California with lower carbon intensity biomass electricity using woody crops and forestry waste. As the CAPCOA equation is based on the lifecycle carbon intensity of electricity, which is not accounted for in the Plan GHG inventory, forecasts, or targets, the measure GHG reductions are presented for informational purposes only and are not included in the Measure Implementation Scenario totals. For additional details on inputs and assumptions, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045. Higher GHG emission reductions may be achieved if cogeneration is used to satisfy onsite heating needs.

Table NW-2. Potential Emissions Reductions from Measure NW-2 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Biomass Energy	846	1,693
Total Reduction	**846**	**1,693**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure as it only impacts electricity use which produces zero emissions by 2045. However, biomass combustion in electricity generation facilities can increase co-pollutant emissions, such as NOx, VOCs, CO, SO_2, $PM_{2.5}$, PM_{10}, and HAPs.[2] Prior to 2045, biomass energy could potentially displace electricity generation sources that have similar or higher co-pollutant emissions. To avoid negative impacts on air quality, choose a biomass combustion technology and best-available control technology based on local air district guidance.

Cost Considerations

Implementation costs for biofuel power generation vary depending on the type of biomass, the technology used, and the size of the installation. While installation costs tend to be high, their initial capital costs could be offsets with credits and rebates.[3]

Health and Other Considerations

Biomass facilities can produce co-pollutant emissions for surrounding communities. Any plans for new biomass-processing facilities would need input from local members of vulnerable or sensitive communities to ensure that impacts or disbenefits from biomass production and processing are addressed before installation. Non-combustion biomass energy projects, including those that create clean hydrogen, should also be considered.

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023.*

[2] *Tran, O., E. Juno, and S. Arunachalam. 2023. Emissions of wood pelletization and bioenergy use in the United States. Renewable Energy. Vol. 219, December 2023. Available: https://doi.org/10.1016/j.renene.2023.119536.*

[3] *California Air Pollution Control Officers Association. 2021. Handbook for analyzing greenhouse gas emission reductions, assessing climate vulnerabilities, and advancing health and equity. Available: https://caleemod.com/documents/handbook/full_handbook.pdf.*

Increase Tree Canopy

Measure NW-3

GHG Mitigation Potential

4,922 MT CO_2e/yr by 2030

4,922 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Increased tree canopies enhance shade and reduce the impacts of extreme heat. Trees contribute to improved air and water quality, flood prevention and habitat conservation. Trees also sequester carbon and provide neighborhood beautification.

Cost

Payer: Public Agency (e.g., local or regional government entity)

Cost Level: High

Measure Description

This measure focuses on increasing the carbon sequestration capacity of the region by planting more trees. Trees in developed areas may also provide other benefits by increasing tree canopy and shaded areas, which can reduce the UHI effect and decrease electricity use for air conditioning in buildings.

Expand Urban Tree Planting: This measure requires increased tree planting in developed areas. Trees capture and store atmospheric CO_2 as they grow, which reduces the amount of GHGs in the environment. Areas with lower existing tree canopy should be a priority for tree-planting programs. Tree-planting programs should consider the following when selecting trees: (1) tree species that are native and require minimal water and maintenance, (2) species that emit low levels of biogenic volatile organic compounds, and (3) low-allergen trees.

Subsector

Natural and Working Lands

Scale of Application

By 2030:

- Plant 150,000 new trees in developed areas.

By 2045:

- Plant 150,000 new trees in developed areas.

Authority to Implement

- **Legislation, Rules, and Policy:** Jurisdictions in California have authority to require landscape plans that include planting and maintenance of trees, as well as ordinances to protect existing trees. Ordinances can include landscape irrigation systems where trees and turf are on different valves, allowing trees to be watered during droughts. Local jurisdictions can pass and enforce tree ordinances to protect and expand canopies in their jurisdictions, while local and state agencies with land holdings (such as school districts, cities, and Caltrans) can implement policies to protect and expand tree canopy on their properties.

- **Incentives:** Local jurisdictions can include funding for turf removal as well as tree planting. The California Department of Forestry and Fire Protection (CAL FIRE) offers grants to tree planting organizations such as the Sacramento Tree Foundation. The Sacramento Tree Foundation and SMUD offer free shade trees to customers through the Free Shade Tree Program.

Monitoring and Reporting

Passage of tree ordinances and tree policies, plus regional canopy estimates will track progress on this measure. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Identify developed areas throughout the seven-county region with low tree canopy and develop tree maintenance plans.
- **Year 1-2:** Initiate educational campaigns and plant 75,000 trees in developed areas.
- **Year 2-3:** Plant an additional 75,000 trees in developed areas and evaluate tree health.

Potential implementation tracking metrics include:

1. Number of trees planted
2. Tree canopy area
3. Number of ordinances passed
4. Metric tons of sequestered CO_2

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure N-2).[1] The CAPCOA Handbook recommends the use of various modeling tools that model CO_2 sequestration from trees, such as the i-Tree Landscape tool,[2] depending on the scale of the application. Carbon sequestration rates per acre of canopy were estimated using the i-Tree Landscape Tool. Urban trees may also provide indirect GHG reductions by reducing the UHI effect, which can vary depending on individual project sites. Indirect GHG reductions were not quantified in this measure. For additional details on inputs and assumptions for this specific analysis for the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table NW-3. Potential Emissions Reductions from Measure NW-3 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Expand Tree Planting	4,922	4,922
Total Reduction	**4,922**	**4,922**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, the methodology for estimating emission reductions for co-pollutants is based on the guidelines in the CAPCOA Handbook. Criteria air pollutant removal emission factors for nitrogen dioxide, PM_{10}, $PM_{2.5}$, SO_2, and ozone were obtained from the average values by county available in the iTree Landscape tool.[2] The VOC air pollutant removal rate was based on an assumption that the change in VOC emissions contributes to 14 percent of ozone formation per the Sacramento Regional 2015 NAAQS 8-Hour Ozone Attainment and Reasonable Further Progress Plan, Appendix B.[3] Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2045. Application of this measure by 2030 was not quantified; therefore, the 2045 estimates below are based on the anticipated implementation by 2050.

Table NW-3.2. Potential Co-Pollutant Reductions (short tons/year) from Measure NW-3 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2045	1.0	0.3	1.9	3.7	0.3	0.3	0.0

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

The upfront cost of planting trees depends on how the land is currently being used and how much maintenance and assistance is necessary to care for the trees. For example, in Los Angeles County, the cost of planting a tree averages $550 per 24-inch box tree with maintenance of around $165 per tree per year.[4] The scale of application by 2045 is assumed to be planting 150,000 trees in developed areas.

Health and Other Considerations

Planting trees and expanding tree canopy, especially in lower income neighborhoods, can improve overall population health and reduce obesity, cardiovascular disease, high blood pressure, type 2 diabetes, asthma, and lung cancer. Tree canopies can reduce the health effects of extreme heat such as heatstroke and heat-related mortality, and reduce exposure to ultraviolet radiation, a major risk factor for most skin cancers. Urban trees and vegetation can improve an individual's ability to cope with stress. Street trees also tend to slow traffic, reducing crashes and injury rates.

REFERENCES

[1] CAPCOA. 2021. *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity.* Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.

[2] i-Tree Landscape Tool v5.2.1. Accessed online in April 2025 at: https://landscape.itreetools.org/.

[3] TreePeople. 2021. Tree planting cost-benefit analysis: A case study for urban forest equity in Los Angeles. Available: https://www.treepeople.org/wp-content/uploads/2021/07/tree-planting-cost-benefit-analysis-a-case-study-for-urban-forest-equity-in-los-angeles.pdf.

[4] SMAQMD, El Dorado County AQMD, Feather River AQMD, Placer County APCD, Yolo-Solano AQMD, SCAG. 2023. Sacramento Regional 2015 NAAQS 8-Hour Ozone Attainment and Reasonable Further Progress Plan. Appendix B: Photochemical Modeling. Available: https://www.airquality.org/ProgramCoordination/Documents/Sacramento%20Regional%202015%20NAAQS%208%20Hour%20Ozone%20Attainment%20and%20Reasonable%20Further%20Progress%20Plan.pdf. Accessed April 2025.

ADDITIONAL SOURCES

Kardan O et al. 2015. Neighborhood greenspace and health in a large urban center. Sci Rep 2015 Jul 9:5:11610. Doi: 10.1038/srep11610. Available: https://www.nature.com/articles/srep11610. Accessed: January 2024.

Lovasi G.S., Quinn J.W., Neckerman KM, et al. 2008. Children living in areas with more street trees have lower prevalence of asthma. Journal of Epidemiology & Community Health 2008;62:647-649. Available: https://jech.bmj.com/content/62/7/647. Accessed: January 2024.

Ulmer JM et al. 2016. Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription. Health & Place 42 (2016) 54-62. Available: https://www.fs.usda.gov/pnw/pubs/journals/pnw_2016_ulmer001.pdf. Accessed: January 2024.

Wolf K.L. et al. 2020. Urban Trees and Human Health: A Scoping Review. Int J Environ Res Public Health. 2020 Jun; 17(12): 4371. Published online 2020 Jun 18. doi: 10.3390/ijerph17124371. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7345658/#B215 ijerph-17-04371. Accessed: January 2024.

Wolf, K.L., S. Krueger, and M.A. Rozance. 2014. Stress, Wellness & Physiology - A Literature Review. In: Green Cities: Good Health (www greenhealth.washington.edu). College of the Environment, University of Washington. Available: https://depts.washington.edu/hhwb Thm_ StressPhysiology.html. Accessed: January 2024.

Carbon Sequestration Program/Carbon Farming

Measure NW-4

GHG Mitigation Potential

168,014 MT CO_2e/yr by 2030

168,014 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

Depending on the type of carbon sequestration project, various resiliency benefits such as improved air quality, soil health, and water conservation could be achieved. A reforestation project could plant trees in areas that have previously been disturbed by wildfires or drought. These projects increase the carbon sequestration capabilities of natural and working lands and support more resilient and healthier ecosystems.

Cost

Payer: Public (e.g., local, regional, or state government entity)

Cost Level: Medium

Measure Description

This measure will establish carbon sequestration or carbon farming projects. Carbon emissions are sequestered through the absorption of CO_2 from the atmosphere into a carbon sink (e.g., tree planting) or storage (e.g., injection into underground reservoirs). Carbon sequestration can occur through biological, chemical, or physical processes.

Establish a Carbon Sequestration Project: The measure reduces GHG emissions by implementing projects that follow the Natural Resources Conservation Service (NRCS) conservation practices from the U.S. Department of Agriculture (USDA).[1] These projects sequester carbon by conserving, maintaining, and restoring natural resources on ranches, farmland, and forestland. Some example projects include:

- Converting irrigated cropland to permanent unfertilized grass cover.
- Replacing synthetic nitrogen fertilizer with beef feedlot manure on managed irrigated pasture.
- Replacing a strip of cropland with one row of woody plants.
- Conversion of grasslands to a farm woodlot.
- Adding legume seasonal cover crop to irrigated cropland.
- Restoring highly disturbed areas by planting permanent vegetative cover.
- Adding biochar as a soil amendment to irrigated cropland.

Subsector

Carbon Sequestration, Miscellaneous

Scale of Application

By 2030:

- 100,000 acres of carbon farming projects that follow NRCS practices in the region.

By 2045:

- 100,000 acres of carbon farming projects that follow NRCS practices in the region.

Authority to Implement

- **Legislation, Rules, and Policy:** Agricultural operations are protected through right-to-farm ordinances at the state and local levels, with certain practices, such as agricultural burning, regulated by appropriate agencies by jurisdiction. Crop selection and rotation are typically exempt from CEQA, but conversion of farmland to urban land uses constitutes an environmental impact and is subject to local land use regulation.
- **Incentives:** The California Department of Food and Agriculture's Healthy Soils Program includes financial and technical assistance. The Strategic Growth Council's Sustainable Agricultural Lands Conservation Program protects critical agricultural lands by facilitating conservation easements. Local and regional governments can build on these programs by offering financial, technical, and material support. For example, successful local organics diversion programs can increase the availability of compost, which can reduce synthetic fertilizer application.

Monitoring and Reporting

Participation in state and local programs will be monitored through annual reporting. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Fund and expand the region's carbon farming partnership program.
- **Year 1-2:** Establish 50,000 acres of carbon farming projects.
- **Year 2-3:** Establish an additional 50,000 acres of carbon farming projects.

Potential implementation tracking metrics include:

1. Acres of carbon sequestration projects by type
2. Rates of carbon sequestration per project
3. Number of participants in the carbon farming partnership program

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure M-1).[2] The potential GHG reductions come from adopting NRCS conservation practices and applying them to farms, ranches and forestland. The estimated GHG reductions shown here are based on implementing projects that add up to 20,000 acres in each of the five conservation practice categories, for a total of 100,000 acres. The five conservation practice categories are:

- Cropland to herbaceous cover
- Grazing lands
- Woody plantings
- Restoration of disturbed lands
- Cropland management

Within each of the five NRCS conservation practices there are several types of projects with varying degrees of carbon sequestration. GHG estimates reflect an average reduction per acre for each of the five conservation practices. Due to the varying degree of GHG reductions per conservation practice (shown in Table NW-4), the maximum reductions would be achieved by applying projects with the greatest carbon sequestration rates, such as woody plantings or restoration of disturbed lands, where feasible. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table NW-4. Potential Emissions Reductions from Measure NW-4 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Establish an NRCS Practice Project: 20,000 acres of Woody Plantings	138,116	138,116
Establish an NRCS Practice Project: 20,000 acres of Restoration of Disturbed Lands	17,679	17,679
Establish an NRCS Practice Project: 20,000 acres of Cropland to Herbaceous Cover	6,749	6,749
Establish an NRCS Practice Project: 20,000 acres of Cropland Management	3,745	3,745
Establish an NRCS Practice Project: 20,000 acres of Grazing Lands	1,724	1,724
Total Reduction	**168,014**	**168,014**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure.

Cost Considerations

Carbon sequestration projects can span a wide range of costs, with the high-cost option being constructing carbon capture and storage facilities. Lower cost options include the use of biochar to sequester carbon in natural and working lands.[3]

Health and Other Considerations

Depending on the location of the carbon sequestration project, care should be taken to ensure that any disbenefits to vulnerable or sensitive communities are avoided.

New carbon sequestration projects could create new job opportunities for members of lower income and disadvantaged neighborhoods, resulting in economic vitality.

REFERENCES

[1] *NRCS. COMET-Planner Tool: Evaluate Potential Carbon Sequestration and Greenhouse Gas Reductions from Adopting NRCS Conservation practices. Accessed Jan 2024 at http://www.comet-planner.com/.*

[2] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*

[3] *California Air Pollution Control Officers Association. 2021. Handbook for analyzing greenhouse gas emission reductions, assessing climate vulnerabilities, and advancing health and equity. Available: https://caleemod.com/documents/handbook/full_handbook.pdf.*

Greenhouse Gas Local Offset Program

Measure NW-5

GHG Mitigation Potential

171,683 MT CO_2e/yr by 2030

171,683 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

GHG offset programs such as livestock projects can help conserve natural and working lands. Nutrients from agricultural byproducts can improve soil health and crop yields and reduce nutrient runoff, protecting local waterways.

Cost

Payer: Private or Public Agency

Cost Level: Low to High (per implementing entity; highly dependent on program design)

Measure Description

This measure focuses on funding and implementing local offset programs designed to mitigate the emission of GHGs. An offset program allows individuals, businesses, and governments to invest in environmental projects around the world in order to balance their carbon footprint.

Geographic priorities for GHG reductions from offset programs should be as follows: (1) near disadvantaged communities with existing air quality issues or areas with at-risk populations in the Sacramento-Roseville CSA, (2) within other areas in the Sacramento-Roseville CSA, (3) within the state of California, and (4) outside of the state of California.

Establish Offset Program: The measure requires implementing a project that would offset local GHG emissions. Emission reductions are project-specific and should be from sources that follow rigorous protocols and third-party verification. Project types could fall under five different categories including livestock, mine CH_4 capture, ODS, rice cultivation, and U.S. Forests projects based on CARB's GHG Local Offset Program Projects.[1] These can be accessed and registered through verified carbon markets such as The Climate Action Reserve.[2]

Subsector

Carbon Sequestration, Miscellaneous

Scale of Application

By 2030:

- Investing in three verified GHG local offset projects that accomplish reductions for an average of 60,000 MT CO_2e per year per project.

By 2045:

- Investing in three verified GHG local offset projects that accomplish reductions for an average of 60,000 MT CO_2e per year per project.

Authority to Implement

- **Legislation, Rules, and Policy:** These projects exist beyond current regulations so their implementation can result in carbon reduction credits. Recent GHG CEQA threshold studies of natural- and low-global warming potential refrigerants by the Sac Metro Air District and the Bay Area Air District determined there is insufficient deployment in the region to make a finding of feasibility for requiring these projects. These projects can be an option as part of a larger environmental compliance program. Credits can be tracked and exchanged through the Sacramento Carbon Exchange Program (Rule 250) adopted in 2010.
- **Incentives:** SMUD has piloted a Natural Refrigerant Incentive Program. Additional funding for more deployment will help determine the appropriate refrigerants and use cases for the Sacramento-Roseville CSA.

Monitoring and Reporting

GHG offset programs can be tracked through annual reporting from incentive programs and carbon credit registration. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Invest in a new verified GHG local offset project.
- **Year 1-2:** Invest in one additional verified GHG local offset project.
- **Year 2-3:** Invest in one additional verified GHG local offset project.

Potential implementation tracking metrics include:

1. Metric tons of GHG emissions reduced per project and project type per year
2. Location of GHG offset projects

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook (measure M-2).[3] CARB's GHG Local Offset Program groups projects into five different categories including livestock, mine CH_4 capture, ODS, rice cultivation, and U.S. Forests projects. Emission reductions associated with mine CH_4 capture and rice cultivation projects are not quantified here. Emission reductions for the remaining project types are taken as the average emission reductions for each project type across a number of ongoing and completed projects (active since 2011 or later) near the Sacramento-Roseville CSA registered with The Climate Reserve.[4] Due to the variance in emission reductions across project types, maximum GHG reductions would be achieved when projects are coupled with carbon sequestration. For additional details on inputs and assumptions for this specific analysis in the Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table NW-5. Potential Emissions Reductions from Measure NW-5 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Sample Offset Project (Livestock Project)	11,085	11,085
Sample Offset Project (Ozone Depleting Substances)	77,188	77,188
Sample Offset Project (U.S. Forests)	83,410	83,410
Total Reduction	**171,683**	**171,683**

Co-Pollutant Reductions Quantification Summary

There are no quantifiable criteria air pollutant reductions associated with this measure.

Cost Considerations

Due to high variability in project type, costs for this measure may range. Offset projects developed under compliance offset protocols tend to have higher project costs when compared to projects developed under voluntary offset protocols.[5]

Health and Other Considerations

Depending on the location of the GHG offset program, care should be taken to ensure that any disbenefits to vulnerable or sensitive communities are avoided.

New local GHG offset programs could create new job opportunities for members of lower income and disadvantaged neighborhoods, resulting in economic vitality.

REFERENCES

[1] *CARB. 2023. California Air Resources Board's Compliance Offset Protocols. Available: https://ww2.arb.ca.gov/our-work/programs/compliance-offset program/compliance-offset-protocols.*

[2] *Climate Action Reserve. 2023. Climate Action Registry Map of Projects 2023. Accessed Jan 2024 at https://www.climateactionreserve.org/registrymap/.*

[3] *CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf.*

[4] *NRCS. (n.d.) COMET-Planner Tool: Evaluate Potential Carbon Sequestration and Greenhouse Gas Reductions from Adopting NRCS Conservation Practices. Accessed Jan 2024 at http://www.comet-planner.com/.*

[5] *California Air Resources Board. (n.d.). Compliance offset protocols. Available: https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols.*

Natural and Working Lands Equipment Emissions Reduction

Measure NW-6

GHG Mitigation Potential

1,922 MT CO_2e/yr by 2030

1,853 MT CO_2e/yr by 2045

Co-Benefits

Climate Resilience

The replacement of conventional gasoline- or diesel-fueled equipment with a low-emissions alternative can lead to long term cost savings from reduced fuel and maintenance costs.

Cost

Payer: Private (e.g., individual household, business)

Cost Level: High (per implementing entity)

Measure Description

This measure focuses on replacing conventional gasoline- or diesel-fueled, off-road natural and working lands equipment with an electric counterpart. The replacement of conventional equipment will reduce fossil fuel combustion and result in a net reduction of GHG emissions.

Use of Electric Off-Road Equipment for Natural and Working Lands: This measure pertains to small equipment with engines that are less than 25 horsepower. The measure includes agricultural equipment such as tractors and all-terrain vehicles (ATVs) that are often used in the management of natural and working lands. Conventional gasoline- or diesel-fueled equipment would be replaced with electric alternatives. This measure also accounts for indirect emissions resulting from increased electricity usage associated with equipment charging.

Subsector

Agricultural Off-Road Equipment

Scale of Application

By 2030:

- 100% penetration rate of electric-powered equipment for tractors and ATVs used in natural and working lands across the region.

By 2045:

- 100% penetration rate of electric-powered equipment for tractors and ATVs used in natural and working lands across the region.

Authority to Implement

- **Legislation, Rules, and Policy:** CARB's Off-Road Diesel Regulations require construction fleets to transition to cleaner equipment. Local jurisdictions may require cleaner equipment than state standards as part of a larger environmental compliance plan.
- **Incentives:** Air districts and CARB provide incentive funds for deployment of cleaner and zero-emission off- road equipment, such as construction or agricultural equipment.

Monitoring and Reporting

Progress is measured through annual reporting on programs administered by CARB and local air districts. Model data updates from CARB's Off-Road and Small Off-Road Engines (SORE) program will also disclose penetration of hybrid and zero-emission engines. A measure implementation schedule for key milestones is as follows:

- **Year 0-1:** Review and expand existing incentive programs in the region.
- **Year 1-2:** Achieve 50% penetration rate of electric-powered equipment.
- **Year 2-3:** Achieve 100% penetration rate of electric-powered equipment.

Potential implementation tracking metrics include:

1. Quantity of hybrid and zero-emission tractors and ATVs
2. Number of electric equipment purchased
3. Number of gasoline- or diesel-fueled equipment retired

GHG Reductions Quantification Summary

The methodology for estimating emission reductions is based on the guidelines in the CAPCOA Handbook Update (measure M-6).[1] Table NW-6 shows the reductions from this measure. GHG reductions are achieved through the replacement of small (less than 25 horsepower) gasoline- and diesel-fueled agricultural tractors and ATVs with an electric counterpart. Replacement of agricultural equipment with hybrid-electric models would result in smaller net reductions in the future. GHG emission reductions are partially offset by GHG emissions resulting from increased electricity usage associated with charging electric equipment.

Emissions for the applicable agricultural equipment in the region were estimated using CARB's OFFROAD.[2] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table NW-6. Potential Emissions Reductions from Measure NW-6 across Sacramento-Roseville CSA

Measure Breakdown	Metric Tons CO_2e/Year in 2030	Metric Tons CO_2e/Year in 2045
Use of Electric Off-Road Equipment for Natural and Working Lands	1,922	1,853
Total Reduction	**1,922**	**1,853**

Co-Pollutant Reductions Quantification Summary

Similar to the GHG emissions reductions, emissions for the applicable agricultural equipment in the region were estimated using CARB's OFFROAD.[2] For additional details on inputs and assumptions for this specific analysis in Sacramento-Roseville CSA, see Appendix C. Annual emission reductions below represent the implementation of this measure across the Sacramento-Roseville CSA and obtainment of the scale of application by 2030 and 2045.

Table NW-6.2. Potential Co-Pollutant Reductions (short tons/year) from Measure NW-6 across Sacramento-Roseville CSA

Year	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	DPM
2030	20.3	280.9	27.1	1.4	1.3	0.0	1.4
2045	17.6	259.6	22.3	1.1	1.0	0.0	1.1

Notes: NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; DPM = diesel particulate matter

Cost Considerations

This estimate assumes the cost of electric tractors is approximately $175,000 each. The estimated price premium for an electric tractor compared to a diesel alternative is approximately $50,000.[3]

Health and Other Considerations

Replacing diesel agricultural equipment with cleaner-fuel equipment reduces the risk to workers of cardiovascular, lung and respiratory disease, and cancer.[4,5,6] Replacing gas-powered equipment with electric- only equipment reduces both the risk of pollutant-related health conditions and effects related to noise – hearing loss and impacts of noise stress including hypertension, elevated cholesterol, and increased risk of heart disease.[7]

REFERENCES

[1] *Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023.*

[2] *CARB. 2021. California Air Resources Board's OFFROAD Model (v1.0.1) Emissions Inventory. Available online at: https://arb.ca.gov/emfac/offroad/.*

[3] *Port Technology International. 2019. Electric yard tractors: Weighing the costs and benefits. Available: https://www.porttechnology.org/wp-content/uploads/2019/05/068-069_Electric_Yard_Tractors_Weighing_the_Costs_and_Benefits.pdf.*

[4] *Kerns E et al. 2018. Cardiovascular conditions, hearing difficulty, and occupational noise exposure within US industries and occupations. Am J Ind Med 2018 Jun;61(6):477-491. Doi: 10.1002/ajim.22833. Available: https://pubmed.ncbi.nlm.nih.gov/29537072/. Accessed: January 2024.*

[5] *Koutros S et al. 2020. Diesel exhaust and bladder cancer risk by pathologic stage and grade subtypes. Environment International 135: February 2020, 10534. Available: https://doi.org/10.1016/j.envint.2019.105346. Accessed: January 2024.*

[6] *U.S. Office of Occupational Safety and Health Administration. 2013. OSHA/MSHA Hazard Alert: Diesel Exhaust/Diesel Particulate Matter. Available: https://www.osha.gov/sites/default/files/publications/OSHA-3590.pdf. Accessed: January 2024.*

[7] *Hammer MS et al. Environmental Noise Pollution in the United States: Developing an Effective Public Health Response. Environmental Health Perspectives (2014) 122:2. Available: https://ehp.niehs.nih.gov/1307272/. Accessed: January 2024.*

Chapter 5. Community Engagement

To successfully implement Plan measures, they must be grounded in the lived experiences, priorities, and challenges of residents, particularly those in communities that have been historically underserved and disproportionately impacted by environmental harms. While data can help identify high-impact climate solutions, their feasibility and effectiveness on-the-ground are dependent on local conditions, including community priorities, infrastructure, jurisdictional and workforce capacity, and cultural context. Equally important is building trust and establishing buy-in from the communities these strategies aim to benefit. Achieving this requires thoughtful engagement that prioritizes listening and collaboration, providing community members the opportunity to co-design solutions. Successful implementation of Plan measures requires practical, inclusive, and community-informed strategies that are responsive to the unique needs and conditions of those most impacted by climate change.

As part of Plan development, the outreach team held a series of interviews and focus groups with CBOs representing the region's socially and geographically diverse communities to understand their needs and priorities around measure implementation. The outcomes of these discussions will inform planning and implementation efforts to ensure that they can address specific community concerns and priorities, avoid unintended consequences and disbenefits, and provide lasting co-benefits such as workforce development and improved quality of life. In the long term, input gathered can also inform future funding opportunities and partnerships for the region.

Engagement Approach

The engagement approach focuses on participation from low-income and other underrepresented communities. Building on previous engagement efforts for the Capital Region Climate Priorities Plan and guided by participant analysis and steering committee input, the planning team developed an engagement strategy to support inclusive approaches and address previous engagement gaps from specific geographic regions and sectors. Refer to Chapter 4 and Appendix D in the Capital Region Climate Priorities Plan for a description of previous community engagement and outreach findings.

Targeted Outreach

The strategy prioritized outreach to populations most vulnerable to climate impacts, including individuals experiencing homelessness, agricultural and outdoor workers, youth, older adults, people with disabilities, and others disproportionately impacted by pollution. These populations face disproportionate environmental burdens, such as exposure to climate pollution and extreme weather conditions, while often lacking adequate access to support services and infrastructure. Focus group attendees were offered stipends for their participation at a rate of $50 per hour.

Geographic Focus

Outreach was focused within the Sacramento-Roseville CSA, encompassing El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba counties. Previous outreach for the Capital Region Climate Priorities Plan resulted in limited engagement from El Dorado, Nevada, Sutter, Yolo, and Yuba counties, leading to an intentional effort to strengthen participation from organizations and residents in these communities to ensure there is robust regional representation in the development of the Plan.

Community-Based Organization Identification and Engagement
Outreach focused on CBOs serving priority populations within the region, including youth, English learners, housing-insecure residents, justice-involved individuals, and low-income communities. The planning team developed a comprehensive list of CBOs aligned with the industry-specific focus areas through online research, which was further refined through steering committee input. Organizations with a demonstrated focus on serving low-income communities were prioritized for engagement. Participating CBOs brought deep local knowledge gained from their strong connections to priority populations.

Subregional Community Focus Groups

The planning team convened five subregional focus groups between May and June 2025 to gather input from CBOs and local residents on Plan measures and to explore implementation approaches grounded in local, place-based knowledge. The focus group aimed to surface community priorities, explore what is relevant and feasible in each county, and identify potential barriers to successful implementation. Participants emphasized the need to address inaccessibility throughout climate action planning and implementation processes, maximizing co-benefits for low-income communities, such as opportunities for workforce training and economic mobility.

The five focus groups were organized by geographic area, with sessions held for 1) El Dorado and Placer counties, 2) Nevada County, 3) Sacramento County, and 4) Yuba and Sutter counties. Focus group meetings were held virtually via Zoom and facilitated by the outreach team. A focus group was not held for Yolo County, which had recently conducted an extensive community engagement process for their Climate Action and Adaptation Plan. To not duplicate engagement efforts, an interview was held with their sustainability staff, who shared input provided during their engagement process.

Focus group sessions included a brief overview of the eight priority climate measures in the Plan, identified by the planning team and CBOs in the outreach advisory committee through a prioritization effort using criteria such as GHG reduction potential, air pollutant reduction potential, implementation feasibility, health co-benefits, and funding availability. Following the overview, participants ranked the climate measures they believed to be most critical based on their lived experience and community knowledge. The second half of each meeting focused on open dialogue, with guided discussion prompts to collect input on insights and strategies for successful on-the-ground implementation.

Key Findings

Urban-Rural Perspectives

Priorities for climate action varied between rural and urban communities, reflecting their unique geographic, political, and cultural landscapes and capacity for climate action. Rural communities voiced strong support for nature-based solutions such as NW-1: Wildfire Resilience and Management, NW-4: Carbon Sequestration/Carbon Farming, and NW-2: Biomass Energy. In contrast, urban areas tended to prioritize measures related to infrastructure such as improved bike lanes, infill development, and building electrification. Forested regions also emphasized the co-benefits of proper land stewardship practices like ladder fuels reduction, prescribed burning, and meadow restoration. These practices not only reduce wildfire risk and sequester carbon but also strengthen local economies. This is evident through the implementation of NW-2: Biomass Energy, where forest and agricultural waste is used for local energy production, creating increased revenue and local jobs.

Participants highlighted opportunities and challenges in implementing climate measures within rural areas. Nature-based solutions like forest and meadow restoration and biomass utilization emerged as a major focus of discussion. Yolo, Yuba, Sutter, Placer, and El Dorado counties have substantial potential for emissions reduction through nature-based solutions that lead to environmental benefits such as wildfire prevention, carbon sequestration, and clean energy generation. These solutions were highlighted not only for their ecological health benefits but also for local economic resiliency by creating jobs and expanding markets for wood-based products.

Jurisdictional Capacity

In addition to cultural and geographic influences, differences in jurisdictional capacity and socioeconomic conditions impact the feasibility of implementing certain measures in specific locations in the region. Many rural communities face significant implementation barriers, including limited staffing and resources to pursue grants or implement complex, resource-intensive climate actions. Strategies like rezoning for infill housing are often impractical in lower-income and less densely populated areas. These realities reinforce that a “one size fits all” approach to climate action is not an appropriate approach for addressing the distinct needs of diverse communities across the region. Implementation strategies must be place-based and community-informed to effectively mitigate harmful climate impacts and tailor support to those who are most vulnerable.

Shared Priorities

Despite nuances between geographies, shared regional interests emerged during the discussions. Participants across different focus groups expressed interest in livable, community-centered neighborhoods with walkable, compact designs that reduce emissions, support local businesses, and build community. There was strong interest in higher-density development with safe bike paths and easy access to healthy food and essential services, with participants noting concerns about the environmental and social impacts of sprawled development.

There was also widespread recognition of the value of responsible land management, not only for climate benefits such as wildfire mitigation and carbon sequestration, but also for promoting economic resilience and creating job opportunities. Workforce development was identified as a critical need to support the long-term transition to a clean energy economy and ensure the region can meet near-term labor demands for implementing the priority climate measures identified in this Plan. Example workforce opportunities include building retrofits and other skilled contract work. To better fund climate measures, participants suggested strategically aligning with state priorities and attracting large employers to grow local tax revenues.

The following section highlights key insights from the focus group discussions on each of the eight priority climate measures.

Key Insights on Priority Climate Measures

BE-1: Land Use Improvements
Across the region, there was strong support for prioritizing infill development and protecting agricultural and natural lands. Participants emphasized the importance of focusing on new housing in areas where people already live, including in rural communities, to avoid the negative impacts of sprawl.

In Sacramento County, concerns were raised about how leaving sprawl unchecked contributes to traffic congestion, longer commutes, increased pollution, and unsustainable infrastructure demands. The volume of asphalt and concrete increases as previously undeveloped areas are paved and developed. One participant expressed that safety and infrastructure needs should be addressed before densification measures are implemented.

Low-density development and jurisdictional capacity were mentioned as hindrances to effective emissions reduction through land use and infrastructure-focused efforts in Nevada County. Regulatory requirements, such as CEQA, were cited as particularly burdensome for rural communities with limited jurisdictional capacity. Simultaneously, participants noted that there is community opposition to new development.

In Yuba and Sutter counties, the local land trust supports infill development as a way of preserving agricultural and natural lands for their economic and environmental benefits. It was suggested that housing should be built in areas that have already been developed.

Respondents in Placer and El Dorado counties noted that increasing residential density is a sensible climate measure for their subregion, but achieving it would require significant political will and policy changes, such as single-family zoning reform. In the Tahoe area, there has been a movement toward expanding housing options through accessory dwelling unit (ADU) policies. In contrast, respondents in Nevada County expressed that residential density is neither a priority nor a viable solution in their communities.

Yolo County faces barriers to densification due to limited community support in higher-income neighborhoods, though efforts are underway to address these challenges. The County maintains strong protections against greenfield development, such as those under the Williamson Act, which restricts expansion beyond urban areas like West Sacramento, Davis, and parts of Woodland.

TR-1: ZEV Adoption and Charging Infrastructure
Participants highlighted key challenges for adopting zero-emission vehicles and charging infrastructure, particularly in rural areas. In Nevada County, concerns were raised about grid reliability and the capacity of older homes to support EV charging.

In Yolo County, the high cost of electrification is a major barrier for rural residents. Additionally, participants noted that residents in more remote areas like Guinda and Dunnigan are concerned that limited EV ranges would make it difficult to reach essential services, further discouraging adoption. Adoption was noted to be closely tied to peer influence; farmers are more likely to try electric equipment when they see neighboring operations successfully using them.

NW-4: Carbon Sequestration Program/Carbon Farming
Comments on carbon sequestration and carbon farming highlight both the promise of regenerative practices in mitigating climate pollution as well as challenges that hinder broader application, particularly for small-scale, low-income, and historically marginalized farmers. Even when farmers are interested in transitioning to carbon farming practices, lack of institutional support and technical assistance prevent widespread adoption.

Access to stable, local markets emerged as a key barrier to implementing carbon farming for smaller farming operations. When markets are inconsistent, unreliable, or require extensive transportation of goods, farmers often deprioritize adoption of carbon sequestration practices. One participant stressed that expanding partnerships between local institutions like schools and hospitals could create dependable demand and enable more producers to invest in carbon farming practices.

Participants in the Yuba/Sutter focus group emphasized that healthy soil is essential for effective carbon farming. Yet large-scale operations often use harmful chemicals and poor soil management practices that disrupt underground ecosystems and reduce the land's capacity to store carbon. In contrast, Full Belly Farm in Yolo County was highlighted for maintaining ethical soil health and regenerative practices at scale, demonstrating that ethical, carbon-conscious farming can be done for larger farming operations.

Institutional capacity to support carbon farming is another barrier. In Yolo County, just one staff person at the Resource Conservation District is responsible for developing carbon farming plans through site visits, which limits the adoption of carbon farming practices. Increased funding and staffing are essential to scale up technical assistance for on-the-ground implementation.

BE-4: Building Decarbonization/ Electrification
Participants emphasized that the transition to electric buildings must involve a review of local conditions, infrastructure limitations, and affordability. Concern was raised around the ability of renters to decarbonize their homes due to limited authority or lack of motivation to invest in homes that they do not own. Renters are also unable to receive the same tax incentives available to homeowners for electrification.

In Placer and El Dorado counties, utilities like Roseville Electric have faced challenges supporting all-electric homes, which often requires costly infrastructure upgrades to transformers and panels. There was a strong call for financial assistance for those unable to afford these upgrades.

In Nevada county, building electrification was broadly viewed as infeasible due to winter storms, older housing infrastructure, and unreliable energy grids. Similarly, outdated infrastructure limits the charging capacity of electric vehicles. Participants expressed strong support for dual-fuel approaches instead of complete reliance on electricity.

NW-1: Wildfire Resilience and Management
Wildfire resilience emerged as a major concern across the region, influenced by the lived experience of residents facing devastating wildfires over the past decade and reinforced by the recent, devastating Los Angeles wildfires in January 2025. Participants expressed that proactive, community-centered approaches are critical to the long-term safety and sustainability of Californian communities.

Community members emphasized the importance of managing and clearing brush vegetation under trees, noting that these practices are economically viable and ecologically responsible. Several participants called for an integration of stewardship practices and Indigenous knowledge with modern fire resilience strategies. Participants recognized that it would take intentional, long-term efforts to undo the impacts of land mismanagement that has left landscapes significantly more flammable than before colonization. Participants noted the importance of asking for Tribal participation in planning processes to mitigate historical land mismanagement.

There was strong support for wildfire resiliency investments in high-risk areas such as power line corridors and for streamlining the permitting process for faster project delivery. Participants shared a case study from Sonoma, CA, to demonstrate how increasing housing density can also enhance fire resilience, pointing to the importance of integrating land use planning and wildfire mitigation strategies. Participants also emphasized the need to account for wildfire-related carbon emissions in climate planning. Using forest residues for biomass energy generation can result in increased wildfire resiliency and demonstrates the interconnectedness of climate measures.

Participants from rural areas within Yolo, Yuba, and Sutter counties, raised concerns about communities facing challenges from limited evacuation routes, which often consist of a single two-lane road. These narrow roads are difficult for residents attempting to evacuate and create dangerous traffic blockages when large firefighting vehicles attempt to pass. In addition to widening key roads and building additional egress routes, participants called for better communication regarding alternative fire response strategies, such as seeking refuge on open land when evacuation is not possible. Current communication strategies rely on informal, ad-hoc neighborhood networks and should be tailored to impacted neighborhoods. The North Yuba Forest Partnership was acknowledged as a collaborative that effectively communicates with its stakeholders and partners.

TR-4: Roadway Improvements for Multi-Modal Use and Access

Participants in Nevada County noted limited transportation options, with bike path accessibility being dependent on seasonal conditions. Microtransit was identified as a particularly effective solution for rural mobility, with participants pointing to successful examples in Truckee. In El Dorado and Placer counties, participants referenced traditional zoning practices and funding as barriers to developing bike lane infrastructure.

NW-2: Biomass Energy

Biomass energy emerged as a practical and locally supported strategy with opportunities for advancing forest health, wildfire prevention, community resilience, and rural economic resilience. In Nevada County, there was strong interest in developing capacity for local biomass energy to reduce the need to transport forest materials long distances, which is emissions-intensive and undermines climate benefits. Stakeholders across Nevada, Yuba, and Sutter counties emphasized that responsibly managed biomass facilities can deliver multiple co-benefits. The Camptonville Community Partnership's Biomass Business Campus in Yuba County was cited as a promising initiative demonstrating alignment between forest stewardship and economic opportunity. Rural communities can benefit from the local production of biomass energy through revenue generation as biomass energy jobs are created. Participants called for public communication and education to counter misinformation about biomass energy and build broader support for it as a sustainable energy source and wildfire mitigation strategy.

E-1A: Onsite Solar Canopies

Sacramento County participants expressed interest in local solar energy but emphasized high infrastructure and installation costs. These costs were noted as particularly prohibitive for low-income households and small businesses. In Yolo County, participants noted that solar installations are not permitted on protected agricultural lands.

Top Priorities by Subregional Focus Groups

In each focus group, participants were invited to rank the eight climate measures based on their lived experience and knowledge of local needs through their community-based advocacy work. Table 1 summarizes the highest ranking measures identified by participants in each subregion, reflecting localized priorities across the region. Notably, participants across multiple counties identified improving residential density (Placer and El Dorado; Sacramento; and Yolo County), wildfire management (Nevada; Placer and El Dorado; and Yuba and Sutter County), and carbon sequestration (Nevada; Yolo; Yuba and Sutter County) as their top priority measures.

Table 1. Top Priorities by Subregional Focus Groups

Subregional Focus Group	Highest Ranking Plan Measures
Nevada County	NW-1: Wildfire Resilience and Management NW-4: Carbon Sequestration Program/Carbon Farming NW-2: Biomass Energy
Placer and El Dorado counties	BE-1: Land Use Improvements NW-1: Wildfire Resilience and Management TR-4: Roadway Improvements for Multi-Modal Use and Access
Sacramento County	BE-1: Land Use Improvements TR-4: Roadway Improvements for Multi-Modal Use and Access E-1A: Onsite Solar Canopies
Yolo County	BE-1: Land Use Improvements NW-4: Carbon Sequestration Program/Carbon Farming BE-4: Building Decarbonization/Electrification
Yuba and Sutter counties	NW-1: Wildfire Resilience and Management NW-4: Carbon Sequestration Program/Carbon Farming NW-2: Biomass Energy

Chapter 6. Low-Income Community Benefits Analysis

Advancing Health in the Capital Region

The landscape of human health has changed greatly since the start of the Industrial Revolution. In the 1700s, the principal causes of death were transmittable diseases such as tuberculosis and malaria. Today, leading causes of death are chronic, “lifestyle” illnesses such as heart disease and cancer. The burning of fossil fuels for energy has profoundly impacted human health in two particularly powerful pathways: (1) the generation of air pollution, causing primary and secondary health damage; (2) and the widespread use of vehicles and equipment that reduce or eliminate the need for daily physical activity. Lack of physical activity is a stressor that increases systemic inflammation which underlies the development of chronic disease.

The environments where people are born, live, learn, work, play, worship, and age affect a wide range of health outcomes. Health outcomes are strongly tied to neighborhood environments and community conditions. The social determinants of health include housing, transportation, and neighborhoods; racism, discrimination, and violence; education, job opportunities, and income; access to nutritious foods and physical activity opportunities; language and linguistic isolation; and polluted air and water.[1]

The social determinants of health also contribute to wide health disparities and inequities. Conditions that support health, such as access to education, good job opportunities, and clean air and water, vary drastically by neighborhood.[2] For example, in low-income communities—where walking outdoors may be considered dangerous, few or no playgrounds exist and streets are hot and without shade—achieving daily physical activity is difficult and raises the risk of health conditions like heart disease, type 2 diabetes, and obesity. These factors lower life expectancy relative to people who do have access to safe walking environments. In these areas, not only are the residents exposed to higher levels of negative environmental factors, but because of the chronic stressors inherent in a life with limited resources, they are less resilient to environmental influences on health. Chronic or repeated challenges cause chronically elevated or fluctuating stress hormone and neural responses, leading to the development of heart disease, type 2 diabetes, chronic pain, fatigue, and other conditions.[3] This increases community vulnerability to both transmittable and chronic illness.

The good news is that collectively, the GHG reduction measures in this Plan offer a tremendous opportunity to reverse the trends and burdens of obesity, chronic illness, and health inequity. They offer a chance to move away from treating chronic illnesses with a medical approach—such as medications and surgery—to instead confronting the underlying causes of illness by creating a more health-supportive environment. Nearly all of the GHG reduction measures in this Plan have significant health co-benefits that manifest on a regional, local, or individual basis. These are detailed in the sections describing each measure. An additional advantage is that these health co-benefits will be experienced faster than the climate mitigation benefits—and usually more locally in the communities that have been most harmed.

Perhaps the biggest health payoff in this Plan is in the land use and transportation measures. Growing research finds consensus around how built environments that facilitate shorter vehicle trips and active modes of transportation tend to have lower rates of obesity, heart disease, and costs due to illnesses related to these conditions. Reducing VMT per capita in a region diminishes acute health impacts (injuries and deaths due to vehicle collisions) as well as chronic health impacts (obesity, hypertension, type 2 diabetes, and heart disease).[4]

Tremendous health co-benefits are also realized with reductions in air pollution emissions. Fine particulates can alter not only respiratory and cardiovascular systems, but also metabolism, gestation, and the nervous system. Air pollutants have greater impacts on vulnerable populations,[5] and can exacerbate existing chronic illnesses. Fine particulate emissions are locally concentrated, and sources of fine particulates are likely to have more impact on vulnerable communities than in communities more representative of the average population of the region. While modeling for this Plan focused on the regional scale, the localized benefits are discussed qualitatively in the measures.

The vision of this Plan is to reduce GHG emissions while delivering other important advantages, including better respiratory health; improved physical fitness; less emotional stress; cleaner air; a quieter environment; fewer traffic injuries and deaths; and greater access to food, health care, and other essentials for healthy living. Reducing GHG emissions in low-income communities can bring health co-benefits to where they are needed most, while also delivering improved health on a larger, regional scale. Once implemented, these GHG reduction measures will move the region toward a healthier, more fair future.

Methodology for Low-Income Community Benefits Analysis

GHG emissions reduction measures selected for implementation are anticipated to alleviate the risks and impacts of climate change and provide additional co-benefits. Benefits identified in low-income communities were evaluated following the EPA's CPRG Technical Reference Document for Benefits Analyses: Low-Income and Disadvantaged Communities[6] and the CAPCOA Handbook.[7] Figure 1 shows a diagram of the methodology used to evaluate these benefits, with more details provided in Appendix E. Quantified low-income community benefits include the amount of air pollutants and GHG reductions and the economic co-benefits of these reductions. Since exact project locations for measure implementation are not known, spatial surrogates were used to help identify likely areas of implementation. Qualitative co-benefits are estimated based on the CAPCOA Handbook guidelines.

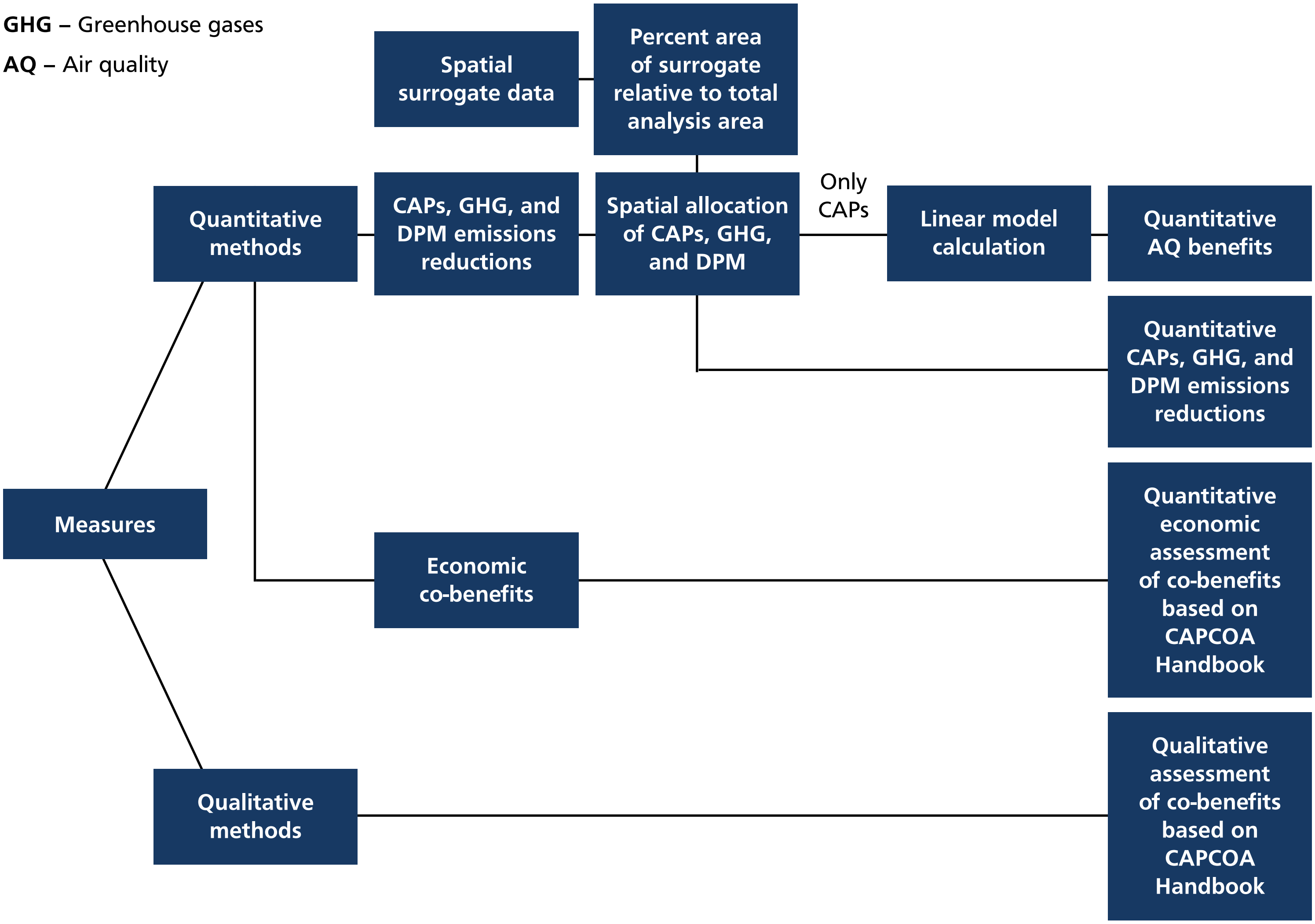
Figure 1. Methodology Diagram

CAPs – Criteria air pollutants (i.e. NOx, $PM_{2.5}$, sulfur dioxide [SO_2], carbon monoxide [CO])

DPM – Diesel particulate matter

GHG – Greenhouse gases

AQ – Air quality



Low-income community benefits will vary depending on how much the community is already burdened and the extent to which measures can be implemented in or near the community. When measures can be implemented in a low-income community, those benefits are referred to as "direct benefits." When measures can be implemented near a low-income community, those benefits are referred to as "indirect benefits." In addition, potential mitigation methods are discussed where localized disbenefits to low-income communities are likely to occur.

Proportion of Community Members in a Low-Income Community

Estimated low-income community benefits can be compared to the percent of population that live in a low-income community to evaluate if the estimated benefits would be equal to, less, or greater than among all people in the Sacramento-Roseville CSA. Table 1 shows the percentage of the population that lives in a low-income community in each county in the Sacramento-Roseville CSA. Across the Sacramento-Roseville CSA, 62% of the people live in an area defined as a low-income community. This baseline value of 62% is the percentage of benefits that low-income communities would enjoy if benefits were evenly shared by all people in the Sacramento-Roseville CSA.

Table 1. Percent of People Living in a Low-Income Community for Each County*

County	Percent of Population Living in a Low-Income Community
Sacramento	74%
Placer	27%
Yolo	63%
El Dorado	23%
Sutter	88%
Yuba	84%
Nevada	49%
Total Sacramento-Roseville CSA	**62%**

** Refer to Chapter 6 and Appendix E in the Capital Region Climate Priorities Plan for a description of how low-income communities were identified.*

Summary for Direct Emission Benefits in Low-Income Communities

Table 2 lists each GHG emissions reduction measure, and the percentage of direct benefits anticipated to occur in low-income communities. Table 2 shows measures with the highest proportion of direct low-income community emission benefits first and measures are shown in order of decreasing direct low-income community emission benefits.

Measures that reduce emissions in low-income communities by more than 62%, the baseline for benefits, are anticipated to have more direct benefits that flow to low-income communities. In general, the measures with the greatest direct benefits to low-income communities involve transportation-related initiatives that reduce VMT and reductions to energy consumption. The measures associated with the highest percentage of benefits to the low-income communities are related to Public Transit Improvements (TR-2, 86%) and Providing Bus Rapid Transit (TR-3, 86%), followed by Improved Land Use (BE-1, 85%), Transportation Demand Management Programs (TR-5, 82%) and ZEV Adoption (TR-1, 82%). In the Sacramento-Roseville CSA, communities adjacent to congested roadways, including the port and distribution centers, are often low-income communities. These communities are exposed to the highest concentration of criteria and toxic air pollution from vehicles and equipment, leading to several demonstrated health impacts such as respiratory illnesses, higher likelihood of cancer development, and premature death.[8] The measures identified above mitigate emissions from transportation and should be prioritized to maximize and expedite direct benefits to the low-income communities.

Measures BE-9 (Reduce Wastewater Emissions), BE-7 (Reduce Solid Waste), and BE-10 (Require Edible Food Recovery Program Partnerships with Food Generators) are estimated to benefit non-low-income communities more than low-income communities. While direct emission reductions happen at the facilities, non-air quality benefits are realized, such as lower utility bills or improved food access. Additional efforts will also be needed during implementation of these measures to identify methods to increase direct low-income community benefits from these measures. This would be particularly important to consider for the Delta communities in southwest Sacramento County, the Yuba-Sutter area, and Yolo County since these communities are currently over-burdened by water and wastewater impacts, as shown in Appendix G in the Capital Region Climate Priorities Plan.

Table 2. Percent Reduction in GHG and Co-Pollutant Emissions in LIDACs

Plan Measure	CAPCOA Measure Name	Information to Estimate Where Emissions Reductions Would Occur (Data Source)	Percent Emissions Reduction in Low-Income Communities[9]	
			2030	2045
TR-2: Public Transit Improvements	T-26. Increase Transit Service Frequency	Frequency of Transit Services per Sq Mi (DOT)	86%	86%
	T-25. Extend Transit Network Coverage or Hours	Frequency of Transit Services per Sq Mi (DOT)	86%	86%
	T-46. Provide Transit Shelters	Frequency of Transit Services per Sq Mi (DOT)	86%	86%
TR-3: Provide Bus Rapid Transit	T-28. Provide Bus Rapid Transit	Frequency of Transit Services per Sq Mi (DOT)	86%	86%
BE-1: Land Use Improvements	T-1. Increase Residential Density	Estimated Average Drive Time to Points of Interest (Min) (DOT)	85%	62%
	T-55. Infill Development	Anticipated Growth in Green Zones (SACOG)	85%	62%
TR-5: Transportation Demand Management Program	T-8. Provide Ridesharing Program	Traffic Proximity and Volume (EJScreen)	82%	82%
	T-9. Implement Subsidized or discounted Transit Program	Traffic Proximity and Volume (EJScreen)	82%	82%
	T-5. Implement Commute Trip Reduction Program (Voluntary)	Traffic Proximity and Volume (EJScreen)	82%	82%
	T-6. Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	Traffic Proximity and Volume (EJScreen)	82%	82%

Table 2. Percent Reduction in GHG and Co-Pollutant Emissions in LIDACs (continued)

Plan Measure	CAPCOA Measure Name	Information to Estimate Where Emissions Reductions Would Occur (Data Source)	Percent Emissions Reduction in Low-Income Communities[9]	
			2030	2050
TR-1: ZEV Adoption and Charging Infrastructure	T-30a. Use of Cleaner- Fuel Vehicles (BEVs)	Traffic Proximity and Volume (EJScreen)	82%	82%
	T-30b. Use of Cleaner- Fuel Vehicles (PHEVs)	Traffic Proximity and Volume (EJScreen)	82%	82%
	T-14. Provide Electric Vehicle Charging Infrastructure	Non Gasoline Alternative Fueling Stations (HIFLD)	73%	73%
BE-2: Building Energy Efficiency Improvements	E-2. Require Energy Efficient Appliances	Electricity Consumption by County (CEC)	72%	0%
BE-3: Increase Use of Renewable Energy in New and Existing Buildings	E-17. Renewable Surplus Buildings	Electricity Consumption by County (CEC)	72%	0%
BE-9: Reduce Wastewater Emissions	E-19. Establish Methane Recovery in Wastewater Treatment Plants	Wastewater Discharge (EJScreen)	50%	50%
BE-7: Reduce Solid Waste	S-1: Institute or Extend Recycling Services	Solid Waste (CalEnviroScreen)	46%	46%
BE-10: Require Edible Food Recovery Program Partnerships with Food Generators	S-3. Require Edible Food Recovery Program Partnerships with Food Generators	Solid Waste (CalEnviroScreen)	46%	46%

Indirect benefits were not quantified. Indirect benefits are anticipated to be similar to the direct benefits whereby indirect benefits that flow to low-income communities would primarily be related to reduced transportation and energy consumption. There are opportunities to increase indirect benefits to low-income communities associated with land use improvements, provided that improvements are managed carefully to prevent or minimize displacement. Similar to direct benefits from measures BE-9, BE-7, and BE-10, additional effort would be needed during implementation of these land use improvement measures to identify methods to increase indirect low-income community benefits from these measures.

In some situations, there is the potential for measures to result in localized disbenefits to low-income communities. Specifically, land use improvements associated with measure BE-1 have the potential to increase displacement. Displacement concerns were also raised during the community engagement phase. To mitigate the potential for displacement of lower-income people from their communities, additional focus will be placed on affordable housing during the review and approval of land use improvement projects related to these measures.

In addition, there is the potential for localized increases in VMT and associated air pollution emissions in low-income communities for measures that increase vehicles in neighborhoods, such as TR-2: Public Transit Improvements and TR-7: Establish a School Bus Program. It is anticipated that associated VMT reductions from these programs would outweigh localized increases of emissions from buses. In addition, due to California’s Innovative Clean Transit Regulation and robust funding for zero-emission school buses, it is likely that bus fleet expansion would be combined with TR-1: ZEV Adoption and Charging Infrastructure, ensuring clean and quiet vehicles providing critical access and mobility to low-income communities.

Low-Income Community Co-Benefits

This section provides a detailed description of the qualitative benefits and quantifiable benefits, when possible, for each of the 10 CAPCOA co-benefits identified in the CAPCOA Handbook.[7]

Improved Air Quality – Criteria Air Pollutants (CAPs)

Maximum air quality benefits in low-income communities for measures that could be quantified are shown in Table 3. In general, as these measures are adopted, they will have minimal impacts on future ambient air pollutant concentrations; however, the potential for more localized benefits is high given that air pollutant concentrations can be quite high near roadways. The measures associated with the highest percentage of air quality benefits to low-income communities are related to BE-1: Land Use Improvements and TR-1: ZEV Adoption and Charging Infrastructure.

Table 3. Maximum Air Pollutant Concentration Reductions in 2045 by Measure in Low-Income Communities

Plan Measure	CAPCOA Measure Name	Maximum Projected Air Quality Concentration Reduction in LIDACs (%)			
		NOx	CO	$PM_{2.5}$	SO_2
BE-1: Land Use Improvements	T-55. Infill Development	0.002%	0.005%	0.0003%	0.002%
TR-1: ZEV Adoption and Charging Infrastructure	T-30a. Use of Cleaner-Fuel Vehicles (BEVs)	0.01%	0.02%	0.001%	0.01%
	T-30b. Use of Cleaner-Fuel Vehicles (PHEVs)	0.001%	0.002%	0.0002%	0.001%
	T-14. Provide Electric Vehicle Charging Infrastructure	0.001%	0.003%	0.0003%	0.001%
TR-5: Transportation Demand Management Program	T-5. Implement Commute Trip Reduction Program (Voluntary)	0.0008%	0.002%	0.0001%	0.0007%
	T-6. Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	0.0008%	0.002%	0.0001%	0.0007%
	T-8. Provide Ridesharing Program	0.0004%	0.0008%	0.0001%	0.0004%
TR-2: Public Transit Improvements	T-25. Extend Transit Network Coverage or Hours	0.0005%	0.001%	0.0001%	0.0005%

In addition to CAPs, there are other mobile source air toxics related to gas combustion and fueling that would be reduced through measure implementation. These include benzene, formaldehyde, butadiene, acetaldehyde, ethylbenzene, and others. These reductions would occur near gasoline dispensing facilities and areas with higher VMT, which tend to be in low-income communities.

Energy and Fuel Savings – Electricity, Natural Gas, Refrigerant, Propane, Gasoline, or Diesel Reductions

The proportion of energy and fuel savings benefits that flow to low-income communities is anticipated to be quite high as shown in Table 4. For those measures that can be spatially distributed, which are shown in Table 2, it is estimated that 72% of the energy savings from all measures combined (in megawatt hours) would flow to low-income communities. Energy-efficient measures can result in lower utility bills for residents, improved indoor air quality, and job opportunities for energy-efficient construction, maintenance, and technology installation. Further, energy costs were one of the top priorities identified by low-income communities during the community engagement phase. Similar to energy savings, it is estimated that 78% of the fuel reductions from both diesel and gasoline would flow to low-income communities. Some measures, such as increased transit and school bus programs, could potentially have a fuel increase (disbenefit) if not coupled with clean-fuel technologies.

While additional fuel reductions are anticipated from biomass energy, these benefits were not able to be estimated quantitatively for low-income communities. It is estimated that low-income communities in mountain-rural areas would benefit from biomass energy fuel reduction measured at levels similar to or perhaps higher than non-low-income communities, depending on the program implementation.

Table 4. Quantified Co-Benefits that Flow to Low-Income Communities

Quantified Co-Benefit	Proportion of Benefits Flowing to Low-Income Communities
Energy Saved (MWh)	72%
Fuel Reductions (diesel)	78%
Fuel Reductions (gas)	78%

VMT Reductions – Reductions in Vehicle Miles Traveled

The proportion of VMT reductions that flow to low-income communities is anticipated to be 78% for those measures that can be spatially distributed (as shown in Table 2). VMT reductions have additional co-benefits associated with air quality, pedestrian and traffic safety, and improved public health. Reducing VMT also has noise and physical activity benefits. The anticipated locations of maximum benefits are generally consistent with locations in low-income communities with existing transportation burdens.

Water Conservation – Water Use Reductions

Benefits of water conservation measure BE-8 were not able to be quantitatively estimated for low-income communities. It is estimated that direct benefits of these measures would not flow to low-income communities in most areas; however, indirect benefits of water conservation, such as lower utility bills through less water use and reduced application of chemical fertilizer due to turf removal, would increase for low-income communities.

Enhanced Pedestrian or Traffic Safety – Reduced Collisions; Pedestrian/Bicyclist Safety

Benefits of GHG emissions reduction measures related to pedestrian and traffic safety were not quantitatively estimated for low-income communities. It is estimated that GHG reduction measures that reduce VMT would enhance pedestrian and traffic safety proportional to locations of reduced VMT. Therefore, it is estimated that 78% of safety benefits associated with GHG reduction measures would flow to low-income communities.

Improved Public Health – Toxic Air Contaminant Reductions (Including Exposure); Increased Physical Activity; Improved Public Safety

While public health benefits were not quantitatively evaluated for low-income communities, it is anticipated that public health benefits associated with transportation improvements and reductions in VMT would flow to low-income communities. Exposure to gasoline and diesel emissions generates systemic inflammation and has damaging effects in the lungs, heart, blood vessels, and brain. People who are disproportionately exposed to pollution are most vulnerable. ZEV use can reduce emissions that cause deficits in lung function, asthma, high blood pressure, cancer, diabetes, cognitive difficulties, and premature death, among other health outcomes. Given that it is estimated in Table 4 that 78% of benefits from fuel reductions would occur in low-income communities, it is anticipated that current public health burdens would be reduced by a similar percentage. Although localized public health benefits could be adversely impacted in the short-term due to construction activities from associated GHG emissions reduction measures, robust implementation of measure BE-5: Construction and Landscape Equipment Emission Reduction will minimize health impacts due to construction.

Improved Ecosystem Health – Improved Biological Diversity and Soil and Water Quality

Much of the Plan's ecosystem benefits result from preserving and enhancing existing natural and working lands. While these are typically located outside of low-income communities, benefits from these measures such as reduced wildfire smoke incidents due to implementation of NW-1, will be advantageous for the whole region.

Ecosystem health would also be improved through NW-3: Increase Tree Canopy. Partners and stakeholders are encouraged to combine tree canopy expansion with active modes and transit shelter improvements and to focus canopy improvements in low-income communities.

Enhanced Energy Security – Systemwide Load Reduction; Local Energy Generation, Levelling Out Peaks

Benefits of GHG emissions reduction measures related to energy security were not quantitatively estimated for low-income communities. Use of renewable energy measures can increase low-income communities' access to clean energy sources. It could also compromise energy security if the transition to renewable energy sources does not have sufficient grid reliability. It is anticipated the energy security for low-income communities would be comparable to non-low-income communities. This area has been identified as a regional need and measures to specifically address energy security will be evaluated in the future.

Enhanced Food Security – Stability of Food Systems; Improved Household Access to Food

Benefits of GHG emissions reduction measures related to food security were not quantitatively estimated for low-income communities. However, measure BE-10: Edible Food Recovery Program Partnerships with Food Generators can reduce agricultural emissions, lower the footprint of food distribution, prevent CH_4 emissions, decrease energy use from landfills, and mitigate food waste-related emissions. Low-income communities often face challenges accessing nutritious food, and edible food recovery programs redirect surplus food that would otherwise go to waste toward people in need. Most of the benefits from measures related to the food recovery program are anticipated to flow to low-income communities.

Social Equity – Address Existing Social Challenges (e.g., Housing/Anti-Displacement, Community Engagement, Availability of Disposable Income)

GHG reduction measures that focus on increasing renewable energy can improve energy equity by increasing low-income communities' access to clean energy sources and improving opportunities for jobs and educational opportunities as part of implementing Plan measures. New jobs can be directed to low-income communities through implementation of training programs to prepare residents for future employment opportunities related to renewable energy (see Workforce Planning Analysis chapter for further information). Potential localized disbenefits could include job displacement.

There are also other benefits for projects that increase housing opportunities in non-low-income community areas. Measure BE-1: Land Use Improvements increases housing investment in non-low-income community areas with low-VMT and higher resource access. Improving affordable housing opportunities in these areas gives the region's residents more choice in where they can live, work, and play.

A Healthier Capital Region

Implementation of GHG emissions reduction measures will provide substantial co-benefits to communities in the Sacramento-Roseville CSA. This analysis assessed qualitative and quantifiable benefits for each GHG measure and, where feasible, estimated the percentage of benefits expected to impact low-income communities. This Plan was crafted with the understanding that some communities in the Capital Region bear a disproportionate share of the negative environmental and social consequences resulting from industrial, governmental, and commercial operations or policies. The current state of affairs is the result of decades of discriminatory policies and actions. As these measures are implemented and new ones are added to the Plan, the steering committee and working groups are committed to ensuring all communities fairly benefit from these measures, and we will continue to engage with low-income communities to ensure that communities participate and benefit from the successful implementation of these GHG reduction measures.

REFERENCES

[1] US Department of Health and Human Services. (Undated.) Social Determinants of Health. Available: https://health.gov/healthypeople priority-areas/social-determinants-health. Accessed: February 2024.

[2] California Healthy Places Index. 2023. Healthy Places Index Guide. Available: https://phasocal.org/wp-content/uploads/2023/06/PHA_HPI Guidance_Report523_4.pdf. Accessed: February 2024.

[3] Mc Ewen BS. 2017. Allostatic Load and Overload, ScienceDirect. Available: https://www.sciencedirect.com/topics/neuroscience/allostatic load. Accessed: February 2024.

[4] UC Davis National Center for Sustainable Transportation. 2017. Cutting Greenhouse Gas Emissions is Only the Beginning: A Literature Review of the Co-Benefits of Reducing Vehicle Miles Traveled. Available: https://ncst.ucdavis.edu/research-product/cutting-greenhouse-gas emissions-only-beginning-literature-review-co-benefits. Accessed: February 2024.

[5] California Air Resources Board. 2020. People at Risk. Available: https://ww2.arb.ca.gov/our-work/programs/people-risk/about. Accessed: February 2024.

[6] U.S. EPA Office of Air and Radiation. Climate Pollution Reduction Grants Program: Technical Reference Document for States, Municipalities, and Air Pollution Control Agencies. Benefits Analyses: Low-Income and Disadvantaged Communities. April 27, 2023. Available online at: https://www.epa.gov/system/files/documents/2023-05/LIDAC%20Technical%20Guidance%20-%20Final_2.pdf.

[7] California Air Pollution Control Officers Association (CAPCOA). Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. December 2021. Available online at: https://www.caleemod.com/documents handbook/full_handbook.pdf.

[8] https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health.

[9] The percentage of emissions reductions at LIDACs was calculated by summing the emissions reductions in LIDAC census block groups and dividing by the sum of emissions reductions in the Sacramento-Roseville CSA.

Chapter 7. Workforce Planning Analysis

Workforce development is a critical component of effective climate planning. It aligns industry demand with the Sacramento-Roseville CSA's available workforce and training opportunities. Preparing the region to take broad action in addressing climate change requires strong environmental strategies and a skilled, inclusive workforce that is equipped to implement them successfully.

This chapter presents the Plan's workforce analysis methodology and findings and:

- Identifies key occupations and skills needed to implement Plan measures
- Analyzes workforce supply and demand for priority occupations
- Summarizes stakeholder feedback to highlight regional workforce needs, infrastructure gaps, and priorities that inform implementation strategies

The workforce planning analysis study area includes the Plan's seven counties spanning two workforce development regions:

- **Capital Region:** El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties (along with Alpine, Colusa, and Glenn counties, which are outside of the Sacramento-Roseville CSA)
- **Northern Rural Training and Employment Consortium (NoRTEC):** Nevada County (along with 10 other counties in northern California outside of the Sacramento-Roseville CSA)

Analysis Approach

The analysis considered the workforce involved in Plan implementation, which encompasses actions critical to making progress on the region's GHG reduction targets. Assessing the current and future state of the workforce provides insight into opportunities and bottlenecks for the workforce ecosystem and is a critical step to developing a workforce strategy to build a workforce that meets the region's demand.

A multistep mapping and screening process was conducted to identify the priority occupations within the workforce. Plan measures were categorized into workforce sectors, industries, and occupations, and the results were evaluated to identify cross-cutting occupations important to multiple sectors as well as those specific to individual measures.

To support further analysis, occupations were then grouped into three tiers:

- **Tier 1** includes 22 occupations that have significant overlap across sectors, and varying levels of prioritization to each individual sector. Occupations in this tier are analyzed by employment, wages, education, training and skills requirements, and demographics.
- **Tier 2** includes 32 occupations where demand is more specific to individual sectors or measures. These occupations are analyzed by employment, wages, education, training and skills requirements, and demographics.
- **Tier 3** includes 10 occupations that are more generally applicable across all industry sectors, regardless of alignment with measures or sectors. Analysis of these occupations includes detail on trends in employment and wages to understand how these occupations are activated in the workforce.

The analysis in this chapter focuses on Tier 1 and Tier 2 occupations, which are listed in Table 1 and Table 2, respectively. These occupations will be directly involved in measure implementation and are sourced from the U.S. Bureau of Labor Statistics (BLS) and organized by Standard Occupational Classification (SOC) code.

See Appendix F for further information on the workforce analytical approach, data sources and limitations, and results of the Tier 3 occupations analysis.

Table 1. Tier 1 Workforce Occupations

SOC Code	Occupation
49-9071	Maintenance and Repair Workers, General
47-2061	Construction Laborers
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers
47-2073	Operating Engineers and Other Construction Equipment Operators
53-3032	Heavy and Tractor-Trailer Truck Drivers
11-9021	Construction Managers
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers
51-4121	Welders, Cutters, Solderers, and Brazers
53-7062	Laborers and Freight, Stock, and Material Movers, Hand
47-2111	Electricians
47-2231	Solar Photovoltaic Installers
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
47-3013	Helpers–Electricians
51-1011	First-Line Supervisors of Production and Operating Workers
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists
47-2152	Plumbers, Pipefitters, and Steamfitters
43-5032	Dispatchers, Except Police, Fire, and Ambulance
47-4011	Construction and Building Inspectors
47-4041	Hazardous Materials Removal Workers
51-2098	Miscellaneous Assemblers and Fabricators
49-3023	Automotive Service Technicians and Mechanics
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers

Table 2. Tier 2 Workforce Occupations

SOC Code	Occupation
47-2051	Cement Masons and Concrete Finishers
49-3042	Mobile Heavy Equipment Mechanics, Except Engines
17-3011	Architectural and Civil Drafters
17-3031	Surveying and Mapping Technicians
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors
49-9051	Electrical Power-Line Installers and Repairers
51-8013	Power Plant Operators
51-8012	Power Distributors and Dispatchers
21-1093	Social and Human Service Assistants
11-9151	Social and Community Service Managers
11-9013	Farmers, Ranchers, and Other Agricultural Managers
33-1021	First-Line Supervisors of Firefighting and Prevention Workers
37-3011	Landscaping and Groundskeeping Workers
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers
51-8031	Water and Wastewater Treatment Plant and System Operators
37-3013	Tree Trimmers and Pruners
45-2099	Agricultural Workers, All Other
45-2091	Agricultural Equipment Operators
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers
45-4011	Forest and Conservation Workers
45-4022	Logging Equipment Operators
33-9094	School Bus Monitors
33-2022	Forest Fire Inspectors and Prevention Specialists
53-3053	Shuttle Drivers and Chauffeurs
53-7081	Refuse and Recyclable Material Collectors
53-3052	Bus Drivers, Transit and Intercity
53-3051	Bus Drivers, School
53-3054	Taxi Drivers

Analysis Overview

The following workforce characteristics were analyzed for occupations in Tiers 1 and 2:

- **Employment:** Historic and current employment information by key occupation category. Includes analysis of job counts, annual growth rate calculations, and the share of employment growth in each occupation between 2014 and 2024, as well as an assessment of the relative concentration of Plan-related occupations in the study region when compared to national averages.
- **Wages:** Current wages by occupation, annual growth and nominal percentage change. Also includes information on the change in the inflation-adjusted real wage over the analysis period.
- **Demographic Profile:** Composition of each occupational category in terms of age, race, and gender, compared to the regional workforce composition.
- **Training and Educational Requirements:** Education and training that are required to enter the selected occupations.
- **Fair Access to Workforce Training:** Maps the available workforce training centers within the study region alongside low-income communities and identifies barriers to fair access.
- **Workforce Gap Analysis:** Projected labor shortages or surpluses by occupation. Includes analysis of projected labor supply and projected labor demand.

Within this analysis, compound annual growth refers to average growth of any value over a specific period and is used to smooth out fluctuations and allow comparison between values of different scales. Calculations presented in this chapter are based on unrounded values to ensure accuracy in the analysis; however, rounded figures are presented in tables and visualizations solely for reporting clarity. Consequently, aggregate values or derived metrics may not align precisely with calculations performed using the rounded figures displayed.

Workforce Development Sectors

To organize the workforce planning analysis, the planning team developed six workforce sectors that broadly represented the unique set of occupations and industries that correspond to Plan measures (see Table 3). These include Building Decarbonization, Solid Waste, Waste and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, and Natural and Working Lands. Workforce sectors were then mapped to occupations that are critical for the implementation of measures in each workforce sector, providing a basis for organizing them into prioritized tiers (see Table 4 and Table 5).

Table 3. Measures and Workforce Development Sectors

<table>
<tr><th>Plan Measures</th><th>Workforce Section</th></tr>
<tr><td>BE-1: Land Use Improvements</td><td rowspan="8">Building Decarbonization</td></tr>
<tr><td>BE-2: Building Energy Efficiency Improvements</td></tr>
<tr><td>BE-3: Increase Use of Renewable Energy in New and Existing Buildings</td></tr>
<tr><td>BE-4: Building Decarbonization/Electrification</td></tr>
<tr><td>BE-5: Construction and Landscape Equipment Emissions Reduction</td></tr>
<tr><td>BE-6: Install Cool Pavement</td></tr>
<tr><td>E-1A: Onsite Solar Canopies</td></tr>
<tr><td>E-1B: Battery Storage-Supported Microgrids</td></tr>
<tr><td>BE-7: Reduce Solid Waste</td><td rowspan="2">Solid Waste</td></tr>
<tr><td>BE-10: Require Edible Food Recovery Program Partnerships with Food Generators</td></tr>
<tr><td>BE-8: Reduce Water Utility Emissions</td><td rowspan="2">Waste and Wastewater</td></tr>
<tr><td>BE-9: Reduce Wastewater Emissions</td></tr>
<tr><td>TR-1: ZEV Adoption and Charging Infrastructure</td><td>ZEV Adoption and Charging Infrastructure</td></tr>
<tr><td>TR-2: Public Transit Improvements</td><td rowspan="7">Transportation and Mobility</td></tr>
<tr><td>TR-3: Provide Bus Rapid Transit</td></tr>
<tr><td>TR-4: Roadway Improvements for Multi-Modal Use and Access</td></tr>
<tr><td>TR-5: Transportation Demand Management Program</td></tr>
<tr><td>TR-6: Active Modes of Transportation for Youth</td></tr>
<tr><td>TR-7: Establish a School Bus Program</td></tr>
<tr><td>TR-8: Electric Bikeshare</td></tr>
<tr><td>NW-1: Wildfire Resilience and Management</td><td rowspan="6">Natural and Working Lands</td></tr>
<tr><td>NW-2: Biomass Energy</td></tr>
<tr><td>NW-3: Increase Tree Canopy</td></tr>
<tr><td>NW-4: Carbon Sequestration Program/Carbon Farming</td></tr>
<tr><td>NW-5: GHG Local Offset Program</td></tr>
<tr><td>NW-6: Natural and Working Lands Equipment Emissions Reduction</td></tr>
</table>

Table 4. Tier 1 Occupations and Applicable Workforce Sectors

SOC Code	Occupation	Applicable Workforce Sectors
11-9021	Construction Managers	Building Decarbonization, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
43-5032	Dispatchers, Except Police, Fire, and Ambulance	Solid Waste, ZEV Adoption and Charging Infrastructure, Transportation and Mobility
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-2061	Construction Laborers	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-2073	Operating Engineers and Other Construction Equipment Operators	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-2111	Electricians	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-2152	Plumbers, Pipefitters, and Steamfitters	Building Decarbonization, Water and Wastewater, Natural and Working Lands
47-2231	Solar Photovoltaic Installers	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-3013	Helpers–Electricians	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
47-4011	Construction and Building Inspectors	Building Decarbonization, Transportation and Mobility, Natural and Working Lands
47-4041	Hazardous Materials Removal Workers	Building Decarbonization, Solid Waste, Natural and Working Lands
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	Building Decarbonization, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
49-3023	Automotive Service Technicians and Mechanics	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Transportation and Mobility
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	Building Decarbonization, Solid Waste, ZEV Adoption and Charging Infrastructure, Transportation and Mobility
49-9071	Maintenance and Repair Workers, General	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands

Table 4. Tier 1 Occupations and Applicable Workforce Sectors (continued)

SOC Code	Occupation	Applicable Workforce Sectors
51-1011	First-Line Supervisors of Production and Operating Workers	Building Decarbonization, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-2098	Miscellaneous Assemblers and Fabricators	Building Decarbonization, ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-4121	Welders, Cutters, Solderers, and Brazers	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Natural and Working Lands
53-3032	Heavy and Tractor-Trailer Truck Drivers	Building Decarbonization, Solid Waste, Water and Wastewater, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	Building Decarbonization, Solid Waste, ZEV Adoption and Charging Infrastructure, Transportation and Mobility, Natural and Working Lands

Table 5. Plan Tier 2 Occupations and Applicable Workforce Sectors

SOC Code	Occupation	Applicable Workforce Sectors
11-9013	Farmers, Ranchers, and Other Agricultural Managers	Natural and Working Lands
11-9151	Social and Community Service Managers	Solid Waste
17-3011	Architectural and Civil Drafters	Building Decarbonization, Transportation and Mobility
17-3031	Surveying and Mapping Technicians	Building Decarbonization, Transportation and Mobility
21-1093	Social and Human Service Assistants	Solid Waste
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	Natural and Working Lands
33-2022	Forest Fire Inspectors and Prevention Specialists	Natural and Working Lands
33-9094	School Bus Monitors	Transportation and Mobility
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	Natural and Working Lands
37-3011	Landscaping and Groundskeeping Workers	Natural and Working Lands
37-3013	Tree Trimmers and Pruners	Natural and Working Lands
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	Natural and Working Lands
45-2091	Agricultural Equipment Operators	Natural and Working Lands
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	Natural and Working Lands

Table 5. Plan Tier 2 Occupations and Applicable Workforce Sectors (continued)

SOC Code	Occupation	Applicable Workforce Sectors
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	Natural and Working Lands
45-2099	Agricultural Workers, All Other	Natural and Working Lands
45-4011	Forest and Conservation Workers	Natural and Working Lands
45-4022	Logging Equipment Operators	Natural and Working Lands
47-2051	Cement Masons and Concrete Finishers	Building Decarbonization, Transportation and Mobility
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	Building Decarbonization, Natural and Working Lands
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	Transportation and Mobility, Natural and Working Lands
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Building Decarbonization
49-9051	Electrical Power-Line Installers and Repairers	ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-8012	Power Distributors and Dispatchers	ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-8013	Power Plant Operators	ZEV Adoption and Charging Infrastructure, Natural and Working Lands
51-8031	Water and Wastewater Treatment Plant and System Operators	Water and Wastewater
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	Solid Waste, Transportation and Mobility
53-3051	Bus Drivers, School	Transportation and Mobility
53-3052	Bus Drivers, Transit and Intercity	Transportation and Mobility
53-3053	Shuttle Drivers and Chauffeurs	Transportation and Mobility
53-3054	Taxi Drivers	Transportation and Mobility
53-7081	Refuse and Recyclable Material Collectors	Solid Waste

Workforce Analysis

Regional Approach to Workforce Development

The region contains two distinct labor markets, the Sacramento-Roseville-Folsom Metro Area (four counties) and the Yuba City Metro Area (two counties). The regional economy is driven by a mix of government, healthcare, education and technology sectors. Government employment is especially prominent due to Sacramento's role as the state capital, with 24% of the region's workforce employed in the public sector. As of April 2025, unemployment rates varied across the region: Placer County had the lowest (3.8%) while Sutter County had the highest (9.6%). Compared to a statewide unemployment rate of 5.3% in April 2025, two counties had unemployment rates exceeding the state average (Yuba and Sutter counties), while five counties had unemployment rates below the state average (El Dorado, Nevada, Placer, Sacramento, Yolo).[1,2]

The state of California has taken deliberate steps to align its economic and workforce development initiatives. Its broader economic strategy, California Jobs First (CJF), is a statewide effort focused on building inclusive and sustainable regional economies. With an emphasis on fair economic development, CJF supports regions in identifying priority sectors, strengthening local capacity, and creating quality jobs. We Prosper Together is the regional community-led initiative that advances the goals of CJF in the Capital Region. Led by Valley Vision, it brings together the seven counties in the Plan area along with Colusa County to support inclusive and sustainable economic development.[3]

California's approach to workforce development builds on the CJF framework and emphasizes economic growth through investments in industry partnerships, job quality, and skill development. Central to this approach is the concept of High Road programming, a suite of strategies that align workforce and economic policy with long-term goals such as environmental sustainability, high-quality employment, and economic resilience. The High Road model focuses on areas where the interests of employers, workers, jobseekers, and environmental goals intersect, creating pathways to quality jobs while elevating existing roles.

In alignment with CJF, High Road Training Partnerships (HRTPs) are industry-led, worker-centered collaborations reflecting state and regional strategic sectors. These partnerships are designed to train workers for in-demand, high-quality jobs. In 2025, California committed over $18 million in grant funding to support the implementation and expansion of HRTPs across the state. Sector-based strategies are built around industries and occupations that are both currently in demand and projected to grow, with a focus on key sectors such as healthcare, clean energy, advanced manufacturing, construction, and information, and communication technologies.

Within the Capital Region, priority sectors include business services, precision manufacturing, working lands, and research and development.[4] Core to the We Prosper Together plan is the creation of high-quality jobs and the expansion of training and upskilling opportunities in clean energy, sustainable agriculture, green construction, and climate adaptation infrastructure. The region benefits from a robust ecosystem of organizations already collaborating to implement impactful, economy-wide workforce development programs, particularly those aligned with climate resilience and sustainability goals.

At the same time, there is a clear need to better connect disinvested communities with emerging green career opportunities. This requires a deliberate focus on fair and inclusive access across all workforce development programs, services, and resources. Successful Plan implementation will depend on cultivating a workforce equipped with the skills, knowledge, and experience to meet the demands of a rapidly evolving green economy.

Current Plan Workforce Analysis

This section describes the current landscape of the Plan workforce in the Capital Region, examining job characteristics such as employment, wages, skill requirements, and demographics. The analysis establishes baseline conditions within the workforce ecosystem, facilitating the identification of opportunities and gaps and informing a preliminary workforce development strategy. For this analysis, the Plan workforce is defined as the workforce that is directly involved in implementing the Plan measures, and reference to the Plan workforce focuses on workers whose place of employment is within the Capital Region, irrespective of their place of residence. The terms clean, green, or climate jobs is used to refer to occupations that contribute directly to GHG emissions reductions, environmental sustainability, and climate resilience. In the context of implementation, this term specifically encompasses the workforce roles required to carry out the Plan measures, ranging from building retrofits and electrification to sustainable transportation, land management, and waste reduction.

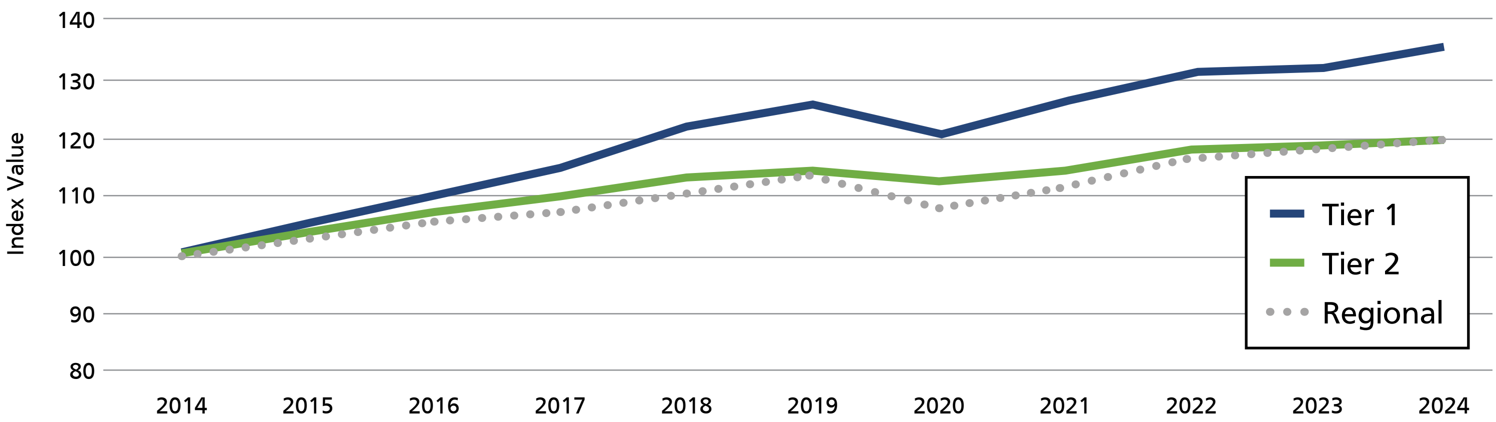
Occupational Profile

Employment

Figure 1 indexes employment growth for Plan occupations in the region compared to growth across all occupations within the region and the nation. Indexing provides a standardized comparison by establishing a common reference point and observing how employment changes over time relative to that point. For this analysis, 2014 was selected as the base period, and the common reference point was set to 100 for both climate-related and regional employment. An index value greater than 100 indicates growth, while an index value less than 100 indicates a decline.

Between 2015 and 2019, Plan employment and the region overall experienced consistent annual growth. Despite facing significant declines during the pandemic, both Plan and regional employment have since rebounded and have either returned to or are nearing pre-pandemic employment levels. Between 2020 and 2024, Tier 1 jobs grew at a faster rate compared to Tier 2 occupations and overall regional employment.

Figure 1. Indexed Employment Growth (Base 100 = 2014)[5]



In 2024, the Tier 1 workforce had an estimated 101,913 jobs, accounting for 68% of all Plan-related occupations and 8% of the total regional workforce. Overall, Tier 1 occupations experienced moderate growth in the last decade, with a 3.1% annual increase between 2014 and 2024. This growth exceeds the trends witnessed in the larger regional workforce, which increased by 1.8% annually in the same period. Within the Tier 1 workforce landscape, employment trends depict a diverse landscape of growth and stability with minimal decline (see Table 6). Traditionally stable roles such as Electricians and Plumbers continue to demonstrate resilience as employment levels have grown in the last ten years. In addition, several occupations have demonstrated explosive growth since 2014, including Solar PV Installers (23.7% annual growth), Electrical and Electronics Repairers (20.1% annual growth), First-Line Supervisors of Construction Trades and Extraction Workers (9.2% annual growth), and Hazardous Materials Removal Workers (8.9% annual growth).

Table 6. Tier 1 Annual Employment Growth by Occupation, 2014 – 2024[6]

SOC Code	Occupation	2014 Jobs	2024 Jobs	Annual Growth Rate	Percent change
49-9071	Maintenance and Repair Workers, General	7,257	9,187	2.4%	26.6%
47-2061	Construction Laborers	7,279	8,149	1.1%	11.9%
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	2,832	6,800	9.2%	140.1%
47-2073	Operating Engineers and Other Construction Equipment Operators	2,178	3,460	4.7%	58.9%
53-3032	Heavy and Tractor-Trailer Truck Drivers	7,666	14,283	6.4%	86.3%
11-9021	Construction Managers	1,957	3,132	4.8%	60.0%
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	3,039	3,719	2.0%	22.4%
51-4121	Welders, Cutters, Solderers, and Brazers	1,443	1,880	2.7%	30.3%
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	18,079	20,810	1.4%	15.1%
47-2111	Electricians	3,642	6,596	6.1%	81.1%
47-2231	Solar Photovoltaic Installers	104	872	23.7%	741.6%
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	48	299	20.1%	522.9%
47-3013	Helpers–Electricians	212	185	-1.4%	-13.0%
51-1011	First-Line Supervisors of Production and Operating Workers	2,095	2,332	1.1%	11.3%
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	1,593	1,691	0.6%	6.2%
47-2152	Plumbers, Pipefitters, and Steamfitters	2,890	3,644	2.3%	26.1%
43-5032	Dispatchers, Except Police, Fire, and Ambulance	1,293	1,535	1.7%	18.7%
47-4011	Construction and Building Inspectors	615	1,167	6.6%	89.7%

Table 6. Tier 1 Annual Employment Growth by Occupation, 2014 – 2024[6] (continued)

SOC Code	Occupation	2014 Jobs	2024 Jobs	Annual Growth Rate	Percent change
47-4041	Hazardous Materials Removal Workers	218	513	8.9%	135.6%
51-2098	Miscellaneous Assemblers and Fabricators	5,187	5,265	0.1%	1.5%
49-3023	Automotive Service Technicians and Mechanics	4,569	5,120	1.1%	12.1%
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	1,214	1,272	0.5%	4.8%
	Total Tier 1 Workforce	**75,409**	**101,913**	**3.1%**	**35.1%**
	Total Regional Workforce	**1,020,792**	**1,220,491**	**1.8%**	**19.6%**

In 2024, the Tier 2 workforce was substantially smaller than the Tier 1 workforce, with an estimated 49,022 jobs that account for 32% of all Plan occupations and 4% of the total regional workforce. Tier 2 occupations experienced stable growth in the last decade, with a 1.8% annual increase between 2014 and 2024, as summarized in Table 7. This growth mirrors trends observed in the larger regional workforce, which also increased by 1.8% annually in the same period. While the Tier 2 workforce has experienced overall growth, this growth is offset by job declines in certain occupations. Notably, Plumber Helpers, School Bus Drivers, Taxi Drivers, and Forest Fire Prevention Specialists demonstrated negative growth at -9%, -8%, -7%, and -5% respective annual growth rates. Other occupations, like Tree Trimers, First Line Supervisors of Firefighting and Prevention Workers, Electrical Power-line Installers, and First Line Supervisors of Transportation and Material Moving Workers demonstrated substantial annual growth ranging from 8% to 13% annual growth.

Table 7. Tier 2 Annual Employment Growth by Occupation, 2014 – 2024[7]

SOC Code	Occupation	2014 Jobs	2024 Jobs	Annual Growth Rate	Percent change
47-2051	Cement Masons and Concrete Finishers	1,459	2,758	6.6%	89.0%
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	667	1,327	7.1%	99.1%
17-3011	Architectural and Civil Drafters	798	955	1.8%	19.7%
17-3031	Surveying and Mapping Technicians	350	302	-1.5%	-14.0%
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	152	57	-9.2%	-62.1%
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	1,777	3,846	8.0%	116.4%
49-9051	Electrical Power-Line Installers and Repairers	482	1,066	8.3%	121.4%
51-8013	Power Plant Operators	293	195	-4.0%	-33.3%
51-8012	Power Distributors and Dispatchers	91	75	-1.9%	-17.8%

Table 7. Tier 2 Annual Employment Growth by Occupation, 2014 – 2024[7] (continued)

SOC Code	Occupation	2014 Jobs	2024 Jobs	Annual Growth Rate	Percent change
21-1093	Social and Human Service Assistants	3,965	4,453	1.2%	12.3%
11-9151	Social and Community Service Managers	1,332	2,331	5.8%	74.9%
11-9013	Farmers, Ranchers, and Other Agricultural Managers	1,382	1,524	1.0%	10.3%
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	252	721	11.1%	185.8%
37-3011	Landscaping and Groundskeeping Workers	8,596	8,340	-0.3%	-3.0%
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	7,168	6,201	-1.4%	-13.5%
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,001	3,360	5.3%	67.9%
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	1,043	1,166	1.1%	11.7%
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	913	1,105	1.9%	21.1%
51-8031	Water and Wastewater Treatment Plant and System Operators	858	1,054	2.1%	22.8%
37-3013	Tree Trimmers and Pruners	289	988	13.1%	241.9%
45-2099	Agricultural Workers, All Other	585	715	2.0%	22.4%
45-2091	Agricultural Equipment Operators	558	678	2.0%	21.7%
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	445	649	3.8%	45.8%
45-4011	Forest and Conservation Workers	493	393	-2.2%	-20.3%
45-4022	Logging Equipment Operators	185	118	-4.4%	-36.1%
33-9094	School Bus Monitors	67	95	3.6%	42.5%
33-2022	Forest Fire Inspectors and Prevention Specialists	56	35	-4.6%	-37.6%
53-3053	Shuttle Drivers and Chauffeurs	1,424	1,838	2.6%	29.1%
53-7081	Refuse and Recyclable Material Collectors	793	1,030	2.7%	29.9%
53-3052	Bus Drivers, Transit and Intercity	1,196	963	-2.1%	-19.5%
53-3051	Bus Drivers, School	1,457	648	-7.8%	-55.5%
53-3054	Taxi Drivers	65	33	-6.5%	-48.9%
	Total Tier 2 Workforce	**41,193**	**49,022**	**1.8%**	**19.0%**
	Total Region	**1,020,792**	**1,220,491**	**1.8%**	**19.6%**

Location Quotient

A location quotient (LQ) is a ratio used to measure the concentration of economic activity in one geographic area compared to a larger geographic unit. This section analyzes LQ to understand the relative concentration of the Plan workforce in the region compared to national employment trends. The LQ is calculated by comparing an occupation's local share of employment with its share of national employment to measure the concentration of Plan-related employment in the Sacramento-Roseville CSA. An occupation LQ is a way of quantifying how concentrated a specific occupation is compared to the nation. For example, if an occupation represented 1% of employment nationally, but 2% of employment within the region, its LQ would be 2.0. An LQ greater than 1 indicates a higher concentration relative to the national average, while an LQ less than 1 suggests the occupation is less concentrated than average and can indicate opportunity for growth.

The majority of Tier 1 occupations are underrepresented in the region, with LQs generally below 1.0. Notable examples include Substation Electrical and Electronics Repairers (LQ 0.2) and Electrician Helpers (LQ 0.4). These extremely low LQs suggest a significant shortage in specialized electrical trade, which could hinder progress across all sectors, especially those related to building and transportation decarbonization. Welders, Assemblers, and Truck Drivers are also underrepresented with LQs ranging from 0.5 to 0.6. This poses risks to supply chain, manufacturing, and logistics components of the Plan measures. Despite being core to many of the measures, Maintenance and Repair Workers (LQ 0.7) and Electricians (LQ 0.8) are also less concentrated than the national average. Tier 1 occupations with an LQ <1 are shown in red in Table 8.

However, there are some Tier 1 occupations that stand out as overrepresented, with LQs above 1.0, indicating a regional specialization. Notably, Solar PV Installers (LQ 2.0) are the most concentrated occupation of the Tier 1 workforce, suggesting a strong local workforce in solar energy installation, a major asset for solar energy deployment and building decarbonization. Moreover, Construction Laborers (LQ 1.1) and Construction Managers (LQ 1.1) are more prevalent than the national average, indicating a solid foundation for measures that involve building retrofits or infrastructure upgrades.

Table 8. Tier 1 Employment Concentration by Occupation[8]

SOC Code	Occupation	Regional LQ 2024
49-9071	Maintenance and Repair Workers, General	0.7
47-2061	Construction Laborers	1.1
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	0.7
47-2073	Operating Engineers and Other Construction Equipment Operators	0.8
53-3032	Heavy and Tractor-Trailer Truck Drivers	0.6
11-9021	Construction Managers	1.1
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	0.9
51-4121	Welders, Cutters, Solderers, and Brazers	0.5
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	1.0
47-2111	Electricians	0.8
47-2231	Solar Photovoltaic Installers	2.0
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	0.2
47-3013	Helpers–Electricians	0.4
51-1011	First-Line Supervisors of Production and Operating Workers	0.5

Table 8. Tier 1 Employment Concentration by Occupation[8] (continued)

SOC Code	Occupation	Regional LQ 2024
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	0.8
47-2152	Plumbers, Pipefitters, and Steamfitters	1.0
43-5032	Dispatchers, Except Police, Fire, and Ambulance	0.9
47-4011	Construction and Building Inspectors	0.9
47-4041	Hazardous Materials Removal Workers	0.7
51-2098	Miscellaneous Assemblers and Fabricators	0.5
49-3023	Automotive Service Technicians and Mechanics	0.9
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	0.6
49-9071	Maintenance and Repair Workers, General	0.7
47-2061	Construction Laborers	1.1
	Average	**0.8**

The regional labor market shows a moderately strong alignment with the needs of Tier 2 roles. The average LQ across these occupations is 1.12, indicating that, overall, the region has a slightly higher-than-average concentration of these roles compared to national trends. However, the data reveals a divergence between areas of strength and potential gaps that could impact the implementation of specific climate strategies.

Several Tier 2 occupations are significantly overrepresented, suggesting that the region has a strong existing workforce for these occupations. For example, Forest and Conservation Workers and Forest Fire Inspectors have extremely high LQs of 4.2 and 3.9, respectively, which indicate a regional specialization in forestry and wildfire prevention that can support measures related to forest fire prevention and clean up. Agricultural and landscaping roles, including Farmworkers (LQ 1.4), Landscaping Workers (LQ 1.3), and Agricultural Equipment Operators (LQ 1.1), are well-represented and support carbon farming and carbon sequestration projects and farm equipment electrification.

Despite the overall regional specialization, several occupations are underrepresented, posing potential bottlenecks for specific measures. Skilled trades and infrastructure roles, such as Plumber Helpers (LQ 0.4), Electrical Power-Line Installer (LQ 0.6), and Mobile Heavy Equipment Mechanics (LQ 0.7), show significant gaps in workforce concentration that could slow progress in energy infrastructure, water systems, and transportation upgrades. Other transportation services occupations such as School Bus Monitors (LQ 0.2), Taxi Drivers (LQ 0.5), and Transit Supervisors (LQ 0.6) are underrepresented, which may impact measures that focus on public transportation improvements. Further, emergency and utility services occupations like First-Line Supervisors of Firefighters (LQ 0.6) and Power Plant Operators (LQ 0.9) are slightly below average, which suggests a need for targeted recruitment and training to provide an adequate workforce for biomass energy generation and wildfire management. Tier 2 occupations with an LQ <1 are shown in red in Table 9.

Table 9. Tier 2 Employment Concentration by Occupation[9]

SOC Code	Occupation	Regional LQ 2024
47-2051	Cement Masons and Concrete Finishers	1.2
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	0.7
17-3011	Architectural and Civil Drafters	1.2
17-3031	Surveying and Mapping Technicians	0.9
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	0.4
53-1047	First-Line Supervisors of Transportation and Material Moving Workers	0.6
49-9051	Electrical Power-Line Installers and Repairers	0.6
51-8013	Power Plant Operators	0.9
51-8012	Power Distributors and Dispatchers	1.0
21-1093	Social and Human Service Assistants	1.3
11-9151	Social and Community Service Managers	1.3
11-9013	Farmers, Ranchers, and Other Agricultural Managers	1.1
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	0.6
37-3011	Landscaping and Groundskeeping Workers	1.3
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	1.4
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	1.0
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	1.0
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	1.2
51-8031	Water and Wastewater Treatment Plant and System Operators	1.0
37-3013	Tree Trimmers and Pruners	1.0
45-2099	Agricultural Workers, All Other	1.2
45-2091	Agricultural Equipment Operators	1.1
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	1.2
45-4011	Forest and Conservation Workers	4.2
45-4022	Logging Equipment Operators	0.9
33-9094	School Bus Monitors	0.2
33-2022	Forest Fire Inspectors and Prevention Specialists	3.9
53-3053	Shuttle Drivers and Chauffeurs	0.8
53-7081	Refuse and Recyclable Material Collectors	0.9
53-3052	Bus Drivers, Transit and Intercity	1.0
53-3051	Bus Drivers, School	0.4
53-3054	Taxi Drivers	0.5
	Average	**1.1**

Wages

In 2024, the median wage for all Tier 1 occupations associated with Plan measures was $35.75 (see Table 10). Workers across several key occupations such as Electrical and Electronics Repairers, Powerhouse, Substation, and Relay ($58.54), Construction and Building Inspectors ($48.27), and Construction Managers ($63.79) earned median wages above the regional median of $40.34 in 2024. However, other occupations, specifically Welders ($28.99) and Plumbers ($35.69), fell below this benchmark.

Between 2015 and 2024, most Tier 1 occupations experienced real wage gains, outpacing inflation. Notable increases were seen among Electrical and Electronics Repairers, Powerhouse, Substation, and Relay (+33%). These trends suggest that investments in renewable energy and electrification are translating into stronger wage outcomes for workers in these fields.

However, some occupations experienced real wage declines. Welders (-8%), Plumbers (-6%), and Construction Managers (-5%) experienced the most significant losses in purchasing power during this period. These declines may reflect wage stagnation in traditional construction trades or increased competition in sectors not yet fully integrated into climate-aligned project pipelines.

Table 10. Tier 1 Wage Growth by Occupation [10]

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024) [11]	2024 Hourly Wage	Annual Growth Rate	Percent Change (Nominal)	Percent Change in Real Wage [12]
49-9071	Maintenance and Repair Workers, General	$19.80	$26.53	$27.30	3%	38%	3%
47-2061	Construction Laborers	$20.71	$27.75	$30.98	4%	50%	12%
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	$36.22	$48.53	$48.90	3%	35%	1%
47-2073	Operating Engineers and Other Construction Equipment Operators	$30.97	$41.49	$44.39	4%	43%	7%
53-3032	Heavy and Tractor-Trailer Truck Drivers	$19.37	$25.96	$29.13	4%	50%	12%
11-9021	Construction Managers	$49.92	$66.89	$63.79	2%	28%	-5%
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	$33.65	$45.09	$45.02	3%	34%	0%
51-4121	Welders, Cutters, Solderers, and Brazers	$23.60	$31.63	$28.99	2%	23%	-8%
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	$13.81	$18.51	$21.69	5%	57%	17%
47-2111	Electricians	$29.03	$38.90	$39.79	3%	37%	2%
47-2231	Solar Photovoltaic Installers	$19.57	$26.22	$32.23	5%	65%	23%
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	$35.01	$46.91	$58.54	5%	67%	25%

Table 10. Tier 1 Wage Growth by Occupation[10] (continued)

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024) [11]	2024 Hourly Wage	Annual Growth Rate	Percent Change (Nominal)	Percent Change in Real Wage [12]
47-3013	Helpers–Electricians	$15.53	$20.81	$24.56	5%	58%	18%
51-1011	First-Line Supervisors of Production and Operating Workers	$28.20	$37.78	$39.50	3%	40%	5%
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	$24.57	$32.93	$33.44	3%	36%	2%
47-2152	Plumbers, Pipefitters, and Steamfitters	$28.40	$38.05	$35.69	2%	26%	-6%
43-5032	Dispatchers, Except Police, Fire, and Ambulance	$17.49	$23.43	$27.22	5%	56%	16%
47-4011	Construction and Building Inspectors	$33.40	$44.76	$48.27	4%	45%	8%
47-4041	Hazardous Materials Removal Workers	$22.79	$30.54	$29.49	3%	29%	-3%
51-2098	Miscellaneous Assemblers and Fabricators	$13.77	$18.45	$22.21	5%	61%	20%
49-3023	Automotive Service Technicians and Mechanics	$22.06	$29.56	$31.70	4%	44%	7%
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	$16.94	$22.70	$23.58	3%	39%	4%
	Tier 1 Workforce	**$25.22**	**$33.79**	**$35.75**	**4%**	**42%**	**6%**
	Total Region	**$28.76**	**$38.54**	**$40.34**	**3%**	**40%**	**5%**

Table 11 summarizes wage growth for Tier 2 occupations. In 2024, the median wage for all Tier 2 occupations was $35.75, slightly below the regional median of $40.34. However, several specialized occupations, such as Power Distributors and Dispatchers ($81.61), Electrical Power-Line Installers and Repairers ($52.83), and First-Line Supervisors of Firefighting and Prevention Workers ($69.63), earned wages well above this benchmark. These roles are critical to the successful deployment and operation of biomass energy infrastructure, supporting the resilience and reliability of energy systems.

Between 2015 and 2024, most Tier 2 occupations experienced real wage growth. Notable gains were seen in roles tied to land stewardship and energy operations. Power Distributors and Dispatchers saw a real wage increase of 31%, while Farmworkers and Laborers in crop, nursery, and greenhouse settings and Logging Equipment Operators each experienced an increase of 35%. These gains reflect growing demand for labor in sectors like regenerative agriculture, forestry management, and distributed energy systems, which support specific climate adaptation and mitigation goals.

However, some Tier 2 occupations experienced real wage declines. Electrical Power-Line Installers and Repairers saw a decline of 24%, Surveying and Mapping Technicians declined by 18%, and Social and Community Service Managers by 9%. These declines may signal a need to modernize training pipelines and compensation structures for occupations that are essential to climate mitigation and adaptation but may be undervalued or under-integrated in current workforce systems.

Table 11. Tier 2 Wage Growth by Occupation [13]

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024) [14]	2024 Hourly Wage	Annual Growth Rate	Percent Change (Nominal)	Percent Change in Real Wage [15]
47-2051	Cement Masons and Concrete Finishers	$21.53	$28.85	$33.16	4%	54%	15%
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	$25.42	$34.06	$36.40	4%	43%	7%
17-3011	Architectural and Civil Drafters	$26.28	$35.22	$36.90	3%	40%	5%
17-3031	Surveying and Mapping Technicians	$32.93	$44.12	$36.31	1%	10%	-18%
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	$16.58	$22.22	$24.44	4%	47%	10%
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	$25.61	$34.32	$32.31	2%	26%	-6%
49-9051	Electrical Power-Line Installers and Repairers	$51.68	$69.25	$52.83	0%	2%	-24%
51-8013	Power Plant Operators	$46.92	$62.88	$68.37	4%	46%	9%
51-8012	Power Distributors and Dispatchers	$49.53	$66.37	$81.61	5%	65%	23%

Table 11. Tier 2 Wage Growth by Occupation[13] (continued)

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024) [14]	2024 Hourly Wage	Annual Growth Rate	Percent Change (Nominal)	Percent Change in Real Wage [15]
21-1093	Social and Human Service Assistants	$18.63	$24.97	$27.14	4%	46%	9%
11-9151	Social and Community Service Managers	$35.45	$47.50	$43.33	2%	22%	-9%
11-9013	Farmers, Ranchers, and Other Agricultural Managers	$23.73	$31.79	$29.51	2%	24%	-7%
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	$45.84	$61.42	$69.63	4%	52%	13%
37-3011	Landscaping and Groundskeeping Workers	$13.85	$18.57	$22.39	5%	62%	21%
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	$10.32	$13.83	$17.44	5%	69%	26%
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$23.84	$31.94	$34.87	4%	46%	9%
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	$12.39	$16.60	$18.58	4%	50%	12%
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	$26.81	$35.93	$32.60	2%	22%	-9%
51-8031	Water and Wastewater Treatment Plant and System Operators	$31.19	$41.80	$42.45	3%	36%	2%
37-3013	Tree Trimmers and Pruners	$22.19	$29.74	$29.39	3%	32%	-1%
45-2099	Agricultural Workers, All Other	$16.42	$22.00	$22.22	3%	35%	1%
45-2091	Agricultural Equipment Operators	$13.55	$18.16	$19.73	4%	46%	9%
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	$19.33	$25.90	$27.25	3%	41%	5%
45-4011	Forest and Conservation Workers	$13.26	$17.77	$20.67	5%	56%	16%

Table 11. Tier 2 Wage Growth by Occupation[13] (continued)

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024) [14]	2024 Hourly Wage	Annual Growth Rate	Percent Change (Nominal)	Percent Change in Real Wage [15]
45-4022	Logging Equipment Operators	$19.41	$26.01	$32.84	5%	69%	26%
33-9094	School Bus Monitors	$15.46	$20.71	$20.02	3%	30%	-3%
33-2022	Forest Fire Inspectors and Prevention Specialists	$34.56	$46.31	$48.39	3%	40%	4%
53-3053	Shuttle Drivers and Chauffeurs	$15.51	$20.79	$20.02	3%	29%	-4%
53-7081	Refuse and Recyclable Material Collectors	$21.74	$29.13	$30.04	3%	38%	3%
53-3052	Bus Drivers, Transit and Intercity	$22.07	$29.58	$27.58	2%	25%	-7%
53-3051	Bus Drivers, School	$15.42	$20.67	$27.16	6%	76%	31%
	Tier 2 Workforce	**$24.49**	**$32.82**	**$33.88**	**3%**	**38%**	**3%**
	Total Region	**$28.76**	**$38.54**	**$40.34**	**3%**	**40%**	**5%**

Demographics

Age

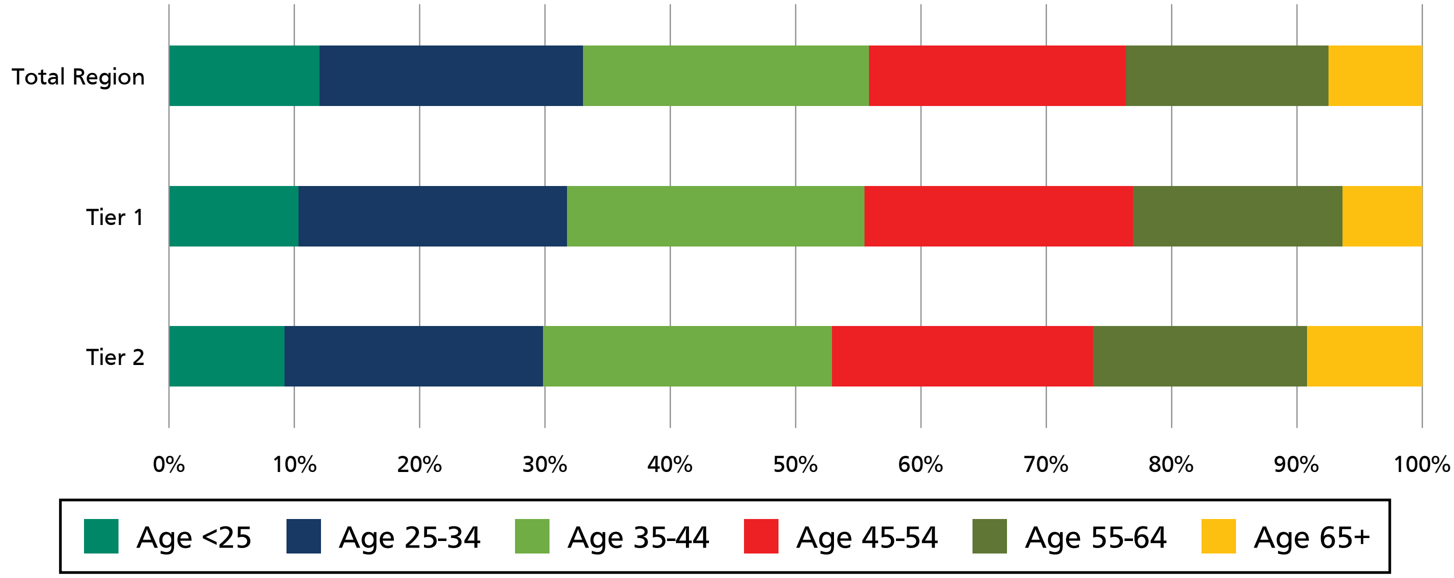
Compared to the total regional workforce, Plan-related occupations have a higher concentration of workers in the 25–44 age range and a lower share of workers under 25 (Figure 2). Interestingly, the regional average shows a higher proportion of workers aged 65+ (16%) than either tier, suggesting that climate-related roles may be less common among retirement-age workers than in the broader labor market.

Tier 1 occupations are predominantly filled by workers in their prime working years (ages 25–54), who account for 67% of the workforce. The largest share is among those aged 35–44 (24%), followed closely by those aged 25–34 (22%) and 45–54 (21%). Workers under 25 make up 10% of the Tier 1 workforce, suggesting some early-career entrants, although this is lower than the 12% composition in the regional workforce. While older workers aged 55 and above comprise 23% of Tier 1 workers, this share is slightly smaller than the regional workforce composition of 24% of workers.

Tier 2 occupations show a similar age profile, with 64% of workers between 25 and 54. Notably, Tier 2 has a higher share of workers aged 55 and older (26%) compared to Tier 1 (23%) and to the regional workforce (24%), which may reflect roles that are more accessible or appealing to older workers. The share of workers under 25 is slightly lower than in Tier 1 and the broader region at 9%.

Across the board, the Plan workforce age distribution highlights a strong reliance on mid-career talent in climate-related roles, with a potential need for outreach through K-12 education to support recruitment and long-term workforce sustainability, as older, more experienced workers begin to retire.

Figure 2. Plan Workforce Age Distribution[16]



Race

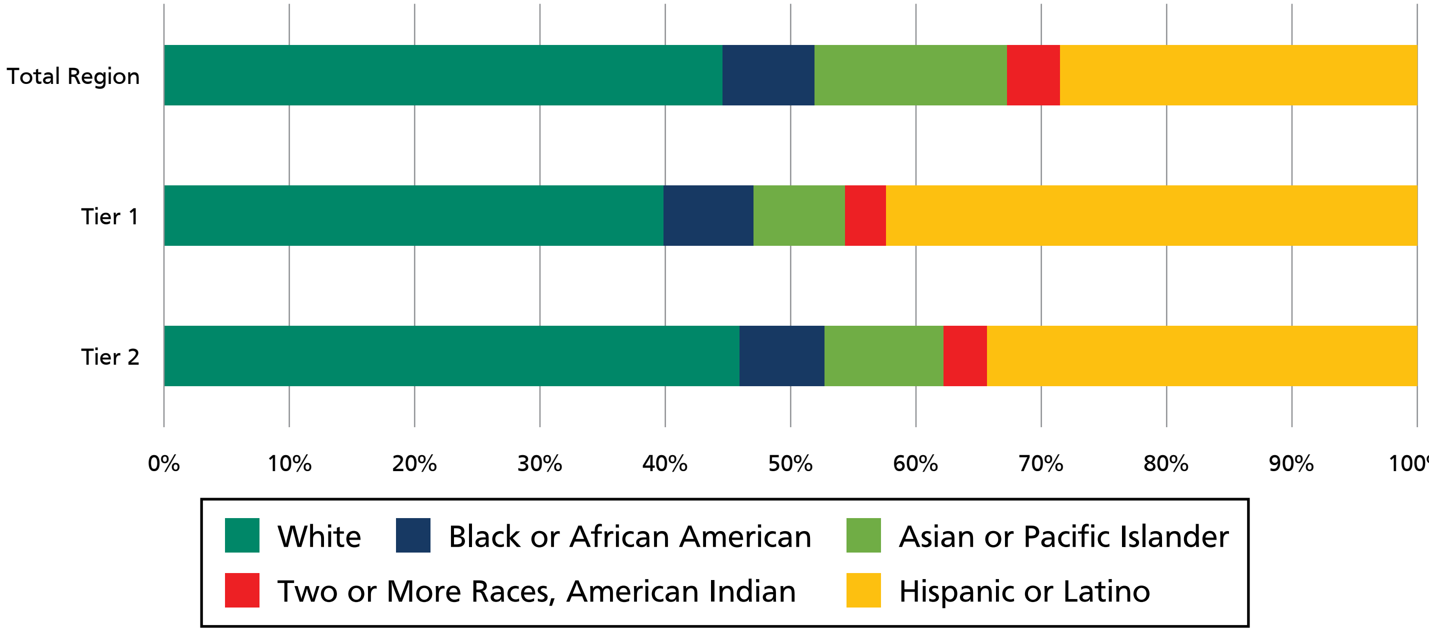
As shown in Figure 3, both Tier 1 and Tier 2 occupations differ notably from the broader regional workforce in terms of racial and ethnic composition. While the Plan workforce is racially and ethnically diverse, representation varies across both groups and occupational tiers.

Hispanic or Latino workers are more represented in both tiers, comprising 42% of Tier 1 and 34% of Tier 2 roles, compared to 28% regionally. White workers make up a slightly larger share in Tier 2 (46%) and a smaller share in Tier 1 (40%), slightly below the regional average of 45%.

Asian and Pacific Islander workers are underrepresented in both tiers, with 7% in Tier 1 and 10% in Tier 2, compared to higher regional levels. Black or African American workers make up 7% in both tiers, aligning with the regional average. However, this consistency still reflects broader underrepresentation in the Plan workforce. Workers identifying as two or more races or American Indian represent 3% in both tiers, slightly below the regional average of 4%.

Overall, Tier 1 roles are less diverse than both Tier 2 roles and the broader regional workforce. However, both Tiers show particularly strong participation from Hispanic or Latino workers, reflecting historical patterns of labor force participation in sectors such as construction, transportation, and agriculture. While Tier 2 occupations demonstrate greater representation across races and are more closely aligned with the regional labor market, they still show low participation of Asian and Black workers. This consistent underrepresentation of Asian and Black workers across tiers points to a potential area for targeted outreach and inclusion efforts.

Figure 3. Plan Workforce Race and Ethnicity Breakdown[17]



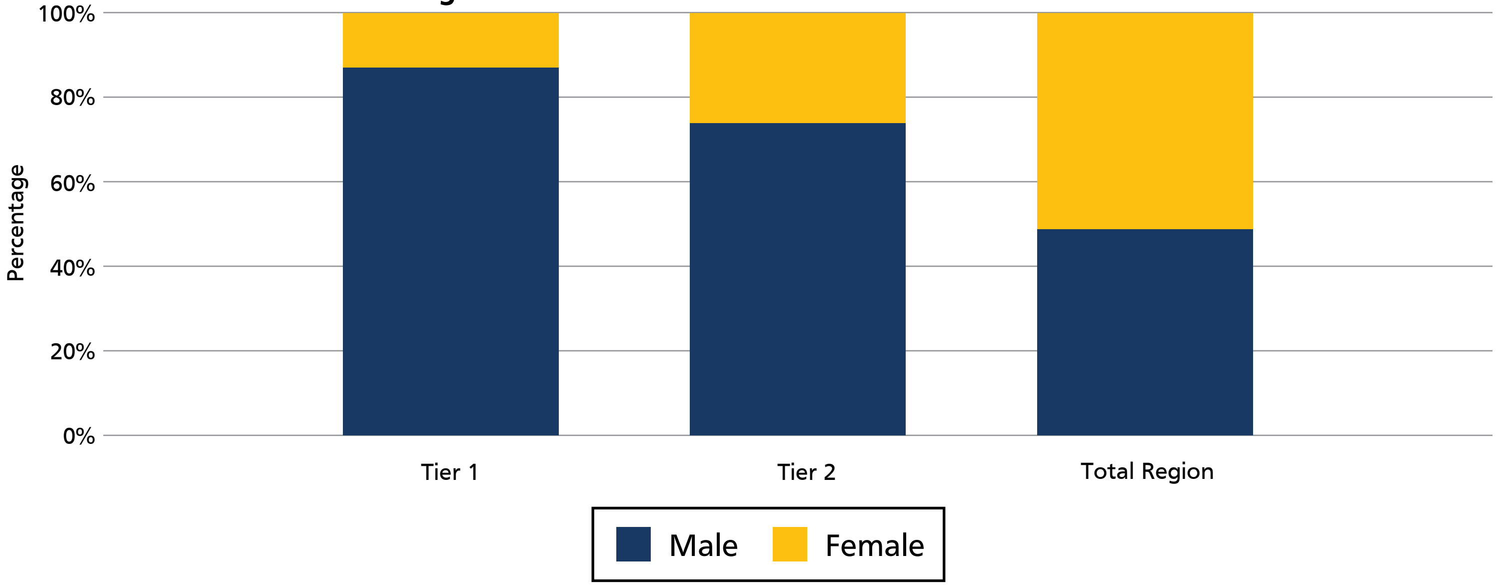
Gender

Compared to the broader regional workforce, the Plan workforce is significantly more male-dominated. While the regional workforce is nearly gender-balanced, with females slightly outnumbering males (51% vs 49%), Plan measure implementation roles show a stark contrast (Figure 4). This gender disparity underscores the need for targeted strategies to recruit, train, and retain women in Plan-related careers, particularly in cross-cutting occupations where the gender gap is most severe.

Tier 1 occupations, described in Table 12, show the most pronounced gender imbalance. With males comprising 87% of the workforce, women are significantly underrepresented at 13%. This suggests that Tier 1 roles may face persistent barriers to entry for women, including limited access to training, mentorship, or inclusive workplace environments.

Tier 2 occupations are somewhat more gender-diverse but still skew heavily male. Males make up 74% of the Tier 2 workforce, while females account for 26%. Although this represents a modest improvement over Tier 1, it still falls far short of the gender balance seen in the broader regional workforce.

Figure 4. Plan Workforce Gender Distribution[18]



Training
This section provides an overview of the typical education and training requirements associated with Tier 1 and Tier 2 occupations. The data is sourced from the Occupational Information Network (O*NET), a comprehensive database developed by the U.S. Department of Labor. O*NET compiles detailed information on job characteristics, including education, on-the-job training (OJT), and work experience requirements for each occupation. This information helps contextualize workforce readiness and identify potential barriers to entry or advancement within Plan-related job pathways.

Tier 1 occupations, described in Table 12, are generally characterized by relatively low barriers to entry, though in general they exhibit a diverse range of opportunities for individuals at various career stages. Many roles provide accessible entry points with minimal educational requirements and short training periods, while others offer structured pathways into more technical or supervisory positions.

Most Tier 1 occupations require only a high school diploma or equivalent, paired with short- to moderate-term OJT. For example, roles such as Construction Laborers, Truck Drivers, and Welders typically involve OJT periods ranging from one to six months. This combination of minimal formal education and brief training makes these positions ideal for individuals entering the workforce or transitioning from other industries.

Some occupations, such as Electrician Helpers and Plumbers, Pipefitters, and Steamfitters, are notable exceptions. While they have low educational requirements, they demand extensive OJT, often lasting four to ten years. These extended training periods are likely to reflect structured apprenticeship programs that pair employment with classroom training to emphasize hands-on learning, skill development, and employment retention.

Other Tier 1 roles, including Electricians, Plumbers, Electrical and Electronics Repairers, and Bus and Truck Mechanics require post-secondary certificates and moderate- to long-term OJT, typically spanning one to ten years. These jobs, while still accessible, involve more intensive preparation due to the technical and safety-critical nature of the work.

Higher educational and training prerequisites are generally associated with roles that demand specialized skills and knowledge. For instance, Construction Managers typically hold a bachelor’s degree and undergo two to four years of OJT, reflecting the advanced competencies required for leadership and project oversight.

Interestingly, some roles reveal a mismatch between training duration and skill demands. Electrician Helpers, for example, undergo long-term training but may not require high levels of specialized knowledge. Conversely, roles like Solar Photovoltaic Installers and Dispatchers require only short-term training but may involve more technical or specialized tasks.

Table 12. Tier 1 Occupations Required Training and Education Profile[19]

SOC Code	Description	Required Education Level	OJT Requirements
49-9071	Maintenance and Repair Workers, General	Post-Secondary Certificate	1 – 3 Months
47-2061	Construction Laborers	High School Diploma or Equivalent	3 – 6 Months
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	Post-Secondary Certificate	6 Months – 1 Year
47-2073	Operating Engineers and Other Construction Equipment Operators	High School Diploma or Equivalent	Up To 1 Month
53-3032	Heavy and Tractor-Trailer Truck Drivers	High School Diploma or Equivalent	Up To 1 Month
11-9021	Construction Managers	Bachelor's Degree	2 – 4 Years
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	High School Diploma or Equivalent	3 – 6 Months
51-4121	Welders, Cutters, Solderers, and Brazers	High School Diploma or Equivalent	1 – 3 Months
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	High School Diploma or Equivalent	1 – 3 Months
47-2111	Electricians	Post-Secondary Certificate	4 – 10 Years
47-2231	Solar Photovoltaic Installers	Post-Secondary Certificate	Up To 1 Month
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	Post-Secondary Certificate	2 – 4 Years
47-3013	Helpers–Electricians	High School Diploma or Equivalent	4 – 10 Years
51-1011	First-Line Supervisors of Production and Operating Workers	High School Diploma or Equivalent	3 – 6 Months
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	Post-Secondary Certificate	1 – 2 Years
47-2152	Plumbers, Pipefitters, and Steamfitters	Post-Secondary Certificate	4 – 10 Years
43-5032	Dispatchers, Except Police, Fire, and Ambulance	High School Diploma or Equivalent	1 – 3 Months
47-4011	Construction and Building Inspectors	High School Diploma or Equivalent	3 – 6 Months
47-4041	Hazardous Materials Removal Workers	Less than a High School Diploma	6 Months – 1 Year
51-2098	Miscellaneous Assemblers and Fabricators	*	*
49-3023	Automotive Service Technicians and Mechanics	Post-Secondary Certificate	6 Months – 1 Year
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	*	*

Note: Asterisks (*) indicate occupations for which education and training data are unavailable

Tier 2 roles span a wide spectrum of educational and training requirements, summarized in Table 13. Many occupations offer accessible entry points with minimal prerequisites, while others provide structured pathways into more technical or supervisory roles. A significant portion of these roles require no more than a high school diploma or equivalent. For example, Cement Masons and Concrete Finishers, Landscaping and Groundskeeping Workers, and Agricultural Equipment Operators typically require less than a high school diploma and offer OJT durations ranging from none to just one month. These roles are particularly accessible to individuals with limited formal education and provide immediate entry into the workforce. Other occupations, such as Electrical Power-Line Installers and Repairers or Heating, Air Conditioning, and Refrigeration Mechanics and Installers, involve longer OJT periods often extending from four to ten years and potentially require post-secondary certificates. These roles demand more intensive training due to the technical complexity and safety considerations involved.

Some positions, like Power Plant Operators and Water and Wastewater Treatment Plant Operators, require only a high school diploma but involve longer OJT periods of up to four years. This suggests that while formal education requirements are modest, the roles themselves require significant hands-on experience and skill development. There are also roles that require a bachelor's degree, such as Social and Human Service Assistants and Social and Community Service Managers. These positions typically involve shorter OJT durations, ranging from one to six months, but reflect a higher baseline of academic preparation, often tied to administrative or supervisory responsibilities within climate-related services.

Table 13. Tier 2 Occupations Required Training and Education Profile[20]

SOC Code	Description	Required Education Level	OJT Requirements
47-2051	Cement Masons and Concrete Finishers	Less than a High School Diploma	Up To 1 Month
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	Post-Secondary Certificate	6 Months - 1 Year
17-3011	Architectural and Civil Drafters	*	*
17-3031	Surveying and Mapping Technicians	*	*
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	High School Diploma or Equivalent	3 - 6 Months
53-1047	First-Line Supervisors of Transportation and Material Moving Workers	*	*
49-9051	Electrical Power-Line Installers and Repairers	High School Diploma or Equivalent	4 - 10 Years
51-8013	Power Plant Operators	High School Diploma or Equivalent	2 - 4 Years
51-8012	Power Distributors and Dispatchers	Post-Secondary Certificate	1 - 2 Years
21-1093	Social and Human Service Assistants	Bachelor's Degree	1 - 3 Months
11-9151	Social and Community Service Managers	Bachelor's Degree	6 Months - 1 Year
11-9013	Farmers, Ranchers, and Other Agricultural Managers	*	*
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	High School Diploma or Equivalent	1 - 3 Months
37-3011	Landscaping and Groundskeeping Workers	Less than a High School Diploma	None

Table 13. Tier 2 Occupations Required Training and Education Profile[20] (continued)

SOC Code	Description	Required Education Level	OJT Requirements
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	Less than a High School Diploma	Up To 1 Month
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Post-Secondary Certificate	4 - 10 Years
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	Some College, No Degree	6 Months - 1 Year
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	Bachelor's Degree	Up To 1 Month
51-8031	Water and Wastewater Treatment Plant and System Operators	High School Diploma or Equivalent	6 Months - 1 Year
37-3013	Tree Trimmers and Pruners	Less than a High School Diploma	6 Months - 1 Year
45-2099	Agricultural Workers, All Other	*	*
45-2091	Agricultural Equipment Operators	Less than a High School Diploma	Up To 1 Month
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	Bachelor's Degree	6 Months - 1 Year
45-4011	Forest and Conservation Workers	High School Diploma or Equivalent	Up To 1 Month
45-4022	Logging Equipment Operators	Less than a High School Diploma	1 - 3 Months
33-9094	School Bus Monitors	*	*
33-2022	Forest Fire Inspectors and Prevention Specialists	High School Diploma or Equivalent	1 - 2 Years
53-3053	Shuttle Drivers and Chauffeurs	*	*
53-7081	Refuse and Recyclable Material Collectors	High School Diploma or Equivalent	Up To 1 Month
53-3052	Bus Drivers, Transit and Intercity	High School Diploma or Equivalent	1 - 3 Months
53-3051	Bus Drivers, School	*	*
53-3054	Taxi Drivers	*	*

Note: Asterisks (*) indicate occupations for which education and training data are unavailable

Quadrant Analysis

This section uses a quadrant analysis to evaluate Plan occupation wage levels relative to the required training and experience of workers entering these fields. Occupations are categorized by earnings relative to the average regional living wage ($31.90 per hour) and standardized metrics of training and skills derived from O*NET data that were normalized into percentiles and combined into a weighted final score for each occupation. [21] The results for Tier 1 and Tier 2 are summarized in Figures 5 and 6, respectively.

A significant number of Tier 1 occupations, such as Construction Managers, Building Inspectors, and Plumbers, require high levels of training and experience but offer wages above the regional living wage. These occupations present a prime opportunity to build a stable, well-compensated workforce that can anchor long-term climate action across multiple workforce sectors.

Conversely, two Tier 1 occupations, Solar PV Installers and Operating and Construction Equipment Engineers, require relatively low levels of training yet offer wages above the living wage. These roles are ideal for rapid workforce scaling and can serve as entry points into the green economy.

However, there is a concentration of Tier 1 occupations that have both low training requirements and wages below the regional living wage. While these roles may be easier to fill due to lower entry barriers, they are often unattractive due to safety concerns and poor compensation.

Notably, one Tier 1 occupation, Electrician Helpers, requires significant training but offers non-commensurate wages. This mismatch presents a critical bottleneck: although the role is foundational to many workforce sectors and Plan measures, low compensation may deter new entrants and lead to attrition among experienced workers.

Figure 5. Workforce Quadrant Analysis, Tier 1 Occupations [22]

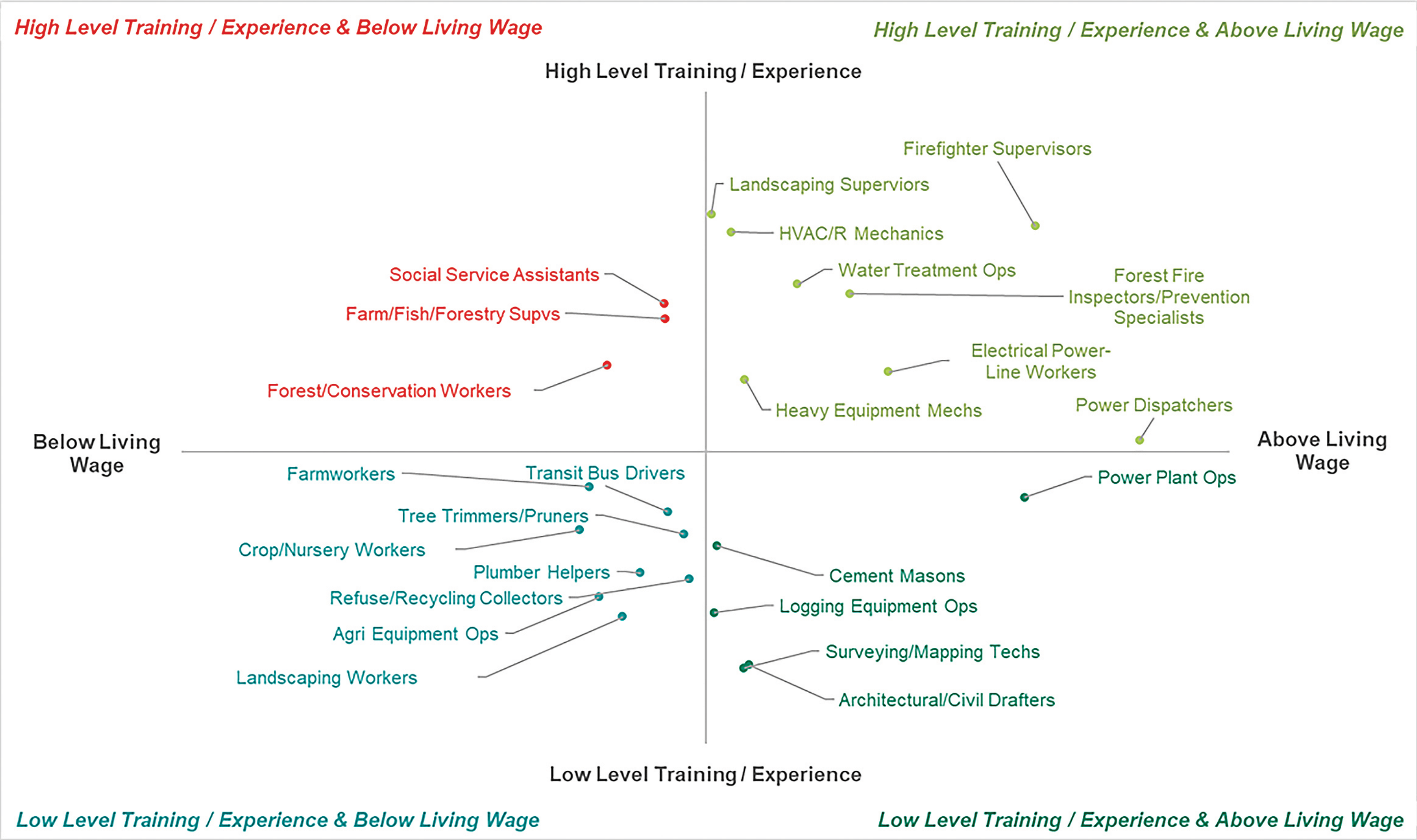
Several Tier 2 occupations, such as Social Service Assistance; Supervisors of Farm, Fish, and Forestry Workers; and Forest and Conservation Workers require significant training and experience but offer wages below the regional living wage. These roles are vital for carbon sequestration and solid waste reduction initiatives, yet their compensation levels may deter entry and retention.

Other occupations such as Firefighter Supervisors, Landscaping Supervisors, HVAC/R Mechanics, and Water Treatment Operators offer both high wages and require advanced training. These roles are well-positioned to support climate action related to fire prevention, building decarbonization, and water/wastewater system decarbonization. Their commensurate compensation levels make them attractive career paths and strong candidates for long-term workforce investment.

Roles such as Transit Bus Drivers, Plumber Helpers, and Refuse Collectors are accessible to a broader base of the labor pool due to low training requirements but are underpaid relative to the living wage. While they can serve as entry points for the Plan workforce, their low wages and limited advancement opportunities may contribute to high turnover or recruitment challenges.

Unlike Tier 1, there is a sizeable group of Tier 2 occupations, including Cement Masons, Surveying/Mapping Technicians, and Power Plant Operators that require relatively low training but offer wages above the living wage. These roles are ideal for rapid workforce scaling in sectors like natural and working lands and transportation and mobility.

Figure 6. Workforce Quadrant Analysis, Tier 2 Occupations[23]



Workforce Gap Analysis

This analysis compares projected employment in 2032 with anticipated job openings across Plan occupations. A positive value indicates a labor surplus (fewer job openings than projected employment), while a negative value indicates a labor shortage (more job openings than projected employment). Employment projection data was sourced from the state of California's Economic Development Department (EDD), which provides occupation-level forecasts and labor demand statistics from 2022 to 2032 using SOC codes.[24] It is important to note that four Plan occupations are not represented in the EDD dataset; as a result, a workforce gap analysis could not be conducted for those roles (Miscellaneous Assemblers and Fabricators; Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters; School Bus Monitors; Forest Fire Inspectors and Prevention Specialists).

By 2032, the broader Tier 1 workforce is projected to face a net shortage of 3,526 workers as described in Table 14. However, this aggregate figure is heavily influenced by the acute shortage from two occupations: Laborers and Freight, Stock, and Materials Movers, which alone accounts for a projected shortage of 8,344 workers, and Heavy and Tractor-Trailer Truck Drivers with a projected shortage of 1,159 workers. When this occupation is excluded, the remaining Tier 1 occupations collectively show a modest labor surplus. This suggests that, outside of transportation and material moving occupations, the labor supply may be sufficient or even exceed projected demand in many Plan occupations. Still, several occupations are projected to face meaningful shortages. Electrical, Electronic, and Electromechanical Assemblers are expected to fall short by 134 workers, and Construction and Building Inspectors (-154) show a notable gap.

Conversely, several occupations are projected to have labor surpluses. First-Line Supervisors of Construction Trades and Extraction Workers are expected to exceed demand by 1,113 workers, while Construction Managers show a surplus of 1,076. Construction Laborers (860), Maintenance and Repair Workers (607), and Supervisors of Mechanics and Installers (546) also show positive gaps. These surpluses may reflect a mismatch between training pipelines and actual job openings, or even a lag in demand for supervisory roles relative to frontline labor. Overall, the gap analysis points to a dual challenge: addressing acute shortages in high-demand roles while also supporting workers in surplus occupations through upskilling and transition pathways.

Table 14. Tier 1 Workforce Gap Analysis by Occupation[25]

SOC Code	Description	Labor Supply				Labor Demand	
		2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
49-9071	Maintenance and Repair Workers, General	8,622	9,234	1%	7%	8,627	607
47-2061	Construction Laborers	11,149	13,055	2%	17%	12,194	860
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	6,761	7,615	1%	13%	6,502	1,113

Table 14. Tier 1 Workforce Gap Analysis by Occupation[25] (continued)

SOC Code	Description	Labor Supply: 2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	Labor Demand: 2032 Job Openings	2032 Surplus or Shortage
47-2073	Operating Engineers and Other Construction Equipment Operators	3,410	3,854	1%	13%	3,484	370
53-3032	Heavy and Tractor-Trailer Truck Drivers	13,630	14,842	1%	9%	16,001	(1,159)
11-9021	Construction Managers	4,307	4,872	1%	13%	3,796	1,076
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	3,760	4,088	1%	9%	3,542	546
51-4121	Welders, Cutters, Solderers, and Brazers	1,762	2,029	1%	15%	2,109	(80)
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	21,290	24,664	1%	16%	33,008	(8,344)
47-2111	Electricians	6,455	7,488	1%	16%	7,107	381
47-2231	Solar Photovoltaic Installers	730	1,060	4%	45%	1,110	(50)
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	160	180	1%	13%	170	10
47-3013	Helpers–Electricians	220	230	0%	5%	260	(30)
51-1011	First-Line Supervisors of Production and Operating Workers	2,463	2,684	1%	9%	2,600	84

Table 14. Tier 1 Workforce Gap Analysis by Occupation[25] (continued)

SOC Code	Description	Labor Supply				Labor Demand	
		2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	1,980	2,073	0%	5%	1,762	311
47-2152	Plumbers, Pipefitters, and Steamfitters	3,607	4,032	1%	12%	3,681	351
43-5032	Dispatchers, Except Police, Fire, and Ambulance	1,492	1,562	0%	5%	1,489	74
47-4011	Construction and Building Inspectors	1,039	1,069	0%	3%	1,223	(154)
47-4041	Hazardous Materials Removal Workers	370	390	1%	5%	430	(40)
51-2098	Miscellaneous Assemblers and Fabricators	*	*	*	*	*	*
49-3023	Automotive Service Technicians and Mechanics	4,838	5,016	0%	4%	4,334	682
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	1,069	1,209	1%	13%	1,343	(134)
	Tier 1 Workforce	**99,115**	**111,248**	**1%**	**12%**	**114,774**	**(3,526)**
	Total Region	**1,184,280**	**1,297,691**	**1%**	**10%**	**1,482,215**	**(184,523)**

Note: Asterisks (*) represent values not calculated as data for the occupation is unavailable.

By 2032, the broader Tier 2 workforce is projected to face a net shortage of 11,604 workers as illustrated in Table 15. Within this shortage, there are several occupations that are projected to face significant labor shortages. The most severe shortage is among Landscaping and Groundskeeping Workers with a projected shortage of 4,641 workers, and Farmworkers and Laborers, Crop, Nursery, and Greenhouse with a projected shortage of 4,392 workers. Notable shortages are also projected in roles such as Shuttle Drivers and Chauffeurs (–623), Tree Trimmers and Pruners (–490), and Social and Human Service Assistants (–331). These occupations are essential to the delivery of ridesharing programs, community-based composting services, and wildfire management, highlighting the need for targeted workforce investments in both technical and service-oriented roles.

At the same time, several occupations are projected to have labor surpluses. Cement Masons and Concrete Finishers are expected to exceed demand by 655 workers, while Heating, Air Conditioning, and Refrigeration Mechanics and Installers show a surplus of 417. Other occupations with modest surpluses include Electrical Power-Line Installers and Repairers (131) and Water and Wastewater Treatment Plant Operators (121). These surpluses may reflect a lag in demand for specialized roles or a misalignment between training pipelines and actual job openings.

Table 15. Tier 2 Workforce Gap Analysis by Occupation[26]

		Labor Supply				Labor Demand	
SOC Code	Description	2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
47-2051	Cement Masons and Concrete Finishers	2,999	3,282	1%	9%	2,628	655
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	1,210	1,336	1%	10%	1,171	165
17-3011	Architectural and Civil Drafters	876	999	1%	14%	989	10
17-3031	Surveying and Mapping Technicians	446	509	1%	14%	627	(117)
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	*	*	*	*	*	*
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	3,769	4,104	1%	9%	4,261	(157)

Table 15. Tier 2 Workforce Gap Analysis by Occupation[26] (continued)

SOC Code	Description	Labor Supply				Labor Demand	
		2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
49-9051	Electrical Power-Line Installers and Repairers	849	1,060	2%	25%	929	131
51-8013	Power Plant Operators	192	202	1%	5%	168	34
51-8012	Power Distributors and Dispatchers	110	120	1%	9%	100	20
21-1093	Social and Human Service Assistants	3,861	4,405	1%	14%	4,736	(331)
11-9151	Social and Community Service Managers	1,878	2,196	2%	17%	1,895	301
11-9013	Farmers, Ranchers, and Other Agricultural Managers	7,648	7,434	0%	-3%	7,582	(148)
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	685	675	0%	-1%	403	272
37-3011	Landscaping and Groundskeeping Workers	11,415	13,790	2%	21%	18,431	(4,641)
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	9,102	9,240	0%	2%	13,632	(4,392)
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	3,864	4,425	1%	15%	4,008	417
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	523	533	0%	2%	789	(256)

Table 15. Tier 2 Workforce Gap Analysis by Occupation[26] (continued)

SOC Code	Description	Labor Supply				Labor Demand	
		2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	2,723	3,361	2%	23%	3,714	(354)
51-8031	Water and Wastewater Treatment Plant and System Operators	1,043	955	-1%	-8%	834	121
37-3013	Tree Trimmers and Pruners	1,110	1,420	2%	28%	1,910	(490)
45-2099	Agricultural Workers, All Other	140	140	0%	0%	200	(60)
45-2091	Agricultural Equipment Operators	781	876	1%	12%	1,322	(446)
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	694	741	1%	7%	981	(240)
45-4011	Forest and Conservation Workers	380	340	-1%	-11%	600	(260)
45-4022	Logging Equipment Operators	121	121	0%	0%	172	(51)
33-9094	School Bus Monitors	*	*	*	*	*	*
33-2022	Forest Fire Inspectors and Prevention Specialists	*	*	*	*	*	*
53-3053	Shuttle Drivers and Chauffeurs	1,223	1,491	2%	22%	2,114	(623)

Table 15. Tier 2 Workforce Gap Analysis by Occupation[26] (continued)

SOC Code	Description	Labor Supply				Labor Demand	
		2022 Employment	2032 Projected Employment	Annual Growth	Percent Change (Nominal)	2032 Job Openings	2032 Surplus or Shortage
53-7081	Refuse and Recyclable Material Collectors	1,064	1,159	1%	9%	1,450	(290)
53-3052	Bus Drivers, Transit and Intercity	1,465	1,505	0%	3%	1,918	(414)
53-3051	Bus Drivers, School	655	705	1%	8%	1,084	(379)
53-3054	Taxi Drivers	230	401	6%	74%	479	(77)
	Tier 2 Workforce	**61,055**	**67,527**	**1%**	**11%**	**79,130**	**(11,604)**
	Total Region	**1,184,280**	**1,297,691**	**1%**	**10%**	**1,482,215**	**(184,523)**

Note: Asterisks (*) represent values not calculated as data for the occupation is unavailable.

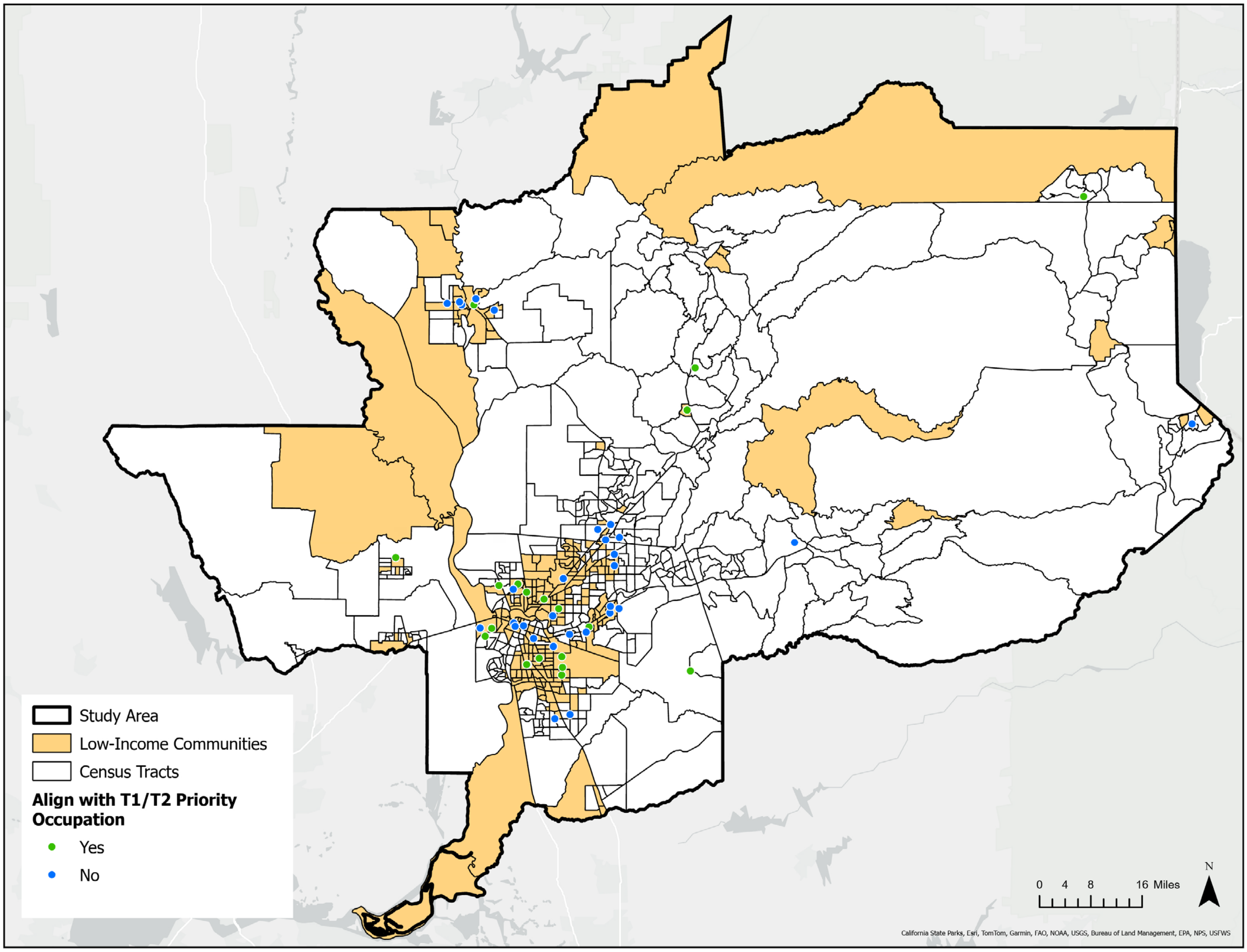
Fair Access to Workforce Training

To better understand fair access to workforce training and career pathways, training program locations were mapped alongside low-income community census tracts across the Capital Region. This analysis aims to assess training accessibility, particularly for historically underrepresented populations and those living in rural or geographically isolated areas. Figure 7 illustrates the spatial distribution of training centers in relation to low-income and rural communities.

Training location marked in green offer programs aligned with Tier 1 and Tier 2 Plan-related occupations, while those in blue represent programs linked to other occupations. The majority of training locations are concentrated in the region's urban core, as shown in Figure 7. Outside of the core, low-income communities on the outer edges of the region have severely constrained access to relevant training programs, highlighting a significant rural-urban disparity. This geographic imbalance suggests that residents in outlying areas may face greater challenges accessing in-person training, especially if programs are not offered in hybrid or remote formats.

To address these disparities, program design should consider incorporating hybrid, mobile, or satellite training models that can adapt to the needs of rural and underserved communities.

Figure 7. Sacramento Region Workforce Training Centers and Low-Income Communities as Identified in the Plan[27]



Workforce Needs Analysis

The planning team engaged a broad range of partners to better understand current workforce development programs, gaps, and opportunities aligned with green jobs and building a climate-resilient economy. The team collaborated with workforce development agencies, educational institutions, employers, and CBOs to assess the region's capacity to meet the growing demand for clean energy and climate-related careers.[28] Insights were gathered from stakeholder interviews, workforce development summits, and existing partner-led regional labor market research. These efforts revealed near- and long-term opportunities aligned with climate priorities and highlighted regional variations by county. The engagement efforts also identified opportunities and gaps in the current landscape of training programs, workforce skills, and employment pathways, particularly in reaching and supporting communities that have historically faced barriers to economic opportunity, including low-income residents, communities disproportionately impacted by pollution, immigrants and refugees, rural communities, and individuals affected by housing insecurity, limited English proficiency, or incarceration.

The regional workforce analysis engaged key agencies with established, ongoing collaboration across a broad network of stakeholders. These agencies served as regional representatives, bringing insights shaped by their direct experience and strong connections with employers, educators, service providers, and community members. Their contributions reflected community voices and the partnerships they help coordinate throughout the region.

Key engagement partners included:

- **Workforce Development Boards** – Sacramento Employment Training Agency (SETA)
- **K-12 and Postsecondary Institutions** – Nevada Joint Union High School District, Sierra College, and Los Rios Community College District
- **Employers and Industry Leaders** – CalFire, Rivian, Sparkz, and SMUD

These engagements were designed to elevate high-level system needs and localized, on-the-ground priorities. Conversations were facilitated in small groups and one-on-one interviews to capture subregional differences across counties, recognizing the distinct needs of urban, suburban, and rural communities. Additional emphasis was placed on identifying nuanced, culturally relevant strategies to promote fair access to job and training opportunities in low-carbon economy sectors.

This section summarizes key insights from that engagement, focusing on regional workforce needs, infrastructure gaps, and priorities to inform climate measure implementation. The findings underscore that building a strong, well-prepared workforce is essential for successful climate action, and that fair workforce development strategies are critical so that historically disinvested communities can benefit from the region's transition to a low-carbon economy.

Key Themes and Insights

Regional Ecosystem and Training Program Capacity

The Capital Region has a growing and diverse ecosystem of industry-specific workforce programs that support pathways into low-carbon economy jobs, with existing collaboration efforts aimed at aligning with industry needs while addressing longstanding accessibility challenges.

CalEPIC (formally California Mobility Center) is a public-private collaborative in the clean mobility sector that offers hands-on training programs to prepare individuals for careers in battery manufacturing, EV mechanics, and high-voltage safety. These programs are co-designed with employers, such as Rivian and Sparkz, to align skill development with job requirements. Similarly, companies like Bosch have partnered with local colleges to offer accelerated adult education programs to enable participants to pursue further educational opportunities or transition directly into the workforce.

Educational institutions play a central role in regional workforce development. Primary and secondary educational institutions, such as Nevada Joint Union High School District, are building early pathways aligned with green jobs by offering students opportunities to attend trade expos, gain hands-on training experience, and participate in certification programs. Partnerships with local non-profits provide paid work-based learning opportunities, such as Sierra Harvest's anticipated District Ranch project that will hire K-12 students who have taken courses in sustainable agriculture to work on a ranch in Nevada County.

Post-secondary institutions, such as the Los Rios Community College District and Sierra College, offer specialty programs in low-carbon economy fields including solar technology, natural resources, water and waste management, sustainable agriculture, field ecology, construction, and alternative fuels. Despite the broad range of offerings, many programs report small enrollment numbers due to limited capacity to conduct outreach or sustain employer engagement that would help demonstrate clear connections between coursework and employment opportunities. Additional barriers include limitations in facility space, available equipment, and transportation services, creating challenges in expanding access to these offerings.

To strengthen career pipelines, SETA places job developers on campuses to provide support for students nearing completion of certification programs by facilitating connections to job opportunities. SETA also offers interview preparation workshops, conflict resolution training, and one-on-one job coaching. Similarly, the United Auto Workers' Center for Manufacturing Green Economy focuses on pre-employment training tailored to high school graduates and entry-level workers.

To maximize the reach and effectiveness of these programs, additional investment in employer partnerships, wraparound student support services, and outreach is needed. The region demonstrates strong momentum and innovation in building alignment around low-carbon economy workforce development, but strengthened coordination, sustained funding, and fair strategies are needed to address existing gaps so that all communities benefit from the transition to a low-carbon economy.

In-Demand Skills and Occupations

Engagement revealed clear connections between the Plan's priority climate measures and the region's emerging low-carbon economy workforce needs. Demand is growing for a wide range of roles in clean energy and climate resilience, and each of the eight priority measures depends on a skilled, job-ready workforce for successful implementation. These roles span sectors such as construction, clean energy, transportation, land management, and agriculture, offering both entry-level and advanced employment opportunities.

Stakeholders identified current and emerging high-demand jobs related to implementing the Plan's prioritized climate measures, along with relevant skills required. Employers and workforce development agencies emphasized the need to expand training in skilled trades, technical certifications, and sustainable land management. They also stressed the importance of early exposure to career pathways, employer-informed training curricula, and place-based strategies that strengthen regional economic resilience while aligning climate goals with employment opportunities for residents.

Employers like CAL FIRE also highlighted the need for administrative and support roles, including Staff Services Analysts, GIS technicians, and program coordinators to support climate action planning and implementation.

While job types vary by climate measure, several essential cross-cutting skills emerged. These include safety training, digital literacy, and applied math and science. Employers consistently cited soft skills, such as communication, teamwork, and problem-solving, as critical yet often underdeveloped, particularly among younger job seekers affected by the social and developmental impacts of the COVID-19 pandemic. Stakeholders also identified other relevant skills for priority measures, which can be found in Appendix F.

Barriers to Effective Program Development

Across the region, workforce partners expressed a shared commitment to connecting and preparing residents for meaningful, high-quality careers in the low-carbon economy. However, stakeholders pointed to persistent challenges that limit the effectiveness of current training programs in meeting employer needs and keeping pace with industry changes.

A major barrier is the misalignment between available funding and the realities of on-the-ground implementation. Launching and scaling climate-aligned training programs are often hindered by fragmented and inconsistent funding streams. These programs typically rely on a patchwork of federal, state, and local grants, private-sector partnerships, and philanthropic investments, each with its own priorities, reporting requirements, and timelines. This complexity makes it difficult to fund the full range of support needed to build sustainable, scalable models.

Community college partners noted that many grants are narrowly focused, such as on curriculum development, requiring additional funding to cover essential components such as participant stipends, faculty positions, and wraparound services (e.g., transportation and childcare). Moreover, grant timelines often do not align with academic calendars or curriculum development cycles. As a result, even well-intentioned efforts can become fragmented, making it difficult for promising programs to gain traction and limiting coordination between education, training, and employment opportunities.

> "You have to write the grant to match the need, but the biggest funding streams aren't aligned, so we're constantly stitching things together just to get a program off the ground."
>
> - Interview with Nevada Joint Union High School District representative

Grant writing and funding acquisition require significant time and staffing resources, often resulting in slow timelines that hinder a program's ability to respond quickly to industry demand and limit accessibility to residents. Additionally, approval processes for community college and Career & Technical Education (CTE) programs can take over a year, further delaying the launch of training aligned with rapidly evolving workforce needs.

Localized approaches are essential to effectively address the geographic diversity of the region. In rural counties, workforce capacity emerged as a key concern for implementing climate measures. A shortage of skilled local labor often leads to reliance on out-of-county workers and union labor. Compounding this issue, a lack of affordable worker housing forces many to commute across county lines, which diverts income away from the communities where the work is performed.

While the region is recognized as a leader in developing models for regional coordination in workforce development and industry growth, stakeholders emphasized persistent challenges in translating training pathways into employment, especially in rural areas. These challenges include limited jurisdictional capacity, inadequate broadband access, and a shortage of industry partners, all of which hinder full participation in regional coordination efforts.

Emerging industries, such as biomass utilization, face additional hurdles due to the absence of established organizational infrastructure. This makes it difficult to attract educational and workforce partners, further complicating efforts to build a skilled workforce for low-carbon economy careers.

Access Barriers

Advancing fair workforce development requires intentional strategies to address systemic barriers faced by low-income communities. Community engagement across counties consistently highlighted how economic, social, and infrastructural inequities intersect with access to training, employment, and participation in the low-carbon economy.

Vulnerable communities, particularly in rural and low-income areas, face disproportionate challenges in accessing paid work experience opportunities. Barriers such as unreliable transportation, childcare, internet access and housing insecurity are common. Educational gaps also persist; for example, programs run by SETA report that many adult learners test below an 8th-grade level in reading or math. Additionally, limited English proficiency among immigrant and refugee populations underscores the need for workforce programs that incorporate English as a Second Language (ESL) instruction and culturally responsive outreach.

Trusted CBOs play a critical role in reaching these populations. While larger institutions often subcontract with CBOs for outreach, stakeholders emphasized the importance of engaging smaller, deeply rooted organizations. Beyond designing programs to benefit disinvested communities, planning must be place-based and inclusive, positioning community members as decision-makers, not just beneficiaries.

For example, the Nevada Joint Unified High School District uses demographic gap tools to identify and address disparities in CTE participation. Their paid industry experience program enables students who otherwise could not afford internships to access work-based learning. Similarly, CalEPIC and other partners highlighted the need for flexible program structures, such as mobile training units or weekend certification programs held in high schools and community centers, to better serve individuals facing access barriers.

At their third annual Regional Workforce Development Summit, SMUD announced a commitment to train 4,000 workers and place 400 local workers in clean energy jobs by 2030. Their approach includes inclusive hiring strategies such as fair chance hiring for justice-impacted individuals, and wraparound supports like childcare and transportation. CBOs like Asian Resources Inc. and the Greater Sacramento Urban League complement these efforts by offering workforce and youth development programs focused on underserved populations, including ESL and refugee support.

Summary of Findings

- **Occupations aligning with Plan measures show both strong and stable historical employment growth.** Tier 1 occupations have demonstrated growth above the region's overall rate, with employment expanding 3.5% annually from 2014 to 2024. Notably, Construction Supervisors (9.2%), Solar PV Installers (23.7%), Electrical and Electronics Repairs (20.1%), and Hazmat Materials Removal Workers (8.9%), have all seen substantial annual growth in the last decade, reflecting sustained demand for these occupations. In contrast, Tier 2 occupations have grown at a more modest rate of 1.8% annually, more closely reflecting regional trends. However, some Tier 2 occupations have demonstrated significant annual growth, including Material Moving Supervisors (8%), Electrical Power Line Installers (8.3%), Firefighter and Fire Prevention Supervisors (11.1%), and Tree Trimmers (13.1%).
- **Despite this momentum, most Tier 1 occupations remain underrepresented in the region.** For example, Electricians (LQ 0.8) and Substation Repairers (LQ 0.2) have location quotients below 1.0, indicating that the local workforce supply is not keeping pace with employer demand. This reinforces projections of future shortages and highlights the need for targeted pipeline development. However, the region demonstrates strong specialization in Solar PV Installers (LQ 2.0) and Construction Laborers & Managers (LQ 1.1), which are essential for solar deployment and infrastructure upgrades. Tier 2 occupations show stronger alignment with national employment patterns (LQ 1.1), with notable concentrations in wildfire prevention and agriculture. This indicates that the region may already have a solid foundation in certain Tier 2 roles. Still, gaps persist in occupations critical for civil and energy infrastructure, entry-level building decarbonization, and wildfire supervisory roles. To meet future workforce needs, it will be essential to strengthen pathways across the spectrum of workforce development, from outreach and pre-training engagement to employment retention, to manage the demand for additional workers and address acute shortages.
- **Many of the prioritized occupations have experienced wage growth since 2014, yet disparities remain that may be contributing to difficulties in talent recruitment and retention.** In 2024, the average hourly wage for occupations in both Tier 1 and Tier 2 was $35.75 and $33.88, each below the regional average of $40.34. While several Tier 1 roles such as Electrical and Electronics Repairers ($58.54) and Construction Managers ($63.79) earned above the regional median, others like Welders ($28.99) and Plumbers ($35.69) have wages below the regional median. Additionally, several occupations experienced declines in purchasing power, including Welders (-8%), Plumbers (-6%), and Hazmat Removal Workers (-3%), as wage growth has not kept up with the pace of inflation. Occupations with below average or stagnating compensation, such as Welders, may be contributing to regional underrepresentation in critical roles and may exacerbate future shortages.
- **Tier 2 occupations showed similar mixed outcomes.** While the average hourly wage was also below the regional median, specialized roles like Power Distributors and Dispatchers ($81.61) and Electrical Power-Line Installers and Repairers ($52.83) earned well above it. Real wage growth was strong in land stewardship roles, with Farmworkers and Logging Equipment Operators seeing real wage increases of 26%, reflecting rising demand in sustainable agriculture and forest conservation. However, key infrastructure and service roles experienced sharp declines. For example, Power-Line Installers saw a 32% nominal wage decrease and Surveying Technicians declined by 24%.

- **The Plan workforce is younger and more racially diverse than the regional workforce, but gender disparities remain stark.** Workers aged 25–44 are overrepresented across priority occupations, while those under 25 and over 65 are underrepresented, indicating a strong reliance on mid-career talent and a need to attract younger workers for long-term sustainability. Tier 1 and Tier 2 occupations show greater racial diversity compared to the regional workforce: 60% of Tier 1 workers and 54% of Tier 2 workers are minorities. Hispanic or Latino workers are especially prominent, comprising 42% of Tier 1 roles and 34% of the Tier 2 roles, compared to 28% regionally. However, Asian and Black workers remain underrepresented across both tiers. Gender disparities are particularly pronounced: Tier 1 occupations are 87% male and Tier 2 are 74% male, compared to a nearly gender-balanced regional workforce. The analysis shows that women and Asian and Black workers may be underrepresented in technical roles, including those with higher training requirements, which may reflect systemic access issues. Strategies must therefore address both representation and compensation to ensure inclusive participation in the Plan workforce.
- **Geographic disparities in workforce training access limit fair workforce development, particularly for rural and underserved communities.** Geospatial analysis reveals that there is a clear urban concentration of training programs aligned with Plan occupations, leaving residents in outlying and rural areas with a longer commute to access training opportunities. This poses a significant barrier to fair participation in the workforce needed for Plan implementation. To close this gap, workforce strategies must prioritize flexible delivery models, such as hybrid, mobile, or satellite programs, which bring training directly to communities excluded from traditional access points.
- **Education and training requirements across occupations vary widely, offering both accessible entry points and long-term career pathways.** Most Tier 1 occupations have relatively low barriers to entry, typically requiring only a high school diploma and short- to moderate-term OJT, making them accessible for both new workforce entrants and individuals seeking career transitions. Others, like Electricians and HVAC/R Mechanics, require post-secondary credentials and significantly longer OJT due to technical complexity of the role. Many of these roles also have low LQs, suggesting that additional investments in pre-apprenticeship programs and expanded access to apprenticeships and other technical education could help address regional workforce gaps. Tier 2 occupations show similar diversity, ranging from low-barrier roles such as Landscaping Workers to more advanced positions like Power-Line Installer and Power Plant Operators. This range presents an opportunity to design flexible credentialing programs and stackable training models that support rapid entry and career advancement.
- **While some occupations show a mismatch between training demands and wages, many others offer strong opportunities with low barriers to entry and compensation surpassing the regional living wage benchmark.** Training investments must be matched with commensurate compensation to ensure a return on investment for workers and support workforce retention. However, several Tier 1 and Tier 2 roles, such as Electrician Helpers, Social Service Assistants, and Forest and Conservation Workers, require extensive training but offer wages below the regional living wage, creating potential barriers to recruitment, training completion, and retention. This mismatch is particularly concerning for occupations that are underrepresented in the region, such as Electrician Helpers, which may signal systemic barriers to workforce entry or retention. In contrast, a strong cluster of Tier 1 and Tier 2 occupations, such as Solar PV Installers and Surveying/Mapping Technicians, offer both above-living-wage pay and relatively low training requirements, making them ideal for rapid workforce scaling.

- **Labor market projections reveal a dual challenge: acute shortages in specific frontline roles and surpluses in others, highlighting the need for better alignment between workforce development and industry needs.** By 2032, Tier 1 occupations are projected to face a net shortage of 3,562 workers, largely driven by two high-demand roles: Laborers and Freight, Stock, and Material Movers (-8,344) and Truck Drivers (-1,159). Excluding these, the remaining Tier 1 occupations show a modest surplus, suggesting that current workforce pipelines may be sufficient in many areas. Still, shortages are expected in roles like Electrical Assemblers and Building Inspectors. Tier 2 occupations face a more pronounced net shortage of 11,604 workers, with the largest gaps in Landscaping Workers as well as Farmworkers. At the same time, several occupations in both tiers, such as Construction Supervisors and Cement Masons, are projected to exceed demand, indicating potential oversupply or misalignment between training and job openings. Roles with low barriers to entry and projected shortages, such as Solar PV Installers and Surveying and Mapping Technicians, can be quickly ramped up to help close urgent gaps.
- **Stakeholder feedback revealed common training needs across a variety of occupations.** While job types differ by climate measure, several cross-cutting skills consistently emerged as priorities, namely safety training, digital literacy, applied math and science, and soft skills such as communication and problem-solving. The widespread demand for these foundational skills suggests that the region would benefit from expanded pre-employment and pre-apprenticeship training programs focused on these topic areas. Pre-apprenticeship programs support inclusive hiring by improving access to growing occupations and preparing individuals for success in more advanced training and employment opportunities.
- **Stronger regional coordination is essential to transform promising climate-related training efforts into fair, scalable, and employment-connected pathways.** The Capital Region has made significant strides in building a diverse and innovative ecosystem of climate-related workforce programs, with strong examples of employer-education partnerships, early exposure initiatives, and wraparound supports. However, these efforts are often fragmented and constrained by misaligned funding, limited outreach capacity, and inconsistent infrastructure, particularly in rural and underserved communities. While stakeholders are deeply committed to inclusive workforce development, the lack of sustained coordination across jurisdictions, institutions, and funding sources undermines the region's ability to scale successful models and ensure fair access. To fully realize the potential of current local efforts and future workforce scaling, regional coordination must be strengthened through sustained investment, shared workforce infrastructure, and fair strategies.

Next Steps

The Capital Region is well-positioned to build a climate-ready workforce, but success depends on addressing several cross-cutting needs. While many occupations aligning with Plan measures are experiencing rapid growth and offer accessible entry points, persistent underrepresentation, wage disparities, and training mismatches threaten the region's ability to meet future labor demands. A younger and more racially diverse workforce is emerging; yet gender disparities and barriers to access, particularly in rural and underserved communities, remain significant.

To support inclusive participation and help meet employer demand, fair access must be embedded throughout implementation planning. This includes prioritizing place-based strategies that uplift low-income communities and center their voices in the transition to a low-carbon economy. Key actions include aligning training with real-time industry needs, expanding access to high-quality pre-apprenticeship and credentialing programs, and offering compensation that reflects the value and complexity of the work. Strengthening regional coordination, streamlining funding, and investing in shared workforce infrastructure will be critical to scaling successful workforce development pathways. By doing so, the region can create lasting, inclusive opportunities for all residents.

To operationalize these goals, the region should prioritize the following strategies for occupations critical to implementing Plan measures. Table 16 offers a high-level, preliminary framework to guide future workforce strategy development. They are grounded in current data and stakeholder input and are intended to serve as a foundation for more detailed planning.

Table 16. Preliminary Framework for Workforce Strategy Implementation

Focus Area	Recommended Action	Intended Outcome
Foundational Skills	Expand pre-apprenticeship and pre-employment training to focus on high-demand, cross-industry skills such as safety, digital literacy, communication, and teamwork	Equip jobseekers with cross-cutting skills needed across Plan occupations
	Develop stackable credentials focused on core skills essential to the implementation of Plan measures and related occupations	Support for multiple entry and re-entry points, enabling workers to start at different stages based on prior experience or education
Regional Coordination	Integrate smaller CBOs into regional workforce planning and program design	Expand training access and reduce employment barriers for historically disinvested communities
	Establish new sector partnerships that align with priority measures, such as Wildfire Resilience and Management, Building Decarbonization/Electrification, or Roadway Improvements for Multi-modal Use and Access	Integrate industry insights and address sector-wide challenges
Recruitment	Increase awareness of climate-related career pathways by partnering with industry to enhance outreach efforts across all education levels, including K-12, CTE, and higher education	Build early awareness and interest in climate-related career pathways

Table 16. Preliminary Framework for Workforce Strategy Implementation (continued)

Focus Area	Recommended Action	Intended Outcome
Supportive Services	Leverage employer partnerships to identify and provide key supportive services, such as transportation vouchers, tools and uniforms, and childcare	Improve participant success and job retention
Flexible	Expand access to training and employment opportunities through flexible delivery models, including hybrid or mobile programs, alternate work/training schedules, and transportation support	Increase participation among rural and underserved communities
Wage Advancement	Offer incumbent worker training to individuals in occupations with wages below the regional living wage	Create pathways for wage growth through targeted skill development
	Prioritize the allocation of funds and resources toward occupations that have low barriers to entry, offer wages at or above the regional living wage, and align with long-term career growth pathways	Increased access for individuals with limited formal education or work experience while also enabling advancement into higher-skilled, higher-wage roles over time

REFERENCES

[1] U.S. Bureau of Labor Statistics. Sacramento Area Economic Summary. Updated May 29, 2025. https://www.bls.gov/regions/west/summary/blssummary_sacramento.pdf.

[2] California Employment Development Department. Nevada County Monthly Labor Force Data. Accessed June 2025. https://labormarketinfo.edd.ca.gov/file/lfmonth/nevadpds.pdf.

[3] California Jobs First. State Economic Blueprint. Accessed June 2025. https://jobsfirst.ca.gov/blueprint/.

[4] We Prosper Together. We Prosper Together Regional Plan: Strategies for a Thriving and Inclusive Economy. October 2024. https://www.weprospertogether.org/wp-content/uploads/2024/10/We-Prosper-Togethers-Regional-Plan.pdf.

[5] U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from Lightcast 2025.1, data run retrieved May 2025; AECOM Analysis.

[6] Ibid.

[7] Ibid.

[8] Ibid.

[9] Ibid.

[10] Ibid.

[11] This column describes 2014 wages inflated to 2024 dollars using the Bureau of Labor Statistics' CPI.

[12] The percent difference in real wage equals the percent change between the real wage for 2024 and the actual wage for 2024. If the percentage is negative, then the wage did not keep up with inflation. If the percentage is positive, the wage outpaced inflation.

[13] U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from Lightcast 2025.1 data run retrieved May 2025; AECOM Analysis.

[14] This column describes 2014 wages inflated to 2024 dollars using the Bureau of Labor Statistics' CPI.

[15] The percent difference in real wage equals the percent change between the real wage for 2024 and the actual wage for 2024. If the percentage is negative, then the wage did not keep up with inflation. If the percentage is positive, the wage outpaced inflation.

[16] U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from Lightcast 2025.1, data run retrieved May 2025; AECOM Analysis.

[17] Ibid.

[18] Ibid.

[19] U.S. Department of Labor, Occupational Information Network; AECOM Analysis.

[20] Ibid.

[21] The median living wage used in this analysis was sourced from MIT's Living Wage Calculator, which offers wage estimates tailored to different household sizes and compositions. Based on the average household size of 2.7 persons in the Sacramento-Roseville CSA, a benchmark living wage of $31.90 per hour was selected. This wage corresponds to the living wage for a household comprising two working adults and two children.

[22] U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from Lightcast 2025.1 data run retrieved May 2025; MIT Living Wage Calculator; U.S. Department of Labor, O*NET; AECOM Analysis.

[23] Ibid.

[24] While both the California EDD and Lightcast rely on OEWS data as a foundational source, their 2022 employment figures differ due to differences in methodology, modeling adjustments, and data enhancements. EDD aligns OEWS data with state-specific industry projections, while Lightcast applies proprietary modeling and may incorporate additional data sources such as job postings and resumes.

[25] California Economic Development Department, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from California Economic Development Department's Labor Market Information, data run retrieved May 2025; AECOM Analysis

[26] Ibid.

[27] Capital Region Climate Priorities Plan (2024), Chapter 5; California Eligible Training Provider List (ETPL), AECOM Analysis.

[28] Outreach to and engagement with regional stakeholders was conducted by Valley Vision, a civic leadership organization based in Sacramento, California.

Chapter 8. Funding & Financing

Planning for and implementing the Plan measures will be an ongoing, resource-intensive process, requiring local jurisdictions within the Capital Region to consider new funding and financing sources. Planning and implementing each measure will likely require multiple funding and financing sources, given the diverse array of sectors and jurisdictions within the seven-county region and the number of projects and programs required to reach the scale of action envisioned by 2045. Additionally, funding in agency budgets have likely already been allocated to existing and near-term projects and programs, resulting in a need for renewed funding and financing sources. This chapter provides a summary of funding and financing sources that may be used to support implementation of Plan measures:

- **Competitive federal and state grant programs** available to local jurisdictions, including city and county governments, transportation agencies, and Tribal governments, in addition to nonprofit and community-based partner organizations.
- **Financing strategies,** including traditional debt instruments like loans and bonds and more innovative debt instruments, in addition to revenue-generating mechanisms, like new local taxes.
- **Consumer programs,** like rebates, incentives, and tax credits, that are available to property owners, businesses, and residents within the Capital Region.

Additional details related to these funding and financing sources can be found in Appendix G, including specific grant program requirements and examples of previous awards.

Key Considerations

When identifying new funding or financing sources to support the planning and implementation of Plan measures, agencies may consider the following factors:

- **Timing:** The amount of time needed to secure funding and financing sources. For grant programs, this involves monitoring federal and state grant application deadlines on an annual or biannual basis. For financing tools, this requires time needed to issue loans, bonds, and other investments.
- **Feasibility:** The likelihood a local agency receives approval, whether it be from the federal government (grants) or voter (revenue-generating mechanisms).
- **Administrative Complexity:** The degree to which funding and financing sources may be implemented within local agencies' existing resources. This includes resources needed to oversee grant applications and administration, as well as resources needed to implement and provide ongoing support for financing tools and revenue-generating mechanisms.
- **Funding Amount or Revenue-Generating Potential:** The range of funds or revenue that each funding source could generate and the volatility of the funding source.
- **Funding Flexibility:** The funding source's requirements and restrictions, and potential to fund multiple measures.
- **Regional Coordination and Engagement:** Regional coordination to develop multi-jurisdiction, multi-benefit projects can strengthen the competitiveness of funding applications. Sustained partnerships with community-based organizations can help to build long-term community support to inform funding applications. Regional initiatives and collaborations, such as the Sacramento Clean Cities Coalition, the Cleaner Air Partnership, and the Capital Region Climate Readiness Collaborative, can help to facilitate these conversations.

Grant Funding

Several competitive federal and state grant programs provide funding for Plan measures in the transportation, energy, waste management, water, and natural and working lands sectors. Some of these programs are expected to expire in 2026, however, these grant funding opportunities may return in the coming years as priorities shift.

Furthermore, some competitive state grant programs relevant to Plan measures have not been renewed in the 2024-2025 state budget, including the Transformative Climate Communities Program, Outdoor Equity Grants Program, Multibenefit Land Repurposing Program, Urban Greening Program, and Regional Climate Collaboratives Program.[1] The passage of Proposition 4 authorizes the state to issue $10 billion in general obligation bonds to create or renew grant and loan programs related to climate action; Table 1 outlines the key funding categories of Proposition 4 and their relevance to Plan measures. Notably, $150 million in restored funding will be allocated to the Transformative Climate Communities Program, which includes grant funding for development and infrastructure projects in disadvantaged communities. In addition to this program, local jurisdictions may monitor the release of new or renewed grant programs related to Plan measures following the passage of the ballot measure.

Table 1. Proposition 4 Funding Categories & Allocations (In Millions)

Category	Relevant Plan Measure	Amount
Drought, Flood, and Water Supply	• BE-8: Reduce Water Utility Emissions • BE-9: Reduce Wastewater Emissions	$1,800
Forest Health and Wildfire Prevention	• NW-1: Wildfire Resilience and Management • NW-2: Biomass Energy	$1,500
Sea Level Rise and Coastal Areas	N/A	$1,200
Land Conservation and Habitat Restoration	• NW-3: Increase Tree Canopy • NW-4: Carbon Sequestration Program/ Carbon Farming	$1,200
Energy Infrastructure	• E-1B: Battery Storage-Supported Microgrids • NW-2: Biomass Energy	$850
Parks	• NW-3: Increase Tree Canopy	$700
Extreme Heat	• NW-3: Increase Tree Canopy • BE-2: Building Energy Efficiency Improvements • BE-6: Install Cool Pavement	$450
Farms and Agriculture	• NW-3: Increase Tree Canopy • BE-2: Building Energy Efficiency Improvements • BE-6: Install Cool Pavement	$300
Total		$10,000

Source: Legislative Analyst's Office, 2024

The competitive federal and state grant programs listed in this section are organized by the seven implementation working groups that formed during the Plan development process and include key details like applicant eligibility and applicability to GHG reduction measures. Additional details, including local match requirements, recurring status, estimated award amount range, and previous awards, are included in Appendix G.

Active Modes

Notably, the following programs fund larger-scale capital investments and are thus more competitive grant programs: Active Transportation Infrastructure Investment Program, and Reconnecting Communities and Neighborhoods Grant Program. Securing these large-scale federal and state programs may involve distinct requirements, including: 1) partnerships with local government agencies and nonprofit organizations, and 2) a 20% local match funding obligation, depending on the program. Smaller jurisdictions interested in making mobility and accessibility investments may consider pursuing the Community Change Grants Program, Active Transportation Program, and Sustainable Transportation Planning Grants.

Table 2. Grant Funding Relevant to Active Modes Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	DOT	**Reconnecting Communities and Neighborhoods Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting
Federal	DOT	**Safe Streets and Roads for All Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting
Federal	Federal Highway Administration (FHWA)	**Active Transportation Infrastructure Investment Program (ATIIP)**	• State/SACOG • Counties or cities	• TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • TR-8: Electric Bikeshare
Federal	EPA	**Community Change Grants Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting
State	Caltrans and SACOG	**Active Transportation Program (ATP)**	• SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth
State	Caltrans	**Sustainable Transportation Planning Grants**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting

Note: These grants are included in the Active Modes working group due to their relative applicability to bicycle and pedestrian infrastructure access; a subset of these grant programs may also be pursued by the Public Fleet EVs & Transit working group.

Building Electrification

The Building Electrification working group comprises representatives from cities and counties, transportation agencies, community-based organizations, and educational institutions throughout the Capital Region. The working group focuses on electrifying residential and commercial buildings throughout the region to advance decarbonization goals. Table 3 lists grant programs relevant to Plan measures and members of the working group.

Notably, the following programs fund larger portfolio building electrification investments and are considered highly sought-after grant programs: Assistance for Adoption of Building Energy Codes, Grants for Energy Efficiency and Renewable Energy Improvements at Public School Facilities, and Greenhouse Gas Reduction Fund: Solar Communities for All Competition. Securing these large-scale federal programs requires partnerships between local government agencies and, in some cases, 20% local match. Smaller jurisdictions interested in planning for building electrification at the community level may consider pursuing the Communities Local Energy Action Program and the Energy Partnership Program to pursue planning efforts.

Table 3. Grant Funding Relevant to Building Electrification Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	US Department of Energy (DOE)	**Assistance for Adoption of Building Energy Codes**	• State/SACOG • Counties or cities	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	DOE	**Communities Local Energy Action Program (LEAP)**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	DOT	**Grants for Energy Efficiency and Renewable Energy Improvements at Public School Facilities**	• Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	EPA	**Greenhouse Gas Reduction Fund: Solar for All Competition**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
State	CEC	**Energy Partnership Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development

Note: These grants are included in the Building Electrification working group due to their relative applicability to building decarbonization and home weatherization efforts; a subset of these grant programs may also be pursued by the Energy working group.

Carbon Farming

The Carbon Farming working group comprises representatives from cities and counties, resource conservation districts, air quality management districts, and educational institutions throughout the Capital Region. The working group focuses on reducing greenhouse gas emissions within the agricultural sector. Table 4 lists grant programs relevant to Plan measures and members of the working group.

Notably, the following programs fund larger-scale carbon farming investments and are thus more competitive grant programs: Environmental Justice Government-to-Government Program and Greening America's Communities Program. Securing these large-scale federal programs requires partnerships between local government agencies and, in some cases, 20% local match. Smaller jurisdictions interested in planning for carbon farming initiatives may consider pursuing state programs like the Climate Smart Land Management Program, Environment Enhancement and Mitigation Grant Program, and Sustainable Agricultural Lands Conservation Program.

Table 4. Grant Funding Relevant to Carbon Farming Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	EPA	**Environmental Justice Government-to-Government Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program
Federal	EPA	**Greening America's Communities Program**	• State/SACOG	• NW-3: Expand Urban Tree Planting • NW-4: Establish a Carbon Sequestration Project
State	California Department of Conservation	**Climate Smart Land Management Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program • NW-6: Use of Electric Off-Road Equipment for Natural and Working Lands
State	California Natural Resources Agency (CNRA)	**Environmental Enhancement and Mitigation Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program
State	California Strategic Growth Council and the Department of Conservation	**Sustainable Agricultural Lands Conservation (SALC) Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program

Energy

The Energy working group comprises representatives from a local Tribal government, cities and counties, and public utilities throughout the Capital Region. The working group focuses on advancing energy goals at the jurisdiction-wide and utility scale. Table 5 lists grant programs relevant to Plan measures and members of the working group.

Notably, the following programs fund larger-scale energy investments and are thus more competitive grant programs: Battery Manufacturing and Recycling Grants, Community Power Accelerator Prize, Energy Future Grants, Energy Improvements in Rural or Remote Areas Program, Grid Resilience and Innovation Partnerships Program, and Tribal Clean Energy Planning and Development Grants. Securing these large-scale federal programs requires partnerships between local government agencies and, in some cases, 20% to 50% local match. Smaller local jurisdictions interested in planning energy investments may consider pursuing the Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants in California, Tribal Energy Development Capacity Grant, and Renewable Energy for Agriculture Program.

Table 5. Grant Funding Relevant to Energy Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	USDA	**Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants in California**	• Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development • NW-2: Biomass Energy • E-1B: Battery Storage-Supported Microgrids
Federal	DOE	**Battery Manufacturing and Recycling Grants**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-3: Require Renewable Surplus Buildings • E-1B: Battery Storage-Supported Microgrids
Federal	DOE	**Community Power Accelerator Prize - Round 3**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• E-1A: Onsite Solar Canopies
Federal	DOE	**Energy Future Grants**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• E-1A: Onsite Solar Canopies • E-1B: Battery Storage-Supported Microgrids
Federal	DOE	**Energy Improvements in Rural or Remote Areas Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development

Table 5. Grant Funding Relevant to Energy Implementation Working Group (continued)

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	DOE	**Grid Resilience and Innovation Partnerships (GRIP) Program: Grid Innovation Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	DOE	**GRIP Program: Smart Grid Grants**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	DOE	**Tribal Clean Energy Planning and Development Grants**	• Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
Federal	US Department of the Interior	**Tribal Energy Development Capacity Grant**	• Other local agencies, nonprofit organizations, or Tribal governments	• BE-2: Require Energy Efficient Appliances • BE-3: Require Renewable Surplus Buildings • BE-4: All-Electric Development
State	CEC	**Renewable Energy for Agriculture Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program • E-1A: Onsite Solar Canopies • E-1B: Battery Storage-Supported Microgrids

Note: These grants are included in the Energy working group due to their relative applicability to jurisdiction-wide energy investments; a subset of these grant programs may also be pursued by the Building Decarbonization working group.

Forest Treatments & Biomass

The Forest Treatments & Biomass working group comprises representatives from cities, counties, and air quality management districts throughout the Capital Region. The working group focuses on advancing forest treatment goals at the jurisdiction-wide scale. Table 6 lists grant programs relevant to Plan measures and members of the working group.

Notably, these federal programs from the USDA may be pursued by smaller jurisdictions interested in planning and preparing for wildfires and supporting new biomass fuel electricity generation capacity.

Table 6. Grant Funding Relevant to Forest Treatments & Biomass Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	USDA	**Community Wildfire Defense Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management
Federal	USDA	**Community Wood Grant Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-2: Biomass Energy
Federal	USDA	**Wood Innovations Grant Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-2: Biomass Energy
Federal	CAL FIRE	**Landscape Scale Restoration Grant Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management • NW-3: Expand Urban Tree Planting
State	CAL FIRE	**California Forest Improvement Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management
State	CAL FIRE	**Forest Legacy Grants**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management
State	CAL FIRE	**Tribal Wildfire Resilience Grants**	• Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management
State	CAL FIRE	**Wildfire Prevention Grants**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-1: Wildfire Resilience and Management

Infill Development

The Infill Development working group comprises representatives from SACOG, cities, counties, and community-based organizations throughout the Capital Region. The working group focuses on advancing infill development, including transit-oriented development, in cities and counties throughout the region. Table 7 lists grant programs relevant to Plan measures and members of the working group.

Table 7. Grant Funding Relevant to Infill Development Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	Federal Transit Administration (FTA)	**Pilot Program for Transit-Oriented Development Planning**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network
Federal	US Economic Development Administration (EDA)	**Public Works and Economic Adjustment Assistance (PWEAA)**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-1: Land Use Improvements
State	California Strategic Growth Council	**Affordable Housing and Sustainable Communities (AHSC) Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting
State	California Department of Housing and Community Development (HCD)	**Infill Infrastructure Grant Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-1: Land Use Improvements
State	HCD	**Multifamily Finance Super Notice of Funding Availability**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-1: Land Use Improvements
State	HCD	**Regional Early Action Planning (REAP) Grants**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-1: Land Use Improvements

Public Fleet Electric Vehicles (EVs) & Transit

The Public Fleet EVs and Transit working group comprises representatives from SACOG, cities and counties, and transit agencies throughout the Capital Region. The working group focuses on advancing transit objectives through infrastructure and electric vehicle adoption measures. Table 8 lists grant programs relevant to Plan measures and members of the working group.

Notably, the following programs fund larger-scale EV and transit investments and are thus more competitive grant programs: Grants for Buses and Bus Facilities Program, Low or No Emission Vehicle Program, Rebuilding American Infrastructure with Sustainability and Equity Grant Program, Strengthening Mobility and Revolutionizing Transportation Program, Clean Heavy-Duty Vehicles Grant Program, Diesel Emissions Reduction Act Funding, Low Carbon Transit Operations Program (LCTOP), and Transit and Intercity Rail Capital Program (TIRCP). Securing these large-scale federal programs requires partnerships between local government agencies and, in some cases, 20% local match. Smaller jurisdictions interested in planning for electric vehicle investments may consider pursuing the Charging and Fueling Infrastructure Discretionary Grant Program, Thriving Communities Program, and Clean School Bus Program Grants.

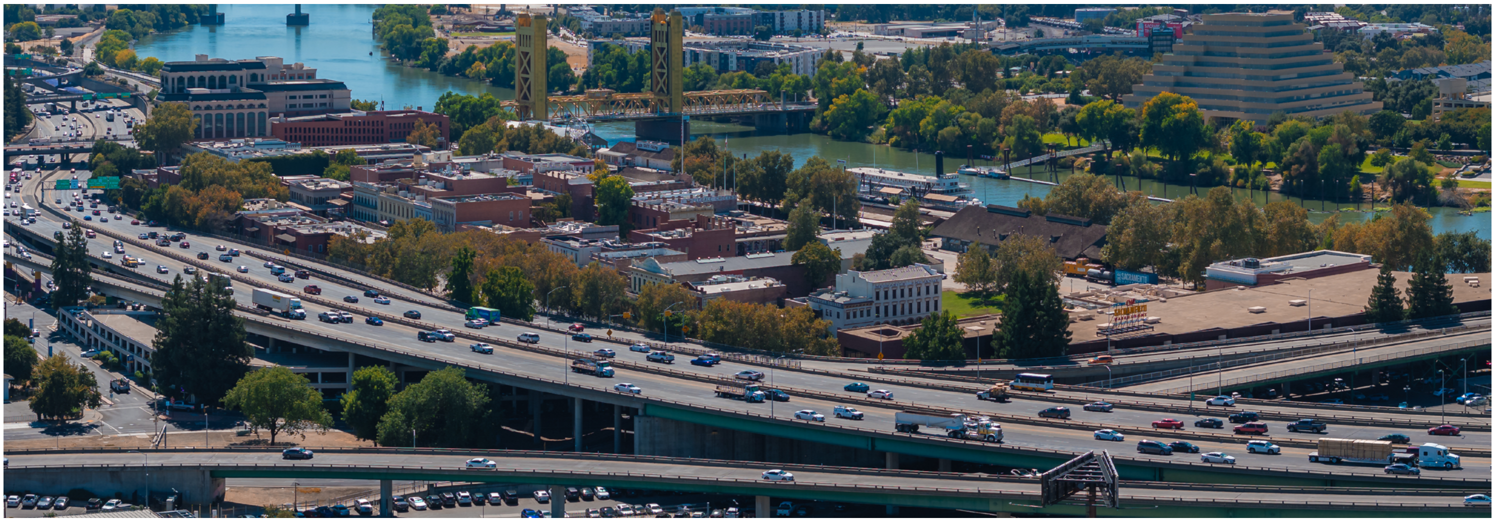
Table 8. Grant Funding Relevant to Public Fleet EVs and Transit Implementation Working Group

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	DOT	**Rebuilding American Infrastructure with Sustainability & Equity (RAISE) Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • NW-3: Expand Urban Tree Planting
Federal	DOT	**Strengthening Mobility and Revolutionizing Transportation (SMART) Program**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit
Federal	DOT	**Thriving Communities Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-6: Installing Cool Pavement • TR-3: Provide Bus Rapid Transit • NW-3: Expand Urban Tree Planting
Federal	DOT	**Clean Heavy-Duty Vehicles Grant Program**	• State/SACOG • Other local agencies, nonprofit organizations, or Tribal governments	• TR-1: Use of Cleaner-Fuel Vehicles
Federal	DOT	**Clean School Bus Program Grants**	• Other local agencies, nonprofit organizations, or Tribal governments	• TR-7: Establish a School Bus Program

Table 8. Grant Funding Relevant to Public Fleet EVs and Transit Implementation Working Group (continued)

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	EPA	**Diesel Emissions Reduction Act (DERA) Funding**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-1: Use of Cleaner-Fuel Vehicles
Federal	FHWA	**Charging and Fueling Infrastructure Discretionary Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-1: ZEV Adoption and Charging Infrastructure
Federal	FTA	**Grants for Buses and Bus Facilities Program 5339(b)**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit
Federal	FTA	**Low or No Emission Vehicle Program 5339(c)**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-1: ZEV Adoption and Charging Infrastructure
State	Caltrans	**LCTOP**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting
State	California State Transportation Agency (CalSTA)	**Transit and Intercity Rail Capital Program (TIRCP)**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• TR-3: Provide Bus Rapid Transit • TR-4: Provide Pedestrian Network Improvements • TR-4: Construct or Improve Bike Boulevards • TR-4: Expand Bikeway Network • TR-6: Active Modes of Transportation for Youth • NW-3: Expand Urban Tree Planting

Note: These grants are included in the Public Fleets and Transit working group due to their relative applicability to public transit and electrification infrastructure investments; a subset of these grant programs may also be pursued by the Active Modes working group.



Additional Grant Programs

The federal grant programs listed in Table 9 do not correspond with any single implementation working group but are relevant to a series of Plan measures.

Table 9. Grant Funding Agnostic to Implementation Working Groups

Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Applicants	Applicability to Plan Measures / Projects
Federal	USDA	**Composting and Food Waste Reduction Cooperative Agreements**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-7: Institute or Extend Recycling Services • BE-7: Implement Organics Diversion Program
Federal	USDA	**Community Development Block Grant (CDBG) – Mitigation**	• State/SACOG • Counties or cities	• All Measures and Projects
Federal	EPA	**Consumer Recycling Education and Outreach Grant Program**	• State/SACOG • Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-7: Institute or Extend Recycling Services • BE-7: Implement Organics Diversion Program • BE-10: Require Edible Food Recovery Program Partnerships with Food Generators
Federal	USDA	**Solid Waste Infrastructure for Recycling Grants for Communities**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• BE-7: Institute or Extend Recycling Services • BE-7: Implement Organics Diversion Program
State	CARB	**Community Air Grants**	• Counties or cities • Other local agencies, nonprofit organizations, or Tribal governments	• NW-4: Establish a Carbon Sequestration Project • NW-5: Establish Offset Program
State	CalRecycle	**Community Composting for Green Spaces Grant**	• Other local agencies, nonprofit organizations, or Tribal governments	• BE-10: Require Edible Food Recovery Program Partnerships with Food Generators

Financing Tools

In addition to securing funding from federal and state grant programs, public agencies may consider pursuing financing tools (i.e., debt instruments), including loans, bonds, and other investments, to fund Plan measures. Financing tools are generally coupled with revenue-generating mechanisms. These financing tools may be applied to a variety of Plan measures. They may be viewed in the following two categories: traditional financing tools and green (or innovative) financing tools.

Traditional Financing Tools

Table 10 lists traditional financing tools including loans, bonds, and other investments that may be applied to infrastructure investments in the transportation and energy sectors.

Table 10. Traditional Financing Strategies

Type	Strategy Name	Description
Bond	Revenue or General Obligation Bonds	Revenue bonds are used to pay for projects such as major improvements to an airport, water system, garage, or other large facilities that generate revenue that is then used to repay the debt. General obligation (GO) bonds are issued to pay for projects that do not have a specific, existing revenue stream. Debt is repaid through local tax revenue that is paid into the general fund.
Bond	Utility Revenue Bonds	A utility revenue bond is a type of municipal bond issued to finance a public utility project that repays investors directly from project revenues. Utility revenue bonds are used to fund capital projects in areas considered essential to public services including hospitals, fire services, water and waste treatment facilities, and improvements to the electrical grid.
Equity Investment	Public Private Partnership (P3)	A cooperative arrangement between one or more public and private agencies. P3s can take different forms, such as private entity financing, building, and/or managing a project in return for a promised stream of payments from a government agency over the projected life of the project. Government agencies elect to pursue P3s as a strategy to secure upfront funds for capital projects that they cannot fund alone.
Investment	Other Private Sector Contributions	Private sector contributions involve one or more parties supplying new financial resources to support needed capital investments, operating subsidies, or ancillary improvements that help build patronage to sustainable levels.
Loan	Infrastructure State Revolving Fund from California IBank	The Infrastructure State Revolving Fund (ISRF) Program (through IBank) is authorized to directly provide low-cost public financing to state and local government entities, including municipalities, universities, schools and hospitals (MUSH borrowers) and to nonprofit organizations sponsored by public agencies for a wide variety of public infrastructure and economic expansion projects.
Loan	Rural Energy Savings Program from USDA	The Rural Energy Savings Program provides loans to rural utilities and other companies who provide energy efficiency loans to qualified consumers to implement durable cost-effective energy efficiency measures.
Loan	Transportation Infrastructure and Innovation Act Loan from US DOT	The Transportation Infrastructure Finance and Innovation Act (TIFIA) program provides credit assistance in the form of direct loans and loan guarantees to large-scale transportation infrastructure projects, including bus rapid transit.
Loan	Water and Waste Disposal Loan Program from USDA	The Water and Waste Disposal program provides funding for clean and reliable drinking water systems, sanitary sewage disposal, and storm water drainage to households and businesses in eligible rural areas.

Green Financing Tools

In addition to traditional financing tools, public agencies may pursue green or innovative financing tools. Various green bonds, including environmental impact bonds and climate bonds, have yet to be pursued by many public agencies nationwide, though levels of adoption are increasing. These tools are listed in Table 11.

Table 11. Green Financing Strategies

Type	Strategy Name	Description
Bond	**Environmental Impact Bond**	An Environmental Impact Bond (EIB) is a financing tool that uses a Pay-for-Success approach to provide up-front capital from private investors for environmental projects, either to pilot a new approach whose performance is viewed as uncertain or to scale up a solution that has been tested in a pilot program.
Bond	**Green or Climate Bonds**	Green or climate bonds are those that specifically finance climate change adaptation or mitigation projects. Eligible projects include those related to renewable energy and energy efficiency, sustainable waste management projects, sustainable land use and biodiversity conservation, clean transportation, and clean drinking water. In 2023, SMUD announced its plans to issue $200 million of climate bond certified green bonds (SMUD, 2023).
Equity Investment	**Energy Savings Performance Contracting**	Energy Savings Performance Contracting (ESPC) is a budget-neutral approach to make building improvements that reduce energy and water use and increase operational efficiency. By partnering with an energy service company (ESCO), a facility owner can use an ESPC to pay for today's facility upgrades with tomorrow's energy savings - without tapping into capital budgets. State and local governments can implement ESPC projects in their own facilities, as well as promote and support ESPC projects through ESPC programs.
Loan	**California Lending for Energy and Environmental Needs (CLEEN) Program**	The CLEEN Program provides public financing to help meet state goals of greenhouse gas reduction, water conservation, and environmental preservation. This program consists of two subprograms: (1) the Statewide Energy Efficiency Program (SWEEP), which helps local governments and nonprofit organizations make small, medium, and large-scale energy-efficiency upgrades and projects, and (2) the Light Emitting Diode Street Lighting Program, which finances the installation of LED streetlights for local governments.
Loan	**Clean Water State Revolving Fund**	The Clean Water State Revolving Fund (CWSRF) provides low-cost financing to communities for a wide range of water quality infrastructure projects, including municipal wastewater facilities, nonpoint source pollution control, decentralized wastewater treatment systems, stormwater runoff mitigation, green infrastructure, estuary protection, and water reuse.
Loan	**Climate Catalyst Program from California IBank**	The Climate Catalyst Revolving Loan Fund is intended to provide flexible, low-cost credit to local jurisdictions to help bridge the financing gap toward achieving advanced technologies. Relevant projects include sustainable vegetation management, forestry practices, and timber harvesting products
Loan	**Greenhouse Gas Reduction Loan Program from CalRecycle**	The Greenhouse Gas Reduction Loan Program provides assistance to recycling manufacturers in financing machinery, equipment, and ancillary costs to site and expand in California.
Loan	**Partnerships for Climate-Smart Commodities from USDA**	Partnerships for Climate-Smart Commodities provide technical and financial assistance to producers to implement climate-smart production practices on a voluntary basis on working lands, including carbon sequestration efforts in the agricultural sector.

Revenue-Generating Mechanisms

Public agencies may require additional revenue-generating mechanisms to directly fund Plan measures, provide match funding, and/or support bond or loan issuances. Public agencies across California and the United States are implementing revenue-generating tools to support similar climate goals. Recent case studies of public agencies that have implemented climate-related revenue-generation tools are summarized in Table 12.

Notably, levying new taxes requires a two-thirds majority to pass in the state of California. For instance, in November 2024, Measure G, which called for a 1% sales tax increase in Folsom, CA, did not receive the two-thirds majority needed to pass. The measure would have funded various municipal services, including fire, parks, recreation, economic development, and capital improvement projects.

Table 12. Revenue-Generating Mechanism Case Studies

Sales Tax	Definition	Jurisdiction & Mechanism Approval Year	Expected Annual Revenue	Mechanism Details	Funding Use Details
Sales Tax	Tax on the sale of goods within the city.	Sacramento, CA, 2018	$95 million	1% increase in municipal sales tax.	Funds city services, including public safety, parks, and youth programs.
Gross Receipts Tax	Tax on a business's gross receipts, or income from taxable business activities. May be universal or levied only on selection of businesses, i.e., only retailers making $1 billion or more annually nationwide.	Portland, OR, 2018	$90 million	The Clean Energy Surcharge (CES) is a 1% gross receipts tax on large retailers not headquartered in Portland, such as Walmart, Target, and Best Buy.	Clean Energy Community Benefits Fund supports renewable energy, energy efficiency, and job training programs.
Utility User Tax (UUT)	Tax on use of utilities such as electricity, gas, water, and sewer. Often levied by the city, collected by the utility on the utility bill, and remitted to the city.	Albany, CA, 2020	$676,000	UUT increase from 7% to 9.5% (electricity and gas) and new UUT of 7.5% on water service. Low-income residents exempted.	Funds climate and emissions reduction projects.
Property Transfer Tax	Tax levied when real estate changes ownership. May be applied only to real estate over a certain value.	Sacramento, CA, 2020	$30 million	Transfer tax of $2.75 per thousand on the full value of consideration.	Funds affordable housing, homelessness services, and youth programs.

Table 12. Revenue-Generating Mechanism Case Studies (continued)

Sales Tax	Definition	Jurisdiction & Mechanism Approval Year	Expected Annual Revenue	Mechanism Details	Funding Use Details
Parcel Tax	Tax levied on parcels of real property.	Marin County, CA, 2020	$20 million	$0.10 tax per building square foot for 10 years.	Funds the planning, financing, implementation, management, ownership, and operation of a multi-jurisdictional agency to prevent and mitigate wildfires in Marin County.
Community Choice Aggregation (CCA) Revenue	CCAs often invest revenues in local energy programs, including energy efficiency incentives.	Peninsula Clean Energy (PCE), San Mateo, CA, 2021	Not applicable	CCA revenue	PCE has offered a home repair and electrification program for two years, serving low-income ratepayers in nearly 200 homes with a $2 million budget. The CCA is planning an expansion of the program in 2024 that will focus on whole home electrification and serve 250 homes per year while leveraging federal and state incentives and offering some services to non-low-income homes. The estimated 3-year cost of the program is $23-27 million, of which more than $10 million is expected to come from federal and state incentives.
		Ava Community Energy (Ava), formerly East Bay Community Energy, Oakland, CA, 2022	Not applicable	CCA revenue	Ava partnered with BlocPower to electrify 60 homes with low- to moderate-income single-family households. Ava provided $1 million in project financing and $400,000 in incentives.

Consumer Programs

In addition to funding and financing sources, a variety of consumer-focused programs support sustainability initiatives. Meeting regional and state decarbonization goals will require participation from residents and businesses across the Capital Region and capitalizing on state and federal incentives is critical in supporting consumers to adopt new technologies. These programs not only support broader sustainability goals but also facilitate residential- and business-specific investments that provide direct benefits to consumers, particularly in the form of reduced utility costs.

Specifically, the consumer programs listed in this section help property owners, private vehicle owners, landowners, and other residents achieve emissions reductions in building electrification, carbon farming, and electric vehicle adoption. Consumer programs include household-level grants, incentives, low-interest financing, rebates, and tax credits. While not listed below, local utilities also offer rebates for households and businesses on building electrification and electric vehicle adoption. While local agencies do not directly facilitate these programs, they may play an important role in supporting their constituents in learning about these programs. Table 13, Table 14, and Table 15 list these consumer programs, organized by applicable implementation working group. Eligible receiving entities, including property owners, may find future incentive and rebate opportunities at The Switch Is On (www.switchison.org/ca) and Rewiring America (https://homes.rewiringamerica.org/).

Table 13. Building Electrification

Program	Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Receiving Entities
Grant	Federal	US Department of Housing and Urban Development (HUD)	**Green and Resilient Retrofit Program - Comprehensive**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance
Grant	Federal	HUD	**Green and Resilient Retrofit Program - Elements**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance
Grant	Federal	HUD	**Green and Resilient Retrofit Program - Leading Edge**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance
Grant	State	California Department of Food and Agriculture (CDFA)	**State Water Efficiency and Enhancement Program (SWEEP)**	Property owners that operate farmland
Incentive	State	California Department of Community Services and Development (CSD)	**Multi-Family & Single-Family Energy Efficiency and Renewables**	Low-income households
Incentive	State	CEC	**Equitable Building Decarbonization Program: Direct Install Program & Statewide Incentive Program**	Property owners

Table 13. Building Electrification (continued)

Program	Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Receiving Entities
Rebate	Federal	DOE	**Home Energy Rebates Program**	Households, with a portion of funds for low- and moderate-income households
Rebate	Federal	DOE	**Tribal Electrification and Appliance Rebates Program**	Residents belonging to Federally-Recognized Tribes
Rebate	Federal	DOE	**Property Assessed Clean Energy Programs**	Commercial and residential property owners
Rebate	State	CEC	**Building Initiative for Low-Emissions Development (BUILD) Program**	Private and public owners, nonprofit organizations
Rebate	State	CSD	**Community Solar Rebates**	Low-income households
Rebate	State	CSD	**Farmworker Housing Single-Family Energy Efficiency and Solar Photovoltaics Rebates**	Low-income farmworker households
Tax Credit	Federal	Internal Revenue Service (IRS)	**Energy Efficient Home Improvements Credit**	Property owners
Tax Credit	Federal	IRS	**Residential Clean Energy Property Credit**	Property owners

Table 14. Carbon Farming

Program	Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Receiving Entities
Grant	State	CDFA	**Conservation Agriculture Planning Grants Program**	Property owners that operate farmland
Grant	State	CDFA	**SWEEP**	Property owners that operate farmland
Grant	State	CDFA	**Healthy Soils Incentives Program (HSP)**	Property owners that operate farmland

Table 15. Public Fleet EVs & Transit

Program	Type (i.e., Federal, State)	Administering Organization	Program Name	Eligible Receiving Entities
Incentive	State	CARB	**Clean Cars 4 All Program**	Individuals who live in priority communities and meet income requirements
Low-Interest Financing	State	CARB	**Financing Assistance for Lower-Income Customers**	Low-income residents with income at or below 300% Federal Poverty Level
Rebate	State	CARB	**Clean Vehicle Assistance Program**	Individuals who live in priority communities and meet income requirements
Rebate	State	CARB	**Clean Vehicle Rebate Project (CVRP)**	Residents who meet income requirements

Moving Toward Implementation

Developing a successful funding and financing strategy to plan for and implement Plan measures requires pursuing multiple revenue sources that depend upon the existing funding landscape, political opportunities, administrative capacity, and relative project priority between measures and projects.

In the near term, local entities within the Capital Region may consider the following in the development of funding and financing strategies:

- Understand current funding sources and identify opportunities to include Plan measures within existing sources of revenue.
- Assess the scale of funding and timeline of associated projects and prioritize projects accordingly, giving consideration to the current grants landscape.
- Engage local stakeholders, including nonprofit and community-based organizations, prior to the pursuit of grant funding opportunities.
- Match projects with current federal and state grant opportunities and develop partnerships to conduct initial studies, as needed, to support applications. Identify local match funding, as needed.

REFERENCES

[1] *These programs were active at the time of research, though programs may be added or removed in the future.*

[2] *Legislative Analyst's Office. 2024. Proposition 4. Available: https://www.lao.ca.gov/BallotAnalysis/Proposition?number=4&year=2024. Accessed November 2024.*

[3] *Ballotpedia. 2024. Folsom, California, Measure G, Sales Tax Enactment Measure (November 2024). Available: https://ballotpedia.org/Folsom,_California,_Measure_G,_Sales_Tax_Enactment_Measure_(November_2024). Accessed: November 2024.*

[4] *Luna, N. 2024. U.S. elections: Will the Inflation Reduction Act be repealed? Available: https://www.columbiathreadneedleus.com/institutional/insights/latest-insights/us-elections-will-the-inflation-reduction-act-be-repealed/details?id=5852cff2-2203-45b9-85f0-15e732a4cc7b. Accessed November 2024.*

[5] *SMUD. 2023. SMUD to issue $495 million in revenue bonds. Available: https://www.smud.org/Corporate/About-us/News-and-Media/2023/2023/SMUD-to-issue-$495-million-in-revenue-bonds. Accessed November 2024.*

[6] *US Department of Commerce. 1990. 1990 Census of Population. Available: https://www2.census.gov/library/publications/decennial/1990/cp-1/cp-1-6-1.pdf. Accessed November 2024.*

[7] *US Department of Transportation. 2024. Bipartisan Infrastructure Law. Available: https://www.fhwa.dot.gov/bipartisan-infrastructure-law/funding.cfm#:~:text=The%20Infrastructure%20Investment%20and%20Jobs,fiscal%20years%202022%20through%202026). Accessed: November 2024.*

Chapter 9. Next Steps for Implementation

The CPRG program facilitated a collaborative process between regional stakeholders to catalyze climate action in the Capital Region. The Sac Metro Air District, the CPRG steering committee, the OAC, and community stakeholders distilled years of work and formed a list of regional priorities that will provide benefits throughout the Capital Region. Local partners identified commonalities within their existing climate, sustainability, and energy plans. Community stakeholders shared their priority actions for climate mitigation and resiliency through the community benefits survey. The 26 GHG reduction measures selected for this Plan address GHG emissions from the transportation, energy, waste management, water, and natural and working lands sectors. Partners will work together to reach the proposed scale of implementation of these measures by 2030 and 2045, supporting not only our regional climate goals, but the state of California's as well.

EPA's Goal for the CPRG Program: Deliver cleaner air by reducing harmful air pollution in our communities.

Implementing the Plan Measures

Through this Plan, progress on measure implementation will be accelerated moving forward, as several of these measures are already designated for action by participating jurisdictions, agencies, and Tribal partners. Ordinances requiring additional building energy efficiency and plans to transition to zero-emission fleets are continually being drafted and approved. The regional collaboration of the seven working groups, support at the federal and state level, lessons learned, and scale of implementation can expedite this transition to a greener economy and ensure our actions are cost effective and fair. In addition, various complementary initiatives to advance the economic resiliency and sustainability of the region are ongoing. We Prosper Together – the Capital Region initiative funded by California Jobs First – aims to strengthen, diversify, and invest in local economies and industries that create high quality jobs for the transition to a greener economy.

To that end, the collaboration formed under the CPRG program will continue and be supported as the Sac Metro Air District develops a status update between 2025 and 2027. This project has created a multidisciplinary network of local and regional agencies, organizations, businesses, and associations that work to implement climate solutions and achieve climate goals in local communities and throughout the Capital Region. The Sac Metro Air District will rely on existing and new partnerships to guarantee the continuation of community and stakeholder engagement during the implementation and evaluation stages and serve as support for the seven working groups that were formed to implement the Plan measures.

Funding is another critical element for implementation. In addition to submitting a CPRG Implementation Grants application in April 2024, the Plan has identified several federal and state funding opportunities for climate projects that each working group is considering. Future tasks include the development of implementation roadmaps that will guide each working group in their pursuit of transforming the GHG reduction measures into fully funded projects. Given capacity limitations for local jurisdictions, agencies, and Tribal partners, the Sac Metro Air District and working groups will be able to leverage their expertise to efficiently procure capital and operating funds to realize the vision of this Plan.

Realizing Reductions and Co-Benefits for Communities

The Capital Region is not only susceptible to the effects of a changing climate but also contributes its fair share of GHG emissions to the statewide inventory. Ultimately, the implemented measures will reduce GHG emissions in the region by increasing infill development over greenfield development, electrifying buildings and vehicles, reducing VMT and supporting sustainable active modes, sequestering CO_2, and maintaining resilient forests to reduce wildfire smoke exposure.

The Sac Metro Air District will continue to play a leading role in the strategic coordination between stakeholders to determine which climate actions are currently needed and what will be necessary long-term to meet regional climate goals in the Capital Region. Stakeholders will monitor and evaluate each project and measure implemented under the CPRG program and provide feedback to partnering jurisdictions and the Sac Metro Air District on which projects and measures are performing as expected, and which ones need further assessment or modification. Each new project will also undergo environmental review to ensure compliance with CEQA and will need to address community and stakeholder concerns. Additionally, under the Community Air Protection Program, the AB 617 community in South Sacramento-Florin and nine other locally nominated communities disproportionately impacted by poor air quality in Sacramento will be a focus for continued air pollution reduction. Continued communication between regional partners and the community increases the likelihood of project or measure adoption and success. The Sac Metro Air District will continue to monitor implementation and will be issuing a status report to EPA in 2027 on progress to date.

Broadening Our Perspective

Meeting the GHG emissions reduction targets and achieving the region's climate goals will require additional collaboration between federal, state, and regional partners. The mobile (on-road) sector continues to be the largest source of emissions in the Capital Region and the industrial sector is the second largest source of emissions in the region. Even with the implementation of all Plan measures, a significant amount of mobile and industrial sector emissions would remain. Federal and state level action to support decarbonization and the transition to cleaner fuel use are critical to further accelerate progress in the region. To meet the 2030 and 2045 targets, additional reductions could be achieved through carbon removal from forests and CDR strategies. Collectively, implementation of the GHG mitigation measures in this Plan and subsequent strategies will create a healthier environment in the Capital Region and more sustainable communities in the future.

Appendix A. Guidelines for Ongoing Emissions Tracking and Inventory Refinement

Developing a comprehensive, bottom-up regional emissions inventory by sector and county is time and resource intensive. For purposes of the Plan, a top-down approach was used to evaluate emissions for the sectors included in this inventory. Below are some aspects of the methodology that could be refined to develop a more accurate emission inventory.

- The USDA National Agricultural Statistics Service (NASS) agricultural data for 2019 was not available at the time of this analysis so 2017 values were used as a scaling surrogate.
- For the industrial sector emission calculations, the CARB Mandatory GHG Reporting Regulation program does not include facilities that emit less than 10,000 metric tons per year; therefore, industrial facilities emitting less than the threshold were not included in this sector.
- Enteric fermentation agricultural emissions were scaled with a singular aggregated livestock factor and do not consider animal (e.g., sheep) specific scalars.
- A California-wide default assumption for the percentage of area with tree coverage was assumed to be consistent across the counties in the Sacramento-Roseville CSA for the forestry sector sequestered emission calculations.
- CalRecycle's Recycling and Disposal Reporting System report did not have a complete dataset for landfill tonnage in 2019 for all counties; therefore, 2020 was used as a surrogate for all counties excluding Sutter, which had a complete dataset for 2021.
- The statewide recycling rate was assumed to be consistent across the Sacramento-Roseville CSA due to lack of county-specific data.
- CH_4 and N_2O emissions were not available for the off-road subsector from the EMFAC2021 Web Database; therefore, emissions are based solely on CO_2.
- Line-Haul Class I and passenger locomotives make up the mobile rail sector. Emissions for switcher locomotives by county were not available.
- Aircraft emissions are not included in the inventory. However, some airport emissions are captured in the inventory across various sectors: the off-road subsector (ground support equipment), the on-road subsector for vehicle fleets in the region servicing airports, the commercial sector for natural gas combustion, and the electricity consumption sector for airport facilities electrical consumption.

Appendix B. Inventory Methods and Assumptions by Sector

Residential Sector

Residential sector emissions were downscaled from the statewide inventory with unique metrics applicable to each subsector. Natural gas consumption was used as a metric to scale fuel combustion and fugitive emissions, as natural gas fuel combustion, compared to other fuel types like propane and wood, accounted for the majority of residential sector combustion-related emissions (>93%) in the California statewide inventory. The CEC's natural gas consumption by county data was used to downscale from state- to county-level emissions. Human population statistics for 2019 were used to downscale other subsector emissions such as landscape fertilizer usage and ODS. The residential sector methodology and data sources are summarized in Table 1.

Table 1. Residential Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Residential	Fuel Combustion, Transmission and Distribution Fugitives	Downscaled	Residential Natural Gas Consumption	Million Therms	CEC[1]
	Fertilizer Usage, ODS, Fuel Storage	Downscaled	2019 Population Data by County	Population Count	State of California Department of Finance[2]

Commercial Sector

Emissions were downscaled from the statewide inventory to the county level by unique subsectors. The subsectors included fuel combustion, commercial use of nitrogen fertilizer on turf, fuel storage, and the use of ODS substitutes. California's non-residential natural gas consumption by county from the CEC was used to downscale the fuel combustion-related emissions from the state level down to the target counties. The remaining three subsectors, which accounted for 43% of the commercial sector emissions, were downscaled using 2019 human population data. The commercial sector methodology and data sources are summarized in Table 2.

Table 2. Commercial Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Commercial	Fuel Combustion of Various Subsectors	Downscaled	Non-Residential Natural Gas Consumption	Million Therms	CEC[3]
	ODS, Fertilizer Usage, Fuel Storage of Various Subsectors	Downscaled	Population Data by County	Population Count	State of California Department of Finance[4]

Recycling and Waste Sector

Emissions were downscaled from the statewide inventory with metrics applicable to each subsector. California's 2020 landfill tonnage from CalRecycle's Recycling and Disposal Reporting System (RDRS) was leveraged to downscale the landfill and solid waste treatment subsectors. Data for landfill tonnage at the county level for 2019 was not available, so 2020 was used. The 2020 population data from the U.S. Census data for California and area counties was used to create scalar values for the wastewater treatment category. The recycling and waste sector methodology and data sources are summarized in Table 3.

Table 3. Recycling and Waste Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Recycling and Waste	Landfills, Solid Waste Treatment	Downscaled	Landfill Tonnage	Tons	CalRecycle's RDRS[5]
	Wastewater Treatment	Downscaled	Population Data by County	Population Count	State of California Census[6]

Agricultural Sector

Emissions were downscaled from the statewide inventory with subsector specific metrics. For agriculture energy use, CARB's OFFROAD2021 v1.0.5 model was used to derive by-county scalers based on fuel consumption from agricultural sector off-road equipment. The fuel usage was converted to energy consumption based on the fuel specific's energy content high heating value. The USDA NASS published California's 2017 agriculture cropland, livestock population, and rice production statistics at the county level. The 2017 USDA NASS data were used to downscale the other subsectors. The agricultural sector methodology and data sources are summarized in Table 4.

Table 4. Agriculture Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Agriculture	Equipment Energy Use	Downscaled	Energy Consumption (Fuel Usage x Fuel Higher Heating Value)	British Thermal Unit (BTU)	CARB's OFFROAD2021 v1.0.5 model[7]
	Residue Burning, Soil Management, Histosol Cultivation	Downscaled	Cropland Acreage	Acres	USDA NASS[8]
	Enteric Fermentation, Manure Management	Downscaled	Livestock Inventory	Count of Cattle, Hogs, Chickens	USDA NASS[9]
	Rice Cultivation	Downscaled	Rice Production	Hundredweight (CWT)	USDA NASS[10]

Industrial Sector

Emissions were gathered from the CARB's Mandatory Reporting GHG Report (MRR). The facility ZIP code was leveraged to identify and assign the emissions to the counties within the Sacramento-Roseville CSA. Not all industries within the Sacramento-Roseville CSA region are included because the industrial sector inventory focuses on major emitting facilities. For instance, the warehousing industry is a prominent business in the region, however warehousing emissions are not included in the industrial sector. Warehousing emissions associated with electricity use are included under the electricity sector; warehousing emissions associated with natural gas use are included under the commercial sector; and warehousing emissions associated with vehicles and equipment are included under the mobile sector. Similarly, any indirect electricity consumption in industrial sectors is captured under the non-residential portion of the electricity sector.

The MRR program represents approximately 80% of the total industrial sector GHG emissions included in the state's GHG inventory. The MRR program requires annual reporting of GHGs by industrial sources that emit more than 10,000 MT CO_2e, but also includes natural gas and petroleum fuel suppliers and marketers (storage and transport intermediate facilities), as well as electricity importers. Facilities with 2019 emissions reported under the EPA's GHG Reporting Program that are not covered by CARB's MRR have also been added to the dataset. The industrial sector methodology and data sources are summarized in Table 5.

Table 5. Industrial Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Industrial	Manufacturing, Petroleum Marketing, Petroleum Refining, Solvent & Chemicals, Transmission and Distribution, Academic Facilities	Bottom Up	Facility Reported Greenhouse Gas Emissions	MT CO_2e	CARB's MRR[12], complemented with EPA's Flight Tool[13]

Electricity Sector

The electricity sector includes emissions related to electricity usage within each of the Sacramento-Roseville CSA counties. In the 2024 Capital Region Climate Priorities Plan, the EPA's 2019 Emissions & Generation Resource Integrated Database (eGRID) emission factors (in pounds CO_2e/megawatt-hour) for the California average grid mix were combined with electricity consumption by county to estimate regional emissions (also known as the location-based method). For the Comprehensive Capital Region Climate Priorities Plan, electricity emissions were updated to follow the market-based method to better reflect local utility clean energy goals. 2019 electricity emissions factors per electric utility were obtained from the CAPCOA Handbook. Switching from the location- to market-based method decreased 2019 electricity sector GHG emissions by 6% and gross GHG emissions by approximately 1%. Electricity consumption quantities were obtained from the CEC. The electricity sector methodology and data sources are summarized in Table 6.

Table 6. Electricity Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Electric Power	Electricity Consumption	Bottom Up	Electricity Consumption	Gigawatt-hours	CEC[14] CAPCOA Handbook[15]

Mobile Sector

Emissions were gathered from CARB's various emissions tools. On-road vehicle GHG emissions were derived from the EMFAC2021 model for the Sacramento-Roseville CSA counties. Off-road equipment emissions at the county level were generated from EMFAC2021 for selected sectors including airport ground support, cargo handling equipment, construction and mining, forestry, industrial, lawn and garden, light commercial, military tactical support, oil drilling, portable equipment, recreational, and transport refrigeration units. Freight rail emissions by county were derived from CARB's rail emissions tool, while the passenger locomotive emissions (Amtrak) were provided by Capitol Corridor Joint Powers Authority for the entire region and segmented by county using Geographic Information System (GIS) mapping. Waterborne sources and emissions by county were derived from EMFAC2021 and cover commercial harbor craft and pleasure craft. The mobile sector methodology and data sources are summarized in Table 7.

Table 7. Mobile Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Mobile	On-Road, Off-Road, Waterborne	Bottom Up	GHG Emissions	MT CO_2e	CARB's EMFAC2021 [15]
	Rail (Freight & Passenger)	Bottom Up	GHG Emissions	MT CO_2e	CARB's Linehaul Class I Emissions Inventory Tool (2021)[17] Regional Amtrak Emissions[18]

Forestry Sector

Emissions were calculated using EPA's Local GHG Inventory Tool (LGGIT).[18] Net carbon sequestration estimates are based on the percentage of area with tree coverage, based on statistics from USDA Forest Service. Using the carbon sequestration factor from the LGGIT (in metric tons of CO_2 per hectare-year) and the estimated tree coverage area by county, the amount of CO_2 sequestered by trees for each of the counties in the Sacramento-Roseville CSA was estimated. The forestry methodology and data sources are summarized in Table 8.

Table 8. Forestry Sector Method and Data Sources

Sector	Subsector	Calculation Methodology	Activity or Downscaling Metric	Unit	Source
Urban Forestry (Carbon Sink)	None	Bottom Up	Area Coverage	Square kilometers	EPA LGGIT[24] USDA Forest Service's Urban Canopy GIS Data[25]

REFERENCES

1 *CEC Gas Consumption by County for 2019. http://www.ecdms.energy.ca.gov/gasbycounty.aspx*

2 *Population and Housing Estimates for Cities, Counties, and the State from State of California's Department of Finance (DOF). 2019 population statistics. https://dof.ca.gov/forecasting/demographics/estimates/estimates-e5-2010-2020/*

3 *CEC Gas Consumption by County for 2019. https://www.eia.gov/state/seds/seds-data-complete.php?sid=US*

4 *Population and Housing Estimates for Cities, Counties, and the State from State of California's Department of Finance (DOF). 2019 population statistics. https://dof.ca.gov/forecasting/demographics/estimates/estimates-e5-2010-2020/*

5 *CalRecycle's Recycling and Disposal Reporting System (RDRS). 2020 https://www2.calrecycle.ca.gov/RecyclingDisposalReporting/Reports OverallJurisdictionTonsForDisposal*

6 *California: 2020 Census. 2020. https://www.census.gov/library/stories/state-by-state/california-population-change-between-census-decade.html California: 2020 Census. 2020.*

7 *California ARB's OFFROAD2021 v1.0.5 model . 2019 https://arb.ca.gov/emfac/offroad/emissions-inventory/fbb6d1db4c4d51d0b8f3ce407a76075486e734b0*

8 *United States's Department of Agriculture's Agricultural Census. 2017. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1, Chapter_2_US_State_Level/*

9 *United States's Department of Agriculture's Agricultural Census. 2017. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1, Chapter_2_US_State_Level/*

10 *United States's Department of Agriculture's Agricultural Census. 2017. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1, Chapter_2_US_State_Level/*

11 *CARB. MRR Program FAQ. 2023. ttps://ww2.arb.ca.gov/sites/default/files/classic/cc/reporting/ghg-rep/reported-data/2022mrrfaqs.pdf*

12 *CARB. Mandatory GHG Reporting – Reported Emissions. 2019. https://ww2.arb.ca.gov/mrr-data*

13 *EPA Flight: 2022 Greenhouse Gas Emissions from Large Facilities. 2019. Accessed online at EPA Flight Website*

14 *CEC. 2019 http://www.ecdms.energy.ca.gov/elecbycounty.aspx*

15 *CAPCOA. 2024. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://caleemod.com/documents/handbook/full_handbook.pdf*

16 *CARB's Emission Factor (EMFAC) 2021 Model. 2019. https://arb.ca.gov/emfac/emissions-inventory/fbb6d1db4c4d51d0b8f3ce407a76075486e734b0*

17 *MSEI Off-road Diesel Model and Documentation. 2019. https://ww2.arb.ca.gov/our-work/programs/msei/road-categories/road-diesel-models-and documentation*

18 *Capitol Corridor Joint Powers Authority. 2023. Email communication from James Allison. September 28.*

19 *EPA. Local Greenhouse Gas Inventory Tool. Accessed online September 2023 at https://www.epa.gov/statelocalenergy/download-local-greenhouse-gas inventory-tool*

20 *USDA Forest Service. Urban Canopy GIS Data. Accessed online September 2023 at https://www.fs.usda.gov/detail/r5/communityforests/?cid=fseprd647385*

Appendix C. GHG Reduction Measure Approach

Built Environment Measures

BE-1: Land Use Improvements
BE-2: Building Energy Efficiency Improvements
BE-3: Increase Use of Renewable Energy in New and Existing Buildings
BE-4: Building Decarbonization/Electrification
BE-5: Construction and Landscape Equipment Emissions Reduction
BE-6: Install Cool Pavement
BE-7: Reduce Solid Waste
BE-8: Reduce Water Utility Emissions
BE-9: Reduce Wastewater Emissions
BE-10: Require Edible Food Recovery Program Partnerships with Food Generators

Transportation Measures

TR-1: ZEV Adoption and Charging Infrastructure
TR-2: Public Transit Improvements
TR-3: Provide Bus Rapid Transit
TR-4: Roadway Improvements for Multi-Modal Use and Access
TR-5: Transportation Demand Management Program
TR-6: Active Modes of Transportation for Youth
TR-7: Establish a School Bus Program
TR-8: Electric Bikeshare

Natural and Working Lands Measures

NW-1: Wildfire Resilience and Management
NW-2: Biomass Energy
NW-3: Increase Tree Canopy
NW-4: Carbon Sequestration Program/Carbon Farming
NW-5: GHG Local Offset Program
NW-6: Natural and Working Lands Equipment Emissions Reduction

Energy Measures

E-1A: Onsite Solar Canopies
E-1B: Battery Storage Supported Microgrids

Updates Made to 2030 GHG Reduction Methodology

The 2030 measure GHG reductions calculated for the Capital Region Climate Priorities Plan were updated with the following changes for the Comprehensive Capital Region Climate Priorities Plan:

- Greenhouse gas GWPs were updated from the Intergovernmental Panel on Climate Change Sixth Assessment Report (AR6) 20-year GWPs to AR4 100-year GWPs to match the region's GHG inventory
- Electricity emissions factors were updated from the estimates in the CAPCOA Handbook to the electricity emission factors forecast for the Plan GHG emissions inventory projections (based on utility-specific zero carbon electricity targets and Senate Bill 100 requirements – see Appendix B for more information)
- CARB EMFAC emissions model on-road and off-road data that referenced the year 2027 was updated to reference the year 2030
- The BAU EMFAC fleet mix assumptions for some Transportation measures were updated to fully reflect the entire fleet fuel mix instead of only partial fuel types (e.g., only gasoline and diesel)

Measure-specific methodology updates are described in the measure sections below.

2045/2050 GHG Reduction Methodology

Measure GHG reductions in 2045 were calculated by estimating GHG reductions in 2050 then interpolating 2045 GHG reductions from the 2030 and 2050 reductions. This applies to all measures except for those that reduce electricity use or add clean energy sources – the electricity emissions factor is zero in 2045, so these measures do not produce additional GHG reductions in 2045 or 2050. Because only 2030 and 2050 inputs were used to calculate GHG reductions and 2045 reductions were interpolated, the measure calculation inputs listed in this Appendix are for the years 2030 and 2050. In the main Plan document, the 2050 inputs are used for the 2045 Scale of Application section for each measure for simplicity.

Transportation Methodology Note

Many measures reference CARB EMFAC2021 v1.0.2 and Off-Road v1.1.0 data for BAU assumptions on regional vehicle types, fuel use, vehicle miles traveled, and emissions. However, neither the EMFAC data nor the GHG BAU forecasts include the impacts of California's ACC II legislation (EMFAC was not updated with ACC II until v2.0.0 in mid-2025). With ACC II in place, all light duty vehicles in California are expected to be BEV or PHEV by 2050. Because ACC II is not integrated into GHG emissions forecasts or measure GHG reductions, a portion of the estimated GHG reductions for ZEV-related actions will most likely be realized through state regulation and not regional action. This means the current ZEV-related measure GHG reductions are likely overestimated as the BAU vehicle fleet will likely generate a much lower amount of emissions than modeled.

Co-Pollutant Methodology Note

Co-pollutant reductions and methodologies are included in the individual measure write-ups in the Comprehensive Capital Region Climate Priorities Plan measures chapter.

Built Environment Measures

BE-1: Land Use Improvements

Summary Description

This measure includes two parts:

- Increasing residential density, which results in shorter and fewer trips by single-occupancy vehicles, thus reducing GHG emissions.
- Infill housing development programs.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure T-1 "Increase Residential Density" and Sac Metro Air District (2023) for Measure T-55 "Infill Development."

1. Increase Residential Density: GHG reductions are calculated based on the estimated percent increase in residential density.
2. Infill Development: GHG reductions are estimated based on the reduction in VMT based on creating infill housing closer to the downtown area.

For increased residential density, emission reduction percentages are applied to EMFAC2021 emissions from the circa 2030 and 2050 regional commuter vehicle fleet to estimate final emission reductions.

Inputs

T-1. Increase Residential Density	2030	2050
Percent Increase in Residential Density	20%	25%
T-55. Infill Development	**2030**	**2050**
Decrease in VMT from Infill Housing	148 million VMT	132 million VMT

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

CARB. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory. Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

BE-2: Building Energy Efficiency Improvements

Summary Description

This measure requires new and existing buildings to install ENERGY STAR-certified appliances that are more energy efficient than conventional appliances.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure E-2 "Require Energy Efficient Appliances." GHG reductions are based on electricity reduction estimates for ENERGY STAR appliances compared to conventional appliances. Calculations assume that 40% of total electricity consumption is for building use; "high turnover restaurant" and "single family housing" were selected to represent commercial and residential land use types, respectively. The total measure reduction percentage is based on the percent electricity reduction by appliance type and the average distribution/ percentage of building electricity used by each appliance. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. In 2045/2050, the measure results in no GHG reductions as it reduces electricity use that already has an emissions factor of zero (i.e., produces no emissions) in the business-as-usual forecast by 2045. 2030 and 2050 electricity use per county was calculated using service population forecasts from the SACOG Draft 2025 Blueprint scenarios (Note: 2030 calculations previously used 2016 data).

Inputs

E-2. Require Energy Efficient Appliances	2030	2050
Electricity for building use	40%	40%
Level of participation	20%	40%
Reduction in electricity from appliance replacements	5.86%	5.86%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

US Energy Information Administration – EIA. 2023. How much energy is consumed in U.S. buildings?. Accessed online in January 2024 at: https://www.eia.gov/tools/faqs/faq.php?id=86&t=1

BE-3: Increase Use of Renewable Energy in New and Existing Buildings

Summary Description

This measure requires new and existing developments to install and generate surplus renewable energy onsite.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure E-17 “Require Renewable Surplus Buildings.” GHG reductions are based on surplus renewable energy (in MWh) from onsite renewable energy production. Calculations assume the new and existing buildings subject to this measure are all-electric and have no onsite fossil fuel consumption. If there is onsite fuel combustion of natural gas, propane, or other fuels, then the estimated GHG reduction would be lower. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. In 2045/2050, the measure results in no GHG reductions as it reduces electricity use that already has an emissions factor of zero (i.e., produces no emissions) in the business-as-usual forecast by 2045.

Inputs

E-17. Require Renewable Surplus Buildings	2030	2050
Onsite surplus renewable energy production	250,000 MWh/yr	475,240 MWh/yr

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EPA. 2020. Emission Factors for Greenhouse Gas Inventories. March. Accessed online in January 2024 at: https://www.epa.gov/sites/production/files/2020-04/documents/ghg-emission-factors-hub.pdf

BE-4: Building Decarbonization/Electrification

Summary Description
This measure includes two parts:

- Deploying new commercial or residential developments that are all-electric with no natural gas usage.
- Limiting wood-burning devices and natural gas/propane fireplaces in new and existing residential developments.

Emission Reduction Estimation Approach
The estimated reductions are based on the CAPCOA Handbook methodology for Measure E-14 "Limit Wood Burning and Natural Gas/Propane Fireplaces in Residential Development" and E-15 "Require All-Electric Development."

1. Limit Wood-Burning Devices and Natural Gas/Propane Fireplaces: GHG reductions were estimated based on the use of electricity in electric heat pumps and electric fireplace inserts to replace fuel combustion emissions from wood-burning devices and natural gas/propane fireplaces.
2. All-Electric Development: GHG reduction was estimated based on the usage of electricity instead of natural gas. The energy use from commercial buildings was estimated by averaging across several land use types (general office building, high turnover sit down restaurant, regional shopping center, and research and development). The energy use from residential buildings was estimated from averaging across two land use types (single family housing and mid-rise apartments).

Wood, propane, and natural gas carbon intensities as well as burning device, fireplace type use, and distribution were provided by CalEEMod defaults. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. The CAPCOA equation calculates GHG reductions that include both biogenic and non-biogenic CO_2 reductions. Biogenic reductions are typically accounted for separately from fossil fuel reductions as biogenic emissions are not typically included in GHG inventories (e.g., the state of California GHG inventory accounts for biogenic emissions separately from their inventory).

Inputs

E-14. Limit Wood Burning	2030	2050
Multi-family housing with no wood burning	1,500 dwelling units	3,000 dwelling units
Single-Family Housing With No Wood Burning	4,000 dwelling units	8,000 dwelling units
E-15. Require All-Electric Development	**2030**	**2050**
All-electric new commercial buildings	50 million square feet	75 million square feet
All-electric new residential buildings	75,000 residences	100,000 residences

REFERENCES

CalEEMod. 2022.1. Accessed online in January 2024 at: http://www.caleemod.com

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EPA. 2020. Emission Factors for Greenhouse Gas Inventories. March. Accessed online in January 2024 at: https://www.epa.gov/sites/production/files/2020-04/documents/ghg-emission-factors-hub.pdf

BE-5: Construction and Landscape Equipment Emissions Reduction

Summary Description

This measure includes three parts:

- Use of electric- or hybrid-powered construction equipment.
- Use of cleaner-fuel construction equipment.
- Replacing gas-powered landscape equipment with zero-emission equivalent equipment.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure C-1-A “Use Electric or Hybrid Powered Equipment,” C-1-B “Use of Cleaner-Fuel Equipment,” and LL-1 “Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape Equipment.”

1. Use Electric- or Hybrid-Powered Equipment: GHG reductions are based on using electric construction equipment and applicable electric generators instead of conventional equipment.
2. Use of Cleaner-Fuel Construction Equipment: GHG reductions are based on using cleaner-fuel construction equipment instead of conventional equipment.
3. Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape Equipment: GHG reductions are based on using zero-emission lawn and garden and light commercial equipment instead of conventional equipment.

For all three measures, GHG reductions are based on the reductions estimated for similar construction equipment measures in the Sacramento Climate Action Plan for 2016. Emissions reduction percentages are applied to circa 2030 and 2050 EMFAC2021 emissions for applicable equipment sectors. GHG reductions estimates consider emissions related to increased electricity usage by new electric equipment. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. As Measures C-1-A and C-1-B apply to the same regional fleet of construction equipment, measure penetration cannot add to over 100% for both components combined.

Inputs

C-1-A. Use Electric or Hybrid Construction Equipment	2030	2050
Penetration	60%	60%
C-1-B. Use of Cleaner-Fuel Construction Equipment	**2030**	**2050**
Penetration	40%	40%
LL-1. Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape Equipment	**2030**	**2050**
Penetration	10%	90%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

CARB. 2023. Off-Road Web Platform. Model Version 1.1.0. Available at: https://arb.ca.gov/emfac/offroad/

Sacramento County. 2016. Sacramento Climate Action Plan. Available at: https://planning.saccounty.gov/PlansandProjectsIn-Progress/Documents/Climate%20Action%20Plan/Final%20Climate%20Action%20Plan.pdf

BE-6: Install Cool Pavement

Summary Description

This measure includes installing cool pavement in place of dark pavements to reduce the electricity needed to provide cooling.

Emission Reduction Estimation Approach

The estimated GHG emission reductions are based on the CAPCOA Handbook Update methodology (Sac Metro Air District, 2023) for Measure E-21 “Install Cool Pavement.” The GHG reduction was estimated based on energy savings associated with installing cool pavement offset by the increase in natural gas usage in the winter. Natural gas carbon intensity was conservatively assumed based on non-residential areas. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. Using the CAPCOA methodology shows that the measure will generate a net increase in 2045/2050 emissions as it is projected to decrease cooling/electricity use in 2045/2050 but increase necessary natural gas use for winter heating – known as the winter heating penalty. Electricity use for cooling produces zero emissions in 2045/2050, but natural gas use produces emissions, resulting in a net increase in emissions. However, the CAPCOA methodology likely overstates the winter heating penalty as the reference study relies upon historical winter temperatures and does not account for projected warming by mid-century. As winters grow warmer, the need for heating is likely to decrease, with Cal-Adapt showing, on average, a decline of about 25-33% in heating degree days across the Capital Region. Thus, the actual winter penalty effect is likely to be smaller than that assumed by the CAPCOA methodology, which will result in a smaller than calculated increase in heating and thus emissions from natural gas combustion. Further, by 2045/2050, a greater share of heating systems is likely to use electricity rather than natural gas. Therefore, GHG reductions were entered as zero for 2045.

Inputs

E-21. Install Cool Pavement	2030	2050
Amount of cool pavement installed	18,480,000 square feet [a]	18,480,000 square feet [a]

[a] Based on the product of 350 lane-miles and an average lane width of 10 feet.

REFERENCES

Cal-Adapt. (n.d.). Cooling Degree Days and Heating Degree Days. Data: LOCA Downscaled CMIP5 Climate Projections (Scripps Institution of Oceanography), Gridded Observed Meteorological Data (University of Colorado Boulder). Available: https://cal-adapt.org/tools/degree-days

California Code of Regulations. 2023. Cal. Code Regs. tit. 14 § 1273.01. Accessed January 2024. Accessed online in January 2024 at: https://casetext.com/regulation/california-code-of-regulations/title-14-natural-resources/division-15-department-of-forestry-and-fire-protection/chapter-7-fire-protection/subchapter-2-state-minimum-fire-safe-regulations/article-2-ingress-and-egress/section-127301-width

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

BE-7: Reduce Solid Waste

Summary Description

This measure includes two parts:

- Increasing recycling services to reduce the volume of landfilled waste.
- Implementing an organics diversion program to reduce the volume of organic waste sent to landfills.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure S-1 “Institute or Extend Recycling Services” and S-2 “Implement Organics Diversion Program.” The basis for emission reductions for each part is summarized below:

1. Institute or Extend Recycling Services: GHG reductions are based on increased recycling instead of landfilling.
2. Implement Organics Diversion Program: GHG reductions are based on increased composting instead of landfilling.

The waste profile for Single Family and Multi-Family residents was obtained from the CAPCOA Handbook. The EPA (2023) WARM model was used to estimate GHG emissions and potential emission reductions from increased recycling or composting instead of landfilling. 2030 reductions were updated using the WARM v15.2 model (originally used the v15.1 model). Population forecasts from the SACOG Draft 2025 Blueprint were used to estimate future waste quantities.

Inputs

S-1. Institute or Extend Recycling Services	2030	2050
Increase in recycled mixed paper, glass, mixed electronics, and mixed plastic	15%	20%
S-2. Implement Organics Diversion Program	**2030**	**2050**
Increase in composted food waste, yard trimmings, and mixed organics	15%	20%

REFERENCES

California Demographics. 2022. Population of each Sacramento-Roseville CSA County. Accessed online in January 2024 at: https://www.california-demographics.com/counties_by_population

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EPA. 2022. Mixed paper recycled baseline. Accessed online in January 2024 at: https://www.epa.gov/facts-and-figures-about-materials-waste-and- recycling/paper-and-paperboard-material-specific-data

EPA. 2023. WARM model. Accessed online in April 2025 at: https://www.epa.gov/warm/versions-waste-reduction-model

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

BE-8: Reduce Water Utility Emissions

Summary Description

This measure includes three parts. Reducing water utility emissions through:

- Low-flow water fixtures.
- Landscapes that are water efficient.
- Reducing or avoiding turf grass in landscapes and lawns.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure W-4 "Require Low-Flow Fixtures," W-5 "Design Water-Efficient Landscapes," and W-6 "Reduce Turf in Landscapes and Lawns."

1. Require Low-Flow Water Fixtures: GHG reductions are based on mitigating water usage associated with low-flow water fixtures.
2. Design Water-Efficient Landscapes: GHG reductions are based on mitigating water usage by replacing traditional landscape areas with water-efficient landscapes.
3. Reduce Turf in Landscapes and Lawns: GHG reductions are based on mitigating water usage by replacing or reducing turf grass in landscapes and lawns.

GHG reductions were estimated based on CAPCOA Handbook guidance estimates of water usage-related electricity reductions from each measure. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region. Population forecasts from the SACOG Draft 2025 Blueprint were used to estimate future water use. In 2045/2050, the measure results in no GHG reductions as it reduces electricity use that already has an emissions factor of zero (i.e., produces no emissions) in the business-as-usual forecast by 2045.

Inputs

W-4. Require Low-Flow Fixtures	2030	2050
Existing indoor water use	9.5 billion gallons/yr[a]	11.3 billion gallons/yr[a]
Water savings	60%	60%
W-5. Design Water-Efficient Landscapes	**2030**	**2050**
Landscape area	1,000 square feet/project	1,000 square feet/project
Special landscape area	500 square feet/project	500 square feet/project
Projects	5,000	5,000
W-6. Reduce Turf Grass in Landscapes and Lawns	**2030**	**2050**
Area of turf to be removed	200,000 square feet	200,000 square feet
Total turf area	300,000 square feet	300,000 square feet

[a] Assumed 48 gallons per day per capita of residential water use with 20% penetration

REFERENCES

California Department of Water Resources. 2022. Model Water Efficient Landscape Ordinance. Accessed online in January 2024 at: https://govt.westlaw.com/calregs/Document/IBCE97A755B6E11EC9451000D3A7C4BC3?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

BE-9: Reduce Wastewater Emissions

Summary Description

This measure would capture CH_4 from existing wastewater treatment plants and combust it to prevent its escape into the atmosphere.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure E-19 "Establish Methane Recovery in Wastewater Treatment Plants." Calculations assume that wastewater is treated at facilities with primary treatment, and that the captured CH_4 is flared. If the heat from the captured CH_4 combustion is used to generate electricity for onsite energy needs, then the estimated GHG reduction may be higher. The percentage of total wastewater treated per day affected by this measure is assumed to be 15% for the entire region based on the City of Sacramento's Climate Action Plan which includes a 15% GHG reduction goal. Wastewater treated per day was forecast using service population forecasts from the SACOG Draft 2025 Blueprint.

Inputs

E-19. Establish CH_4 Recovery in Wastewater Treatment Plants	2030	2050
Total wastewater affected by measure	15%	15%
Wastewater treated in the Sacramento-Roseville CSA	638 million liters/day	712 million liters/day

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

BE-10: Require Edible Food Recovery Program Partnerships with Food Generators

Summary Description

This measure involves partnering with food service establishments, wholesale providers, and retail sources with food recovery programs to collect edible foods which would otherwise be sent to landfills.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook Update (Sac Metro Air District, 2023) methodology for Measure S-3 "Require Edible Food Recovery Program Partnerships with Food Generators." GHG reductions are based on the avoided emissions from the decomposition of edible food in landfills, by recovering and redistributing the food for consumption. Emission reduction calculations account for the increase in GHG emissions from transportation vehicles and refrigeration equipment used in the food recovery process. Calculations assume the use of gasoline-refrigerated vans, large walk-in commercial refrigerators with solid doors, default refrigerant charge size, and default leak rates based on the CAPCOA Update. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region.

Inputs

S-3. Require Edible Food Recovery Program Partnerships with Food Generators	2030	2050
Delivery vehicles	100	150
Average miles per delivery vehicle	7,300 miles/yr	10,950 miles/yr
Refrigeration units	100	150
Refrigeration compartment per refrigeration unit	960 cubic feet	960 cubic feet
Edible food recovered per year	2,500,000 lb/yr	4,000,000 lb/yr

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

Transportation Measures

TR-1: ZEV Adoption and Charging Infrastructure

Summary Description
This measure includes two parts:

- Providing EV charging infrastructure to decrease PHEV gasoline mileage.
- Use of cleaner-fuel vehicles, including BEVs and PHEVs.

Emission Reduction Estimation Approach
The estimated reductions are based on the CAPCOA Handbook methodology for Measures T-14 "Provide Electric Vehicle Charging Infrastructure" and T-30 "Use of Cleaner-Fuel Vehicles.

1. Provide EV Charging Infrastructure: GHG reductions are based on the increase in electric mode mileage share from PHEVs with availability of chargers offset by emissions from increased energy demand.
2. Use of Cleaner-Fuel Vehicles: GHG reductions for BEVs and PHEVs are calculated based on the replacement of conventional fuel vehicles with these cleaner fuel vehicle options.

Emissions reduction percentages are applied to base emissions for a 2030 and 2050 light-duty vehicle fleet based on EMFAC2021. GHG reductions estimates consider emissions related to increased electricity usage by EVs. Electricity carbon intensity was from the Plan GHG emissions forecasts, which use a market-based emissions projection method to forecast the electricity carbon intensity for electricity suppliers in the region.

Inputs

T-14. Provide Electric Vehicle Charging Infrastructure	2030	2050
Chargers installed	6,500	13,000
Total vehicles accessing chargers per day	12,175	28,794
T-30. Use of Cleaner-Fuel Vehicles	**2030**	**2050**
Vehicle fleet converted for each potential type	15%	15%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

CARB. 2023. Emission FACtor 2021 (EMFAC) Model Version 1.0.2. Available at: https://arb.ca.gov/emfac/emissions-inventory/

Sacramento County. 2016. Sacramento Climate Action Plan. Available at: https://planning.saccounty.gov/PlansandProjectsIn-Progress/Documents/Climate%20Action%20Plan/Final%20Climate%20Action%20Plan.pdf

TR-2: Public Transit Improvements

Summary Description
This measure includes three parts:

- Expansion of local transit network coverage or hours to encourage the use of transit.
- Increasing public transit service frequency to improve the user experience and attractiveness of transit service.
- Providing transit bus shelters to improve comfort and safety while waiting for the bus.
- Providing transit shelters with real-time arrival information to improve comfort and safety while waiting for the bus.

Emission Reduction Estimation Approach
The estimated reductions are based on the CAPCOA Handbook methodology for Measure T-25 “Extend Transit Network Coverage or Hours” and T-26 “Increase Transit Service Frequency” and Sac Metro Air District (2023) methodology for Measure T-46 “Provide Transit Shelters.”

1. Extend Transit Network Coverage or Hours: GHG reductions are calculated based on increase in transit service hours associated with displacing some passenger car and passenger truck commutes.
2. Increase Transit Service Frequency: GHG reductions are estimated based on a percentage increase in transit frequency and level of implementation across transit routes displacing some passenger-car and passenger-truck commutes.
3. Provide Transit Shelters: GHG reductions are estimated based on percent increase in bus transit trips, due to providing bus shelters and real-time arrival information, to replace some passenger-car and passenger-truck trips.

Emissions reduction percentages are applied to EMFAC2021 emissions from the 2030 and 2050 regional commuter vehicle fleet to estimate final emission reductions. The CAPCOA formulas do not reflect any increase in transit vehicle travel and emissions, which can at least partially offset the reduction in GHG emissions from passenger vehicle travel.

Inputs

T-25. Extend Transit Network Coverage or Hours	2030	2050
Total transit service hours before expansion	4,549	4,549
Total transit service hours after expansion	8,399	8,399
T-26. Increase Transit Service Frequency	**2030**	**2050**
Increase in transit frequency	30%	40%
Level of implementation	90%	90%
T-46. Provide Transit Shelters	**2030**	**2050**
Transit stops with new bus shelters and benches	48	48
Average boardings per day at each transit station with added amenities	100	100
Average boardings per day across the transit agency	26,250	27,563

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

CARB. 2023. Emission FACtor 2021 (EMFAC) Model Version 1.0.2. Available at: https://arb.ca.gov/emfac/emissions-inventory

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

Sacramento Area Council of Governments (SACOG). 2016. Metropolitan Transportation Plan/Sustainable Communities Strategy. Available at: https://www.sacog.org/sites/main/files/file-attachments/mtpscs_complete.pdf

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

Sacramento Regional Transit District Fact Sheet. Available at: https://www.sacrt.com/documents/RT%20Fact%20Sheets/RT%20Fact%20Sheet.pdf

TR-3: Provide Bus Rapid Transit

Summary Description
This measure includes the implementation of a BRT system to encourage the use of transit.

Emission Reduction Estimation Approach
The estimated reductions are based on the CAPCOA Handbook methodology for Measure T-28 "Provide Bus Rapid Transit." The GHG reduction is based on the light-duty VMT reduction associated with increased bus use. The affected vehicle fleet is assumed to include passenger cars and passenger trucks for the projected 2030 and 2050 GHG emissions sourced from EMFAC2021. The CAPCOA formula does not reflect any increase in transit vehicle travel and emissions, which can at least partially offset the reduction in GHG emissions from passenger vehicle travel.

Inputs

T-28. Provide BRT	2030	2050
Increase in transit frequency due to BRT	125%	125%
Level of implementation	20%	25%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EMFAC. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sacramento Area Council of Governments (SACOG). 2016. Metropolitan Transportation Plan/Sustainable Communities Strategy. Available at: https://www.sacog.org/sites/main/files/file-attachments/mtpscs_complete.pdf

TR-4: Roadway Improvements for Multi-Modal Use and Access

Summary Description

This measure includes three parts:

- Increasing sidewalk coverage to improve pedestrian access.
- Constructing new and improving existing bike boulevards.
- Increasing the length and interconnectivity of bike networks.

Emission Reduction Estimation Approach

The emission reductions are based on the CAPCOA Handbook methodology for Measure T-18 "Provide Pedestrian Network Improvements," T-19B "Construct or Improve Bike Boulevard," and T-20 "Expand Bikeway Network."

1. Provide Pedestrian Network Improvements: The GHG reduction is based on VMT reduction associated with enhanced pedestrian access and associated displacement of light-duty VMT.
2. Construct or Improve Bike Boulevard: The GHG reduction is based on VMT reduction associated with increased bicycle use and associated displacement of light-duty VMT.
3. Expand Bikeway Network: The GHG reduction is based on VMT reduction associated with increased bicycle use and associated displacement of light-duty VMT.

Emissions reduction percentages are applied to EMFAC2021 emissions from the circa 2030 regional commuter vehicle fleet to estimate GHG emission reductions.

Inputs

T-18. Provide Pedestrian Network Improvements	2030	2050
Additional sidewalks	15%	15%
T-19B. Construct or Improve Bike Boulevard	**2030**	**2050**
Additional bicycle boulevards	20%	20%
T-20. Expand Bikeway Network	**2030**	**2050**
Additional bike lanes	45%	50%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EMFAC. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sacramento Area Council of Governments (SACOG). 2016. Metropolitan Transportation Plan/Sustainable Communities Strategy. Available at: https://www.sacog.org/sites/main/files/file-attachments/mtpscs_complete.pdf

TR-5: Transportation Demand Management Program

Summary Description

This measure includes the implementation of various programs to reduce use of single-occupancy vehicles:

- Implementing a voluntary or mandatory CTR program.
- Implementing ridesharing programs to encourage carpooled vehicle trips.
- Subsidized or discounted, or free transit passes for employees and/or residents. Reducing cost for choosing transit improves the competitiveness of transit against driving, thus decreasing single-occupancy trips.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measures T-5 “Implement CTR Program (Voluntary),” T-6 “Implement CTR Program (Mandatory Implementation and Monitoring),” T-8 “Provide Ridesharing Program,” and T-9 “Implement Subsidized or Discounted Transit Program.” The GHG reduction is based on VMT reductions associated with increased shifting away from single occupancy vehicle trips. GHG emissions are reduced for passenger cars and passenger trucks based on EMFAC2021, accounting for the estimated commuter traffic fraction from SACOG congestion trends. This measure has multiple options for implementation and GHG reductions were calculated for each option. However, reductions from all implementation options cannot be summed because some options are overlapping, which would result in double-counting reductions. Therefore, the implementation option that results in the maximum reductions (T-6 Implement Mandatory CTR Program) was included in the Measure Implementation Scenario.

Inputs

T-5. Implement CTR Program (Voluntary)	2030	2050
Employees Eligible for Program	76%	76%
Region-wide Penetration Rate	45.5%	60%
T-6. Implement CTR Program (Mandatory Implementation and Monitoring)	**2030**	**2050**
Employees Eligible for Program	76%	76%
Region-wide Penetration Rate	45.5%	60%
T-8. Provide Ridesharing Program	**2030**	**2050**
Employees Eligible for Program	30%	35%
Region-wide Penetration Rate	45.5%	60%
T-9. Implement Subsidized or Discounted Transit Program	**2030**	**2050**
Fare Reduction	75%	75%
Individuals Eligible for Subsidy	30%	30%
VMT Reduced from Opted-In Individuals	100%	100%
Region-wide Penetration Rate	45.5%	60%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

EMFAC. 2021. California Air Resources Board’s EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

SACOG. 2025. SACOG Draft 2025 Blueprint (Metropolitan Transportation Plan/Sustainable Communities Strategy). Available online at: https://www.sacog.org/planning/blueprint

TR-6: Active Modes of Transportation for Youth

Summary Description

This measure includes the implementation of active modes of transportation for the youth including new sidewalks, bike lanes, off-street pathways, and street crossings.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook Update methodology (Sac Metro Air District, 2023) for Measure T-56 "Active Modes of Transportation for Youth." The GHG reduction is based on the light-duty VMT reduction associated with increased modes of transportation for youth within two miles of the school. The affected vehicle fleet is assumed to include passenger cars, passenger trucks, and motorcycles for the projected 2030 and 2050 GHG emissions sourced from EMFAC2021.

Inputs

T-56. Active Modes of Transportation for Youth	2030	2050
Students within 2 miles who are driven to school after project implementation	20%	15%

REFERENCES

EMFAC. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

TR-7: Establish a School Bus Program

Summary Description

This measure includes establishing or expanding a school bus program to provide transportation to school for students.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook Update (Sac Metro Air District, 2023) methodology for Measure T-40 "Establish a School Bus Program." The GHG reduction is based on the light-duty VMT reduction associated with increased school bus use through a school bus program, accounting for increased bus activity and emissions. The affected vehicle fleet is assumed to include passenger cars, passenger trucks, and motorcycles for the projected 2030 and 2050 GHG emissions sourced from EMFAC2021.

Inputs

T-40. Establish a School Bus Program	2030	2050
Students across the school who begin riding the bus as a result of the program	50%	50%
Students served by bus system (regardless of whether they ride)	100%	100%
Target average student occupancy of school buses	25	25

NOx Reductions

This measure will annually reduce NOx emissions by up to 3.20 short tons/year.

REFERENCES

EMFAC. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

TR-8: Electric Bikeshare

Summary Description

This measure includes establishing electric bikeshare programs to increase ridership across the region, thereby reducing single-occupancy vehicle trips and VMT.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure T-22-B "Transition Conventional to Electric Bikeshare." The GHG reduction is based on the light-duty VMT reduction associated with increased bikeshare usage due to increased ridership and accessibility. The affected vehicle fleet is assumed to include passenger cars, passenger trucks, and motorcycles in the Sacramento-Roseville CSA for 2030 and 2050. GHG emissions are sourced from EMFAC2021.

Inputs

T-22-B. Transition Conventional to Electric Bikeshare	2030	2050
Residences in plan/community with access to electric bikeshare program without measure	0%	0%
Residences in plan/community with access to electric bikeshare program with measure	15%	15%

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available online at: https://www.caleemod.com/handbook/full_handbook.html

EMFAC. 2021. California Air Resources Board's EMFAC Model (v1.0.2) Emissions Inventory Accessed online in January 2024 at: https://arb.ca.gov/emfac/

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

Natural and Working Lands Measures

NW-1: Wildfire Resilience and Management

Summary Description

This measure involves implementing fuel treatments in forests to reduce the severity and carbon emissions of wildfire events long term.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook Update methodology (Sac Metro Air District, 2023) for Measure N-7 “Wildfire Resilience and Management.” GHG reductions are based on the difference between total carbon sequestered in treated versus untreated forest stands, as calculated using the calculation sheet provided with the CAPCOA Handbook Update (Sac Metro Air District, 2023a). Calculations assume a project duration of 50 years since long-term duration is necessary to realize GHG reductions.

The annual GHG reduction represents an average reduction per year, over the entire project duration. However, the average reduction is not expected every year since there would be an increase of carbon emissions short-term (from the use of fuel treatments and prescribed burns) and would result in carbon reductions long-term (from lower wildfire intensities in the long-term).

Inputs

N-7. Wildfire Resilience and Management	2030	2050
Project duration	50 years	50 years
Total additional acres of mixed-conifer forest treated	4,000 acres	4,000 acres
Total additional acres of Ponderosa forest treated	4,000 acres	4,000 acres
Average mixed-conifer forest stand age	100 years	100 years
Average Ponderosa forest stand age	100 years	100 years

REFERENCES

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

Sac Metro Air District. 2023a. Measure NW-1 Calculation Sheet. Provided by Sac Metro Air District December 26, 2023.

NW-2: Biomass Energy

Summary Description
This measure involves installing new biomass or biofuel electricity generation. Biofuels have lower life-cycle carbon intensity than fossil fuels.

Emission Reduction Estimation Approach
The estimated reductions are based on the CAPCOA Handbook Update methodology (Sac Metro Air District, 2023) for Measure E-26 "Biomass Energy." The GHG reduction was estimated based on power generated by replacing typical California lifecycle electricity carbon intensity with biomass energy.

California lifecycle electricity carbon intensity is based on the CAPCOA Handbook Update. GHG reductions are based on biomass electricity generation with the dedicated woody crops and forest residual fuel and capacity factor for wood biomass. The CAPCOA equation accounts for lifecycle carbon intensity of electricity, which is not accounted for in the Plan GHG inventory, emissions forecasts, or targets. Therefore, the GHG reductions from this action cannot be counted toward target achievement since they are accounting for emissions not addressed in the Plan. The measure GHG reductions are presented for informational purposes only and are not included in the reduction totals.

Inputs

E-26. Biomass Energy	2030	2050
Dedicated Woody Crops	189.6/lb CO_2e/MWh	189.6/lb CO_2e/MWh
Forest Residues	374.8/lb CO_2e/MWh	374.8/lb CO_2e/MWh
Capacity Factor for Biomass Electricity Generation in the United States (Wood)	59%	59%
Rated peak generation power	1 MW	1 MW

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

NW-3: Increase Tree Canopy

Summary Description

This measure would increase tree planting in urban and natural areas. Trees sequester carbon and directly reduce GHG emissions.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure N-2 "Expand Urban Tree Planting" and account for carbon sequestered by trees. Trees may also provide shade, which can reduce the UHI effect, and decrease energy (air conditioning) usage, depending on the project. Indirect potential reductions are not accounted for in this analysis.

The average carbon sequestration rate per acre of canopy was estimated using the i-Tree Landscape Tool for the counties in the Sacramento-Roseville CSA (2030 calculations previously used i-Tree County tool, which is no longer available). The acres of canopy were estimated as the product of the number of trees planted and canopy per tree. Canopy per tree was assumed to be the minimum shade cover value for 15 year-old trees (which ranges from 314 square feet to 962 square feet per tree), as provided in the Planning and Environmental Review Master Tree List from Sacramento County (2015).

Inputs

N-2. Expand Urban Tree Planting	2030	2050
Number of trees	150,000	150,000
Canopy per tree	0.0072 acres/tree	0.0072 acres/tree
Acres of canopy	1,081	1,081

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

i-Tree Landscape Tool v5.2.1. Accessed online in April 2025 at: https://landscape.itreetools.org/

Sacramento County. 2015. Planning and Environmental Review Master Tree List (version 1-8-14). Accessed online in January 2024 at: https://planning.saccounty.gov/Programs/Documents/Tree%20Coordinator/Tree%2015-year%20shade%20values%201-8-14.pdf

NW-4: Carbon Sequestration Program/Carbon Farming

Summary Description

This measure will establish a carbon sequestration and/or carbon farming project(s).

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook methodology for Measure M-1 "Establishing a Carbon Sequestration Project." GHG reductions are based on conservation practices associated with carbon farming including cropland to herbaceous cover, grazing lands, woody plantings, restoration of disturbed lands, and cropland management using the NRCS's COMET-planner tool.

After selecting a general conservation practice category, the tool allows the user to select a NRCS conservation practice standard to generate emission factors in MT CO_2e/yr-acre. An emission factor for each general conservation practice (i.e., cropland to herbaceous cover, grazing lands, woody plantings, restoration of disturbed lands, cropland management) was calculated by averaging emission factors across all applicable NRCS conservation practices. Project acreage for each general conservation practice was multiplied by the applicable average emission factor to estimate potential GHG reductions.

Inputs

M-1. Establishing a Carbon Sequestration Project	2030	2050
Total carbon sequestration/carbon farming acreage	100,000[a]	100,000[a]

[a] 20,000 acres each for the five general conservation practices

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

Comet-Planner Tool. Accessed online in January 2024 at: http://www.comet-planner.com/

NW-5: GHG Local Offset Program

Summary Description

This measure will reduce GHG emissions by funding and implementing GHG offset projects.

Emission Reduction Estimation Approach

This measure is based on CAPCOA Handbook Measure M-2 "Establish Offsite Mitigation." The estimated reductions are based on the verified projects included in CARB's GHG Local Offset Program. Potential project types include (i) livestock – installing biogas control system, (ii) mine CH_4 capture, (iii) ODS related projects, (iv) U.S forest projects, and (v) rice cultivation projects. Project-specific emissions reduction examples are available through the Climate Action Reserve Registry. Project reductions were taken from the Climate Reserve database for each project type based on the following hierarchy.

1. Projects in the Sacramento County area
2. Projects in California
3. Projects in the United States

Emission reductions were estimated for each project type as the average across all example project type-specific reductions (shown in the table below). Total potential emission reductions were estimated as the sum of the average emissions for each of the following project types: (i) livestock – installing biogas control system, (ii) ODS related projects, and (iii) U.S forest projects. Reductions for rice cultivation projects were not estimated as there are no rice cultivation projects available through the Climate Action Reserve. Mine CH_4 capture projects were not included as mine CH_4 capture projects are not expected to occur within the project area.

Inputs

Sample Projects from Climate Action Reserve Registry		
Project Description	Project Type	2030 and 2050 Reduction in GHG Emissions from GHG Offset Protocols (MT CO_2e/project)
Cottonwood Dairy Organic Waste Digestion Project	Livestock projects - Installing Biogas Control System	22,229
Fiscalini Farms Anaerobic Digester	Livestock projects - Installing Biogas Control System	3,372
Fiscalini Farms Anaerobic Digester	Livestock projects - Installing Biogas Control System	3,538
RemTec International ODS Destruction Domestic Project #2	ODS Projects	38,082
EOS ARB ODS 2014-2	ODS Projects	33,214
ClimeCo ODS Destruction 34	ODS Projects	127,338
Monte Rio Improved Forest Management Project	U.S. Forests	4,692
Montesol - Forest Carbon Partners Improved Forest Management Project	U.S. Forests	1,620
Rips Redwoods - Improved Forest Management	U.S. Forests	7,287

REFERENCES

CAPCOA. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Accessed online in January 2024 at: https://www.caleemod.com/handbook/full_handbook.html

CARB. (n.d.). Compliance Offset Protocols – Project Types. Accessed online in January 2024 at: https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols

Climate Action Reserve. 2023. Map of Projects. Accessed online in January 2024 at: https://www.climateactionreserve.org/registry/map/

NW-6: Natural and Working Lands Equipment Emissions Reduction

Summary Description

This measure includes replacing natural and working lands fossil-fueled equipment with electric equipment.

Emission Reduction Estimation Approach

The estimated reductions are based on the CAPCOA Handbook Update methodology (Sac Metro Air District, 2023) for Measure MISC-1 "Use Electric or Hybrid Powered Equipment." GHG reductions are based on the reductions estimated for similar construction equipment measures in the Sacramento Climate Action Plan for 2016. Emissions reduction percentages are applied to 2030 and 2050 EMFAC2021 emissions for applicable equipment including diesel agricultural tractors and diesel and gasoline agricultural ATVs. GHG reductions estimates consider emissions related to increased electricity usage by new electric equipment. Increased emissions from electric equipment are based on an electricity carbon intensity projection for electricity suppliers in the region from the Plan GHG emissions forecasts, which use a market-based emissions projection method. 2030 implementation was updated from 55% to 100% as the Sacramento CAP assumes 100% penetration by 2030.

Inputs

M-6. Off-Road Equipment Efficiency in Natural Working Land Groups	2030	2050
Penetration of Electric Construction and Mining Equipment	100%	100%
Penetration of Zero-Emission Landscape Equipment	10%	90%

REFERENCES

CARB. 2023. Off-Road Web Platform. Model Version 1.1.0. Available at: https://arb.ca.gov/emfac/offroad/

Sac Metro Air District. 2023. 2021 CAPCOA Handbook Update Task 1.2 Deliverable: Develop process and summaries for up to 10 quantification measures (Draft). Provided by Sac Metro Air District December 22, 2023. Available: https://caleemod.com/handbook/resources.html

Sacramento County. 2016. Sacramento Climate Action Plan. Available at: https://planning.saccounty.gov/PlansandProjectsIn-Progress/Documents/Climate%20Action%20Plan/Final%20Climate%20Action%20Plan.pdf

Energy Measures

E-1A: Onsite Solar Canopies

Summary Description
This measure implements shade structure solar energy systems over parking lot areas or adjacent to playgrounds at K-12 schools.

Emission Reduction Estimation Approach
The estimated reductions are based on a combination of the CAPCOA Handbook (Measure E-10-B), electricity generation estimates from the REopt tool, and utility-specific GHG intensity.

1. Size of the solar systems: Historical local solar projects were analyzed to determine the typical system sizes by school type.
2. Model the solar systems via REopt: The REopt tool estimated solar system performance for a representative elementary, middle, and high school in each school district, based on the solar system size (from step 1 above), school location, and the energy demand profile for each school.
3. Calculate the GHG savings: The performance data was used alongside the electricity emission factors for each local utility to determine the avoided GHG emissions.

The solar system specifications including azimuth, tilt, and losses were provided by REopt defaults. A maximum of eight projects per year per school district was assumed to account for the limited market of solar technicians. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for SMUD and PG&E. In 2045, the measure does not reduce GHG emissions as it only reduces grid electricity use, which generates zero emissions by 2045.

Inputs

Solar Canopy Installation for Each School District					
School District	EGUSD	Sutter	Yuba	Yolo	Totals
2030 onsite renewable energy production	21,714 MWh/yr	5,665 MWh/yr	3,955 MWh/yr	543 MWh/yr	31,876 MWh/yr
2050 onsite renewable energy production	39,743 MWh/yr	6,437 MWh/yr	4,470 MWh/yr	543 MWh/yr	51,193 MWh/yr

REFERENCES

Anderson, Kate, et al. 2021. REopt Lite User Manual. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy21osti/79235.pdf.

CAPCOA. 2024. 2024 Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity.https://www.caleemod.com/documents/handbook/full_handbook.pdf

E-1B: Battery Storage – Supported Microgrids

Summary Description
This measure installs onsite lithium-ion battery storage units to store excess solar energy on K-12 school campuses when paired with Measure E-1A: Onsite Solar Canopies.

Emission Reduction Estimation Approach
The estimated reductions are based on a combination of the CAPCOA Handbook, the REopt tool, and utility-specific grid data.

1. Size of the solar and battery systems: Historical local solar projects were analyzed to determine the typical system sizes by school type. The assumed battery power capacities were 50kW, 100kW, and 250kW for elementary, middle, and high schools, respectively. The assumed time of continuous discharge at full power capacity was 4 hours across all battery units.
2. Model the solar and battery systems via REopt: The REopt tool estimated solar and battery system performance for a representative elementary, middle, and high school in each school district, based on the solar and battery system sizes (from step 1 above), school location, and the energy demand profile for each school.
3. Calculate the GHG savings: The performance data was used alongside the electricity emission factors for each local utility to determine the avoided GHG emissions.

The solar and battery system specifications, including module type, azimuth, tilt, and losses, were provided by REopt defaults. A maximum of eight projects per year per school district was assumed to account for the limited market of solar technicians. The GHG intensity of electricity is based on the market-based electricity emissions factor projections for SMUD and PG&E. In 2045, the measure does not reduce GHG emissions as it only reduces grid electricity use, which generates zero emissions by 2045.

Inputs

Solar Canopy Installation for Each School District					
School District:	EGUSD	Sutter	Yuba	Yolo	Totals
2030 onsite renewable energy production	12 MWh/yr	8 MWh/yr	7 MWh/yr	2 MWh/yr	29 MWh/yr
2050 onsite renewable energy production	23 MWh/yr	9 MWh/yr	8 MWh/yr	2 MWh/yr	42 MWh/yr

REFERENCES

Anderson, Kate, et al. 2021. REopt Lite User Manual. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy21osti/79235.pdf.

CAPCOA. 2024. 2024 Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://www.caleemod.com/documents/handbook/full_handbook.pdf Hand, M.M. et al. Renewable Electricity Futures Study, National Renewable Energy Laboratory, 2012, https://www2.nrel.gov/analysis/re-futures

Appendix D. List of Low-Income Communities

List of Census Tracts (2010 Geography) Classified as a Low-Income Community in CEJST
February 2024

County	Tract ID
El Dorado	06017030302
El Dorado	06017030602
El Dorado	06017031302
El Dorado	06017031600
Nevada	06057000600
Nevada	06057000900
Placer	06061020106
Placer	06061020107
Placer	06061020901
Placer	06061021403
Placer	06061021603
Placer	06061022300
Sacramento	06067000600
Sacramento	06067000700
Sacramento	06067001101
Sacramento	06067001700
Sacramento	06067002000
Sacramento	06067002200
Sacramento	06067002800
Sacramento	06067003000
Sacramento	06067003101
Sacramento	06067003102
Sacramento	06067003202
Sacramento	06067003203
Sacramento	06067003204
Sacramento	06067003600
Sacramento	06067003700
Sacramento	06067003800
Sacramento	06067004100
Sacramento	06067004201
Sacramento	06067004202
Sacramento	06067004203
Sacramento	06067004300
Sacramento	06067004401
Sacramento	06067004402
Sacramento	06067004501

County	Tract ID
Sacramento	06067004502
Sacramento	06067004601
Sacramento	06067004602
Sacramento	06067000600
Sacramento	06067000700
Sacramento	06067001101
Sacramento	06067001700
Sacramento	06067002000
Sacramento	06067002200
Sacramento	06067002800
Sacramento	06067003000
Sacramento	06067003101
Sacramento	06067003102
Sacramento	06067003202
Sacramento	06067003203
Sacramento	06067003204
Sacramento	06067003600
Sacramento	06067003700
Sacramento	06067003800
Sacramento	06067004100
Sacramento	06067004201
Sacramento	06067004202
Sacramento	06067004203
Sacramento	06067004300
Sacramento	06067004401
Sacramento	06067004402
Sacramento	06067004501
Sacramento	06067004502
Sacramento	06067004601
Sacramento	06067004602
Sacramento	06067004701
Sacramento	06067004702
Sacramento	06067004801
Sacramento	06067004802
Sacramento	06067004903
Sacramento	06067004904
Sacramento	06067004905
Sacramento	06067004906
Sacramento	06067005001
Sacramento	06067005002
Sacramento	06067005101
Sacramento	06067005102

County	Tract ID
Sacramento	06067005205
Sacramento	06067005301
Sacramento	06067005502
Sacramento	06067005505
Sacramento	06067005506
Sacramento	06067005508
Sacramento	06067005509
Sacramento	06067005510
Sacramento	06067005601
Sacramento	06067005903
Sacramento	06067006003
Sacramento	06067006101
Sacramento	06067006102
Sacramento	06067006201
Sacramento	06067006202
Sacramento	06067006300
Sacramento	06067006400
Sacramento	06067006500
Sacramento	06067006600
Sacramento	06067006701
Sacramento	06067006702
Sacramento	06067006800
Sacramento	06067006900
Sacramento	06067007001
Sacramento	06067007004
Sacramento	06067007019
Sacramento	06067007202
Sacramento	06067007301
Sacramento	06067007402
Sacramento	06067007403
Sacramento	06067007406
Sacramento	06067007413
Sacramento	06067007414
Sacramento	06067007416
Sacramento	06067007422
Sacramento	06067007423
Sacramento	06067007424
Sacramento	06067007426
Sacramento	06067007429
Sacramento	06067007501
Sacramento	06067007503
Sacramento	06067007602

County	Tract ID
Sacramento	06067007701
Sacramento	06067008131
Sacramento	06067008139
Sacramento	06067008141
Sacramento	06067008911
Sacramento	06067009005
Sacramento	06067009006
Sacramento	06067009007
Sacramento	06067009008
Sacramento	06067009010
Sacramento	06067009105
Sacramento	06067009110
Sacramento	06067009314
Sacramento	06067009316
Sacramento	06067009318
Sacramento	06067009319
Sacramento	06067009320
Sacramento	06067009329
Sacramento	06067009501
Sacramento	06067009503
Sacramento	06067009601
Sacramento	06067009606
Sacramento	06067009611
Sacramento	06067009633
Sacramento	06067009634
Sacramento	06067009639
Sacramento	06067009800
Sacramento	06067009900
Sutter	06101050101
Sutter	06101050102
Sutter	06101050201
Sutter	06101050202
Sutter	06101050301
Sutter	06101050302
Sutter	06101050501
Sutter	06101050701
Sutter	06101050702
Sutter	06101050900
Sutter	06101051000
Yolo	06113010101
Yolo	06113010102
Yolo	06113010203

County	Tract ID
Yuba	06115040100
Yuba	06115040301
Yuba	06115040302
Yuba	06115040400
Yuba	06115040500
Yuba	06115040600
Yuba	06115041100

Appendix E. Low-Income Benefits Analysis Methodology

This methodology document outlines the approach for spatially allocating air quality and GHG benefits, quantifies and spatially allocates co-benefits, and describes qualitative benefits for lower-income communities in the Capital Region. The methodology outlined below is consistent with the EPA's CPRG Technical Reference Document for Benefits Analyses: Low-Income and Disadvantaged Communities and the CAPCOA Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity.

The overall approach is visualized in the Figure 1: Methodology Diagram and is summarized as:

1. Benefits were provided in both quantitative and qualitative estimates with descriptions.
2. Quantitative benefits were estimated for: CAPs, GHGs, and other air toxics. For census blocks in the project domain, the quantitative benefits consist of attribution of each census block to emission reductions, and CAPs account for air quality benefits for key air quality pollutants.
3. Economic co-benefits were quantified according to the CAPCOA Handbook and include estimates of economic benefits such as, but not limited to, number of jobs created and fuel savings.
4. Qualitative benefits were identified for each measure and described in aggregate for low-income communities.

Air Quality and GHG Benefits

Air Toxics

For air toxics, emissions reductions of DPM were analyzed over the project domain for six of the GHG reduction measures. To spatially allocate DPM to census blocks within the domain, EJScreen traffic proximity data were used. The spatial fraction assigned to each census block were calculated using the value of the traffic count indicator in each census block over the total in the domain. For each census block, the spatial fraction was multiplied by the domain-wide DPM emission reduction to obtain the census block-level DPM emissions reduction.

CAPs

For CAPs, emissions reductions were quantified for NOx, carbon monoxide (CO), PM 10 microns or less (PM_{10}), PM 2.5 microns or less ($PM_{2.5}$), and SO_2. To quantify the emissions reductions per census block in the domain, spatial surrogate data was used for each CAPCOA measure for which CAPs emissions reductions were quantified. Table 1 shows the spatial surrogate data used for each measure. If the spatial surrogate resolution is smaller than the census block level, the resolution was scaled up by summing up spatial surrogate data within each census block. If the spatial surrogate resolution is larger than the census block level, the resolution was scaled down based on the population density, traffic volume, or one-to-one mapping. From the census block values, spatial fractions were calculated using the proportion of the census block value out of the sum of the domain values. The CAP emissions reductions for the total domain were multiplied by the spatial fraction for each census block to obtain the spatially allocated emissions reductions values across the domain.

Table 1. Spatial Surrogates for CAPs Reductions Per Measure

Plan Measure	CAPCOA Measure	Spatial Surrogate
ZEV Adoption and Charging Infrastructure	Provide Electric Vehicle Charging Infrastructure	Non Gasoline Alternative Fueling Stations (HIFLD)
	Use of Cleaner-Fuel Vehicles (BEVs)	Traffic Proximity and Volume (EJScreen)
	Use of Cleaner-Fuel Vehicles (PHEVs)	Traffic Proximity and Volume (EJScreen)
	Use of Cleaner-Fuel Vehicles (Gasoline Hybrid)	Traffic Proximity and Volume (EJScreen)
Public Transit Improvements	Extend Transit Network Coverage or Hours	Frequency of Transit Services per Sq Mi (DOT)
	Increase Transit Service Frequency	Frequency of Transit Services per Sq Mi (DOT)
Roadway Improvements for Multi-Modal Use and Access	Provide Pedestrian Network Improvement	N/A (qualitative analysis)
	Construct or Improve Bike Boulevard	N/A (qualitative analysis)
	Expand Bikeway Network	N/A (qualitative analysis)
VMT Reductions	Provide Bus Rapid Transit	Frequency of Transit Services per Sq Mi (DOT)
Construction Equipment Emissions Reduction	Use Electric- or Hybrid-Powered Equipment	N/A (qualitative analysis)
	Use of Cleaner-Fuel Equipment	N/A (qualitative analysis)
	Replace Gas-Powered Landscape Equipment with Zero-Emission Landscape Equipment	N/A (qualitative analysis)
Transportation Demand Management Program	Provide Ridesharing Program	Traffic Proximity and Volume (EJScreen)
	Implement Subsidized or Discount Transit Program	Traffic Proximity and Volume (EJScreen)

CAP Air Quality Assessment

Once the emission reduction values for CAPs were attributed to each census block group using the approach described above, these estimates were used to calculate corresponding percentage reductions for the same census block groups relative to the cumulative emissions from the 2045 co-pollutant inventory.

GHGs

Similar to CAPs and air toxics, GHG reductions across the domain were spatially allocated to CBGs for those measures that have available data to spatially allocate the benefits. The spatial surrogates used to allocate GHG reductions across the domain are shown in Table 2. The spatial surrogate data were used to derive percentages for CBGs, and the percentages were used to spatially allocate the total GHG reductions per measure.

Table 2. Spatial Surrogate Datasets for GHG Reduction Measures

Plan Measure	Spatial Surrogate
ZEV Adoption and Charging Infrastructure	Non Gasoline Alternative Fueling Stations (HIFLD)
Building Energy Efficiency Improvements	Electricity Consumption by County (CEC)
Increased Use of Renewable Energy in New and Existing Buildings	Electricity Consumption by County (CEC)
Building Decarbonization/Electrification	N/A (qualitative analysis)
Land Use Improvements	Estimated Average Drive Time to Points of Interest (min) (DOT)
Public Transit Improvements	Frequency of Transit Services per Sq. Mi. (DOT)
Reduce Solid Waste	Solid Waste (CalEnviroScreen)
Roadway Improvements for Multi-Modal Use and Access	N/A (qualitative analysis)
VMT Reduction	Frequency of Transit Services per Sq. Mi. (DOT)
Increase Tree Canopy	N/A (qualitative analysis)
Carbon Sequestration Program/Carbon Farming	N/A (qualitative analysis)
Construction and Landscape Equipment Emissions Reduction	N/A (qualitative analysis)
Reduce Water Utility Emissions	N/A (qualitative analysis)
Transportation Demand Management Program	Traffic Proximity and Volume (EJScreen)
Reduce Wastewater Emissions	Wastewater discharge (EJScreen)
GHG Local Offset Program	N/A (qualitative analysis)
Biomass Energy	N/A (qualitative analysis)
Wildfire Resilience and Management	N/A (qualitative analysis)
Install Cool Pavements	N/A (qualitative analysis)
Natural and Working Lands Equipment Emissions Reduction	N/A (qualitative analysis)
Electric Bikeshare	N/A (qualitative analysis)
Active Modes of Transportation for Youth	N/A (qualitative analysis)
Establish a School Bus Program	N/A (qualitative analysis)
Require Edible Food Recovery	Solid Waste (CalEnviroScreen)

Other Quantifiable Co-Benefits

Quantifiable co-benefits were evaluated using the CAPCOA Handbook methodology. The economic benefits were estimated using the same assumptions and inputs as the GHG and co-pollutant emission reduction estimates. Benefits such as reduction in VMT, reductions in fuel use, water savings, and energy savings were taken directly from inputs used in the GHG and co-pollutant emission reduction calculations.

Benefits from expanding the tree canopy used GHG, and co-pollutant calculation assumptions based on the canopy area of each tree and the number of trees in the Sacramento-Roseville CSA. Estimates of number of jobs created were calculated by scaling the number of existing jobs by the percent increase in parameters affected by each measure, such as number of transit service hours for public transit improvement measures. Additional economic co-benefits including, but not limited to, energy savings and estimated number of jobs created in low-income communities were quantified and spatially allocated where spatial surrogates were available.

Qualitative Assessment

Qualitative benefits for each measure were discussed in the Plan, consistent with those listed for each measure in the CAPCOA Handbook.

REFERENCES

[1] *https://ww2.arb.ca.gov/applications/cepam2019v103-standard-emission-tool*

Appendix F. Workforce Analysis Methodology

Analytical Approach

A multistep mapping and screening process was conducted to identify the priority occupations within the workforce:

- **Sector and Industry Mapping:** Plan measures were first categorized into workforce sectors. Priority North American Industry Classification System (NAICS) industries were then mapped to these sectors, beginning with a broad scope and refined based on subject matter experience and professional experience.
- **Occupational Identification:** Staffing patterns for each identified NAICS industry were analyzed to determine priority occupations, based on their relative share within each industry. This produced a preliminary list of occupations relevant to Plan implementation.
- **Crosswalk and Screening:** Once a preliminary list of occupations was established, these roles were mapped to the workforce sectors to identify cross-cutting occupations as well as those specific to individual measures. A qualitative screening process was then applied to determine which occupations are critical for measure implementation in each workforce sector.
- **Tiering Framework:** The filtered list of occupations was reorganized using three metrics: cross-sector applicability (how many times an occupation appears in each workforce sector), sector-specific prioritization (for how many sectors is the occupation a priority), and estimated 2024 employment. This resulted in the Tier 1, Tier 2, and Tier 3 occupation lists evaluated in the Workforce Planning Analysis.

Data Sources and Limitations

The analysis draws on a combination of national and regional labor market data, including the U.S. Bureau of Labor Statistics' Occupational Employment and Wage Statistics (OEWS), accessed via Lightcast, as well as EDD employment projection data. Historical employment growth, wage trends, and occupational characteristics are based on data current as of 2024 and reflect the geography of the study region, by place of work.

While the U.S. Energy and Employment Report is widely recognized as the gold standard for analyzing climate and clean energy workforce trends, granular occupational data is only available at the state level and does not disaggregate to the county or sub-regional level. As a result, this analysis relied on broader occupational data from OEWS, which includes all workers within a given occupation regardless of whether their work is directly tied to climate mitigation-related activity. Consequently, the workforce trends reported in this chapter may differ from those that would emerge with more granular, climate-specific data.

Tier 3 Occupation Analysis

Table 1, Table 2, and Table 3 present annual employment growth, employment concentrations, and wage growth for Tier 3 occupations. Calculations presented are based on unrounded values to ensure accuracy in the analysis. Rounded figures are presented in tables solely for reporting clarity. Consequently, aggregate values or derived metrics may not align precisely with calculations performed using the rounded figures displayed.

Table 1. Tier 3 Annual Employment Growth by Occupation, 2014 – 2024[1]

SOC Code	Occupation	2014 Jobs	2024 Jobs	Annual Growth Rate	Percent change
11-9041	Architectural and Engineering Managers	1,549	1,733	1%	12%
11-1021	General and Operations Managers	14,214	19,533	3%	37%
13-1082	Project Management Specialists	3,486	6,969	7%	100%
13-1111	Management Analysts	16,820	25,097	4%	49%
17-1011	Architects, Except Landscape and Naval	736	658	-1%	-11%
17-1022	Surveyors	417	392	-1%	-6%
17-2051	Civil Engineers	4,712	5,774	2%	23%
17-2071	Electrical Engineers	1,414	1,504	1%	6%
19-1031	Conservation Scientists	213	236	1%	11%
43-9061	Office Clerks, General	24,051	24,896	0.3%	4%
	Total Tier 3 Workforce	**67,612**	**86,791**	**2.5%**	**28%**
	Total Regional Workforce	**1,020,792**	**1,220,491**	**1.8%**	**19.6%**

Table 2. Tier 3 Employment Concentration by Occupation[2]

SOC Code	Occupation	Location Quotient
11-9041	Architectural and Engineering Managers	1.1
11-1021	General and Operations Managers	0.9
13-1082	Project Management Specialists	1.1
13-1111	Management Analysts	3.6
17-1011	Architects, Except Landscape and Naval	1.1
17-1022	Surveyors	1.3
17-2051	Civil Engineers	2.3
17-2071	Electrical Engineers	1.1
19-1031	Conservation Scientists	1.3
43-9061	Office Clerks, General	1.0
	Average	**1.5**

Table 3. Tier 3 Wage Growth by Occupation[3]

SOC Code	Occupation	2014 Hourly Wage ($2014)	2014 Hourly Wage ($2024)[4]	2024 Hourly Wage	Annual Growth Rate	Percent Chang (Nominal)	Percent Change in Real Wage [5]
11-9041	Architectural and Engineering Managers	$66.29	$88.82	$92.79	3%	40%	4%
11-1021	General and Operations Managers	$52.92	$70.91	$66.90	2%	26%	-6%
13-1082	Project Management Specialists	$33.10	$44.35	$57.15	6%	73%	29%
13-1111	Management Analysts	$36.44	$48.83	$41.62	1%	14%	-15%
17-1011	Architects, Except Landscape and Naval	$45.86	$61.45	$58.14	2%	27%	-5%
17-1022	Surveyors	$41.97	$56.24	$57.35	3%	37%	2%
17-2051	Civil Engineers	$47.14	$63.17	$61.52	3%	30%	-3%
17-2071	Electrical Engineers	$50.53	$67.71	$64.85	3%	28%	-4%
19-1031	Conservation Scientists	$33.75	$45.22	$44.42	3%	32%	-2%
43-9061	Office Clerks, General	$16.04	$21.49	$24.99	5%	56%	16%
	Tier 3 Workforce	**$42.40**	**$56.82**	**$56.97**	**3%**	**34%**	**0.4%**
	Total Region	**$28.76**	**$38.54**	**$40.34**	**3%**	**40%**	**5%**

Identified Relevant Skills of Priority Measures

Table 4 highlights high-demand occupations and skills that employers uplifted in response to each of the eight priority climate measures.

Table 4. Measures and Workforce Development Sectors

Relevant Skills	Priority Measures	Workforce Sector
• Land use & zoning knowledge • Geographic information systems & mapping Skills • Code and regulatory compliance	BE-1: Land Use Improvements	Building Decarbonization
• Installation and maintenance of electric appliances and heat pumps • Retrofitting gas systems to electric alternatives	BE-4: Building Decarbonization/ Electrification	
• Solar panel installation, wiring, and system integration • Permitting and grid interconnection • Ladder safety and rooftop installation protocols • Customer education and inspection readiness	E-1A: Onsite Solar Canopies	
• High-voltage and Personal Protective Equipment (PPE) safety training (OSHA-10, PPE protocols) • Troubleshooting and repair of EV charging systems • Familiarity with automation and digital diagnostic tools	TR-1: ZEV Adoption and Charging Infrastructure	ZEV Adoption and Charging Infrastructure
• ADA compliance and multimodal design • Instruction and active learning • Construction site safety and project coordination	TR-4: Roadway Improvements for Multi-Modal Use and Access	Transportation & Mobility
• Ladder fuels reductions • Machinery operations	NW-1: Wildfire Resilience and Management	Natural and Working Lands
• Equipment maintenance • Resource management	NW-2: Biomass Energy	
• Soil health monitoring and sustainable farming practices • Irrigation system and water resource management	NW-4: Carbon Sequestration Program/Carbon Farming	

REFERENCES

1 *U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics and U.S. Census Bureau, sourced from Lightcast 2025.1 data run retrieved May 2025; AECOM Analysis*

2 *Ibid.*

3 *Ibid.*

4 *This column describes 2014 wages inflated to 2024 dollars using the Bureau of Labor Statistics' CPI.*

5 *The percent difference in real wage equals the percent change between the real wage for 2024 and the actual wage for 2024. If the percentage is negative, then the wage did not keep up with inflation. If the percentage is positive, the wage outpaced inflation.*

Appendix G. Funding & Financing Sources

This document provides a summary of funding and financing tools that Capital Region agencies may consider for planning and implementing the GHG reduction measures identified in the Plan. The funding (i.e., grant programs) and financing tools summarize key details about each source, including applicability to Plan measures and agency eligibility. These matrices consider other criteria to support Capital Region partner agencies in developing a funding and financing strategy, including local match requirements, recurring rounds of funding, potential funded activity, and previous relevant awards. Finally, a list of consumer programs, including rebates and incentives targeted at households and property owners, may be linked to changes in local policies. Note that all funding information in this matrix is up-to-date as of December 2024; as opportunities expire, it is recommended to look for information on future funding rounds or similar opportunities offered by the same agency.

Grant Funding Programs

This table summarizes a list of competitive federal and state grant programs that may be applied to the Plan measures. Many of these federal sources originate from the Infrastructure Investment & Jobs Act (IIJA) and IRA. Notably, IIJA funds are currently expected to sunset in 2026. While application deadlines have recently passed for some of these programs, it is expected that respective agencies will update websites as upcoming rounds of funding are made available for recurring grant programs. Due to the current California State Budget deficit, a number of state grant programs do not have renewed funding in the 24/25 State Budget. These programs, among others, include the Outdoor Equity Grants Program, Multibenefit Land Repurposing Program, Urban Greening Program, and Regional Climate Collaboratives Program. However, Proposition 4 intends to issue $10 billion in bonds to fund state and local parks, environmental protection projects, water infrastructure projects, energy projects, and flood protection projects; the passage of this ballot measure may result in the return of these programs.

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
Federal													
Federal Highway Administration (FHWA)													
Active Transportation Infrastructure Investment Program (ATIIP)	Provides funding to enable communities to plan and construct connected active transportation systems, including bicycle and pedestrian infrastructure and greenways.	IIJA	20%	Yes	$100,000	$15,000,000	State / SACOG, counties and cities	Planning and Implementation		TR-2, TR-3, TR-4, TR-6, TR-8			N/A
Charging and Fueling Infrastructure Discretionary Grant Program	Provides funding to strategically deploy publicly accessible electric vehicle charging infrastructure and other alternative fueling infrastructure, consisting of two tracks: (1) corridor charging to deploy electric vehicle charging, and (2) community charging to install electric vehicle charging and alternative fuel.	IIJA	20%	Yes	$500,000	$2,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-1			N/A
Federal Transit Administration (FTA)													
Grants for Buses and Bus Facilities Program 5339(b)	Provides funding to replace, rehabilitate, and purchase buses and related equipment and to construct bus-related facilities, including technological changes or innovations to modify low or no emission vehicles or facilities.	Neither	20%	Yes	$100,000	$50,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation		TR-3, TR-7			In 2024, the City of Davis was awarded $1.6 million to construct infrastructure and buy charging equipment to support its battery electric bus fleet.
Low or No Emission Vehicle Program 5339(c)	Provides funding for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities.	IIJA	20%	Yes	$1,000,000	$50,000,000	State / SACOG, counties and cities	Implementation		TR-1, TR-3, TR-7, TR-8			In 2024, the Sacramento Regional Transit District was awarded nearly $77 million to buy new hydrogen fuel cell buses to replace older buses, modernize a maintenance facility, and initiate a workforce development program.
Pilot Program for Transit-Oriented Development Planning	Provides funding to integrate land use and transportation planning with a new fixed guideway or core capacity transit capital investment, including comprehensive planning that focuses on economic development and ridership, multimodal connectivity and accessibility, and transit access for pedestrian and bicycle traffic.	IIJA	20%	Yes	$200,000	$2,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-1, BE-6	TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			In 2023, the City of Phoenix was awarded $1.2 million to conduct a comprehensive transit-oriented development planning project in support of three new light rail stations under construction in the Downtown Phoenix Corridor.
US Department of Agriculture (USDA)													
Community Wildfire Defense Grant Program	Provides funding to help at-risk local communities plan for and reduce wildfire risk through the development of Community Wildfire Protection Plans and implementation of projects.	Neither	10% - 20%	Yes	$2,500,000	$10,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-1		In 2024, Nevada County was awarded $250,000 for its Community Wildfire Protection Plan update.
Community Wood Grant Program	Provides funding to install thermally led community wood energy systems or to build innovative wood product manufacturing facilities.	Neither	None	Yes	N/A	$1,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-2		In 2024, the Sierra Institute for Community and Environment was awarded $1 million to launch mass timber manufacturing in California.
Composting and Food Waste Reduction (CFWR) Cooperative Agreements	Provides funding to assist local and municipal governments with projects that develop and test strategies for planning and implementing municipal compost plans and food waste reduction plans. This includes projects that increase access to compost for agricultural producers, improve soil quality and encourages innovative, scalable waste management plans that reduce and divert food waste from landfills.	IIJA	25%	Yes	$45,000	$300,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-7				In 2024, the Confederated Tribes of the Umatilla Indian Reservation was awarded $200,000 to expand community efforts to improve waste management and diversion of food waste from Tribal government facilities, while engaging members on food waste management issues.
Landscape Scale Restoration (LSR) Grant Program	Provides funding for collaborative, science-based restoration of priority rural forest landscapes, leverages public and private resources, and supports State Forest Action Plans.	Neither	20%	Yes	$25,000	$600,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation			NW-3		In 2024, the Sullivan County Soil and Water Conservation District was awarded $100,000 to protect threatened hemlocks in the New York Catskills.
Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants in California	Provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements.	IRA	25%	Yes	$2,500	$500,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-2, BE-3, BE-4		NW-2	E-1B	N/A

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
Wood Innovations Grant Program	Provides funding to install thermally led community wood energy systems or to build innovative wood product manufacturing facilities using the most stringent control technologies.	Neither	None	Yes	$10,000	$1,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-2, NW-5		In 2024, the South Tahoe Refuse Co. was awarded nearly $300,000 to advance community supported wood energy In the Tahoe Basin.
US Department of Energy (DOE)													
Assistance for Adoption of Building Energy Codes	Provides funding to states and local governments with the authority to adopt building codes and standards to lead the way with innovative approaches to decarbonization that may impact the entirety of the commercial and residential building stocks.	IRA	None	N/A	N/A	N/A	State / SACOG, counties and cities	Planning	BE-2, BE-3, BE-4				N/A
Battery Manufacturing and Recycling Grants	Provides funding to strengthen and secure manufacturing and energy supply chains needed to modernize the nation's energy infrastructure and support a clean and equitable energy transition. This includes the construction and retrofitting of new commercial-scale facilities.	IIJA	50%	Yes	$50,000	$1,500,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation				E-1B	In 2024, Merced County Regional Waste Management Authority was awarded nearly $90,000 to conduct outreach and provide educational material to increase community awareness about the importance of responsible battery disposal and recycling.
Communities Local Energy Action Program (LEAP)	Provides funding to facilitate sustained community-wide economic and environmental benefits primarily through DOE's clean energy deployment work, with a focus on low-income energy-burdened communities that are also experiencing either direct environmental justice impacts or direct economic impacts from a shift away from historical reliance on fossil fuels.	Neither	None	Yes	$500,000	$1,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-2, BE-3, BE-4	TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			In 2023, the City of Stockton was selected for technical assistance for carbon capture and storage and critical minerals recovery.
Community Power Accelerator Prize - Round 3	Provides funding to expand community solar to include other forms of distributed solar energy technologies.	IIJA	None	Yes	$50,000	$400,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning				E-1A	In 2023, Sien, Inc., California was awarded $50,000 in Round 2 to prioritize equitable access to clean energy for low-to-moderate income communities in the Central Valley of California.
Energy Future Grants (EFG)	Provides technical assistance and financing to scale local strategies that increase resiliency and improve access to affordable clean energy.	IIJA	None	N/A	N/A	$500,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning				E-1A, E-1B	In 2024, the City of Oakland was awarded funds for the Oakland Thermal Renewable and Electrification Enterprise (OakTREE).
Energy Improvements in Rural or Remote Areas (ERA) Program	Provides funding to improve the resilience, reliability, and affordability of energy systems in communities across the country with 10,000 or fewer people.	IIJA	5% - 50%	Yes	$2,000,000	$50,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-2, BE-3, BE-4				In 2024, Navajo and Hopi communities in Arizona, New Mexico, and Utah were awarded funds to install off-grid solar and battery storage systems to electrify 300 Tribal homes.
Grid Resilience and Innovation Partnerships (GRIP) Program: Grid Innovation Program	Provides funding to deploy projects that use innovative approaches to transmission, storage, and distribution infrastructure to enhance grid resilience and reliability. Projects include interregional transmission projects, investments that accelerate interconnection of clean energy generation, and utilization of distribution grid assets to provide backup power and reduce transmission requirements.	IIJA	None	Yes	N/A	N/A	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-2, BE-3, BE-4			E-1A, E-1B	In 2024, the California Energy Commission was awarded $600 million to advance reliable grid enhancing technologies for transmission.
Grid Resilience and Innovation Partnerships (GRIP) Program: Smart Grid Grants	Provides funding to increase the flexibility, efficiency, and reliability of the electric power system, with particular focus on increasing capacity of the transmission system, preventing faults that may lead to wildfires or other system disturbances, integrating renewable energy at the transmission and distribution levels, and facilitating the integration of increasing electrified vehicles, buildings, and other grid-edge devices.	IIJA	None	Yes	N/A	N/A	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-2, BE-3, BE-4			E-1A, E-1B	In 2024, the Sacramento Municipal Utility District was awarded $50 million to deploy distributed grid-edge intelligence at scale, including a partnership with the Miwok people of the Wilton Rancheria Tribe.

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
Tribal Clean Energy Planning and Development Grants	Provides funding to support Tribal clean energy planning and development, including feasibility assessments of clean energy technology on Tribal lands and/or energy project design and development activities.	Neither	N/A	N/A	$100,000	$25,000,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-2, BE-5		NW-2	E-1B	N/A
US Department of Housing and Urban Development (HUD)													
Community Development Block Grant (CDBG) - Mitigation (MIT)	Provides funding to area impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses. These funds may also support transit-oriented development (TOD) projects, bicycle and pedestrian infrastructure, and multimodal connectivity.	Neither	25%	Yes	N/A	N/A	State / SACOG, counties and cities	Planning and Implementation			NW-1		N/A
US Department of the Interior													
Tribal Energy Development Capacity (TEDC) Grant	Provides funding to develop Tribal policies, codes, regulations, and ordinances related to energy resource, including land-lease regulation for energy development purposes or for business purposes connected to an energy project.	Neither	None	Yes	$10,000	$1,000,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-2, BE-5		NW-2	E-1B	In 2022, the Paskenta Band of Nomlaki Indians was awarded $70,000 for a Tribal utility and microgrid planning project.
US Department of Transportation (DOT)													
Grants for Energy Efficiency and Renewable Energy Improvements at Public School Facilities	Provides funding to make public schools and their vehicle fleets more energy efficient. Eligible projects include improvements, repairs, and renovations that reduce energy costs, installation of renewable energy, alternative fuel vehicle infrastructure, and purchases or leases of alternative fueled vehicles.	IIJA	20%	Yes	N/A	N/A	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-2, BE-3, BE-4	TR-1, TR-7			N/A
Rebuilding American Infrastructure with Sustainability & Equity (RAISE) Grant Program	Provides funding to complete critical freight and passenger transportation infrastructure projects with significant local or regional impact.	IIJA	20%	Yes	$5,000,000	$25,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-5, BE-6	TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8	NW-1, NW-3		In 2024, the Sacramento Regional Transit District was awarded $10 million for the Dos Rios Multimodal Station Access project.
Reconnecting Communities and Neighborhoods Grant Program	Provides funding to help reconnect neighborhoods divided by infrastructure, mitigate negative impacts of transportation facilities or construction projects on communities, and support equitable transportation planning. This program makes community planning grants, capital construction grants, and technical assistance available to eligible receiving entities.	IIJA	20%	Yes	$100,000	$90,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-2, TR-3, TR-4, TR-6, TR-8	NW-3		In 2023, the Sacramento Area Council of Governments was awarded $2.25 million for the Green Zone Access and Equity Regional Planning Project, which advances planning, engineering, design, and project development activities to address barrier transportation facilities in disadvantaged communities.
Safe Streets and Roads for All (SS4A) Grant Program	Provides funding to support the planning and implementation of projects that prevent death and serious injury on roads and streets involving all roadway users, including pedestrians, bicyclists, public transportation, and micromobility users.	IIJA	20%	Yes	$100,000	$25,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-3, TR-4, TR-6, TR-8	NW-3		In 2024, the City of Rancho Cordova was awarded $520,000 to develop a comprehensive safety action plan, evaluate and update the traffic calming program, and test different traffic safety data software options.
Strengthening Mobility and Revolutionizing Transportation (SMART) Program	Provides funding to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems in order to improve transportation efficiency and safety.	IIJA	20%	Yes	N/A	$2,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-3			In 2022, the Tahoe Transportation District was awarded $1.5 million to optimize Lake Tahoe region travel using sensors at each of the Basin's seven entry points.
Thriving Communities Program	Provides funding to enable disadvantaged and under-resourced communities to advance a pipeline of transformative infrastructure projects that will increase mobility, reduce pollution, and expand affordable transportation options, connecting communities to the essential opportunities and resources that will help them thrive.	IIJA	None	Yes	N/A	N/A	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-6	TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8	NW-3		In 2023, the City of Santa Rosa was awarded funds to redevelop a two-mile strip of vacant land into a greenway.
US Economic Development Administration (EDA)													
Public Works and Economic Adjustment Assistance (PWEAA)	Provides funding to support bottom-up strategies that build on regional assets to spur economic growth and resiliency, including the development of initiatives that present new ideas and creative approaches to advance economic prosperity in distressed communities.	Neither	None	Yes	$100,000	$30,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-1				N/A

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
US Environmental Protection Agency (EPA)													
Clean Heavy-Duty Vehicles Grant Program	Provides funding to replace higher emission heavy-duty vehicles with zero-emission vehicles, support zero-emission vehicle infrastructure, and to train and develop workers.	IRA	20% - 50%	Yes	$500,000	$60,000,000	State / SACOG and other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation		TR-1			N/A
Clean School Bus Program Grants	Provides funding to replace existing school buses with zero-emission and low-emission models to reduce harmful emissions from older, higher emission buses.	IIJA	None	N/A	$20,000	$400,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation		TR-1, TR-7			N/A
Community Change Grants Program	Provides funding for environmental and climate justice activities that benefit disadvantaged communities through projects that reduce pollution, increase community climate resilience, and build community capacity to address environmental justice challenges.	IRA	None	N/A	$10,000,000	$20,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-1, BE-6	TR-2, TR-3, TR-4, TR-6, TR-8	NW-3, NW-4		In 2024, the City of Bakersfield and Building Healthy Communities Kern were awarded funds to improve community connectivity in central and southeast Bakersfield by expanding residents' access to safe, clean, and convenient active transportation and public transit options.
Consumer Recycling Education and Outreach Grant Program	Provides funding to support local waste management infrastructure and recycling programs as well as improve public education and outreach.	IIJA	None	N/A	$5,000,000	$35,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-7, BE-10				N/A
Diesel Emissions Reduction Act (DERA) Funding	Provides grants and rebates that protect human health and improve air quality by reducing harmful emissions from diesel engines.	IIJA	0% - 50%	N/A	N/A	$4,500,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation		TR-1, TR-7			In 2008, SMAQMD was awarded $550,000 to replace seven medium/heavy duty hybrid trucks and replace 15 hybrid electric school buses.
Environmental Justice Government-to-Government Program	Provides funding to support government activities that lead to measurable environmental or public health impacts in communities disproportionately burdened by environmental harms.	IRA	None	N/A	N/A	$1,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-1, BE-6	TR-2, TR-3, TR-4, TR-6, TR-8	NW-3, NW-4		In 2023, the Buena Vista Rancheria of Me-Wuk Indians was awarded funds to address environmental issues related to water and Tribal cultural uses of water and water dependent resources, including aquatic plants and animals.
Greenhouse Gas Reduction Fund: Solar for All Competition	Provides funding to expand the number of low-income and disadvantaged communities that are primed for investment in residential and community solar.	IRA	None	Yes	N/A	$400,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-2, BE-3, BE-4			E-1A	In 2024, the Hopi Utilities Corporation was awarded $25 million to deploy residential solar and storage systems on the Hopi Reservation.
Greening America's Communities Program	Provides technical assistance to help cities develop an implementable vision of environmentally friendly neighborhoods that incorporate innovative green infrastructure and other sustainable design strategies. Eligible projects include the implementation of changes to local codes and ordinances to better support sustainable growth and green infrastructure.	Neither	None	Yes	N/A	$1,000,000	State / SACOG	Planning	BE-1, BE-6	TR-2, TR-3, TR-4, TR-6, TR-8	NW-3, NW-4		In 2014, the City of Austin was awarded funding and technical assistance to visualize public open spaces, green infrastructure improvements, and safe spaces for people to walk and bike in the South Central Waterfront area.
Solid Waste Infrastructure for Recycling Grants for Communities	Provides funding for management pathways of source reduction, reuse, sending materials to material recovery facilities, composting, industrial uses, and feeding animals. This includes innovative solutions or programs that provide or increase access to prevention, reuse, and recycling in areas that currently do not have access.	IIJA	None	Yes	$500,000	$5,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-7, BE-8, BE-10				In 2023, the Shingle Springs Band of Miwok Indians was awarded over $650,000 to create an updated recycling center on the reservation.
State													
California Air Resources Board (CARB)													
Community Air Grants	Provides funding to build local capacity, improve air quality, and support community participation under the Community Air Protection Program (CAPP). This includes supporting community operated air monitoring, data collection and analysis, and partnership development.	Neither	None	Yes	N/A	$500,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning			NW-4, NW-5		N/A

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
California Department of Conservation													
Climate Smart Land Management Program	Provides funding to build the capacity of local agencies to increase the pace and scale of climate action on California's natural and working lands in a socially, ecologically, and geographically equitable manner.	Neither	None	Yes	$500,000	$2,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning			NW-4, NW-5, NW-6		In 2023, the Eastern Sierra Land Trust was awarded nearly $1.2 million to build Tribal capacity to provide valuable contributions to strategic planning and regional land management.
California Department of Forestry and Fire Protection (CAL FIRE)													
California Forest Improvement Program (CFIP)	Provides funding to encourage improved management of California forest lands and resources. This focus is to ensure adequate high quality timber supplies, related employment and other economic benefits, and the protection, maintenance, and enhancement of a productive and stable forest resource system for the benefit of present and future generations.	Neither	10% - 20%	Yes	N/A	N/A	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-1		N/A
Forest Legacy Grants	Provides funding to protect environmentally important forest land threatened with conversion to non-forest uses. Protection of California's forests through this program ensures they continue to provide such benefits as sustainable timber production, wildlife habitat, recreation opportunities, watershed protection and open space.	Neither	50%	Yes	$1,000,000	$4,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-1		In 2023, the Placer Land Trust was awarded $1.5 million for the acquisition and conservation of Owl Creek.
Tribal Wildfire Resilience Grants	Provides funding to support California Native American Tribes in managing ancestral lands, implementing and promoting Traditional Environmental Knowledges in wildfire resilience, and establishing wildfire safety for Tribal communities.	Neither	None	Yes	$250,000	$5,000,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-1		In 2023, the Berry Creek Rancheria of Maidu Indians of California were awarded $1.5 million for the Berry Creek Restoration Program.
Wildfire Prevention Grants	Provides funding for projects in and near fire threatened communities to improve public health and safety while reducing greenhouse gas emissions.	Neither	None	Yes	$100,000	$2,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-1		In 2023, the El Dorado County Fire Safe Council was awarded $938,000 to support its Defensible Space Assistance Program, in which households on the western slope of El Dorado County can receive services valued up to $1,500 per property from a licensed contractor to assist with meeting defensible space requirements.
California Department of Housing and Community Development (HCD)													
Infill Infrastructure Grant Program	Provides funding to promote infill housing development by providing financial assistance for capital improvement projects that are an integral part of, or necessary to facilitate the development of affordable and mixed income housing.	Neither	None	Yes	$500,000	$10,000,000	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-1				In 2023, Brinshore Development, LLC was awarded $2.2 million for the 641 5th Street affordable housing development project in West Sacramento, alongside Operative Office, Inc. and New Hope Community Development Corporation.
Multifamily Finance Super Notice of Funding Availability (NOFA)	A streamlined application process to support multifamily and affordable housing production in California for four grant programs in California (the Multifamily Housing Program, Joe Serna, Jr. Farmworker Housing Grant, Infill Infrastructure Grant Program, Veterans Housing and Homelessness Prevention Program).	Neither	None	Yes	$500,000	$10,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation	BE-1				The St. Joseph Community Land Trust and Related Companies of California, LLC, were awarded $15 million for the Sugar Pine Village multifamily development in South Lake Tahoe, El Dorado County, of which 50 percent of the units will be affordable.
Regional Early Action Planning (REAP) Grants	Provides funding to accelerate the progress towards state housing goals and climate commitments through a strengthened partnership between the state, its regions, and local entities.	Neither	None	Yes	$1,000,000	$50,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-1				In 2021, SACOG was awarded $31.7 million to fund the Green Means Go Program, which provides planning and capital infrastructure investments for non-transportation projects in locally adopted Green Zones that improve housing affordability.
California Department of Resources Recycling and Recovery (CalRecycle)													
Community Composting for Green Spaces Grant	Provides funding for the creation of new or expanded capacity of small-scale composting programs in green spaces within disadvantaged and low-income communities. Green spaces may include community gardens, urban farms, and other public spaces where small-scale composting is appropriate.	Neither	None	N/A	N/A	N/A	Other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning	BE-10				N/A

Background Information									Applicability to GHG Reduction Measures				Additional Information
Program Name	**Description**	**IIJA or IRA Funded?**	**Local Match Requirement**	**Recurring Program***	**Estimated Award Amount Range (Low)***	**Estimated Award Amount Range (High)***	**Eligible Applicants / Receiving Entities**	**Funded Activity**	**Built Environment**	**Transportation**	**Natural and Working Lands**	**Energy**	**Previous Awards**
California Department of Transportation (Caltrans)													
Active Transportation Program	Provides funding to encourage increased use of active modes of transportation by achieving the following goals via increased biking and walking infrastructure, safety and mobility for non-motorized users, and other public health co-benefits.	Neither	None	Yes	$250,000	$500,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-2, TR-3, TR-4, TR-6, TR-8			In 2019, the City of Pittsburg was awarded funds to develop an Active Transportation Plan.
Low Carbon Transit Operations Program (LCTOP)	Provides funding to provide operating and capital assistance for transit agencies to reduce greenhouse gas emission and improve mobility, with a priority on serving disadvantaged communities.	Neither	None	Yes	N/A	$1,000,000	State / SACOG, counties and cities	Planning and Implementation		TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			N/A
Sustainable Transportation Planning Grants	Provides funding to encourage local and regional planning that supports state goals and greenhouse gas reduction targets. The program consists of the Sustainable Communities Competitive Program, Sustainable Communities Formula Program, Climate Adaptation Planning Grants, and Strategic Partnerships Grants.	Neither	20%	N/A	$100,000	$1,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			In 2024, the City of Sacramento was awarded nearly $380,000 for the Fruitridge Road Safety and Mobility Plan.
California Energy Commission (CEC)													
Energy Partnership Program	Provides funding to help identify the most cost-effective, energy-saving opportunities for buildings and new construction.	Neither	None	N/A	N/A	N/A	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation	BE-2, BE-3, BE-4				N/A
Renewable Energy for Agriculture Program	Provides funding for the adoption of on-site renewable energy technologies (such as wind and solar) at agricultural operations.	Neither	None	Yes	N/A	N/A	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-2, NW-4, NW-5	E-1A, E-1B	N/A
California Natural Resources Agency (CNRA)													
Environmental Enhancement and Mitigation Grant Program	Provides funding to projects to mitigate environmental impacts caused by new or modified public transportation facilities. Eligible projects include those that offset vehicular emissions of carbon dioxide, allow for the acquisition of resource lands, and/or mitigate the impact of proposed transportation to enhance the environment.	Neither	None	Yes	N/A	$1,500,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning			NW-3, NW-4, NW-5, NW-6		In 2023, the American River Conservancy was awarded $1.5 million for the acquisition of the El Dorado Ranch to contain 3.8 miles of riparian frontage along Slate Creek and Big Canyon Creek.
California State Transportation Agency (CalSTA)													
Transit and Intercity Rail Capital Program (TIRCP)	Provides funding for transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems, and bus and ferry transit systems, to significantly reduce emissions of greenhouse gases, vehicle miles traveled, and congestion.	Neither	None	Yes	$1,000,000	$50,000,000	State / SACOG, counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Implementation		TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			In 2024, the Sacramento Regional Transit District was awarded $28 million to make investments in new stations and light rail vehicles.
California Strategic Growth Council													
Affordable Housing and Sustainable Communities (AHSC) Program	Provides funding for affordable housing and transportation projects near jobs, schools, and other daily destinations. This includes sustainable transportation infrastructure, such as new transit vehicles, sidewalks, and bikeways.	Neither	None	Yes	$5,000,000	$40,000,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation		TR-1, TR-2, TR-3, TR-4, TR-5, TR-6, TR-7, TR-8			In 2015, the City of West Sacramento was awarded over $6.7 million for the West Gateway Place Affordable Housing and Grand Gateway Transportation Infrastructure Project, a four-story mixed-use development project.
Sustainable Agricultural Lands Conservation (SALC) Program	Provides funding to protect agricultural lands on the outskirts of cities and near residential neighborhoods from development. This initiative supports California's food security and encourages infill development and low-carbon transportation to curb sprawl.	Neither	10%	Yes	$450,000	$500,000	Counties and cities, other local agencies and non-profit organizations (i.e., transit agencies, CBOs, school districts, Tribal governments)	Planning and Implementation			NW-3, NW-4, NW-5, NW-6		In 2023, the Sacramento Valley Conservancy was awarded $2.6 million for the acquisition and conservation of lands.

Traditional Financing Tools

This table summarizes traditional financing (debt) instruments, including loans, bonds, and investments, that are applicable to local governments and may be used to fund Plan measures. While these financing tools are commonly used to fund a variety of infrastructure investments, they may also be applied to Plan measures. Notably, this table does not include revenue-generating mechanisms.

Type	Strategy Name	Description
Bond	**Revenue or General Obligation Bonds**	Revenue Bonds are used to pay for projects such as major improvements to an airport, water system, garage, or other large facilities that generate revenue that is then used to repay the debt. General obligation (GO) bonds are issued to pay for projects that do not have a revenue stream. Debt is repaid through local tax revenue.
Bond	**Utility Revenue Bonds**	A utility revenue bond is a type of municipal bond issued to finance a public utility project that repays investors directly from project revenues. Utility revenue bonds are used to fund capital projects in areas considered essential to public services including hospitals, fire services, water and waste treatment facilities, and improvements to the electrical grid.
Equity Investment	**Public Private Partnership (P3)**	A cooperative arrangement between one or more public and private sectors that can take different forms, such as private entity financing, building, and/or managing a project in return for a promised stream of payments from a government agency over the projected life of the project. Government agencies elect to pursue P3s as a strategy to secure upfront funds for capital projects that they cannot fund alone.
Investment	**Leasing Agreement**	Tax-exempt lease-purchase agreements provide state and local governments with the opportunity to finance upgrades and use energy savings to pay for financing costs. While leasing arrangements have higher rates compared to bond financing, they are often faster and more flexible revenue-generating mechanisms.
Investment	**Other Private Sector Contributions**	Private sector contributions involve one or more parties supplying new financial resources in order to support needed capital investments, operating subsidies, or ancillary improvements that help build patronage to sustainable levels. For example, a developer may choose to make contributions to hydropower or solar photovoltaic initiatives due to the social benefit incurred by these projects.
Loan	**Infrastructure State Revolving Fund (ISRF)**	The Infrastructure State Revolving Fund (ISRF) Program (through IBank) is authorized to directly provide low-cost public financing to state and local government entities, including municipalities, universities, schools and hospitals (MUSH borrowers) and to nonprofit organizations sponsored by public agencies for a wide variety of public infrastructure and economic expansion projects.
Loan	**Rural Energy Savings Program (RESP) from USDA**	The Rural Energy Savings Program provides loans to rural utilities and other companies who provide energy efficiency loans to qualified consumers to implement durable cost-effective energy efficiency measures.
Loan	**Transportation Infrastructure and Innovation Act (TIFIA) Loan from US DOT**	The Transportation Infrastructure Finance and Innovation Act (TIFIA) program provides credit assistance in the form of direct loans and loan guarantees to large-scale transportation infrastructure projects, including bus rapid transit.
Loan	**Water and Waste Disposal Loan Program from USDA**	The Water and Waste Disposal program provides funding for clean and reliable drinking water systems, sanitary sewage disposal, and storm water drainage to households and businesses in eligible rural areas.

Green Financing Tools

This table summarizes green, innovative financing (debt) instruments, including loans, bonds, and investments, in addition to specific federal and state loan programs made available to local jurisdictions implementing climate investments.

Type	Strategy Name	Description
Bond	**Environmental Impact Bond (EIB)**	An Environmental Impact Bond (EIB) is an innovative financing tool that uses a Pay for Success approach to provide up-front capital from private investors for environmental projects, either to pilot a new approach whose performance is viewed as uncertain or to scale up a solution that has been tested in a pilot program.
Bond	**Green or Climate Bonds**	Green or climate bonds are those that specifically finance climate change adaptation or mitigation projects. Eligible projects include those related to renewable energy and energy efficiency, sustainable waste management projects, sustainable land use and biodiversity conservation, clean transportation, and clean drinking water.
Equity Investment	**Energy Savings Performance Contracting (ESPC)**	Energy Savings Performance Contracting is a budget-neutral approach to make building improvements that reduce energy and water use and increase operational efficiency. By partnering with an energy service company (ESC), a facility owner can use an ESPC to pay for today's facility upgrades with tomorrow's energy savings - without tapping into capital budgets. State and local governments can implement ESPC projects in their own facilities, as well as promote and support ESPC projects through ESPC programs.
Loan	**California Lending for Energy and Environmental Needs (CLEEN) Program**	The CLEEN Program provides public financing to help meet state goals of greenhouse gas reduction, water conservation, and environmental preservation. This program consists of two subprograms: (1) the Statewide Energy Efficiency Program (SWEEP), which helps local governments and nonprofit organizations make small, medium, and large-scale energy-efficiency upgrades and projects, and (2) the Light Emitting Diode Street Lighting Program, which finances the installation of LED street lights for local governments.
Loan	**Clean Water State Revolving Fund**	The Clean Water State Revolving Fund (CWSRF) provides low-cost financing to communities for a wide range of water quality infrastructure projects, including municipal wastewater facilities, nonpoint source pollution control, decentralized wastewater treatment systems, stormwater runoff mitigation, green infrastructure, estuary protection, and water reuse.
Loan	**Climate Catalyst Program**	The Climate Catalyst Revolving Loan Fund (through IBank) is intended to provide flexible, low-cost credit to local jurisdictions to help bridge the financing gap toward achieving advanced technologies. Relevant projects include sustainable vegetation management, forestry practices, and timber harvesting products.
Loan	**Greenhouse Gas Reduction Loan Program from CalRecycle**	The Greenhouse Gas Reduction Loan Program provides assistance to recycling manufacturers in financing machinery, equipment, and ancillary costs to site and expand in California.
Loan	**Partnerships for Climate-Smart Commodities from USDA**	Partnerships for Climate-Smart Commodities provide technical and financial assistance to producers to implement climate-smart production practices on a voluntary basis on working lands, including carbon sequestration efforts in the agricultural sector.

Consumer Programs

This table summarizes a series of grants, incentives, rebates, and tax credit programs available to consumers, such as households and property owners. These programs may serve as a catalyst for the passage of local initiatives, like new ordinances on the topic of zoning or building regulations; household- and property-level funding can support larger municipal goals.

Program	Type (i.e., Federal, State, Local)	Administering Organization	Program Name	Eligible Receiving Entities	Description	Applicability to GHG Reduction Measures	Source
Grant	Federal	US Department of Housing and Urban Development (HUD)	**Green and Resilient Retrofit Program - Comprehensive**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance	Provides funding to properties with a high need for investment in utility efficiency and climate resilience, including deep utility efficiency, renewable energy generation, carbon emissions reductions, and climate resilience retrofits.	BE-2, BE-3, BE-4	https://www.hud.gov/GRRP
Grant	Federal	US Department of Housing and Urban Development (HUD)	**Green and Resilient Retrofit Program - Elements**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance	Provides funding to properties in the midst of a recapitalization transaction that includes utility efficiency, renewable energy, carbon emission reduction, and/or climate resilience measures.	BE-2, BE-3, BE-4	https://www.hud.gov/GRRP
Grant	Federal	US Department of Housing and Urban Development (HUD)	**Green and Resilient Retrofit Program - Leading Edge**	Property owners receiving HUD rental assistance under Multifamily Section 8 project-based rental assistance	Provides funding to owners with ambitious plans involving carbon reduction, renewable energy generation, use of building materials with lower embodied carbon, and resilience goals through achieving an advanced green certification.	BE-2, BE-3, BE-4	https://www.hud.gov/GRRP
Rebate	Federal	US Department of Energy (DOE)	**Home Energy Rebates Program**	Households, with a portion of funds for low- and moderate-income households	Provides funding to help American households save money on energy bills, upgrade to clean energy equipment and improve energy efficiency, and reduce indoor and outdoor air pollution.	BE-2, BE-3, BE-4	https://www.energy.gov/scep/home-energy-rebate-programs
Rebate	Federal	US Department of Energy (DOE)	**Property Assessed Clean Energy Programs**	Commercial and residential property owners	Provides homeowners with financing toward energy efficiency, renewable energy, and other eligible improvements on their homes using private sources of capital.	BE-2, BE-3, BE-4	https://www.energy.gov/scep/slsc/property-assessed-clean-energy-programs#residential
Rebate	Federal	US Department of Energy (DOE)	**Tribal Electrification and Appliance Rebates Program**	Residents belonging to Federally-Recognized Tribes	Provides home electrification and appliance rebates to households for energy efficiency and electrification upgrades.	BE-2, BE-3, BE-4	https://www.energy.gov/scep/tribal-home-electrification-and-appliance-rebates-program
Rebate	Federal	US Department of Energy (DOE)	**Weatherization Assistance Program**	Low-income households	Provides funding to reduce energy costs for low-income households by increasing the energy efficiency of their homes, while ensuring their health and safety.	BE-2, BE-3, BE-4	https://www.energy.gov/scep/wap/weatherization-assistance-program
Tax Credit	Federal	Internal Revenue Service (IRS)	**Energy Efficient Home Improvements Credit**	Property owners	Provides tax credits equal to 30% of certain qualified expenses, including qualified energy efficiency improvements installed during the year, residential energy property expenses, and home energy audits.	BE-2, BE-3, BE-4	https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit
Tax Credit	Federal	Internal Revenue Service (IRS)	**Residential Clean Energy Property Credit**	Property owners	Provides tax credits equal to 30% of the costs of new, qualified clean energy properties for homes installed anytime from 2022 to 2033.	BE-2, BE-3, BE-4	https://www.irs.gov/credits-deductions/residential-clean-energy-credit
Grant	State	California Department of Food and Agriculture (CDFA)	**Conservation Agriculture Planning Grants Program**	Property owners that operate farmland	Provides funding for the development of plans that help farmers and ranchers identify actions for climate change mitigation and adaptation, further environmental stewardship on farms and ranches, and ensure agricultural food security into the future.	NW-6	https://www.cdfa.ca.gov/oefi/planning/
Grant	State	California Department of Food and Agriculture (CDFA)	**State Water Efficiency and Enhancement Program (SWEEP)**	Property owners that operate farmland	Provides funding to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations, including soil moisture monitoring, drip systems, switching to low pressure irrigation systems, pump retrofits, variable frequency drives, and installation of renewable energy to reduce on-farm water use and energy.	NW-4, NW-5, NW-6	https://www.cdfa.ca.gov/oefi/sweep/

Program	Type (i.e., Federal, State, Local)	Administering Organization	Program Name	Eligible Receiving Entities	Description	Applicability to GHG Reduction Measures	Source
Incentive	State	California Air Resources Board (CARB)	**Clean Cars 4 All Program**	Individuals who live in disadvantaged communities and meet income requirements	Provides incentives to help replace older, high-polluting vehicles with zero- or near-zero emission alternatives. The program focuses on benefits to low-income and disadvantaged communities and has a heavy emphasis on consumer protections, education of new technologies, and coordination with other clean transportation programs.	TR-1	https://ww2.arb.ca.gov/our-work/programs/clean-cars-4-all
Incentive	State	California Air Resources Board (CARB)	**Clean Off-Road Equipment Voucher Incentive Project**	All off-road equipment users in California	Provides incentives to purchase or lease currently commercialized zero-emission off-road equipment. This streamlined voucher incentive project helps offset the higher cost of zero-emission technology with a point-of-sale discount.	TR-1	https://ww2.arb.ca.gov/our-work/programs/clean-off-road-equipment-voucher-incentive-project
Incentive	State	California Air Resources Board (CARB)	**Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project**	All California residents	Provides incentives to California residents purchasing clean-air vehicles with point-of-sale discount.	TR-1	https://californiahvip.org/purchasers/
Incentive	State	California Department of Community Services and Development (CSD)	**Multi-Family & Single-Family Energy Efficiency And Renewables**	Low-income households	Provides technical assistance and incentives for the installation of energy-efficiency measures and solar photovoltaics in low-income multi-family dwellings.	BE-2, BE-3, BE-4	https://www.caclimateinvestments.ca.gov/multifamily-energy-efficiency-renewables
Incentive	State	California Department of Food and Agriculture (CDFA)	**Healthy Soils Incentives Program (HSP)**	Property owners that operate farmland	Provides financial incentives to California growers and ranchers to implement conservation management practices that sequester carbon, reduce atmospheric greenhouse gases, and improve soil health.	NW-4, NW-5, NW-6	https://www.cdfa.ca.gov/oefi/healthysoils/IncentivesProgram.html
Incentive	State	California Energy Commission (CEC)	**Equitable Building Decarbonization Program: Direct Install Program & Statewide Incentive Program**	Property owners	Provides incentives to reduce GHG emissions in homes and advance energy equity through two subprograms: 1) the Direct Install Program, which provides decarbonization retrofits to low- and moderate-income households, and 2) the Statewide Incentive Program, which incentivizes the increased adoption of low-carbon technologies.	BE-2, BE-3, BE-4	https://www.energy.ca.gov/programs-and-topics/programs/equitable-building-decarbonization-program
Low-Interest F	State	California Air Resources Board (CARB)	**Financing Assistance for Lower-Income Customers**	Low-income residents with income at or below 300% Federal Poverty Level	Provides low-interest loans and vehicle price buy-downs for lower-income customers to purchase new or used battery electric, plug-in hybrid electric, or fuel cell electric vehicles and grants for charging installation or charge cards plus a portable charger.	TR-1	https://ww2.arb.ca.gov/resources/fact-sheets/financing-assistance-lower-income-consumers
Rebate	State	California Air Resources Board (CARB)	**Clean Vehicle Assistance Program**	Individuals who live in disadvantaged communities and meet income requirements	Provides funding and financing to help income-qualified California purchase or lease a new or used plug-in hybrid, fuel cell, or electric vehicle.	TR-1	https://cleanvehiclegrants.org/
Rebate	State	California Air Resources Board (CARB)	**Clean Vehicle Rebate Project (CVRP)**	Residents who meet income requirements	Provides funding to promote clean vehicle adoption in California by offering rebates from $1,000 to $7,500 for the purchase or lease of new, eligible zero-emission vehicles, including electric, plug-in hybrid electric and fuel cell vehicles.	TR-1	https://cleanvehiclerebate.org/en
Rebate	State	California Department of Community Services and Development (CSD)	**Community Solar Rebates**	Low-income households	Provides rebates to low-income households that do not have the ability to participate in existing low-income solar photovoltaic programs due to lack of homeownership.	BE-2, BE-3, BE-4	https://www.csd.ca.gov/Pages/Community-Solar-Pilot.aspx
Rebate	State	California Department of Community Services and Development (CSD)	**Farmworker Housing Single-Family Energy Efficiency and Solar Photovoltaics Rebates**	Low-income farmworker households	Provides no-cost direct installation of energy efficiency measures, solar water heating, and solar photovoltaic systems at farmworker dwellings.	BE-2, BE-3, BE-4	https://www.caclimateinvestments.ca.gov/farmworker-housing-singlefamily-energy-efficiency-solar-photovoltaics
Rebate	State	California Energy Commission (CEC)	**Building Initiative for Low-Emissions Development (BUILD) Program**	Private and public owners, nonprofit organizations	Provides incentives and technical assistance to new all-electric low-income residential buildings that reduce greenhouse gas emissions.	BE-2, BE-3, BE-4	https://www.energy.ca.gov/programs-and-topics/programs/building-initiative-low-emissions-development-program-build

Appendix H. Implementation Roadmaps

This document presents a set of implementation roadmaps that translate key Comprehensive Capital Region Climate Priorities Plan measures into actionable steps. Measures were selected through a prioritization process conducted with Sac Metro Air District and community-based organizations (CBOs) from the Outreach Advisory Committee. Participants scored the 26 Plan measures across key criteria, such as greenhouse gas (GHG) reduction potential, implementation complexity, funding availability, and benefits for low-income communities and climate resilience, with the highest ranked eight measures emerging as regional priorities. For these eight measures, implementation roadmaps were developed with input from the Climate Pollution Reduction Grants (CPRG) working groups and agency coordination to ensure they are practical, actionable, and aligned with regional priorities.

The following measures have detailed roadmaps.

BE-1
Land Use Improvements

BE-4
Building Decarbonization / Electrification

TR-1
Zero-Emission Vehicle (ZEV) Adoption and Charging Infrastructure

TR-4
Roadway Improvements for Multi-Modal Use and Access

NW-1
Wildfire Resilience and Management

NW-2
Biomass Energy

NW-4
Carbon Sequestration Program / Carbon Farming

E-1A
Onsite Solar Canopies

Together, these roadmaps provide a framework to guide local governments, regional agencies, and partners in delivering these measures across the Captial Region.

INTEGRATED IMPLEMENTATION

These roadmaps can be implemented individually, but in combination, they can achieve greater GHG reductions and community benefits. A holistic approach toward planning and implementation can account for shared infrastructure needs, create efficiencies, reduce costs, shorten timelines, enhance benefits across sectors, and achieve common goals. As each of these measures address core priorities for the Capital Region, the greatest impact comes when they are planned and executed together. Below are some examples of how measures can work together.

Land Use as a Foundational Action
Land use improvements (BE-1) that encourage infill development directly support many measures, such as active transportation (TR-4) and ZEV adoption (TR-1) by locating housing and jobs closer to transit and services. Compact, mixed-use neighborhoods reduce vehicle miles traveled (VMT), making investments in EV charging and multimodal infrastructure more effective. Additionally, infill development is often associated with smaller dwelling units that are easier to electrify (BE-4), while also decreasing growth in the wildland urban interface, enhancing wildfire resilience and potentially facilitating fuel management work (NW-1).

Shared Infrastructure and Construction Efficiencies
Bundling allows cities to align construction schedules and avoid redundant work. For example, trenching for new EV charging infrastructure (TR-1) can also include conduits for building electrification (BE-4) or underground connections for solar canopies (E-1A). Coordinating these activities reduces material costs, limits construction disruptions, and accelerates project delivery.

Energy and Load Management Synergies
Electrified buildings (BE-4), EV charging infrastructure (TR-1), and onsite solar canopies with battery storage (E-1A) can be paired to balance grid demand. During the day, solar power generated onsite offsets building loads and charges batteries; in the evening, stored energy supports EV charging or essential building operations. During peak demand events, vehicle to grid (V2G) technology and battery systems can reduce building energy demands. This integrated energy system lowers peak demand, reduces utility costs, and increases resilience.

Circular Resource Use in Natural Systems
Forest fuel management (NW-1) can supply the necessary feedstock for biomass facilities (NW-2). Guaranteed purchase contracts can provide financial certainty to all parties involved, enabling both feedstock generators and biomass facilities to move forward. Forest residues can also be processed into biochar and returned to agricultural soils, closing the carbon loop and improving soil health for carbon farming (NW-4). This interrelationship turns what would be waste material into a productive input that enhances carbon sequestration and wildfire resilience.

Governance and Financing Coordination
When measures are bundled together, agencies can coordinate planning, design, permitting, financing, and procurement for multiple activities as a single project, across multiple departments. To support multi-jurisdiction implementation, regional governance models or cooperative purchasing agreements can reduce costs, support participation from lower-capacity agencies, build technical expertise, and enable pooled funding. Bundling can also leverage incentives and funding from different sources (for example, infrastructure, energy, and resilience grants).

Community and Equity Benefits
Communities often have multiple priorities and needs that cannot be addressed through a single project, and a holistic approach enables jurisdictions to be more responsive to community concerns by delivering visible neighborhood improvements on multiple fronts. A coordinated implementation approach can streamline community engagement activities, alleviate outreach fatigue, and strengthen local ownership of climate actions.

HOW TO USE THE ROADMAPS

These roadmaps are modular and can stand alone or be combined as a package. Each roadmap explains the practical steps, key actions, phasing, and other details needed to achieve the targeted GHG reductions and co-benefits identified in the Plan. Each roadmap includes:

Measure description
An overview of the strategy and expected outcomes.

Lead agencies and partners
Roles and responsibilities for key implementing agencies and partners.

Implementation steps and timeline
Actions phased by prerequisite actions and early-, middle-, and long-term actions. Note that in some cases, the roadmaps and the measures in the CCAP may not fully align. The roadmaps take a more comprehensive approach to implementation than the equivalent CCAP measure as it considers the full range of actions needed to support meaningful deployment.

Regional solutions
Actions and best practices to support coordination, funding, and implementation at a regional scale.

Challenges and opportunities
Barriers and strategies to overcome them.

Community benefit considerations
Actions to minimize negative impacts and increase benefits for low-income communities.

Cost effectiveness
The cost-effectiveness analysis evaluates the cost per metric ton of GHG emission reductions achieved by measure implementation. The analysis considers annualized capital costs, operational costs, and any savings resulting from deviations from the business-as-usual approach. Capital costs are annualized over each measure's expected operational lifetime. A uniform real discount rate of 5% was used for all actions to convert future costs into their present value. Where possible, the cost-effectiveness analysis includes operational and maintenance costs and savings, including for residents and businesses. It is important to note that the calculated cost per metric ton does not represent a market price for carbon mitigation but rather serves to compare the relative impacts of different measures. This comparison can help prioritize measures according to their cost-effectiveness and expected impact.

For some measures (TR-4 and BE-1), savings were calculated from anticipated reductions in vehicle miles traveled (VMT) to reflect the benefits of decreased car trips and associated emissions. These savings were incorporated in the cost-effectiveness analysis and are also shown separately as they rely on behavioral changes.

Case studies
Examples of comparable projects and transferable lessons for replication.

CROSS-CUTTING THEMES

Across all roadmaps, common needs and repeatable actions emerged. Applying these cross-cutting themes and solutions consistently across measures will speed delivery, lower soft costs, and improve outcomes.

Note: Each theme is demonstrated by one or more corresponding case studies, designated by the colored dots.

Regional governance and coordination

Standing working groups, shared priority maps, clear lead-agency roles, and multi-jurisdiction delivery protocols.

Utility and infrastructure readiness
Early grid/water/sewer coordination, predictable service timelines, corridor/district capacity planning, and transformer/feeder programs.

Funding architecture and grant readiness
Pooled match funds, joint applications, shelf-ready (10–30%) concepts, phasing to fit award rules, and rolling grant calendars.

Streamlined approvals and compliance
Ministerial/checklist permits, programmatic CEQA/NEPA where applicable, model ordinances, and pre-approved plan libraries.

Workforce and delivery capacity
Regional training and apprenticeships, vetted contractor benches, on-call contracts, and cooperative purchasing to surge delivery.

Data, metrics, and reporting
Standardized monitoring and reporting to inform future projects, priorities, and grant applications. Standardized key performance indicators, dashboards, and annual scorecards tied to budgets.

Equity and community engagement
CBO-led, multilingual outreach; priority siting in low-income areas; tenant/small-business protections; affordability pathways.

Context-specific tailoring
Urban/suburban/rural siting standards, sequencing, and design details to match land use, travel patterns, and market conditions.

Risk and resilience alignment
Delivery linked to evacuation reliability, watershed/source-water protection, heat and comfort strategies, and wildfire risk reduction.

CROSS-DEPARTMENT CLIMATE INTEGRATION

Coordinating climate action implementation across departments can be especially challenging, particularly as many agencies face staffing and budget constraints. Climate change staff can sometimes be siloed within sustainability offices or city manager's offices, making it difficult to effect change within other departments or program projects within capital budgets. Below are some examples of cities that have sought to integrate climate planning, financing, engagement, and implementation.

Climate Resilience Districts — CRD Initiative

Los Angeles, CA

Los Angeles County is evaluating cross-jurisdictional Climate Resilience Districts enabled by SB 852 to coordinate and finance multi-benefit climate projects, using tools such as Enhanced Infrastructure Financing Districts (EIFD) tax-increment, special assessments, grants, and public-private partnerships. The approach explores setting up shared governance across cities and special districts, standardizing delivery and transparent project pipelines, and prioritizing equity-focused site selection and bundled investments (for example, microgrids, cooling centers, and green stormwater systems) to scale regional resilience.

Western Riverside Council of Governments – Energy Resilience Plan

Riverside County, CA

In response to increasing power disruptions, the Western Riverside Council of Governments (WRCOG) developed an Energy Resilience Plan to provide a decision-making framework to identify critical facilities and develop energy resilience strategies including solar photovoltaics with battery storage, microgrids, and community resilience hubs. The Plan was informed by a stakeholder-first approach to identifying the energy resilience needs of the subregion.

Southern Border Coalition

San Diego and Imperial County, CA

As part of the California Jobs First Initiative, the Southern Border Coalition (SBC) brings together data-driven research and community engagement to create strategies to support high-quality, green jobs and green workforce development in San Diego and Imperial County, including in rural and underserved areas. The SBC developed a regional roadmap – the Southern Border Region Regional Plan – to support multijurisdictional collaboration and promote climate strategies such as sustainable agricultural practices and renewable energy. Recommendations were informed by hyperlocal data, oral histories, and public feedback, with over 200 public meetings with CBOs, workforce agencies, Tribal representatives, and private sector leaders. To reduce systemic barriers, 50 percent of decision-making roles were held by representatives from disadvantaged communities.

Grant Center within the Office of Economic Development & Government Affairs

San Diego, CA

San Diego County coordinates grant pursuits and administration across four business units through a centralized Grant Center. Each business unit designates grants coordinators, and the center provides shared tools, schedules, and reporting to leadership so departments move in sync despite lean staffing.

Office of Climate Action, Sustainability and Resiliency (CASR)

Denver, CO

The City of Denver centralizes grants, contracts, and financial administration for climate programs within CASR's Finance and Administration team, which frees technical staff to focus on delivery. The City funds projects in part through a voter-approved Climate Protection Fund and uses shared reporting tools to track outcomes and audit readiness across departments.

Department of Energy and Environment (DOEE)

Washington, DC

DOEE standardizes pre-award and post-award processes through a dedicated Grants Management Division. The agency also partners with an intermediary (the Chesapeake Bay Trust) that runs outreach, applicant support, review panels, and disbursements so DOEE staff can concentrate on technical assistance, equity outcomes, and program oversight.

Maryland Energy Administration (MEA)

State of Maryland

MEA manages a portfolio of efficiency and electrification programs supported by the Strategic Energy Investment Fund. The administration uses multidisciplinary review committees and an end-to-end grants IT system to handle applications, equity targeting, compliance, and performance tracking across many program lines.

Pre-Approved Accessory Dwelling Unit Plan Libraries

California

Many cities in California, including Davis, Galt, Lincoln, Sacramento, and Woodland, offer free, pre-approved, permit-ready accessory dwelling unit (ADU) plans at varying sizes. These plans can significantly reduce plan review fees and speed approvals.

BE-1 LAND USE IMPROVEMENTS

This measure focuses on reducing vehicle miles traveled (VMT) by increasing residential density through infill housing and mixed-use development. Reducing the distance that people must travel to access goods and services and reducing the number of trips by single-occupancy vehicles can lead to reductions in GHG emissions.

Increase Residential Density. Requires new residential developments to achieve a higher density than the average U.S. residential density. Increased density allows people greater options for modes of travel and results in shorter and fewer vehicle trips.

Infill Development. Encourages infill housing development programs that allow residents to live closer to downtown areas, increasing access to jobs and activities. Developing more housing closer to downtown areas leads to VMT and GHG reductions.

LEAD AGENCIES

Cities and counties update general plans and zoning, update, revise or establish parking standards, lead entitlement processes, develop and implement impact fees, establish tax increment financing districts, and invest in streets and public spaces that enable infill and higher residential densities.

Regional planning agencies like the **Sacramento Area Council of Governments (SACOG),** the **Tahoe Regional Planning Agency (TRPA),** and the **Nevada County Transportation Commission** frame regional policy, develop regional transportation plans/sustainable community strategies (RTP/SCS), identify regional priorities, and support local adoption and multi-jurisdiction coordination.

Housing authorities such as **Sacramento Housing and Redevelopment Agency** lead public land disposition, mixed income projects, and gap financing.

IMPLEMENTATION PARTNERS

Water, sewer, stormwater, and sanitation districts, such as Sacramento Area Sewer District (SacSewer), are responsible for infrastructure and capacity upgrades and connection policies that make higher density feasible.

Transit operators such as Sacramento Regional Transit and Capitol Corridor Joint Powers Authority lead station area planning, joint development, and transit-oriented development agreements.

California Department of Housing and Community Development (HCD) sets housing law, certifies Housing Elements, and administers key infill funding.

California Strategic Growth Council (SGC) funds integrated housing, transportation, and climate projects and supports cross-agency alignment.

California Department of Transportation District 3 manages state right of way and can contribute airspace and excess parcels for housing near transit.

United States Department of Housing and Urban Development Region 9 (HUD Region 9) administers Community Development Block Grants and related federal housing programs for infill districts.

Community land trusts and mission-driven housing developers such as the Sacramento Land Trust and Mutual Housing deliver permanently affordable infill and missing-middle projects. Other community land trusts, such as the Yolo Land Trust and Placer Land Trust, support infill indirectly by conserving natural and agricultural lands.

Community development financial institutions and local lenders supply predevelopment, acquisition, and bridge capital tailored to infill timelines.

Business improvement districts and **property-based improvement districts** co-fund streetscape, lighting, and activation that support higher density.

Brownfield and environmental cleanup partners (for example, California Department of Toxic Substances Control and U.S. Environmental Protection Agency) clear contaminated sites or provide grant funding for remediation so infill can proceed.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Update general plans and zoning.** Adopt or update general plans and land use elements to support infill and missing middle housing. Align plans with California's 30x30 targets. Expand areas that allow higher densities and remove barriers such as restrictive setbacks, height transitions, lot coverage limits, and open space minimums. Urban areas can upzone transit corridors and apply by-right standards, suburban areas can convert commercial strips and single-family zones to mixed use and missing middle types, and rural communities can focus higher density development in town centers while protecting agricultural and natural lands.
- ☐ **Update parking and access policy.** Remove or reduce minimum parking requirements and set context-specific maximums at infill sites. Urban areas can eliminate minimums near high-frequency transit and manage curb space, suburban areas can reduce minimums in centers and manage shared parking, and rural communities can right-size parking in town cores; all communities can add walk and bike connections.
- ☐ **Provide accessory dwelling unit (ADU) tools.** Offer preapproved ADU plan libraries and checklist-based submittals to cut soft costs and timelines. Consider adopting ordinances under Assembly Bill 1033 to allow separate sale of ADUs as condominiums and expand attainable homeownership. Urban areas can use ADUs to add gentle density, or small-scale increases in housing units that maintain the area's overall character and scale, within existing neighborhoods. Urban and suburban areas can pair ADUs with lot splits and parking reform and rural communities can focus units in serviced townsites.
- ☐ **Streamline approvals and program alignment.** Use clear, objective project approval standards and align local streamlining with regional priority programs that support near term infill delivery. Urban areas can apply ministerial approvals in specific plans and transit overlays, suburban areas can adopt small area plans for mall and office park conversions, and rural communities can use by-right standards in town centers.
- ☐ **Develop a funding strategy.** Match funding sources to project types and pair value capture and local fee updates with grants to close infrastructure gaps. Reduce impact fees in infill locations with existing access to infrastructure and where travel demand and infrastructure demand is lower due to compact design and mixed-use environments.
- ☐ **Assess brownfield and site readiness.** Screen sites early for environmental conditions and coordinate cleanup funding, environmental review, and site design to shorten delivery.
- ☐ **Align with conservation strategies.** Pair infill and selective greenfield planning with farmland and habitat conservation to meet growth management and conservation goals, including the State of California's 30x30 strategy, together. Build on efforts such as SACOG's Rural-Urban Connections Strategy (RUCS) and the Coordinated Rural Opportunities Plan (CROP) to create a regional "greenprint" plan that identifies and protects important natural and working lands for preservation and habitat corridors. Address habitat connectivity and equitable access to nature as required by SB 1425 and AB 1889.

Focus areas

Urban areas can use value capture near transit, and channel most growth to existing neighborhoods and transit corridors.

Suburban areas can package town center infrastructure with phased housing, and redevelop underused centers before expanding.

Rural communitiess can bundle small sites and target main street programs. Consider vacancy fees to spur development of vacant parcels. Rural communities also can concentrate growth in towns and use conservation easements and land trusts to protect working lands.

BE-1 LAND USE IMPROVEMENTS

IMPLEMENTATION STEPS AND TIMELINE

0–3 YEARS

EARLY PHASE

- ☐ **Adopt infill-ready zoning and design standards.** Update zoning codes and land use policies to enable higher-density, mixed-use, and missing middle housing types. Prepare objective design standards to streamline staff approvals. Adopt by-right approvals in transit corridors, create overlay zones for commercial and mall conversions, and enable small-lot subdivisions within existing town footprints. Create a regional Greenprint Plan to go with the Blueprint, identifying and protecting important natural and working lands for preservation and habitat corridors.

- ☐ **Reform parking and improve access.** Eliminate or reduce parking minimums in infill areas near transit and establish context-specific maximums. Pair parking reforms with first/last-mile access plans that expand walkways, bikeways, and transit connectivity to new housing areas.

- ☐ **Expand accessory dwelling unit (ADU) programs.** Launch preapproved ADU plan sets, checklist-based submittals, and expedited permitting processes. Adopt Assembly Bill 1033 provisions to allow ADU condominiums and expand attainable homeownership. Pair ADU rollout with lot-split and parking reforms to encourage small-scale infill on existing parcels.

- ☐ **Assess infrastructure readiness and timing.** Coordinate early with electric, water, and sewer providers on near-term upgrades in growth areas. Identify infill neighborhoods with infrastructure capacity constraints and plan system upgrades for priority areas. Publish predictable service timelines, coordinate interconnections, and bundle infrastructure upgrades with near-term infill projects.

- ☐ **Launch early funding partnerships.** Establish pooled regional match funds and coordinate formation of EIFDs and Community Facilities Districts (CFDs) to finance utilities, public realm, site-readiness improvements, and other activities demonstrated to expedite private investment and infill development. Use local fee credits, State Revolving Fund / Water Infrastructure Finance & Innovation Act (SRF/WIFIA) financing, and value-capture tools to reduce costs for early projects.

- ☐ **Conduct community engagement early.** Conduct engagement early and build a strong coalition of stakeholders and partners around key infill neighborhoods and project concepts to be ready before grant opportunities become available.

- ☐ **Pilot early sites and build community support.** Identify demonstration projects in target corridors or town centers to showcase infill benefits. Pair early investments in public-realm upgrades with multilingual engagement to address displacement concerns and highlight benefits such as improved walkability, safety, and access to services. Consider funding opportunities and feasibility for modular housing developments to reduce effective costs and increase the amount of housing delivered per dollar.

Focus areas

Urban areas can prioritize transit-oriented districts, mid-rise mixed use, and parking reform.

Suburban areas can adopt corridor and center overlays and enable mall or office conversions.

Rural areas can focus on main-street infill, small-lot subdivisions inside town footprints, and ADUs.

4–7 YEARS

MIDDLE PHASE

- ☐ **Finalize and institutionalize zoning updates.** Adopt citywide zoning and parking amendments and apply ministerial, checklist-based approvals in designated infill districts. Refine design standards to improve predictability for developers and staff.
- ☐ **Scale ADU and small-plex programs.** Expand lot-split and small-plex programs with transparent dashboards that monitor production, affordability, and location trends. Use incentives and streamlined permitting to encourage reinvestment in aging neighborhoods.
- ☐ **Bundle infrastructure upgrades.** Coordinate capital improvement planning across multiple infill corridors to deliver utility and public-realm upgrades concurrently. Phase projects by district and align schedules with private construction timelines to reduce downtime and costs.
- ☐ **Align incentives and financing.** Update impact and connection fees to reflect compact development patterns and lower per-unit infrastructure demand. Pair local fee updates with targeted grant applications, regional match funds, and revolving loan programs to support infill readiness.
- ☐ **Expand partnerships and outreach.** Conduct outreach to residents, community-based organizations, and developers to refine implementation strategies and address barriers such as financing, permitting, and displacement. Share success stories from pilot projects to build momentum for larger-scale redevelopment.
- ☐ **Enhance climate resilience in the public realm.** Counter potential increases in the urban heat island effect due to increased density by investing in parks, open space, bikeways, and transit access and add shade trees, green infrastructure, and cool pavements, roofs, and other passive cooling strategies. Rewild urban areas by adding biodiversity and converting underutilized pavements and empty lots to natural areas.

8–12 YEARS

LATE PHASE

- ☐ **Scale full infill delivery.** Deploy streamlined approvals and infrastructure programs across transit station areas, corridors, and town centers. Integrate infill priorities into long-term capital improvement and Housing Element cycles.
- ☐ **Institutionalize predictable permitting and financing**. Maintain predictable permitting, utility capacity programs, and financing schedules that align with the private development pipeline. Adopt recurring program updates every 3–5 years to sustain housing delivery momentum.
- ☐ **Measure performance and refine programs.** Track annual housing production, infrastructure delivery, and affordability outcomes. Publish transparent performance dashboards and adjust programs based on market feedback, regional goals, and community input.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Coordinate with and support SACOG efforts to seek funding from state and federal sources. Expand Green Means Go-style catalytic funding and pursue replacement resources as older sources wind down.
- ☐ Stand up a regional technical assistance team, share model ordinances and permit templates, and use on-call contracts to surge capacity. Provide regional assistance for smaller jurisdictions looking at joint development opportunities and use of surplus land for infill development.
- ☐ Track production, permits, and infrastructure delivery in designated infill areas and publish annual results to guide the next cycle of investments and reforms.
- ☐ Create a regional vehicle miles traveled mitigation strategy that funds housing supportive infrastructure and projects that reduce driving.

BE-1 LAND USE IMPROVEMENTS

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Underbuilt corridor infrastructure. Streets, utilities, and public spaces are costly to retrofit one project at a time.	Create a regional VMT mitigation strategy that funds housing-supportive infrastructure and projects that reduce driving. Align impact fee policy with infill goals through predictable credits and reductions for affordable housing and compact housing types.
Macro cost headwinds. Interest rates, insurance, and construction inflation erode feasibility.	De-risk with pre-entitlements, public realm upgrades, schedule certainty, and pro-housing designations. De-risk refers to reducing financing, entitlement, and delivery uncertainty so a project becomes bankable, shovel-ready, and predictable to deliver. Create local match funding for conservation to leverage federal and state programs such as the Sustainable Agricultural Lands Conservation program, Proposition 4, and the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS).
Limited ownership pipeline. Condominium liability discourages multifamily ownership delivery.	Explore liability reforms, consider rent-then-convert models, and use land trusts and cooperatives for ownership.
Dispersed greenfield growth. Low-density development increases vehicle miles traveled and emissions.	Focus expansion where needed and pair with conservation so new areas function like infill sooner.
Market and community expectations. Demand is uneven in suburban and rural centers.	Invest in placemaking, parks, lighting, bikeways, and transit access and deliver early mixed-income wins.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Focus resources inside locally nominated infill zones, pair funding with hands-on assistance, and reserve set asides for lower-income neighborhoods.
- Use early activation grants for infrastructure tied to subsidized affordable projects in priority corridors.
- Broaden housing types to include missing middle formats so projects deliver attainable price points near jobs and services.
- Reduce parking minimums where appropriate and streamline ADUs with preapproved plans and faster staff review.
- Fund corridor-level studies and utility planning for suburban corridor retrofit projects to enable near-term projects in lower income areas.
- Expand infill in high-opportunity neighborhoods to leverage existing infrastructure, mature tree canopy, strong schools, parks, and frequent transit.
- Pair high-opportunity infill with affordability tools, such as inclusionary zoning, community land trusts, and housing voucher acceptance, to broaden access to neighborhood amenities (e.g., transit, schools, and job centers) for lower-income households and mitigate potential gentrification and displacement.

Avoid adverse consequences

- Dedicate a share of infill zone investments to affordable or mixed-income housing so benefits reach lower income residents.
- Align new buildings to neighborhood form with diverse products so communities accept change.
- Calibrate parking reductions and on-street parking management to avoid spillover on adjacent lower-income blocks.
- Plan multi-year allocations so programs do not leave corridors with half-delivered infrastructure.
- Complete essential infrastructure studies and near-term fixes first so initial projects do not stall or shift costs onto residents.

COST EFFECTIVENESS

$36,000,000

Total Costs between 2026 – 2030

+

$0
O&M Costs

$36,000,000
Upfront Capital Costs

-

$0
Savings (total; for agency)

$38,607,000
Savings (annual; for residents and businesses)

-$135*

per metric ton of GHG emissions reductions

**negative values indicate cost savings per ton.*

Cost estimates are based on the Green Means Go program, which in 2024 allocated $24,788,000 to eight capital improvement projects, which is estimated to support the development of 9,750 infill units in Sacramento, Placer, and Sutter County. This equates to an average funding level of $1,893 per unit. Guided by GHG reduction targets, SACOG's goal is to add 19,000 infill units by 2030—an average of 3,800 units per year. The 19,000 was used as a proxy to provide a reasonable basis for analysis in the absence of finalized data. At the Green Means Go funding rate, this would require approximately $7,200,000 annually, or $36,000,000 total by 2030. No operations and maintenance costs were calculated, as the measure focuses on planning and infrastructure improvements to support infill developments.

By full implementation in 2030, this measure is estimated to result in additional savings of $38,607,000 from VMT reductions. Critically, these are savings for residents and businesses, who can benefit from reduced fuel and vehicle maintainance costs from reduced driving. These savings are reflected in the total cost effectiveness metric. The upfront capital costs is associated with public agency planning costs and infrastructure upgrade costs necessary to enable infill development. It does not include the development cost itself, which is expected to largely come from developers. As such, only a portion of the cost is captured in this analysis.

CASE STUDIES

Green Means Go Infill Acceleration
SACOG's regional initiative targets infill "Green Zones" for housing, infrastructure, and main-street improvements, pairing policy support and technical assistance with funding to speed delivery. Notably, the program provided over $27 million in investments for the critical backbone infrastructure needed to support increased density in Green Zones across the region, with further investments to come pending funding availability. Additionally, SACOG also awards funds to support planning processes such as Housing Element updates, development and zoning code updates, and infrastructure assessments. This case shows how a regional framework can align jurisdictions and concentrate resources for infill.

Pre-Approved Accessory Dwelling Unit Plan Libraries
The City of Sacramento's permit-ready ADU plans cut soft costs and speed approvals; neighboring jurisdictions are adopting similar approaches. This case shows how standard plans remove friction for density infill and speed up the permitting process.

West Sacramento Bridge District Specific Plan
A riverfront district plan guiding mixed-use infill. This case shows how a specific plan can coordinate public realm, parcels, and development standards at a district scale.

Sacramento Railyards Specific Plan
One of the largest urban infill sites in the US, the Railyards converts former rail yards next to Sacramento Valley Station into a mixed-use district with housing, employment, and civic uses on brownfield land. The plan and environmental work lay out phased infrastructure and transit-oriented growth right in the city center. This case shows how a long-range, rail-adjacent brownfield can anchor regional infill with a clear phasing and infrastructure strategy.

Rancho Cordova Mills Crossing Mixed-Use District
A civic campus-anchored district near Mather Field and the Mills light rail area that combines public facilities, open space, and future private development to catalyze infill on Folsom Boulevard. This case shows how a city-led civic investment can unlock adjacent private infill.

Folsom East Bidwell Corridor Infill Program
A central business district effort that organizes mixed-use reinvestment along East Bidwell Street with streetscape, land use, and economic strategies. This case shows how corridor-scale planning can coordinate infill and public realm upgrades.

City of Sacramento Vacant Parcel and Sites Inventory
A web-based sites inventory linked to Housing Element implementation and zoning updates that moves vacant and underused parcels into production. This case shows how a formal inventory can focus infill actions.

Yolo County and City of Woodland Yolano and Donnelly Public Housing Revitalization
A planned partnership to rebuild and expand aging public housing with mixed-income units and services near jobs and transit. This case shows how public sector land and partnerships can deliver equitable infill at scale.

Adopt or update general plans and land use elements to support infill and missing middle housing and align plans with California's 30x30 targets.

BE-4 BUILDING DECARBONIZATION / ELECTRIFICATION

This measure focuses on decarbonizing existing buildings and new developments by promoting the transition from fossil fuel-powered devices to electric appliances and all-electric end uses. The most common fossil fuel-powered energy end uses are natural gas systems for space heating, water heating, and cooking equipment. Appliances (such as stoves, water heaters and fireplaces) powered by natural gas, propane, or wood are more emissions-intensive than their electric counterparts as electricity from the grid increasingly transitions to renewable sources. The implementation of this measure is made up of two parts:

All-Electric Development. This measure supports new residential and commercial developments that use all-electric appliances and end uses. Installing electric systems for space heating, water heating, cooking, pool heating, and any other system that would otherwise use natural gas or propane decreases GHG emissions.

Limit Wood-Burning Devices and Natural Gas/Propane Fireplaces in Residential Developments. The most efficient alternatives to wood-burning devices or gas fireplaces are electric fireplace inserts and electric heat pumps. This measure applies to existing and new residential dwellings.

LEAD AGENCIES

Cities and counties adopt enabling policies and reach codes where allowed under AB 130, update permitting requirements and issue permits, track all-electric versus mixed-fuel permits, streamline inspections, provide incentives and education, and align general plans and climate action plans with electrification.

Electric utilities such as the Sacramento Municipal Utility District (SMUD) and PG&E set rates and incentives; coordinate panel, transformer, and feeder upgrades; and pilot storage and virtual power-plant programs.

County air districts such as the Sac Metro Air District fund targeted incentives, including woodstove to heat pump swaps, and lead public health messaging on indoor air quality.

California Public Utilities Commission (CPUC) administers neighborhood-scale decarbonization pilots with investor-owned utilities.

IMPLEMENTATION PARTNERS

Community-based organizations (CBOs) deliver resident education on heat pumps, induction appliances, incentives, and health benefits and connect customers to vetted installers.

Contractor networks recruit installers, coordinate training, maintain approved vendor lists, and support quality assurance and workforce development.

Heating, ventilation, and air conditioning (HVAC) and electrical contractors perform panel upgrades and appliance change-outs, assist with permits, and help customers capture utility and tax incentives.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Evaluate feasibility of building code updates.** Evaluate Assembly Bill 130 to determine if agencies qualify under exemptions that would allow the adoption of reach codes or building codes to enable electrification; exemptions are allowed if the agency has GHG reduction strategies as part of their adopted general plan policies or can justify the code update to protect health and safety.

- ☐ **Evaluate grid capacity.** Coordinate with utilities to identify neighborhoods where service or transformer upgrades are needed to support neighborhood-wide electrification and seek grants to carry out updates on a systemic scale, rather than by customer request. Use hosting-capacity maps and feeder studies to find constraints, hold pre-application meetings to confirm service/protection/metering, sequence transformer/feeder/substation upgrades with electrification programs, assess non-wires options (storage, managed EV, demand response) before new builds, and share typical designs/lead times to inform project schedules.

- ☐ **Assess current utility rates, incentives, and cost signals.** Factor the end of mixed-fuel line-extension subsidies into greenfield economics, and include the avoided costs of gas laterals, meters, trenching, and service upgrades in pro formas. This typically improves the cost-competitiveness of all-electric new construction. Urban and suburban areas can pair time-of-use rates with demand response and smart controls and coordinate utility rebates, while rural communities can emphasize weatherization, and propane-to-electric conversions.

- ☐ **Existing building triggers and program design.** Use triggers like air conditioner replacements to encourage heat pump adoption, paired with simple compliance pathways. Align local programs with available federal and state rebates or tax credits and emphasize multifamily and commercial paths where funding remains. In urban areas, time upgrades to rental turnovers and capital planning cycles; in rural communities, prioritize propane appliance replacements and wood stove changeouts.

0–3 YEARS

EARLY PHASE

- ☐ **Update codes and policies** to enable all-electric new construction where allowed. For reach codes, prepare cost-effectiveness studies and plan for re-adoption each code cycle. Urban areas can adopt strong reach codes in transit and activity centers; suburban areas can use overlays and builder agreements to raise minimum performance; and rural communities can allow simple, prescriptive all-electric paths suited to small projects and manufactured homes.

- ☐ **Support service and panel upgrades.** Offer targeted incentives and streamlined permits for panel upgrades where required. For older neighborhoods, focus on relieving transformer hotspots near high-load pockets and run neighborhood panel programs paired with subdivision transformer upgrades. Rural communities can address long feeders, install storage-ready panels, and build microgrids at critical facilities.

- ☐ **Streamline and simplify permitting.** Offer simple online permit intake for licensed contractors and focus inspections on life-safety essentials so more retrofits are permitted and incentive-eligible. Publish clear checklists to raise permit compliance and reduce rework. For eligible non-combustion retrofits (e.g., heat pumps/heat pump water heaters) with no new gas piping or structural work, use a checklist tailored to the hazard profile, which streamlines delivery without reducing life-safety review and is subject to the inspection department's discretion. Launch express, checklist permits and next-day inspections for heat pump space and water-heating replacements.

- ☐ **Engage and support homeowners.** Align outreach campaigns with federal tax-credit deadlines and run contractor blitzes so households do not miss incentives. Publish a vetted installer and contractor list, and align incentives with utilities. Expand on-bill financing and grants, and target deed-restricted properties first. Leverage letters of intent to coordinate bulk purchasing across property owners and provide tiered support for under-resourced buildings.

- ☐ **Support multifamily adoption.** Tie affordable housing financing and rehabilitation milestones to all-electric upgrades where feasible. Offer owners/landlords electrification packages tied to tenant protections.

BE-4 BUILDING DECARBONIZATION / ELECTRIFICATION

IMPLEMENTATION STEPS AND TIMELINE

- ☐ **Conduct outreach.** Conduct culturally relevant, multilingual outreach to understand and address people's concerns around electrification, particularly for gas stoves. Coordinate with air districts on public health messaging and consider appliance emissions standards that reduce indoor combustion exposure. Provide additional incentives for multi-property or unit owners making a single large purchase and those who transition to heat pumps.

- ☐ **Start workforce, contractor, and realtor education.** Run regional training to counter misinformation about electrification (e.g., heat pump performance) and to simplify participation in incentive networks. Use vetted contractor lists and equipment verification within programs. Use Home Energy Score pilots to target upgrades and pair with training to expand local installer capacity. Potential innovative approaches for contractors include: 1) Facilitating a teaming approach for small businesses (e.g., an HVAC installer teaming with an electrician to upgrade electrical service needed for heat pumps), which can allow smaller or dedicated contractors to group together as "Virtual Mechanical, Electrical, and Plumbing" firms; 2) Providing education and capacity building with leave-behind QR codes linking to informative websites; 3) Providing financial incentives for keeping heat pump technologies in stock, with additional incentives for installation; 4) Collecting letters of intent from property owners to demonstrate interest to the market and contractors; 5) Promoting contractors as "electrification certified"; 6) Offering incentives for including heat pumps as an option in all-replacement quotes (i.e., standard efficiency furnace, high-efficiency furnace, and heat pump options).

- ☐ **Develop a pipeline of projects.** Coordinate a transparent upgrade queue and plan feeder upgrades by district.

- ☐ **Track permits by fuel type.** To support monitoring and tracking, permitting departments can add a permit field that tracks fuel type and determine a baseline of all-electric versus mixed-fuel permits. Progress can be reported in an internal dashboard.

Focus areas

Urban areas can target multifamily and single-family homes and mixed-use districts and coordinate transformer relief.

Suburban areas can target existing buildings in commercial corridors and neighborhood centers and streamline single-family heat pump replacements with express permits.

Rural areas can prioritize reliability with storage, plan propane-to-electric conversions, and address long-feeder constraints.

4–7 YEARS

MIDDLE PHASE

- ☐ **Neighborhood-scale pilots and data.** Participate in neighborhood decarbonization pilots to shift from one-home-at-a-time programs to block-level delivery with utility coordination. Deliver bundled neighborhood or portfolio retrofits that pair heat pumps, water heaters, and induction cooking appliances. Build datasets for rental and owner stock that record existing appliance types and ages to target incentives when programs open. In urban areas, run block-based pilots for multifamily and small commercial; in suburban areas, convert whole subdivisions; and in rural areas, pilot main-street blocks and clusters of public facilities that anchor nearby homes.

- ☐ **Coordinate with utilities to address remaining challenges for low-income households.** Test on-bill financing for lower-income households, such as pathways that cover electrical service panel and whole-home electrification. Track costs, timelines, and participation and refine annually. Work with utilities to explore additional solutions to support electrification for rural areas and low-income households, who could be increasingly burdened with the cost of maintaining aging natural gas infrastructure, as higher-income households electrify. For example, the maintenance cost of gas infrastructure in individual neighborhoods could be used to electrify that neighborhood instead; this is likely to require coordination and tradeoffs between utilities depending on the service territory.

Focus areas

In urban areas, scale multifamily and public or affordable housing conversions.

In suburban areas, retrofit corridors and centers and pilot large-site conversions.

In rural areas, package weatherization, heat pumps, and storage to improve reliability.

8–12 YEARS

LATE PHASE

- ☐ **New construction.** Make all-electric delivery standard practice for new construction.

- ☐ **Scale up.** Scale neighborhood-scale programs with batch design, procurement, and synchronized utility upgrades, making sure low-income communities are not left behind.

- ☐ **Track and monitor data.** Publish annual scorecards on production and retrofits and adjust incentives, codes, and staffing.

Focus areas

In urban areas, complete districtwide conversions.

In suburban areas, finish center and corridor programs and scale to all housing types.

In rural areas, sustain resilient retrofits with storage and right-sized utility upgrades.

BE-4 BUILDING DECARBONIZATION / ELECTRIFICATION

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Align code updates regionwide with shared model language, a common calendar, and joint hearings so jurisdictions move together.
- ☐ Create a regional study hub, share templates and findings, and offer technical assistance so jurisdictions can utilize common findings to improve overall program delivery and impact.
- ☐ Prepare shared cost-effectiveness studies and adopt consistent reach code language. Provide express, checklist permits for compliant heat pump and panel upgrades.
- ☐ Coordinate predictable service timelines and capacity upgrades with utilities. Stand up a regional electrical panel upgrade program. Align with neighborhood decarbonization pilots under Senate Bill 1221.
- ☐ Launch a one-stop application that auto-bundles federal, state, regional, and utility incentives. Expand on-bill financing and low-income offerings. Provide landlord packages for deed-restricted and naturally occurring affordable housing.
- ☐ Fund recurring regional trainings, maintain vetted contractor lists, and run quality-assurance feedback sessions to improve installation quality.

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Split incentives in multifamily. Owners pay while tenants save.	Use tariffed on-bill offerings, master-meter strategies where feasible, and performance-based incentives for measured savings.
Contractor capacity and quality. Too few trained installers leads to long waits and oversizing.	Fund recurring trainings, require program participation for rebates, publish vetted contractor lists, and add quality-assurance reviews.
Data and reporting gaps. Agencies cannot see where upgrades stall.	Standardize permit fields and dashboards that track permits, timelines, costs, and incentives by neighborhood.
Resistance to electrification and limiting wood-burning and gas fireplaces. Cultural and financial concerns are a deterrence.	Run multilingual outreach with hands-on demos, publish total-cost comparisons, and highlight early adopters. Continue providing rebates for electric inserts and include heat pump packages, provide design guidance, and phase compliance with remodels.
Grid reliability worries. Households fear outages and peak costs.	Bundle storage, demand-response enrollment, and vehicle-to-home options with electrification.
Commercial kitchen electrification. Specialized equipment and practices complicate change.	Plan early with utilities, specify electric equipment, and train staff.
Multifamily water-heating constraints. Space, noise, and venting limit in-unit equipment.	Use shared or central heat pump water heating with load-management and sound-rated enclosures.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Stack local, utility, state, and federal incentives for heat pumps, panel upgrades, and weatherization. Expand on-bill financing with income-qualified terms. Time upgrades to affordable housing rehab cycles.
- Provide simple checklists, online permit pulls, and navigator services that schedule contractors and inspections.
- Incentivize owners to electrify with tenant protections. Prioritize all-electric upgrades when making financing decisions for affordable multifamily projects.
- Fund training and pre-apprenticeships for heat pump, electrical, and weatherization work. Work with CBOs to recruit residents.
- Offer multilingual, culturally relevant outreach and hands-on demos for induction and heat pump appliances. Direct households to vetted contractor lists.

Avoid adverse consequences

- Avoid shifting costs to tenants. Calibrate incentives to cover common retrofit extras and pair with stable rate plans.
- In rural areas or areas with more grid instability (e.g., due to storms or public safety power shutdowns), combine electrification with weatherization and, when feasible, storage or vehicle-to-home options. Recognize that homes in rural areas may need to have dual-fuel backup and residents may be concerned about the reliability of electrification.
- Minimize inspection visits through standardized scopes and contractor-neutral navigator support.
- Offer comparable programs across service territories so customers outside municipal-utility areas are not left behind.
- Present technologies as options. Offer loaner cooktops and try-before-you-buy events.

BE-4 BUILDING DECARBONIZATION / ELECTRIFICATION

Limit Wood-Burning Devices and Natural Gas/Propane Fireplaces in Residential Development

$1,972,000

Total Costs between 2026 – 2030

+ $1,261,000
O&M Costs

$10,780,000
Upfront Capital Costs

- $10,069,000
Savings

Require all-electric development to use electric instead of natural-gas powered appliances in new residential developments

$324,000,000

Total Costs between 2026 – 2030

+ $261,000,000
O&M Costs

$926,000,000
Upfront Capital Costs

- $863,000,000
Savings

COST EFFECTIVENESS

$34

per metric ton of GHG emissions reductions

The first part of the measure focuses on installing electric fireplaces in place of natural gas or wood-burning stoves in residential developments. Based on GHG reduction targets, it is assumed that 5,500 stoves will be installed by 2030, or about 1,100 per year. Research from California-based sources indicate an average unit cost of $1,960 for an electric stove. Applying this to the target results in an annual cost of $2,156,000 and a total cost of $10,780,000 by 2030. Electric fireplaces result in savings for building occupants, as they are cheaper to maintain and operate. This results in an annual saving of $2,014,000 annually, which leaves a total cost of $1,972,000 over the 2026-2030 period.

$1,434

per metric ton of GHG emissions reductions

The second part of the measure covers installing electric appliances in new residential developments instead of natural gas models. It is estimated that the Capital Region forecasts 75,000 new residential units by 2030. The total cost of installing these appliances is $926,000,000. However, electric appliances are generally cheaper than their natural gas counterparts, generating estimated savings of $172,608,000 per year. These savings are offset by higher operational costs, as electricity rates exceed natural gas rates. The additional operational cost is $52,179,000 per year. This results in a total cost between 2026-2030 of $324,000,000 (inclusive of O&M and savings).

CASE STUDIES

San Mateo County Whole-Home Electrification Case Study

Pilot retrofits show practical pathways for switching existing homes to heat pumps for space and water heating, induction cooking, and peak management. Findings include ways to avoid some panel upgrades through load management, the value of contractor training and concierge support, variable costs by home type, and measurable GHG reductions, which inform scalable county programs.

May Lee State Office Building, all-electric commercial kitchen

A new State of California office complex in downtown Sacramento demonstrating full building electrification, including a commercial kitchen that uses electric equipment such as an induction stove and an oven, supporting zero-carbon operations and improved indoor air quality. Key lessons include early design coordination with utilities, careful equipment selection, staff training, and operational change management for public facilities.

Create a regional study hub, share templates and findings, and offer technical assistance so jurisdictions can utilize common findings to improve overall program delivery and impact.

TR-1 ZEV ADOPTION AND CHARGING INFRASTRUCTURE

This measure focuses on increasing the use of cleaner fuel and ZEVs by replacing conventional combustion vehicles that generate more GHG emissions, and by increasing access to charging infrastructure for ZEVs. The measure covers light-duty vehicles such as passenger cars and light-duty trucks. The implementation of this measure is made up of two parts:

Use of Cleaner-Fuel Vehicles. Promotes transitioning gasoline- or diesel-powered vehicles to a combination of cleaner-fuel vehicles that include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). This measure would support fleet transition within the Sacramento-Roseville CSA and would complement the planned transition to ZEV-only sales required by California's Advanced Clean Cars II (ACCII) program. Currently, the ACCII regulation requires that new vehicle sales in California would reach 68% by 2030.

Provide Electric Vehicle (EV) Charging Infrastructure. Promotes installing more EV chargers at buildings with designated parking areas (such as commercial, educational, retail, and multi-family buildings) and investigates curbside charging strategies in urban areas.

This measure also promotes the integration of Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) technologies. G2V technology enables intelligent charging of EVs based on grid conditions and electricity pricing, shifting charging to off-peak hours and times of abundant renewable energy generation, which reduces strain on the grid and lowers costs for drivers. V2G technology takes this a step further by allowing EVs to discharge stored electricity back to the grid, providing additional capacity during peak demand periods and enhancing grid stability. Together, G2V and V2G support a more resilient, cost-effective, and renewable-powered transportation-energy system.

LEAD AGENCIES

Metropolitan planning organizations and councils of governments such as **Sacramento Area Council of Governments (SACOG)**, the **Tahoe Regional Planning Agency (TRPA)**, and the **Nevada County Transportation Commission** guide transportation planning, regional coordination, and funding allocation.

Cities and counties adopt zoning, permitting, and building code updates and oversee implementation within their jurisdictions. This includes city and county sustainability managers who set and measure goals and bring information to their voting body who provide approval for the local implementation of measures. **Public works and transportation departments** install, maintain, and operate public charging in parking lots, curbside locations, and community facilities.

The **California Air Resources Board (CARB)** sets standards and mandates for zero-emission vehicle adoption, and the **California Energy Commission (CEC)** adopts triennial building code updates, and both fund clean transportation programs.

IMPLEMENTATION PARTNERS

PG&E and **SMUD** manage grid capacity, integrate electric vehicle loads, set electricity rates including special rates for EVs, provide rebates for charging infrastructure and vehicles, and partner on G2V and V2G. **Electric utilities**, including community choice aggregators like Valley Clean Energy and smaller utilities like Roseville Electric may also provide rebates.

Transit agencies such as **Sacramento Regional Transit** (SacRT) transition fleets to zero-emission buses and plan depot charging and hydrogen fueling to meet the state requirement for zero-emission bus purchases starting in 2029.

Private charging networks deploy infrastructure, scale commercial installations, expand consumer access, and engage delivery fleet operators to align corridor and workplace charging with direct current fast charging needs.

Workforce and education partners design training for electricians, mechanics, and technicians, including skills for V2G systems.

Community-based organizations lead outreach, education, and engagement, such as to develop mobility hubs in low-income neighborhoods.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Align land use and local policy.** Update zoning and land use policies to streamline EV charger installation. Adopt building code updates and strengthen enforcement to support cost-effective deployment of EV-ready infrastructure, particularly for multifamily and commercial developments. Evaluate suitable locations for charging infrastructure through zoning considerations, as each community type faces different land use patterns and siting opportunities. Urban areas can prioritize infill and multifamily retrofits; suburban areas can focus on commercial corridors, shopping centers, and park and ride hubs; and rural communities will benefit from flexible zoning that enables shared charging facilities along highways.

- ☐ **Upgrade grid capacity and coordinate with utilities.** Engage with utilities early to assess local grid capacity for both fast charging and Level 2 charging and plan upgrades where needed, as inadequate grid infrastructure is one of the biggest barriers to expansion of EV charging in older neighborhoods. Work with utilities to create incentives that offset the cost of panel, service, and/or transformer upgrades where grid capacity is insufficient, and pair with solutions that minimize panel upgrades through load-sharing technology. Both urban and suburban areas may need extensive grid modernization in older residential neighborhoods, while suburban areas may focus on supporting large scale retail and auto malls. Rural communities may explore microgrids, distributed energy solutions, and charging in town centers.

- ☐ **Establish financial and incentive structures.** Offer incentives to encourage retrofits of existing multifamily housing and low-income properties. Develop funding mechanisms such as grants, rebates, and public private partnerships to reduce upfront costs for deployment. Support innovation that lowers retrofit costs, such as low-power chargers or shared infrastructure, to expand access and affordability. Urban areas can focus on subsidies for retrofitting existing housing, suburban areas can benefit from incentives for homeowner associations and commercial plazas, and rural communities may require state or regional grants to overcome limited tax bases.

- ☐ **Build a regional network.** Align city, county, and regional studies to build a more connected and efficient charging network, avoiding fragmentation. Identify and fill gaps on key corridors and highways. Prioritize neighborhoods with grid constraints for early pilots where V2G infrastructure can help reduce peak load stress on the grid during high-demand hours and avoid costly distribution upgrades. Build on existing ZEV plans rather than duplicating efforts and tailor strategies to specific community needs. Scale successful pilots across the region to accelerate adoption and provide visible proof of concept. Coordination strategies should consider differing needs. Urban areas can lead on dense charging networks, suburban areas can coordinate through joint planning bodies such as SACOG, and rural communities can rely on regional hubs and partnerships with utilities for cost-effective siting.

- ☐ **Build capacity and enhance technical assistance.** Provide staffing and technical assistance support to help smaller jurisdictions with limited capacity and bridge resource gaps, particularly in suburban and rural areas. Technical assistance programs should consider the variety of governance structures across the region.

- ☐ **Align fleet planning with AB 39.** Establish a regional working group of fleet, sustainability, and transportation managers. This group will support coordinated compliance. Convene agencies regularly to share best practices, procurement strategies, successful approaches for right-sizing vehicles, ZEV fueling/charging considerations, facility upgrade implications, and timing needs. Use insights from this group to develop high-level guidance and recommended milestones that agencies can adapt to their operational needs and resources. Assign a designated fleet transition lead (e.g., within Public Works or Fleet) to coordinate with Sustainability, Transportation, and the local utility.

- ☐ **Plan for dual-fuel depots.** Where duty cycles require, include hydrogen alongside electricity. Coordinate early with utilities on electric service upgrades and with hydrogen providers on delivery or onsite generation, storage, safety setbacks, and fire authority approvals.

- ☐ **Establish demonstration governance.** Pre-clear design-build-operate (DBO) or P3 contracting options for storage/hydrogen pilots, along with data-sharing and measurement & verification (M&V) requirements.

TR-1 ZEV ADOPTION AND CHARGING INFRASTRUCTURE

IMPLEMENTATION STEPS AND TIMELINE

0–3 YEARS

EARLY PHASE

- ☐ **Map demand, grid capacity, and siting opportunities.** Identify priority land uses such as residential, commercial, and transit hubs that are most suitable for charging. Partner with utilities early to identify pilot sites and plan grid upgrades. Identify priorities such as multifamily housing and low-income areas. Select sites based on factors such as charging gaps, proximity to major corridors and destinations, traffic counts, equity, and grid capacity.

- ☐ **Assess technology and infrastructure readiness.** Plan for the unique charging needs of light-, medium-, and heavy-duty vehicles and delivery fleets when installing charging infrastructure and developing policy for infrastructure siting. Consider hydrogen fueling infrastructure at the regional scale for commercial and truck fleets where battery electric vehicles may be less practical.

- ☐ **Conduct community engagement.** Use community anchors such as libraries, community centers, and transit hubs as both charging locations and outreach points. Maintain consistent messaging, even amidst shifting state or federal policies, to reduce confusion and strengthen community trust. Tailor engagement practices to each community, with multilingual and neighborhood-based outreach and trusted messengers such as schools, civic associations, agricultural cooperatives, and chambers of commerce. Frame EV adoption as a voluntary, cost-saving opportunity rather than a mandate, to help adoption feel like a choice rather than imposed.

- ☐ **Use blended funding from local, state, federal, and private sources.** Create public-private partnerships in which private charging companies manage chargers at multifamily sites. Use pilots to demonstrate success and attract new funding.

- ☐ **Launch a battery–hydrogen storage demonstration.** At one fleet depot or mobility hub, co-locate solar canopies (E-1A), stationary batteries, hydrogen storage/fuel cells, and V2G-ready chargers to support fast charging, peak shaving, and backup power.

- ☐ **Define siting and safety for hydrogen.** Adopt National Fire Protection Association (NFPA)/International Fire Code (IFC) requirements, ventilation, separation distances, and emergency procedures in coordination with local fire authorities; select one or two pilot depots.

Focus areas

Urban areas should prioritize grid-constrained neighborhoods, multifamily retrofits, and curbside charging.

Suburban areas can map opportunities at auto malls, schools, park and ride hubs, and commercial corridors.

Rural areas can plan public charging at highway stops, community centers, and other sites, and consider long-term needs of agricultural communities.

4–7 YEARS

MIDDLE PHASE

- ☐ **Pilot new approaches for multifamily sites and grid-constrained locations.** Pilot charging technologies in these sites to test feasibility in more challenging implementation sites. Implement multifamily retrofits using a cohort approach with standardized specifications, streamlined design and permitting, joint procurement, and technical assistance to reduce transaction costs and accelerate equitable access. Adjust infrastructure design to match different travel and work patterns.

- ☐ **Expand incentives based on performance.** Expand retrofit incentives, especially for low-income and multifamily housing. Evaluate pilot performance to inform scaling decisions.

- ☐ **Establish local workforce pipeline.** Launch workforce training with community colleges and trade schools.

- ☐ **Sustain community engagement.** Maintain clear public messaging to build trust as policies evolve. Listen to community concerns around EV adoption, such as those of the agricultural communities.

- ☐ **Pilot bidirectional charging in grid-constrained areas.** Map grid-constrained neighborhoods and pair them with V2G and bidirectional charging pilot opportunities. Explore policies and pilots for V2G and bidirectional charging to provide opportunities to improve grid resilience.

- ☐ **Scale successful elements of the battery–hydrogen demo.** Expand to additional depots where duty cycles justify hydrogen, and standardize designs (electrical one-lines, hydrogen equipment footprints, safety zones).

- ☐ **Pilot bidirectional operations at public fleets and schools.** Combine managed charging, stationary storage, and V2G to support critical loads and participate in demand response/virtual power plants.

- ☐ **Update AB 39 plans as needed.** Report ZEV adoption, charger/fueler buildout, costs/savings, equity outcomes, and progress on grid/facility upgrades; adjust procurement and schedules based on market conditions.

Focus areas

Test smart charging and V2G in grid-constrained neighborhoods and install curbside pilots in **urban areas**. Urban areas can emphasize curbside, workplace, and mobility hub charging.

Suburban areas can demonstrate large-scale charging in malls, shopping centers, and workplaces. Suburban areas can expand charging in shopping centers and schools

Rural areas can pilot shared fast-charging hubs at truck stops. Rural communities can prioritize highway corridors and agricultural fleet needs.

8–12 YEARS

LATE PHASE

- ☐ **Scale and integrate network.** Scale infrastructure regionwide with an equity focus. Integrate charging with solar, storage, and other distributed energy resources. Monitor usage, equity outcomes, and grid impacts to guide upgrades. Develop long-term revenue and cost sharing models for charging operations.

- ☐ **Expand V2G operations.** Expand V2G integration to public fleets, schools, and transit agencies. Build a combined transportation and electric sector business case so V2G and managed charging deliver long term value for site hosts, utilities, and residents.

- ☐ **Integrate depots into a resilient energy network.** Combine solar + storage + hydrogen fuel cells at priority depots to provide firm capacity, support black-start for critical operations following power outages, and enable regional emergency charging.

- ☐ **Expand V2G/V2B operations.** Move from pilots to standard practice for suitable fleets and multifamily/garage contexts, with clear tariffs and revenue models.

Focus areas

Urban areas build dense networks of curbside and workplace charging, and concentrate V2G-ready hubs at fleet depots, mobility hubs, and multifamily garages.

Suburban areas provide robust charging at major commercial centers, schools, and civic campuses, with standardized V2G capability at workplaces, auto malls, and public fleet yards.

Rural areas integrate EV charging and V2G into community microgrids at fire stations, schools, and community centers for resilience.

In all areas, connect highway corridors with fast charging and hydrogen stations for trucks and buses.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Provide technical assistance to jurisdictions with limited staff and align local plans with county and regionwide strategies. Coordinate among utilities and jurisdictions for interoperability and equitable coverage. Technical assistance can be provided through SACOG or similar collaboratives for feasibility studies, site selection, ordinance development, and implementation.

- ☐ Complete a regional zero-emission vehicle-ready charging plan that inventories existing infrastructure, analyzes demand, and identifies gaps and priority sites for community adoption. Coordinate with utilities on distribution upgrades and interconnection.

- ☐ Coordinate with agencies, utilities, and partners to fill charging infrastructure gaps along key transportation corridors and in rural areas to enable freight systems and agricultural stakeholders to meet zero-emissions goals for their respective fleets.

- ☐ Publish a regional AB 39 toolkit. Provide plan templates, duty-cycle analysis methods, siting/safety checklists (including hydrogen), standardized specifications, and a shared procurement cooperative.

- ☐ Create a hydrogen and safety working group. Convene utilities, fire authorities, air districts, depot operators, and OEMs to align on permitting, emergency response, and training.

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Political Resistance and Equity Barriers. Some communities resist mandates, and low-income households have the least access to vehicles and chargers.	Use incentives and voluntary programs and pair deployment with education on cost savings and air quality benefits. Provide targeted subsidies for low-income households such as rebates, used vehicle incentives, and lower charging rates.
Uncertainty Around Market Dynamics and Innovation. Costs of equipment and materials necessary for ZEV deployment may not always decline overtime as predicted because of tariffs and supply chain issues, and rapid innovation creates a risk that policies become outdated.	Adopt flexible and adaptive policies that respond to market conditions. Support innovation pilots, monitor cost trajectories, and update building requirements and incentive programs regularly.
Multifamily and Existing Development Retrofits. Existing properties lack charging and face high panel upgrade costs.	Use load managed and shared charging to avoid upgrades. Offer rebates, on-bill financing, or low interest loans for panel and service upgrades when needed. Pair funding with technical assistance to reduce soft costs and project complexity.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Target incentives and education toward low-income and rural communities to address disparities in adoption, as these groups face higher barriers to electric vehicle ownership.
- Offer rebates or financing for multifamily and existing buildings to add shared chargers or app-based metering to avoid panel upgrades.
- Where feasible, have the utility own or operate chargers so residents can access affordable electric vehicle rates for installations within multifamily buildings.
- Team utilities, affordable housing developers, and nonprofit organizations to co-fund and deliver projects.
- Partner with CBOs, agencies, and utilities to establish mobility hubs in low-income communities, community centers, and CBO-owned spaces to provide charging and other services.
- Explore curbside chargers in dense areas and at community anchors where designated parking is limited.
- Provide incentives to assist residents in older homes to upgrade panels and build capacity to enable at-home charging installations.
- Align charging infrastructure installs with refinancing and rehabilitation schedules to reduce costs and disruption.

Avoid adverse consequences

- Use grants, cost share programs, or utility-owned models rather than shifting expenses to residents.
- Provide multilingual, culturally relevant education and outreach that frames adoption as a choice with cost and health benefits and dispels misconceptions or safety concerns around EVs. Employ peer-to-peer education to address cultural or identity-related attachments to gasoline-powered vehicles.

TR-1 ZEV ADOPTION AND CHARGING INFRASTRUCTURE

COST EFFECTIVENESS

Use of Cleaner-Fuel Vehicles

-$21,755,000

Total Savings between 2026 – 2030

+ **$2,203,570,590** ZEV O&M Costs

$896,764,000 Upfront Capital Costs

\- **$918,518,496** Savings

-$404

per metric ton of GHG emissions reductions

To estimate the costs associated with ZEV adoption, a business-as-usual (BAU) scenario was compared to a ZEV transition scenario. Achieving the goal of transitioning 30% of light-duty vehicles to ZEVs by 2030 would require roughly 325,000 internal combustion engine (ICE) vehicles under the BAU scenario to switch to ZEVs. Capital costs were calculated by assessing the difference between the average prices of ICE and ZEV vehicles, assuming price parity is reached by 2030. Results indicate that the premium paid for new ZEVs would result in an upfront capital cost of $896,764,000 across the 2026–2030 horizon. While ZEVs are more expensive than ICE vehicles to purchase, their operations and maintenance (O&M) costs are lower. Compared to the BAU scenario, O&M costs for these 325,000 cars generate $918,518,000 in savings, based on per-mile cost differences between ICE and ZEVs. In the first two years under the transition scenario, capital costs will be greater than savings from fuel and O&M, but starting in 2028, cost savings will start to set in. Across the 2026-2030 horizon, upfront capital costs are more than offset by O&M savings, resulting in a net savings of $21,755,000 for residents, businesses, and fleet operators.

Charging Infrastructure

$270,763,000

Total Costs between 2026 – 2030

+ **$8,364,000** O&M Costs

$262,399,000 Upfront Capital Costs

\- **$0** Savings

$2,530

per metric ton of GHG emissions reductions

To estimate the costs of installing 6,500 new EV chargers between 2025 and 2030, the assessment developed assumptions around charger types, installation costs, and deployment timelines, modeling a steady annual rollout. The focus was on expanding access to chargers at buildings with designated parking. Cost estimates therefore assumed using a mix of Level 2 and DC fast chargers (DCFC), based on estimates from the Southern California Association of Governments' Plug-In Electric Vehicle Infrastructure Plan. Charger type distribution was determined using the U.S. Department of Energy's Electric Vehicle Infrastructure Projection Tool, which estimates the number of chargers needed based on fleet size. The total upfront capital costs for 6,500 new chargers are $262,399,000, while the total costs inclusive of operations and maintenance are estimated to be approximately $270,763,000 by 2030.

CASE STUDIES

East Palo Alto – Multifamily Housing (MFH) Low-Cost Charging Retrofit
A condominium complex successfully installed shared EV charging infrastructure at a cost of just $405 per parking spot, demonstrating that retrofitting existing multifamily housing can be affordable and scalable. The project used shared Level 2 chargers paired with residents' own charging handles, reducing electrical panel upgrades and lowering infrastructure costs. This model is highly replicable for other multifamily properties seeking cost-effective solutions.

SacRT Mobility Hubs Project
SacRT, the Sac Metro Air District, and the Sacramento Clean Cities Coalition are partnering to develop mobility hubs within low-income communities to support low-carbon mobility options, including access to EV charging infrastructure, EV carshare, and electric microtransit shuttles. Three light rail stations have been selected for the initial pilot stage as the result of a community-driven implementation plan. The pilot can provide a replicable model for the development of similar mobility hubs both at transit stations and within neighborhoods.

PG&E Vehicle-to-Everything (V2X) Pilot
PG&E launched a V2X pilot program that enables certain electric vehicles to send power back to homes and the grid. The pilot provides incentives for participants and tests the potential for EVs to act as distributed energy resources, supporting grid reliability and reducing peak demand. Lessons from this pilot can inform policies for regional V2G integration.

SMUD / ARV Heavy- and Medium-Duty Zero Emission Vehicle Blueprint
SMUD is planning hydrogen and electric fueling/charging stations for medium- and heavy-duty vehicles. For example, the plan includes two hydrogen stations at the Port of West Sacramento to support both port fleet pilots and public hydrogen fueling. This case shows how to build infrastructure for fleets (which need larger fuel or charging capacity) and scale regionally.

TR-4 ROADWAY IMPROVEMENTS FOR MULTI-MODAL USE AND ACCESS

This measure focuses on the improvement and expansion of multi-modal transportation routes to encourage a mode shift from single-occupancy vehicles to active modes of transportation such as bicycling or walking. The implementation of this measure is made up of three parts:

Provide Pedestrian Network Improvements. This measure will expand the sidewalk network to improve connectivity and access. Increasing the number of well-maintained pedestrian sidewalks will enhance the pedestrian experience and encourage people to walk instead of drive. The GHG reductions associated with this measure are based on the displacement of light-duty VMT.

Construct or Improve Bike Boulevards. This measure will construct or improve peripheral Class III bicycle boulevards that connect to the larger bikeway network. These supplementary Class III bikeways create safe, low-stress connections to encourage a mode shift from driving to bicycling, thus displacing VMT and reducing GHGs.

Expand Bikeway Network. This measure will expand bikeway networks. A bicycle network is an interconnected system of bike lanes, boulevards, and paths that improve the bicycling conditions of a community, often redesigning streets to accommodate protective infrastructure, signage, and paint to facilitate a safe and convenient route of travel. Bicycle networks also have the capacity to increase the "catchment area" of existing transit hubs through increased access, ultimately increasing public transit ridership.

LEAD AGENCIES

City and county public works and transportation departments adopt and implement street standards; approve encroachment permits and implement permit conditions; manage the public right of way; and fund, design, build, and maintain bike lanes and sidewalks.

Metropolitan planning organizations and **councils of governments** such as **Sacramento Area Council of Governments (SACOG)** and the **Tahoe Regional Planning Agency (TRPA),** guide transportation planning, lead travel demand modeling, coordinate among agencies, and allocate state and federal transportation funding for active transportation.

Regional and county transportation planning agencies, such as the Placer County Transportation Planning Agency and the Nevada County Transportation Commission, coordinate cross-jurisdictional projects, program regional funds for active transportation, and develop and align local plans.

City and county parks districts and departments plan, build, and maintain off-street pathways and trail facilities.

California Department of Transportation (Caltrans) owns and operates sidewalks and roadways on state routes and issues permits for construction within the state right of way.

State land managers, such as **California State Parks,** own and maintain certain trail facilities and coordinate trail connections with local jurisdictions.

Federal land managers, such as the United States Forest Service, the Bureau of Reclamation, and the United States Army Corps of Engineers, manage trails, roads, and shoreline segments on federal lands where local networks connect.

Some sidewalks and path segments are owned or maintained by **other entities** such as homeowners associations, school districts, universities, business campuses, and trail conservancies. Within those boundaries, these owners act as the lead agency for design, access, and maintenance.

IMPLEMENTATION PARTNERS

Community-based organizations (CBOs) and neighborhood associations lead corridor outreach, walk and ride audits, multilingual engagement, and community advisory roles.

Contractors deliver design, permitting, and construction within the public right of way.

Employers and business districts coordinate wayfinding and maintenance at interfaces with public facilities and may provide funding or access easements.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Update or align with adopted plans and standards.** Update or align with existing active transportation plans, bicycle and pedestrian plans, trails master plans, and general plan policies to authorize and guide projects. Apply development and street improvement standards that require sidewalks and bikeway elements in new projects. Keep plan maps and standard drawings current to match up-to-date design practices.

- ☐ **Tailor designs, roles, and requirements** to each agency's adopted policies and standards. Urban areas can update modal network maps and street typologies for dense grids; suburban areas can add connectivity standards for large parcels and superblocks; rural communities can focus on paved shoulders, context-sensitive trail alignments, and simple standards that fit low volume roads.

- ☐ **Adopt policies to improve safety and comfort.** Develop policies to monitor and better enforce vehicle speed limits, such as speed camera auto ticketing and speed feedback signs. Implement traffic-calming projects and add shade infrastructure in targeted pedestrian/bicycle zones.

- ☐ **Coordinate with capital projects.** Scan five-year capital improvements plans and programs and bundle walking and bicycling improvements where feasible. Use change orders to add sidewalk, crossing, and bikeway elements when nearby projects mobilize. Sequence construction to avoid demolishing recent work and to reduce traffic control costs. Urban areas can pair street resurfacing with protected bike lanes and curb extensions; suburban areas can attach path segments and crossings to school modernizations and arterial widenings; rural communities can combine shoulder paving and bridge rehabs with new crossings and trail connections.

- ☐ **Policy backstop for contested projects.** Adopt clear local policies for walking and bicycling and reference them in staff reports and hearings. Codify street design standards and frontage requirements so projects advance consistently. Integrate active transportation priorities into general plans and capital programs to support delivery when projects face opposition. Where supportive policies and standards are absent, expect greater risk of delay, deferral, or denial due to project pushback; adopt clear multi-modal policies before advancing corridor designs. Urban areas can adopt network-level complete streets policies and street design standards that apply to arterials and transit corridors; suburban areas can adopt safe routes policies and street retrofit standards for commercial arterials; rural communities can adopt shoulder widening, crossing safety, and trail access policies that fit lower speeds and volumes.

TR-4 ROADWAY IMPROVEMENTS FOR MULTI-MODAL USE AND ACCESS

IMPLEMENTATION STEPS AND TIMELINE

0–3 YEARS

EARLY PHASE

- ☐ **Select priority corridors.** Based on latest plans, prepare a short list of priority corridors identified in local plans for grant applications. Begin outreach in coordination with CBOs and partners to build public support.

- ☐ **Establish funding and grant readiness.** Move toward grant readiness for priority corridors with clear scopes, planning level costs, and community support. Align grant applications with program criteria and priorities and prepare match strategies and phasing plans that adhere to grant program rules and timelines. Hold early coordination meetings with Caltrans and other funders. Maintain shelf-ready concepts or preliminary designs to accelerate delivery when funds arrive. Urban areas, including smaller cities, can package large- and small-scale complete streets projects for competitive state programs; suburban areas can phase projects by school and employment center catchments; rural communities can target safety and tourism-oriented grants and bundle small segments into one deliverable.

- ☐ **Complete baseline analyses and assessments.** Collect traffic counts and walk and bike audits at multiple times of day; run intercept surveys; establish equity and performance metrics; and map approaches and last-mile connections to transit or other active transportation facilities. Conduct night audits and identify lighting gaps and visibility needs along corridors and last-mile connections to transit, and add lighting to project scopes if needed.

- ☐ **Clarify projects that span multiple owners.** Map ownership early and clarify ownership and maintenance responsibilities. If needed, draft access and maintenance agreements for private or institutional links and set campus edge connection standards; assign a lead agency for each boundary segment.

- ☐ **Develop initial designs.** Complete 10 to 30% corridor concepts, update planning-level costs and grant ready scopes, and align with utility and public works schedules. Prototype with quick-build materials; adjust designs based on observed behavior before committing to capital. Include electricity conduits in resurfacing projects; coordinate with utilities for metering and rebates.

- ☐ **Identify corridors for bicycle boulevards (low-stress bike routes).** Not every local street is suitable for low-stress routing and diversion, and crossings require careful selection. Map low-volume streets parallel to arterials; start with speed management and crossings and add diversion where support exists; monitor outcomes and scale to similar corridors.

- ☐ **Engage communities and build support.** Budget a dedicated outreach line item and partner with CBOs to support a robust outreach process. Use regional technical assistance funds for engagement. Provide multilingual, plain language visuals, pop-up demos, and walk audits. Provide businesses with clear access plans and loading zones. Provide decision-makers with data and information on the positive economic and quality of life benefits.

Focus areas

Urban areas can target priority corridors in plans and last-mile connections to transit stations, and close gaps in sidewalk networks.

Suburban areas can target school catchments, superblock connections, and commercial arterials.

Rural communities can target paved shoulders, highway crossings, and shared use path links to parks, trails, and schools.

4–7 YEARS

MIDDLE PHASE

- ☐ **Fund projects and complete planning.** Secure funding and advance projects through environmental review, utility coordination, right of way, and design to bid readiness.
- ☐ **Expedite permitting with clear submittal expectations.** Use pre-application meetings and checklists; standardize traffic control and restoration details; leverage on-call construction; set an escalation path to resolve review conflicts.
- ☐ **Develop corridor-scale quick-build pilots.** Evaluate and convert successful pilots to permanent construction. Build near-term segments that close gaps to schools, transit hubs, town centers, and employment areas.
- ☐ **Maintain momentum.** Keep a living pipeline with 10 to 30% concepts and planning-level costs; align corridor packages to program criteria; refresh priority lists after each grant cycle.
- ☐ **Minimize impact to communities.** Maintain recurring outreach and communications on project progress and manage construction to protect resident, business, and emergency access.
- ☐ **Avoid utility conflicts and costly rework.** Uncoordinated trenching and resurfacing damages new facilities and missed conduit raises future costs. Publish a two- to five-year look ahead; adopt a joint trench and spare conduit policy; preapprove restoration details for bikeways; add scope via change orders when nearby crews mobilize.
- ☐ **Plan for maintenance and collect data.** Create operations and maintenance plans and publish before and after results on safety, usage, access, and equity. Write maintenance agreements that assign sweeping, vegetation, storm response, lighting checks, and pavement repair; stock shared spare parts; add assets to each agency's asset management system; address use of assets by people experiencing homelessness. Adopt shared metrics for safety, usage, access, and equity; collect synchronized counts and near-miss indicators; publish annual scorecards tied to funding.

Focus areas

Urban areas can focus on protected lanes, safer crossings, sidewalk gaps, curbside upgrades, and station access lighting.

Suburban areas can complete off-street path spines, school access routes, and mid-block connections.

Rural communities can deliver shoulder widening, trailheads, and town to park path segments.

TR-4 ROADWAY IMPROVEMENTS FOR MULTI-MODAL USE AND ACCESS

8–12 YEARS

LATE PHASE

- ☐ **Complete networks.** Scale construction to close remaining gaps in bike networks and sidewalks and complete corridor transformations. Integrate walking and bicycling projects with transit priority, first- and last-mile access, regional trail links, and corridor lighting. Sustain delivery with ongoing grant cycles and public-private partnerships and publish annual reports tied to budget decisions.

- ☐ **Execute maintenance plans.** Fund long-term operations and maintenance, and update local street design standards on a set schedule. Track performance annually using safety, usage, mode share, access, and equity metrics and adjust programs and budgets.

Focus areas

Urban areas can aim to build dense, connected networks with protected facilities, frequent crossings, and well-lit corridors and transit station approaches.

Suburban areas should focus on providing strong access at schools, commercial centers, and civic campuses and finish long shared-use path segments.

Rural communities can connect towns with shoulder and path projects and link paths to regional recreation assets and intercity transit stops.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Create a regional working group of cities, counties, transit agencies, school districts, state land managers, and federal land managers. Meet regularly, track issues, and use one set of rules for permits and maintenance.

- ☐ Use a shared-corridor priority map and annual targets for miles built, gaps closed, and station approaches lit. Publish progress.

- ☐ Apply and target project funding within SACOG's identified mobility zones and Green Means Go zones. Coordinate cross-jurisdictional projects to build or close gaps between sidewalks and bike lanes. Use the SACOG regional trails plan to align routes and staging.

- ☐ Establish a pooled regional match fund.

- ☐ Submit joint grant applications for multi-corridor packages and keep a rolling two-year grant calendar with ready templates.

- ☐ Use federal, state, regional, and local programs as appropriate, and keep standard benefit, cost, and performance text up-to-date to help expedite grant application processes, especially for programs that require complex cost-benefit analysis.

- ☐ Publish a regional design toolkit for sections, protection, crossings, lighting near stations, trail junctions, and curb management. Set a regional bicycle boulevard policy with diversion thresholds and device options. Use common specifications and adopt a regional policy for low-stress bike routes with clear thresholds and device options.

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Limited local staff capacity. Small jurisdictions juggle many programs, and may lack capacity for scoping and grants.	Stand up a regional technical assistance team; share model ordinances and permit templates; use on-call contracts to surge design and outreach capacity.
Rising construction costs and supply volatility. Price spikes shrink scope and long lead times delay construction schedules.	Use cooperative purchasing; include additive alternates; deploy quick-build materials first, then convert to permanent construction; use prefabricated materials and reused materials; incorporate bicycle and pedestrian scope to vehicular street and infrastructure projects.
Limited right of way width. Narrow streets lead to tradeoffs and may create controversy and delays.	Apply context-sensitive cross sections; use side paths; acquire targeted easements; manage curbs for loading, micromobility, and pick up and drop off; coordinate with fire departments to ensure active transportation projects do not impede emergency access.
School schedule constraints. Work windows are short, and changes during the school year disrupt families and create safety risks.	Coordinate with school calendars; plan projects near schools during breaks; provide temporary routes and crossing guards during construction.
Overlapping mobility zones and cross-jurisdiction corridors. Overlaps create confusion about lead roles and standards and staging drifts without a regional view.	Apply mobility zones to set common priorities; when zones overlap, assign a lead agency and shared standards; use the regional trails plan to synchronize staging.

CHALLENGES	OPPORTUNITIES
Traffic stress and speed. Heavy volumes and high speeds suppress comfort and reduce bike lane use, especially on unprotected facilities.	Calm traffic with lane reallocation, speed management, and signal timing; build protected bikeways on arterials; route trucks and through traffic to appropriate corridors; build parallel low-stress networks on side streets.
Personal security and bike theft. Fear of crime lowers ridership and discourages bike parking at destinations.	Apply appropriate crime prevention through environmental design; add secure bike parking cages and lockers; use cameras where appropriate; fund corridor ambassadors; support bike registration and recovery; improve lighting at entrances and racks.
Political support and approvals. City Council or Board of Supervisors hesitancy can stall or water down projects despite technical readiness.	Adopt strong policy frameworks; present pilot results with before and after data; provide businesses with access plans; gather letters of support from schools, businesses, and community groups; brief decision-makers early and often.

TR-4 ROADWAY IMPROVEMENTS FOR MULTI-MODAL USE AND ACCESS

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- **Funding and resources.** Reserve set asides, waive or lower local match, provide grant writing help with templates, and pair corridors with low-cost programs such as helmet and light kits, repair vouchers, and income-qualified micromobility passes.
- **Community engagement and language access.** Contract CBOs to cohost audits, pop ups, and door to door outreach; compensate residents for time, childcare, food, and translation; define whether engagement will inform, consult, co-create, or empower; provide multilingual, plain language materials; meet at schools, faith venues, markets, clinics, parks, and transit hubs; and use trusted messengers.
- **Site understanding and prototyping.** Observe corridor use at different times of day and week, run intercept surveys at key destinations, and test concepts with quick build materials before capital construction.
- **Design and accessibility.** Add universal design elements such as tactile paving, accessible pedestrian signals, and compliant cross slopes at all new crossings and curb ramps.
- **Heat and climate comfort.** Add shade trees, shade canopies, drinking water access, and cooling spots along priority corridors, especially on routes to schools and transit.
- **Safety and personal security.** Add lighting and clear sightlines, install secure bike parking at libraries and community centers, apply appropriate crime prevention through environmental design, and where supported, fund corridor ambassadors or unarmed safety teams.
- **Micromobility affordability and safety.** Offer income qualified electric bicycle programs and provide secure charging, parking, and battery safety guidance at community facilities.
- **Jobs and local capacity.** Set local hire goals where allowed, fund pre-apprenticeship and apprenticeship pathways, train residents for sweeping, vegetation control, sign replacement, and lighting checks, and favor contracts with paid internships and on the job training for local youth.
- **Delivery and maintenance from day one.** Install near-term safety fixes, collect feedback and performance data, convert successful pilots to permanent construction, execute maintenance agreements, stock spare parts, and add new assets to the asset management system with service life and replacement schedules.
- **Housing and small business coordination.** Phase construction to protect access and deliveries, add secure bike parking near entrances, and coordinate with tenant stabilization and small business support programs.

Avoid adverse consequences

- **Construction access.** Maintain Americans with Disabilities Act access and signed detours, provide temporary crossings and protected walkways, and schedule school area work during breaks and off-peak periods.
- **Displacement and cost burdens.** Track rent, sales, and vacancy trends, use right to return preferences and small business stabilization grants where risk rises, align corridor investments with affordable housing, avoid shifting maintenance or utility costs to tenants or small property owners, coordinate utility metering and tariffs for corridor lighting and signals, and offer targeted rebates for security lighting and bike parking.
- **Non-punitive safety and profiling.** Rely on self-enforcing designs such as protection, speed management, signal timing, and lighting; emphasize outreach and education with lights, bells, and locks; minimize discretionary stops of people walking, biking, or rolling; use trained ambassadors and service referrals instead of police-led engagement where feasible; and provide simple incident reporting with quick resolution.
- **Data and privacy.** Collect anonymous, disaggregated before and after data on safety, harassment, and profiling; share findings with community partners; and co-design responses such as lighting upgrades, safe passage routes, and staffed hubs.
- **Curb access and disability needs.** Reserve accessible parking and paratransit zones near key destinations, set delivery windows and loading areas before removing parking, and communicate changes with wayfinding signs, mailers, and onsite ambassadors.

- **Traffic stress and comfort.** Build protected bikeways on busier streets, calm traffic with lane reallocation and speed management, provide parallel low stress routes on side streets, and upgrade wide arterial crossings with refuge islands, signals, or beacons.

- **Accountability and grievance process.** Provide a multilingual hotline and web form with response timelines, publish contact information on corridor signage, and track issue resolution to closure.

COST EFFECTIVENESS

Provide Pedestrian Network Improvements

$18,478,000

Total Costs between 2026 – 2030

+ **$300,000** O&M Costs
$61,922,000 Upfront Capital Costs

- **$43,744,000** Savings (annual)

-$1,031

per metric ton of GHG emissions reductions

Construct or Improve Bike Boulevards

$11,991,000

Total Costs between 2026 – 2030

+ **$1,083,000** O&M Costs
$12,243,000 Upfront Capital Costs

- **$1,335,000** Savings (annual)

-$221

per metric ton of GHG emissions reductions

Expand Bikeway Network

$76,159,000

Total Costs between 2026 – 2030

+ **$2,537,000** O&M Costs
$2,537,000 Upfront Capital Costs

- **$1,143,000** Savings (annual)

$4,021

per metric ton of GHG emissions reductions

TR-4 ROADWAY IMPROVEMENTS FOR MULTI-MODAL USE AND ACCESS

All unit cost estimates were derived from the City of Elk Grove's 2021 Bicycle, Pedestrian, and Trails Master Plan, which included construction and soft costs such as engineering, administration, and project management. Land acquisition costs are not accounted for. Annual maintenance costs are assumed to cost $2,732 per mile, based on data from Rails to Trails. However, since new sidewalks and bike paths typically do not need major repairs in the first few years following construction, this estimate is likely to overstate actual maintenance costs early on.

To estimate the costs of expanding pedestrian sidewalks across the region, existing sidewalk lengths were sourced from the 2022 Sacramento County Active Transportation Plan. The total upfront capital costs are $61,922,000, while the total costs inclusive of operations and maintenance are estimated to be $62,222,000 total for the expansion project. By 2030, additional savings of $43,744,000 annually are estimated from fuel and maintenance savings due to vehicle miles traveled (VMT) reductions. These savings will benefit residents.

To estimate the number of bike boulevards needed to displace 20% of VMT in the region, the analysis used the mileage of existing bicycle boulevards from Sacramento's 2018 Bicycle Master Plan, as the 2022 Active Transportation Plan did not have estimates on bike infrastructure mileage. VMT reduction was calculated using CARB's 2021 Quantification Methodology, which factors in trip length, usage frequency, and mode share. The total upfront capital costs are estimated to be $12,243,000, while the total costs inclusive of operations and maintenance are estimated to be $13,326,000 total. By 2030, additional savings of $1,335,000 annually are estimated from fuel and maintenance savings in VMT reductions. These savings will be experienced by households as they can reduce their driving needs.

To estimate the cost of expanding the bicycle network, existing network mileage was referenced from Sacramento's 2018 Bicycle Master Plan. Total upfront capital costs are estimated to be $74,765,000, while the total costs inclusive of operations and maintenance are estimated to be $77,302,000 total. By 2030, residents can benefit from an additional savings of $1,143,000 annually due to reductions in fuel and maintenance costs as a result of reduced VMT.

All costs were scaled across the broader Capital Region using county-level population data from the California Department of Finance and proportionally adjusted to Sacramento County's estimates based on each county's share of the regional population.

CASE STUDIES

Sacramento Area Council of Governments – Regional Trail Network Action Plan

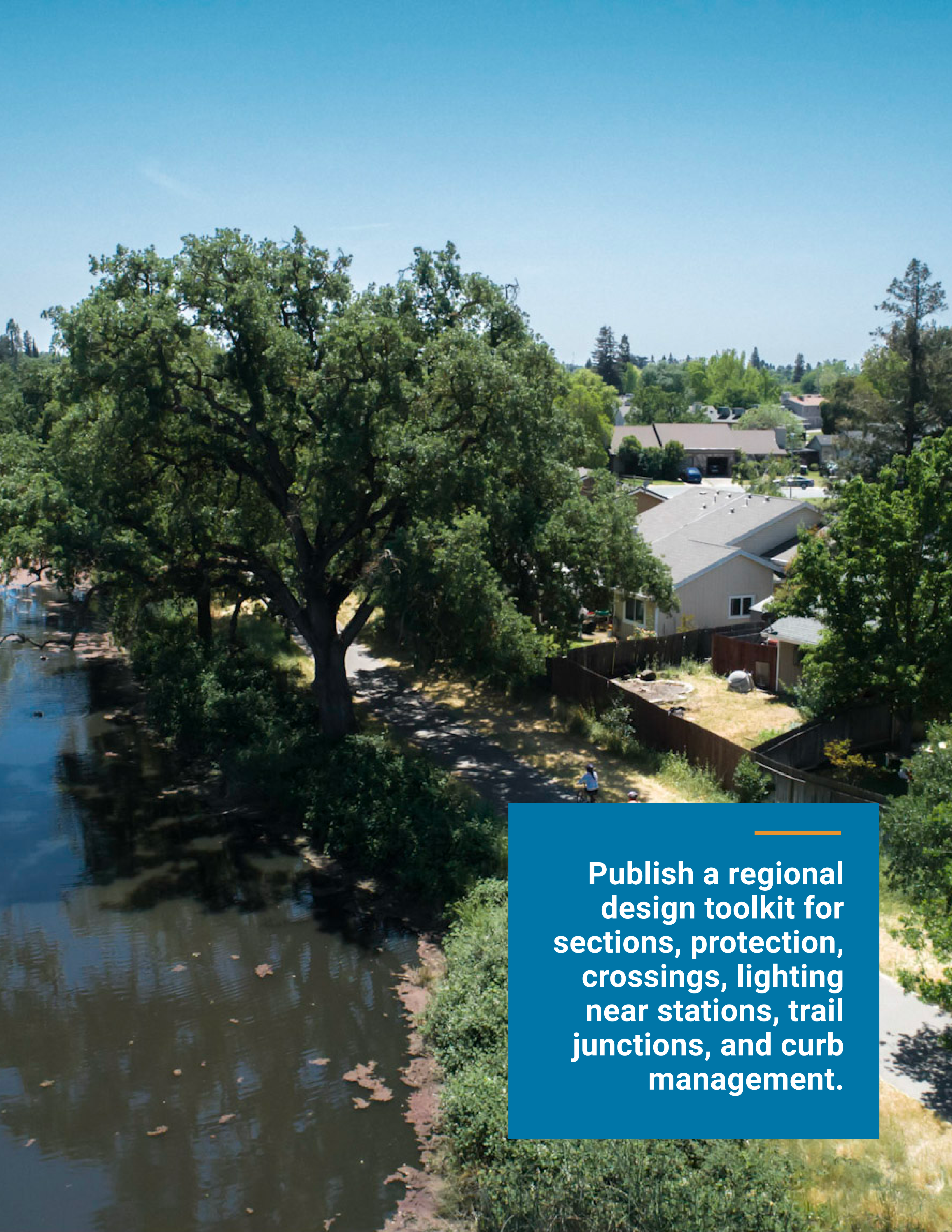
The Action Plan advances a connected, multi-county Sacramento Regional Trail Network, with a prioritized map and a technical assistance program that helps jurisdictions move projects from plan to delivery. It provides a regional framework to stitch together city and county segments into a continuous system. This case shows how a regional map, shared standards, and hands on technical assistance can accelerate multi-jurisdiction delivery.

Placer and Sacramento Gateway Corridor (PSGC)

The PSGC bundles multimodal improvements along the I-80 and Capitol Corridor gateway, including transit capacity, station access, and first and last mile pedestrian and bicycle upgrades positioned for the Solutions for Congested Corridors Program. It demonstrates how to package linked investments to reduce delay while improving active mode connections. This case shows how to assemble corridor scale multimodal packages and pursue joint state funding to deliver linked projects across county lines.

East Bay Greenway – Lake Merritt BART to South Hayward BART

Alameda County Transportation Commission is advancing a 16-mile regional trail and bikeway that generally follows the BART alignment through Oakland, San Leandro, Ashland, Cherryland, and Hayward, connecting multiple stations with a mix of multi-use paths and protected on-street facilities delivered in phases. The project creates a continuous north–south spine that links neighborhoods to high-capacity transit. This case shows how to leverage rail corridors and phased delivery to build long regional spines that connect communities to transit and services.



Publish a regional design toolkit for sections, protection, crossings, lighting near stations, trail junctions, and curb management.

NW-1 WILDFIRE RESILIENCE AND MANAGEMENT

This measure focuses on mitigating the intensity of wildfires in forested areas by implementing fuel treatments. Fuel treatments include thinning, prescribed burning (broadcast and pile burning), managed fire, pruning, grazing, and mechanical understory treatments, such as mastication or mowing to reduce fuel. During a wildfire event, the majority of GHG emissions are released from the burning of live tree biomass. After fuel treatments, forest stands often have lower fire severity than untreated forest stands, leading to lower GHG and co-pollutant emissions from mitigating combustion of dead and live biomass in a forest. Lower-intensity wildfires also often burn with slower spread, improving containment outcomes and protection for nearby communities. Notably, this measure roadmap also emphasizes the importance of maintenance – follow-up fuel treatments applied over time to sustain lower vegetation densities – which is often overlooked by funders and excluded from project scopes and budgets.

Wildfire Resilience and Management. Requires the use of fuel treatments on public and private lands to reduce future wildfire intensity. Treated forest stands will result in less severe wildfires and will reduce the amount of stored carbon released during wildfires.

Maintenance. Plan and fund recurring maintenance activities, including follow-up prescribed fire, selective thinning, slash removal, invasive species control, and fuel load reduction, to sustain initial treatment effectiveness and extend benefits over time.

LEAD AGENCIES

United States Forest Service (USFS) manages national forest lands and leads planning, permitting, and implementation of landscape-scale thinning and prescribed fire on federal lands.

Bureau of Land Management (BLM) and Bureau of Reclamation manage fuels work on their lands and facilities, including reservoirs and canal corridors, and coordinate permits and access.

California Department of Forestry and Fire Protection (CAL FIRE) funds and implements fuel treatments, administers prescribed fire in state responsibility areas, and partners with local agencies and landowners.

Cities and counties lead vegetation management and fuel treatment, working through key departments such as Parks, Public Works, and the Office of Emergency Services.

Resource conservation districts (RCDs) such as the Placer County RCD and the El Dorado County RCD coordinate cross-jurisdictional projects through wildfire preparedness and resilience offices, develop grants, provide technical assistance, and manage implementation.

Water agencies such as the Yuba County Water Agency safeguard source water watersheds and treatment facilities by leading priority fuels work around critical infrastructure and intake corridors, while **electric utilities** manage vegetation along power line corridors and coordinate shaded fuel breaks and access.

Other state agencies such as **California State Parks** and the **University of California** conduct forest restoration activities on land they own or manage. Similarly, the **California Tahoe Conservancy** conducts forest restoration on its managed properties and funds, plans, and leads forest management activities in their area of jurisdiction.

Railroads and **transportation agencies** manage vegetation along rail and highway rights of way that can function as linear fuel breaks and access lines.

Tribal cultural fire practitioners conduct cultural burns and forest restoration activities.

County and community Fire Safe Councils and Firewise Communities organize neighborhood-scale readiness, secure grants, engage residents, and deliver on-the-ground fuel reduction and defensible space work. Activities vary by individual organization.

Industrial timberland owners and small forest landowners implement treatments with the goal of and prescription to reduce wildfire severity within private forests that connect public land projects and provide access for haul routes.

IMPLEMENTATION PARTNERS

The **Sierra Nevada Conservancy** funds, plans, and leads forest management activities, with an increasing focus on multi-jurisdictional, multi-benefit, large-scale projects. Other state partners include the **California Wildfire and Forest Resiliency Task Force** as a key coordinator.

Federal partners include the Natural Resources Conservation Services (NRCS), which help private landowners and Tribes restore forests, the Federal Emergency Management Agency, and the Department of Housing and Urban Development.

Fire protection districts fund and assist in providing labor for wildfire mitigation projects.

Multiparty partnerships such as French Meadows, North Yuba Forest Partnership, and Truckee River Watershed Forest Alliance, align priorities across owners and move large landscape projects through planning and delivery.

Registered Professional Foresters, Licensed Timber Operators, burn bosses, and **fuels contractor teams** provide environmental compliance support and deliver mechanical thinning, pile burning, and prescribed fire.

Prescribed burn associations organize landowner-led prescribed fire, training, and shared risk arrangements that expand capacity on private and mixed ownership lands. Some assist with planning, permitting, and implementation.

California Conservation Corps and local conservation corps deliver hand-thinning, pile-building, chipping, and post fire stabilization while training local workers.

Local air quality management districts regulate smoke and issue prescribed burn permits and smoke management plans.

Biomass and wood utilization partners, including bioenergy plants, sawmills, biochar firms, and specialty wood producers, accept small-diameter material to reduce piles and lower treatment costs. The Greater Sacramento Economic Council and local economic development departments can support industry attraction and market development for biomass and wood-utilization products.

Targeted grazing operators and rangeland specialists manage fine fuels along shaded fuel breaks, utility corridors, and community perimeters.

Insurance carriers and resilience finance partners offer community mitigation credits and risk modeling to prioritize treatments.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Establish baseline implementation funding.** Create dedicated pre-project funding and pooled regional match for environmental review and planning. Commit seed funding to match grants, support environmental compliance and permitting, and bridge timing gaps between planning and project implementation.

- ☐ **Streamline environmental review.** Develop streamlined programmatic California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), Endangered Species Act (ESA), and National Historic Preservation Act reviews to enable faster, project-specific approval and implementation. Create standard checklists, model scopes, survey protocols, and biological and cultural resource checklists and preapproved methods to accelerate repeat projects. Bundle permitting across adjacent projects to share costs; however, issues with one project can slow down others.

- ☐ **Develop and expand regional workforce training programs.** Invest in regional workforce training opportunities in forestry work, environmental review, biomass utilization, and other efforts. Build partnerships to fund and develop regional workforce training programs, such as through community colleges and regional California Jobs First initiatives (e.g., Sierra Jobs First), for both forestry maintenance work and environmental permitting and compliance. Fund apprenticeships and certifications, guarantee multiyear talent pipelines, and coordinate contractor mobilization across neighboring projects.

- ☐ **Catalyze biomass and wood product utilization industry.** Plan end markets and logistics for removed material before implementation so fuel treatments do not stall for lack of outlets. Coordinate with partners to establish robust regional biomass utilization and value-added wood products manufacturing industries through pilot projects, public-private investments, catalyst funding (e.g., regional California Jobs First initiatives), and job training. Work with economic development initiatives to advance diversified biomass outlets beyond power generation, including biochar, specialty wood products, mass timber construction materials (e.g., cross-laminated timber), and small combined heat and power (CHP).

NW-1 WILDFIRE RESILIENCE AND MANAGEMENT

IMPLEMENTATION STEPS AND TIMELINE

0–3 YEARS

EARLY PHASE

- ☐ **Conduct landscape-scale planning and prioritization.** Develop or update Community Wildfire Protection Plans and conduct a countywide or region-wide prioritization process to identify priority treatment areas and coordinate on project development, focusing on the wildland urban interface (WUI) and evacuation corridors. Other focus areas include greenbelts, riparian corridors, undeveloped vegetated areas, canyons, community buffers, and large forest blocks and rangelands that influence fire spread.
- ☐ **Establish collaborative governance and community plans.** Convene or participate in standing collaboratives, which are likely to vary by region but could include state and federal agencies (e.g., USFS, CAL FIRE), local agencies and special districts such as resource conservation districts, Fire Safe Councils, Firewise communities, Tribes, land trusts, and counties or cities.
- ☐ **Identify grants and funding opportunities.** Consider financing mechanisms such as climate resilience districts (CRDs), forest resilience bonds, and carbon credits. Package multi-partner projects to enable joint funding applications.
- ☐ **Include full scale of needs in project scopes and budgets.** Include transport, processing, and storage costs for biomass in project budgets and agreements. Develop maintenance plans and budgets at project start to maintain previously treated areas and establish maintenance set-asides or escrow per project. Maintenance plans should also incorporate previously treated areas where maintenance has not been funded and areas that have burned under managed fire or unmanaged wildfire regimes.
- ☐ **Conduct environmental reviews and execute agreements.** Conduct environmental reviews if not covered under existing programmatic reviews. Execute land access and stewardship agreements across public, private, and federal parcels. Coordinate and execute any needed memoranda of understanding (MOUs) and coordinate with partners such as utilities, special districts, and other stakeholders.
- ☐ **Engage communities, stakeholders, and Tribes.** Conduct community outreach around planned activities, benefits, and proposed end uses for biomass.
- ☐ **Plan for biomass end-uses.** Map biomass outlets and hauling logistics and line up near-term uses such as biochar and small CHP.

4–7 YEARS

MIDDLE PHASE

- ☐ **Secure funding and execute.** Secure grants, permits, and right-of-entry and move projects to implementation readiness. Deliver priority fuel treatments including mechanical thinning, pile-burning during safe windows, and prescribed broadcast burning.
- ☐ **Scale up capacity and maintain project pipeline.** Ramp up workforce training with contractors and training partners. Expand crews, trucking, and equipment capacity and keep qualified contractor benches active. Maintain a rolling list of shovel-ready, pre-cleared or pre-approved, or tiered projects with costs, benefits, and lead implementers to improve grant competitiveness.
- ☐ **Scale up biomass utilization opportunities.** Pilot and scale biomass utilization contracts so material leaves sites reliably and does not accumulate. Aggregate feedstock across projects, make long-term supply commitments, and coordinate hauling so material leaves the forest promptly.
- ☐ **Track and monitor progress.** Track treatments and observations of monitored regrowth in a shared database and schedule reentry based on results, before fuels rebound. Track acres treated, cost per acre, air quality impacts and risk reduction. Monitor vegetation regrowth in treated areas and adapt treatment plans based on observed conditions rather than a calendar-based schedule.
- ☐ **Explore creative insurance mechanisms.** Develop solutions to pair fuel treatment activities with reductions in insurance premiums for nearby residents and businesses.

8–12 YEARS

LATE PHASE

- ☐ **Conduct maintenance based on monitoring outcomes.** Institutionalize, treat, and maintain rotations matched to vegetation type and fire behavior. Set adaptive maintenance schedules for treated acres, including reentry intervals, invasive species control, and follow-up burning or mastication. Create a dedicated maintenance funding mechanism that blends county funds, grants, and stewardship contracts with landowners.

- ☐ **Update plans and scale across jurisdictions.** Refresh plans, priorities, and agreements every three to five years using monitoring data and community input. Scale cross-jurisdictional operations with shared crews, staging, and equipment. Publish annual outcomes and adjust prescriptions, maintenance frequency, and workforce investments.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Stand up a multi-county, multi-jurisdiction collaborative to plan, fund, and deliver treatments across boundaries. Use MOUs and joint work plans, and align with Fire Safe Councils and watershed partnerships.

- ☐ Define roles for counties, resource conservation districts, Fire Safe Councils, federal land managers, water agencies, air districts, etc., and use shared priority maps and joint work plans.

- ☐ Explore multi-benefit partnerships to protect headwaters, improve air quality, and harden energy and water infrastructure. Use joint agreements to co-fund priority treatments in source water and utility corridors.

- ☐ Adopt landscape-level prioritization and a project design process that ranks treatment areas using transparent criteria such as community protection, evacuation routes, habitat, and water supply to support coordinated project development. Seek input from community members and stakeholders to select high-return treatment areas.

- ☐ Use decision-support tools to map priority polygons and publish an annually refreshed treatment pipeline of both new areas for treatment and areas requiring maintenance treatments.

NW-1 WILDFIRE RESILIENCE AND MANAGEMENT

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
General funding scarcity. Partners lack dedicated funds to advance ready plans.	Coordinate applications to state and federal programs to reduce piecemeal delivery. However, note that this may result in an extended environmental review process. Create pooled match funds, pursue resilience financing, and enlist water and air districts where co-benefits exist.
Funding program misalignment. Most grants focus on implementation. Pre-project work and maintenance compete with new acre implementation.	Establish separate, stable funding tracks for planning, environmental compliance, permitting, implementation, and multi-cycle maintenance. Value upkeep equal to initial treatment.
Limited end-uses and markets for removed biomass. Lack of buyers for removed biomass make it difficult for fuel treatment projects to be self-sustaining after initial grant funding runs out.	Provide technical assistance and investment to pilot community-scale and distributed biomass and wood utilization facilities as part of economic development activities.
Prioritization gaps on non-federal lands. Private and mixed-ownership areas lag prioritization.	Extend risk-based tools and community wildfire protection planning to private and institutional lands and confirm priorities through public forums and steering committees.
Fragmented coordination across jurisdictions. Multiple owners and programs slow cross-boundary work.	Align local and federal priorities so projects stack into contiguous, defendable fuel breaks. Use access agreements and right-of-entry templates to streamline work on mixed-ownership landscape mosaics. Align treatment prescriptions so transitions across property lines do not create weak links. Maintain a single coordination calendar for scoping, permitting, implementation, and maintenance to reduce duplication.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Prioritize fuel treatments where communities face the highest wildfire risk and where water and power infrastructure need protection, and coordinate delivery with Fire Safe Councils, Firewise communities, and resource conservation districts.
- Create paid local workforce development pathways by funding training and apprenticeships for key roles (e.g., foresters, operators, trucking, and compliance support), and include local hire targets in contracts. Actively conduct job training outreach in low-income or under-represented communities.
- Partner with Tribes to develop Tribally led and implemented projects incorporating cultural burning, Traditional Ecological Knowledge, and other practices.
- Partner with water agencies and utilities to co-fund work that protects headwaters, hydropower assets, and electric infrastructure, and align treatment schedules with their capital programs.
- Engage communities early and often through multilingual meetings and field days on treatment sites, treatment types, burn windows, and biomass utilization options.

Avoid adverse consequences

- Ahead of controlled burns, communicate activities and risks to sensitive groups, distribute N95 respirator masks or HEPA filters, and provide clean air refuges. Explore diversion of material to utilization options such as bioenergy or biochar when feasible.
- Site biomass processing facilities (e.g., any combustion or CHP facilities) away from sensitive receptors and engage communities throughout process.
- Reduce process burdens by streamlining compliance where appropriate and coordinate permits across agencies so projects do not stall or shift costs to residents.
- Frame activities and biomass facilities as fuel-reduction tools, highlight wildfire risk reduction, watershed protection, and safety benefits, and use local case studies to build support.
- Engage communities throughout the process to address issues proactively and incorporate local priorities in identification of treatment areas, development of biomass utilization opportunities, and job training.
- Publish results on risk reduction, air quality, economic development, and other community benefits to sustain support.

COST EFFECTIVENESS

$16,627,000

Total Costs between 2026 – 2030

+ **$300,000** O&M Costs

$16,627,000 Upfront Capital Costs

- **$0** Savings

$1,151

per metric ton of GHG emissions reductions

Cost estimates are based on the French Meadows Forest Reduction Project (2023), which implemented wildfire mitigation measures including mechanical thinning, mastication, hand thinning, road improvements, and the staffing costs to carry out these measures. Timber harvested for biomass helped offset project costs, resulting in an average cost of $1,907 per acre. Adjusted to 2025 prices, the cost is estimated at $2,078 per acre. Based on GHG reduction targets, 8,000 acres are to be treated by 2030—about 1,600 acres annually. At this rate, total upfront capital costs are estimated to be $3,325,307 per year, or $16,626,538 total from 2026 to 2030. No operations and maintenance or savings calculations were made for this measure. These figures reflect only the per-acre treatment costs of wildfire reduction measures and do not include operational expenses. This estimate only captures the upfront costs associated with this measure.

NW-1 WILDFIRE RESILIENCE AND MANAGEMENT

CASE STUDIES

French Meadows Forest Restoration Partnership
A watershed-focused collaboration in Placer County aligned the county, Placer County Water Agency, the USFS, and other partners to plan and implement large-scale fuel treatments to protect hydropower and drinking water assets while reducing wildfire severity. This case study shows how a water utility-led partnership can unlock funding, prioritize high-value headwaters, and deliver multi-benefit landscape-scale forest resilience.

North Yuba Forest Partnership
A landscape collaboration in Sierra and Yuba Counties organized partners around a large planning area, used shared prioritization pillars, and advanced treatments through coordinated pathways, with projects lined up for the next 20 years. This example shows how a multi-jurisdictional partnership can set common priorities, phase projects, and keep community protection and biodiversity goals aligned.

Placer County Cabin Creek
After community opposition to a traditional biomass-to-energy facility, Placer County re-scoped to a smaller biochar production approach supported by purchase commitments, preserving an outlet for treatment residues. The project illustrates how adaptive project design and right-sizing technology can maintain social license while still solving material disposition challenges.

Colfax I Forest Resilience Bond
The first forest resilience bond to be led and implemented by a Tribal organization, the Colfax I Forest Resilience Bond (FRB) brings Indigenous knowledge and cultural fire treatments to restoration activities spanning Tribal trust lands, private holdings, and Bureau of Land Management lands across Placer and El Dorado counties. The project demonstrates how innovative financing mechanisms can be applied to strengthen the capacity of Tribal stewardship, community-led restoration activities, and Tribal workforce activities.

Tahoe Central Sierra Initiative
A region-wide collaboration of federal, state, local, Tribal, utility, and nonprofit partners aligning forest and watershed resilience across the Central Sierra Nevada region. The initiative advances shared priority maps, joint planning, and coordinated delivery that spans multiple ownerships and counties. This case shows how a multi-partner framework can synchronize funding, permitting, and operations at the landscape scale.

Nevada County Biomass Pilot Project
Nevada County is testing community-scale biomass solutions to provide reliable outlets for treated fuels, with work on siting, technology selection, air quality coordination, and funding. The pilot pairs hazardous fuel removal with local utilization to keep residues moving off treated acres. This case study shows how a county can de-risk first mover projects that support ongoing maintenance of fuel breaks and treatment units.

Local air district mitigation funds for forest health
The Placer County Air Pollution Control District directed development-related air quality mitigation fees to a forest health and wildfire mitigation fund that can pay for permitting and early studies. This demonstrates how local mitigation dollars can seed pre-project compliance and planning to unlock implementation funding.

Water agency early-stage funding in Yuba County
The Yuba County Water Agency provided early de-risk capital for shovel-ready biomass projects linked to watershed protection goals, helping bridge financing gaps for private investors in advance of permitting approvals. This case study shows how water agencies can anchor predevelopment and accelerate projects that reduce wildfire risk to critical infrastructure.

Coordinate with partners to establish robust regional biomass utilization and value-added wood products manufacturing industries through pilot projects, public-private investments, catalyst funding and job training.

NW-2 BIOMASS ENERGY

This measure focuses on the local generation of electricity (or cogeneration) with biomass to displace fossil fuel-based electricity generation. Biomass energy has lower lifecycle GHG emissions than conventional fossil fuel energy because of the carbon uptake from plants grown to produce biomass fuel.

Biomass Energy. This measure would support new biomass fuel electricity generation capacity to produce electricity, or electricity and heat (cogeneration). By installing biomass energy generation locally, the carbon intensity of the electricity supply would decrease, reducing GHG emissions from local electricity consumption.

LEAD AGENCIES

Counties and cities plan, permit, and approve local biomass electricity and combined heat and power (CHP) projects and align policies with climate and air quality goals.

Water agencies, wastewater districts, and special districts host facilities at wastewater and energy campuses, procure equipment, secure interconnection, and use electricity and useful heat for onsite loads.

Regional planning bodies coordinate cross-county siting, environmental review, and schedule alignment for multi-jurisdictional projects, including basin specific approvals where required.

IMPLEMENTATION PARTNERS

Utilities and community choice aggregators coordinate interconnection studies, metering, and tariffs; procure energy and execute power purchase agreements; and enable grid services and demand response.

Solid waste and biomass operators aggregate, chip, and deliver feedstock from transfer stations, landfills, forest operations, and agricultural removals and manage hauling and storage logistics.

United States Forest Service and state forestry agencies secure long-term feedstock through stewardship contracts and vegetation management projects and coordinate access and timelines.

Project developers and technology providers site, design, finance, build, commission, operate, and maintain biomass facilities and provide performance guarantees and training.

Resource conservation districts and University of California Cooperative Extension deliver technical assistance, producer outreach, workforce training, and monitoring, reporting, and verification.

Air districts permit biomass facilities, offer incentive funding for cleaner engines and controls, verify emissions, monitor air quality, and document exceedances in criteria air pollutants.

Economic development and finance partners structure public and private funding, apply bioeconomy investment zone ratings, and arrange credit enhancements or insurance for feedstock supply and offtake risk.

Tribal governments and community-based organizations (CBOs) lead local engagement, workforce pathways, and benefit sharing and help align projects with community priorities.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Establish Bioeconomy Development Opportunity (BDO) Zones.** Identify and pursue Ecostrat BDO Zone ratings for Placer, El Dorado, and Nevada counties, noting that Yuba County is paired with Butte County, and Yolo County has already applied. After rating has been achieved, run a three-to-six-month promotion phase with economic development teams to recruit hosts and investors.
- ☐ **Align with plans and policies.** Align with Climate Action Plans, natural and working lands strategies, wildfire protection plans, and Senate Bill 1383 organics diversion. Reference any strategic plans that include biomass to energy to align actions and budgets.
- ☐ **Conduct advocacy.** Advocate for the importance of extending or replacing the Bioenergy Market Adjusting Tariff to avoid project attrition if current procurement sunsets. Coordinate with state agencies to regionalize bioenergy generation and procurement targets and keep funding stable for technical assistance and implementation.
- ☐ **Pre-screen candidate sites.** Review and pre-screen potential implementation sites at wastewater plants, transfer stations, industrial parks, and energy campuses for utility access, noise, traffic, and buffer requirements. If possible, gather community input.
- ☐ **Plan for feedstock supply and contracts.** Plan for procurement reality. The primary challenge is securing reliable feedstock for at least 3-5 years; contract terms should explicitly address quality specifications, shipping frequency, and onsite storage capacity to keep moisture and contamination within targets. Execute long-term feedstock contracts with price and quality specifications and delivery schedules — 3-5 years as a baseline, targeting 10-to-20-year U.S. Forest Service stewardship agreements where feasible. Stand up aggregation nodes and preprocessing for chipping, moisture reduction, and contamination control, sized to match contracted delivery cadence and storage dwell times. Use insurance or reserve mechanisms to backstop volume and price risk during wildfire, flood, or market disruptions.
- ☐ **Identify heat load and thermal use.** Identify year-round thermal hosts for CHP such as wastewater plants, industrial users, and district energy loops. Design heat recovery and distribution to meet temperature and reliability needs and to maximize overall efficiency.

0–3 YEARS

EARLY PHASE

- ☐ **Select and permit sites.** Based on pre-screening criteria, feasibility, and community input, select candidate site. Address site control constraints early, especially at privately owned mill or industrial properties. Use option agreements, leases, or public site control to keep schedules reliable and maintain contingency sites.
- ☐ **Secure funding and incentives.** Secure near-term funding for feasibility, permitting, engineering, and site control. Secure multi-year capital and operating funds from county, state, and federal programs for equipment, interconnection, and emissions controls. Combine grants, bonds, and private capital with credit enhancements. Apply for rapid grants to fund feasibility, front-end engineering and design, and site control. Where available, stack resources from air quality programs, wildfire and fuels management funds, and organics recycling programs to lower delivered cost.
- ☐ **Select technology.** Select proven technologies matched to feedstock such as combustion steam cycle, gasification with engine or turbine, or pyrolysis with biochar co-product. Complete front-end engineering and design with performance guarantees, availability targets, and spare parts plans. Include fire protection, odor control, and noise mitigation in baseline design.
- ☐ **Engage communities.** Conduct early outreach with nearby residents, Tribes, and CBOs and provide clear, transparent information on planned site designs and environmental impacts, using non-technical language. Listen to community concerns and reflect input in siting and design. Share community benefits such as reduced open burning, reduced wildfire risk, local jobs, backup power potential, and biochar or heat access where applicable.
- ☐ **Complete environmental review and permitting.** Conduct California Environmental Quality Act (CEQA) reviews, align with local general plans and zoning, and secure all required permits. Use best available control technology for emissions and prepare air permit applications with validated stack test data.
- ☐ **Reduce air quality impacts.** Work with the local air district to comply with emission limits and establish monitoring and reporting methods. Select controls for nitrogen oxides, carbon monoxide, volatile organic compounds, and particulate matter appropriate to unit size and technology.

IMPLEMENTATION STEPS AND TIMELINE

Plan for visible emissions observations and continuous monitoring as required.

- ☐ **Coordinate grid interconnection and tariffs.** Start utility pre-application meetings to confirm interconnection pathway, protection requirements, and meter configuration. Select tariffs that support export or net energy metering where eligible and evaluate resource adequacy and demand response options. Define power purchase agreement terms with utilities or community choice aggregators and set milestones for testing and commissioning.

- ☐ **Coordinate logistics and infrastructure.** Build or contract for chipping, staging, and storage with stormwater and fire safety measures, right-sized to haul frequency and seasonal variability to maintain fuel quality. Plan haul routes and hours and coordinate with transfer stations and landfills for inbound and outbound traffic. Provide calibrated scales and moisture testing to manage payment and performance.

- ☐ **Secure feedstock supply.** Map feedstock by source and season and execute letters of intent with operators. Include contingency sources and storage plans to provide reliable year-round supply. Prioritize local suppliers and community-based operators to strengthen regional economic benefits.

Focus areas

In urban areas, site small units at wastewater plants and transfer stations with strict emissions controls and traffic management.

In suburban areas, co-locate at materials recovery and transfer nodes and design for both electricity and thermal use or combined heat and power units by public facilities.

In rural areas, place facilities near feedstock sources and sawmills, prioritize CHP for industrial or water-agency loads, and build regional aggregation yards.

4–7 YEARS

MIDDLE PHASE

- ☐ **Procure, build, and commission** a small, CHP pilot at a public facility with a year-round thermal host. Finalize interconnection, witness testing, and commissioning and begin grid services or demand response enrollment. Stand up parts inventory, uptime reporting, and preventative maintenance schedules.

- ☐ **Build workforce.** Hire and train operators, electricians, and mechanics with clear standard operating procedures. Establish local hiring standards and coordinate with local colleges, workforce boards, and conservation corps for training and internships.

- ☐ **Aggregate biomass supply.** Stand up aggregation yards and preprocessing for chipping, staging, moisture management, and contamination control. Execute multiyear feedstock contracts and delivery schedules, including stewardship contracts and seasonal access where federal lands are involved.

- ☐ **Reduce financial risk.** Secure long-term purchase agreements (offtake) with programs such as the Bioenergy Market Adjusting Tariff or successor procurement programs and reference supportive statutes such as Senate Bill 1109 in procurement strategies. Bundle projects into portfolios and advance each to shovel-ready status with site control, interconnection progress, permits, and offtake before seeking private investment. Ideally, de-risk the pipeline by carrying one small behind-the-meter project to shovel-ready and one larger site to advanced design for investor review. Use insurance or reserve accounts to backstop feedstock and offtake risk.

- ☐ **Scale up.** Advance a second wave of projects in parallel, including very small units in sensitive basins where cleaner profiles are required, taking into account lessons learned.

- ☐ **Monitor and report data.** Publish annual data and metrics on air quality impacts, biomass tonnage diverted, GHG reductions, jobs created, and other co-benefits. Provide clear data and accountability to community members through a complaints hotline and email.

8–12 YEARS

LATE PHASE

- ☐ **Continue to scale up.** Establish a distributed network of right-sized facilities near feedstock sources and public thermal loads.
- ☐ **Lock long-term risk tools** and use insurance or reserve mechanisms to backstop feedstock and interconnection risk.
- ☐ **Institutionalize workforce pipelines** with community colleges, workforce boards, and conservation corps.
- ☐ **Maintain procurement signals** and integrate biomass utilization into climate, air quality, wildfire, and organics plans.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Prioritize small, modular CHP units behind the meter in sensitive areas and use them as test cases to update basin rules when cleaner profiles are proven. Document pivots to smaller kiln-based designs where larger plants face opposition: In places where community opposition blocks large biomass plants, show that shifting to smaller, modular "kiln-based" systems (i.e., biochar units) can be an acceptable, lower-impact alternative.
- ☐ Standardize fuel specifications and sign multi-year supply agreements with local refuse and disposal operators to stabilize delivered cost and volume. Leverage utility and program procurement to support offtake, pair projects with county promotion windows and designated investment zones, and present bundled, shovel-ready portfolios to investors.
- ☐ Partner with existing forest resilience projects to provide a stable outlet and market for forest biomass, supporting the long-term sustainability of fuel treatment and maintenance projects.
- ☐ Show workable scales through early pilots and publish measured emissions and air quality benefits compared to open-pile burning. Share operations, cost, and performance data to build confidence.
- ☐ Collaborate with experienced counties and districts as technical leads and replicate large landscape collaborations that coordinate fuel reduction, feedstock flows, and siting across county lines. Formalize collaboration through a Joint Powers Authority or a Memorandum of Understanding so counties can coordinate siting, procurement, and shared services.

NW-2 BIOMASS ENERGY

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
High and/or variable grid interconnection costs and long timelines. Distribution upgrade costs can exceed budgets and timing can jeopardize grants.	Engage utilities early, choose sites near available capacity, and prioritize behind-the-meter CHP.
Community acceptance and siting near sensitive receptors. Some residents associate biomass with older high-emission plants without measured performance data.	Site at wastewater plants, transfer stations, or industrial campuses and share verified performance data.
Weak markets for biochar and other co-products. Without contracted buyers, co-product revenue is speculative.	Secure buyers before build and target water treatment and agriculture uses.
Policy and procurement uncertainty for biomass power. Changes in program rules, mandates, and tariffs can strand projects.	Use community choice aggregators and local power purchase agreements and advocate for program continuity and successor procurements.
Hauling distance and delivered feedstock cost. Long routes raise trucking expense and increase moisture loss and contamination risk.	Co-locate near feedstock and transfer stations and optimize routes, staging, and moisture management.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Set local hire goals, fund training, and advertise openings so residents benefit from new facilities and feedstock operations.
- Offer workshops, school partnerships, and site tours to explain modern biomass systems, air controls, and how projects reduce open burning and wildfire smoke.
- Place smaller, cleaner, behind the meter CHP units where they can serve public facilities in communities that face frequent outages.
- Work with air districts to direct mitigation and incentive dollars toward forest health, wildfire mitigation, and biomass utilization near overburdened neighborhoods.
- Secure letters of intent for biochar and other co-products to create regional value chains and stable revenue that supports community jobs.
- Engage water agencies, utilities, Tribes, and CBOs to co-invest in projects that improve watershed health and grid resilience.

Avoid adverse consequences

- Prefer distributed, small-scale facilities with modern controls and avoid locations with a history of air quality concerns. Conduct early engagement to address community concerns and perceptions shaped by legacy plants.
- Reduce truck impacts by co-locating near transfer stations or landfills that already handle woody material and by shortening haul routes.
- Adjust scale and technology when projects face opposition and involve basin planning agencies early in sensitive locations.
- Include local hire, training, and transparent air monitoring in agreements so benefits are delivered, and concerns are addressed throughout development and operations.

COST EFFECTIVENESS

$6,617,000

Total Costs between 2026 – 2030

+ **$786,000**
O&M Costs

$5,831,000
Upfront Capital Costs

- **$0**
Savings

$675

per metric ton of GHG emissions reductions

Cost estimates are based on the CAPCOA Handbook Update example and other publicly available sources. The estimated upfront capital cost to construct a 1 MW biomass facility is $5,831,000. Annual operating expenses are projected at $157,000, totaling $786,000 over a typical five-year period. Total costs inclusive of operations and maintenance and savings are therefore estimated to be $6,617,000. These figures are derived from the U.S. Energy Information Administration's 2020 study, adjusted for inflation to reflect 2025 values. For smaller-scale applications, a biomass generator capable of producing 50 kW is estimated to cost $100,000. This estimate is based on the 2018 study Estimated Costs of New Utility-Scale Generation in California, also adjusted to 2025 prices.

CASE STUDIES

Placer County — French Meadows Headwaters Partnership and Biomass Utilization
Forest-thinning projects protect drinking water and hydropower headwaters while routing woody material to local biomass uses. This case shows how to link watershed resilience, fuels reduction, and biomass markets to deliver air quality and climate benefits.

Yuba County — North Yuba Forest Partnership and Watershed-Linked Biomass
A landscape-scale partnership coordinates fuels work with nearby biomass outlets to keep projects moving from plan to construction. This case shows how aligning restoration, feedstock logistics, and procurement builds a durable project pipeline.

Tahoe Basin — Small CHP Pilot at Public Site
A very small, behind the meter unit with modern controls serves a public thermal load and gathers measured emissions data. This case shows how right-sized pilots can unlock siting in sensitive basins and update local rules with real performance.

Placer County — Cabin Creek Biochar Pilot
The county shifted from a large energy concept to a smaller kiln that produces biochar backed by buyer commitments. This case shows how a market-first approach can reduce risk, improve financing, and speed approvals.

Placer, El Dorado, and Nevada Counties — Bioeconomy Investment Zones
Designated investment zones and county promotion windows signal low risk and help attract private capital to priority sites. This case shows how clear siting pathways and standardized reviews crowd in investors for regional replication. El Dorado, Placer, and Nevada partners convened to address investment barriers, long term feedstock contracting, and risk reduction tools needed to finance facilities that can accept forest treatment byproducts. This case shows how multi-county coordination and shared analytics can aggregate supply, lower investor risk, and accelerate siting of outlets essential to sustained fuel reduction.

Yuba County — Interconnection Lesson and Early Funding Bridge
A project relocated after interconnection costs proved prohibitive, then advanced to shovel ready with early public funding. This case shows why early utility vetting and bridge financing prevent stranded development and keep projects on track.

City of Grass Valley — Small Biomass Pilot with West Biofuels and Pioneer Community Energy
A small project proceeds toward interconnection with Pacific Gas and Electric while pairing generation with local resilience goals. This case shows how early utility engagement and a committed community choice aggregator can move a pilot from planning to commissioning.

NW-4 CARBON SEQUESTRATION PROGRAM/CARBON FARMING

This measure will establish carbon sequestration or carbon farming projects. Carbon emissions are sequestered through the absorption of CO_2 from the atmosphere into a carbon sink (e.g., tree planting) or storage (e.g., injection into underground reservoirs). Carbon sequestration can occur through biological, chemical, or physical processes.

Establish a Carbon Sequestration Project. The measure reduces GHG emissions by implementing projects that follow the Natural Resources Conservation Service (NRCS) conservation practice standards from the U.S. Department of Agriculture (USDA). These projects sequester carbon by conserving, maintaining, and restoring natural resources on ranches, farmland, and forestland. Some example projects include:

- Converting irrigated cropland to permanent unfertilized grass cover.
- Replacing synthetic nitrogen fertilizer with beef feedlot manure on managed irrigated pasture.
- Replacing a strip of cropland with one row of woody plants.
- Converting grasslands to a farm woodlot.
- Adding legume seasonal cover crop to irrigated cropland.
- Restoring highly disturbed areas by planting permanent vegetative cover.
- Adding compost or biochar as a soil amendment to irrigated cropland.

LEAD AGENCIES

Resource Conservation Districts (RCDs) such as the Yolo County RCD lead county-level delivery, provide technical assistance (TA), manage cost-share funds, and oversee on-farm projects.

County and city sustainability and land use departments co-lead program design, sequencing, permitting alignment, and reporting.

The California Conservation Planning Partnership (C2P2)—which includes the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS), California Department of Food and Agriculture (CDFA), University of California Agriculture and Natural Resources (UC ANR), and California Association of Resource Conservation Districts (CARCD)—coordinates project standards, funding alignment, training, and regional consistency.

IMPLEMENTATION PARTNERS

Research and extension institutions turn science into field guidance, train technical assistance staff, and lead monitoring and reporting. Example institutions include UC ANR, University of California Cooperative Extension, and the California Farm Demonstration Network, and the Center for Regenerative Agriculture and Resilient Systems (CRARS) at CSU Chico, which runs a robust training program and conducts research on NRCS practices.

Industry and commodity groups signal market demand, spread best practices, support outreach, and help set procurement preferences. Examples include farm bureau chapters, commodity boards, processors, and food hubs.

Nongovernmental and community-based organizations (CBOs) provide trusted outreach, producer coaching, application support, workforce development, and education for climate smart products. Examples include the California Association of Resource Conservation Districts, Carbon Cycle Institute, American Farmland Trust, California Rangeland Trust, Community Alliance with Family Farmers, Kitchen Table Advisors, conservation corps, conservancies, land trusts such as the Sierra Cascade Land Trust Council, Center for Land Based Learning, community colleges, and Future Farmers of America chapters.

Air districts provide burn alternatives and clean equipment incentives, coordinate permits, and verify air quality benefits.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Policy alignment and advocacy.** Align with climate action plans and Natural and Working Lands (NWL) strategies and fast-track permits for priority practices. Align with Senate Bill 1383 organics and local compost procurement to enable free or low-cost compost with subsidized hauling. Align with AB 1757, which calls for coordination to provide a bottom-up regional approach to nature-based climate solutions that can be more effective than top-down mandates.

- ☐ **Establish compost and biomass infrastructure.** Explore opportunities such as composting, chipping, mastication, pyrolysis, and whole-orchard and whole-vineyard recycling. Coordinate with solid waste programs and air districts to align supply, specifications, timing, and low-particulate matter technologies.

- ☐ **Enhance workforce and capacity.** Fund full-time planners and field technicians, and provide safety and equipment training. Share specialist staff across counties for outreach, planning, and grant writing through memoranda of understanding (MOUs). Create quick-hire rosters for seasonal workloads that include planting, mulch application, and fencing. Partner with workforce boards, CBOs, universities and community colleges, and cross-train RCD crews.

- ☐ **Build market development and partnerships.** Enhance and align ongoing projects and prioritize upgrades to projects already underway. Explore compost, biochar, and other byproduct sales, green procurement premiums, and service contracts (e.g., biomass handling, soil testing) to stabilize cash flow and diversify revenue streams while credit markets mature.

- ☐ **Assess 'carbon credit-readiness' of regional partners.** Evaluate existing structures and systems to determine best investments to develop pathways for future participation in the carbon market. Work with commodity groups, food hubs, and processors to add premiums and specialized marketing opportunities for goods grown with climate-smart practices. Develop public and private pilots for soil carbon amendments like biochar and compost where carbon credits are not yet viable. Explore pathways for future participation in carbon markets through partnerships with experienced organizations.

0–3 YEARS

EARLY PHASE

- ☐ **Build partnerships and relationships.** Identify county leads and RCD teams, and map practice priorities by crop, soil, and farm economics. Build relationships with CDFA, California Natural Resources Agency (CNRA), and USDA NRCS to align regional priorities with upcoming program design and secure longer term funding streams.

- ☐ **Complete carbon farm plans, if needed.** Build practice packages using COMET tools, Carbon Planner, and NRCS conservation standards. Deliver site-specific carbon farm plans with standardized tools and specifications to reduce farmer paperwork.

- ☐ **Identify effective, tested, priority carbon farming practices by county.** Partner with RCDs, Farm Bureau chapters, producers, and other stakeholders to identify priority sequestration practices best suited to local conditions (e.g., soil, crops, and land use types) for each county. This can support seeking funding for carbon sequestration practices that have greater buy-in and support and can be implemented successfully at the local level.

- ☐ **Secure funding and incentives.** Align funding cycles with NRCS, CDFA, air districts, and county block grant programs. Secure multi-year cost-share and incentive funds from state, federal, and local programs to de-risk compost, cover crops, reduced tillage, and hedgerows. Allocate flexible dollars for technical assistance, quality assurance and quality control (QA/QC), and post-installation maintenance, with set-asides for small and low-income producers. Explore county block grants and federal and commodity costshare programs. Build contingency timelines and diversify funding sources to maintain delivery during federal or state program slowdowns. In partnership with organizations experienced in credit generation, design and implement a local carbon offset program that supports and helps fund carbon farming activities.

- ☐ **Streamline information-sharing and technical assistance (TA).** Build a one-stop online portal with practice menus, specifications, and unified incentive applications. Designate county or regional TA providers or hire and train TA providers to prepare carbon farm plans, conduct site visits, select practices, navigate funding, and host mobile clinics and office hours. Establish MMRV (measuring, monitoring, reporting, and verification) protocols and provide simple

IMPLEMENTATION STEPS AND TIMELINE

reporting kits to growers. Launch a farmer-ambassador network and seasonal field days with the California Farm Demonstration Network to accelerate peer learning. Ask producers about problems, goals, rotations, soils, and constraints to better tailor technical assistance program offerings.

- ☐ **Reduce costs of hauling.** Address hauling-cost barriers with shared services or transfer nodes near farms. Pilot proof-of-concept and deploy mobile roll-off pyrolyzers and onsite chipping or mastication for orchard, vineyard, and rangeland biomass where feasible; include rangeland-fuels chipping and mastication.

- ☐ **Provide support and guarantees to farmers.** Reduce risks for participating farms by establishing supply chains for local purchasers, such as institutions (schools, hospitals, local grocery stores) and supporting the development of local food hubs, such as the Yolo Food Hub and the Spork Food Hub, which can help aggregate produce and provide value-added processing.

4–7 YEARS

MIDDLE PHASE

- ☐ **Launch and execute pilots.** Issue cost-share awards and standard agreements and deploy prequalified vendors and field crews. Install the first wave of practices that include compost application, cover crops, no-till, hedgerows, whole-orchard recycling, whole-vineyard recycling pilots, and rangeland-fuels chipping. Launch pilots aligned with Natural Climate Solutions (NCS) strategies (e.g., riparian restoration, agroforestry, prescribed grazing) to stack benefits and speed delivery. Prioritize practices that fit existing operations with immediate economic benefit.

- ☐ **Establish shared compost depots and transfer nodes** to reduce hauling costs and increase participation. Pair free or low-cost compost with subsidized hauling where needed.

- ☐ **Host on-farm demonstrations** and farmer-to-farmer learning events to show yield gains and input-cost savings. Stand up a farmer-ambassador and demonstration network to accelerate peer-to-peer adoption. Support farmer-led demonstration sites and storytelling to showcase co-benefits.

- ☐ **Conduct measuring, monitoring, reporting, and verification.** Assign a monitoring lead such as UC Cooperative Extension to design light-lift protocols, periodic site visits, and reporting templates. Track specific metrics to quantify benefits i.e., soil organic carbon, GHG reductions, particulate matter reductions, water use, yield, and input reductions (fertilizer, diesel). Use accepted planning/estimation tools (e.g., COMET-Planner, Carbon Planner) to estimate and cross-check GHG and soil benefits; align field data with tool assumptions for consistency. Train growers and crews to use photo logs and basic soil and practice tracking and provide TA, simple MMRV kits, and app-based reporting tools.

- ☐ **Adjust practices based on monitoring and outcomes.** Establish feedback loops to track, monitor, and adjust carbon farming practices based on outcomes, evaluating not only carbon sequestered but also agricultural yield, soil amendments applied, cost, and other criteria. Summarize results each season, convene producer/stakeholder debriefs, update practice guidance and incentives, and flag policy refinements for advocacy. Publish anonymized outcomes on yield, input reductions, soil metrics, etc., to build social proof-of-concept. Conduct quality assurance and quality control (QA/QC) site visits to ensure compliance without adding to farmers' workload.

- ☐ **Plan for future projects.** Maintain a live matrix of eligibility, timelines, and stackability across NRCS, the CDFA Healthy Soils Program (HSP), air-district programs including Carl Moyer, the U.S. Environmental Protection Agency (EPA) Targeted Airshed program, and local grants. Partner with food hubs, processors, and cooperatives to build procurement preferences for climate-smart commodities. Use public and private project readiness funds and institutional procurement to unlock private investment ahead of credit market maturity while continuing to advance a local carbon offset program.

- ☐ **Provide continuity strategies for long-term sustainability** and braid multi-year funding streams, reserve O&M/TA set-asides in every award, create pooled regional match and revolving bridge funds, pre-approve on-call TA contracts, and consider endowment-style reserves to maintain funding and technical assistance beyond program establishment. Create workforce development programs, internships, and quickly hire seasonal crews to provide field support and build a regional bench of skilled practitioners.

8–12 YEARS

LATE PHASE

- ☐ **Scale successful practices regionwide** and institutionalize cross-region mentoring, standardization of specifications, and equipment fleet sharing. Fund field support and onsite coaching to install practices that go beyond typical operations, including tribal projects. Right-size delivery and operate hybrid TA in which county-based navigators are supported by regional hubs that train staff and fill knowledge gaps.

- ☐ **Secure multi-year funding** for TA, implementation support, and MMRV with dedicated resources for small and low-income producers. Rebalance incentives toward high-uptake, high-impact measures. Expand rolling application windows. Formalize partnerships with processors, food hubs, and commodity groups to create value-added markets for climate-smart products.

- ☐ **Advocate for agriculture inclusion in statewide resilience investments,** such as 30 by 30 conservation efforts – which calls for conserving 30 percent of California's natural land and waters – and air quality incentive guidelines.

NW-4 CARBON SEQUESTRATION PROGRAM / CARBON FARMING

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Convene counties, RCDs, Farm Bureaus, growers, Tribes, and CBOs to identify locally relevant practices by soil type, crop type, and economic feasibility.
- ☐ Publish and update a regional practice menu annually.

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Upfront costs for compost, cover crops, and reduced tillage make adoption difficult for farmers operating on thin margins. Farmers often lack cash flow and credit to prepay and then wait for reimbursement.	Expand cost share and microgrant programs; braid local, state, and federal funding to reduce out of pocket costs and improve adoption rates.
Limited and inconsistent funding for TA and carbon farm plan development. Programs open and close unpredictably, which interrupts support and delays project pipelines. The capacity required to administer these TA programs is often also a barrier to small local organizations working with farmers towards implementation.	Secure multiyear funding for TA providers; formalize regional soil hubs to mentor staff and maintain a steady pipeline of trained planners. Publish a rolling calendar of program windows for NRCS, CDFA, and air district programs with prefilled forms. For regional technical assistance and workforce, establish hubs, train carbon farm planners, build seasonal crews and internship pipelines, and share equipment fleets.
Lack of a streamlined process for stacking multiple incentive programs. Different eligibility rules and timelines force producers to navigate multiple portals and forms, which lowers participation.	Tap into the C2P2, a locally led technical assistance group focused on easing communication between TA providers to allow for less complex processes for farmers seeking TA and funding. Operate a one-stop portal that stacks NRCS, CDFA, and air district programs. Provide microgrants with rapid approvals and flexible timelines.
Reduce financial risks. Farmer participation is critical to implementation, but many may be concerned about impacts of carbon sequestration practices on yield.	Build strong relationships with local buyers and establish branding to strengthen the local market for farms that practice carbon sequestration, such as a regenerative farming label. Collaborate with local food hubs and farm shops to enable aggregation of produce and shared hauling to market. Convene farmer-to-farmer roundtables to share information and discuss issues of concern, such as potential impacts on yield, cost, and savings. Develop research or demonstration projects with UC Davis and other universities.
Market volatility for crops like walnuts and grapes leads to orchard removal and burning. Disposal costs and lack of alternatives push producers toward open burning that harms air quality.	Pilot whole orchard and whole vineyard recycling and biochar production programs to divert biomass from open burning and create soil amendments.
Farmer fatigue and mistrust of government programs. Complex rules and past delays reduce confidence and willingness to participate.	Center engagement around peer-to-peer learning, highlight co-benefits like soil health and water savings, and design simple, flexible participation processes.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Direct funding and technical assistance to small producers and farms in low-income census tracts.
- Provide multilingual materials, community navigators, and mobile clinics.
- Base valuable resources for carbon farming and carbon sequestration where they are most accessible to underserved rural communities.
- Pair projects with heat mitigation, water quality improvements, and job creation.
- Define and report equity outcome metrics (e.g., percent of total funds reaching low-income producers, percent of TA hours delivered in DACs, number of producers served, jobs created in target areas).
- Track participation by geography and demographics and adjust outreach to close gaps.
- Include Tribes as priority partners and provide technical assistance plus labor support where capacity is constrained.
- Launch educational programs that engage non-farming residents on the importance of carbon farming, soil health, and climate action. Use school partnerships, libraries, public workshops, and demonstration field days to build broad public support.
- Establish an Equity Advisory Board and hold regular listening sessions to gather community input on program design, eligibility criteria, scoring, and outreach.

Avoid adverse consequences

- Monitor farmland conversion pressure, displacement of small growers, and cost burdens from maintenance.
- Fund long-term maintenance and training to minimize ongoing costs.
- Rely on peer-to-peer ambassadors and trusted partners to reduce program fatigue.
- Offer multilingual guidance and prefilled forms to streamline participation.
- Engage Tribes, CBOs, and small producers early and continuously to identify and mitigate risks.

NW-4 CARBON SEQUESTRATION PROGRAM / CARBON FARMING

COST EFFECTIVENESS

$39,629,000

Total Costs between 2026 – 2030

+

$0

O&M Costs

$39,629,000

Upfront Capital Costs

$0

Savings

-

A cost-effective metric for this measure was not calculated due to the wide variety in costs, implementation outcomes, and timelines across various carbon sequestration practices on agricultural lands. Some practices, like cover cropping, occur annually, while others, such as biochar application or agroforestry, may be one-time or infrequent interventions. This inconsistency makes it difficult to standardize costs or compare outcomes over time as a single number. Additionally, the effectiveness of these practices varies significantly by region, soil type, and climate, and measuring carbon gains is complex and often uncertain. These factors undermine the comparability and reliability required for a meaningful analysis, making alternative evaluation methods more appropriate for assessing agricultural carbon strategies.

One-off measures include soil carbon amendment, prescribed burning, filter stripping, grassed waterways, and range planting. Annual measures include herbaceous weed treatment, conservation crop rotation, cover cropping, mulching, prescribed grazing, strip-cropping, nutrient management, and various tillage management techniques.

Cost estimates are based on the USDA Environmental Quality Incentives Program (EQIP), which provides incentive payments for sustainable agricultural practices:

- Average cost per acre for one-off measures. $839
- Average cost per acre for annual measures. $286

Costs greatly varied based on practices, from $1.86 per acre for strip-cropping to $2,485 per acre for grassed waterway. To facilitate cost estimation for the 100,000-acre target assumed for 2030, an 80/20 split was applied between annual and one-off measures—80% of the land (80,000 acres) is assumed to adopt annual practices, while 20% (20,000 acres) is allocated to one-off measures. This assumption is not prescriptive but serves as a practical modeling approach to reflect the likely predominance of ongoing land management practices in large-scale sequestration efforts, while still accounting for the upfront impact of foundational changes.

The total upfront capital cost to implement and support these practices across the 100,000-acre target is estimated at $39,629,000 by 2030, with an average annual cost of $7,926,000. These costs reflect USDA incentive levels and are intended to support adoption of carbon-sequestering practices by landowners and farmers.

CASE STUDIES

San Joaquin Valley — Orchard Biomass to Energy Pilots
A multi-county effort bundles orchard and vineyard removals into coordinated chipping and conversion projects. The program shows how mobile units and shared logistics can cut open burning, reduce particulates, and create usable energy streams.

Marin County — Biomass to Compost Pathway
County partners divert agricultural woody debris to composting instead of burning. The model demonstrates how local compost production and farm application can close the loop and lower hauling costs.

San Mateo County — Carbon Fund for Local Sequestration
A county-run fund channels mitigation fees into climate-smart projects on working lands. The case shows how a stable, local funding source accelerates implementation across multiple practices.

Santa Clara County — Agricultural Resilience Initiative One-Stop Incentives

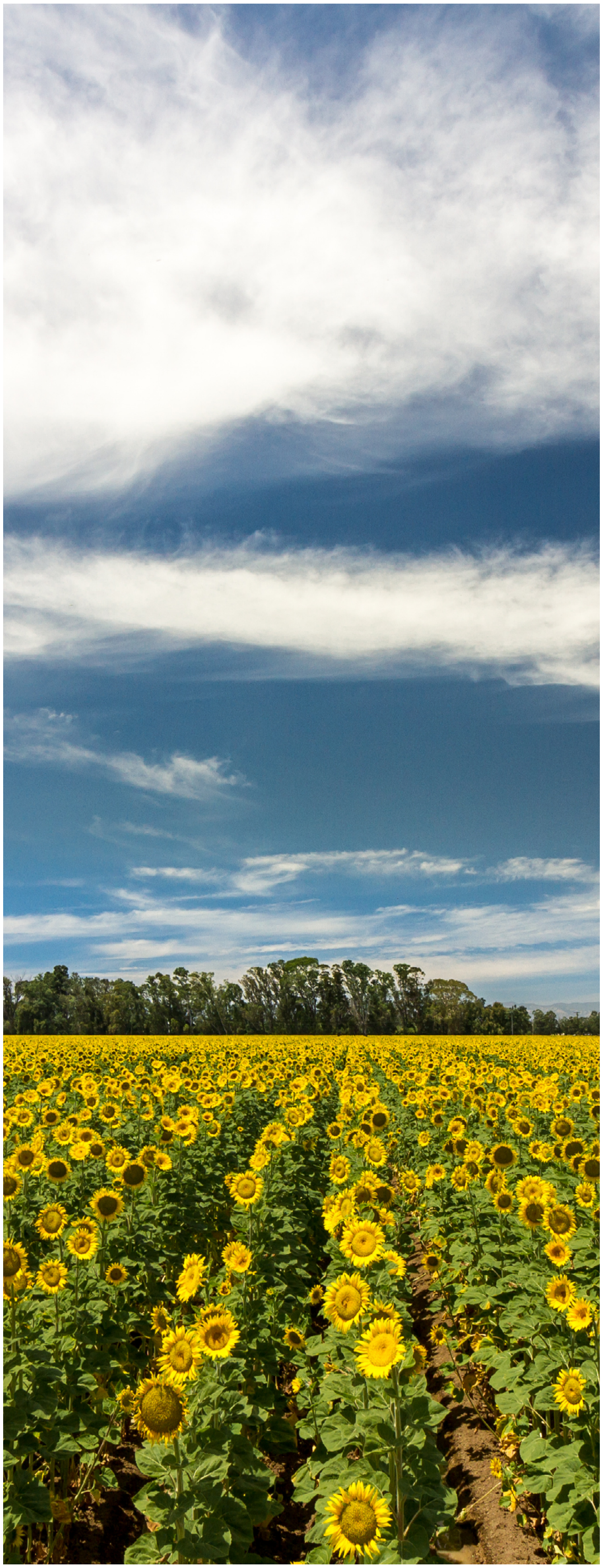
A unified portal and pre-vetted practice menu let growers stack funding in a single application. The playbook proves that streamlined intake and standard agreements speed delivery and increase participation. For example, the County reported more than $200,000 awarded in 2023 and, since launch, over $561,000 to 36 growers by early 2025.

Yolo County — "Good Grains" Value-Added Labeling

Growers package wheat products with clear descriptions of soil-health practices. The case shows how transparent labeling can capture premium markets and reward climate-smart production.

Yolo County — Food Hub for Local Processing and Packaging

A local food hub supports small-scale farmers by consolidating aggregation, processing, storage, packing, and transport closer to farms. The Yolo Food Hub envisions a food hub - housed in a historic barn - that enables value-added services to help boost farm revenues, create new market opportunities, and keep jobs local. The food hub can also increase consumer access to local foods and strengthen relationships between farmers, institutions, and local communities.



E-1A ONSITE SOLAR CANOPIES

This measure installs shade structure solar energy systems over parking lot areas or adjacent to playgrounds at K-12 schools and can also be applied to industrial, commercial, and other public sites. This measure would offset the building's electricity consumption from electricity utility providers by using onsite renewable energy and is cost-effective in locations with high electricity costs. Expanding this model supports affordable electrification and energy self-sufficiency across diverse property types, including schools, warehouses, commercial centers, and public facilities. In addition to reducing grid reliance and utility costs, solar shade structures provide valuable secondary benefits such as shaded parking for staff and visitors, reduced heat island effect on school and site grounds, efficient outdoor lighting opportunities such as the integration of light fixtures under canopies and improved outdoor comfort and safety for visitors and students—particularly in play areas.

LEAD AGENCIES

School districts (such as Davis Joint Unified School District and Elk Grove Unified School District) plan, procure, permit, interconnect, operate, and maintain solar canopy, battery storage, and microgrid projects on campuses.

Cities and counties align zoning and shading ordinances, streamline permits, coordinate right-of-way needs, and link projects to resilience hub plans.

Private companies, local governments, and commercial property owners can design, finance, construct, and maintain canopy and storage systems on their properties, supporting long-term affordability and innovation.

IMPLEMENTATION PARTNERS

Electric utilities such as SMUD and PG&E coordinate interconnection studies, net-metering, and tariffs and enable storage, demand response, and virtual power plant (VPP) enrollment.

Grant funders and program administrators provide capital, incentives, and technical assistance for schools, commercial properties, and community sites.

School facility planners and energy consultants align projects with bond programs, modernization/retrofit schedules, and procurement rules.

Local permitting and fire authority staff publish checklists, enable online permit intake, and coordinate inspections.

Community-based organizations and teachers support outreach, student learning, and campus programming that build buy-in.

EV charging providers install managed and bidirectional vehicle-to-building (V2B) chargers for staff fleets and community use.

Multifamily, warehouse, and commercial property owners replicate canopy-plus-storage models at large parking lots.

Community center operators and industrial site managers can adopt similar canopy and storage approaches to lower energy costs and increase resilience.

IMPLEMENTATION STEPS AND TIMELINE

PREREQUISITES & ENABLING CONDITIONS

- ☐ **Streamline solar permitting by using Division of the State Architect (DSA) pre-check canopy systems.** Submit complete structural, electrical, and anchorage packages. Standardize online intake and checklists with consolidated inspections.

- ☐ **Adopt a site and design playbook.** Reconcile parking shade ordinances, tree retention goals, and stormwater management best practices with solar canopy designs and layouts.

- ☐ **Complete utility pre-application reviews.** Lock metering, tariff choices, export rules, and any net billing or aggregation details. Coordinate early on Electric Rule 21 interconnection, transformer capacity, and feeder upgrades. Publish predictable timelines so summer construction windows hold.

- ☐ **Establish delivery and governance.** Explore options such as power purchase agreements, leases, or direct ownership. Stack incentives including federal direct pay. Bundle campuses through cooperative purchasing with a single Owner's Requirements Manual to scale projects and lower prices. Create a regional working group with other interested schools to share best practices. Prepare to run batch preapplication screenings, publish an interconnection queue, and bundle transformer or service upgrades by feeder or substation.

0–3 YEARS

EARLY PHASE

- ☐ **Select lead districts and sites and map facility planning cycles.** Define the first cohort of school sites and large non-school lots (e.g., large parking lots at commercial, public, or industrial developments) to establish a project pipeline, prioritizing Title I schools and low-shade schools or neighborhoods. Site selection should consider factors such as socioeconomic and demographic data, urban heat island effects, parking lot size, and existing shade coverage. Potential data sources include the Healthy Places Index, Trust for Public Land's Heat Severity map, and the California Board of Education's Free or Reduced-Price Meal data.

- ☐ **Coordinate with utilities to plan electrical integration in advance.** Coordinate inverter siting, conduit routing, combiner and alternating current (AC) disconnect locations, and transformer placement to minimize voltage drop and trenching. Set direct current (DC)-to-AC ratios and stringing. Manage shading. Meet rapid-shutdown requirements. Confirm switchgear, meter, and interconnection capacity for bidirectional EV charging, battery storage, and building loads. Explore opportunities for demand response and VPP participation.

- ☐ **Run batch utility pre-application reviews.** Publish an interconnection queue for diverse site types. Scope feeder and substation upgrades for bundled sites. In urban districts, manage multiple interconnections in parallel; in suburban districts, phase work by feeder; in rural communities, start long-lead interconnections early.

- ☐ **Set up commercial delivery and prequalify vendors.** Choose the financing approach for each campus/site. Standardize drawings, specifications, and agreements across districts and non-educational partners through a regional solicitation that supports power purchase agreements, leases, and direct purchase. Sequence federal, state, and utility incentives. Apply a regional financial model that compares options, including operations, maintenance, and inverter replacements. Urban districts can stack multiple sources across large portfolios. Suburban districts can form medium bundles, while rural communities can assemble smaller portfolios with simple financing.

IMPLEMENTATION STEPS AND TIMELINE

- ☐ **Complete concept designs.** Pair photovoltaic canopies with battery storage by default. Balance shade ordinances with tree retention and integrate stormwater controls. Assess potential glare issues and mitigate with module tilt, setbacks, screening, anti-glare coatings, or angled canopies. Protect bus loops, drop-off and pick-up lanes, fire lanes, and accessible routes during and after construction. Maintain clear sightlines and well-lit walkways where canopies cross pedestrian paths. Ensure foundations, column locations, and overhangs do not obstruct vehicle turning or emergency access. Meet DSA pre-check requirements. Plan for future canopy height and clearance needs. For urban sites, prioritize urban heat island mitigation. In suburban areas align with landscape standards.
- ☐ **Develop an equity and education plan for all host sites.** Consider outdoor learning opportunities and clear onsite information and signage. Include shade over playgrounds and lunch areas where it improves comfort and health.
- ☐ **Integrate resilience hubs.** Consider critical loads in sizing solar system and battery capacity so that schools, community centers, and other public facilities can function as resilience hubs during climate emergencies. Define resilience hub functions such as providing cooling, clean air, and shelter and plan for staffing and operational needs. Evaluate opportunity for microgrids.

4–7 YEARS

MIDDLE PHASE

- ☐ **Finalize commercial commitments and approvals.** Execute power purchase agreements or secure funding. Submit interconnection applications. Complete detailed engineering.
- ☐ **Procure equipment and prepare sites.** Purchase canopies, battery systems, controls, and bidirectional EV charging equipment. Pre-wire for future bus charging and vehicle-to-building pilots. Install EV-ready conduit, panels, and stub-outs at staff, fleet, and visitor parking for all facility types.
- ☐ **Build, commission, and operate the first cohorts.** Shift solar production to school loads with storage so that the electricity generated by solar panels can be used by the school's own facilities rather than sent immediately to the grid. Test weekend export along with demand-response and VPP revenue to improve project payback. Implement microgrid use cases where they fit site needs.
- ☐ **Integrate, replicate, and communicate.** Explore opportunities to integrate solar photovoltaics into curriculum. Work with local partners (e.g., county public health departments and offices of emergency services) to launch high-visibility pilots at schools, industrial campuses, and community hubs in combination with a coordinated communications plan. Use shared templates, schedules, and owner standards to roll out additional solar projects at additional schools. Bundle upgrades to reduce time and cost and develop a standard "solar + storage + EV charging" package schools can slot into bond or modernization programs.
- ☐ **Measure and improve while growing the workforce.** Track performance, costs, savings, thermal comfort, and shade benefits. Publish results and update designs, permitting workflows, and financial models. Set local-hire and apprenticeship goals. Offer student learning modules and onsite training. Continue to prioritize low-income campuses with high cooling loads and heat-island exposure. In urban districts, pair projects with community hubs at transit-adjacent campuses. In suburban districts, emphasize district-wide programs at larger lots.

8–12 YEARS

LATE PHASE

- ☐ **Complete district and regional portfolios and expand to other large parking lots.** Plan refresh cycles for inverters, batteries, and control systems to maintain performance.
- ☐ **Deepen grid integration.** Optimize dispatch through VPP and coordinated export. Integrate EV fleets. Pilot bidirectional charging (vehicle-to-grid and vehicle-to-building) where feasible.
- ☐ **Revise shade, planting, and facility standards to account for both trees and solar canopies.** Coordinate urban forestry with solar performance. Keep requirements for accessibility, safety, lighting, and circulation current.
- ☐ **Strengthen governance and finance.** Maintain regional coordination. Refresh the Owner's Requirements Manual. Update incentive strategies. Refine operations and maintenance practices and long-term financial models to sustain affordable electrification and lifecycle cost savings.
- ☐ **Report results.** Publish annual scorecards on savings, reliability, educational use, heat mitigation, and community benefits. Complete networks of school-based resilience hubs in urban districts. Finish campus and corporation yard conversions in suburban districts. Sustain microgrids at priority schools and community facilities in rural communities.

SOLUTIONS TO DEPLOY MEASURE AT REGIONAL SCALE

- ☐ Create a regional clean energy working group of school districts, county offices of education, local governments, community center operators, utilities, and private sector facility directors to align timelines, specs, and interconnection queues; share best practices and provide solutions; and coordinate on joint financing mechanisms and other funding opportunities to support affordable electrification across all property types.
- ☐ Develop a master set of agreements, memoranda of understanding (MOU), and checklists so each participating district, local agency, or entity follows the same path from screening to operation.
- ☐ Run utility pre-application screenings for all candidate campuses and additional commercial, industrial, and public sites at once and publish an interconnection queue with target dates.
- ☐ Bundle transformer and service upgrades by feeder or substation to shorten schedules and cut mobilization costs.
- ☐ Adopt regional and cross-sector design standards for clear height, column spacing, wind criteria, integrated LED lighting, ADA paths, sightlines, and drop-off circulation.
- ☐ Require EV-ready conduit, panels, and stub-outs at staff, fleet, and visitor parking areas. Include shade for play areas and outdoor gathering spaces at community centers or commercial plazas where space allows.

E-1A ONSITE SOLAR CANOPIES

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Upfront cost and funding gaps. Schools, local governments, and small businesses may lack capital for canopy and battery systems.	Pursue grants and incentives; pair solar with battery storage and VPP and/or demand-response to improve payback and create resilience value. Aggregate funding opportunities regionally to lower soft costs and extend affordability to smaller or disadvantaged property owners.
Storage integration and use-case fit. Summer or off-hours loads limit onsite use.	Right-size batteries, enable weekend export, and design microgrids that serve school, commercial, and community center loads and generate revenue off-hours.
Many districts on different capital cycles. Hard to time projects. Similarly, private entities and municipalities operate on different budget cycles.	Work through facilities master plans; offer a standard "solar + storage + EV charging" package that any partner can integrate into capital or retrofit programs.
Utility alignment and interconnection. Programs and tariffs must support the business case.	Engage utilities early to align tariffs, net-metering, interconnection, demand-charge management, and VPP enrollment; tie projects to affordable electrification and resilience hub objectives.
Equity and resilience delivery. Benefits may miss low-shade, high-need neighborhoods.	Prioritize sites in low-income areas; pair canopies with batteries, EV charging, and resilience hub functions for cooling and clean air during extreme events. Include community centers and small businesses in lower-income areas for shared regional benefits.

COMMUNITY BENEFIT CONSIDERATIONS

Support implementation in low-income communities

- Prioritize schools, commercial corridors, and public facilities in neighborhoods with limited shade, high climate vulnerability, low air conditioning access, or high heat exposure. Pair solar canopies with battery storage to provide cooling and clean air during outages, wildfire, and extreme heat events. Explore staffing and operational needs for schools and community centers to function as resilience hubs, providing services and resources during emergency events.
- Work with utilities to explore innovative financing mechanisms and affordability programs (e.g., community solar tariffs, inclusive utility investment models, and on-bill repayment) that lower upfront costs and enable small businesses and nonprofits to participate alongside public entities.
- Combine solar canopies, storage, and grid programs such as VPP participation to reduce electricity utility charges and generate off-hour revenue that districts, agencies, and business owners can reinvest (e.g., in community or workforce programs).
- Use canopies as shaded outdoor classrooms, community gathering spaces, or public event areas with signage and curriculum tie-ins. Offer student internships, workforce training, and site tours during installation.
- Site structures to preserve and expand tree canopy rather than replace it. Integrate planting and landscaping so all sites gain both clean power and natural cooling.
- Provide multilingual outreach through trusted school channels, and cohost meetings with community partners so that community input can shape design and access and build community ownership in the project.

Avoid adverse consequences

- Avoid removing healthy trees; meet shading ordinances through a mix of canopy structures and new planting.
- Right-size battery storage and interconnection to avoid export constraints in summer and ensure the system supports resilience and maximizes financial benefits.
- Schedule construction outside school or business hours and testing windows, maintain safe circulation and drop-off patterns, and protect play areas.
- Address glare, lighting, and views with thoughtful orientation and finishes; invite input from adjacent residents and businesses.
- Use transparent criteria so early projects do not cluster only in well-resourced school districts or higher-income commercial centers.

COST EFFECTIVENESS

$140,833,000

Total Costs between 2026 – 2030

\+ $1,885,000
O&M Costs

$165,844,000
Upfront Capital Costs

\- $26,846,000
Savings

$16,859

per metric ton of GHG emissions reductions

To estimate the cost of installing 27 MW of solar capacity across 77 schools by 2030, the analysis assumed a steady rollout of installations at about 16 schools per year. Installation costs were calculated by multiplying the average cost per watt by the number of MW installed each year. The cost per watt was obtained from the California Distributed Generation Statistics site, and a premium of $1.38 per watt was added to account for the costs of the solar canopy structure, based off previous AECOM costing work for solar canopies in California. Operations and maintenance costs were sourced from the National Renewable Energy Laboratory's (NREL) 2024 Solar Installed System Cost Analysis, specifically for commercial rooftop systems. To estimate annual electricity savings, the average commercial electricity rate in California—sourced from the U.S. Energy Information Administration—was multiplied by the expected energy production per kilowatt-hour (kWh). These savings were then subtracted from annual installation and operations and maintenance costs to determine the annual electric premium associated with installing solar canopies across the school sites. Total upfront capital costs are estimated to be $165,844,000, while the total costs inclusive of operations and maintenance as well as savings are estimated to be approximately $140,883,000. While the original cost model focused on schools, comparable cost-per-watt estimates can apply to commercial, industrial, and public facilities, with total lifecycle savings improving as system scale and shared infrastructure increase.

CASE STUDIES

Davis Joint Unified School District — Solar Canopies on Multiple Campuses

District-wide parking lot solar canopies provide onsite generation and shade; this roadmap's measure was modeled on their program. This case shows how a school district can standardize designs across sites and scale quickly while delivering visible heat relief and energy savings.

Long Beach Unified School District — District-wide Solar for Schools

A large, multi-campus rollout demonstrates how bundling sites under one procurement and schedule can lower costs and accelerate delivery. This case shows how school systems can adopt repeatable canopy-and-storage packages that fit varied campuses.

Denver (City and County) — Solar Canopies as Learning and Cooling Assets

Solar canopies double as shaded outdoor classrooms and include signage to support curricula, linking energy literacy with heat-mitigation benefits. This case shows how to pair generation with education and public visibility to build community support.

Petaluma Affordable Housing Microgrid — Solar, Storage, and Bidirectional EV

An affordable housing project integrates solar canopies, battery storage, a microgrid, and bidirectional EV charging to enhance resilience and reduce costs. This case shows how the solar-plus-storage model used at schools can transfer to multifamily sites and resilience hubs.

Define the first cohort of school sites and large non-school lots to establish a project pipeline, prioritizing Title I schools and low-shade schools or neighborhoods.