Appendix D:

Technical Methodology for the Roadmap Business-As-Usual Greenhouse Gas Emission Projections

Contents

1 Introduction

The business-as-usual (BAU) projections serve as baselines against which the Roadmap's Implementation Scenario can be compared (see **Appendix E**). These projections illustrate how the emissions in the San Diego region could change in the absence of new local, state, and federal actions (No-Action Business-As-Usual) or if only currently adopted state and federal legislation and regulations are implemented (Legislatively-Adjusted Business-As-Usual). SANDAG contracted with the University of San Diego School of Law's Energy Policy Initiatives Center (USD EPIC) to estimate the 2022 greenhouse gas (GHG) emissions for the San Diego region and to project GHG emissions for the years 2035 and 2045. This document details the methods to calculate both the No-Action BAU and Legislatively-Adjusted BAU projections. **Appendix E** details the methods for calculating the Implementation Scenario. The projections consider the following:

1.1 BAU Projections

1. **No-Action Business-As-Usual (BAU) Projection** showing an emissions projection of 2022 per-capita emissions levels scaled to follow forecast population changes, with no future action taken to reduce GHG emissions beyond 2022. This BAU 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.
2. **Legislatively-Adjusted BAU Projection** showing emissions reductions due to the future impacts of currently adopted legislation and regulations at the state and federal level.

To the extent possible, USD EPIC followed the same methods used in developing the GHG projections from SANDAG's Draft 2025 Regional Plan[1], with the following exceptions:

1. The No-Action BAU has been added as a secondary BAU projection
2. The impacts of the Draft 2025 Regional Plan have been removed from the Legislatively-Adjusted BAU and listed as a separate projection in the Implementation Scenario described in Appendix C
3. Impacts of California's low- and zero-emission vehicle regulations adopted through 2024 are incorporated into the Legislatively-Adjusted BAU projection

1.2 Overview of the Appendix

This appendix includes the following sections:

- **Background** provides common background information on the selection of the BAU projections.
- **Projection Results** provides the results of each BAU projection for the goal years 2035 and 2045.
- **Method to Calculate each Projection** includes subsections by BAU projection and emissions categories, which cover methods used to develop each projection.

[1] **2025 Draft Regional Plan**. SANDAG.

2 Background

2.1 BAU Projections

Under the No-Action BAU projection, GHG emissions are projected to increase based on anticipated regional growth patterns, such as population increases, with no additional action taken to reduce GHG emissions beyond 2022. This BAU 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, anticipated reductions in regional GHG emissions are expected to occur due to the future impacts of currently adopted federal and state legislations and regulations.

2.2 Demographics

SANDAG estimates and forecasts population, housing, and employment for the San Diego region. The demographic estimates and projections through 2050 are provided in **Table D.1**.[2]

Table D.1: Demographic Estimates and Projections in the San Diego Region

Year	Population	Jobs	Manufacturing Jobs*	Housing Units
2022	3,287,306	2,139,083	126,650	1,235,642
2026	3,302,237	2,160,403	120,865	1,287,570
2029	3,334,675	2,181,532	121,999	1,320,010
2032	3,373,033	2,201,223	125,751	1,346,977
2035	3,404,362	2,231,573	134,142	1,372,884
2040	3,432,211	2,289,762	149,065	1,410,615
2045**	3,416,231	2,331,407	160,579	1,424,538
2050	3,400,250	2,373,052	172,093	1,438,461

2022 population and housing data are estimates. The rest are projections based on SANDAG Series 15 Regional Growth Forecast (2025 Regional Plan)
*Manufacturing jobs are included in jobs
**2045 projection year is estimated using a straight-line interpolation between Series 15 data years 2040 and 2050.

Source: SANDAG

2.3 Rounding of Values in Tables and Figures

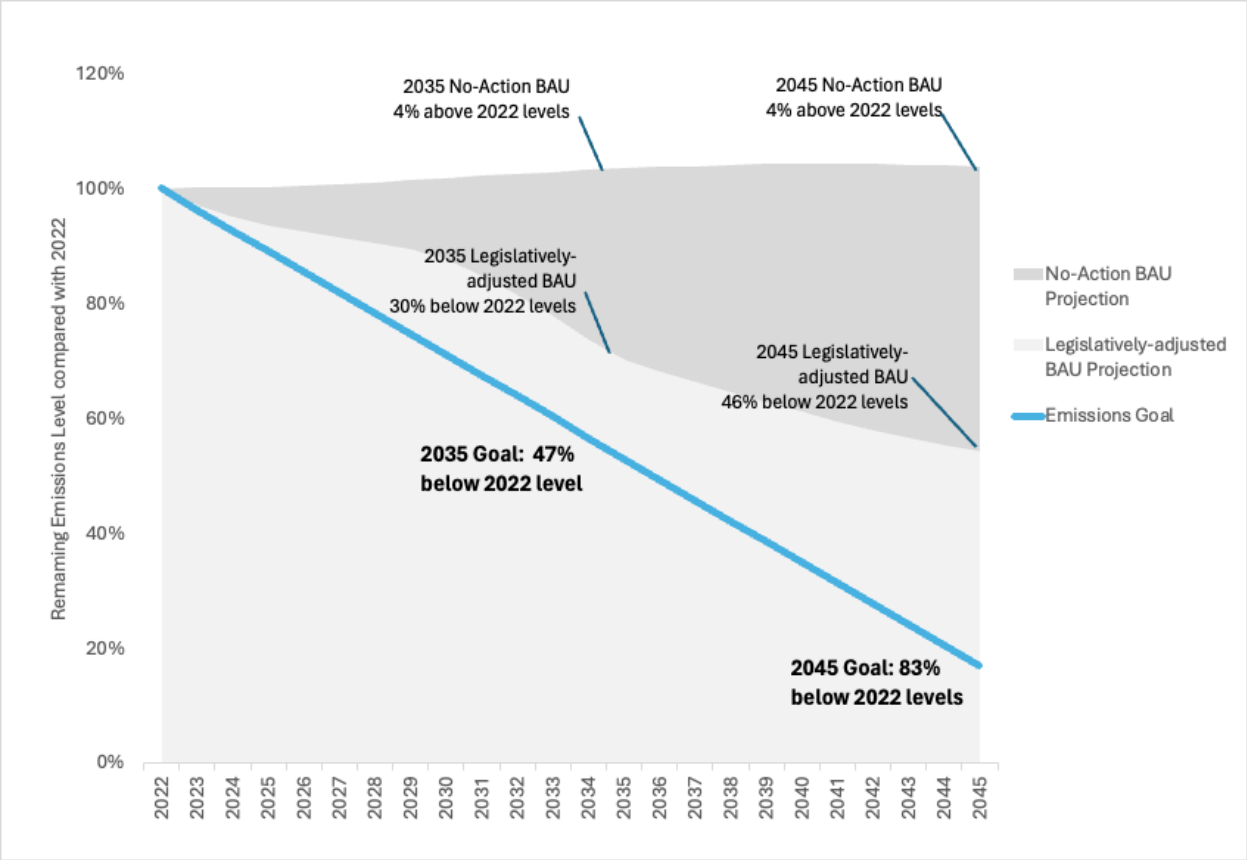
Rounding is used only for the final GHG values within the tables and figures throughout the document. Values are rounded to the nearest integer. Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values summed in any table or figure.

[2] Population, jobs, and housing estimates and projections are based on SANDAG Series 15 Regional Forecast, provided by SANDAG staff to USD EPIC, May 2024.

3 Summary of Results

Figure D.1 shows the Roadmap goals, the No-Action BAU projection, and Legislatively-Adjusted BAU projection by goal year.

Figure D.1: Roadmap BAU Projections and GHG Reduction Goals



Source: USD EPIC, 2025

Table D.2 provides a summary of the 2022 GHG inventory and the GHG projections in the San Diego region.

Table D.2: Summary of 2022 Greenhouse Gas Inventory and Projections

Greenhouse Gas Emissions (MMT CO_2e)					
		No-Action BAU		Legislatively-Adjusted BAU	
Emissions Category	**2022**	**2035**	**2045**	**2035**	**2045**
On-Road Transportation (Passenger Cars, Light Duty Vehicles, and Heavy Duty Vehicles)	7.80	10.44	10.48	6.77	3.39
Electricity	4.03	4.17	4.18	0.85	0.44

Greenhouse Gas Emissions (MMT CO_2e)					
Natural Gas	3.01	3.12	3.13	3.02	3.01
Industrial	2.40	2.48	2.49	2.54	2.79
Other Fuels	0.86	0.89	0.89	0.87	1.06
Off-Road Vehicles	0.62	0.64	0.64	0.61	0.63
Solid Waste	0.32	0.33	0.33	0.08	0.08
Aviation	0.31	0.32	0.32	0.43	0.46
Water	0.25	0.26	0.26	0.05	0.00
Agriculture	0.18	0.19	0.19	0.20	0.20
Marine Vessels	0.11	0.12	0.12	0.13	0.18
Wastewater	0.05	0.05	0.05	0.05	0.05
Rail	0.03	0.03	0.03	0.01	0.00
Total	**22.25**	**23.04**	**23.12**	**15.61**	**12.10**

MMT – million metric tons
2022 is an inventory year; 2035 and 2050 are forecast years.

Source: USD EPIC, 2025

This inventory does not include emissions from and sequestration by vegetation. This approach follows the California Air Resources Board's (CARB) approach to track statewide GHG emissions from anthropogenic activities separately from the GHG flux associated with carbon stocks in California's natural and working lands[3] and wildfire emissions. This is because wildfires are a part of Earth's carbon cycle making it challenging to determine how much of the wildfire emissions are from anthropogenic activities.[4, 5]

4 Method to Calculate the No-Action BAU Projection

The No-Action BAU projection represents no further action being taken to reduce GHG emissions beyond 2022. Instead, GHG emissions per capita are held steady and regionwide emissions fluctuate with population trends.

Table D.3: Key Inputs, Values, and Units for the No-Action BAU Projection

Key Input	Value	Unit
2022 Per Capita Emissions	6.77	MT CO_2e per capita
2022 – 2035 Population Change	3.6	%
2022 – 2045 Population Change	3.9	%

[3] CARB began a natural and working lands carbon and GHG flux assessment in 2018 based on IPCC principles. See **arb.ca.gov/nwl-inventory.**
[4] CARB: **Frequently Asked Questions: Wildfire Emissions.**
[5] 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. See **California Wildfire Burn Acreages and Preliminary Emissions Estimates**.

Key Input	Value	Unit
No-Action BAU Projected 2035 Emissions	23.04	MMT CO_2e
No-Action BAU Projected 2045 Emissions	23.12	MMT CO_2e

Source: USD EPIC, 2025

5 Method to Calculate the Legislatively-Adjusted BAU

The Legislatively-Adjusted BAU projection includes the regional effects of existing federal and state polices and regulations to reduce GHG emissions. The projected reductions are based on the current implementation timeline of these regulations. For more information on how the California 2022 Scoping Plan goals and actions that have been adopted through state law or regulation have been incorporated in the Roadmap's Legislatively-Adjusted BAU, see Table C.21 in **Appendix C**.

5.1 On-Road Transportation

The method used to develop projections is similar to the method used to estimate 2022 emissions described in **Appendix A**, based on results from an EMFAC2017 model run with SANDAG VMT (vehicle miles traveled) inputs. For forecast years, the latest EMFAC2025 model was used to include the impact of all new regulatory measures for both light-duty and heavy-duty vehicles adopted through 2024. The key new regulations incorporated into EMFAC2025 are federal multi-pollutant emissions standards for model years 2027 and later and Advanced Clean Car II for light-duty vehicles, and Federal clean trucks plan and heavy-duty phase 3 GHG rule and Clean Trucks Partnership for heavy-duty vehicles.[6]

Because different EMFAC models have different average vehicle emission rates for the same year due to modeling updates, the absolute emissions rates from EMFAC2025 are not used directly (e.g., EMFAC2017 accounts for 374 g CO_2 per mile in 2022 and EMFAC2025 accounts for 453 g CO_2 per mile in 2022). Instead, for the forecast years 2035 and 2045, the percent below the 2022 emission rate under EMFAC2025 is applied to 2022 EMFAC2017 emission rate. For example, in EMFAC2025, the 2035 emission rate is 47% below the 2022 emission rate, and the 47% is applied to the 2022 EMFAC2017 emission rate of 374 g CO_2 per mile, as shown in **Table D.4**. These adjusted emission rates are applied to SANDAG VMT inputs to calculate 2035 and 2045 emissions from on-road transportation.

Shifting from combustion vehicles to electric vehicles (EVs) adds additional electricity use from charging the vehicles. The emissions from additional EV load are added to the on-road transportation sector, based on the EV efficiency (kWh per mile) of EVs, miles driven by EVs, and the region-wide electricity emission factor (discussed in the **Electricity** section below).

Several regional programs fund or incentivize EVs and EV infrastructure development. GHG reduction estimates assume that EV adoption and EV infrastructure resulting from regional programs are already captured in the regional EV adoption rate in EMFAC2025, which also accounts for statewide EV regulations and programs. As such, a portion of the GHG reduction from achieving the EMFAC 2025 EV adoption rate is subtracted from the total and allocated to measure T-5 based on the number of EVs funded through the regional programs. These programs and GHG results are discussed in **Appendix E**.

[6] 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.

The key inputs and results are shown in **D.4**.[7]

Table D.4: Projected Greenhouse Gas Emissions from On-Road Transportation After Federal and State Regulations

Projected Greenhouse Gas Emissions from On-Road Transportation –On-Road Transportation After Federal and State Regulations		
Projection Year	**2035**	**2045**
VMT (Miles per weekday)	73,453,955	73,313,426
Average Vehicle Emission Rates (g CO_2e/mile)*	198 (47% below 2022)	78 (79% below 2022)
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)**	317 (light-duty) 304 (heavy-duty)	317 (light-duty) 305 (heavy-duty)
GHG Emissions (MT CO_2e)	5,547,000	2,196,000
Additional Emissions from EV Charging Load (MT CO_2e)	121,000	0
GHG Emissions with EV Charging Load (MT CO_2e)	5,669,000	2,196,000
GHG Reduction from Roadmap Measure T-5 (Regional Electric Vehicle and Infrastructure Programs)***	143,000	177,000
GHG Emissions (MT CO_2e)	**5,812,000**	**2,374,000**
GHG Emissions (MMT CO_2e)	**5.81**	**2.37**

*Adjusted average vehicle emission rates based on EMFAC2025 default San Diego regional results and 2022 GHG inventory on-road transportation results to factor in SANDAG VMT inputs and projections

**Conversion factors vary slightly by year and by types of vehicle

*** GHG reduction from Roadmap Measure T-5 are calculated in Appendix E

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: CARB 2025; SANDAG 2025; USD EPIC 2025

5.2 Electricity

To project emissions for the electricity category, USD EPIC estimated the impact of federal and state policies and regulations to reduce both electricity consumed as well as the emissions intensity of electricity consumed (by increasing renewable or zero-carbon electricity).

[7] VMT input files and emission output files were provided by SANDAG Staff, December 2024.

Senate Bill 100 (de León, 2018) (SB 100) increases California's Renewables Portfolio Standard (RPS) to 60% by 2030.[8] The legislation also provides goals for the years leading up to 2030 and establishes a state policy requiring eligible renewable resources and zero-carbon resources to supply 100% of all retail electricity sales by 2045. SB 1020 (Laird, 2022) then added interim targets to provide renewable energy and zero-carbon supply of all retail sales to 90% by 2035, 95% by 2040, and 100% by 2045.[9]

All load serving entities must meet these RPS requirements, including investor-owned utilities (e.g., San Diego Gas & Electric (SDG&E)), electric service providers (ESPs) for direct access (DA) customers, and Community Choice Aggregators (CCAs). USD EPIC assumed that all load serving entities would meet the 2030 and 2045 SB 100 targets.

In addition, the CCA San Diego Community Power (Community Power) started delivering power in March 2021. Community Power planned to start with 55% GHG-free (i.e., zero-carbon)[10] electricity in 2021 and to supply 100% renewable electricity no later than 2035.[11] Community Power's member cities in 2022 included the cities of San Diego, Chula Vista, Encinitas, Imperial Beach, and La Mesa. Community Power has since enrolled National City, and the unincorporated communities of San Diego County in the years following.[12] The CCA Clean Energy Alliance (CEA) has a goal to provide 100% renewable electricity to all CEA customers by 2035, which is also included in the projections here.[13] CEA's member cities include the cities of Oceanside, Carlsbad, Vista, San Marcos, Escondido, Solana Beach, and Del Mar. The projected renewable or GHG-free content and electricity emission factors for each supplier are shown in **Table D.5**.

[8] **California Senate Bill 100** (de León, 2018) (Chapter 312, Statutes of 2018).
[9] **California Senate Bill 1020** (Laird, 2022) (Chapter 361, Statues of 2022).
[10] Eligible renewables refer to energy generated by solar, wind, eligible hydroelectric, geothermal, biomass and biowaste. GHG-free and zero-carbon refer to eligible renewable sources as well as nuclear and large hydroelectric. Language in this section reflects the stated goals by respective CCAs.
[11] SDCP: **Community Choice Aggregation Implementation Plan and Statement of Intent** (2019). SDCP: **Board of Directors Meeting**, (2020), SDCP **Renewable and GHG-Free Targets**, (2025).
[12] SDCP Member Cities **Timeline**
[13] CEA: **Draft FY 2024/2025 – FY 2026/2027 Strategic Plan**.

Table D.3: Projected Renewable or Greenhouse Gas–Free Content and Emission Factors of Load Serving Entities

Projected Renewable or Greenhouse Gas–Free Content and Emission Factors of Load Serving Entities				
Retail Electricity Provider	**2030**	**2035**	**2040**	**2045**
Projected Renewable or GHG-free Content (%)*				
SDG&E Bundled	60%	90%	95%	100%
Community Power - Power On	82%	100%	100%	100%
CEA – Clean Impact	75%	100%	100%	100%
CEA – Clean Impact Plus	84%	100%	100%	100%
ESPs for Direct Access	60%	90%	95%	100%
Projected Electricity Emission Factor (lbs CO_2e/MWh)**				
SDG&E Bundled	368	92	46	0
Community Power - Power On	149	0	0	0
CEA – Clean Impact	234	0	0	0
CEA – Clean Impact Plus	55	0	0	0
ESPs for Direct Access	417	104	52	0

*Based on SB 100 RPS targets (2030 and 2045 target years), SB 1020 carbon free targets (2035 and 2040 target years), and CEC programs' implementation plans

**Calculated based on 2022 energy provider's emission factors and percent renewable provided in its 2022 Power Source Disclosure.

Source: USD EPIC, 2025

The latest California Energy Commission (CEC) California Energy Demand 2023–2040 Revised Forecast projects electricity sales in the SDG&E planning area (service area) through 2040. The electricity sales account for the impact of behind-the-meter photovoltaic (PV) and non-PV self-generation, behind-the-meter storage, current electricity rate structures, and appliance and building energy efficiency standards up to 2022.[14] USD EPIC applied the rate of increase from CEC's Demand Forecast electricity sales projection for the SDG&E planning area to the 2022 San Diego region's electricity sales. As no forecast is available after 2040, USD EPIC used the 2036–2040 average annual electricity sales increase, 1.6%, to project sales beyond 2040.

To allocate projected electricity sales to load serving entities, USD EPIC used Community Power's and CEA's specified 2023 – 2035 load forecast from their respective 2022 Integrated Resource Plans,[15,16] assumed the same proportion of DA customers, and assigned the remaining forecasted electricity load for the San Diego region to SDG&E's bundled customers. Assuming there are no additional new retail electricity suppliers in San Diego region, the projected electricity sales by supplier are shown in Table 6.

[14] CEC: **Final 2023 Integrated Energy Policy Report. California Energy Demand Forecast Update** (February 2024).
[15] San Diego Community Power **2022 Integrated Resource Plan** (November 2022)
[16] Clean Energy Alliance **2022 Integrated Resource Plan** (November 2022).

Table D.4: Projected Electricity Sales of Electric Retail Providers

Projected Electricity Sales of Retail Electricity Providers		
Retail Electricity Supplier	**2035**	**2045**
Projected Electricity Sales (GWh)		
SDG&E Bundled	4,680	4,118
San Diego Community Power	9,425	11,836
Clean Energy Alliance	1,589	1,871
ESPs for Direct Access	4,400	4,766

Figures in table represent total projected sales to each load serving entity. Breakdown of electricity sold under each power plan (i.e. Community Power-Power On versus Community Power-Power 100) assumes the same portion of customers subscribe to each power plan as 2022.

Source: USD EPIC, 2025

With the projected electricity sales and emission factor of each supplier, assuming 2022 self-serve natural gas and co-generation plants will still be operational at existing levels in the forecast years, the projected emissions are shown in **Table D.7.**

Table D.5: Projected Greenhouse Gas Emissions from Electricity

Projected Greenhouse Gas Emissions from Electricity		
Projection Year	**2035**	**2045**
GHG Emissions from Electricity Sales (MT CO_2e)*	436,500	0
GHG Emissions from Water Treatment Excluded (MT CO_2e)	-21,700	0
GHG Emissions from Rail Excluded (MT CO_2e)	-3,000	0
GHG Emissions from On-site Self-serve Electricity Generation Included (MT CO_2e)	435,600	435,600
Adjusted GHG Emissions (MT CO_2e)	**847,400**	**435,600**
GHG Emissions (MMT CO_2e)	**0.85**	**0.44**

*Electricity sales from SDG&E, Community Power, CEA, and ESPs for DA

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

5.3 Natural Gas

To project emissions for the natural gas category, USD EPIC estimated the impact of federal and state policies and regulations on reducing natural gas use using the CEC California Energy Demand 2023–2040 Forecast. The natural gas emission factor, 0.00545 MT CO_2e per therm, is a constant.

The 2023 version of the CEC California Energy Demand 2023–2040 Forecast projects natural gas sales in the SDG&E planning area through 2040.[17] The natural gas sales already account for the impact of the current natural gas rate structure, as well as appliance and building energy efficiency standards up to 2022. Unlike SDG&E's electricity service area, SDG&E's natural gas service area matches the boundaries of the San Diego region. USD EPIC applied the rate of change from the CEC Demand Forecast for the SDG&E planning area to 2022 natural gas sales for the San Diego region. Because no forecast was available after 2040, USD EPIC used the 2036–2040 average annual natural gas sales rate of change, -0.02%, as the post-2040 annual increase. Assuming the 2022 co-generation plants adjustment does not change, the projected emissions are shown in **Table D.8**.

Fugitive pipeline emissions were assumed to continue at the same percent of total natural gas delivered as 2022, at 1.85%.

Table D.6: Projected Greenhouse Gas Emissions from Natural Gas

Projected GHG Emissions from Natural Gas		
Projection Year	**2035**	**2045**
Projected Natural Gas Sales (therms)*	536,765,682	534,903,292
Natural Gas Emission Factor (MT CO_2e/therm)	0.00545	0.00545
GHG Emissions from Natural Gas Sales (MT CO_2e)	2,927,500	2,917,400
Fugitive Emissions from Natural Gas Pipelines (MT CO_2e)	54,900	−435,600
Total Adjustment for Self-Generation (moved to Electric Sector) (MT CO_2e)**	−435,600	-435,600
Total Adjustment for Utility Electricity Generation Co-Generation Thermal Output (MT CO_2e)	4,100	4,100
GHG Emissions (MT CO_2e)	**3,021,500**	**3,011,200**
GHG Emissions (MMT CO_2e)	**3.02**	**3.01**

*Estimate based on CEC 2023–2040 energy demand forecast, 2024 version

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

[17] The CEC Energy Demand Forecast has a one-year cycle for the electricity demand forecast, but a two-year cycle for the natural gas demand forecast.

5.4 Industrial

USD EPIC projected emissions for the Industrial sector based on the San Diego regional population, housing, jobs, and VMT projections. Each specific industry is projected separately based on the type of activity. For example, the emissions from transportation lubricant use were projected based on the San Diego regional VMT forecast; and the emissions from solvents and chemicals were projected based on the San Diego regional manufacturing jobs forecast. The projected emissions are shown in **Table D.9**.

Table D.7: Projected Greenhouse Gas Emissions from Industrial

Projected Greenhouse Gas Emissions from Industrial		
Projection Year	**2035**	**2045**
Population Increase Compared with 2022 (%)	4%	4%
VMT Increase Compared with 2022 (%)	4%	5%
Housing Increase Compared with 2022 (%)	11%	15%
Total Jobs Increase Compared with 2022 (%)	4%	9%
Manufacturing Jobs Change Compared with 2022 (%)	6%	27%
Construction Jobs Change Compared with 2022 (%)	5%	8%
Total GHG Emissions (MMT CO_2e)	**2.54**	**2.72**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the table, some totals may not equal the exact values equated from tables or figures.

Source: SANDAG Series 15 Regional Growth Forecast, 2025; USD EPIC, 2025

5.5 Other Fuels

Except for the agriculture sector, USD EPIC projected emissions for the other fuels sector based on the San Diego regional population, jobs, and VMT projections. The projected emissions associated with the industrial and commercial sectors were based on the manufacturing and total jobs forecast. The projected emissions associated with the residential sector were based on the population forecast. The projected emissions associated with the transportation sector were based on the VMT forecast.

For the agriculture sector, USD EPIC used Microsoft Excel's GROWTH function to project the ratio of San Diego regional to statewide agriculture revenue and applied that ratio to CARB's statewide emissions from agriculture. The GROWTH function predicts the growth using historical data, to which USD EPIC used 2016 – 2022 historical data to forecast. The projected emissions are shown in **Table D.10**.

Table D.10: Projected Greenhouse Gas Emissions from Other Fuels

Projected Greenhouse Gas Emissions from Other Fuels		
Projection Year	**2035**	**2045**
Total Agricultural GHG Emissions (MT CO_2e)	8,600	0

Projected Greenhouse Gas Emissions from Other Fuels		
Total Commercial GHG Emissions (MT CO_2e)	217,300	260,100
Total Residential GHG Emissions (MT CO_2e)	128,200	128,600
Total Transportation GHG Emissions (MT CO_2e)	30,900	31,100
Total Industrial GHG Emissions (MT CO_2e)	486,900	582,800
Total GHG Emissions (MT CO_2e)	**871,800**	**1,002,700**
Total GHG Emissions (MMT CO_2e)	**0.87**	**1.00**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

5.6 Off-Road Transportation

USD EPIC used the same OFFROAD2021 model, as used in the inventory, to generate emission projections for the subcategories, as shown in **Table D.11**.

Table D.11: Projected Greenhouse Gas Emissions from Off-Road Transportation

Projected Greenhouse Gas Emissions from Off-Road Transportation		
Projection Year	**2035**	**2045**
Airport Ground Support (MT CO_2e)	21,200	23,700
Cargo Handling Equipment (MT CO_2e)	2,500	2,800
Construction and Mining (MT CO_2e)	155,300	156,400
Industrial (MT CO_2e)	101,400	104,300
Large Spark Ignition Fleet (MT CO_2e)	87,600	87,600
Lawn and Garden (MT CO_2e)	26,200	6,900
Light Commercial (MT CO_2e)	66,800	54,900
Military Tactical Support (MT CO_2e)	20,100	20,100
Pleasure Craft (MT CO_2e)	69,500	77,000
Portable Equipment (MT CO_2e)	86,300	99,100
Recreational Vehicles (MT CO_2e)	3,600	3,900
Transportation Refrigeration Unit (MT CO_2e)	36,600	39,600
Total GHG Emissions (MT CO_2e)	**677,300**	**676,200**
Total GHG Emissions (MMT CO_2e)	**0.68**	**0.68**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: CARB: OFFROAD2021; USD EPIC, 2025

5.7 Solid Waste

USD EPIC projected the emissions, as shown in **Table D.12**. Total waste disposed is projected based on per capita waste disposal in 2022 adjusted for population growth and a reduction of organic waste to landfill by reaching SB 1383 goals of diverting 75% of 2016 organics levels from landfills by 2025. Diverting 75% of organic material would result in an overall short ton to landfill reduction of 44% by 2025. This analysis assumes that reduction is met before 2035, but does not impact the analysis done for the 2022 inventory year. The emission factor is also projected based on California reaching SB 1383 policy goals. This emission factor was calculated using the 2016 statewide waste characterization study[18] and assumes that the total tons of organics to landfill will decrease to 75% below 2016 levels by 2025. At the time of publication, the State has not completed an updated waste characterization study to track the progress towards SB 1383 goals. This analysis assumes the organics diversion requirement is met for the 2035 projection. The landfill gas capture rate of 85% is based on a default set by the San Diego County APCD to align with CARB's regulation to reduce methane emissions from active municipal landfills[19]. Because this is the default landfill gas collection efficiency used by APCD, USD EPIC used this target for 2035 and 2050 projections.

Table D.12: Projected Greenhouse Gas Emissions from Solid Waste

Projected Greenhouse Gas Emissions from Solid Waste		
Projection Year	**2035**	**2045**
Total Waste Disposal (Short tons)	1,831,122	1,818,582
Mixed Waste Emission Factor (MT CO_2e/short ton)	0.34	0.34
Landfill Gas Capture Rate	0.85	0.85
Oxidation Rate	0.10	0.10
Total GHG Emissions (MT CO_2e)	**84,200**	**83,600**
Total GHG Emissions (MMT CO_2e)	**0.08**	**0.08**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

[18] CalRecycle: **2016 Statewide Waste Characterization Study**.
[19] San Diego County APCD **Landfill Operations Emissions Inventory Request**.

5.8 Civil Aviation

To project emissions for the civil aviation category, USD EPIC applied the rate of increase of the projected passengers[20] served at SAN to the 2018 aircraft emissions using the constrained projection.[21] For McClellan-Palomar Airport (CRQ), the projected 2036 aircraft emissions for the "proposed project alternative" (middle scenario) under the proposed CRQ Master Plan are used directly and kept fixed through 2050.[22] For the remaining County municipal and private airports, a growth forecast was used based on operations from 2016 – 2023[23] as no passenger projections were available. The projected emissions are shown in **Table D.13**.

Table D.13: 2022 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Civil Aviation

2022 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Civil Aviation			
Year	**2022**	**2035**	**2045**
SAN GHG Emissions (MT CO_2e)	289,200	392,800	409,700
CRQ GHG Emissions (MT CO_2e)	14,200	34,700	36,400
County Airports GHG Emissions (MT CO_2e)	6,100	6,900	7,400
Total GHG Emissions (MT CO_2e)	**309,500**	**434,400**	**453,500**
Total GHG Emissions (MMT CO_2e)	**0.31**	**0.43**	**0.45**

SAN: San Diego International Airport; CRQ: McClellan-Palomar Airport; County Airports refer to Gillespie Field, Fallbrook Airpark, Ramona Airport, Borrego Valley Airport, Agua Caliente Airport, and Jacumba Airport.

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

5.9 Water

To project emissions for the water category, USD EPIC estimated the impact of state policies and regulations on reducing the electricity emission factor (increasing renewable or zero-carbon electricity) and increasing water efficiency, respectively.

As discussed in the **Electricity** section, all load serving entities must meet the RPS requirement of 60% renewable electricity by 2030 and 100% renewable or zero-carbon electricity by 2045. USD EPIC assumed all load serving entities that provide electricity for water supply and treatment will meet the 2030 and 2045 RPS targets as well as the SB 1020 requirement to provide 90% of retail electricity supply from renewable or zero-carbon energy sources by 2035, 95% by 2040, and 100% by 2045.

[20] **Aviation Activity Forecast Update**. San Diego International Airport. (2019).
[21] The constrained projection is based on SDIA's single runway capacity. The unconstrained projection is based on airport demand.
[22] CRQ Master Plan Update PEIR: **Appendix H – Climate Change Technical Report** (2018).
[23] **Operations Counts**. San Diego County Department of Public Works.

The San Diego County Water Authority (SDCWA) preliminary 2020 Urban Water Management Plan estimates the long-range water demand in its service area through 2045. The water demand forecasts include a baseline demand forecast (based on the SANDAG projected growth forecast, local weather data, historical water use, and retail rates) and a long-range demand forecast with additional water conservation savings. The additional water conservation savings include both "active" program savings (from implementation of water conservation programs) and "passive" code-based water savings (future savings from appliance standards, plumbing code changes, and updated Model Water Efficient Landscape Ordinances).[24] USD EPIC applied the long-range demand forecast rate of increase to the 2022 water demand to be consistent with the projection methods in other emissions categories. Assuming the water-energy intensities are fixed, the projected emissions are shown in **Table D.14**.

SDCWA's long-range water demand forecast indicated a significant portion of increased demand would be served using potable reuse from the City of San Diego's Pure Water facility and East County Advanced Water Purification (AWP) facility. To achieve drinking water quality, the treated water (tertiary level) undergoes a subsequent advanced treatment. The energy intensity used for the Pure Water and AWP facilities includes just the advanced water treatment stage.

[24] SDCWA Water Planning and Environmental Committee May 19, 2021, Meeting: **Adoption of Resolution No. 2021- to approve Water Authority's 2020 Urban Water Management Plan, Water Shortage Contingency Plan**, accessed February 2025.

Table D.14: Projected Greenhouse Gas Emissions from Water

Projected Greenhouse Gas Emissions from Water		
Projection Year	**2035**	**2045**
Projected Upstream Emissions		
Imported Treated Water (Acre-feet)	129,036	141,853
Imported Raw Water (Acre-feet)	245,436	269,814
California Average Emission Factor (lbs CO_2e/MWh)	78	0
Upstream Emissions (MT CO_2e)*	23,700	0
Projected Local Emissions		
Water Treated at Local Water Treatment Plants (Acre-feet)	321,595	342,473
Water Further Treated to Potable Reuse (Acre-feet)**	112,562	112,562
Water Treated with Desalinization (Acre-feet)	6,000	6,000
Local Emissions (MT CO_2e)***	21,700	0
Projected Total Emissions		
Total (Upstream + Local) Emissions (MT CO_2e)	**45,400**	**0**
Total Emissions (MMT CO_2e)	**0.05**	**0.00**

*Assume upstream energy intensities 1,862 kWh/acre-foot(AF) for imported treated water and 1,817 kWh/acre-foot for imported untreated water remain unchanged (Appendix A Table 14).
Energy intensity and water treatment quantities used for Pure Water Facility is 1,173kWh/AF (Pure Water EIR**) and for AWP is 1,584kWh/AF (based on project-specific information provided to USD EPIC).
***Assume energy intensities at local water treatment plants remain unchanged (Appendix A Table 1).

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

5.10 Marine Vessels

The CARB OFFROAD2021 model was used to project emissions for the marine vessel category.[25] The emissions from the OFFROAD2021 database include the impacts of adopted rules and regulations in each subcategory, as shown below:

- California OGV Fuel Regulation (beginning in 2009) and North American Emission Control Area (beginning in 2015)
- OGV At-Berth CARB Approved Emission Control Strategy Regulation (2020) and compliance reporting

The projected emissions are shown in **Table D.15**.

[25] CARB: **Emissions Inventory Offroad Emissions**, accessed January 2025.

Table D.15: Projected Greenhouse Gas Emissions from Marine Vessels

Projected Greenhouse Gas Emissions from Marine Vessels		
Year	**2035**	**2045**
Projected Emissions from Ocean-Going Vessel Emissions from OFFROAD Compared with 2022*	178,900	210,800
Projected Emisisons from Commercial Harbor Craft Emissions from OFFROAD Compared with 2022*	63,400	63,100
Total GHG Emissions (MT CO_2e)	**242,400**	**273,900**
Total GHG Emissions (MMT CO_2e)	**0.24**	**0.27**

*San Diego region only. Emissions in OFFROAD2021 database are reported in tons per day.

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: OFFROAD2021, USD EPIC, 2025

5.11 Agriculture

This inventory uses the Microsoft Excel GROWTH function to estimate the cattle population using historical cattle population data from 2016 – 2022.[26] USD EPIC projected both enteric fermentation and manure management emission estimates to 2050 based on the estimated cattle population, because the emissions from cattle constitute 95% of enteric fermentation and manure management emissions. Agricultural equipment used projections from CARB's OFFROAD2021 directly, details of which can be found in the **Off-Road Transportation** section. Emissions from soil management were projected using the Series 15 Regional Forecast of agricultural acreage.[27] Projected emissions are shown in **Table D.16**.

Table D.16: Projected Emissions from Agriculture

Projected Emissions from Agriculture		
Projection Year	**2035**	**2050**
Enteric Fermentation (MT CO_2e)	37,200	39,000
Manure Management (MT CO_2e)	42,500	44,600
Agricultural Equipment (MT CO_2e)	68,200	64,700
Soil Management (Nitrogen and Carbon Inputs)(MT CO_2e)	54,400	56,400
Total GHG Emission (MT CO_2e)	**202,300**	**204,700**
Total GHG Emission (MMT CO_2e)	**0.20**	**0.20**

[26] USDA. Total Head of Cattle in San Diego County. National Agricultural Statistics Service.
[27] SANDAG. Series 15 Regional Forecast.

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2025

5.12 Wastewater

To project emissions for the wastewater category, USD EPIC applied the population rate of increase from 2022 to 2050 to the 2022 wastewater emissions. The projected emissions are shown in **Table D.17.**

Table D.17: Projected Greenhouse Gas Emissions from Wastewater

Projected Greenhouse Gas Emissions from Wastewater		
Year	**2035**	**2045**
San Diego Region Population*	3,404,362	3,416,231
Population Increase Compared with 2022 (%)	3.6%	3.9%
Total GHG Emissions (MT CO_2e)	**50,800**	**50,900**
Total GHG Emissions (MMT CO_2e)	**0.05**	**0.05**

*Population forecast is from SANDAG Series 15 Growth Forecast, as shown in **Table D.1**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: USD EPIC, 2021

5.13 Rail

USD EPIC used the emissions projection from CARB's OFFROAD 2021 model directly to project emissions from freight and other inter-regional locomotive emissions. For intra-regional light rail, USD EPIC used the rate of change of emissions projected for passenger rail in the OFFROAD 2021 model and scaled 2022 emissions from fuel use accordingly. CARB includes an assumption that 64% of passenger rail fleets and 82% of all other locomotive fleets will be electrified by 2050. Key inputs and GHG emissions from rail are listed in **Table D.18**. Emissions from electric rail are based on an assumption that 1 gallon of locomotive diesel is equivalent to 40.7 kWh. SDG&E bundled emission factors were used as a default assumption for the projection year.

Table D.8: Projected Greenhouse Gas Emissions from Rail

Projected Greenhouse Gas Emissions from Rail		
Projection Year	**2035**	**2045**
Freight and Other Inter-Regional Diesel Rail (OFFROAD) (MT CO_2e)	800	600
Freight and Other Inter-Regional Electric Rail (OFFROAD) (MT CO_2e)	300	0
Percent of Freight and Other Inter-Regional Rail Population Electrified (OFFROAD)	71%	78%
Intra-Regional Diesel Light Rail (MT CO_2e)	4,900	65
Intra-Regional Electric Light Rail (MT CO_2e)	2,700	0
Percent of Passenger Rail Population Electrified (OFFROAD)	14%	47%
Total Emissions from Rail (MT CO_2e)	**8,700**	**700**
Total Emissions from Rail (MMT CO_2e)	**0.01**	**0.001**

Values are not rounded in the intermediary steps in the actual calculation. Because of rounding of the values in the tables, some totals may not equal the exact values equated from tables or figures.

Source: CARB 2021, USD EPIC, 2025