SANDAG

San Diego Regional Climate Action Roadmap

DECEMBER 1, 2025

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SANDAG collaborated with local jurisdictions, regional agencies, community-based organizations, tribal nations, and other stakeholder groups to develop the Roadmap. SANDAG also worked closely with the University of San Diego School of Law's Energy Policy Initiatives Center (USD EPIC) on the collection and analyses of greenhouse gas emissions data. SANDAG acknowledges the contributions of the many stakeholders who lent their time, insights, and expertise to the development of the Roadmap, through participation in outreach events, regional workshops, technical meetings, the public survey, and other feedback opportunities for the Roadmap. Their time and input are deeply appreciated and have helped shape and strengthen the Roadmap.

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Contents

List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AB	assembly bill
AF	acre feet
AR4	Fourth Assessment Report (By IPCC)
AR5	Fifth Assessment Report (By IPCC)
AR6	Sixth Assessment Report (By IPCC)
ARP	Apprenticeship Readiness Program
ASHP	air source heat pump
AWP	advanced water purification
BAU	business-as-usual
BRT	bus rapid transit
C&D	construction and demolition
CALeVIP	California Electric Vehicle Infrastructure Project
CalRecycle	California's Department of Resources Recycling and Recovery
Caltrans	California Department of Transportation
C	carbon
CAP	climate action plan
CARB	California Air Resources Board
CBA	community benefits agreement
CBO	Community-based organization
CCA	Community Choice Aggregator
CCAP	Comprehensive Climate Action Plan
CCS	carbon capture and storage
CDFA	California Department of Food and Agriculture
CEA	Clean Energy Alliance
CEC	California Energy Commission
CHC	commercial harbor craft
CH_4	methane
CNRA	California Natural Resources Agency
CO	carbon monoxide
CO_2	carbon dioxide
COG	Council of Governments
Community Power	San Diego Community Power

CPRG	Climate Pollution Reduction Grant
CPUC	California Public Utilities Commission
CRQ	McClellan-Palomar Airport
DA	Direct Access
DER	distributed energy resources
DOE	U.S. Department of Energy
EAP	Early Action Program
EIA	Energy Information Administration
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
ESP	electric service providers
EV	electric vehicle
EVITP	Electric Vehicle Infrastructure Training Program
FARMER	Funding Agricultural Replacement Measures for Emission Reductions
FLIGHT	Facility Level Information on Greenhouse Gases Tool
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbons
HVAC	heating, ventilation, and air conditioning
HVAC-R	heating, ventilation, air conditioning, and refrigeration
IBEW	International Brotherhood of Electrical Workers
ID	irrigation district
IEPR	Integrated Energy Policy Report
IPCC	Intergovernmental Panel on Climate Change
LAFCO	San Diego County Local Agency Formation Commission
LTO	Landing and Takeoff Cycle
LPG	liquefied petroleum gas
MDHD	medium-duty and heavy-duty
MT CO_2e	metric tons of carbon dioxide equivalents
MMT CO_2e	million metric tons of carbon dioxide equivalents
MPO	Metropolitan Planning Organization
MRR	Regulation for the Mandatory Reporting of Greenhouse Gas Emissions
MSA	Metropolitan Statistical Area
MTS	San Diego Metropolitan Transit System

N	nitrogen
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NCTD	North County Transit District
NEV	neighborhood electric vehicles
NGO	non-governmental organization
NH_3	ammonia
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
OGV	ocean-going vessels
O_3	ozone
PAC	Policy Advisory Committee
PCAP	Priority Climate Action Plan
PEIR	Program Environmental Impact Report
PLA	project labor agreement
PM	particulate matter
PSPS	public safety power shutoff
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QFER	Quarterly Fuel and Energy Report
RCD	Resource Conservation District
RDF	Integrated Regional Decarbonization Framework
RGF	Regional Growth Forecast
Roadmap	San Diego Regional Climate Action Roadmap that serves as the CCAP for the San Diego-Chula Vista-Carlsbad MSA
ROG	reactive organic gas
RPS	Renewables Portfolio Standard
RTIP	regional transportation improvement programs
RTP	Regional Transportation Plan
SAN	San Diego International Airport
SANDAG	San Diego Association of Governments
SB	senate bill
SCS	Sustainable Communities Strategy
SDAPCD	San Diego County Air Pollution Control District

SDCWA	San Diego County Water Authority
SDG&E	San Diego Gas & Electric
SDREN	San Diego Regional Energy Network
SDTC	San Diego Tribal Collaborative
SLCP	short-lived climate pollutants
SO_2	sulfur dioxide
TDM	Transportation Demand Management
TDS	Transmission, Distribution, and Storage
TEK	Traditional Ecological Knowledge
TOD	transit-oriented development
TransNet EMP	Environmental Mitigation Program
UEG	utility-level electric generation
USD EPIC	University of San Diego Energy Policy Initiatives Center
USEER	United States Energy and Employment Report
VMT	vehicle miles traveled
VOC	volatile organic compound
WARM	Waste Reduction Model
WD	water district
WG	Working Group
WFP	water filtration plant
WTP	water treatment plant
ZEV	zero-emission vehicles

Executive Summary

The San Diego Regional Climate Action Roadmap (Roadmap) provides a comprehensive shared vision for how the San Diego region can work collaboratively to reduce greenhouse gas (GHG) emissions. It covers the San Diego-Chula Vista-Carlsbad Metropolitan Statistical Area (MSA) and encompasses all of San Diego County. The Roadmap was developed by the San Diego Association of Governments (SANDAG) through a planning grant from U.S. Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant (CPRG) Program and serves as our Comprehensive Climate Action Plan (CCAP). It draws on efforts to reduce GHGs already underway in the region, including the **San Diego Regional Priority Climate Action Plan** (PCAP), which was also developed through this EPA planning grant. The PCAP focused on strategies to reduce GHG emissions from the highest-emitting sectors in the San Diego region through 2030. The Roadmap builds on that foundation to address both near-term and long-term GHG emissions reductions across a broader set of sectors.

The Roadmap shows how the San Diego region could reduce GHG emissions 47% below 2022 levels by 2035 through coordinated regional action and additional funding. It also highlights that more action will be needed for the San Diego region to meet the 2045 Roadmap goal of reducing emissions by 83%, underscoring the importance of developing new technologies, mobilizing large scale investment, and advancing supportive policies. Local governments and regional agencies can use the Roadmap to align efforts, coordinate resources, and pursue state, federal, and philanthropic funding to move projects forward. While the Roadmap offers an ambitious vision for what could be possible, advancing it will require continued collaboration across the region to secure the resources needed to make meaningful progress. The Roadmap reflects extensive input from local governments, regional agencies, tribal nations, community-based organizations, non-profit organizations, and other stakeholders. Key elements of the Roadmap include:

- A summary of **outreach and engagement** conducted, including a public survey in which community members identified planting more trees, restoring natural habitats, and faster and better public transit as their top priorities for regional action.
- A new **regional GHG inventory** for the base year 2022, showing that the largest sources of emissions in the San Diego region are transportation (50.1%), electricity (18.1%), and natural gas use in buildings (13.5%).
- Regional near-term (2035) and long-term (2045) **economy-wide GHG emission reduction goals** that align with state goals and are consistent with the timeframes of many local Climate Action Plans (CAPs).
- 23 **GHG reduction measures** that span eight sectors (Transportation, Electricity, Buildings, Industry, Solid Waste & Materials Management, Water & Wastewater, Agriculture, and Natural & Working Lands) and a scenario showing how the measures, alongside other regional and state actions, could achieve the 2035 goal and make substantial progress toward the 2045 goal, offering a shared vision of what would be needed, to guide local and regional action.
- An **air pollutant analysis** showing how the measures could provide air quality co-benefits by reducing key pollutants, such as ozone precursors and particulate matter.

- An analysis showing how the GHG reduction measures could deliver broad community **benefits**, such as improved public health and transportation and energy affordability.
- A **workforce analysis** showing a growing demand for clean energy, building, and transportation-related trades and highlighting opportunities to expand training and prepare the region's labor force long-term.

1. Introduction

The San Diego Regional Climate Action Roadmap (Roadmap) provides as a comprehensive long-term vision for collaborative action to reduce climate pollution. The Roadmap includes a greenhouse gas (GHG) inventory and GHG projections for the San Diego region, measures to reduce emissions by 2045, and analyses of reductions in air pollutants, workforce needs, and benefits of GHG reduction measures. The Roadmap was developed in collaboration with local jurisdictions, tribal nations, community-based organizations, and other stakeholders and reflects community needs and priorities. The Roadmap is focused on improving the health and quality of life in the San Diego region by fostering regional collaboration to create and scale programs that reduce climate pollution.

1.1 CPRG Overview

The U.S. Environmental Protection Agency (EPA) Climate Pollution Reduction Grant (CPRG) program awarded grants to states, local governments, tribes, and territories to address climate pollution and other harmful air pollutants. The EPA provided planning grants to 47 states, 81 metropolitan statistical areas (MSAs),[1] and 93 tribes and territories. The San Diego Association of Governments (SANDAG) serves as the project lead for the San Diego-Chula Vista-Carlsbad MSA.

The CPRG program requires state and MSA grantees to prepare three deliverables over four years. The first was the Priority Climate Action Plan (PCAP), completed in March 2024, that identified ways to reduce emissions by 2030. The second is this document, the Roadmap, which identifies ways to reduce emissions through 2045 and serves as the Comprehensive Climate Action Plan deliverable for the grant. The third deliverable is a progress report on Roadmap implementation, due to EPA in June 2027.

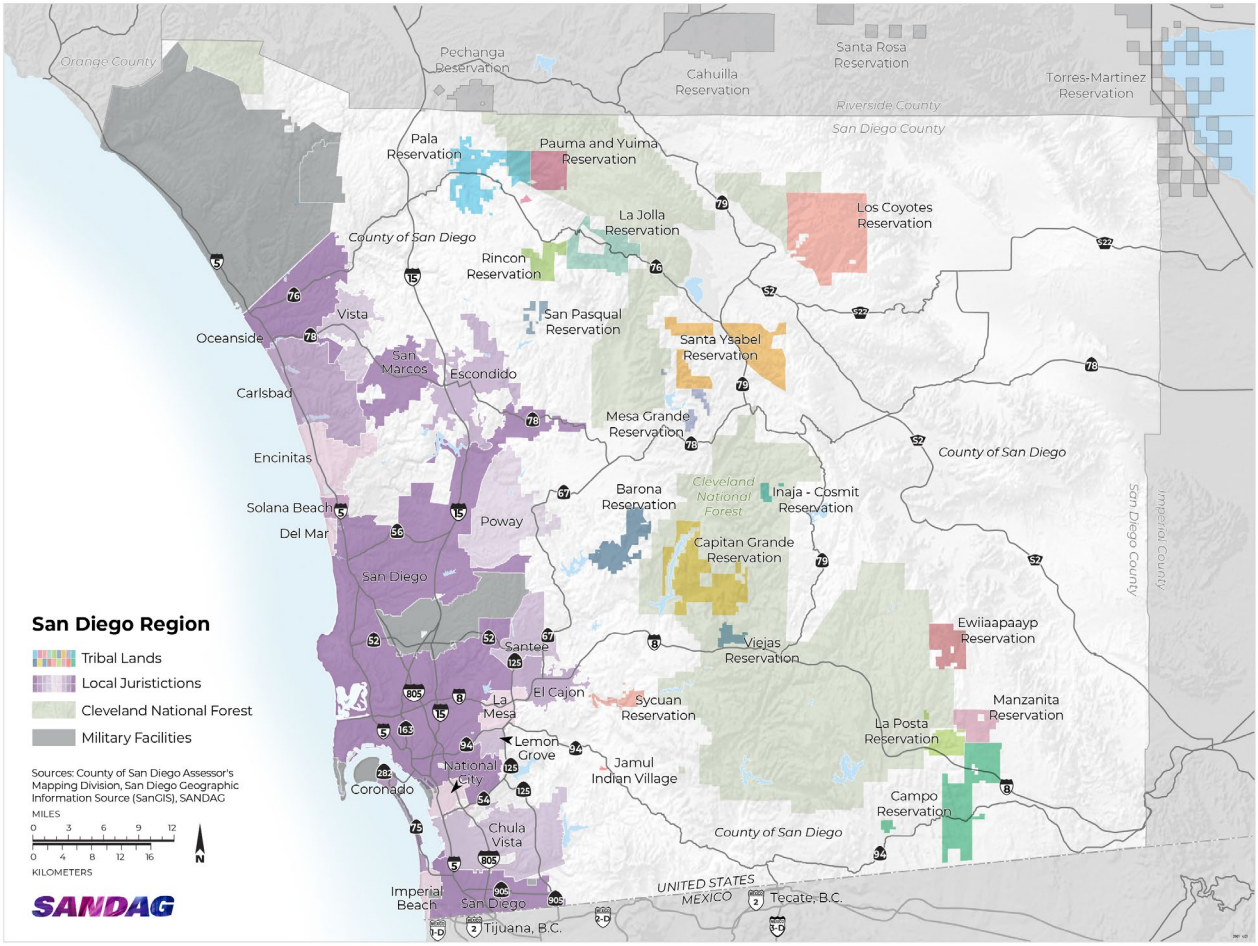
In addition to SANDAG's CPRG grant, EPA awarded three CPRG grants to tribes in the region. These included the San Diego Tribal Collaborative (SDTC), a consortium of four Tribal governments—the Pala Band of Mission Indians (grant awardee), Jamul Indian Village of California, Viejas Band of Kumeyaay Indians, and La Posta Band of Mission Indians—as well as individual awards to the Rincon Band of Luiseño Indians and the La Jolla Band of Luiseño Indians.

1.2 Roadmap Purpose and Scope

The Roadmap provides a long-term comprehensive vision for reducing emissions across the San Diego-Chula Vista-Carlsbad MSA and County of San Diego (referred to as the "San Diego region" in this report). The County of San Diego is approximately 4,200 square miles, home to 3.3 million people, 19 local jurisdictions, and several military bases. It is also home to 17 federally recognized tribal nations with jurisdiction over 18 reservations—more than any other county in the United States (see Figure 1 below).

[1] MSAs are defined by the United States Office of Management and Budget and contain a county or counties with at least one urban area with a population of at least 50,000 people, plus neighboring counties with a high degree of social and economic integration with this urban core.

Figure 1: Local Jurisdictions and Tribal Nations in the San Diego Region



SANDAG serves as both the Metropolitan Planning Organization (MPO) and Council of Governments (COG) for the San Diego region. The agency works with local governments and organizations to address regional issues including transportation, air quality, economic development, goods movement, public safety, and housing. SANDAG is governed by a Board of Directors made up of elected officials from the region's 18 cities and the County of San Diego.

The regional Roadmap builds on local Climate Action Plans (CAPs) and the regional PCAP. Several local jurisdictions, regional agencies, tribal nations, and other entities have developed CAPs and are responsible for their implementation. Some tribal nations in the region have also produced PCAPs and climate resilience reports. Similarly, the County of San Diego developed the Regional Decarbonization Framework (RDF), which promotes public and private interests working together to move the San Diego region to reach zero carbon emissions.[2]

[2] "Regional Decarbonization Framework," (County of San Diego, 2022)

It is important to note that the Roadmap is different than a local CAP in several ways. A local CAP is adopted by an individual jurisdiction and focuses on emissions that can be attributed to that jurisdiction and reduction measures within that jurisdiction's authority. In contrast, the Roadmap addresses economy-wide emissions across the entire San Diego region, including sources typically outside local jurisdictional control such as aviation, marine vessels, and industrial processes. SANDAG led development of the Roadmap on behalf of the region to identify opportunities for coordinated action and shared investment. While several actions in the Roadmap will be led by SANDAG, most will require collaboration with local and regional partners and many will be led by other agencies, particularly in areas such as solid waste, water, and industry where SANDAG does not have implementation authority. For each sector described in Chapter 6, the Roadmap identifies the potential implementing agencies that will play a critical role in advancing the GHG reduction measures. This underscores the importance of regional coordination and collaboration to move the region toward the shared vision outlined in the Roadmap.

The Roadmap contributes to statewide emission reduction efforts. The Roadmap's near-term and long-term goals align with California Senate Bill 32 (Pavley, 2016) (SB 32), under which California aims to reduce anthropogenic (human-made) emissions[3] 40% below 1990 levels by 2030, and California Assembly Bill 1279 (Muratsuchi, 2022) (AB 1279), under which California aims to reduce anthropogenic GHG emissions by at least 85% below 1990 levels and achieve carbon neutrality by 2045 (see Chapter 4).

The Roadmap primarily targets emissions from anthropogenic sources within regional boundaries, consistent with state and federal GHG accounting practices. This approach reflects the areas where local and regional agencies have implementation authority and where reductions can be most directly influenced. The Roadmap also recognizes the important role of natural and working lands in supporting long-term carbon neutrality goals through carbon sequestration. While sequestration-related strategies, such as habitat restoration, soil health improvements, and tree planting are described in the Roadmap, quantitative estimates were included for informational purposes only. These estimates were based on data from the County of San Diego's 2024 Climate Action Plan, which covers activities in the unincorporated area. They are presented to reflect current work occurring within the region, but were not developed using the same regional modeling methods applied to other Roadmap measures, nor are they scaled to represent regionwide sequestration potential. This approach aligns with AB 1279, which created a statewide target to achieve an 85% reduction in anthropogenic emissions by 2045 that together with sequestration efforts would achieve an overall net zero target.

The Roadmap illustrates how regional GHG emissions could be reduced 47% below 2022 levels by 2035, to align with the state's GHG reduction targets established in SB 32 and AB 1279. This pathway provides a shared vision of the scale of action needed, while recognizing that meeting this ambitious goal would depend on significant new investment. It also shows how the region could make progress toward the long-term 2045 goal of reducing emissions by 83% below 2022 levels, recognizing that reaching this long-term goal will depend on the development of new technologies and continued large-scale investment from the public and private sectors. Table 1 provides a summary of our state and regional GHG reduction goals.

[3] "**2022 Scoping Plan for Achieving Carbon Neutrality**," (CARB, 2022)

Table 1: Roadmap Goals and California Statewide Economy-Wide GHG Reduction Targets

Category	Near-Term Year	Long-Term Year
Statewide (California)	40% reduction by 2030 from 1990 levels	85% reduction by 2045 from 1990 levels
Roadmap (San Diego region)	47% reduction by 2035 from 2022 levels	83% reduction by 2045 from 2022

The Roadmap includes a new regional GHG inventory with base year 2022, whereas the PCAP inventory base year was 2016. GHG reduction measures in the Roadmap focus on reducing emissions across eight economic sectors (Transportation, Electricity, Buildings, Industry, Solid Waste & Materials Management, Waste & Wastewater, Agriculture, and Natural & Working Lands) that contribute GHG emissions in this region.

The Roadmap also identifies potential funding sources to implement measures and potential agencies and organizations that may be able to lead implementation. Finally, the Roadmap includes analyses of air pollutant emissions reductions, workforce development needs, and other benefits associated with the GHG reduction measures.

1.3 Approach to Developing the Roadmap

Timeline

Work began on the Roadmap in summer 2024. To develop the draft GHG reduction measures, SANDAG carried out outreach, conducted research, and hosted technical meetings with subject matter experts. In July 2024, SANDAG convened a workshop to hear from local governments, public agencies, community-based organizations (CBOs), tribes, and other stakeholders about their priorities for reducing emissions. The workshop input, along with priorities from existing local CAPs and the County of San Diego's RDF, were incorporated into an initial set of draft measures. In October 2024, SANDAG held a series of technical meetings to refine the draft measures which were then presented to SANDAG's working groups and committees in January-March 2025. Another stakeholder workshop was held in February 2025, followed by a public survey to gain wider feedback on the Roadmap's development. From January-April 2025, the University of San Diego's Energy Policy Initiatives Center (USD EPIC) prepared a new regional GHG inventory with base year 2022 and regional GHG projections to 2035 and 2045. From April-August 2025 SANDAG, with support from USD EPIC, drafted the remaining report components to finish development of the Roadmap.

Technical Support

SANDAG contracted with USD EPIC to provide technical support on the Roadmap. USD EPIC is a research center within USD's School of Law that studies energy policy issues affecting California and the San Diego region. USD EPIC has quantified local and regional GHG inventories, projections, and reductions for numerous jurisdictions and agencies. They developed the first San Diego Regional GHG Inventory in 2008 and have prepared regional GHG inventories for SANDAG's last three Regional Transportation Plans.

As our sub-awardee for CPRG, USD EPIC prepared the new regional GHG inventory, projections, and reduction goals that align with state and local goals. They quantified the GHG emissions reductions under the Implementation Scenario (Chapter 6) and provided support with the air pollutant emissions reduction analysis (Chapter 7).

The data collection and analysis were subject to SANDAG's Quality Assurance and Quality Control (QA/QC) process and were consistent with our approved EPA Quality Assurance Project Plan (QAPP) and workplan.

Regional Engagement and Collaboration

To guide outreach for the Roadmap, SANDAG developed a plan for outreach and engagement that lists key stakeholders, establishes messaging, and identifies five strategies:

1. Inform and get input from the public using existing community relationships, events, and activities (meet people where they are).
2. Develop new materials and opportunities for outreach and engagement to learn the community's priorities for reducing climate pollution.
3. Host interagency meetings to get input on our approach, content development, and potential opportunities for collaboration.
4. Engage tribal nations in the region to understand the climate needs of their communities and identify opportunities for alignment.
5. Consult with local stakeholders including environmental groups and business associations.

SANDAG gathered input from stakeholders to ensure that the Roadmap reflects regional priorities and addresses community needs. We worked closely with local jurisdictions to ensure that our activities built upon and did not duplicate existing efforts. Table 2 lists the types of engagement conducted for the Roadmap. More details are provided in Chapter 2.

Table 2: Types of Engagement Conducted for the Roadmap

Engagement Format	Participants
Interagency Meetings	Local jurisdictions, tribal nations, and regional agencies (e.g., air district, port authority, water authority, community choice aggregators, transit operators, etc.)
Sector Advisory Meetings	Technical staff and subject matter experts at local jurisdictions and regional agencies
SANDAG Working Groups and Policy Advisory Committees	Elected officials, local jurisdiction staff, tribal nations, and the general public
Regional Workshops	Local jurisdictions, public agencies, tribal nations, CBOs, and environmental groups
Community Outreach Events	General public with a focus on low-income communities
Business and Trade Association Meetings	Utilities, business associations (e.g., Cleantech San Diego and Industrial Environmental Association) and members
Public Survey	General public in San Diego region
Public Comment Period	General public in San Diego region

2. Outreach and Engagement

SANDAG undertook extensive outreach and engagement to prepare the Roadmap, consistent with our approved project workplan submitted for the CPRG program. SANDAG consulted and collaborated with stakeholders so that they would be informed, involved, and empowered through both the planning process and to ensure their input informed the Roadmap. This chapter highlights methods that SANDAG used to seek input on the Roadmap. More information on outreach and engagement for the Roadmap is included in Appendix A.

2.1 Interagency Meetings

To align the Roadmap with regional goals and priorities, SANDAG held bimonthly interagency coordination meetings. At these meetings, local jurisdictions, regional agencies, and tribal governments received updates on Roadmap progress and provided input on key Roadmap elements. Additionally, SANDAG, the California Air Resources Board (CARB), and other California MSAs met on a regular basis to facilitate effective communication and coordination on complementary approaches to MSA and State CPRG deliverables. This interagency coordination was especially important given that it allowed potential implementers of the GHG reduction measures to provide direct input on the Roadmap.

2.2 Sector Advisory Meetings

SANDAG held four meetings in October 2024 with staff from local jurisdictions and regional agencies with expertise or knowledge about specific emissions sectors (e.g., transportation, electricity). Together, participants in these meetings provided over 500 comments to help refine the proposed GHG reduction measures through a series of activities. In May 2025, this group also provided feedback on draft sections of Chapter 6 of this report.

2.3 SANDAG Working Groups and Policy Advisory Committees

SANDAG Working Groups (WGs) are advisory bodies that have a specialized area of responsibility, such as mobility, military, or sustainable communities, among others. The WGs report to Policy Advisory Committees (PACs), which have focused public policy and funding responsibilities, such as transportation and regional planning. WGs are typically comprised of subject matter experts, while the PACs are made up of elected officials. The PACs also advise the SANDAG Board of Directors on policy-level matters related to regional programs. WGs and PACs provide opportunities for elected officials, agency staff, representatives of civic and community groups, and the public to come together to discuss or act on specific subject areas.

SANDAG staff gave 14 presentations to various WGs and PACs at key milestones during the Roadmap's development. In May 2024, staff sought input on the approach to developing the Roadmap from PAC members. In September 2024, staff presented at WG meetings with tribes and CBOs to share updates and seek input on the Roadmap. In January, February, and March 2025, staff presented to several WGs and PACs to share the draft GHG reduction measures and get feedback from local jurisdiction staff, elected officials, tribes, and CBOs. In September and October 2025, staff presented and sought feedback on the draft Roadmap to several WGs and one PAC.

2.4 Regional Workshops

SANDAG held three regional workshops to seek feedback from stakeholders during the Roadmap development process. The workshops served as listening sessions and community sharing sessions. They convened local jurisdictions, regional agencies, tribes, CBOs, non-governmental organizations (NGOs), and other stakeholders and took place in July 2024, February 2025, and October 2025. At the July 2024 workshop, attendees were asked to share examples of successful measures and actions to reduce emissions, and to identify near- and long-term priorities for reducing emissions across various sectors. At the February 2025 workshop, staff shared the draft GHG reduction measures to gather stakeholder feedback and received more than 400 comments, which helped inform the final Roadmap measures. At the October 2025 workshop, staff provided an overview of the draft Roadmap, gathered stakeholder feedback, and discussed opportunities for regional collaboration to advance the Roadmap's vision.

2.5 Community Outreach Events

SANDAG partnered with 11 CBOs in the region that work in low-income communities. These organizations serve on a SANDAG CBO taskforce and a SANDAG WG. The Roadmap was presented to the CBO taskforce at key milestones in the report's development. The 11 CBOs also shared our public survey on the Roadmap with their communities. SANDAG contracted with 3 of these CBOs to conduct additional outreach at local events, community meetings, and other opportunities. Together, these 3 CBOs conducted nearly 60 outreach events where they educated the community and gathered input on the Roadmap. Events included farmers markets, resource fairs, community clean ups, celebrations, and community meetings. Through these efforts over 130 community members participated in Roadmap activities. The outreach conducted by our CBO partners also greatly supported SANDAG in gathering responses to our public survey (see below).

2.6 Business and Trade Association Meetings

SANDAG conducted outreach with San Diego Gas & Electric (SDG&E), the investor-owned utility that serves the San Diego region, on GHG reduction measures for several sectors. SDG&E provided feedback on the transportation, electricity, buildings, and industrial sectors. SANDAG also coordinated with Cleantech San Diego and some of its members to gain input on these sectors. In addition, SANDAG engaged the Industrial Environmental Association and some of its members to solicit input on the region's industrial sector.

2.7 Public Survey

SANDAG conducted a regional survey to learn which climate measures and benefits were most important to the public. Question 1 in the survey included a simplified list of strategies based on our draft GHG reduction measures. It asked respondents to indicate the importance of each strategy as either “Very Important,” “Important,” “Not Important,” or “Don’t Know.” SANDAG calculated a weighted score for each strategy by applying a weight of 3, 2, 1, or 0 to each of these response options respectively. Question 2 asked respondents to rank five different benefits associated with the strategies in question 1 from most to least important. SANDAG then used a similar weighted scoring process to what was applied to the question 1 responses for the question 2 responses, by assigning a factor of 5 to the highest-ranked benefit, continuing down to a factor of 1 for the lowest-ranked benefit in each response. In total, more than 680 survey responses were received. The results of question 1 are discussed in more detail in Chapter 6, and the results of question 2 are included in Chapter 7.

2.8 Public Comment

The Draft Roadmap was made publicly available for four weeks from September through October 2025 for feedback prior to its completion and submittal to the EPA. SANDAG received over 60 comments during this period and evaluated the feedback to inform revisions to the final Roadmap.

3. GHG Inventory

SANDAG partnered with USD EPIC, a research center focused on energy and climate policy in California and the San Diego region, to conduct several technical analyses for the Roadmap. These included the development of the regional GHG inventory (Chapter 3), GHG reduction goals (Chapter 4), business-as-usual (BAU) GHG projections (Chapter 5), the implementation scenario projections, GHG emission reductions, and cost estimates (Chapter 6). This chapter focuses on the regional GHG inventory, which provides a comprehensive estimate of GHG emissions from key sources in the San Diego region. It includes total emissions for the year 2022, organized by sector. This chapter also outlines the methodology, sector definitions, geographic scope, data year, and inventory results.

3.1 Inventory Methodology

The 2022 regional GHG inventory follows, to the extent possible, the approaches of both CARB's California statewide GHG inventory (referred to as "CARB statewide inventory")[4] and the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (referred to as US Community Protocol).[5] To be consistent with the CARB statewide inventory, SANDAG through USD EPIC selected the same emissions sectors, used the Intergovernmental Panel on Climate Change's (IPCC) AR4 Global Warming Potential (GWP), and followed CARB's overarching scope of including anthropogenic emissions within the inventory and listing carbon sinks from measure implementation as informational items. The geographic boundaries and calculation methodologies follow the US Community Protocol. These items are further explained in this chapter, and a more detailed description of the calculation methodologies of each inventory sector can be found in Appendix B.

Emissions Sectors

The 2022 GHG inventory and projections include 15 categories of emissions calculated based on the U.S. Community Protocol and CARB statewide inventory methodology. The descriptions of each sector are listed in Table 3. The GHG inventory accounts for emissions across all major sectors in the region, though some sectors, such as transportation (covered by measures T-1 through T-6), span multiple inventory categories (e.g., passenger vehicles and rail). Therefore, the CPRG sector categories used for the GHG reduction measures do not align exactly with the GHG inventory categories.

Table 3: Inventory Category Descriptions

Category	Description
Passenger Cars and Light-Duty Vehicles	Tailpipe GHG emissions resulting from fossil fuel combustion (i.e., gasoline, diesel, natural gas) in passenger cars and light-duty vehicles on freeways, highways, and local roads.
Electricity	Emissions from regional electricity consumption. Includes consumption for retail electricity users (SDG&E Bundled, Community Choice Aggregators (CCAs), Direct Access), and self-generation.

[4] "Current California GHG Emission Inventory Data," (CARB, 2024)
[5] "US Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions," (ICLEI - Local Governments for Sustainability USA, 2019)

Category	Description
Natural Gas	Emissions from building end-use natural gas for purposes other than electric generation. Includes residential and non-residential retail use, co-generation plants (thermal output only), and fugitive pipeline emissions. Excludes natural gas used for utility-level electric generation (UEG).
Industrial	Emissions from high-GWP gases used in industrial processes and products. High-GWP gases are used in air conditioning units and refrigeration, as well as in the manufacturing of electronics, fire protection equipment, insulation, and aerosols.
Heavy-Duty Trucks and Other Vehicles	Tailpipe GHG emissions resulting from fossil fuel combustion (i.e., gasoline, diesel, natural gas) in medium- and heavy-duty vehicles on freeways, highways, and local roads.
Other Fuels	Emissions from fuels not otherwise accounted for in other categories, including distillate (other than in power production), kerosene, gasoline (other than in transportation), liquefied petroleum gas (LPG), residual fuel oil (other than in power production), and wood (wet).
Off-Road Vehicles	Emissions from mobile equipment not used on the road. This category includes the following subcategories by equipment type: construction and mining equipment, cargo handling equipment, industrial equipment, large spark ignition fleets (forklifts), airport ground support, recreational vehicles, lawn and garden equipment, transport refrigeration units, military tactical support equipment, pleasure craft, and other portable equipment.
Solid Waste	Emissions from solid waste include the methane emissions from the decomposition of the solid waste generated in the San Diego Region and disposed in landfills in 2022.
Aviation	Emissions from the combustion of jet fuel and aviation gasoline associated with the Landing-Takeoff Cycle of aircraft flights taking off from San Diego International Airport (SAN), McClellan-Palomar, as well as other municipal and private airports in the region.
Water	Emissions from the energy associated with upstream supply and conveyance, and local treatment of water, including surface water and groundwater treatment, desalinization, and potable water reuse.
Agriculture	Emissions from livestock (enteric fermentation and manure management), agricultural off-road vehicles, agricultural non-vehicle fuel use, and soil management practices.
Marine Vessels	Emissions from ocean-going vessels and commercial harbor craft in County waters. Excludes military vessels and vessels traveling to/from military bases. Pleasure craft is included in the Offroad sector.

Category	Description
Wastewater	Fugitive and process emissions associated with treating community-generated wastewater.
Rail	Emissions from both passenger and freight rail resulting from the combustion of fuels in internal combustion engines. The rail category includes freight, passenger, and long-haul locomotive operating in the San Diego region as well as light commuter rail and Trolley systems operated by San Diego Metropolitan Transit System (MTS) and North County Transit District (NCTD).

Source: USD EPIC, 2025

This inventory does not include emissions from or sequestered by vegetation, which follows CARB's approach to track statewide GHG emissions from anthropogenic (human-made) activities separately from the GHG flux associated with carbon stocks in California's natural and working lands[6] and wildfire emissions. This is because wildfires are part of Earth's carbon cycle and it is difficult to determine what portion of wildfire emissions are from anthropogenic activities.[7, 8]

Geographic Scope

The 2022 regional GHG inventory captures emissions within the San Diego-Chula Vista-Carlsbad MSA and encompasses the entire County of San Diego. While the overarching inventory approach is intended to follow the CARB statewide inventory to understand the region's contribution to both statewide emissions and mitigation efforts, the inventory boundaries align with the U.S. Community Protocol. As a result, direct emissions that occur within geographic boundaries are included as well as emissions that are directly generated within the community but occur outside of the region. An example of this is solid waste that is generated by San Diego communities but disposed of in landfills outside of the region.

Data Year

The emissions inventory year was chosen to be consistent with SANDAG's Draft 2025 Regional Plan, which serves as our Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS)[9] and uses a travel demand model base year of 2022. Both the federal government and California mandate that each MPO update their RTP every four years. While federal requirements focus on demonstrating air quality conformity under the Clean Air Act, California requires MPOs to include an SCS in their RTPs that demonstrates progress toward reducing per capita GHG emissions from cars and light-duty trucks through integrated transportation, housing, and land use planning. To be consistent with the RTP and SCS, which were developed concurrently with the Roadmap, an inventory year of 2022 was chosen for the Roadmap.

6 "**An Inventory of Ecosystem Carbon in California's Natural & Working Lands**," (CARB, 2018). CARB began a natural and working lands carbon and GHG flux assessment in 2018 based on IPCC principles.
7 "**Frequently Asked Questions: Wildfire Emissions**," (CARB)
8 "**California Wildfire Burn Acreages and Preliminary Emissions Estimates**," (CARB, 2020). California Senate Bill 901 (Dodd, 2018) (SB 901) requires that the state develops a report assessing GHG emissions from wildfire and forest management activities by December 2020 and every five years thereafter. The SB 901 2020 report provides wildfire estimates for the years 2000–2019.
9 "**Draft 2025 Regional Plan**," (SANDAG, 2025)

3.2 Inventory Results

Based on the methodology described above, Table 4 provides a summary of the 2022 GHG inventory in million metric tons of carbon dioxide equivalent (MMT CO_2e) by sector in the San Diego region.

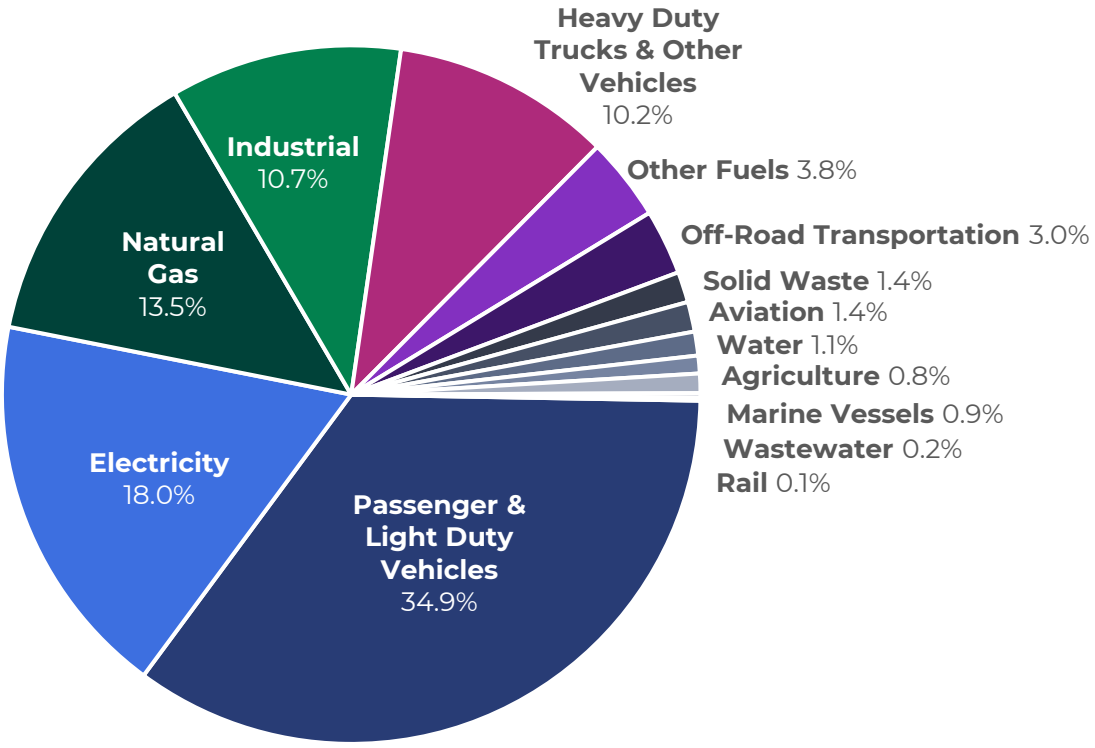
Table 4: Total GHGs by Sector, 2022 (MMT CO_2e)

Emissions Category	Total MMT CO_2e (2022)
Passenger Cars and Light-Duty Vehicles	7.80
Electricity	4.03
Natural Gas	3.01
Industrial	2.40
Heavy-Duty Trucks and Other Vehicles	2.28
Other Fuels	0.86
Off-Road Vehicles	0.68
Solid Waste	0.32
Aviation	0.31
Water	0.25
Marine Vessels	0.20
Agriculture	0.18
Wastewater	0.05
Rail	0.03
Total	**22.39**

Source: USD EPIC, 2025

Figure 2 on the following page provides a graphical summary of the 2022 GHG inventory for the San Diego region.

Figure 2: Pie Chart of the 2022 San Diego Regional GHG Inventory



Source: USD EPIC, 2025

3.3 Inventory Trends and Analysis

USD EPIC has prepared GHG inventories of the San Diego region for the years 2006, 2012, 2016, and most recently 2022. SANDAG has included data from each of these inventories in its related RTPs beginning in 2011. Because methodological approaches and available data sources have evolved over time, these inventories are not directly comparable. However, when considered together, the 2012, 2016 and 2022 regional GHG inventories, which were developed to inform RTPs, indicate a downward trend in economy-wide GHG emissions (measured in MMT CO_2e). In 2012, the San Diego regional inventory totaled an estimated 33.32 MMT CO_2e, whereas the 2016 inventory totaled 26 MMT CO_2e, and the 2022 inventory 22.39 MMT CO_2e. This trend reflects an overall decline in total regional emissions since at least 2012. At the regional level, this reflects continued progress in reducing GHG emissions over time.

4. Near-Term and Long-Term Economy-Wide GHG Reduction Goals

This chapter, prepared with support from USD EPIC, presents economy-wide, voluntary GHG reduction goals for the San Diego region. These goals, based on the region's 2022 GHG inventory, serve as the foundation for the Roadmap's long-term vision. While not regulatorily required, these goals are intended to guide collaborative regional action and support long-term planning to reduce emissions in the region. It is important to distinguish that SANDAG's Regional Plan and SCS focus on how coordinated transportation, housing, and land use will meet the target for reducing per capita greenhouse gas (GHG) emissions from Passenger Cars and Light-Duty Vehicles set by the California Air Resources Board (CARB); whereas the Roadmap is a vision for reducing emissions across all sectors economy-wide. The regional goals reflect the scale of reductions needed to align with statewide climate targets and are intended to inform planning and policy decisions by a range of agencies, jurisdictions, and organizations across the San Diego region. This chapter includes both near-term (2035) and long-term (2045) reduction goals, the BAU scenario used for comparison, and the rationale behind selecting these goals and goal years.

4.1 Economy-Wide GHG Reduction Goals

The near-term and long-term economy-wide GHG reduction goals for the San Diego region in the Roadmap are listed below and illustrated in Figure 3:

- Near-term 2035 goal: 47% reduction below 2022 GHG levels or 11.8 MMT CO_2e; and
- Long-term 2045 goal: 83% reduction below 2022 GHG levels or 3.8 MMT CO_2e.

These goals serve as regional guideposts aligned with California's statewide GHG reduction targets established in SB 32 and AB 1279. Progress to meet these goals will be dependent on significant investment and coordinated action across all levels of government, the private sector, and communities. For more details as to how these goals were calculated, see Section 4.2 below and Appendix C.

4.2 Goal Setting Approaches

Approach to Selecting a Base Year and Goal Years

Base Year

The Roadmap uses 2022 as the base year for GHG reduction goal setting for two reasons. First, for consistency with SANDAG's Draft 2025 RTP, which also uses the base year 2022 in several components, such as the Series 15 Regional Growth Forecast. Second, the Draft 2025 RTP also includes the latest regional GHG emissions inventory, which also uses base year 2022. Using 2022 as the base for goal setting ensures the goals are set based on the latest GHG inventory methodology, data, and data sources. In addition, the 2022 regional GHG inventory covers emissions from all key economic sectors and is representative of general emissions patterns in the San Diego region.

Goal Years

The Roadmap uses 2035 as the near-term goal year for GHG reduction goal setting for two reasons. First, 2035 aligns with the target year for SANDAG's SCS, which is a state-mandated component of the Draft 2025 RTP focused on reducing per capita emissions from cars and light-duty trucks by 2035 through coordinated transportation, housing, and land use planning. Second, the goal year 2035 is consistent with the near-term target years in many local CAPs, most of which have either 2030 or 2035 near-term target years.

Similarly, the Roadmap uses 2045 as the long-term goal year because it aligns with California's long-term statewide climate goal year mandated in AB 1279 (discussed in more detail in the next section and Appendix C). It also aligns with the long-term goal years in most local CAPs adopted in the last five years.

Approach to Selecting Emission Reduction Percentages

California has statewide GHG reduction targets to:

- Reduce anthropogenic emissions to 40% below 1990 levels by 2030, as directed by SB 32, and;
- Reduce anthropogenic emissions to 85% below 1990 levels and achieve carbon neutrality by 2045, as directed by AB 1279.

The latest Scoping Plan from CARB, published in 2022, identifies a path to achieve carbon neutrality by 2045 while assessing the progress California is making towards achieving the 2030 interim target established in SB 32. CARB's approach to achieve carbon neutrality is to reduce GHGs to meet the anthropogenic emissions target (i.e., 85% reduction below 1990 levels), to expand actions to capture and store carbon through the State's natural and working lands, and through a variety of mechanical carbon removal approaches.

The Roadmap assesses anthropogenic emissions as the emissions within the San Diego region's influence and control. As such, the 2045 anthropogenic emissions reduction goal is used in the Roadmap, rather than the carbon neutrality goal. In addition, based on regional conditions, a technologically feasible and cost-effective path to achieve carbon removal through natural solutions and mechanical carbon capture and storage technologies is currently limited. As CARB and other state agencies evaluate and provide more guidance on carbon removal solutions, the feasibility of a regional 2045 carbon neutrality goal can be reassessed. Many local jurisdictions with CAPs are taking the same approach, using the 2045 anthropogenic emissions targets rather than the 2045 carbon neutrality goal. While California's targets are based on 1990 GHG emissions levels, the San Diego region does not have a 1990 GHG emissions inventory; therefore, proportional goal reduction percentages for the Roadmap were developed relative to the 2022 base year. Details on how the 2035 and 2045 emission reduction percentages and goals were calculated are provided in Appendix C.

Although local CAPs have different base years than the Roadmap, the methods for estimating GHG reduction percentages from a more recent base year, and the base year GHG inventory described above, are consistent with the methods used by local jurisdictions in the San Diego region when determining their CAP goals.

5. BAU GHG Emission Projections

This chapter, developed with technical support from USD EPIC, provides two sets of GHG emissions projections in the San Diego region through 2045. Under the No-Action BAU projection, GHG emissions increase based on expected regional growth patterns, such as population growth, with no further action taken to reduce GHG emissions beyond 2022. This projection represents expected emission trends in the absence of new local, state, and federal actions, and without the future impacts of existing local, state, and federal actions. Under the Legislatively-Adjusted BAU projection, reductions in regional GHG emissions are expected to occur because of the future impacts of currently adopted federal and state legislation and regulations. This chapter summarizes the modeling approach, key assumptions, and projection results of these two BAU projections. The impact of regional policies and programs is described in Chapter 6.

5.1 No-Action BAU Projection Methodology

The No-Action BAU projection is based on no further federal, state, or local action being taken to reduce GHG emissions beyond 2022. Instead, GHG emissions per capita are held steady and regionwide emissions fluctuate with population trends.

5.2 Legislatively-Adjusted BAU Projection Methodology

The Legislatively-Adjusted BAU emission projection estimates include the regional effects of existing state policies and regulations to reduce GHG emissions. Federal policies are not included in this analysis as the relevant California state policies surpass federal emissions reduction goals. The projected emissions are based on the current implementation timeline of these regulations. Projection years 2035 and 2045 were used to align with the emissions goals, as discussed in Chapter 4. Additional details on the calculation of each BAU projection can be found in Appendix D.

Table 5 describes the legislative adjustments included in each emissions sector in the BAU projection. These adjustments are intended to reflect known emissions reduction efforts at the state level at the time of this report.

Table 5: Regulation and Legislation included in the Legislatively-Adjusted BAU Projection by Sector

GHG Emissions Category	Regulation and Legislation Adjustments
On-Road Transportation (Light-Duty and Heavy-Duty Vehicles)	Includes estimate for zero-emission vehicle (ZEV) market penetration using the possible emissions reductions from recent California state vehicle efficiency and ZEV regulations.[10] This assumes these vehicle regulations would be implemented as planned, however, uncertainty exists around the implementation of these current regulations in California and at the federal level. Also includes projects that already exist as part of the current transportation network and no-build projects (recently completed or in progress and fully funded through construction) that would be built in the region in absence of SANDAG's 2025 Regional Plan (2025 Draft Regional Plan 'No-Build' scenario).
Electricity	Includes increasing electricity demand in the transportation sector and buildings as well as increased onsite solar and battery storage, as projected by the California Energy Commission (CEC).[11] Includes demand migration post-2022 from SDG&E to CCA programs, increased electricity demand across the various regional load serving entities per the CCA and SDG&E demand forecasts. Assumes Renewables Portfolio Standard (RPS) and California Senate Bill 1020 (Laird, 2022) (SB 1020) compliance by all load serving entities. Includes electricity demand changes due to building standards, federal appliance standards, and utility energy efficiency programs as of 2023.
Natural Gas	Includes fluctuation in natural gas demand for the SDG&E area as projected by the CEC[12] which accounts for increased electrification of building stock, gas changes due to building standards, federal appliance standards, and utility energy efficiency programs as of 2023.
Industrial	None

[10] For a list of all new regulatory measures included in EMFAC2025, see CARB **April 30, 2025 EMFAC2025 Final 4th Public Workshop**. EMFAC2025 v 2.0.0, released in May 2025.

[11] This analysis uses the CEC 2023 – 2040 Energy Demand Forecast which includes impacts of the 2022 California Building Energy Code, impacts of extreme weather variants, projected rates, and statewide incentive programs for electric vehicle and appliance transitions. More details on the forecast are included in the **Adopted 2023 Integrated Energy Policy Report**.

[12] This analysis uses the CEC 2023 – 2040 Energy Demand Forecast which includes impacts of the 2022 California Building Energy Code, impacts of extreme weather variants, projected rates, and statewide incentive programs for electric vehicle and appliance transitions. More details on the forecast are included in the **Adopted 2023 Integrated Energy Policy Report**.

GHG Emissions Category	Regulation and Legislation Adjustments
Other Fuels	Includes the California goal to reduce GHGs from agricultural non-mobile equipment by 40% below 1990 levels by 2030, and achieve carbon neutrality by 2045, Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program.[13]
Off-Road Transportation	Includes off-road vehicle efficiency standards by equipment type as projected by CARB per the In-Use Off-Road Diesel-Fueled Fleets Regulation.[14]
Solid Waste	Includes organic waste reduction and emission factor reduction from reaching California Senate Bill 1383 (Lara, 2016) (SB 1383) policy goal.
Water	Includes impact of water efficiency standards California Senate Bill 606 (Hertzberg, 2018) (SB 606) and California Assembly Bill 1668 (Friedman, 2018) (AB 1668) as forecast by various regional water authorities.
Aviation	None
Rail	Includes impact of CARB's In-Use Locomotive Regulation.[15]
Wastewater	None
Agriculture	Includes mobile equipment efficiency standards by equipment type as projected by CARB per the In-Use Off-Road Diesel-Fueled Fleets Regulation.[16]
Marine Vessels	Includes California Ocean-Going Vessel Fuel Regulation[17] and At-Berth Emissions Control Strategy Regulation.[18]

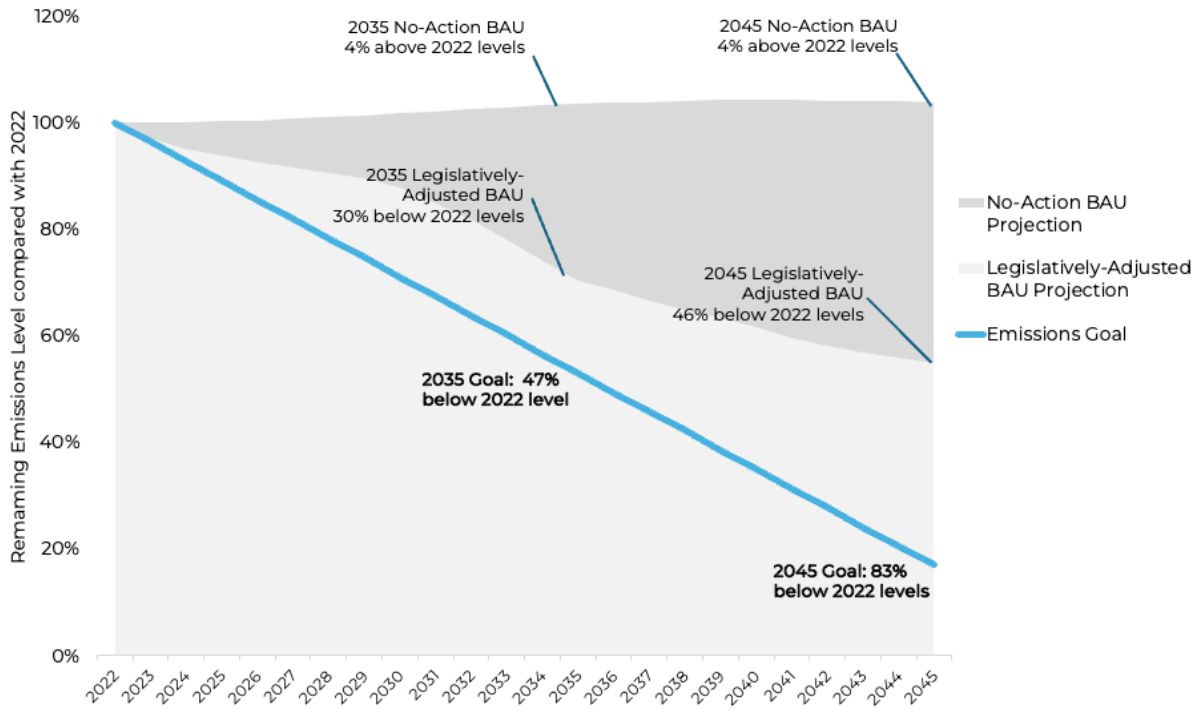
Source: USD EPIC, 2025

[13] "**Funding Agricultural Replacement Measures for Emissions Reductions Program**," (CARB)
[14] "**In-Use Off-Road Diesel-Fueled Fleets Regulation**," (CARB)
[15] CARB's **In-Use Locomotive Regulation** was approved April 2023 and repealed in June 2025 as it did not get authorization from the EPA to enforce the regulation. This was included in the Legislatively-Adjusted BAU as during the analysis was conducted before the regulation was repealed.
[16] "**In-Use Off-Road Diesel-Fueled Fleets Regulation**," (CARB)
[17] "**California Ocean-Going Vessel Fuel Regulation**," (CARB)
[18] "**At-Berth Emissions Control Strategy Regulation**", (CARB)

5.3 BAU Projection Results

The No-Action BAU projection shows a 4% increase in regionwide GHG emissions in both 2035 and 2045, following projected population increases. The Legislatively-Adjusted BAU projection shows a 30% reduction in regionwide emissions below 2022 levels by 2035, and a 46% reduction below 2022 levels by 2045, primarily driven by reductions to the electricity sector through the RPS and regionwide participation in CCA programs. Vehicle emission standards (e.g., Advanced Clean Cars I), which have already reduced emissions in new vehicles, also lower the Legislatively-Adjusted BAU projection for on-road transportation as newer models make up a higher percentage of the overall fleet in future years. Figure 3 shows the BAU projections compared to the near- and long-term emissions goals described in Chapter 4.

Figure 3: BAU Projections and GHG Reduction Goals



Source: USD EPIC, 2025

Table 6 shows the projected Legislatively-Adjusted BAU GHG emissions levels in goal years 2035 and 2045 compared to estimated 2022 levels.

Table 6: 2022 GHG Emissions and Legislatively-Adjusted BAU Projections for Goal Years 2035 and 2045 by Category

Emissions Category	MMT CO_2e		
	2022	2035	2045
Passenger Cars, Light-Duty Vehicles, and Heavy-Duty Vehicles	7.80	6.77	3.39
Electricity	4.03	0.85	0.44
Natural Gas	3.01	3.02	3.01
Industrial	2.40	2.54	2.72
Other Fuels	0.86	0.87	1.00
Off-Road Vehicles	0.68	0.68	0.68
Solid Waste	0.32	0.08	0.08
Aviation	0.31	0.43	0.45
Water	0.25	0.05	0.00
Marine Vessels	0.20	0.24	0.27
Agriculture	0.18	0.20	0.20
Wastewater	0.05	0.05	0.05
Rail	0.03	0.01	0.00
Total	**22.25**	**15.61**	**12.10**

Source: USD EPIC, 2025

Table 7 below shows the percentage change of projected BAU GHG emissions compared to the 2022 baseline of each emissions sector in goal years 2035 and 2045.

Table 7: Legislatively-Adjusted BAU Emissions Change Relative to 2022 Baseline in Goal Years 2035 and 2045

Emissions Category	Percent Change (2022 to 2035)	Percent Change (2022 to 2045)
Passenger Cars, Light-Duty Vehicles, and Heavy-Duty Vehicles	-33%	-66%
Electricity	-79%	-89%
Natural Gas	0%	0%
Industrial	6%	13%
Other Fuels	1%	17%
Off-Road Vehicles	0%	0%
Solid Waste	-74%	-74%
Aviation	40%	47%
Water	-82%	-100%
Marine Vessels	21%	36%
Agriculture	10%	11%
Wastewater	4%	4%
Rail	-69%	-97%
Total	**-30%**	**-46%**

Source: USD EPIC, 2025

6. Implementation Scenario Projections and GHG Emission Reduction Measures

The Roadmap includes 23 GHG emission reduction measures across eight sectors: Transportation, Electricity, Buildings, Industry, Solid Waste & Materials Management, Waste & Wastewater, Agriculture, and Natural & Working Lands. The first section of this chapter introduces the Implementation Scenario, which illustrates the cumulative GHG reductions that could be achieved if the Roadmap measures were implemented alongside additional regional and state actions. The second section includes a summary table of these 23 measures and then describes our approach to developing them. The last section of this chapter describes each measure in detail, beginning with an overview of the sector including key emissions sources, regional trends, and relevant policies or programs. These sector overviews are followed by the descriptions of the measures including what each aims to achieve, the actions that could support implementation, which agencies could be involved, how progress could be tracked, and estimated GHG reductions by measure.

6.1 Implementation Scenario Projections

The Implementation Scenario illustrates what levels of GHG reductions could be achieved if Roadmap measures were implemented alongside other state and regional actions. The Implementation Scenario is displayed in Figure 4 and shows:

- **Legislatively-Adjusted BAU Projection**: Future impacts of currently adopted legislation and regulations at the state and federal level
- **SANDAG Draft 2025 Regional Plan**: Projected impact of implementing SANDAG's Draft 2025 Regional Plan
- **Roadmap Measures**:[19] Projected impact of implementing all GHG reduction measures included in the Roadmap
- **California Scoping Plan Goals**: Projected impact of programs identified in the 2022 California Scoping Plan to reduce statewide emissions that have yet to be enacted through legislation or whose implementing authority lies outside of regional actors

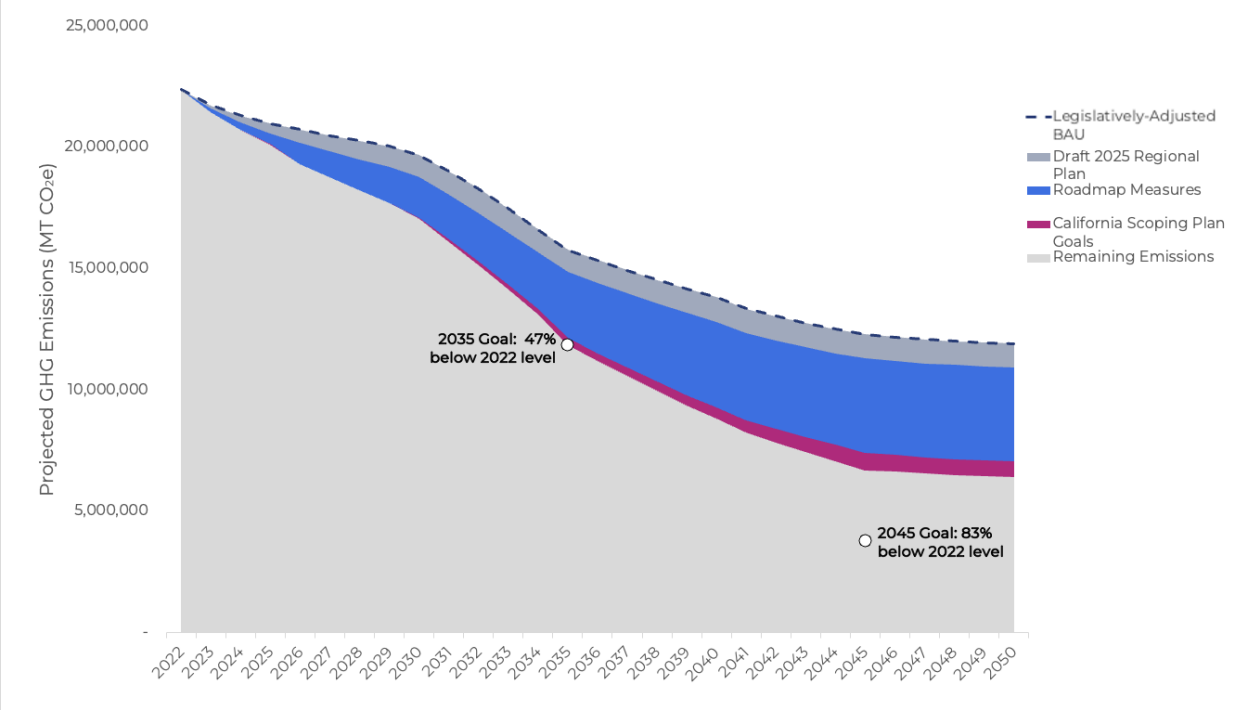
Together, these efforts illustrate how economy-wide GHG emissions could be reduced to 47% below 2022 levels by 2035 in the San Diego region. The Roadmap also shows how the region could make substantial progress toward the 2045 goal of reducing GHGs 83% below 2022 levels. The modeled Roadmap reductions achieve approximately a 70% reduction in GHG emissions by 2045. The Roadmap's GHG reduction goals align with statewide legislative GHG goals established in SB 32 and AB 1279.

[19] While the Draft 2025 Regional Plan fulfills the requirements set out by SB 375, which sets a GHG reduction target of 19% reduction in per capita emissions from cars and light-duty trucks by 2035 relative to 2005 levels, the 2025 Regional Plan category in Figure 4 depicts the reductions from implementing the Draft 2025 Regional Plan translated into economy-wide regional emissions reductions.

While several Climate Action Plans from California cities have modeled pathways that achieve this long-term target within their jurisdictions, the Roadmap covers a broader range of emission sources across the entire region, including sectors that are beyond the authority of any single city or county. Achieving the Roadmap's long-term 83% GHG reduction goal will require coordinated effort across multiple levels of government. It will also require continued large-scale public and private investment both to accelerate progress in the region's largest emitting sectors—Transportation, Buildings, and Electricity—and to address hard-to-reduce sources such as aviation, marine vessels and certain industrial processes. This coordinated effort at the local and regional level is already underway with the significant work that local governments, ports, and water agencies in the San Diego region have done to identify pathways for reaching 2035 and 2045 targets under their respective authorities.

Figure 4 shows the projected emission reductions under the Implementation Scenario. From the top down: GHG reductions are represented by the Legislatively-Adjusted BAU projection (dark blue dotted line) and implementation of SANDAG's 2025 Regional Plan in dark gray. This is followed by the Roadmap Measures shown in blue, the California Scoping Plan Goals in magenta, and remaining emissions in light gray. The California Scoping Plan Goals category includes goals the State has identified in CARB's 2022 Scoping Plan, which have not yet been legislatively enacted. Additional details of the Implementation Scenario are described in Appendix E.

Figure 4: Economy-Wide Emission Reduction Projection by Implementation Category



Source: USD EPIC, 2025

6.2 GHG Emission Reduction Measures Summary

Table 8 lists the number and name of the Roadmap GHG reduction measures for each sector.

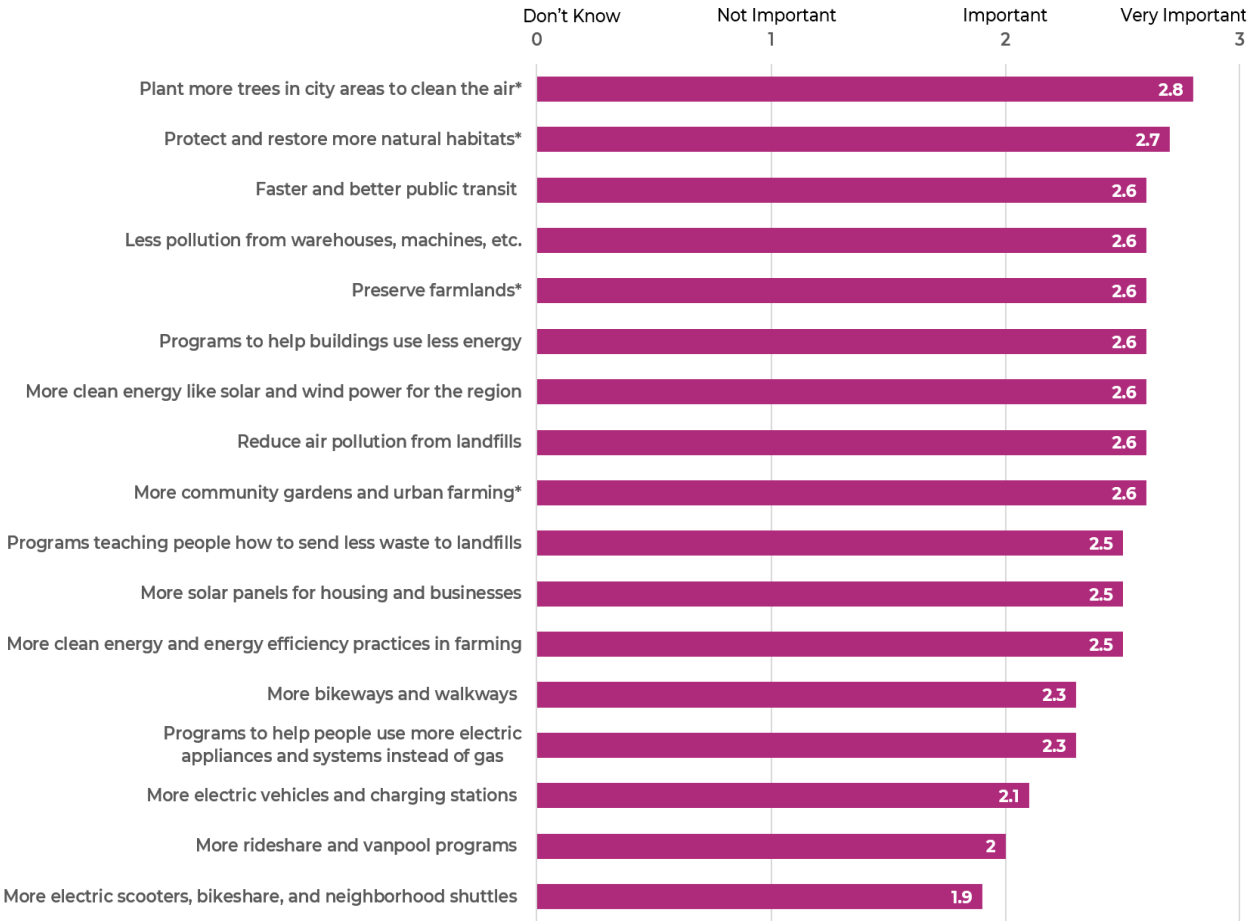
Table 8: Summary of the 23 GHG Reduction Measures by Sector

Sector	Measure Number	Measure Name
Transportation	T-1	Reduce Vehicle Miles Traveled (VMT) through Increased Transit Use
	T-2	Reduce VMT through Active Transportation
	T-3	Reduce VMT through Expansion of Flexible Fleets
	T-4	Reduce VMT through Transportation Demand Management (TDM)
	T-5	Increase Adoption of Zero-Emission Vehicles (ZEVs)
	T-6	Reduce Fuel Use from Idling
Electricity	E-1	Decarbonize the Regional Electric Grid
Buildings	B-1	Increase Energy Efficiency of Buildings
	B-2	Increase Electrification of Buildings
Industry	IND-1	Reduce Short-Lived Climate Pollutants Emissions
	IND-2	Reduce Energy Intensity of Industrial Facilities
Solid Waste & Materials Management	SW-1	Divert Waste from Landfills
	SW-2	Reduce Waste Emissions through Increased Methane Capture
Water & Wastewater	WW-1	Reduce Demand for Potable Water
	WW-2	Optimize Energy Use in Water and Wastewater Systems
	WW-3	Reduce Methane Emissions from Wastewater Systems
Agriculture	AG-1	Reduce Emissions from Agricultural Operations
	AG-2	Expand Urban Agriculture in the Region
	AG-3	Improve Agricultural Practices to Sequester Carbon
	AG-4	Conserve Agricultural Land
Natural & Working Lands	NWL-1	Conserve Coastal and Wetland Ecosystems
	NWL-2	Conserve Forest, Shrublands, and Chaparral Ecosystems
	NWL-3	Increase Urban Greening

Approach to Developing the GHG Reduction Measures

To develop the GHG reduction measures, SANDAG gathered stakeholder input through outreach, workshops, technical meetings, WGs and PACs, and a public survey. SANDAG also incorporated actions from local CAPs adopted by many of our local jurisdictions, as well as the draft 2025 Regional Plan, so that the Roadmap would build on these existing efforts. This approach enabled the Roadmap measures to reflect regional priorities and address community needs. The regional survey that SANDAG conducted allowed us to learn which measures and benefits were most important to members of the public. The results of the first question in the survey are pictured below in Figure 5. Survey participants were asked to rank climate strategies by level of importance to them. The results show that there is less than a one-point difference (0.9) between the highest-ranked strategy at 2.8, and lowest-ranked strategy at 1.9, with most rated between important and very important. The highest rated strategies overall were planting more trees and protecting natural habitats, which can capture and store carbon. The highest rated strategies that reduce GHG emissions directly were those related to improving public transit, reducing pollution from warehouses, and reducing energy use in buildings. This stakeholder input informed the final GHG reduction measures included in the Roadmap and is discussed in more detail in Appendix A.

Figure 5: Public Survey Strategy Scores



*Carbon sinks
n=683

Measure Structure

Based on the approach above, SANDAG developed the Roadmap GHG reduction measures described in Section 6.3. Section 6.3 is organized by sector, each beginning with a narrative describing the sector, its main sources of emissions, and any relevant context or key considerations. Each sector narrative is followed by the GHG reduction measures for the sector. Each measure includes the following components:

- **Objectives**: Identifies what could be achieved under each high-level measure.
- **Supporting Actions**: Includes more detail on projects, plans, and programs that could help the region achieve the objectives.
- **Geographic Scope**: Describes where the measure would be implemented.
- **Cost Information**: Indicates the estimated cost of the measures using a relative scale of high, medium, or low. These categories are used for comparative purposes within this plan and do not represent precise estimates. The high-cost category generally involves larger capital-intensive infrastructure projects, whereas the low-cost category generally captures policy, outreach, education, and/or technical assistance that would have a relatively lower cost to implement. Costs and benefits (e.g., energy bill savings) borne by residents and businesses that might result from the measures were not considered.
- **Implementing Authorities**: Describes the possible agencies, jurisdictions, or utility that would have the authority to implement the measures.
- **GHG Emission Reductions**: Includes the estimated GHG reductions that could be achieved if the measure were implemented.
- **Metrics for Tracking Progress**: Provides sample indicators that could be used to gauge whether implementation is on track. Metrics will vary by project.
- **High-Level Implementation Schedule and Milestones**: Includes illustrative examples of when key points and activities could occur to support measure implementation, organized into near-term (2035) and long-term (2045) timeframes. Note that the illustrative examples are intended to indicate that an action is anticipated to occur at some point during that window (2026-2035 or 2036-2045). It does not imply that the activity will span the entire duration of the timeframe. Timing and activities will vary by project based on capacity and funding. This component is only provided for the highest-emitting sectors (Transportation, Buildings, Electricity, and Industry), which account for almost 95% of GHG emissions.
- **Intersection with Other Funding Availability**: Provides a list of possible funding sources to implement measures for each sector.

6.3 GHG Emission Reduction Measures

The first sector—Transportation—begins on the following page.

Transportation Sector

The Transportation sector includes the movement of people and goods by cars, trucks, bikes, airplanes, trains, ships, and other vehicles. Transportation is the largest source of GHG emissions in the San Diego region, contributing 50.5% of emissions. Passenger and light-duty vehicles alone account for 34.9% of regional emissions. A major driver of transportation emissions is vehicle miles traveled (VMT), the total number of miles traveled vehicles within a specific timeframe. To reduce GHG emissions, the region will need to expand mobility choices, reduce reliance on driving alone in personal vehicles, and transition all vehicle types to cleaner fuel choices. These efforts will both reduce tailpipe emissions and improve local air quality.

The region's transportation system is complex with various agencies responsible for different aspects of transportation planning, operations, and infrastructure. Given this complexity, regional coordination is critical. For instance, SANDAG serves as the federally identified MPO and state Regional Transportation Planning Agency (RTPA), responsible for developing plans for how people and goods will move around the region, and designing and building mobility projects. MTS and NCTD operate and maintain transit services in their respective service areas. Local jurisdictions manage local streets and rights-of-way, issue permits for projects on their streets, and coordinate with transit operators in their communities. The California Department of Transportation (Caltrans) is responsible for state highways and freeways, including their design, operations, and permits for projects that affect these facilities.

The Transportation measures included in the Roadmap encompass priorities identified in local CAPs and SANDAG's Regional Transportation Plan, and reflect significant input from stakeholders through workshops, technical meetings, and the public survey. Stakeholders voiced the importance of safety, sustained program funding, and public outreach to ensure that transportation projects and programs in the Roadmap are responsive to the needs of each community.

The Transportation measures also align with state laws like California Senate Bill 375 (Steinberg, 2008) (SB 375). Through SB 375, CARB establishes per capita GHG reduction targets for MPOs across California. For the San Diego region, the current target set by CARB is to reduce per capita GHGs from passenger vehicles by 19% below 2005 levels by 2035. CARB will establish new regional targets for MPO in 2026. SANDAG develops an SCS as part of its RTP to meet this target through various VMT reduction programs, policies and projects. The Transportation measures also align with state zero-emission transportation regulations, like the Innovative Clean Transit, Advanced Clean Trucks, and Advanced Clean Car rules.

While the Roadmap provides a comprehensive set of strategies to reduce transportation emissions, not every measure, objective, or action will be suitable for all communities. It will be important for implementing agencies to engage local communities to understand their unique priorities and concerns. For instance, while roundabouts may be effective tools for traffic management in some neighborhoods, other communities may prefer alternative solutions. This tailored approach will help ensure that Roadmap measures effectively address local needs.

Measure T-1
Reduce VMT through Increased Public Transit Use

Description: Measure T-1 focuses on increasing the use of public transit through transit incentive programs, improvements to existing service, and the addition of new services. Public transit includes buses, light rail, commuter rail, and the associated infrastructure (e.g. transit stops and stations). Increasing transit availability is essential to reduce VMT impacts on human health and the environment. The table below identifies objectives and actions that would expand the bus and light rail systems, advance alternatives to driving alone, and promote the benefits of using public transit; while addressing safety, accessibility, and affordability.

Objectives:

- T-1.1 Increase transit ridership
- T-1.2 Add Bus Rapid Transit (BRT) services
- T-1.3 Increase the frequency and span of service of existing routes
- T-1.4 Expand Trolley/light rail service

Supporting Actions:

a) Continue and expand programs such as **Youth Opportunity Pass** and **Try Transit** to increase transit ridership

b) Explore additional incentives for low-income residents to increase transit accessibility

c) Identify opportunities to improve transit stop amenities, such as installation of shade (including trees and green infrastructure), seating, lighting, bike parking, Wi-Fi, and restrooms, focusing on safety, accessibility, and thermal comfort

d) Identify parking constraints at transit stations and Park & Rides and explore solutions to improve access to high-use transit stations

e) Expand bus priority features where appropriate, such as queue jumps, level boarding, dedicated bus lanes, and transit signal priority

f) Plan and implement BRT routes to expand transit services

g) Increase frequency of transit services and opportunities for 24-hour service, especially for transit-dependent communities

h) Plan improvements to regional commuter rail service such as increased frequency, enhanced rail car features, etc.

i) Continue planning for a **Purple Line project** to create a fast and frequent transit route connecting people to destinations from San Ysidro to Sorrento Mesa through Chula Vista, National City, City Heights, and Kearny Mesa

j) Continue planning for regional rail and light rail network enhancements

k) Identify and plan rail infrastructure upgrades, such as double tracking of rail corridors and grade separations to reduce delays and improve reliability

l) Plan and implement a regional airport transit connection for San Diego International Airport and explore transit connections to Tijuana Cross Border Xpress

m) Explore feasibility and opportunities for expanding transit-oriented development (TOD)

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as SANDAG, MTS, NCTD, Caltrans, and local jurisdictions	By 2035: 193,400 By 2045: 153,600	• Transit ridership • Number of participants in transit incentive programs • Number of new or expanded routes

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Identify sustainable funding and partnership opportunities for transit incentive programs, including identifying funding to continue the Youth Opportunity Pass transit subsidy program for riders aged 18 years and younger
- Plan, design, and implement new BRT routes
- Explore and coordinate opportunities for TOD
- Improve airport transit services, such as bus connections

Long Term (2036-2045)

- Complete double tracking and grade separations for regional rail system
- Implement a fixed regional airport transit connection
- Continually assess transit needs, particularly in low-income communities and areas with limited transit access

Measure T-2
Reduce VMT through Active Transportation

Description: Measure T-2 focuses on enhancing active transportation options by expanding and improving bikeways and sidewalks across the region. These actions support healthier lifestyles, reduce travel costs, and provide safe alternatives to driving, thereby reducing VMT. The objectives and actions below build on many existing efforts and include key priorities for investments, such as the Vision Zero Action Plan. The region has made significant progress in developing a regional bikeway network, with more than 1,800 miles of bikeways. Continued coordination and investment in planning and funding improvements are essential to ensure that biking and walking are safe and comfortable for everyone.

Objectives:

- T-2.1 Build and/or improve bikeways to expand safe and accessible routes
- T-2.2 Build and/or improve sidewalks to expand safe and accessible routes

Supporting Actions:

a) Advance SANDAG's remaining Bikeways Early Action Program (EAP) and support other projects in the **Regional Active Transportation Plan**

b) Continue SANDAG's **Active Transportation Grant Program** to fund implementation of bikeways by member agencies

c) Seek additional funding for the **Bike, Pedestrian, and Neighborhood Safety** portion of TransNet to build more EAP and grantee projects, sooner

d) Coordinate and implement Safe Routes to Schools and Transit projects regionwide that create safe access for students to walk, bike, and roll to school and transit

e) Implement Complete Streets elements in all roadway projects, from repaving to full reconstruction, that allow pedestrians, bicyclists, motorists, and transit users of all ages and abilities to travel safely within the public right of way

f) Implement **Vision Zero Action Plan** safety countermeasures to improve visibility and safety of people walking and riding bikes

g) Develop and/or expand incentive and education programs for bikes and e-bikes including regionwide bike share and loan-to-own programs

h) Increase secure public bicycle parking, such as SANDAG **Bike Parking** facilities

i) Expand signal prioritization and optimization for people walking and riding bikes

j) Conduct outreach and education on benefits, opportunities, regulations, and safety tips related to active transportation, such as through SANDAG **Bike Education Services**

k) Expand bikeways and walking paths to connect to natural areas

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SANDAG and local jurisdictions	By 2035: 124,300 By 2045: 64,600	• Number of miles of new and upgraded bikeways • Number of users post-construction compared to pre-construction • Rate of crashes resulting in fatalities and/or serious injuries • Number of participants in outreach and education events • Number of participants in bike parking programs

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Continue to advance EAP projects
- Plan, fund, and implement Vision Zero Action Plan safety countermeasures
- Conduct outreach and education on active transportation

Long Term (2036-2045)

- Expand traffic signal prioritization for people walking and riding bikes
- Update relevant plans, such as the Regional Active Transportation Plan and Vision Zero Action Plan

Measure T-3
Reduce VMT through Expansion of Flexible Fleets

Description: Measure T-3 focuses on reducing VMT from single occupancy vehicles by expanding the use of Flexible Fleets throughout the region. Flexible Fleets can provide first- and last-mile connections to transit and major destinations (e.g., work, healthcare, school, etc.), improve mobility in areas that are difficult to serve with other transportation options, and reduce private vehicle dependence for short trips. These on-demand services provide people with convenient and affordable alternatives to driving alone. While several flexible fleet pilot projects have been launched in the region, ensuring these services are consistently available, affordable, and well-integrated with the broader transportation network is critical. Sustainable funding, regional coordination, and strategic deployment are essential to maintain these services and expand them to more communities.

Objectives:

- T-3.1 Increase micromobility options such as electric scooters, bikeshare, and e-bikes
- T-3.2 Increase microtransit, including neighborhood electric vehicles (NEVs)
- T-3.3 Increase carshare and vanpool opportunities

Supporting Actions:

a) Explore opportunities for bikeshare programs and sustainable funding options

b) Expand and implement Flexible Fleets (such as microtransit) to improve mobility and access

c) Expand first/last mile connections to transit, particularly in areas with high transit dependency and communities with limited walking and biking infrastructure

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SANDAG, MTS, NCTD, local jurisdictions, tribal governments, and mobility service providers	By 2035: 136,400 By 2045: 53,300	• Number of new Flexible Fleets deployed • Ridership and number of trips • Trip replacement data, where available

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Implement SANDAG Flexible Fleet Grant Program and identify additional funding to continue and expand Flexible Fleet projects
- Identify transit routes/stops that could benefit from Flexible Fleets to enable first/last mile connections

Long Term (2036-2045)

- Implement long-term funding model(s) for Flexible Fleets
- Integrate payment systems for Flexible Fleets with other transit and other mobility services to support development of a regional “mobility wallet”

Measure T-4
Reduce VMT through TDM

Description: Measure T-4 focuses on reducing VMT in the region by promoting a range of Transportation Demand Management (TDM) strategies that offer alternatives to driving alone in a personal vehicle. These include teleworking, vanpooling, biking, walking, transit, shared rides, and other commuter services to provide more sustainable transportation choices for commuters. SANDAG has a long history of working with employers in the region to deliver TDM programs that benefit both businesses and employees. These partnerships have expanded commuting options and access to sustainable transportation choices. The continued implementation of TDM strategies is essential for meeting regional GHG reduction goals.

Objectives:

- T-4.1 Reduce single-occupancy vehicle trips through TDM strategies

Supporting Actions:

a) Expand SANDAG's **Sustainable Transportation Services** programs that encourage bike, walk, transit, shared rides, and telework

b) Leverage the **2023 Remote Work Policies & Practices Report** to increase telework in the region as feasible

c) Expand outreach and education with organizations (for example, through SANDAG's **Employer Commuter Program**) and residents to increase participation in regional rideshare (e.g., vanpool) and commuter services

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SANDAG, local jurisdictions, and employers/businesses	By 2035: 59,200 By 2045: 47,500	• Number of commutes by biking, walking, transit, and/or shared rides • Number of employers participating in the Sustainable Transportation Services programs or offering telework options • Number of participants at outreach and education events

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Conduct outreach with organizations and residents to increase participation in TDM programs
- Expand vanpool program to include options for hybrid workers and explore opportunities to expand other SANDAG Sustainable Transportation Services program offerings

- Continue SANDAG School Commuter Program

Long Term (2036-2045)

- Conduct additional research, studies, and outreach to understand evolving commuting preferences and needs

Measure T-5
Increase Adoption of ZEVs

Description: Measure T-5 focuses on accelerating the transition to ZEVs for cars, trucks, buses, and rail. It includes regional incentive programs to make ZEVs more affordable and increase access to charging and refueling infrastructure. While San Diego county has the fourth largest ZEV population in California (CEC 2024), zero-emission cars and trucks remain unaffordable for many low-income households. Also, air pollution from gas-powered trucks is highest in communities near ports and the U.S.–Mexico international border. The objectives and actions below will help ensure that all communities can access and benefit from cleaner transportation options.

Objectives:

- T-5.1 Increase the light-duty ZEV population
- T-5.2 Increase the medium- and heavy-duty ZEV population
- T-5.3 Install charging and refueling infrastructure for light-duty ZEVs
- T-5.4 Install charging and refueling infrastructure for medium- and heavy-duty ZEVs
- T-5.5 Convert passenger rail cars to zero-emission

Supporting Actions:

a) Implement and/or expand incentive program(s) for new and used light-duty ZEVs

b) Conduct outreach and education on ZEV benefits and incentives

c) Encourage fleet electrification for local jurisdictions, tribal governments, and public agencies by providing technical assistance and facilitating regional coordination

d) Implement and/or expand incentive program(s) for medium- and heavy-duty ZEVs, such as trucks, transit buses, school buses, and rail

e) Develop and implement regional programs to install ZEV charging and refueling infrastructure for light-duty vehicles, with attention to rural communities, low-income communities, multifamily properties, and Park & Rides

f) Support permit streamlining across the region to expedite ZEV infrastructure deployment

g) Develop and implement regional programs to install charging and refueling infrastructure for medium- and heavy-duty vehicles

h) Support electrification of passenger rail, such as NCTD's COASTER and SPRINTER

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as	By 2035: 142,600	• Number of light-, medium-, and heavy-duty ZEVs

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
SANDAG, local jurisdictions, MTS, NCTD, San Diego County Air Pollution Control District (SDAPCD), San Diego Community Power, Clean Energy Alliance, and SDG&E	By 2045: 177,300	• Number of ZEV charging or refueling stations • Number of incentives provided • Number of local jurisdictions that are permit streamlined for ZEV infrastructure • Number of participants in outreach and education events

Implementation Schedule and Milestones:

Near Term (2026-2035)

- APCD to continue to administer the Clean Cars 4 All program to scrap older, high-polluting vehicles with cleaner light-duty ZEVs and plug-in hybrids and pursue additional funding to continue the program
- SDG&E to continue to administer its Power Your Drive programs, which help provide EV charging infrastructure for various sites such as apartments and condos, workplaces, and for medium- and heavy-duty fleets
- SDG&E, in partnership with other investor-owned utilities, to launch the Affordable Public Charging Program to offer public charging credits for income qualified customers
- SDG&E as an administrator of California's Electric Program Investment Charge, launch the Community Resource Center Resilience project to pilot new vehicle-to-everything charging stations that can provide backup power at a community center in wildfire-prone and high-use areas
- Expand incentive programs for light-, medium-, and heavy-duty ZEVs and related infrastructure

Long Term (2036-2045)

- Expand the regional ZEV infrastructure network and identify remaining gaps
- Continue to encourage and support public and private fleet electrification
- Procure and operate zero-emission passenger rail cars

Measure T-6
Reduce Fuel Use from Idling

Description: Measure T-6 focuses on reducing fuel use from idling through infrastructure improvements and roadway management strategies including traffic calming measures, traffic signal optimization, and curb management . Idling in a gas- or diesel-powered vehicle consumes fuel without moving the vehicle, emits unnecessary tailpipe emissions, and is economically inefficient because drivers are paying for what is essentially wasted fuel.

Objectives:

- T-6.1 Install traffic calming measures, like roundabouts and/or traffic circles where appropriate and consistent with local conditions
- T-6.2 Optimize traffic signals to facilitate traffic flow and improve safety
- T-6.3 Implement curb management strategies that reduce idling and enable efficient and safe traffic flow

Supporting Actions:

a) Identify appropriate traffic calming measures to improve traffic flow and enhance public safety

b) Conduct outreach and education about proper roundabout navigation

c) Expand the use of smart intersection signals

d) Explore and implement curb management strategies including passenger loading and drop-off zones, delivery zones, and time of use policies, particularly in commercial areas and at transit stations

e) Implement actions outlined in the Sustainable Freight Strategy to reduce idling from medium- and heavy-duty vehicles

f) Advance the Otay Mesa East Port of Entry project to reduce fuel use from idling in the California-Baja California border region

g) Support traffic flow planning and project prioritization that addresses safety for all travel modes

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as SANDAG, Caltrans, Port of San Diego, and local jurisdictions	By 2035: 5,700 By 2045: 3,700	• Number of traffic calming measures installed and curb management strategies deployed • Intersection and traffic efficiency data • Number of participants in outreach and education events

Implementation Schedule and Milestones:

Near Term (2026-2035)

- SANDAG and regional partners continue to plan and seek funding for the Habor Drive 2.0/Vesta Street Bridge project
- Collaborate with local jurisdictions to identify and plan locally appropriate traffic calming
- Identify optimal location types for curb management strategies

Long Term (2036-2045)

- Implement priority actions in the Sustainable Freight Implementation Strategy to reduce truck idling
- Continue to support local and regional traffic flow planning assessments

Intersection with Other Funding Availability for the Transportation Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the transportation measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Energy	**Vehicle Technology Office Funding Opportunities**
U.S. Department of Homeland Security	**Transit Security Grant Program** (Federal Emergency Management Agency)
U.S. Department of Transportation	**Better Utilizing Investments to Leverage Development Program** (Federal Transit Administration)
	Capital Investment Grants Program (Federal Transit Administration)
	Grants for Buses and Bus Facilities Program (Federal Transit Administration)
	Infrastructure for Rebuilding America Program
	Innovative Coordinated Access and Mobility Grants (Federal Transit Administration)
	Low or No Emission Grant Program (Federal Transit Administration)
	Nationally Significant Federal Lands and Tribal Projects Program (Federal Highway Administration)
	Port Infrastructure Development Program (Maritime Administration)
State Programs	
California Energy Commission	**California Electric Vehicle Infrastructure Project**
	Clean Mobility Options
	Communities in Charge
	Depot Charging and Hydrogen Refueling Infrastructure for Zero-Emission Medium- and Heavy-Duty On-Road, Off-Road, and Specialty Vehicles
	Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles
	Reliable, Equitable, and Accessible Charging for Multi-family Housing
	Rural EV Charging 2.0

Agency/Organization Name	Program Name
	Zero-Emission School Bus Charging and Fueling Infrastructure
California Environmental Protection Agency (CalEPA)	Advanced Technology Demonstration and Pilot Projects (CARB)
	Clean Cars 4 All (CARB)
	Clean Off-Road Equipment Voucher Incentive Project (CARB)
	Clean Vehicle Rebate Project (CARB)
	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (CARB)
California State Transportation Agency	Active Transportation Program (Caltrans)
	Low Carbon Transit Operations Program (Caltrans)
	Port and Freight Infrastructure Program
	Sustainable Transportation Planning Grants (Caltrans)
	Transit and Intercity Rail Capital Program
	Zero-Emission Transit Capital Program
California Transportation Commission	Local Partnership Program
	Solutions for Congested Corridors Program
	State Transportation Improvement Program
	Trade Corridor Enhancement Program
Governor's Office of Land Use and Climate Innovation	Affordable Housing and Sustainable Communities Program (California Strategic Growth Council)
	Transformative Climate Communities (California Strategic Growth Council)
Regional/Local Programs	
SANDAG	Access for All Grant Program
	Specialized Transportation Grant Program
	California Active Transportation Program
	Flexible Fleet Pilot Grant Program
	TransNet Active Transportation Grant Program
	TransNet Smart Growth Incentive Program
SDAPCD	Clean Air For All Grant Campaign (Carl Moyer Memorial Air Quality Standards Attainment Program and Community Air Protection Program)
	Proposition 1B Goods Movement Emission Reduction Program
	Zero-Emission Truck Pilot Project
SDG&E	Pre-owned Electric Vehicle Rebate Program

Agency/Organization Name	Program Name
	Power Your Drive for Apartments and Condos
	Power Your Drive for Fleets
	Power Your Drive for Workplaces
	Transportation Electrification Advisory Services

Electricity Sector

The Electricity sector includes the generation, transmission, and distribution of electricity. It is the second largest source of emissions in the San Diego region, accounting for 18.0% of GHG emissions. To reduce emissions, the region will need to continue to transition away from fossil-fuel generated electricity to clean energy sources such as solar and wind power. The Roadmap measure for this sector focuses on decarbonizing the regional electric grid by expanding distributed renewable energy generation and increasing regional participation in fully renewable electricity options ahead of state mandates.

The Electricity sector is impacted by environmental and climate stressors like more frequent and intense wildfires. As such, SDG&E implements Public Safety Power Shutoffs (PSPS) during high wind and wildfire conditions to reduce potential fire risk. Integrating local distributed energy resources (DER) (like solar, battery storage, and microgrids) can enhance energy resilience across the region by reducing demand on the grid and offering redundant power during grid disruptions.

The Electricity measure is intended to help accelerate progress in the region toward the state's goal of 100% renewable and zero-carbon electricity by 2045, as established by California Senate Bill 100 (De León, 2018) (SB 100). The region has already made significant progress through the formation of two Community Choice Aggregators (CCAs): San Diego Community Power (Community Power) and Clean Energy Alliance (CEA). The CCAs have accelerated goals of providing 100% renewable and zero-carbon energy as their default energy product by 2035. The CCAs allow customers to opt into a 100% renewable energy rate today.

Meeting these goals will require coordination among multiple entities with distinct responsibilities. For instance, local jurisdictions make land use and zoning decisions, issue permits for DER projects, and may participate in CCA programs that supply renewable energy to residents and businesses. State agencies establish clean energy targets, regulate utilities, and issue permits for energy projects that require state-level approval. SDG&E operates and maintains the regional electric grid, delivers electricity to customers, and manages interconnections for DER.

The Electricity measure reflects regional priorities for reducing electricity emissions identified in local CAPs, as well as input from stakeholders gathered through the public survey, workshops, and technical meetings. Stakeholders voiced the desire for more local clean energy sources, more opportunities to install solar for residential and commercial spaces, and concern for energy affordability. The Electricity measure also works together with measures in other sectors of the Roadmap to maximize benefits to the region. As the region shifts to cleaner sources of energy (E-1), there will be even greater GHG reduction benefits from electrifying buildings (B-2) and transportation (T-5).

The region faces some of the highest electricity rates in the country, making regional coordination critical to ensure that the clean energy transition improves affordability for all. Effective coordination among local governments, SDG&E, CCAs, other energy providers, and regulators will be essential to advancing these shared goals.

Measure E-1
Decarbonize the Regional Electric Grid

Description: Measure E-1 is focused on accelerating the transition to clean, renewable energy sources through incentive programs, support for advanced technologies and grid modernization, and improved coordination among agencies. This includes efforts such as incentive programs for rooftop solar, battery storage, and microgrids as well as exploring opportunities to streamline siting and permitting processes. By increasing cleaner and more distributed sources of energy, this measure helps lower energy costs, enhance energy reliability, support long-term affordability, and better equip the region to face environmental stressors. Education and outreach to help communities understand the benefits of clean energy, available incentives, and how to access programs will be important. Workforce training and apprenticeship programs are also needed to build the skilled labor force required to install and maintain solar, battery storage, and other clean energy systems.

Objectives:

- E-1.1 Increase distributed renewable energy generation
- E-1.2 Increase regional participation in fully renewable electricity options ahead of state mandates

Supporting Actions:

a) Expand residential programs to incentivize rooftop solar and battery storage (single- and multifamily), with a focus on low-income communities

b) Develop or expand a regional program to incentivize rooftop solar and battery storage for commercial buildings, with a focus on low-income communities

c) Develop or expand a municipal program to support local jurisdiction, tribal government, and public agency solar and battery storage projects

d) Develop or expand regional programs to incentivize community solar and microgrids with a focus on renters, low-income communities, and rural communities

e) Identify opportunities to streamline the siting and permitting of DER projects

f) Identify opportunities to expand utility-scale renewable energy options including solar and wind installations

g) Identify opportunities to modernize the distribution grid, address capacity constraints, and enable greater renewable energy integration

h) Explore opportunities to improve efficiency and increase electricity affordability

i) Expand outreach and education on DER programs and accessing incentives

j) Expand community education and engagement on battery storage systems, uses, and safety features to address public support

k) Expand local workforce training and apprenticeship programs to increase access to careers in the installation and maintenance of solar, battery storage, and other distributed energy systems

l) Support local jurisdiction and public agency participation in community choice aggregation programs

m) Explore opportunities for pilot projects and programs that leverage emerging technologies, such as virtual power plants

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations including San Diego Regional Energy Network (SDREN), Community Power, CEA, and SDG&E, along with local jurisdictions	By 2035: 47,700 By 2045: 0	• Number of participants in incentive programs • Number of solar and battery storage projects completed • Participation rate in CCAs • Enrollment in workforce training programs • Number of participants in outreach and education events

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Community Power to launch Residential Solar Battery Savings Program to provide incentives to single-family homeowners
- Community Power to implement Flex Load Strategy to shift electricity demand away from peak periods, increase use of renewable energy when it is most available, and improve grid reliability
- SDREN to implement Market Access Program to provide incentives to reduce peak electricity demand
- Clean Energy Alliance to implement Solar Plus and Solar Plus Connect Programs to provide solar and battery storage to residential and commercial customers
- Clean Energy Alliance to implement Battery Bonus and Battery Bonus Connect Program to provide customers with existing solar systems with a battery storage systems
- Clean Energy Alliance to implement PeakSmart Savers Program to incentivize reduced energy use during high-demand periods
- Implement and expand incentive programs for DER projects
- Develop resources for local jurisdictions to streamline the planning, permitting, and installation processes for DER projects

Long Term (2036-2045)

- Integrate advanced technologies in the transmission and distribution networks to expand overall infrastructure capacity
- Achieve net zero energy in 2045, in alignment with state goals

Intersection with Other Funding Availability for the Electricity Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the electricity measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Energy	**Solar Research and Development Funding Programs**
	Grid Resilience and Innovation Partnerships Program
	Wind Energy Funding Programs
	Distributed Energy Resources Interconnection Solutions Collaborative
State Programs	
California Energy Commission	**Electric Program Investment Charge Program**
	Solar for All Program – Partnership with California Public Utilities Commission (CPUC)
	Gas Research and Development Program
	Community Energy Reliability and Resilience Investment Program
	Long Duration Energy Storage Program
Governor's Office of Land Use and Climate Innovation	**Transformative Climate Communities** (California Strategic Growth Council)
	Community Resilience Centers (California Strategic Growth Council)
Regional/Local Programs	
SDG&E	**Emergency Load Reduction Program**
Community Power	**Solar Battery Savings Program**
	Solar for Our Communities

Buildings Sector

The Buildings sector encompasses residential, commercial, and municipal buildings. GHG emissions from buildings come from the use of natural gas and electricity for heating and cooling, cooking, lighting, and appliances. The use of natural gas in buildings accounts for 13.5% of regional GHG emissions. Electricity used in buildings is accounted for under the electricity category of the regional GHG inventory (see Chapter 3). The GHG reduction measures for the Buildings sector of the Roadmap address ways to reduce both the use of natural gas and electricity in buildings.

To reduce emissions and energy costs, the region will need to continue to prioritize weatherization and energy efficiency improvements such as better insulation, updating windows, and switching to high-efficiency lighting, appliances, and equipment. Electrifying existing buildings that use natural gas will reduce GHG emissions as well as improve indoor air quality, benefiting human health. As the percentage of renewable content on the electric grid continues to grow to 100% by 2045 (pursuant to SB 100), the benefits of building electrification will continue to increase.

Achieving these goals will depend on coordination among several entities with different areas of authority. For example, local jurisdictions adopt and enforce building codes, issue permits for building projects and may adopt reach codes or ordinances that exceed state standards. State agencies set building energy codes, establish appliance standards, and regulate building-related emissions. SDG&E delivers electricity and natural gas to buildings and manages interconnections for new or upgraded building systems. SDG&E and the CCAs offer their customers various energy- and cost-saving programs.

The Building measures are grounded in regional and state policy, local CAPs, building codes, and existing building stock analyses. Measures are consistent with California's **Building Decarbonization Assessment**, which provides a roadmap for reducing emissions from buildings to meet California Assembly Bill 3232's (Friedman, 2018) (AB 3232) goal of achieving a 40% reduction in emissions from buildings by 2030. Similarly, the **Statewide Reach Codes Program** provides support to local jurisdictions to exceed state energy codes.

The measures also reflect input from local stakeholders received through workshops, technical meetings, and the public survey. Key themes shared by stakeholders include the desire for regional programs that provide technical assistance and incentives, expanding education to renters on available programs, and supporting local workforce development.

The region is well-positioned to accelerate progress on reducing building emissions through the formation of SDREN in 2024. SDREN, which is a partnership between the County of San Diego and Community Power, can provide a platform for implementing energy efficiency and electrification programs that offer incentives, technical assistance, workforce development, and targeted support for renters, building owners, and local governments.

Measure B-1
Increase Energy Efficiency of Buildings

Description: Measure B-1 focuses on improving the energy efficiency of new and existing residential, commercial, and municipal buildings. This is achieved through a range of strategies like improving insulation, upgrading windows, installing high-efficiency heating, cooling, and lighting systems, and upgrades to energy-efficient appliances. This measure includes regional energy efficiency programs that provide incentives and technical assistance to property owners and occupants. These programs will also provide workforce training opportunities, ensuring that local contractors have the skills needed to implement energy-saving technologies. By making energy efficiency improvements accessible and scalable, this measure can help reduce energy consumption and lower energy bills.

Objectives:

- B-1.1 Increase energy efficiency of municipal buildings
- B-1.2 Increase energy efficiency of residential buildings
- B-1.3 Increase energy efficiency of commercial buildings

Supporting Actions:

a) Develop and expand regional municipal energy efficiency programs for local jurisdictions, tribal governments, and public agencies

b) Maintain and expand regional residential energy efficiency programs that provide incentives and technical assistance for residences in low-income communities, rural communities, and for multifamily properties

c) Maintain and expand regional non-residential energy efficiency programs that provide incentives and technical assistance to owners, operators, and renters of commercial properties

d) Conduct cost effectiveness studies to support development of building performance standards, building benchmarking ordinances or other ordinances that support energy efficiency retrofits in existing buildings

e) Develop model building performance standards, building benchmarking ordinances, or other ordinances that support energy efficiency retrofits in existing buildings

f) Support municipal adoption of procurement policies that prioritize energy-efficient equipment, appliances, and infrastructure upgrades for public buildings

g) Expand local workforce training and apprenticeship programs to increase access to careers in energy-efficient building upgrades

h) Conduct outreach to help residents, building managers, and businesses access energy efficiency incentives, financing, and rebate programs

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and utilities such as SDREN, Community Power, CEA, and SDG&E, along with local jurisdictions, nonprofits, colleges, and trade programs	By 2035: 1,548,800* By 2045: 2,180,400* *This GHG reduction estimate also includes measures B-1 and B-2.	• Enrollment in technical assistance and incentive programs • Number of building standards adopted or updated • Enrollment in workforce development programs

Implementation Schedule and Milestones:

Near Term (2026-2035)

- SDREN to launch programs to expand energy efficiency and building electrification in single-family and multifamily housing, with a focus on hard-to-reach households
- SDREN to implement Small & Medium Business Energy Coach program
- SDREN to offer technical assistance and direct install programs for public agencies and tribes
- SDREN to implement its Workforce Training & Capacity Building program benefitting both new entrants and incumbent workers
- SDREN to implement its Energy Pathways workforce program that will introduce high school students to energy careers, offering no-cost career technical education, mentorship and direct ties to local employers

Long Term (2036-2045)

- Secure sustainable funding to scale technical assistance and incentive programs
- Continue outreach and education on energy efficiency programs and upgrades

Measure B-2
Increase Electrification of Buildings

Description: Measure B-2 focuses on advancing the electrification of buildings to reduce energy consumption, reduce emissions, and improve air quality. This transition involves replacing natural-gas powered systems with high-efficiency electric alternatives, such as heat pumps for space and water heating and electric appliances instead of gas-powered ones. This measure includes the expansion and development of incentive programs and technical assistance, providing building owners and renters with the resources and financial support needed to make electrification upgrades. Supporting actions such as model reach code and ordinance language, building stock assessments, and building energy benchmarking will help guide implementation across jurisdictions. Workforce training and outreach can help ensure that local contractors are prepared to install and maintain electric systems.

Objectives:

- B-2.1 Electrify municipal buildings
- B-2.2 Electrify residential buildings
- B-2.3 Electrify commercial buildings

Supporting Actions:

a) Develop and implement a municipal electrification program to provide technical assistance and incentives to local jurisdictions, tribal governments, and public agencies to replace gas water heaters, boilers, and traditional heating, ventilation, and air conditioning (HVAC) systems with high-efficiency heat pumps and electrification technologies

b) Expand regional programs that provide technical assistance and incentives to help residents replace gas water heaters, stoves, and traditional HVAC systems with high-efficiency heat pumps and electric appliances, with a focus on support for multifamily properties and low-income communities

c) Develop and implement a regional program to provide technical assistance and incentives to replace gas water heaters, boilers, and traditional HVAC systems in commercial buildings with high-efficiency heat pump technologies, with a focus on support for properties in low-income communities

d) Increase awareness of potential health effects from indoor gas appliances and electric options through expanded outreach to residents, building managers, and businesses

e) Expand technical assistance and support to local jurisdictions to implement regional and local electrification efforts

f) Expand local workforce training and apprenticeship programs to increase access to careers in building electrification system installation and maintenance

g) Develop a model reach code or ordinance that supports the transition to all-electric systems in the construction of new residential and commercial buildings and major retrofits of existing buildings

h) Develop and implement a regional energy benchmarking program with clear performance standards and reporting mechanisms to drive electrification in existing buildings

i) Conduct a regional building stock assessment to help target the deployment of building electrification programs, based on Community Power's existing analysis

j) Research and identify pathways to establish indoor nitrogen oxides (NO_x) limits for appliances and promote electric alternatives

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SDG&E, SDREN, Community Power, CEA, SDAPCD, CARB, CEC, and local jurisdictions	By 2035: Included in B-1 By 2045: Included in B-1	• Enrollment in incentive programs and number of projects completed • Dollar amount of incentives provided • Participation in workforce training programs

Implementation Schedule and Milestones:

Near Term (2026-2035)

- SDREN to launch programs to expand energy efficiency and building electrification in single-family and multifamily housing, with a focus on hard-to-reach households
- SDREN to implement its Workforce Training & Capacity Building program and Energy Pathways program
- Establish or expand incentive programs for electrification upgrades
- Implement education and outreach on electrification and programs/resources
- Achieve 40% reduction in emissions from buildings by 2030

Long Term (2036-2045)

- Review and update regional data, tools & standards
- Continue upgrades, maintenance, and operation of building electrification projects

Intersection with Other Funding Availability for the Buildings Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the buildings measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Energy	**Building Envelope Innovation Prize – Secondary Glazing Systems**
	Weatherization Assistance Program
	Energy Efficiency and Conservation Block Grant Program
State Programs	
California Energy Commission	**Electric Program Investment Charge Program**
	Building Initiative for Low-Emissions Development Program
	Distributed Electricity Backup Assets Program
	Equitable Building Decarbonization Program
Governor's Office of Land Use and Climate Innovation	**Transformative Climate Communities** (California Strategic Growth Council)
Regional/Local Programs	
SDREN	**SDREN Programs**
Community Power	**Community Clean Energy Grant Program**
	Solar Battery Savings Program
CEA	**Clean Energy Alliance Programs** (multiple)
SDG&E	**SDG&E Energy Efficiency Programs** (multiple)
	SDG&E Demand Response Programs (multiple)
Center for Sustainable Energy (on behalf of CPUC for our region)	**Self-Generation Incentive Program**

Industry Sector

The Industrial sector of the San Diego region encompasses a diverse range of manufacturing and processing activities, including aerospace, semiconductors, cleantech, biotechnology, pharmaceuticals, medical devices, and consumer goods. Industry accounts for 10.7% of the GHG emissions in the San Diego region. These emissions come from industrial processes (not including fuel combustion) that directly release carbon dioxide (CO_2) and other potent GHGs into the air. Refrigerants used in commercial and residential applications also contribute to short-lived climate pollutant (SLCP) emissions, which are accounted for in the Industrial sector.

The San Diego region is a recognized leader in clean technology and innovation driven by collaboration among local universities, research institutions, companies, and government agencies. The region's cleantech sector includes startups and companies working on smart grid technologies, renewable technologies, energy efficiency, energy storage, microgrids, electric vehicles, and other pollution-reducing technologies. The Industrial sector plays a critical role in the region's economy, supporting more than 120,000 jobs across more than 4,400 establishments. Given the diversity of industrial operations in the region, which are owned and operated by a mix of public and private entities, collaboration among businesses, public agencies, and industry organizations will be critical.

To reduce emissions from this sector, Roadmap measures focus on reducing the use of SLCPs such as hydrofluorocarbons (HFCs) (commonly used as refrigerants), increasing industrial energy efficiency, and expanding the use of renewable energy in industrial operations. The SLCP measure will help accelerate progress in the region toward California Senate Bill 1383's (Lara, 2016) (SB 1383) target to reduce HFC emissions by 40% below 2013 levels by 2030.

The Industrial measures address priorities identified in regional and state sustainability plans including CARB's 2022 Scoping Plan and the County of San Diego's Regional Decarbonization Framework. They also reflect input from stakeholders received through workshops, technical meetings, and the public survey. Key themes shared by stakeholders include the importance of addressing safety and public health concerns and prioritizing emission reductions at industrial sites located in low-income communities.

Measure IND-1
Reduce Short-Lived Climate Pollutant Emissions

Description: Measure IND-1 focuses on reducing SLCP emissions such as HFCs, which are potent GHGs with short atmospheric lifetimes. In the Industrial sector, HFCs are commonly used as refrigerants in residential, commercial, and industrial cooling systems. This measure promotes upgrades to systems that use lower-emission refrigerant alternatives through education, outreach, and incentive programs that prioritize safety, affordability, and energy efficiency.

Objectives:

- IND-1.1 Reduce high global warming potential (GWP) refrigerant use

Supporting Actions:

a) Develop and expand incentive programs to accelerate the transition to low-GWP refrigeration systems in commercial, industrial, and transportation cooling systems, ensuring safety, affordability, and efficiency

b) Develop and expand regional outreach and education to encourage the transition to appliances that use low-GWP refrigerants

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
State agencies such as CARB, local jurisdictions, and regional agencies	By 2035: 284,700 By 2045: 940,200	• Number of facilities participating in incentive programs • Number of participants in outreach and education events

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Identify funding and conduct an assessment of current commercial and industrial refrigerant use and leakage rates
- SDREN implements the Efficiency Refrigeration program that helps small grocery stores, corner stores, and small businesses transition to low-GWP refrigeration
- Develop and implement regional incentive program(s) to accelerate the transition to low-GWP refrigeration in commercial and industrial sites
- Achieve 40% reduction in HFC emissions by 2030

Long Term (2036-2045)

- Ensure regular maintenance and leak detection practices are standard at sites that use low- and high-GWP refrigerants
- Transition any remaining high-GWP refrigerants to low-GWP refrigerant alternatives

Measure IND-2
Reduce Energy Intensity of Industrial Facilities

Description: Measure IND-2 focuses on reducing industrial emissions through energy efficiency improvements and increased DER use. It includes support for incentive programs, rate reform, pilot projects, and workforce training to enable a skilled labor force. By enhancing energy efficiency and expanding the use of DERs, the Industrial sector can reduce GHG emissions, improve operational resiliency, and lower energy costs.

Objectives:

- IND-2.1 Increase industrial energy efficiency
- IND-2.2 Increase the use of DER (renewable or alternative fuel use) in industrial facilities

Supporting Actions:

a) Develop a regional program to help industrial facilities utilize high efficiency and electrification technologies, prioritizing facilities in low-income communities

b) Explore opportunities to incentivize the electrification of industrial sites through rate changes

c) Expand and develop incentives to promote the use of electric-powered or alternatively fueled equipment for industrial activities

d) Launch pilot programs that incentivize the adoption of DER projects at industrial sites

e) Expand local workforce training and apprenticeship programs to support careers in industrial energy efficiency and electrification systems

Geographic Scope: Regional

Cost Information: High

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
State and regional agencies and organizations such as CARB, CEC, SDG&E, SDAPCD, SDREN, Community Power, and CEA	By 2035: Included in B-1 By 2045: Included in B-1	• Number of participants in energy efficiency programs • Number of distributed energy resource pilot projects • Enrollment in workforce development programs

Implementation Schedule and Milestones:

Near Term (2026-2035)

- Develop guidance for industrial-specific sectors on electrification opportunities
- Identify funding for and develop incentive programs for electric-powered or alternatively fueled industrial equipment

Long Term (2036-2045)

- Integrate DER into industrial facilities
- Expand workforce training and apprenticeship programs for energy efficiency and electrification systems

Intersection with Other Funding Availability for the Industry Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the industry measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Energy	**Distributed Energy Resources Interconnection Solutions Collaboratives**
	Better Plants Program
State Programs	
California EPA	**Advanced Technology Demonstration and Pilot Projects** (CARB)
	Clean Off-Road Equipment Voucher Incentive Project (CARB)
	F-gas Reduction Incentive Program (CARB)
CEC	**Electric Program Investment Charge Program**
Regional/Local Programs	
SDAPCD	**Clean Air For All Grant Campaign (Carl Moyer Memorial Air Quality Standards Attainment Program and Community Air Protection Program)**
Community Power	**Efficient Refrigeration Program**

Solid Waste & Materials Management Sector

The Solid Waste & Materials Management sector includes emissions from waste disposed of in landfills. Solid waste makes up 1.4% of GHG emissions in the San Diego region. Organic materials such as food scraps and yard trimmings generate methane, a highly potent GHG with 25 times the global warming potential of carbon dioxide, when decomposing in landfills.[20] Other types of waste, such as construction and demolition waste, contribute to embodied carbon emissions through the energy intensive processes of material extraction, manufacturing, and transport. By diverting waste and capturing methane gas from landfills, the region can reduce emissions. Measures related to wastewater are included in the Water & Wastewater sector.

California's Senate Bill 1383 (SB 1383) provides a policy framework that requires additional solid waste and materials management in the region. SB 1383 calls for a 75% reduction in organic waste being sent to landfills and for 20% of unsold edible food to be sent to food recovery organizations by 2025. It also directs CARB to develop a strategy to reduce SLCP, set targets to reduce methane emissions from organic waste in landfills, and promote food recovery.

Solid waste and materials management in the San Diego region is complex and involves a range of agencies and organizations with distinct responsibilities. Local jurisdictions oversee solid waste collection and diversion programs. The San Diego Air Pollution Control District ensures compliance with air quality rules related to landfill gas capture, while the San Diego Regional Water Quality Control Board regulates discharges from solid waste and organics processing facilities through permits and monitoring requirements. At the state level, the California Department of Resources Recycling and Recovery (CalRecycle) administers SB 1383 implementation, monitors compliance with organic waste and food recovery targets, and provides technical assistance to support local diversion efforts. CARB sets methane and other pollutant reduction goals and tracks statewide progress under SB 1383. Landfill operators are responsible for day-to-day facility operations and maintaining compliance with permits.

The Solid Waste & Materials Management measures encompass priorities identified in local CAPs and other relevant local and regional documents including the County's **Food Justice Community Action Plan**, which includes community-identified priorities related to edible food recovery infrastructure, education, and resources. The measures also draw on the San Diego Regional Climate Collaborative's **Building Climate Resilience through Food Recovery** report, which highlights regional progress on SB 1383 and opportunities for strengthening local food recovery. They also reflect input from stakeholders through workshops, technical meetings, and the public survey. Stakeholders emphasized the importance of education on proper waste sorting and composting to reduce contamination and improve participation in waste diversion programs.

The Solid Waste & Materials Management measures also complement GHG reduction measures in other sectors in the Roadmap. For instance, compost enhances soil health and can enhance regenerative agricultural practices (see Measure AG-3), thereby strengthening the region's food system and carbon sequestration efforts.

[20] "**IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials**," (IPCC, 2013)

Measure SW-1
Divert Waste from Landfills

Description: Measure SW-1 focuses on reducing the amount of waste sent to landfills by diverting organic materials and construction & demolition (C&D) debris. Organic waste includes materials such as food scraps and yard trimmings, which generate methane—a potent GHG—when decomposing in landfills. C&D materials, such as lumber, drywall, and concrete, contribute to landfill volume but are often reusable or recyclable if recovered properly. Keeping materials in use for as long as possible reduces the need for new material extraction, processing, and transportation, all of which generate emissions. Prioritizing waste prevention and reuse helps cut emissions across the entire lifecycle of materials. This measure encompasses expanded waste diversion through efforts that reduce waste and extend the life of materials. It includes targeted outreach and education about proper waste sorting and available diversion programs to make participation in waste diversion more accessible and widespread.

Objectives:

- SW-1.1 Increase diversion of organic waste from landfills
- SW-1.2 Increase edible food recovery
- SW-1.3 Increase diversion of C&D waste from landfills

Supporting Actions:

a) Develop a regional assessment of participation in organic waste collection programs, identify barriers to adoption, and evaluate outreach strategies to improve diversion

b) Expand targeted outreach and education on organic waste collection to improve participation and compliance with SB 1383

c) Support increased participation in composting by expanding outreach, technical assistance, and access to infrastructure for multifamily housing, schools, and low-income communities

d) Expand partnerships and incentives to distribute compost from organic waste collection services for use in landscapes, community gardens, and farms, with a focus on low-income communities

e) Support the expansion of the food waste prevention network by increasing infrastructure for edible food recovery, supporting local food rescue programs, and improving coordination with food banks and distribution hubs

f) Expand public outreach, education, and infrastructure to support reuse and repair efforts, including community reuse events, fix-it clinics, tool libraries, and material exchange programs

g) Expand deconstruction programs and incentives to increase the reuse of reclaimed building materials, prioritize salvage over demolition, and connect recovered materials to resale markets

h) Support and expand incentives to increase the recycling of C&D waste

i) Develop and implement regional workforce training programs in deconstruction, salvage, and material reuse industries

j) Develop and scale pilot projects for end markets for recycled construction debris and deconstructed materials

k) Conduct a regional waste audit every 5 years to track diversion progress, identify trends, and inform continuous improvement

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as local jurisdictions, regional and state agencies like CalRecycle and the San Diego Regional Water Quality Control Board	By 2035: 5,800 By 2045: 11,700	• Tons of organic waste diverted from landfills • Tons of food recovered by or sent to food recovery organizations • Tons of C&D waste recycled or reused • Number of participants in outreach and education events

Measure SW-2
Reduce Waste Emissions through Increased Methane Capture

Description: Measure SW-2 focuses on reducing methane emissions from the waste sector by increasing the rate of methane capture. Methane is a highly potent GHG and capturing it before it is released into the atmosphere will reduce its impacts. This measure includes expanding field testing and monitoring, supporting the deployment of new methane capture technologies, and supporting the development of anerobic digestion infrastructure. Captured methane can be used as renewable biogas to generate heat or electricity, helping advance clean energy and GHG reduction goals.

Objectives:

- SW-2.1 Expand and implement methane capture at waste facilities

Supporting Actions:

a) Conduct field testing and emissions monitoring at waste facilities to assess methane capture efficiency, identify leaks, and guide methane reduction efforts

b) Expand and optimize methane capture programs at regional landfills (both operational & closed) by improving landfill gas recovery efficiency and supporting integration of advanced methane mitigation technologies

c) Support the development of new anaerobic digestors that process organic waste and produce biogas for use as a renewable energy source

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as CARB, SDAPCD, local jurisdictions, and landfill operators	By 2035: 0 By 2045: 55,700	• Annual posting of field test results • Tons of organic waste processed through anaerobic digestion • Methane gas collection system efficiency

Intersection with Other Funding Availability for the Solid Waste & Materials Management Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for solid waste & materials management measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Agriculture	Water & Waste Disposal Loan & Grant Program
	Composting and Food Waste Reduction Cooperative Agreements
	Solid Waste Management Grant Program
U.S. Department of Energy	WASTE: Waste Analysis and Strategies for Transportation End-uses
State Programs	
CalRecycle	Organics Grant Program
	SB 1383 Local Assistance Grant Program
	Beverage Container Recycling Grant Program
	Greenhouse Gas Reduction Loan Program
	Co-Digestion Grant Program
California Infrastructure and Economic Development Bank	Infrastructure State Revolving Fund Program
Regional/Local Programs	
San Diego Foundation	Community Food Grant Program

Water & Wastewater Sector

The Water & Wastewater sector includes the delivery, storage, and treatment of water, as well as the collection and treatment of wastewater. The energy used to transport water from its source to the place it's needed, along with the energy required for water treatment and the fugitive and process emissions[21] from wastewater treatment represent 1.3% of regional GHG emissions. While direct water and wastewater emissions account for a small share of regional GHG emissions, water is essential for people and the economy, making it critical to ensure access to clean water. A significant portion of the region's water supply is imported, with a smaller share from local sources such as groundwater, surface water, recycled water, and desalinated seawater.

More frequent and severe droughts and shifting precipitation patterns are intensifying strain on existing water and wastewater systems. Meeting future needs while reducing emissions will require coordination across a range of agencies and organizations responsible for water sourcing, distribution, treatment, purification, and water quality monitoring. For instance, local jurisdictions establish land use policies, building codes, and development standards that influence water demand. Water agencies and districts manage water supply, drinking water treatment, and distribution systems and operate infrastructure needed to deliver water to customers. The San Diego County Water Authority (SDCWA) plans for the region's long-term water supply, imports and delivers water to its member agencies, develops large-scale water infrastructure projects, and runs regional water efficiency programs. The San Diego Regional Water Quality Control Board regulates water quality and issues permits for wastewater discharges, ensuring compliance with state and federal standards. The San Diego County Sanitation District, the Metro Wastewater Joint Powers Authority, and other individual wastewater treatment plants operated by cities or special districts operate facilities that treat and discharge wastewater.

Measures in this sector include reducing demand through water conservation and expanding water reuse, and increasing system efficiency, renewable energy use, and methane capture at wastewater treatment facilities. Potable reuse projects provide an added opportunity to deliver safe, high-quality drinking water from local sources and cut emissions associated with importing water while aligning with California's Recycled Water Policy.[22]

The Water & Wastewater measures in the Roadmap align with local CAPs and builds on existing projects to expand water reuse and improve system efficiency, while also maintaining affordability and reliability as the region transitions to more local water sources. During outreach and engagement efforts, stakeholders emphasized the importance of addressing water and wastewater needs in the region, especially advancing water reuse. The Water and Wastewater measures are included to reflect these community priorities.

[21] Fugitive and process emissions are gases unintentionally and intentionally released by industry equipment and processes.

[22] "**Water Quality Control Policy for Recycled Water**," (State Water Resources Control Board)

Measure WW-1
Reduce Demand for Potable Water

Description: Measure WW-1 focuses on reducing GHG emissions associated with the pumping, treatment, and distribution of water by improving water use efficiency and reducing overall demand in municipal, residential, and commercial settings. This includes regional programs to retrofit plumbing and appliances, install smart meters, and repair leaks to improve water efficiency. It also features programs that encourage the replacement of turf with native, drought-resistant landscaping and water conservation strategies like rainwater harvesting, and graywater reuse that reduce the amount of potable water needed to maintain landscaping. Green infrastructure features that help capture and infiltrate stormwater closer to where it falls (NWL-3.3) can reduce the need for potable water to irrigate landscapes and complement these efforts to reduce the use of potable water. Outreach and workforce development actions support participation in water efficiency programs, with targeted assistance identified for multifamily properties, low-income households, and rural communities. By empowering people to understand and adjust their usage, and transitioning to practices that use water more efficiently, this measure can help reduce indoor and outdoor water use.

Objectives:

- WW-1.1 Reduce municipal water use
- WW-1.2 Reduce residential water use
- WW-1.3 Reduce commercial and industrial water use

Supporting Actions:

a) Develop and expand regional municipal water efficiency programs for indoor and outdoor water use, such as fixture upgrades, leak detection, turf replacement, and efficient irrigation, for local jurisdictions, tribal governments, and public agencies

b) Maintain and expand regional residential water efficiency programs for indoor and outdoor water use, such as fixture upgrades, leak detection, turf replacement, and efficient irrigation, with technical assistance for multifamily properties, low-income communities, and rural communities

c) Maintain and expand regional commercial and industrial water efficiency programs for indoor and outdoor water use, such as fixture upgrades, leak detection, turf replacement, and efficient irrigation, prioritizing users and facilities with high water use, and offer technical assistance for small businesses

d) Expand programs and incentives to reduce outdoor water use by encouraging rainwater harvesting, graywater reuse, turf replacement, low water use landscaping, and efficient irrigation

e) Expand local workforce training and apprenticeship programs to support careers in installing and maintaining water-efficient building and landscape upgrades, as well as leak detection

f) Conduct outreach to help residents, building managers, and businesses access water efficiency incentives and rebate programs, prioritizing low-income communities and high-water use properties

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SDCWA, San Diego Regional Water Quality Control Board, local jurisdictions, and water districts	By 2035: 21,700 By 2045: 0	• Gallons per capita per day (GPCD) consumed • Number of participants enrolled in water efficiency programs, including those in low-income communities • Number of water efficiency retrofits installed • Enrollment in workforce development programs

Measure WW-2
Optimize Energy Use in Water and Wastewater Systems

Description: Measure WW-2 focuses on expanding the use of recycled water and potable water reuse while improving the energy performance of water and wastewater systems. These efforts help reduce GHG emissions and reduce dependence on imported water sources. Wastewater is the water that leaves homes, businesses, and public facilities. A portion is treated for non-potable uses and recycled for purposes such as agricultural, landscaping, and industrial use. Advanced water purification projects can further treat wastewater to meet drinking water standards for potable reuse. Both approaches help make the local water supply more reliable and reduce the energy needed to import water from outside sources. Optimizing water treatment and delivery processes and increasing the use of renewable and distributed energy resources in these systems can help reduce the GHG emissions required to recycle, purify, and deliver water.

Objectives:

- WW-2.1 Improve energy efficiency of water and wastewater systems
- WW-2.2 Increase use of DER in water and wastewater operations
- WW-2.3 Expand water reuse

Supporting Actions:

a) Improve the energy efficiency of recycled water and potable reuse systems by optimizing treatment processes

b) Expand and implement biogas energy recovery projects at water and wastewater treatment facilities

c) Implement DER projects in water and wastewater systems such as pumped storage, solar, battery storage, and microgrids, prioritizing high energy use facilities

d) Support continued advancement of recycled water projects and potable water reuse projects, such as Pure Water San Diego, the East County Advanced Water Purification Program, and Oceanside Pure Water, to reduce reliance on water from outside the region

e) Conduct outreach and education, focusing on residents of multi-family housing and low income and rural communities, to build public understanding and support for potable water reuse and encourage adoption

f) Explore strategies to make water more affordable for residents and businesses

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such SDCWA, CARB, San Diego Water Quality Control Board, Sanitation Districts including the San Diego County Sanitation District and participating agencies under the Metro Wastewater Joint Powers Authority, local jurisdictions, water districts, and water and wastewater treatment plant operators	Combined with Measure WW-1	• Amount of water recycled in acre-feet per year • Number of new or upgraded water reuse systems installed • Percentage of energy used in water and wastewater systems from renewable sources • Energy consumed per acre-foot of wastewater treated

Measure WW-3
Reduce Methane Emissions from Wastewater Systems

Description: Measure WW-3 focuses on reducing methane emissions from wastewater systems by improving methane capture and utilization at treatment plants and managing emissions from septic and onsite wastewater systems. Wastewater treatment processes can generate methane as a byproduct, which is a potent GHG with a significantly higher global warming potential than carbon dioxide.[23] This measure includes strategies to capture and convert methane to biogas, a renewable energy source, reducing emissions and supporting on-site energy generation. Efforts to reduce methane emissions from wastewater systems can complement regional strategies to increase methane capture at landfills (SW-2), particularly where anaerobic digestors at wastewater treatment plants can be used to process organic waste. This approach can reduce emissions while maximizing the use of existing infrastructure.

Objectives:

- WW-3.1 Increase efficiency of methane capture and utilization systems at wastewater treatment facilities
- WW-3.2 Reduce methane emissions from wastewater and septic systems

Supporting Actions:

a) Expand and optimize methane capture and biogas utilization systems at wastewater treatment facilities by improving anaerobic digestion efficiency, reducing methane leaks, and recovering energy

b) Explore co-location opportunities for wastewater facilities and anaerobic digestors to process organic waste, such as the City of Oceanside's Food Scraps to Energy Project, to enable co-digestion of wastewater solids and food waste

c) Conduct field testing, monitoring, and reporting to identify and reduce methane leaks at treatment plants and improve efficiency

d) Support local efforts to reduce methane emissions from septic systems through maintenance, upgrades, replacements, septic to sewer conversions, or other improvements

e) Convene binational and regional stakeholders to facilitate collaboration in addressing transboundary wastewater flows and their associated methane emissions

Geographic Scope: Regional

Cost Information: Medium

[23] "IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials," (IPCC, 2013)

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies and organizations such as SDCWA, SDAPCD, CARB, State Water Resources Control Board, Sanitation Districts including the San Diego County Sanitation District and participating agencies under the Metro Wastewater Joint Powers Authority, local jurisdictions, water districts, and water and wastewater treatment plant operators	By 2035: 4,200 By 2045: 7,400	• Number of anaerobic digestors installed or upgraded • Number of wastewater treatment plants using biogas for on-site energy • Number of septic systems upgraded or replaced • Methane capture rate

Intersection with Other Funding Availability for the Water & Wastewater Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for solid waste & materials management measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Agriculture	Water & Waste Disposal Loan & Grant Program
	Emergency Community Water Assistance Grant Program
	Watershed and Flood Prevention Operations Program
U.S. EPA	Sewer Overflow and Stormwater Reuse Municipal Grants Program
State Programs	
Department of Fish and Wildlife	Addressing Climate Impacts
CalRecycle	Co-Digestion Grant Program
CA Infrastructure and Economic Development Bank	Infrastructure State Revolving Fund Program
Governor's Office of Emergency Services	Hazard Mitigation Grant Program
State Water Resources Control Board	Clean Water State Revolving Fund Program – Water/Energy Audit
	County-Wide and Regional Funding Program
	Drinking Water State Revolving Fund Grants and Loan Program
	Drinking Water State Revolving Fund Planning
	Drinking Water State Revolving Fund Construction
	General Fund – Water Resilience Infrastructure – Water Recycling
	Proposition 1 – Water Recycling
	Replacing, Removing, or Upgrading Underground Storage Tanks Grant
	Small Community Clean Water/Wastewater Funding

Agriculture Sector

The Agriculture sector encompasses growing and harvesting crops, raising livestock, and aquaculture. It accounts for approximately 0.8% of regional GHG emissions, primarily from the use of fuel for agricultural equipment, livestock production, and certain soil management practices. However, agricultural lands with healthy soils can serve as carbon sinks. According to the EPA, a carbon sink is a natural or artificial reservoir that absorbs more carbon from the atmosphere than it releases, thereby sequestering it. The San Diego region is home to 5,000 farms—many under 10 acres in size—more than any other U.S. county.[24] The region also supports community gardens and urban farms, providing access to fresh produce. Local crops include avocados, citrus, strawberries, nursery plants, and cut flowers.[25] The region's aquaculture industry produces shellfish and seaweed.[26]

The Agriculture measures support increasing energy efficiency on farms and transitioning to clean energy sources to help reduce emissions. Expanding urban farms and community gardens can reduce transportation-related emissions by shortening the distance between food production and consumption. On agricultural lands, regenerative practices can enhance soil health, boost the soil's ability to capture and store carbon, and reduce reliance on synthetic fertilizers. In marine ecosystems, regenerative aquacultural practices increase carbon uptake. Conserving agricultural land protects carbon already stored in undeveloped lands by preventing conversion.

Agricultural planning and stewardship in the region involve a range of agencies and organizations. For instance, the County and other local jurisdictions shape where and how agricultural activities can occur through land use planning, zoning, permitting decisions, leasing, and agricultural conservation programs. The California Department of Food and Agriculture (CDFA) sets statewide goals related to agriculture and provides support for implementation. Resource Conservation Districts (RCDs) are locally governed special districts that implement projects on public and private lands and educate landowners and the public about resource conservation. RCDs and the University of California Cooperative Extension offer technical assistance to growers and land managers, who often work with nonprofits to implement local agricultural efforts. The Port of San Diego manages leases and permitting for aquaculture operations within port-controlled areas and has supported pilot projects.

The measures reflect priorities identified in local CAPs, the County of San Diego's RDF, and Food Justice Community Action Plan, and statewide goals for land stewardship. They also reflect feedback gathered through stakeholder workshops, technical meetings, and the public survey. Stakeholders emphasized the importance of making programs accessible to all producers and expanding access to locally sourced food through urban farms and community gardens. Reducing the use of synthetic fertilizer and incorporating Traditional Ecological Knowledge (TEK) in agricultural practices were also priorities for stakeholders.

[24] "**San Diego County Small Farms,**" (University of California Agriculture and Natural Resources)

[25] "**2024 Crop Statistics and Annual Report,**" (County of San Diego, 2025)

[26] "**Aquaculture**," (Port of San Diego)

Measure AG-1
Reduce Emissions from Agricultural Operations

Description: Measure AG-1 focuses on reducing GHG emissions in the agricultural sector by supporting the transition to cleaner energy sources and improving the efficiency of agricultural machinery and equipment. This includes the use of on-site renewable energy solutions such as battery storage and microgrids, participation in distributed energy programs, and replacement of diesel-powered equipment with electric or zero-emission alternatives. To help producers access these technologies and programs, this measure includes incentives, technical assistance, and outreach. In addition to reducing emissions, these efforts can also help lower operating costs and support the long-term sustainability of producer operations.

Objectives:

- AG-1.1 Transition agricultural operations to cleaner fuels and energy sources
- AG-1.2 Improve energy efficiency of agricultural machinery and farm equipment

Supporting Actions:

a) Expand opportunities for clean energy adoption in agricultural operations by supporting efforts such as agrivoltaics, on-farm renewable energy, battery storage, microgrids, and participation in distributed energy and buy-back programs

b) Expand regional incentive programs and outreach to support the transition of diesel-powered farm equipment to more efficient or zero-emission alternatives, such as electric machinery

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Emission Reductions (MT CO_2e):	Metrics for Tracking Progress:
Agencies, utilities, and organizations such as SDAPCD, SDG&E, SDREN, Community Power, CEA, and local jurisdictions	By 2035: 11,400 By 2045: 20,200	• Number of clean energy projects on farms • Number of farms participating in incentive programs for efficient or zero-emission equipment • Number of participants in outreach and education events

Measure AG-2
Expand Urban Agriculture in the Region

Description: Measure AG-2 focuses on expanding community gardens and urban farms across the region by increasing access to land, integrating urban agriculture into local planning processes, and prioritizing efforts in low-income communities. Community gardens are small-scale, shared spaces where individuals or groups can grow fruits, vegetables, herbs, and flowers for themselves or their community. In contrast, urban farming encompasses the cultivation of crops or raising animals for food within an urban environment, often on a larger scale than community gardens. Food grown through these forms of urban agriculture travels shorter distances from production to consumption, helping reduce emissions from food transportation-related emissions, an important benefit given that transportation is the largest source of emissions in the region. Urban agriculture can also enhance carbon sequestration by supporting practices that improve soil health and retain carbon in the ground. Furthermore, it supports local food production and helps foster community connections. This measure emphasizes the importance of partnering with schools, parks, and community centers to support access to fresh, locally grown food. Education and workforce training will also be essential to help communities gain the skills needed to establish and maintain urban agriculture projects. Local food procurement efforts can strengthen connections between growers and institutions such as schools, food banks, and farmers markets, and help scale the impact of urban agriculture across the region.

Objective:

- AG-2.1 Increase land use for urban farms and community gardens

Supporting Actions:

a) Encourage the expansion of urban farming in new and existing developments through activities such as updating zoning codes, integrating urban agriculture into general plans, and addressing barriers related to land access and permitting
b) Conduct a regional assessment to identify and prioritize locations for community gardens and urban farms, particularly in public parks, schools, municipal buildings, community centers, multifamily properties, with a focus on low-income communities
c) Expand education and training programs to support the creation and long-term maintenance of community gardens and urban farms, with a focus on schools and low-income communities
d) Expand local food procurement efforts by connecting urban farms and local agricultural businesses with food purchasers such as schools, food banks, and farmers markets to strengthen regional food systems

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Sequestration (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as Resource Conservation Districts, local jurisdictions and regional agencies, University of California Cooperative Extension, environmental organizations, the CDFA, and other state agencies	*Not Quantified*	• Number of urban farms and community gardens • Pounds of food grown locally by urban farms • Enrollment in workforce development programs • Number of participants in outreach and education events

Measure AG-3
Improve Agricultural Practices to Sequester Carbon

Description: Measure AG-3 focuses on expanding the adoption of regenerative agriculture and aquaculture practices through regional incentive programs and workforce training opportunities. Healthy soils can store more carbon in the ground, making them an important tool to sequester carbon. On agricultural lands, regenerative practices such as crop rotation, composting, reduced tillage, and cover cropping can enhance soil health and boost the soil's ability to capture and store carbon. These methods also reduce the need for synthetic fertilizers, which emit nitrous oxide (N_2O), a potent GHG. In marine ecosystems, regenerative aquaculture practices, such as cultivating seaweed and shellfish can support carbon sequestration. Together, these practices reduce GHG emissions and improve the health and productivity of agricultural land and marine ecosystems. This measure also supports collaboration with tribal governments to integrate TEK into agricultural land management practices and expand access to training and incentive programs for producers.

Objectives:

- AG-3.1 Increase adoption of regenerative agriculture practices on agricultural lands
- AG-3.2 Increase adoption of regenerative aquaculture practices in marine areas

Supporting Actions:

a) Develop and expand programs to support producers in adopting regenerative agricultural practices, such as crop rotation, compost application, reduced tillage, and cover cropping with a focus on improving soil health, and incentivizing reductions in synthetic fertilizer use
b) Establish workforce training and technical assistance to build capacity among producers to implement regenerative practices and reduce reliance on synthetic fertilizers
c) Coordinate and engage with tribal governments to integrate indigenous TEK into the management of agricultural lands to enhance soil health
d) Explore opportunities to support regenerative aquaculture efforts, such as pilot projects to cultivate seaweed and shellfish

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as the Port of San Diego, RCDs, other regional agencies, local jurisdictions, tribal governments, environmental organizations, CDFA,	*By 2035: 47,700* *By 2045: 121,600*[27]	• Enrollment in workforce development programs • Number of producers participating in incentive programs for regenerative agricultural practices • Number of participants in outreach and education events

[27] "Climate Action Plan Combined Measures Workbook: Measure A-4.1," (County of San Diego, 2024)

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
and other state agencies		

*As discussed in Chapter 4, GHG sequestration values are not included in the overall emissions reduction projections. However, when possible, this information is listed as an informational item to showcase the work being done by other jurisdictions. These sequestration projections are based on the County unincorporated area and are not scaled to the entire region.

Measure AG-4
Conserve Agricultural Land

Description: Measure AG-4 focuses on protecting agricultural land through voluntary preservation strategies such as conservation easements, zoning protections, and regional programs. By maintaining agricultural land in productive use, this measure supports the region's agricultural economy and GHG goals. Agricultural lands with healthy soils can also serve as carbon sinks. When paired with sustainable land management practices, such as regenerative agriculture (see Measure AG-3), land conservation can improve soil health and increase carbon storage in the ground. This measure also emphasizes outreach and engagement with producers to identify barriers to land preservation and connecting them with available incentives and technical assistance.

Objectives:

- AG-4.1 Preserve agricultural land in the region

Supporting Actions:

a) Support voluntary preservation of agricultural land through conservation easements, zoning protections, and other actions that preserve agricultural lands, such as the County of San Diego Purchase of Agricultural Conservation Easement (PACE) Program
b) Conduct regional outreach and engagement with producers to identify barriers to agricultural land preservation, including access to incentive programs and technical assistance

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as the San Diego County Local Agency Formation Commission (San Diego LAFCO), RCDs, CDFA, local jurisdictions, and regional agencies	*By 2035: 12,200* *By 2045: 17,300*[28]	• Acres of agricultural land preserved • Number of producers participating in incentive programs • Number of participants in outreach and education events

*As discussed in Chapter 4, GHG sequestration values are not included in the overall emissions reduction projections. However, when possible, this information is listed as an informational item to showcase the work being done by other jurisdictions. These sequestration projections are based on the County unincorporated area and are not scaled to the entire region.

[28] "Climate Action Plan Combined Measures Workbook: Measure A-3.1," (County of San Diego, 2024)

Intersection with Other Funding Availability for the Agriculture Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the agriculture measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Department of Agriculture	**Regional Conservation Partnership Program**
	Conservation Reserve Program
	Conservation Stewardship Program
State Programs	
California Department of Conservation	**Sustainable Agricultural Lands Conservation Program**
California Department of Food and Agriculture	**California Nutrition Incentive Program**
	Farm to Community Food Hubs Grant
	Healthy Soils Program Incentive Grants
California Environmental Protection Agency	**Clean Off-Road Equipment Voucher Incentive Project** (California Air Resources Board)
	Funding Agricultural Replacements for Emission Reductions Program (California Air Resources Board)
California Governor's Office of Emergency Services	**Hazard Mitigation Grant Program**
Regional/Local Programs	
City of San Diego	**Urban Agriculture Incentive Zone**
County of San Diego	**Property Assessed Clean Energy** Programs (solar financing)
	Purchase of Agricultural Conservation Easement Program
	Sustainable Operations in Land Stewardship Program
SDAPCD	**Clean Air For All Grant Campaign (Carl Moyer Memorial Air Quality Standards Attainment Program and Community Air Protection Program)**
University of California San Diego	**Growing Equity Funding Urban Agriculture**

Natural & Working Lands Sector

Natural and working lands (NWLs) are important resources for storing carbon and supporting biodiversity and providing benefits such as clean air and water. The San Diego region is one of the most biodiverse areas in the United States, with landscapes that include shrubland and chaparral (48.7%), developed lands (17.6%), sparsely vegetated lands (12%), forests (7.7%), grasslands (4.7%), cropland (1.5%), wetlands (0.94%), and seaweeds and seagrasses (0.34%).[29] To be consistent with CARB methods, the Roadmap's GHG inventory accounts for emissions from human activities separately from carbon emissions and sequestration from natural and working lands. While NWLs are not included in the inventory, they are included in the Roadmap measures to recognize the important role these lands play in storing carbon. In 2016, San Diego County's natural and working lands, including urban landscapes, stored approximately 238.5 million metric tons (MT) of CO2e, a 6.3% decline since 2001.[30]

The NWL measures focus on increasing carbon storage and avoiding GHG emissions by both preventing emissions associated with land conversion and wildfire risk, conserving ecosystems, and improving the comfort and safety of walking, biking, and transit. Strategies include protecting and restoring coastal, wetland, forest, shrubland, and chaparral ecosystems, along with nature-based solutions such as prescribed burns, living shorelines, tree canopy expansion, and green infrastructure. These approaches can also improve air and water quality, support public health, and enhance habitat connectivity.

Achieving these measures will require collaboration among a wide range of land managers and agencies with different authorities and responsibilities. For instance, local jurisdictions regulate land use, zoning, and permitting for projects within their boundaries. Resource Conservation Districts often work in partnership with other agencies and landowners to plan and carry out conservation and restoration projects. State agencies manage state-owned lands and waters, set statewide conservation goals, provide technical guidance, and issue permits for projects that affect protected habitats or coastal areas. Federal agencies manage federally protected lands and waters and regulate activities affecting endangered species and coastal habitats. Regional agencies such as SANDAG coordinate multi-jurisdictional planning for conservation challenges and consistent data tracking. Strong regional coordination among these entities will help ensure efforts are complementary across the region.

The NWL measures are informed by local CAPs, as well as regional and state priorities such as California's Natural and Working Lands Climate Smart Strategy and California's 30x30 goal to conserve 30% of the state's lands and coastal waters by 2030.[31] They also reflect stakeholder input gathered through workshops, technical meetings, and the public survey. Stakeholders voiced the need for sustained funding and continued public outreach to ensure that projects are responsive to the needs of communities. They also emphasized the importance of Traditional Ecological Knowledge (TEK), wildfire prevention, urban tree planting, and green infrastructure.

[29] "**Natural and Working Lands Climate Smart Strategy**,"(California Natural Resources Agency, 2022)
[30] "**Carbon Storage and Sequestration Study**," (SANDAG, 2022)
[31] "**Pathways to 30x30 California**," (California Natural Resources Agency, 2022)

Measure NWL-1
Conserve Coastal and Wetland Ecosystems

Description: Measure NWL-1 focuses on a range of conservation efforts, including expanding restoration and invasive species management programs, implementing living shoreline projects, and protecting habitat through conservation planning. These efforts prioritize the use of nature-based solutions, adaptive management, and the integration of TEK through collaboration with tribal governments. Coastal and wetland ecosystems, such as estuaries, lagoons, salt marshes, kelp forests, and eelgrass beds, are effective natural systems for capturing and storing carbon. These ecosystems can also improve water quality, support biodiversity, and help protect coastal areas from the impacts of sea level rise and flooding. This measure also supports existing coastal and wetland conservation efforts such as SANDAG's TransNet Environmental Mitigation Program[32] (EMP), which has already conserved over 9,215 acres as open space across the region with a total value of $164 million in addition to funding regional land management and monitoring programs.

Objectives:

- NWL-1.1 Preserve and restore wetlands, including lagoons, estuaries, and salt marshes
- NWL-1.2 Preserve and restore kelp forests and eelgrass beds

Supporting Actions:

a) Continue and expand regional programs restoring and protecting coastal wetlands to increase carbon sequestration and reduce risks from sea level rise and flooding through nature-based solutions, adaptive management, and continued restoration efforts, such as those funded under the TransNet EMP

b) Implement the Multiple Species Conservation Programs and Multiple Habitat Conservation Program to protect and restore biodiversity-rich coastal and wetland ecosystems that provide significant carbon storage

c) Expand regional invasive species management programs to protect and enhance the carbon sequestration of ecosystems, incorporating long-term maintenance, native species restoration, and ecological monitoring aligned with the **Invasive Plant Strategic Plan**

d) Coordinate and engage with tribal governments to integrate indigenous TEK into coastal and wetland restoration efforts

e) Expand programs that protect and restore seagrass and kelp forests

f) Expand riparian and river protection and restoration programs to improve water quality, reduce sedimentation, and protect downstream coastal and wetland ecosystems that store carbon, prioritizing waterways that flow into estuaries and the ocean

g) Identify opportunities to streamline permitting processes for habitat restoration projects

Geographic Scope: Regional

[32] "**TransNet Environmental Mitigation Program**," (SANDAG)

Cost Information: Low

Implementing Authorities:	GHG Sequestration* ($MT CO_2e$):	Metrics for Tracking Progress:
Agencies such as local jurisdictions, Port of San Diego, RCDs, SANDAG, California Department of Conservation, California Natural Resources Agency (CNRA), other state, federal, and regional agencies, tribal governments, and environmental organizations	*Not quantified*	• Acres of conserved and restored coastal and wetland ecosystems • Number of living shoreline projects implemented • Acres of seagrass and/or kelp forests restored • Acres with invasive species removed

Measure NWL-2
Conserve Forest, Shrublands, and Chaparral Ecosystems

Description: The San Diego region is home to diverse forest, shrubland, and chaparral ecosystems that store a considerable amount of carbon and provide habitat for a wide range of plant and animal species. These ecosystems face increasing threats from development and other types of land conversion, which is the permanent loss of these ecosystems to other land uses. They also face pressures from invasive species and more frequent and intense wildfires. Measure NWL-2 focuses on preserving and restoring forest, shrubland, and chaparral ecosystems to increase carbon sequestration and maintain ecosystem health. These efforts include expanding regional restoration initiatives and invasive species management, protecting high carbon value areas through conservation easements, and applying climate smart land management strategies, such as prescribed and cultural burns, to reduce the intensity of fire events. This measure encompasses existing efforts, including SANDAG's TransNet EMP. It also identifies workforce development opportunities in sustainable forestry and ecosystem restoration, that would equip local workers with skills in habitat management, invasive species control, and wildfire prevention. TEK will play an essential role in guiding these efforts and will be important to incorporate to ensure that conservation practices are informed by the cultural expertise of tribal communities.

Objectives:

- NWL-2.1 Preserve and restore forest ecosystems to prevent carbon loss
- NWL-2.2 Preserve shrublands and chaparral ecosystems to prevent land conversion and retain stored carbon
- NWL-2.3 Restore degraded shrubland and chaparral ecosystems to improve carbon storage on the landscape

Supporting Actions:

a) Expand regional programs that protect and restore forest, shrubland, and chaparral ecosystems, prioritizing areas with high carbon storage potential and risk of loss, such as wildfire recovery areas, through habitat restoration, erosion control, and reforestation under initiatives such as the TransNet EMP

b) Implement the Multiple Species Conservation Programs and Multiple Habitat Conservation Program to protect and restore high-priority ecosystems, enhance ecological connectivity, and maintain long-term carbon storage

c) Expand invasive species management efforts under the **Invasive Plant Strategic Plan** to enhance the carbon sequestration of ecosystems, reduce wildfire risks, restore native species, and support nurseries and native seed banks for long-term restoration, with native seedlings available for use in programs such as the TransNet EMP

d) Support local governments and environmental organizations in acquiring and protecting open space easements with high carbon sequestration potential to avoid conversion

e) Implement climate smart land management strategies, such as buffer zones, fuel management, and prescribed and cultural burns, particularly near communities and transportation infrastructure, to maintain ecosystem health and reduce the risk of catastrophic wildfires

f) Coordinate and engage with tribal governments to integrate indigenous TEK into habitat restoration efforts in forest, shrublands, and chaparral ecosystems

g) Expand workforce development programs in ecological restoration, wildfire recovery, and sustainable forestry

h) Identify opportunities to streamline permitting for ecological restoration projects that deliver carbon sequestration benefits

Geographic Scope: Regional

Cost Information: Low

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
Agencies such as local jurisdictions, RCDs, SANDAG, CNRA, other state, federal, and regional agencies, tribal governments, and environmental organizations	*By 2035: 72,400* *By 2045: 92,400*[33]	• Acres of conserved and restored forest, shrubland, and chaparral ecosystems • Acres of invasive species removed • Number of climate smart land management projects • Number of participants in workforce training programs

*As discussed in Chapter 4, GHG sequestration values are not included in the overall emissions reduction projections. However, when possible, this information is listed as an informational item to showcase the work being done by other jurisdictions. These sequestration projections are based on the County unincorporated area and are not scaled to the entire region.

[33] "Climate Action Plan Combined Measures Workbook: Measures A-1.1 and A-1.2," (County of San Diego, 2024)

Measure NWL-3
Increase Urban Greening

Description: Measure NWL-3 focuses on expanding urban tree canopy, green space, and green infrastructure to capture and store carbon in plants and soils while reducing GHG emissions. Urban greening produces a local cooling effect that reduces the need for air conditioning, cuts energy use, lowers cooling costs, and improves public health. It can also make walking, biking, and transit more appealing, which can reduce emissions from driving. In addition, urban greening provides essential ecosystem services, such as filtering air pollutants, providing shade, reducing stormwater runoff, improving water quality, and providing habitat for wildlife. This measure also identifies opportunities for workforce development to equip local workers with skills in tree care, planting, and green infrastructure maintenance. It will be important for these efforts to prioritize communities that experience greater heat exposure and air quality challenges.

Objectives:

- NWL-3.1 Increase urban tree canopy cover
- NWL-3.2 Increase urban green space
- NWL-3.3 Expand adoption of green infrastructure

Supporting Actions:

a) Promote the use of native, non-invasive, climate-adaptive, and low water-use trees and shrubs in landscaping with targeted outreach and education on the benefits of urban tree canopy, particularly in communities with low canopy cover and those most impacted by urban heat

b) Support the development and implementation of a regional urban forestry management plan, such as the Plan & Plant project, to guide sustainable urban forestry practices, integrate tree equity metrics, and conduct a regional canopy inventory every 5 years to track progress

c) Expand regional tree planting efforts, long-term maintenance programs, and workforce training in tree care, prioritizing communities with low canopy cover and those most affected by extreme heat

d) Expand and maintain green infrastructure, such as rain gardens and permeable surfaces, in community infrastructure projects and urban green spaces, prioritizing low-income communities, flood-prone areas, and heat-vulnerable neighborhoods

e) Incorporate urban canopy and green infrastructure improvements into active transportation and transit projects to enhance shade and comfort

Geographic Scope: Regional

Cost Information: Medium

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
State, federal, and regional agencies	*By 2035: 4,300*	• Percent change in urban tree canopy cover in areas with the

Implementing Authorities:	GHG Sequestration* (MT CO_2e):	Metrics for Tracking Progress:
such as SDCWA, as well as local jurisdictions, tribal governments, and environmental organizations	*By 2045: 6,800*[34]	greatest heat exposure and lowest existing canopy cover • Number of trees planted and maintained • Total area of urban green space created • Number of participants in workforce training programs

*As discussed in Chapter 4, GHG sequestration values are not included in the overall emissions reduction projections. However, when possible, this information is listed as an informational item to showcase the work being done by other jurisdictions. These sequestration projections are based on the County unincorporated area and are not scaled to the entire region.

[34] "**Climate Action Plan Combined Measures Workbook**: Measures A-2.1 and A-2.2," (County of San Diego, 2024)

Intersection with Other Funding Availability for the Natural & Working Lands Sector:

Below is a non-exhaustive list of examples of federal, state, and local grant programs that may offer funding opportunities for the NWL measures in the Roadmap. This list reflects information available as of November 2025. Funding program details and availability may change over time. For the most current information about availability of funding, please refer to program websites.

Agency/Organization Name	Program Name
Federal Programs	
U.S. Fish & Wildlife Service	Endangered Species Act Cooperative Endangered Species Conservation Fund Grant Programs
	U.S. Standard Grant (North American Wetlands Conservation Council)
State Programs	
California Department of Fish and Wildlife	Restoration Grant Program
California Department of Conservation	Climate Smart Land Management Program
California Department of Forestry and Fire Protection (CAL FIRE)	California Forest Improvement Program
	Forest Health Grants
	Tribal Wildfire Resilience Grants
California Natural Resources Agency	Environmental Enhancement and Mitigation Grant Program
California State Coastal Conservancy	Coastal Conservancy Grants
California Wildlife Conservation Board	California Wildlife Conservation Board General Grant
	Climate Adaptation and Resiliency
Regional/Local Programs	
San Diego River Conservancy	Proposition 4 – 2024 Climate Bond

GHG Emissions Reductions by Measure

Based on the GHG reduction measures described above, Table 9 documents the projected emissions reductions in the goal years 2035 and 2045 by measure for each Roadmap measure.

Table 9: GHG Emissions Reductions by Measure

Measure Number	Measure Name	MT CO_2e Reduction in 2035	MT CO_2e Reduction in 2045
T-1	Reduce VMT through Increased Transit Use	193,400	153,600
T-2	Reduce VMT through Active Transportation	124,300	64,600
T-3	Reduce VMT through Expansion of Flexible Fleets	136,400	53,300
T-4	Reduce VMT through Transportation Demand Management (TDM)	59,200	47,500
T-5	Increase Adoption of ZEVs	142,600	177,300
T-6	Reduce Fuel Use from Idling	5,700	3,700
E-1	Decarbonize the Regional Electric Grid	47,700	0*
B-1	Increase Energy Efficiency of Buildings	1,548,800	2,180,400
B-2	Increase Electrification of Buildings	Calculation combined with Measure B-1	Calculation combined with Measure B-1
IND-1	Reduce Short-Lived Climate Pollutants Emissions	284,700	940,200
IND-2	Reduce Energy Intensity of Industrial Facilities	Calculation combined with Measures B-1 and B-2	Calculation combined with Measures B-1 and B-2
SW-1	Divert Waste from Landfills	5,800	11,700
SW-2	Reduce Waste Emissions through Increased Methane Capture	0	55,700
WW-1	Reduce Demand for Potable Water	21,700	0
WW-2	Optimize Energy Use in Water and Wastewater Systems	Combined with Measure WW-1	Combined with Measure WW-1
WW-3	Reduce Methane Emissions from Wastewater Systems	4,200	7,400

Measure Number	Measure Name	MT CO_2e Reduction in 2035	MT CO_2e Reduction in 2045
AG-1	Reduce Emissions from Agricultural Operations	11,400	20,200
AG-2	Expand Urban Agriculture in the Region	**	**
AG-3	Improve Agricultural Practices to Sequester Carbon	**	**
AG-4	Conserve Agricultural Land	**	**
NWL-1	Conserve Coastal and Wetland Ecosystems	**	**
NWL-2	Conserve Forest, Shrublands, and Chaparral Ecosystems	**	**
NWL-3	Increase Urban Greening	**	**
Total Reduction from Listed Measures (MT CO_2e)		**2,586,000**	**3,716,000**

*Note: This is assuming the state's goal of 100% renewable and zero-carbon electricity by 2045 gets met, as established by California SB 100.

**Note: Measures targeting sequestration are not included as the regional emissions goal applies only to anthropogenic emissions, as discussed in Chapter 4. When possible, emissions sequestration estimates are listed as informational items in Section 6.3.

Source: USD EPIC, 2025

7. Air Pollutant Emissions Reduction Analysis

7.1 Air Quality in the San Diego Region

Air quality affects the health and well-being of everyone in the San Diego region. Multiple factors contribute to local air quality conditions, including population density, vehicle usage, land use, and industrial activity. Air pollutants come from both mobile sources (such as cars, trucks, and ships) and stationary sources (such as power plants and industrial operations). Communities located near high-traffic corridors and industrial sites can face higher exposure to pollutants. For example, Barrio Logan, which is situated between Interstate 5 and the Coronado Bridge, ranks among the top 5% of California's most polluted neighborhoods.[35]

To protect air quality, the EPA sets National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants with well-documented health impacts. Five of these six "criteria pollutants" are prevalent in the San Diego region—ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO). The sources and health impacts of the criteria air pollutants are discussed in more detail in Section 7.2.

While the region has made progress in reducing some pollutants, ozone and particulate matter ($PM_{2.5}$ and PM_{10}) levels remain a concern. The San Diego-Chula Vista-Carlsbad MSA was ranked among the top ten worst regions in the United States for ozone pollution and 8th for high ozone days nationwide in the **American Lung Association's State of the Air 2025**. The San Diego region is designated as nonattainment for ozone, meaning it does not meet the federal air quality standards set by EPA under the Clean Air Act.[36] Due to the region's nonattainment status, RTPs and regional transportation improvement programs (RTIPs) must demonstrate transportation conformity for planned and programmed capacity increasing projects to show that they will not worsen pollution or delay progress toward attainment. Meeting conformity is essential for protecting public health and maintaining access to federal transportation funding. The San Diego region is in attainment for $PM_{2.5}$, indicating compliance with federal air quality standards set by the EPA under the Clean Air Act.[37] However, the EPA announced a stricter annual $PM_{2.5}$ standard, which may require further reductions to meet attainment in the future.[38] For PM_{10}, the region is currently designated as unclassified under federal standards, meaning additional monitoring and data are needed to determine compliance.[39]

[35] "**Equinox Quality of Life Dashboard: Air Quality**," (The Nonprofit Institute), accessed June 27, 2025
[36] "**Attainment Status**," (SDAPCD), accessed June 27, 2025
[37] "**Attainment Status**," (SDAPCD), accessed June 27, 2025
[38] "**National Ambient Air Quality Standards (NAAQS) for PM**", (EPA, 2025)
[39] "**Attainment Status**," (SDAPCD), accessed June 27, 2025

Because GHG emissions and air pollutants often originate from the same sources, measures in the Roadmap that reduce GHGs often also improve air quality. For example, replacing gas- and diesel-powered vehicles with zero-emission alternatives, reduce both GHG emissions and particulate matter pollution. Building electrification reduces air pollution by eliminating emissions from natural gas appliances, which are sources of nitrogen oxides, carbon monoxide, and particulate matter. Expanding tree canopy or restoring natural lands, which helps sequester carbon, can also help filter air pollutants. Community input emphasized the importance of the air quality benefits associated with the Roadmap measures, with stakeholders ranking "cleaner air and improved public health" as the most important benefit that could be derived by implementing Roadmap measures in the public survey SANDAG conducted (see Chapter 6). The Roadmap complements other regional air quality efforts underway in the region, including SDAPCD's **Regional Air Quality Strategy** and their **Community Emissions Reduction Plans** for the portside and international border communities in the San Diego region.

7.2 Sources of Criteria Air Pollutants

Ozone (O_3) is not a directly emitted air pollutant but rather forms in the atmosphere when volatile organic compounds (VOCs) and nitrogen oxides (NO_x) react in the presence of sunlight. In the transportation sector, VOCs and NO_x are emitted from vehicle tailpipes from gasoline and diesel engines. In San Diego County, 40% of VOC emissions and 93% of NO_x emissions are from mobile sources.[40] Buildings generate VOC emissions through the use of certain cleaning agents, paints, varnishes, and solvents, while gas-powered appliances emit NO_x. Electricity generation from fossil fuels, especially natural gas, is a significant NO_x source, and some industrial processes also release ozone precursors. Ground-level ozone, also known as tropospheric ozone, is a key component of smog and can cause or worsen respiratory conditions such as asthma, reduce lung function, and increase susceptibility to respiratory infections. Children, older adults, and those with lung diseases are particularly vulnerable to these health effects. Ozone can also cause damage to native plants, forests, and reduce crop yield. Rising temperatures and more frequent and intense heat waves can increase the formation of ground-level ozone.

[40] "**2024 Annual Air Quality Report**," (SDAPCD, 2025)

Particulate matter ($PM_{2.5}$ and PM_{10}) consists of microscopic solid and liquid particles suspended in the air. Particulate matter is both directly emitted and can also be formed through chemical reactions. PM is emitted directly from diesel engines (especially in medium- and heavy-duty trucks), residential fuel combustion (i.e. water heaters, furnaces, cooking), construction and demolition, aircraft, and from paved road dust. Power plants and some industrial facilities contribute to both direct and secondary PM emissions. It is also formed secondarily when gaseous pollutants such as NO_x, SO_2, and ammonia (NH_3) react in the atmosphere. $PM_{2.5}$ (particles less than 2.5 microns in diameter), also known as fine PM, can penetrate deep into the lungs and even enter the bloodstream, leading to cardiovascular and respiratory illnesses, including heart attacks, strokes, asthma complications, and premature death, especially in communities near freeways, ports, and industrial sites. Diesel particulate matter (diesel PM), a subset of fine PM, is emitted from diesel engines and is a known carcinogen. PM_{10} (particles less than 10 microns) can irritate the eyes, nose, and throat, and contribute to respiratory problems. Drought, heat waves, and wildfires can worsen particulate matter levels. Drought conditions can increase airborne dust and raise the levels of particulate matter. Wildfires, exacerbated by low moisture and high temperatures, release large quantities of particulate matter along with other harmful pollutants.

Nitrogen dioxide (NO_2) is formed during fuel combustion, primarily from motor vehicles and power plants. It is a major component of the broader group of NO_x and contributes to both ozone and PM formation. NO_2 is often used as an indicator for NO_x because NO_2 is the most prevalent form of NO_x from combustion sources. It is abundant in vehicle exhaust, particularly from diesel engines. In the electricity sector, natural gas power plants emit NO_2, as do gas-powered appliances in buildings, such as furnaces and water heaters. Industrial boilers and combustion equipment are also significant sources. NO_2 has direct health impacts, including inflammation of airways, increased asthma symptoms, and a higher risk of respiratory infections, particularly in children.

Sulfur dioxide (SO_2) is primarily released from burning fuel that contains sulfur, such as coal and oil. SO_2 is the most abundant form of sulfur oxide (SO_x) in the air. SO_2 levels serve as an indicator to represent the broader SO_x pollutant group in air quality standards. Sources of SO_2 include power plants and industrial facilities, motor vehicles, locomotives, ships, and off-road diesel equipment that use high-sulfur fuel. SO_2 can react in the atmosphere to form fine particulate matter. Exposure to SO_2 can cause respiratory irritation and aggravate asthma, particularly in children, older adults, and those with existing heart and lung conditions.

Carbon monoxide (CO) is formed from the incomplete combustion of fossil fuels. It is primarily emitted by motor vehicle exhaust, especially older or poorly maintained engines, and from gas appliances in buildings such as stoves and heaters. Industrial furnaces can also release CO. Inhalation of CO limits the blood's ability to carry oxygen to vital organs and can lead to fatigue, confusion, dizziness, unconsciousness, and may even be fatal at high concentrations. People with heart conditions are especially sensitive to CO exposure.

Potential Air Pollutant Emissions Reductions

Table 10 summarizes the potential air quality benefits of each GHG reduction measure in the Roadmap if implemented.

Table 10: Benefits of GHG Reduction Measures to Air Pollution

Measure	Benefits to Air Pollution
Transportation	
T-1 Reduce VMT through Increased Public transit use	Reduces emissions from passenger vehicle exhaust by shifting trips to cleaner transit options. Public transit generally generates lower per-passenger emissions and may be zero- or low-emission, reducing air pollution in high-traffic corridors. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
T-2 Reduce VMT through Active Transportation	Eliminates emissions from vehicle exhaust by replacing passenger vehicle trips with zero-emission modes such as walking and biking. This can reduce local air pollution, especially in urban communities and near schools. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
T-3 Reduce VMT through Expansion of Flexible Fleets	Reduces emissions by replacing passenger vehicle trips with Flexible Fleets, such as micromobility, microtransit, and shared rides. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
T-4 Reduce VMT through TDM	Lowers overall vehicle use by encouraging alternatives to driving alone, such as teleworking and vanpooling. This can improve air quality during times of high pollution formation, such as morning ozone peaks. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
T-5 Increase Adoption of ZEVs	Reduces tailpipe emissions from gasoline and diesel vehicles. Benefits are the greatest in communities near major roadways and freight corridors. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
T-6 Reduce Fuel Use from Idling	Reduces localized emissions from vehicle exhaust during periods of idling through infrastructure improvements and roadway management such as roundabouts and traffic signal optimization, especially in areas with high congestion. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_x, CO
Electricity	
E-1 Decarbonize the Regional Electric Grid	Reduces emissions from fossil-fuel generated electricity. Benefits increase over time as clean energy replaces fossil fuel power plants. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2

Buildings	
B-1 Increase Energy Efficiency of Buildings	Decreases electricity demand, thereby lowering emissions from fossil-fuel generated electricity. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2
B-2 Increase Electrification of Buildings	Reduces emissions by switching natural-gas powered systems with electric alternatives, improving indoor air quality and outdoor pollution. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NO_x, SO_2, CO
Industry	
IND-1 Reduce SLCP Emissions	Reduces emissions from fossil-fuel generated electricity through higher efficiency systems. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2
IND-2 Reduce Energy Intensity of Industrial Facilities	Reduces emissions from fossil-fuel generated electricity and on-site natural gas consumption, through higher efficiency systems and fuel switching; thereby lowering emissions at industrial facilities and nearby communities. **Air Pollutants Reduced:** $PM_{2.5}$, NH_3, NO_x, SO_2, CO
Solid Waste & Materials Management	
SW-1 Divert Waste from Landfills	Increasing the diversion of waste reduces methane emissions and other ozone precursors by preventing anaerobic decomposition in landfills. It also decreases the need for waste transport and processing, lowering vehicle-related pollutants. **Air Pollutants Reduced:** VOCs, CH_4*, $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO
SW-2 Reduce Waste Emissions through Increased Methane Capture	Capturing and utilizing methane from landfills and other waste facilities prevents its release to the atmosphere, reducing ozone precursors, including methane and VOCs. **Air Pollutants Reduced:** VOCs, CH_4*
Water & Wastewater	
WW-1 Reduce Water Use	Lowers energy demand for water treatment and delivery, reducing emissions from fossil-fuel generated electricity. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2
WW-2 Improve Efficiency in Water and Wastewater Systems	Reduces energy-related emissions through improved system efficiency and greater use of clean energy at water and wastewater facilities, lowering emissions from fossil-fuel generated electricity. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2
WW-3 Reduce Methane Emissions from Wastewater Systems	Methane capture and utilization at wastewater facilities lowers emissions of ozone precursors, including methane and VOCs. **Air Pollutants Reduced:** VOCs, CH_4*

Agriculture	
AG-1 Reduce Emissions from Agricultural Operations	Reduces emissions from on-site combustion, electricity use, and equipment in agricultural operations. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, NH_3, NO_x, SO_2, CO
AG-2 Expand Urban Farming in the Region	Lowers transportation-related emissions by shortening delivery distances, as more food is grown locally in urban farms and community gardens. **Air Pollutants Reduced:** VOCs, $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO
AG-3 Improve Agricultural Practices to Sequester Carbon	Regenerative agriculture practices such as reduced tillage and cover cropping lower particulate matter emissions by minimizing soil disturbance and windblown dust. **Air Pollutants Reduced:** $PM_{2.5}$, PM_{10}
AG-4 Conserve Agricultural Land	Limited direct impact on air pollution, but avoids conversion of land to uses that may generate higher air pollutant emissions. If regenerative agricultural practices are applied to conserved land, it can lower particulate matter emissions (see AG-3).
Natural & Working Lands	
NWL-1 Conserve Coastal and Wetland Ecosystems	Healthy wetlands can trap particulate matter on vegetation, water, and soil. They also filter nitrogen compounds from runoff, which can reduce precursors to ozone. **Air Pollutants Reduced:** $PM_{2.5}$, PM_{10}, NO_x
NWL-2 Conserve Forest, Shrublands, and Chaparral Ecosystems	Restores and maintains vegetation and trees that capture particulate matter and uptake gaseous air pollutants, including ozone. It also reduces the risk of wildfire emissions. **Air Pollutants Reduced:** O_3, VOCs, $PM_{2.5}$, NO_x, SO_2, CO
NWL-3 Increase Urban Greening	Trees and greenery can capture particulate matter on their leaves and absorb gaseous air pollutants, including ozone. **Air Pollutants Reduced:** O_3, $PM_{2.5}$, NO_x, SO_2, CO

*CH_4 or methane, is a potent greenhouse gas and a long-lived precursor to ground-level ozone formation.

Table 11 below provides quantified estimates of air pollutant reductions for the Transportation, Electricity, and Building sectors, along with the total reductions for these combined sectors, which are the region's largest sources of GHG emissions. Quantification was limited to sectors and air pollutants where data and tools were available. A detailed description of the calculation methodology and tools used for each measure can be found in Appendix F.

Table 11: Estimated Air Pollutant Reductions by Sector

Air Pollutants Reduced	2035 Reduction (MT/year)	2045 Reduction (MT/year)
Transportation		
VOCs*	162.21	454.83
$PM_{2.5}$	6.58	9.63
PM_{10}	7.26	10.28
NO_x	295.68	492.51
SO_x	4.85	7.90
CO	10,075.23	18,360.72
Electricity		
VOCs	0.57	0
$PM_{2.5}$	1.81	0
NH_3	1.16	0
NO_x	1.60	0
SO_2	0.12	0
Buildings		
VOCs	53.32	94.17
PM	74.99	132.45
NO_x	935.65	1,652.56
SO_2	5.82	10.27
CO	401.84	709.75
Total for Transportation, Electricity, & Buildings Sectors		
VOCs	216.09	549.00
PM	90.65	152.36
NH_3	1.16	0
NO_x	1,232.92	2,145.07
SO_x	10.79	18.18
CO	10,477.06	19,070.47

*Note: EMFAC2025 reports reactive organic gas (ROG) emissions. Because the EMFAC2025 User's Guide states that the ROG class is the same as the EPA's VOCs definition, VOC results are reported here.

Anticipated Disbenefits and Limitations

While GHG-reducing actions are expected to bring air quality benefits, it is important to acknowledge potential challenges. Since tailpipe emissions are a major source of air pollutants in the region, replacing gasoline and diesel vehicles with zero-emission vehicles can substantially reduce emissions of NO_x, VOCs, and particulate matter from exhaust. However, as the transportation and building sectors become electrified, the resulting increase in electricity demand could temporarily lead to higher local power plant emissions if that demand is met by fossil fuel generation. This risk is expected to decrease as the regional grid transitions toward cleaner energy sources. Another consideration is that while electric vehicles eliminate tailpipe emissions, they still generate non-exhaust particulate matter emissions due to tire and brake wear. These impacts are relatively minor compared to the benefits of reducing exhaust emissions and can be further mitigated as vehicle technology improves.

8. Workforce Analysis

Realizing the Roadmap's long-term vision for cleaner air, lower emissions, and healthier communities will open new economic opportunities for the San Diego region. This chapter provides an overview of potential workforce needs and solutions to enable the coordination and collaboration needed to grow the region's workforce and meet long-term needs for the Transportation, Electricity, Buildings, and Industry sectors, which account for about 95% of regional GHG emissions.

8.1 Workforce Supply and Needs

Key Industries

The Roadmap's workforce analysis begins at the industry level to provide a foundation for understanding the workforce needs for the Transportation, Electricity, Buildings, and Industry sectors. To ensure consistency with national data, the Roadmap uses industry definitions from the 2024 U.S. Energy and Employment Report[41] (USEER) and highlights the industries that underpin our clean energy and emissions reduction strategies. These industries, defined in Table 12 below, illustrate where the workforce shifts are likely to occur as the region transitions to cleaner energy and more efficient systems. The following sections examine the anticipated workforce needs within these industries and identify the occupations and skills that would be needed to carry out the Roadmap measures.

Table 12: Key Industries for Roadmap Workforce Needs

Key Industry	USEER Industry Definition
Electric Power Generation	Includes solar, wind, natural gas, coal, oil, and other sources of electricity. This industry also encompasses various activities such as construction, maintenance, operation, and decommissioning of utility and non-utility generation facilities.
Transmission, Distribution, and Storage (TDS)	Covers traditional TDS, energy storage, microgrids, etc., and activities related to constructing, operating, and maintaining TDS infrastructure. This includes employment related to transmission lines, pipeline construction, and manufacturing of equipment associated with electrical transmission.
Fuels	Includes traditional fuels such as coal, petroleum, and natural gas, as well as some clean fuels. Encompasses activities such as fuel extraction, mining, and processing, and businesses that manufacture machinery to support these activities.

[41] "United States Energy and Employment Report 2024," (U.S. DOE, 2024)

Key Industry	USEER Industry Definition
Energy Efficiency	Encompasses traditional HVAC, high-efficiency and renewable HVAC, and efficient lighting. Relevant activities include the production, wholesale trade, installation, and repair/maintenance of products that increase energy efficiency, along with services that reduce energy consumption in buildings.
Motor Vehicles	Includes manufacturers and shippers of vehicles and parts, designers of vehicles and parts, and repairers of motor vehicles. Note that this technology area does not include traditional transportation jobs, such as bus or taxi drivers, which are covered separately later in this analysis.

Key Industry Employment

USEER employment data provides a snapshot of how employment in San Diego County's five key energy-related industries has changed between 2016 and 2024. During this period, there was growth in the Electric Power Generation industry (14,896 jobs in 2016 to 17,163 jobs in 2024) and Energy Efficiency industry (30,554 jobs in 2016 increasing to 31,621 jobs in 2024). However, several industries experienced negative growth including the TDS industry (12,293 jobs in 2016 to 9,412 jobs in 2024), the Fuels industry (4,498 in 2016 to 2,027 jobs in 2024), and the Motor Vehicles industry (14,531 jobs in 2016 to 14,182 jobs in 2024).

When combined, these trends show that the overall employment across these five industries has decreased by 2,188 jobs from 2016 to 2024. While further analysis would be needed to understand the drivers of these changes, understanding employment shifts over time is important for anticipating future workforce needs.

Anticipated Workforce Needs

Achieving the Roadmap's GHG reduction goals will require a wide range of skills and workers across many industries. Each industry described in Table 12 includes hundreds of occupations spanning different phases of work—from construction and engineering to finance, operations, and customer service. While the Roadmap analysis does not capture every occupation, it highlights examples of high-demand roles that most directly tie to the Roadmap's GHG reduction measures.

The Motor Vehicles and Fuels industries described in Table 12 include occupations that will be important for the Roadmap's transportation measures, such as:

- Basic (e.g. laborers and carpenters) and skilled (e.g. electricians and heavy equipment operators) construction trades needed to complete capital projects such as active transportation infrastructure and transit station improvements.
- Certified electricians with specialized training to install and maintain EV charging infrastructure, along with re-trained vehicle mechanics who can repair and maintain the growing ZEV population.

The TDS and Electric Power Generation industries include occupations that will be important for the electricity and buildings measures in the Roadmap, such as:

- Skilled construction trades to support decarbonizing the electric grid through both utility-scale projects and distributed energy projects, such as microgrids and battery storage.
- Skilled jobs in system operations and maintenance.

The Energy Efficiency industry includes occupations that will be important for building measures in the Roadmap, such as:

- Energy auditors to assess building performance and identify opportunities for reducing energy use through energy efficiency improvements like insulation, air sealing, and lighting upgrades.
- Licensed contractors, engineers, and other technicians to implement these energy-saving projects in new and existing buildings.
- Licensed contractors and technicians who can install and maintain electric appliances and equipment such as electric heat pumps, water heaters, induction cooktops, and other electric cooking appliances.

The Fuels and Energy Efficiency categories also include occupations that will be important for industry measures in Roadmap, such as:

- Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC-R) technicians to support the transition to low-GWP refrigeration systems at commercial and industrial sites.
- Contractors and technicians to design, install, and maintain distributed energy systems and electrification projects at industrial sites.

8.2 Workforce Development Strategies

To meet the region's anticipated workforce needs described in Section 8.1, workforce development efforts will need to scale up to fill gaps and ensure that new jobs generated through GHG reduction efforts are high quality and provide livable wages that support workers and their families. This section discusses supply-side approaches to grow the qualified workforce and demand-side approaches to improve job quality. A key regional resource that informed the Roadmap's workforce development strategies is the County of San Diego's Putting San Diego County on the High Road report, which provides recommendations on both supply- and demand-side workforce needs.[42, 43]

Supply-Side Strategies

Roadmap implementation depends on building a strong and prepared workforce. The supply-side strategies from the County's High Road report, summarized below, align with the Roadmap's goals by equipping workers with the skills needed to access quality jobs in decarbonization-related industries.

[42] "**Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050**," (County of San Diego, 2022)

[43] High road jobs are positions that offer family-supporting pay and benefits, long-term career pathways, and worker protections, and are accessible to local workers.

1. Support comprehensive vocational training programs that incorporate green components.
2. Align existing training programs with state high road training initiatives, such as High Road Training Partnerships and High Road Construction Careers.
3. Support attainment of industry recognized skill certifications.
4. Align existing industry training partnerships and new programs with best practice guidelines to help place workers from low-income communities in quality, career track jobs.
5. Invest in curriculum upgrades and instructor training for apprenticeship programs, community colleges, and four-year colleges to incorporate emerging technologies.
6. Track outcomes of all training programs through metrics such as number of enrollees, number of graduates, attainment of industry-recognized credentials, job retention, initial wages, and wage mobility over time.
7. Support programs and pathways for students and workers from low-income communities to enter into white collar or technical clean energy careers, such as jobs requiring a college degree or professional license that support the design, planning, and administration of GHG reducing policies and programs.

Several workforce development programs aimed at advancing climate action are already underway in the San Diego region, providing a foundation that the Roadmap can build on. For example, the region has over 20 state-certified construction trade apprenticeship programs.[44] These programs encompass basic trades such as laborers and carpenters, as well as skilled trades including electricians, plumbers, and pipefitters. The Electric Vehicle Infrastructure Training Program (EVITP) is an example of a national certification program being implemented in the region. EVITP trains certified electricians to install electric vehicle supply equipment. It has been promoted within the region through the International Brotherhood of Electrical Workers (IBEW) and through the CALeVIP: San Diego County Incentive Project. SANDAG also supports workforce training through its collaboration with the San Diego Workforce Partnership, San Diego County Building and Construction Trades Council, San Diego Continuing Education Foundation, Southwestern College, Vista School District and various tribal workforce training centers to develop the **Apprenticeship Readiness Program** (ARP). This pre-apprenticeship program connects trainees with pathways into the union construction trades and includes a curriculum emphasizing green construction practices. The City of San Diego's **Clean Energy Career Map** also supports local workforce development by identifying critical occupations across five major clean energy industry sectors and tracing potential progression from entry to senior level positions. This interactive tool can help individuals such as educators, career-advisors, students, and job-seekers identify long-term career pathways.

Demand-Side Strategies

Demand-side workforce strategies can help lead to competitive, high-quality jobs and advancement opportunities. The County High Road report outlines the following demand-side strategies that can attract workers for roles that help advance the Roadmap measures.

[44] "**Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050**," (County of San Diego, 2022)

1. Expand the use of project labor agreements (PLAs), including with local and/or targeted hire, on climate investments involving large-scale construction projects.
2. Use inclusive procurement policies for public procurement of large capital equipment, contracts for public services, and in grant programs in non-construction industries.
3. Include responsible employer standards in all climate-related incentive program requirements, including skill standards, living wage standards, and verification of compliance with all employment and labor law.
4. Use public-sector insourcing or exclusive franchise contracting models to support labor and environmental standards for public services and some incentive and low-income programs.
5. Use metrics to measure the impact of climate policies on job numbers, job quality, and job access.
6. Provide technical assistance to agencies implementing climate policy on how and when to apply these demand-side workforce interventions.
7. Identify and focus investments on win-win strategies that meet both climate and workforce goals.

A regional example of a PLA is SANDAG's Community Benefits Agreement (CBA). PLAs are collective bargaining agreements with one or more labor unions that establish the terms and conditions of employment for workers on specific construction projects. The SANDAG CBA goes beyond a typical PLA as it benefits the San Diego region with job prospects for individuals in low-income areas and those who are facing barriers to employment. For example, the CBA negotiated between SANDAG and the San Diego County Building and Construction Trades Council is inclusive of all state and federally approved apprenticeship programs and has goals for hiring low-income residents, veterans, former foster youth, ARP graduates, and single parents.[45] While these programs demonstrate regional progress in workforce development and job quality, continued investment and collaboration is needed to address projected long-term workforce needs. There are several large construction projects already started or set to commence in the region over the next few years. One of the major objectives of establishing CBAs is to work with the trades to ensure that there is a pipeline of skilled and trained workers who can participate on future projects.

Key Partners Supporting Workforce Development

Implementing Roadmap measures will depend on strong coordination among local, regional, and state stakeholders to address workforce needs across the San Diego region. Some regional examples include:

- Educational institutions and training providers such as community colleges, four-year colleges and universities, and any state or federally approved apprenticeship program.
- The California Workforce Development Board provides statewide guidance and support for aligning workforce investments with climate goals, including funding apprenticeship programs.
- The San Diego Workforce Partnership, which connects job seekers and employers through a variety of training programs, career services, and job placement programs.

[45] "**Community Benefits Agreement**," (SANDAG)

- The San Diego County Building and Construction Trades Council and its affiliated construction and trade unions, which support quality employment and training highly skilled workers through efforts such as apprenticeship programs and the establishment of PLAs or CBAs.
- The County of San Diego's Green Industries and High-Road Jobs initiative underway now is intended to help attract businesses to locate their headquarters in the San Diego region and create regional jobs in decarbonization.

Strong partnerships can help remove barriers to training and employment, support access to jobs with competitive wages and benefits, and create pathways that offer long-term opportunities for career advancement in the region.

While this chapter focuses on the industries and occupations most closely tied to implementation of the Roadmap, it is important to recognize that a wide range of supporting occupations will also play a role, such as financial services, information services, and other professional or business services. Future studies could explore supporting occupations and additional jobs within the key industries identified here to strengthen long-term workforce planning.

9. Community Benefits Analysis

The measures in the Roadmap can reduce climate pollution while delivering a range of additional benefits that can improve the quality of life for residents, including supporting affordability, public health, and safety. This chapter summarizes the expected benefits of the Roadmap if the measures are implemented from the four highest-emitting sectors, which account for almost 95% of GHG emissions.

9.1 Benefits of GHG Reduction Measures to Communities

Table 13 below describes economic, public health, and safety benefits to communities in the San Diego region associated with the GHG reduction measures from the Transportation, Electricity, Buildings, and Industry sectors. More information on air quality benefits including the types of air pollutants expected to be reduced in the region and their health impacts is provided in Chapter 7.

Table 13: Benefits of GHG Reduction Measures to Communities

Measure	Benefits to Communities
Transportation	
T-1 Reduce VMT through increased public transit use	• Expands affordable and convenient transit options • Transit incentives lower household transportation costs for participants • Increases access to jobs, education, healthcare, and other essential services • Improving station amenities makes taking transit safer and more pleasant • Improves air quality by reducing vehicle emissions
T-2 Reduce VMT through active transportation	• Expands affordable, sustainable, and convenient transportation options • Improved bikeways and walkways make walking safer and more pleasant, and support critical connections to schools and transit • Biking and walking support physical and mental health • Improves air quality by reducing vehicle emissions
T-3 Reduce VMT through expansion of Flexible Fleets	• Provides affordable and convenient transportation options • Connects people to transit and other destinations • Can reduce parking demand • Improves air quality by reducing vehicle emissions from driving alone

Measure	Benefits to Communities
T-4 Reduce VMT through Transportation Demand Management (TDM)	• Provides affordable, sustainable, and convenient transportation options • Improves air quality by reducing vehicle emissions
T-5 Increase adoption of zero-emission vehicles (ZEVs)	• Improves air quality, especially in communities burdened by traffic from goods movement • Incentive programs can make ZEVs more affordable • ZEVs have lower vehicle maintenance costs • Expanding public and workplace ZEV infrastructure helps residents who lack access to home charging • Improves air quality as ZEVs produce no tailpipe emissions (e.g. diesel PM and $PM_{2.5}$)
T-6 Reduce fuel use from idling	• Enhances safety and traffic flow • Reduces costs for drivers and fleet operators by reducing wasted fuel consumption • Improves air quality by reducing tailpipe emissions
Electricity	
E-1 Decarbonize the regional electric grid	• Utility bill savings from solar and storage systems • Improves energy reliability, helping communities maintain power during grid disruptions • Improves air quality by reducing emissions from fossil fuel power plants
Buildings	
B-1 Increase energy efficiency of buildings	• Utility bill savings from increased energy efficiency • Reduces demand on the electric grid, which supports energy reliability and improved air quality
B-2 Increase electrification of buildings	• Improves indoor air quality and reduces outdoor air pollution from gas appliances, supporting public health
Industry	
IND-1 Reduce SLCP emissions	• Certain low-GWP refrigerant alternatives improve efficiency and reliability of cooling systems, lowering operating costs and maintenance needs
IND-2 Reduce energy intensity of industrial facilities	• Cost savings from increased energy efficiency, improved energy reliability during outages, and reduced strain on the grid • Higher efficiency systems improve air quality by reducing emissions from energy generation

10. Next Steps

The San Diego Regional Climate Action Roadmap provides a vision for how the region can reduce GHG emissions across eight sectors and is the second of three deliverables for the EPA CPRG planning grant that SANDAG received. The Roadmap can be used by local jurisdictions, regional agencies, tribal nations, CBOs, and other stakeholders to support effective regional collaboration to reduce climate pollution and pursue funding to implement the GHG reduction measures.

The San Diego region has a long history of collaboration among local governments, regional agencies, utilities, community organizations, and other stakeholders to advance shared GHG reduction goals. Building on this strong foundation will be essential to realizing the vision laid out in the Roadmap. Significant work is already underway—or about to begin—to implement the Roadmap's measures and actions. For instance, SDREN has a $124 million budget to support energy efficiency projects in the Electricity, Buildings, and Industry sectors. The San Diego Regional Energy Academy also equips community leaders, jurisdictional staff, and nonprofit partners with the knowledge and networks necessary to advance clean energy initiatives. The Academy is led by USD EPIC in partnership with SDRCC, SDG&E, and Community Power. Similarly, the County of San Diego has begun a Green Industry and High-Road Jobs initiative to help identify opportunities to attract businesses aligned with the region's GHG reduction goals to be headquartered in the region and to support workforce development.

The San Diego region is also making strides in the Transportation sector through coordinated efforts that expand access to clean mobility options. SANDAG is planning and implementing transit, active transportation, Flexible Fleets, and other programs in coordination with transit operators and local governments to provide more options for how people and goods move throughout the region. APCD's Clean Cars 4 All program and SDG&E's Pre-owned Electric Vehicle (POEV) program are helping residents replace older, higher-polluting vehicles. To reduce emissions from the Solid Waste sector, the County is developing a Circular Economy Assessment that will identify organization and regionwide opportunities to share, reuse, repair, remanufacture, and upcycle existing materials and products.

To support continued local climate action, SANDAG's Draft 2025 Regional Plan and SCS calls for SANDAG to continue to support CAP implementation and monitoring. As such, we are re-establishing our Climate Planning Services program that will support the development, update, and monitoring of local jurisdictions' CAPs. SANDAG will also work with jurisdictions and stakeholders to track and share progress through our Climate Action Data portal and through continued interagency meetings and regional workshops. The data portal will provide a transparent, publicly accessible platform for monitoring implementation of GHG reduction measures and related efforts. SANDAG will also prepare a Status Report for the EPA planning grant in June 2027, marking the end of SANDAG's CPRG grant. The Status Report will summarize the region's progress on Roadmap implementation and include any relevant updates to technical analyses in the Roadmap.

The San Diego region is well positioned for continued coordinated action and innovation. The Roadmap provides a shared vision to guide progress, align priorities, and ensure that as funding becomes available, the region is ready to act. By working together strategically and aligning efforts across agencies, our region can continue to address climate pollution and demonstrate measurable progress toward shared goals.