# Appendix G: 2022 Greenhouse Gas Emissions Inventory and Projections for the San Diego Region

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# 2022 Greenhouse Gas Inventory and Projections for the San Diego Region

## Introduction

SANDAG contracted the Energy Policy Initiatives Center (EPIC) at the University of San Diego (USD) to estimate the 2022 greenhouse gas (GHG) emissions for the San Diego region and to project GHG emissions for the years 2035 and 2050. The projections consider the effect of existing federal and California regulations and regional policies and programs to reduce GHG emissions. GHG emissions estimates and projections are included in the 2025 Regional Plan and its associated Environmental Impact Report (EIR). This appendix summarizes the methodologies and data used to conduct this analysis.

To the extent possible, EPIC followed the same methods used in developing the 2016 GHG emissions inventory and projections t 2021 Regional Plan.[1] Where appropriate, methodologies have been updated and documented in this appendix in accordance with the latest best practices and protocols. The 2022 GHG inventory and projections include 15 categories of emissions calculated based on the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions and California Air Resources Board (CARB) California statewide GHG inventory methodology.

### Overview

This appendix includes the following sections:

- Background provides common background sources and assumptions used for the inventory and projections.
- Summary of Results provides the results of the 2022 GHG inventory and the GHG projections.
- Method Used to Calculate Emissions Inventory and Projections by Category includes subsections that cover the methods used to develop the inventory and projections by emissions category. Each subsection also describes how the methods to calculate the 2022 inventory may vary from those used in the previous 2016 GHG inventory.

[1] SANDAG: San Diego Forward: 2021 Regional Plan, Appendix X (2021).

# Background

## Greenhouse Gases

The primary GHGs included in this document are carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$); others are included where data is available. Each GHG has a different capacity to trap heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to $CO_2$ and expressed in carbon dioxide equivalents ($CO_2e$). The 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used by CARB to estimate GHG emissions inventories statewide.[2] The GWPs in this document are from the IPCC Fourth Assessment Report (AR4), provided in Table G.1.[3] The IPCC AR4 values were used in lieu of updated values from the Sixth Assessment Report (AR6) to be consistent with California's statewide GHG inventory, which uses AR4 values to maintain year over year consistency.

### Table G.1: Global Warming Potentials in the Regional GHG Inventory and Projections

| Greenhouse Gas | Global Warming Potential |
|---|---|
| Carbon dioxide ($CO_2$) | 1 |
| Methane ($CH_4$) | 25 |
| Nitrous oxide ($N_2O$) | 298 |
| Difluoromethane (HFC-32) | 675 |
| 1,1,1,2-Tetrafluoroethane (HFC-134a) | 1,430 |
| Pentafluoroethane (HFC-125) | 3,500 |
| 1,1,1-Trifluoroethane (HFC-143a) | 4,470 |
| Carbon tetrafluoride ($CF_4$) | 7,390 |
| Octafluoropropane ($C_3F_8$) | 8,830 |
| 1,1,1,3,3,3-Hexafluoropropane (HFC – 236fa) | 9,810 |
| Octafluorocyclobutane ($C_4F_8$) | 10,300 |
| Hexafluoroethane ($C_2F_6$) | 12,200 |
| Fluoroform (HFC-23) | 14,800 |
| Nitrogen trifluoride ($NF_3$) | 17,200 |
| Sulfur hexafluoride ($SF_6$) | 22,800 |

*Source: IPCC 2013*

[2] CARB: Current California GHG Emission Inventory Data. 2000–2022 GHG Inventory (2024 Edition).
[3] IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials (2013).

### 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 G.2.[4]

#### Table G.2: Demographic Estimates and Projections in the San Diego Region

| Year | Population | Total Jobs | Manufacturing Jobs | Wage and Salary Jobs | Housing Units |
|---|---|---|---|---|---|
| 2022 | 3,287,306 | 2,139,083 | 126,650 | 1,611,632 | 1,235,642 |
| 2035 | 3,404,362 | 2,231,573 | 134,142 | 1,678,929 | 1,372,884 |
| 2050 | 3,400,250 | 2,373,052 | 172,093 | 1,782,389 | 1,438,461 |

*Notes: Manufacturing Jobs and Wage and Salary Jobs are included in Total Jobs; 2022 population and housing data are estimates. The rest are* projections based on SANDAG Series 15 Regional Growth Forecast (2025 Regional Plan).

*Source: SANDAG*

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

## Summary of Results

#### Table G.3: Summary of 2022 GHG Inventory and Projections (Million Metric Tons [MMT] CO2e)

| Emissions Category | 2022 | 2035 | 2050 |
|---|---|---|---|
| Passenger Cars and Light Duty Vehicles | 7.80 | 5.68 | 5.32 |
| Electricity | 4.03 | 0.85 | 0.44 |
| Natural Gas | 3.01 | 3.02 | 3.01 |
| Industrial | 2.40 | 2.54 | 2.79 |
| Heavy Duty Trucks and Other Vehicles | 2.28 | 2.14 | 2.17 |
| Other Fuels | 0.86 | 0.87 | 1.06 |
| Off-Road Vehicles | 0.62 | 0.61 | 0.63 |
| Solid Waste | 0.32 | 0.08 | 0.08 |
| Aviation | 0.31 | 0.43 | 0.46 |
| Water | 0.25 | 0.05 | 0.00 |
| Agriculture | 0.18 | 0.20 | 0.20 |
| Marine Vessels | 0.11 | 0.13 | 0.18 |
| Wastewater | 0.05 | 0.05 | 0.05 |

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

| Emissions Category | 2022 | 2035 | 2050 |
|---|---|---|---|
| Rail | 0.03 | 0.01 | 0.00 |
| **Total** | **22.25** | **16.67** | **16.40** |

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

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| Wastewater | 0.05 | 0.05 | 0.05 |
| Rail | 0.03 | 0.01 | 0.00 |
| **Total** | **22.25** | **16.67** | **16.40** |

*Note: 2022 is an inventory year; 2035 and 2050 are forecast years. The GHG emissions projections include the impact of federal and state regulations and regional policies and programs to reduce GHG emissions.*

*Source: EPIC, USD 2025*

This inventory does not include emissions from and sequestration to vegetation, which follows CARB's 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[5] and wildfire emissions. This is because wildfires are part of Earth's carbon cycle and it is difficult to determine how much of the wildfire emissions are from anthropogenic activities.[6,7]

[5] CARB began a natural and working lands carbon and GHG flux assessment in 2018 based on IPCC principles. See arb.ca.gov/nwl-inventory.

[6] CARB: Frequently Asked Questions: Wildfire Emissions.

[7] 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.

The forecast includes the regional effects of existing federal and state policies and regulations to reduce GHG emissions. The projected reductions are based on the current implementation timeline of these regulations.

## Method to Calculate Emissions Inventory and Projections by Category

### On-Road Transportation – Passenger Car and Light-Duty Vehicles

The passenger car and light-duty vehicle emissions category includes tailpipe GHG emissions resulting from fossil fuel combustion (i.e., gasoline, diesel, natural gas) in mobile vehicles on freeways, highways, and local roads. This passenger car and light-duty vehicles emissions category covers the GHG emissions from EMFAC2017 vehicle classes LDA, LDT1, LDT2, and MDV.[8] The GHG emissions from other on-road vehicles are accounted for in the subsection titled Difference from Previous 2016 Inventory

Methods to estimate emissions from the Industrial sector are the same in both the 2016 and 2022 inventories. However, the "2A: Mineral Industry" category was added as census data indicated there were employment and establishments operating in 2022. Additionally, instead of using broader employment categories to develop ratios for scaling statewide data, data from North American Industry Classification System (NAICS) codes related to the specific activity were used where available to create more relevant employment-based scaling factors.

On-Road Transportation – Heavy-Duty Trucks and Other Vehicles. Passenger car and light-duty vehicle emissions are the largest contributor of GHG emissions in the San Diego region, accounting for about 35% of total GHG emissions in the 2022 inventory and 33% of total GHG emissions in the 2050 projection.

#### Method Used to Estimate 2022 Emissions

SANDAG developed an updated activity-based model (ABM15.2.1), which estimates the vehicle miles traveled on an average weekday by vehicle type. Modeling generated estimates for the year 2022 and forecasted values for years 2026, 2029, 2032, 2035, 2040, and 2050. EMFAC2017, CARB's on-road mobile sources emissions model, was used to estimate emissions for passenger cars and light-duty vehicles.[9] EMFAC 2017 was used to maintain consistency with the 2025 Regional Plan air quality conformity analysis. The EMFAC model provides $CO_2$ emissions in tons per a typical Monday through Friday weekday for each vehicle category and each fuel type. CARB creates this model using fuel sales, smog testing data, and vehicle registration data to model the current and projected emissions intensity of cars on the road in the San Diego region.

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[8] LDA: passenger cars; LDT1: light-duty trucks with (GVWR) less than 6,000 lbs. and equivalent test weight (ETW) no larger than 3,750 lbs.; LDT2: light-duty trucks with GVWR less than 6,000 lbs. and ETW between 3,750 and 5,750 lbs.; and MDV: medium-duty trucks with GVWR between 6,000 and 8,500 lbs.

[9] CARB: Mobile Source Emissions Inventory. EMFAC 2017.

To convert the emissions output from tons of $CO_2$ per typical weekday to metric tons of $CO_2e$ per year, EPIC used the weekday-to-year conversion factor and $CO_2$-to-$CO_2e$ ($CO_2$, $CH_4$, and $N_2O$) conversion factor for each EMFAC vehicle category, based on statewide GHG inventory assumptions and EMFAC2017 default run results, respectively.[10] The weekday-to-annual conversion factors for LDA, LDT1, LDT2, and MDV are all 347 weekdays per year. The $CO_2$ to $CO_2e$ conversion factors range from 1.01 for gasoline LDA to 1.05 for diesel LDA.[11] The key inputs and results are shown in Table G.4.

### Table G.4: Key Inputs and 2022 GHG Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles

| Key Inputs and Emissions | 2022 Results |
|---|---|
| Vehicle Miles Traveled (VMT) (Miles per weekday)* | 71,244,124 |
| $CO_2$ Emissions (Tons per weekday)** | 24,543 |
| Conversion Factor (Tons $CO_2$ per weekday to MT $CO_2e$ per year) | 318 |
| GHG Emissions (MT $CO_2e$) | 7,804,900 |
| **GHG Emissions (MMT $CO_2e$)** | **7.80** |

*Notes: *SANDAG ABM15.2.1 VMT; **EMFAC2017 model run with custom VMT inputs from ABM15.2.1; Passenger car and light-duty vehicles are EMFAC2017 vehicle classes LDA, LDT1, LDT2, and MDV; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: CARB 2021; SANDAG 2025; EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

The method used to develop projections is similar to the method used to estimate 2022 emissions, based on an EMFAC2017 model run with SANDAG VMT inputs. For forecast years, EMFAC2017 model results include the effect of all key federal and state laws, regulations, and legislative actions that were adopted as of December 2017. The updated regulations for passenger cars and light-duty vehicles since the release of EMFAC2017 are the California Advanced Clean Car (ACC) and Advanced Clean Car II (ACCII) programs, which includes:

- Tailpipe emissions standards equivalent to Corporate Average Fuel Economy (CAFE) standards for vehicle model years 2017–2025.
- A zero-emission vehicle (ZEV) regulation that requires manufacturers to produce increasing numbers of ZEVs and plug-in hybrid electric vehicles for model years 2017–2025.
- Low- and zero-emission vehicle standards for model years 2026-2035 that contribute to meeting federal ambient air quality ozone standards and California's carbon neutrality targets through ACCII.

These regulations are not reflected in EMFAC2017 model runs or the projected GHG emissions.

[10] This approach is recommended by CARB EMFAC staff. Personal communication, January 27, 2020.
[11] The weekday-to-year conversion factors are based on CARB's **California's 2004–2014 Greenhouse Gas Emission Inventory Technical Support Document. 2016 Edition**. The $CO_2$-to-$CO_2e$ conversion factors are based on EMFAC2017 default 2016 emissions run for San Diego region by vehicle category and fuel type, March 2025, model run.

With the same tons of $CO_2$ per weekday to MT $CO_2e$ per year conversion method discussed in the previous inventory method section, the key inputs and results are shown in Table G.5.[12]

### Table G.5: Projected GHG Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations

| Projection Year | 2035 | 2050 |
|---|---|---|
| VMT (Miles per weekday) | 73,453,955 | 73,313,426 |
| $CO_2$ Emissions (Tons per weekday)* | 17,905 | 16,758 |
| Conversion Factor (Tons $CO_2$ per weekday to MT $CO_2e$ per year)** | 317 | 317 |
| GHG Emissions (MT $CO_2e$) | 5,684,000 | 5,320,600 |
| **GHG Emissions (MMT $CO_2e$)** | **5.68** | **5.32** |

*Notes: *Conversion factors vary slightly by year; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: CARB 2016, 2017; SANDAG 2025; EPIC, USD 2025*

The VMT projected using the SANDAG's ABM does not capture the miles and trips avoided as a result of SANDAG's off-model strategies in the 2025 Regional Plan, which include shared mobility strategies (i.e., carshare and vanpool).

The detailed strategy descriptions and the methods to estimate resulting $CO_2$ reductions are provided in Appendix M: Travel Demand Modeling Tools. EPIC converted the weekday $CO_2$ reductions to annual $CO_2e$ reductions using the same conversion method as described above. To be consistent with Appendix M, the results for or off-model strategies presented here only include the GHG reductions from running exhaust and starting exhaust processes. The projected GHG reductions from shared mobility strategies are shown in Table G.6.

### Table G.6: Projected GHG Reductions from SANDAG Shared Mobility Off-Model Strategies

| Projection Year | 2035 | 2050 |
|---|---|---|
| GHG Reduction from Car Share Program (MT $CO_2$ per year)* | 10,900 | 0 |
| GHG Reduction from Van Pool Program (MT $CO_2$ per year)* | 25,100 | 24,604 |
| Conversion Factor (MT $CO_2e$ per MT $CO_2$)** | 1.01 | 1.01 |
| GHG Reduction from SANDAG Off-Model Strategies (MT $CO_2e$) | 36,300 | 24,800 |
| **GHG Reduction from SANDAG Off-Model Strategies (MMT $CO_2e$)** | **0.36** | **0.25** |

*Notes: *GHG reduction from the programs and program design are described in Appendix M of the 2025 Regional Plan; **EMFAC2017 assumptions for passenger car and light-duty vehicle classes: LDA, LDT1, LDT2, and MDV; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source:CARB 2017; SANDAG 2025; EPIC, USD 2025*

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

### Difference from Previous 2016 Inventory

Methods to estimate emissions from passenger cars and light-duty vehicles are the same in 2016 and 2022 regional GHG inventories. However, the previous version of the SANDAG ABM (ABM2+) was used to calculate the 2016 GHG emissions. ABM15.2.1 is used for analysis related to the 2025 Regional Plan (additional information included in Appendix M). Additionally, the previous projected emissions from passenger vehicles included two different variations: one that analyzed the anticipated emissions impact with the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rules and one that omitted the anticipated increase in emissions from SAFE Vehicle Rules. As the National Highway Traffic Safety Administration repealed the SAFE rule in 2022, only one projection is provided in this analysis.

## Electricity

The electricity category accounts for emissions from regional electricity consumption. GHG emissions from electricity use in the region account for 18% of total emissions in the 2022 inventory and 3% in the 2050 projection.

### Method Used to Estimate 2022 Emissions

To estimate GHG emissions from grid-supplied electricity use, EPIC adjusted 2022 electricity sales to reflect transmission and distribution losses and multiplied the adjusted sales by the electricity emission factor for the respective electricity provider, expressed in pounds of $CO_2e$ per megawatt-hour (lbs. $CO_2e$/MWh).

The local utility, San Diego Gas & Electric (SDG&E), provided 2022 San Diego regional electricity sales data separately by bundled customers (i.e., receiving both energy and delivery from SDG&E), Direct Access (DA) customers (i.e., receiving energy from an energy service provider and delivery from SDG&E), and Community Choice Aggregation (CCA)(i.e., receiving energy from a CCA and delivery from SDG&E) for each customer class. The San Diego regional electricity sales data account for electricity sales to all local jurisdictions, including military bases and tribal reservations.[13] The transmission and distribution loss factor, 0.082, is the loss estimate for the entire SDG&E service territory (larger than San Diego region) and accounts for the difference between electricity generated for load and electricity sales.[14]

SDG&E, CCAs, and electric service providers (ESPs) for DA customers have different power mixes in their electricity supplies. The SDG&E 2022 bundled and CCA electricity supply emission factors were retrieved from the California Energy Commission (CEC) Power Source Disclosure Program. Table G.7 documents each load serving entity's respective 2022 reported emission factors. The DA emission factor, 641 lbs. $CO_2e$/MWh, was calculated using a statewide average of all ESP's emission factors weighted by total energy supplied, also retrieved from the CEC's Power Source Disclosure Program.[15]

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[13] Electricity sales data provided by SDG&E to EPIC, February 2025.

[14] Loss factor is from CEC Energy Demand 2023 Forecast. For each forecast cycle, utilities provide the estimates, which remain relatively stable.

[15] CEC. Power Source Disclosure Program data.

### Table G.7: San Diego Regional 2022 Emission Factors

| Load Serving Entity/ Service Option | lbs. $CO_2e$/ MWh |
|---|---|
| SDG&E Bundled[16] | 508 |
| San Diego Community Power – Power On[17] | 375 |
| San Diego Community Power – Power 100 | 0 |
| Clean Energy Alliance – Clean Impact Power[18] | 472 |
| Clean Energy Alliance – Clean Impact Power Plus | 143 |
| Clean Energy Alliance – Green Impact Power | 0 |
| Direct Access Energy Service Providers | 641 |

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

*Source: CEC 2024; EPIC, USD 2025*

Three adjustments are made to the emissions estimate for grid-supplied electricity:

- Emissions associated with electricity use at water treatment plants in the San Diego region were allocated to the water category and removed from the electricity category. The method used to identify electricity use at water treatment plants is discussed in the Difference from Previous 2016 Inventory

In the 2016 inventory, EPIC used the 2016 waste characterization studies from the cities of Chula Vista, Oceanside, and San Diego to estimate the waste composition in the region. To reflect regulations impacting the composition of organic waste in the landfill, the more recent 2021 statewide waste composition study was used.

## Civil Aviation

The GHG emissions from commercial aviation operations account for 1.4% of total emissions in the 2022 inventory and 2.8% in the 2050 projection. The San Diego International Airport (SAN) and McClellan-Palomar Airport (CRQ) are the only airports in the San Diego region in 2022 with scheduled commercial flight services. The County of San Diego governs CRQ as well as the remaining municipal and private airports in the region: Gillespie Field, Fallbrook Airpark, Ramona Airport, Borrego Valley Airport, Agua Caliente Airport, and Jacumba Airport. GHG emissions in this category are from the combustion of jet fuel and aviation gasoline used by aircraft operating in the Landing and Takeoff (LTO) Cycle.

### Method Used to Estimate 2022 Emissions

EPIC used the aircraft emissions reported by the following entities:

- SAN: 2018 GHG Emissions from San Diego International's Final Environmental Impact Report GHG Emissions Inventory for Proposed Airfield Improvements and Terminal 1 Replacement Project (SAN EIR). GHG emissions were estimated for 2022 using SAN reported enplanement data from 2018 to 2022.

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[16] SDG&E 2022 Power Content Label.

[17] SDCP 2022 Power Content Label.

[18] CEA 2022 Power Content Label.

- CRQ: 2016 Emissions Inventory developed for the McClellan-Palomar Airport Master Plan Update (PEIR). GHG emissions were estimated for 2022 using FAA airport operations data.
- San Diego County Municipal and Private Airfields: The remaining SD County aviation emissions for municipal and private airfields were taken from the GHG inventory included in the County of San Diego Draft Airports Sustainability Management Plan. Aviation emissions specified to be for military use were delineated and omitted.

The aircraft emissions in the SAN EIR followed Federal Aviation Administration guidelines and include aircraft emissions from the LTO cycle, which include aircraft start-up, taxi and delay, take-off, climb-out, up to mixing height (3,000 feet), approach, landing, and taxi to gate. These emissions differ from what is published in the SAN 2022 GHG Inventory, as SAN now participates in the Airports Council International's Airport Carbon Accreditation (ACA) program and uses an expanded boundary (full flight emissions) to quantify emissions. To maintain consistency with the boundaries of this inventory (regional), FAA guidelines, and the emissions boundaries of the other airports in the San Diego region that used LTO emissions boundaries, LTO emissions for SAN were estimated using available data described above.

Of the total regional aircraft emissions in 2022, SAN accounted for 93%, CRQ for 5%, and County Municipal airports for 2%. Because methods used to estimate inventory year and projection year emissions are similar, inventory and projection emissions are shown together in Table G.25.

### Method Used to Develop Emissions Projections

To project emissions for the civil aviation category, EPIC applied the rate of increase of the projected passengers served at SAN to the 2018 aircraft emissions using the constrained projection. For 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. For the remaining County municipal and private airports, a growth forecast was used based on operations from 2016 – 2023 as no passenger projections were available. The projected emissions are shown in Table G.25

### Table G.25: 2022 GHG Emissions and Projected GHG Emissions from Civil Aviation

| Year | 2022 | 2035 | 2050 |
|---|---|---|---|
| SAN GHG Emissions (MT $CO_2$e) | 289,200 | 392,800 | 418,100 |
| CRQ GHG Emissions (MT $CO_2$e) | 14,200 | 34,700 | 36,400 |
| County Airports GHG Emissions (MT $CO_2$e) | 6,100 | 6,900 | 7,600 |
| Total GHG Emissions (MT $CO_2$e) | 309,500 | 434,400 | 462,200 |
| **Total GHG Emissions (MMT $CO_2$e)** | **0.31** | **0.43** | **0.46** |

*Notes: 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, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

### Difference from Previous 2016 Inventory

In both 2016 and 2022 inventories, EPIC used emissions from SAN and CRQ GHG Inventories. However, the 2016 SAN GHG Inventory used the LTO methodology, and the 2022 SAN GHG Inventory used full flight emissions. Therefore, 2018 SAN GHG emissions from their Terminal expansion EIR (with LTO methodology) were used to estimate 2022 SAN emissions. Additionally, the 2016 inventory did not include County municipal and private airports.

- Water section of this appendix.

### Emissions associated with electric commuter rail in the San Diego region were allocated to the rail category and removed from the electricity category. The method used to identify electricity use for commuter rail is discussed in the Difference from Previous 2016 Inventory

In the 2016 inventory, EPIC used the 2016 waste characterization studies from the cities of Chula Vista, Oceanside, and San Diego to estimate the waste composition in the region. To reflect regulations impacting the composition of organic waste in the landfill, the more recent 2021 statewide waste composition study was used.

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### Method Used to Estimate 2022 Emissions

EPIC used the aircraft emissions reported by the following entities:

- SAN: 2018 GHG Emissions from San Diego International's Final Environmental Impact Report GHG Emissions Inventory for Proposed Airfield Improvements and Terminal 1 Replacement Project (SAN EIR). GHG emissions were estimated for 2022 using SAN reported enplanement data from 2018 to 2022.
- CRQ: 2016 Emissions Inventory developed for the McClellan-Palomar Airport Master Plan Update (PEIR). GHG emissions were estimated for 2022 using FAA airport operations data.
- San Diego County Municipal and Private Airfields: The remaining SD County aviation emissions for municipal and private airfields were taken from the GHG inventory included in the County of San Diego Draft Airports Sustainability Management Plan. Aviation emissions specified to be for military use were delineated and omitted.

The aircraft emissions in the SAN EIR followed Federal Aviation Administration guidelines and include aircraft emissions from the LTO cycle, which include aircraft start-up, taxi and delay, take-off, climb-out, up to mixing height (3,000 feet), approach, landing, and taxi to gate. These emissions differ from what is published in the SAN 2022 GHG Inventory, as SAN now participates in the Airports Council International's Airport Carbon Accreditation (ACA) program and uses an expanded boundary (full flight emissions) to quantify emissions. To maintain consistency with the boundaries of this inventory (regional), FAA guidelines, and the emissions boundaries of the other airports in the San Diego region that used LTO emissions boundaries, LTO emissions for SAN were estimated using available data described above.

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In both 2016 and 2022 inventories, EPIC used emissions from SAN and CRQ GHG Inventories. However, the 2016 SAN GHG Inventory used the LTO methodology, and the 2022 SAN GHG Inventory used full flight emissions. Therefore, 2018 SAN GHG emissions from their Terminal expansion EIR (with LTO methodology) were used to estimate 2022 SAN emissions. Additionally, the 2016 inventory did not include County municipal and private airports.

- Water section of this appendix.

- Emissions associated with natural gas used for electric generation that is consumed by the customer on-site (i.e., self-serve), mostly at co-generation plants, were removed from the natural gas category and allocated to the Electricity category. EPIC used the CEC Quarterly Fuel and Energy Report (QFER) Power Plant Owner Reporting database, U.S. Energy Information Administration (EIA) Form 923 data, and the 2022 SDG&E Power Source Disclosure Program Schedule 1: Procurements and Retail Sales to identify the co-generation plants and the amount of self-serve electric generation.

With these adjustments, the key inputs and results are shown in Table G.8.

### Table G.8: Key Inputs and 2022 GHG Emissions from Electricity

| Key Inputs and Emissions | 2022 Results |
|---|---|
| Electricity Sales – Bundled (MWh) | 6,331,771 |
| Electricity Sales – Direct Access (MWh) | 3,711,568 |
| Electricity Sales – CCA (MWh) | 6,104,049 |
| Transmission and Distribution Loss Factor | 0.082 |
| GHG Emissions (MT $CO_2e$) before adjustments | 3,684,429 |
| GHG Emissions associated with Electricity for Water Treatment – Excluded (MT $CO_2e$) | −79,939 |
| GHG Emissions associated with Electricity for Rail – Excluded (MT $CO_2e$) | −13,108 |
| GHG Emissions Associated with Natural Gas Used at On-site Self-serve Electric Generation – Added (MT $CO_2e$) | 435,609 |
| GHG Emissions (MT $CO_2e$) | 4,027,000 |
| **GHG Emissions (MMT $CO_2e$)** | **4.03** |

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

*Source: CEC 2024, SDG&E 2025, EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

To project emissions for the electricity category, 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).

Senate Bill 100 (de León, 2018) (Chapter 312, Statutes of 2018) (SB 100), the 100 Percent Clean Energy Act of 2018, increases California's Renewables Portfolio Standard (RPS) to 60% by 2030.[19] 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. Senate Bill 1020 (Laird, 2022) (Chapter 361, Statutes of 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.[20]

All load serving entities must meet these RPS requirements, including investor-owned utilities (e.g., SDG&E), ESPs for DA customers, and CCAs. EPIC assumed that all load serving entities would meet the 2030 and 2045 SB 100 targets.

[19] California Senate Bill 100 (de León, 2018) (Chapter 312, Statutes of 2018).
[20] California Senate Bill 1020 (Laird, 2022) (Chapter 361, Statues of 2022).

In addition, San Diego Community Power (SDCP) started delivering power in March 2021. SDCP planned to start with 55% GHG-free (i.e., zero-carbon)[21] electricity in 2021 and to supply 100% renewable electricity no later than 2035.[22] SDCP's member cities in 2022 included cities of San Diego, Chula Vista, Encinitas, Imperial Beach, and La Mesa. SDCP has since enrolled National City, and the unincorporated communities of San Diego County in the years following.[23] 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.[24] The projected renewable or GHG-free content and electricity emission factors for each supplier are shown in Table G.9. CEA's member cities include cities of Oceanside, Carlsbad, Vista, San Marcos, Escondido, Solana Beach, and Del Mar.

### Table G.9: Projected Renewable or GHG–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% |
| SDCP - 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 |
| SDCP - 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 |

*Notes: *Based on SB 100 RPS targets (2030 and 2045 target years), SB1020 carbon free targets (2035 and 2040 target years), and CCE programs' implementation plans; **Calculated based on 2022 energy provider's emission factors and percent renewable provided in its 2022 Power Source Disclosure.*

*Source: EPIC, USD 2025*

[21] 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.

[22] SDCP: **Community Choice Aggregation Implementation Plan and Statement of Intent** (2019). SDCP: **Board of Directors Meeting**, (2020), SDCP **Renewable and GHG-Free Targets**, (2025).

[23] SDCP Member Cities **Timeline**

[24] CEA: **Draft FY 2024/2025 – FY 2026/2027 Strategic Plan**.

The latest 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.[25] 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, 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, EPIC used SDCP and CEA's specified 2023 – 2035 load forecast from their respective 2022 Integrated Resource Plans,[26,27] 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 G.10.

### Table G.10: Projected Electricity Sales of Electric Retail Providers (GWh)

| Retail Electricity Supplier | 2035 | 2050 |
|---|---|---|
| SDG&E Bundled | 4,680 | 3,334 |
| San Diego Community Power | 9,425 | 11,836 |
| Clean Energy Alliance | 1,589 | 1,996 |
| ESPs for Direct Access | 4,400 | 4,767 |

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

*Source: EPIC, USD 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 G.11.

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

### Table G.11: Projected GHG Emissions from Electricity

| Projection Year | 2035 | 2050 |
|---|---|---|
| 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** |

*Notes: *Electricity sales from SDG&E, SDCP, CEA, and ESPs for DA Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

#### Difference from Previous 2016 Inventory

Overarching methods to estimate emissions from electricity are the same in the 2016 GHG inventory. However, source data has been updated and refined. First, in the 2016 inventory, the DA emission factor, 836 lbs. $CO_2e$/MWh, was a default taken from the California Public Utilities Commission Decision 14-12-037.[28] In the 2022 inventory, additional data has been added to the CEC Power Source Disclosure Program, which made it possible to calculate a statewide weighted average emission factor for DA energy service providers as described above. Because DA energy providers are also subject to compliance with the Renewables Portfolio Standard, updating emission factors is important to reflect changes in electricity supply characteristics.

Second, in the 2016 inventory, EPIC calculated the electricity emission factors using data provided in the CEC Power Source Disclosure Program with methods documented in its technical working paper "Estimating Annual Average Greenhouse Gas Emission Factors for the Electricity Sector: A Method for Inventories." [29] However, starting in data year 2019, CEC now provides emission factors directly associated with each electricity provider and electricity service option as described above, so no additional calculations are needed.

## Natural Gas

The natural gas category accounts for emissions from building end-use natural gas for purposes other than electric generation with the exception of co-generation plants, of which the useful thermal output is also captured in this category. The Natural Gas category accounts for 14% of total emissions in the 2022 inventory and 18% of the 2050 projection.

[28] D.14-12-037, December 18, 2014 in Rulemaking 11-03-012 (filed March 24, 2011). The recommended emission factor is 0.379 MT $CO_2e$/MWh (836 lbs $CO_2e$/MWh).

[29] EPIC: Estimating Annual Average Greenhouse Gas Emission Factors for the Electric Sector: A Method For Inventories (2016).

### Method Used to Estimate 2022 Emissions

To estimate GHG emissions from metered natural gas end-use, EPIC multiplied the metered natural gas sales by a constant natural gas emission factor. EPIC used the natural gas emission factor, 0.00545 MT $CO_2e$ per therm, based on CARB's statewide inventory data.[30] Fugitive pipeline emissions associated with the natural gas distribution system was retrieved from the US Environmental Protection Agency (EPA) Facility Level Information on Greenhouse Gases Tool (FLIGHT) Database,[31] to which Sempra Energy reports natural gas distribution leaks within the county annually.

SDG&E provided the 2022 San Diego regional natural gas sales by customer class. The San Diego regional natural gas sales are sales to all local jurisdictions, military bases, and tribal reservations. Utility-level electric generation (UEG) and on-site self-serve electric generation are accounted for under the electricity category. However, certain co-generation plants generate electricity use for both on-site use and sales to the utility. SDG&E provided data delineating natural gas use for on-site electric generation as well as sales back to the utility so the following categorization adjustments could be made:

- Emissions associated with natural gas used at on-site self-serve electric generation were removed from this category and allocated to the electricity category. EPIC used natural gas consumption data for self-serve electricity generation provided by SDG&E to identify and remove the emissions from the natural gas sector. EPIC then used the CEC QFER Power Plant Owner Reporting database and U.S. EIA Form 923 data to identify the portion of self-serve electricity attributed to the thermal energy from co-generation plants to add to the natural gas sector.
- Emissions associated with heat output from utility-level and co-generation plants were estimated separately and added to this category. This natural gas use is not captured in the SDG&E natural gas sales. EPIC assumed that excess heat output was used for a beneficial purpose (e.g., space heating and cooling) and therefore would necessitate categorization in the natural gas sector instead of waste heat for electrical generation. The method to identify the plants is the same as above.

With these adjustments, the key inputs and results are shown in Table G.12.

[30] CARB: **Documentation of California's Greenhouse Gas Inventory** (2023 Edition) accessed March 2025. The natural gas emission factor is also used in CARB Mandatory GHG Reporting (MRR) and is the same under each customer class (e.g., residential, commercial).
[31] **US EPA Flight Database**

### Table G.12: Key Inputs and 2022 GHG Emissions from Natural Gas

| Key Inputs and Emissions | 2022 Results |
|---|---|
| Natural Gas Sales (Therms) | 621,630,424 |
| Natural Gas Emission Factor (MT $CO_2e$/Therm) | 0.00545 |
| GHG Emissions (MT $CO_2e$) | 3,390,400 |
| Fugitive Emissions from Natural Gas Pipelines (MT $CO_2e$) | 54,700 |
| GHG Emissions from Natural Gas Used at On-site Self-serve Electric Generation – Removed and added into Electric sector (MT $CO_2e$) | -470,700 |
| GHG Emissions Associated with Useful Thermal Output from Self-Serve Co-generation Plants – Added back into Natural Gas sector (MT $CO_2e$) | 35,100 |
| GHG Emissions Associated with Heat Output from Utility-level Co-generation Plants – Added to Natural Gas sector (MT $CO_2e$) | 4,100 |
| GHG Emissions (MT $CO_2e$) | 3,013,600 |
| **GHG Emissions (MMT $CO_2e$)** | **3.01** |

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

*Source: CARB 2019, SDG&E 2025, EPA 2025, EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

To project emissions for the natural gas category, 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.[32] 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, its natural gas service area matches the boundaries of the San Diego region. 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, 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 G.13.

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

[32] 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.

### Table G.13: Projected GHG Emissions from Natural Gas

| Projection Year | 2035 | 2050 |
|---|---|---|
| Projected Natural Gas Sales (Therms)* | 536,765,682 | 534,332,373 |
| Natural Gas Emission Factor (MT $CO_2e$/Therm) | 0.00545 | 0.00545 |
| GHG Emissions from Natural Gas Sales (MT $CO_2e$) | 2,927,500 | 2,914,200 |
| Fugitive Emissions from Natural Gas Pipelines (MT $CO_2e$) | 54,900 | 54,600 |
| 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 | 3,008,000 |
| **GHG Emissions (MMT $CO_2e$)** | **3.02** | **3.01** |

*Notes: *Estimated 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, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

#### Difference from Previous 2016 Inventory

Methods to estimate emissions from natural gas are the same in both the 2016 and 2022 inventories. However, the source data (i.e., the data associated with co-generation plants in the San Diego region) have been updated and refined. Fugitive pipeline emissions have been re-categorized from the Industrial category to Natural Gas category in the 2022 inventory.

### Industrial

Emissions of high GWP gases used in industrial processes and products account for 11% of total emissions in the 2022 inventory and 17% of the 2050 projection. 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. Emissions from activities to process materials for manufacturing (e.g., mineral aggregate products, chemicals, metals, refrigerants, electronics, and other consumer goods) are also included in this category. This category focuses on industrial processes that directly release $CO_2$ and other GHGs with high GWPs (i.e., $SF_6$, $C_2F_6$, $C_3F_8$, $CF_4$, $C_4F_8$, HFC-23, $NF_3$, HFC-125, HFC-134a, HFC-143a, HFC-236fa, HFC-32) by processes other than fuel combustion.

#### Method Used to Estimate 2022 Emissions

EPIC scaled down the industrial emissions in the CARB statewide GHG inventory to the San Diego region based on the ratio of San Diego region to state data relevant to each economic sector.[33]

The following are the IPCC category numbers, subcategory numbers, headings, codes, and fuel types used within each type of activity in the statewide inventory. Only those categories, subcategories, activities, and fuel types causing emissions in the San Diego region are shown:

[33] CARB: CARB GHG Inventory from 2000 to 2022, accessed October 2024.

- 2A: Mineral Industry
  - Manufacturing: Stone, Clay, Glass & Cement: Cement > Clinker production
  - Manufacturing: Stone, Clay, Glass & Cement: Lime > Lime production
- 2D1: Industrial Lubricant Use
  - Not Specified Industrial > Fuel consumption – Lubricants > $CO_2$
  - Not Specified Transportation > Fuel consumption – Lubricants > $CO_2$
- 2D3: Industrial Solvent Use
  - Solvents & Chemicals: Evaporative losses: Fugitives > Fugitive emissions > $CO_2$
- 2E: Electronic Industry
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $C_2F_6$
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $C_3F_8$
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $C_4F_8$
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $CF_4$
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > HFC-23
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $NF_3$
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > $SF_6$
- 2F: Product Uses as Substitutes for Ozone Depleting Substances
  - Not Specified Commercial
    - Aerosols > HFC-134a, HFC-152a, HFC-43-10mee
  - Fire Protection > $CF_4$, HFC-125, HFC-227ea, HFC-236fa
    - Foams > HFC-134a, HFC-245fa
    - Refrigeration and Air Conditioning > HFC-125. HFC-134a, HFC-143a, HFC-152a, HFC-236fa, HFC-32
  - Not Specified Industrial
    - Aerosols > HFC-134a, HFC-152a, HFC-43-10mee
    - Fire Protection > $CF_4$, HFC-125, HFC-227ea, HFC-236fa
    - Foams > HFC-134a, HFC-245fa
    - Refrigeration and Air Conditioning > HFC-125. HFC-134a, HFC-143a, HFC-152a, HFC-236fa, HFC-32

- Not Specified Residential
  - Aerosols > HFC-134a, HFC-152a, HFC-227ea, HFC-43-10mee
  - Foams > HFC-134a, HFC-245fa
  - Refrigeration and Air Conditioning > HFC-125. HFC-134a, HFC-32
- Not Specified Transportation
  - Aerosols > HFC-134a,
  - Refrigeration and Air Conditioning > HFC-125. HFC-134a, HFC-143a, HFC-32

- 2G1b: Use of Electrical Equipment
  - Imported Electricity: Transmission and Distribution > Electricity transmitted > $SF_6$
  - In State Generation: Transmission and Distribution > Electricity transmitted > $SF_6$
- 2G4: Other Industrial Product – $CO_2$, Limestone
  - Not Specified Industrial > $CO_2$ consumption > $CO_2$
  - Not Specified Industrial > Limestone and dolomite consumption > $CO_2$
  - Not Specified Industrial > Soda ash consumption > $CO_2$

EPIC used different ratios to scale down the activities above to the San Diego region. Table G.14Table G.14: shows the ratios used and their values in 2022.

### Table G.14: Key Inputs and 2022 GHG Emissions from Industrial

| Economic Sector/Industry | Basis for Ratio Value | California (MMT $CO_2e$) | Ratio Value | San Diego Region (MMT $CO_2e$) |
|---|---|---|---|---|
| 2A: Mineral Industry | San Diego cement and product manufacturing employees / California cement and product manufacturing employees (NAICS* code 3273xx) | 4.70 | 7.5% | 0.35 |
| 2D1: Industrial Lubricant Use > Not Specified Industrial | San Diego manufacturing sector employees/California manufacturing sector employees | 0.72 | 8.9% | 0.06 |
| 2D1: Industrial lubricant Use - Not Specified Transportation | San Diego VMT/California statewide VMT | 0.74 | 8.6% | 0.07 |
| 2D3: Industrial Solvent Use – Solvents and Chemicals | San Diego manufacturing sector employees/ California manufacturing sector employees | 0.35 | 8.6% | 0.03 |

| Economic Sector/Industry | Basis for Ratio Value | California (MMT $CO_2e$) | Ratio Value | San Diego Region (MMT $CO_2e$) |
|---|---|---|---|---|
| 2E: Electronic Industry – Semiconductor Manufacture | San Diego semiconductor manufacturing sector employees/California semiconductor manufacturing sector employees (NAICS code 3344xx) | 0.30 | 7.8% | 0.02 |
| 2F: Not Specified Residential | San Diego total residential units/California total residential units | 4.86 | 8.4% | 0.41 |
| 2F: Not Specified Commercial and Industrial | San Diego total employees/California total employees | 12.07 | 8.4% | 1.02 |
| 2F: Not Specified Transportation | San Diego VMT/California statewide VMT | 3.85 | 8.9% | 0.34 |
| 2G1B: Imported Electricity – Transmission and Distribution | San Diego purchased electricity/California purchased electricity | 0.07 | 16.7% | 0.012 |
| 2G1B: In State Generation – Transmission and Distribution | San Diego in-county electricity generated/ California in-state electricity generated | 0.17 | 2.8% | 0.005 |
| 2G4: Other Industrial Product > CO2 and soda ash consumption | San Diego manufacturing sector employees/ California manufacturing sector employees | 0.84 | 8.6% | 0.07 |
| 2G4: Other Industrial Product > Limestone and dolomite consumption | San Diego construction sector employees/ California construction sector employees | 0.15 | 9.9% | 0.01 |
| **Total GHG Emissions (MMT $CO_2e$)** | | **28.81** | **N/A** | **2.40** |

*Notes: *NAICS code refers to the North American Industry Classification System; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: **2022 County Business Patterns**; SANDAG ABM15.2.1 VMT; **EMFAC2017 statewide on-road emission inventory**; SANDAG Demographic data; EPIC, USD 2025*

Emissions from the following categories were included in CARB's statewide inventory but not in the 2022 regional inventory because County Business Pattern data indicated no employment or business establishments existed in the San Diego region. The categories are:

- 2B2: Manufacturing: Chemical and Allied Products: Nitric Acid > Nitric Acid Production > $N_2O$
- 2C: Metal Industry > Lead Production
- 2H3: Petroleum Refining: Transformation > Fuel Consumption > $CO_2$

### Method Used to Develop Emissions Projections

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, as shown in Table G.14. For example, the emissions from transportation lubricants 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 G.15.

### Table G.15: Projected GHG Emissions from Industrial

| Projection Year | 2035 | 2050 |
|---|---|---|
| Population Increase Compared with 2022 (%) | 4% | 3% |
| VMT Increase Compared with 2022 (%) | 4% | 5% |
| Housing Increase Compared with 2022 (%) | 11% | 16% |
| Total Jobs Increase Compared with 2022 (%) | 4% | 11% |
| Manufacturing Jobs Change Compared with 2022 (%) | 6% | 36% |
| Construction Jobs Change Compared with 2022 (%) | 5% | 7% |
| **Total GHG Emissions (MMT $CO_2$e)** | **2.54** | **2.79** |

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

*Source: SANDAG 2025, EPIC, USD 2025*

### Difference from Previous 2016 Inventory

Methods to estimate emissions from the Industrial sector are the same in both the 2016 and 2022 inventories. However, the "2A: Mineral Industry" category was added as census data indicated there were employment and establishments operating in 2022. Additionally, instead of using broader employment categories to develop ratios for scaling statewide data, data from North American Industry Classification System (NAICS) codes related to the specific activity were used where available to create more relevant employment-based scaling factors.

## On-Road Transportation – Heavy-Duty Trucks and Other Vehicles

The heavy-duty trucks and other vehicles emissions category includes tailpipe GHG emissions resulting from fossil fuel combustion (i.e., gasoline, diesel, natural gas) in mobile vehicles on freeways, highways, and local roads. This vehicle emissions category covers the GHG emissions from all other EMFAC2017 vehicle classes not included in the passenger and light duty vehicles category.[34] The on-road transportation heavy-duty trucks and vehicles category accounts for 10% of total GHG emissions in the 2022 inventory and 13% of the 2050 projection.

[34] Vehicle classes are all except LDA, LDT1, LDT2, and MDV as shown in EMFAC2017 Technical Documentation, Table 6.1-1.

### Method Used to Estimate 2022 Emissions

EPIC used the same method to estimate emissions from this category and the on-road transportation passenger cars and light-duty vehicles category. Emissions derive from an EMFAC2017 model run using VMT from SANDAG ABM15.2.1 and are converted from tons of $CO_2$ per weekday to MT $CO_2e$ per year. The key inputs and results are shown in Table G.16.

## Table G.16: Key Inputs and 2022 GHG Emissions from On-Road Transportation – Heavy-Duty Trucks and Other Vehicles

| Key Inputs and Emissions | 2022 Results |
|---|---|
| VMT (Miles per weekday)* | 6,862,024 |
| $CO_2$ Emissions (Tons per weekday)** | 7,605 |
| Conversion Factor (Tons $CO_2$ per weekday to MT $CO_2e$ per year) | 304 |
| GHG Emissions (MT $CO_2e$) | 2,276,300 |
| **GHG Emissions (MMT $CO_2e$)** | **2.28** |

*Notes: *SANDAG ABM15.2.1 VMT; **EMFAC2017 model run with custom VMT inputs from SANDAG; Heavy-duty trucks and vehicles are EMFAC2017 vehicle categories except LDA, LDT1, LDT2, and MDV. Conversion factors are different for each vehicle class.*

*Source: CARB 2017; SANDAG 2025; EPIC, USD 2025*

### Method Used to Develop Emissions Projections

The method used to develop the GHG projections for heavy-duty trucks and vehicles is the same as the method used to project emissions from passenger cars and light-duty vehicles. The new and updated regulations for heavy-duty trucks and vehicles since the release of EMFAC2017 are:

- Innovative Clean Transit regulation, adopted by CARB in 2018, requires all public transit agencies in California to gradually transition to a 100% zero-emission bus fleet. This regulation applies to all transit agencies that own, operate, or lease buses with GVWR above 14,000 lbs.
- Zero-Emission Airport Shuttle Bus, adopted by CARB in 2019, requires airport shuttle fleets to fully transition to zero-emission by 2035.
- Advanced Clean Truck (ACT), adopted by CARB in 2020, requires manufacturers of Class 2b-8 chassis or complete vehicles with combustion engines to sell zero-emission trucks as an increasing percentage of their annual California sales from 2024 to 2035. By 2035, zero-emission truck/chassis sales would need to be 55% of Class 2b–3 truck sales, 75% of Class 4-8 vocational truck sales, and 40% of Class 7-8 truck tractor sales.

These regulations are not reflected in EMFAC2017 model runs or the projected GHG emissions.

Using the same conversion method from tons of $CO_2$ per weekday to MT $CO_2e$ per year discussed in the inventory method section, the key inputs and results are shown in Table G.17:Table G.17.

### Table G.17: Key Inputs and Projected GHG Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles

| Projection Year | 2035 | 2050 |
|---|---|---|
| VMT (Miles per weekday) | 7,638,553 | 8,446,857 |
| $CO_2$ Emissions (Tons per weekday) | 7,088 | 7,177 |
| Conversion Factor (MT $CO_2e$ per year/Tons per weekday)* | 304 | 305 |
| GHG Emissions (MT $CO_2e$) | 2,139,400 | 2,169,600 |
| **GHG Emissions (MMT $CO_2e$)** | **2.14** | **2.17** |

*Notes: *Conversion factors vary slightly by year; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: CARB 2017; SANDAG 2025; EPIC, USD 2025*

#### Difference from Previous 2016 Inventory

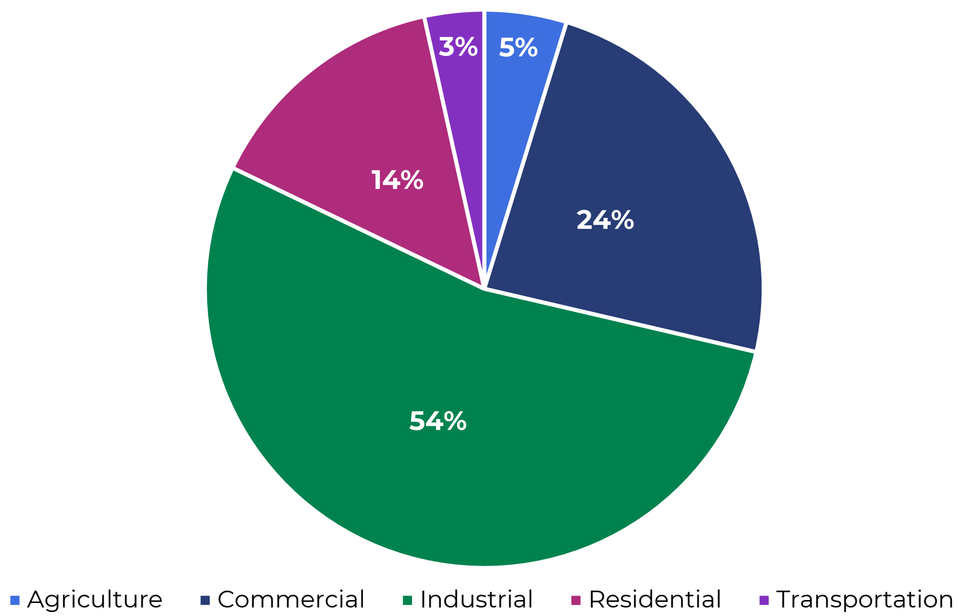
Methods to estimate emissions from heavy-duty trucks and vehicles are the same in both 2016 and 2022 inventories. However, SANDAG ABM 14.2.2 was used to calculate these emissions in the 2016 GHG inventory. ABM15.2.1 is used for analysis related to the 2025 Regional Plan (additional information included in Appendix M).

### Other Fuels

The Other Fuels category accounts for 4% of the total emissions in the 2022 inventory and 6% of the 2050 projection. This category includes fuels that are not otherwise accounted for in other sectors, such as distillate (other than in power production), coal, kerosene, gasoline (other than in transportation), liquefied petroleum gas (LPG), residual fuel oil (other than in power production), and wood (wet). Cement manufacturing is estimated to contribute 26% of the Other Fuels category, primarily from coal and petroleum coke use.

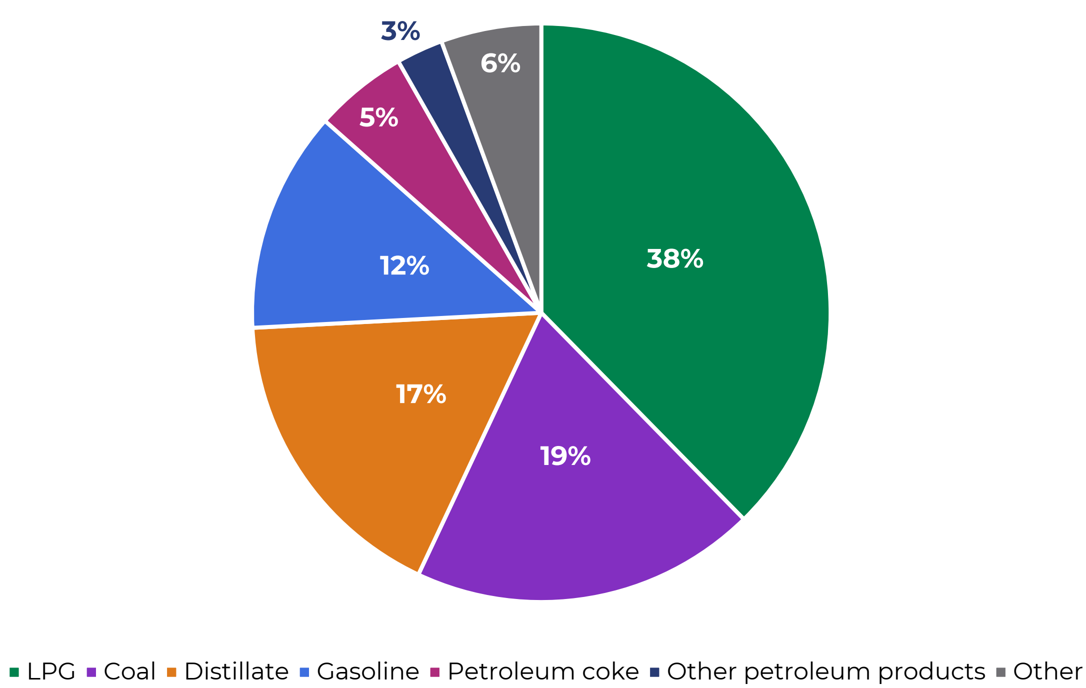
Emissions from this category are divided into the following economic sectors, according to the CARB statewide GHG inventory: agriculture, commercial, industrial, residential, and transportation. The relative distribution of emissions by economic sector is provided in Figure G.1 and by fuel type in Figure G.2.

### Figure G.1: Relative Distribution of 2022 GHG Emissions from Other Fuels by Economic Sectors




*Source: EPIC, USD 2025*

### Figure G.2: Relative Distribution of 2022 GHG Emissions from Other Fuels by Fuel Type




*Source: EPIC, USD 2025*

### Method Used to Estimate 2022 Emissions

The GHG emissions from the CARB statewide inventory were the basis of the regional estimates.[35] EPIC scaled down the statewide emissions by economic sector to the San Diego region based on whether a particular sector had any economic activity in San Diego region using relevant economic, population, employment, or transportation data. Therefore, not all the CARB's statewide emissions from these economic sectors are included in the 2022 regional inventory.

CARB uses the IPCC category and subcategory names and codes, as specified in the IPCC 2006 Guidelines for GHG Inventories, to be consistent with the EPA national inventory. Below are only those IPCC categories, subcategories, activities, and fuel types with GHG emissions in the San Diego region, based on economic activity data in the San Diego region.

*CARB Agriculture Sector*

EPIC scaled down the emissions from the following categories to the San Diego region using the ratio of the revenue generated by agricultural activities in the San Diego region to the statewide agricultural revenue for 2022.[36]

- 1A4c: Agriculture > Ag Energy Use > Not Specified > Fuel Combustion
  - Biodiesel > $CH_4$, $N_2O$
  - Distillate > $CO_2$, $N_2O$
  - Ethanol > $CH_4$, $N_2O$
  - Gasoline > $CH_4$, $CO_2$, $N_2O$
  - Kerosene > $CH_4$, $CO_2$, $N_2O$
  - Renewable Diesel > $CH_4$, $N_2O$

*CARB Commercial Sector*

EPIC scaled down the emissions from the following categories to the San Diego region using the ratio of the number of employees in the San Diego region's manufacturing sector to the statewide manufacturing sector for 2022.[37]

- 1A4a: Commercial > Not Specified > Fuel Combustion
  - Biodiesel > $CH_4$, $N_2O$
  - Coal > $CH_4$, $CO_2$, $N_2O$
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - Ethanol > $CH_4$, $N_2O$
  - Gasoline > $CH_4$, $CO_2$, $N_2O$
  - Kerosene > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - Renewable Diesel > $CH_4$, $N_2O$
  - Residual Fuel Oil > $CH_4$, $CO_2$, $N_2O$
  - Wood (wet) > $CH_4$, $N_2O$

[35] CARB GHG Emission Inventory for years 2000 to 2022 (2024 edition). Accessed October 2024

[36] California Department of Food & Agriculture: California Agricultural Statistics Review, 2022-2023. accessed October 2024.

[37] 2022 County Business Patterns, accessed October 2024. The 2022 NAICS Code for the manufacturing sector is 31-33.

*CARB Residential Sector*

EPIC scaled down the emissions from the following categories to the San Diego region using the ratio of the San Diego regional population to the statewide population for 2022.[38]

- 1A4b: Residential > Household Use > Not Specified > Fuel Combustion
  - Biodiesel > $CH_4$, $N_2O$
  - Coal > $CH_4$, $CO_2$, $N_2O$
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - Kerosene > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - Renewable Diesel > $CH_4$, $N_2O$
  - Wood (wet) > $CH_4$, $N_2O$

*CARB Transportation Sector*

This category includes emissions from fuel sold to on-road transportation agencies but reported by the end users as non-road, therefore not already included in the transportation sector. EPIC scaled down the emissions from the following categories to the San Diego region using the ratio of San Diego regional VMT to statewide VMT for 2022.[39]

- 1A3: Transport > Not Specified Transportation
  - Biodiesel > $CH_4$, $N_2O$
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - Renewable Diesel > $CH_4$, $N_2O$

*CARB Industrial Sector*

EPIC scaled down the emissions from the following categories to the San Diego region using the ratio of the number of employees in the San Diego region's manufacturing sector and the statewide manufacturing sector for 2022.[40]

- 1A2f: Manufacturing Industries > Construction > Fugitives & Fuel Combustion
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - MSW > $CH_4$, $CO_2$, $N_2O$
  - Petroleum Coke > $CH_4$, $CO_2$, $N_2O$
  - Residual Fuel Oil > $CH_4$, $CO_2$, $N_2O$
  - Tires > $CH_4$, $CO_2$, $N_2O$
- 1A2k: Manufacturing Industries > Fugitives
  - Gasoline > $CH_4$, $CO_2$, $N_2O$
- 1A2m: Manufacturing Industries and Construction > Non-Specified Industry
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - Gasoline > $CH_4$, $CO_2$, $N_2O$
  - Kerosene > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - Petroleum Coke > $CH_4$, $CO_2$, $N_2O$
  - Residual Fuel Oil > $CH_4$, $CO_2$, $N_2O$
- 1B2: Oil and Natural Gas > Manufacturing

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[38] San Diego demographic data are shown in Table G.2. Statewide population projections are from **California Department of Finance**, accessed October 2024.
[39] San Diego regional 2022 VMT are provided in **Table G.4**: and **Table G.**16:. California statewide VMT is from EMFAC2017 accessed October 2024.
[40] **2022 County Business Patterns**. The 2012 NAICS Code for manufacturing Sector is 31-33.

- Chemicals and Allied Products > Fugitives > Fugitive Emissions > $CH_4$
- Construction > Fugitives > Fugitive Emissions > $CH_4$
- Electric and Electronic Equipment > Fugitives > Fugitive Emissions > $CH_4$
- Food Products > Fugitives > Fugitive Emissions > $CH_4$
- Fugitives > Fugitive Emissions > $CH_4$
- Plastic and Rubber > Fugitives > Fugitive Emissions > $CH_4$
- Primary Metals > Fugitives > Fugitive Emissions > $CH_4$
- Pulp and Paper > Fugitives > Fugitive Emissions > $CH_4$
- Storage Tanks > Fugitives > Fugitive Emissions > $CH_4$

Several categories were included in CARB's statewide inventory, but not in this 2022 regional inventory, because 2022 census business patterns data for the San Diego region indicated no economic activities under these categories. The categories are:

- 1A1b: Petroleum Refining
  - Associated Gas > $CH_4$, $CO_2$, $N_2O$
  - Catalyst Coke > $CH_4$, $CO_2$, $N_2O$
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - LPG > $CH_4$, $CO_2$, $N_2O$
  - Petroleum Coke > $CH_4$, $CO_2$, $N_2O$
  - Refinery Gas > $CH_4$, $CO_2$, $N_2O$
  - Residual Fuel Oil > $CH_4$, $CO_2$, $N_2O$
- 1A1c: Manufacture of Solid Fuels and Other Energy Industries
  - Associated Gas > $CH_4$, $CO_2$, $N_2O$
  - Crude Oil > $CH_4$, $CO_2$, $N_2O$
  - Distillate > $CH_4$, $CO_2$, $N_2O$
  - Residual Fuel Oil > $CH_4$, $CO_2$, $N_2O$
- 1B2: Oil and Natural Gas > Manufacturing: Stone, Clay, Glass, and Cement: Fugitives > Fugitive Emissions > $CH_4$
- 1B2a: Oil > Petroleum Refining: Process Losses: Fugitives > Fugitive Emissions > $CH_4$
- 1B3: Other Emissions from Energy Production > In State Generation: Merchant Owned > Geothermal Power – Geothermal > $CO_2$
- 1B3: Other Emissions from Energy Production > In State Generation: Utility Owned > Geothermal power > $CO_2$

The key inputs and results are shown in Table G.18: Key Inputs and 2022 GHG Emissions from Other Fuels.

### Table G.18: Key Inputs and 2022 GHG Emissions from Other Fuels

| Economic Sectors Associated with Other Fuels* | GHG Emissions ($MT CO_2e$) |
|---|---|
| Agriculture | 40,900 |
| Commercial | 205,100 |
| Industrial | 459,700 |
| Residential | 123,800 |
| Transportation | 29,700 |
| Total GHG Emissions ($MT CO_2e$) | 859,200 |
| **Total GHG Emissions ($MMT CO_2e$)** | **0.86** |

*Notes: *Economic sectors used in CARB statewide GHG inventory; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: **California Ag Stats review 2022-2023**; **2022 County Business Patterns**; SANDAG ABM15.2.1 VMT; **EMFAC2017 statewide on-road emission inventory;** EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

Except for the agriculture sector, 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, 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 EPIC used 2016 – 2022 historical data to forecast. The projected emissions are shown in Table G.19: Projected GHG Emissions from Other Fuels.

### Table G.19: Projected GHG Emissions from Other Fuels

| Projection Year | 2035 | 2050 |
|---|---|---|
| Total Agricultural GHG Emissions | 8,600 | 0 |
| Total Commercial GHG Emissions | 217,300 | 278,700 |
| Total Residential GHG Emissions | 128,200 | 128,000 |
| Total Transportation GHG Emissions | 30,900 | 31,100 |
| Total Industrial GHG Emissions | 486,900 | 624,600 |
| Total GHG Emissions ($MT CO_2e$) | 871,800 | 1,062,400 |
| **Total GHG Emissions ($MMT CO_2e$)** | **0.87** | **1.06** |

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

*Source: EPIC, USD 2025*

### Difference from Previous 2016 Inventory

Methods to estimate emissions from other fuels are the same in both the 2016 and 2022 inventories. However, the 2022 inventory categorization follows the CARB 2022 statewide inventory, which reflects recategorization of several sectors, including previously termed energy and manufacturing categories into industrial.

## Off-Road Transportation

The Off-Road Transportation 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, and other portable equipment. The GHG emissions from off-road transportation fuel combustion account for 3% of total emissions in the 2022 inventory and 4% of the 2050 projection.

### Method Used to Estimate 2022 Emissions

CARB maintains the OFFROAD2021 model to generate off-road vehicle emission data by county, vehicle category, vehicle type, Horsepower (HP), and fuel type. Due to overlap with other emissions sectors, the following OFFROAD2021 categories were excluded from this category: commercial harbor freight, ocean-going vessels, and pleasure craft (included in Marine category); locomotive (included in Rail category); aircraft (included in Aviation category); and agricultural equipment (included in Agriculture sector). Potential emissions from pleasure craft operated on inland lakes may not be captured in the Marine category as OFFROAD2021 does not provide granular enough data to differentiate between pleasure craft on ocean versus inland waterways. The 2022 GHG emissions by off-road vehicle subcategory are shown in Figure G.20.

### Table G.20: 2022 GHG Emissions from Off-Road Transportation

| Subcategories | GHG Emissions (MT $CO_2e$) |
|---|---|
| Airport Ground Support | 18,100 |
| Cargo Handling Equipment | 2,200 |
| Construction and Mining | 154,900 |
| Industrial | 98,200 |
| Large Spark Ignition Fleet | 87,600 |
| Lawn and Garden | 52,500 |
| Light Commercial | 76,100 |
| Military Tactical Support | 20,100 |
| Portable Equipment | 69,400 |
| Recreational Vehicles | 3,000 |
| Transportation Refrigeration Unit | 34,700 |
| Total GHG Emissions (MT $CO_2e$) | 616,700 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.62** |

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

*Source: CARB: OFFROAD2021, EPIC, USD 2025*

### Method Used to Develop Emissions Projections

EPIC used the same models described in the previous section to generate emission projections for the subcategories, as shown in Table G.21: Projected GHG Emissions from Off-Road Transportation (MT CO2e).

### Table G.21: Projected GHG Emissions from Off-Road Transportation (MT CO2e)

| Projection Year | 2035 | 2050 |
|---|---|---|
| Airport Ground Support | 21,200 | 23,600 |
| Cargo Handling Equipment | 2,500 | 4,400 |
| Construction and Mining | 155,300 | 155,400 |
| Industrial | 101,400 | 104,100 |
| Large Spark Ignition Fleet | 87,600 | 87,600 |
| Lawn and Garden | 26,200 | 5,000 |
| Light Commercial | 66,800 | 53,900 |
| Military Tactical Support | 20,100 | 20,100 |
| Portable Equipment | 86,300 | 120,800 |
| Recreational Vehicles | 3,600 | 4,500 |
| Transportation Refrigeration Unit | 36,600 | 46,400 |
| Total GHG Emissions (MT $CO_2$e) | 675,900 | 686,600 |
| **Total GHG Emissions (MMT $CO_2$e)** | **0.68** | **0.69** |

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

*Source: CARB: OFFROAD2021; EPIC, USD 2025*

### Difference from Previous 2016 Inventory

The previous 2016 inventory also relied on CARB's models to calculate emissions from off-road equipment, though at that time the most up to date models were the ORION 2017, SORE 2020, and RV 2018 models. These models have since been consolidated into the OFFROAD2021 model.

## Solid Waste

Emissions from solid waste are a result of biodegradable, carbon-bearing waste decomposing in largely anaerobic environments. The degradation process, which can take 5 to 50 years depending on conditions, produces methane landfill gas. Emissions from solid waste contribute 1.4% of total emissions in the 2022 inventory and 0.5% 2050 projection. For this inventory, EPIC calculated the future emissions due to the waste disposed in 2022. Emissions from waste-in-place at landfills are not calculated to be consistent with the 2016 GHG inventory methods.

### Method Used to Estimate 2022 Emissions

EPIC estimated the emissions from solid waste using method SW.4 from the ICLEI U.S. Community Protocol.[41] The emissions are based on the disposed waste in a given year, the characterization of the waste stream, and emission factors for each type of waste. Because a recent waste characterization study for the entire region was not available, EPIC used the statewide waste characterization study compiled by CalRecycle in 2021.[42] The solid waste emission factors, MT $CO_2$e per short ton of waste by type, are from the EPA Waste Reduction Model (WARM) version 16.[43] Table G.22 shows the waste composition derived and the corresponding emission factors.

## Table G.22: Estimated San Diego Region Solid Waste Composition (2021 Study Results)

| Type of Waste | Percentage of Total Composition | Landfill Methane Emission Factor from WARM v16 (MT $CO_2$e/short ton)* |
|---|---|---|
| Paper | 16% | 0.87 |
| Plastic | 13% | 0.00 |
| Glass | 2% | 0.00 |
| Metal | 5% | 0.00 |
| Organics | 29% | 0.52 |
| Electronics | 1% | 0.00 |
| Inerts and Other | 12% | 0.00 |
| Household Hazardous Waste | 0% | 0.00 |
| Special Waste | 5% | 0.56 |
| Mixed Residue | 17% | 0.56 |

*Notes: *The WARM v16 assumption of 0.02MT CO2e emissions from transporting materials to landfills and operating landfilling equipment have been removed from these figures to estimate landfill methane emissions; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: CalRecycle 2021, EPA WARM v16.*

The 2022 emissions from solid waste are provided in Table G.23.

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[41] ICLEI: U.S. Community Protocol Appendix E, accessed in October 2024.

[42] 2021 Disposal-Facility-Based Characterization of Solid Waste in California (DRRR-2024-1737).

[43] U.S. EPA Waste Reduction Model (WARM) Version 16.

### Table G.23: Key Inputs and 2022 GHG Emissions from Solid Waste

| Key Inputs and Emissions | 2022 Results |
|---|---|
| Total Waste Disposal (Short tons) | 3,473,333 |
| Mixed Waste Emission Factor (MT $CO_2e$/short ton)* | 0.41 |
| Landfill Gas Capture Rate** | 0.75 |
| Oxidation Rate | 0.10 |
| Total GHG Emissions (MT $CO_2e$) | 317,800 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.32** |

*Notes: *Weighted average from Table G.22; ** The 2022 regional landfill gas capture rate was estimated using a weighted average of landfill gas capture rates and total landfill emissions reported to the EPA FLIGHT database for all regional landfills, including West and North Miramar Sanitary Landfill, Sycamore Landfill, San Marcos Landfill, Otay Landfill, Nand Las Pulgas Landfill; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

### Method Used to Develop Emissions Projections

EPIC projected the emissions, as shown in Table G.21. 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[44] 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 Air Pollution Control District (APCD) to align with CARB's regulation to reduce methane emissions from active municipal landfills[45]. Because this is the default landfill gas collection efficiency used by APCD, EPIC used this target for 2035 and 2050 projections.

[44] CalRecycle: 2016 Statewide Waste Characterization Study
[45] San Diego APCD: Landfill Operations Emissions Inventory Request

### Table G.24: Projected GHG Emissions from Solid Waste

| Projection Year | 2035 | 2050 |
|---|---|---|
| Total Waste Disposal (Short tons) | 1,831,122 | 1,835,467 |
| 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 | 84,400 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.08** | **0.08** |

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

*Source: EPIC, USD 2025*

#### Difference from Previous 2016 Inventory

In the 2016 inventory, EPIC used the 2016 waste characterization studies from the cities of Chula Vista, Oceanside, and San Diego to estimate the waste composition in the region.[46] To reflect regulations impacting the composition of organic waste in the landfill, the more recent 2021 statewide waste composition study was used.

### Civil Aviation

The GHG emissions from commercial aviation operations account for 1.4% of total emissions in the 2022 inventory and 2.8% in the 2050 projection. The San Diego International Airport (SAN) and McClellan-Palomar Airport (CRQ) are the only airports in the San Diego region in 2022 with scheduled commercial flight services. The County of San Diego governs CRQ as well as the remaining municipal and private airports in the region: Gillespie Field, Fallbrook Airpark, Ramona Airport, Borrego Valley Airport, Agua Caliente Airport, and Jacumba Airport. GHG emissions in this category are from the combustion of jet fuel and aviation gasoline used by aircraft operating in the Landing and Takeoff (LTO) Cycle.

#### Method Used to Estimate 2022 Emissions

EPIC used the aircraft emissions reported by the following entities:

- SAN: 2018 GHG Emissions from San Diego International's Final Environmental Impact Report GHG Emissions Inventory for Proposed Airfield Improvements and Terminal 1 Replacement Project (SAN EIR).[47] GHG emissions were estimated for 2022 using SAN reported enplanement data from 2018 to 2022.[48]
- CRQ: 2016 Emissions Inventory developed for the McClellan-Palomar Airport Master Plan Update (PEIR).[49] GHG emissions were estimated for 2022 using FAA airport operations data.[50]

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[46] The City of Chula Vista and the City of Oceanside's waste characterization studies were provided by the jurisdictions. Personal communication. **City of San Diego Waste Characterization Study**.
[47] Final Environmental Assessment. **San Diego International Airport Airfield Improvements and Terminal 1 Replacement Project**. (2021).
[48] **SAN Air Traffic Reports**.
[49] CRQ Master Plan Update PEIR: **Appendix H – Climate Change Technical Report**. (2017).
[50] **FAA Airport Tower Operations**.

- San Diego County Municipal and Private Airfields: The remaining SD County aviation emissions for municipal and private airfields were taken from the GHG inventory included in the County of San Diego Draft Airports Sustainability Management Plan.[51] Aviation emissions specified to be for military use were delineated and omitted.

The aircraft emissions in the SAN EIR followed Federal Aviation Administration guidelines[52] and include aircraft emissions from the LTO cycle, which include aircraft start-up, taxi and delay, take-off, climb-out, up to mixing height (3,000 feet), approach, landing, and taxi to gate. These emissions differ from what is published in the SAN 2022 GHG Inventory, as SAN now participates in the Airports Council International's Airport Carbon Accreditation (ACA) program and uses an expanded boundary (full flight emissions) to quantify emissions. [53] To maintain consistency with the boundaries of this inventory (regional), FAA guidelines, and the emissions boundaries of the other airports in the San Diego region that used LTO emissions boundaries, LTO emissions for SAN were estimated using available data described above.

Of the total regional aircraft emissions in 2022, SAN accounted for 93%, CRQ for 5%, and County Municipal airports for 2%. Because methods used to estimate inventory year and projection year emissions are similar, inventory and projection emissions are shown together in Table G.25.

### Method Used to Develop Emissions Projections

To project emissions for the civil aviation category, EPIC applied the rate of increase of the projected passengers[54] served at SAN to the 2018 aircraft emissions using the constrained projection.[55] For 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.[56] For the remaining County municipal and private airports, a growth forecast was used based on operations from 2016 – 2023[57] as no passenger projections were available. The projected emissions are shown in Table G.25

[51] Baseline Assessment and Inventory Reference: CoSD Airports Baseline Assessment and Inventory Report_03082023. **County of San Diego Airports Sustainability Management Plan**. (2023).
[52] **Aviation Emissions and Air Quality Handbook**. Federal Aviation Administration. Office of Environment and Energy.
[53] **2022 Greenhouse Gas Emissions Inventory**. San Diego International Airport. (2023)
[54] **Aviation Activity Forecast Update**. San Diego International Airport. (2019).
[55] The constrained projection is based on SDIA's single runway capacity. The unconstrained projection is based on airport demand.
[56] CRQ Master Plan Update PEIR: **Appendix H – Climate Change Technical Report** (2018).
[57] **Operations Counts**. San Diego County Department of Public Works.

### Table G.25: 2022 GHG Emissions and Projected GHG Emissions from Civil Aviation

| Year | 2022 | 2035 | 2050 |
|---|---|---|---|
| SAN GHG Emissions (MT $CO_2e$) | 289,200 | 392,800 | 418,100 |
| CRQ GHG Emissions (MT $CO_2e$) | 14,200 | 34,700 | 36,400 |
| County Airports GHG Emissions (MT $CO_2e$) | 6,100 | 6,900 | 7,600 |
| Total GHG Emissions (MT $CO_2e$) | 309,500 | 434,400 | 462,200 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.31** | **0.43** | **0.46** |

*Notes: 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, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

### Difference from Previous 2016 Inventory

In both 2016 and 2022 inventories, EPIC used emissions from SAN and CRQ GHG Inventories. However, the 2016 SAN GHG Inventory used the LTO methodology, and the 2022 SAN GHG Inventory used full flight emissions. Therefore, 2018 SAN GHG emissions from their Terminal expansion EIR (with LTO methodology) were used to estimate 2022 SAN emissions. Additionally, the 2016 inventory did not include County municipal and private airports.

## Water

The GHG emissions from energy associated with upstream supply and conveyance, and treatment of water (including surface water and groundwater treatment, desalinization, and potable water reuse) account for 1.1% of total emissions in the 2022 inventory and 0% of the 2050 projection. This category does not include emissions associated with energy used for water distribution and water end-use (e.g., water heating at homes), nor does it account for the energy emissions associated with treating and distributing recycled water. The emissions from energy used for treating and distributing recycled water, and water end-use are captured in the electricity and natural gas categories, discussed in previous sections.

### Method Used to Estimate 2022 Emissions

The San Diego County Water Authority (SDCWA) is the water wholesaler for the San Diego region. SDCWA imports raw and treated water on behalf of its 24 member agencies. The raw water sources, from the State Water Project and Colorado River, vary year by year depending on water availability; therefore, the energy needed to supply and convey water differs as well. The latest available upstream energy intensity, in kWh per acre-foot of water, is from the average of fiscal years 2018 and 2019 in the SDCWA 2020 Urban Water Management Plan. EPIC calculated the GHG emissions from upstream water supply by multiplying the water supplies with their respective energy intensities or the California average electricity GHG emission factor in 2022.[58] The upstream emissions are shown in Table G.26.[59]

[58] SDCWA 2021: Urban Water Management Plan 2020, Metropolitan Water District of Southern California, Urban Water Management Plan 2020. The Western Electricity Coordinating Council CAMX (eGRID Subregion) emission rate from eGRID was used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID 2022 Edition, released January 30, 2024, accessed October 2024.

[59] 2022 water source and demand for each SDCWA member agency were provided by SDCWA staff to EPIC, September 12, 2024.

### Table G.26:2022 Upstream Emissions from Water Supply

| Water Source | Imported Treated Water | Imported Raw Water |
| --- | --- | --- |
| Water Demand (Acre-feet) | 142,374 | 270,806 |
| Energy Intensity (kWh/Acre-foot)* | 1,873 | 1,767 |
| California Average Electricity Emission Factor (lbs. $CO_2$e/MWh)** | 499 | 499 |
| **Total Upstream GHG Emissions (Treated and Raw) (MT $CO_2$e)** | | **167,600** |

**Includes water conveyance from the State Water Project & Colorado River to Metropolitan Water District and SDCWA system. The difference between energy intensity for treated and raw water is the water treatment energy intensity; **eGRID 2022 CAMX subregion emission factor; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

SDCWA has its own water treatment plant (WTP), Twin Oaks WTP, and many SDCWA member agencies have their own WTPs. Member agencies that do not have WTPs may purchase treated water from other member agencies or from SDCWA. For example, the City of San Diego and the City of Del Mar are member agencies of the SDCWA, but the City of San Diego provides water treatment services for the City of Del Mar. Local water treatment energy intensity depends on water sources, treatment level, capacity, and efficiency of the WTP. For example, brackish groundwater requires advanced treatment, such as reverse osmosis, to remove the salinity in the water, so its treatment has a higher energy intensity than surface water treatment with conventional methods. Table G.27 below shows the WTPs in San Diego region, the quantity of water treated, and the associated electricity use for water treatment in 2022.[60] EPIC calculated the GHG emissions from water treatment by multiplying the electricity used for water treatment with SDG&E bundled 2022 electricity GHG emission factor as a default, unless the specific LSE is known, as indicated in the footnotes of Table G.27.

[60] Data were collected for City of San Diego and Helix facilities through EPIC's continued technical assistance role with the entities. Carlsbad Desalination Plant was calculated using the expected average electricity demand of 32MWh/h when operating at 50mgd as noted in the **Supplement to the Precise Development Plan and Desalination Plant Project Final Environmental Impact Report (EIR 03-05)**. The remaining WTP energy intensities are from the following sources: **Escondido 2020 UWMP**, **Olivenhain 2020 UWMP**, **Sweetwater Authority 2020 UWMP**, **Poway 2020 UWMP**, **Oceanside 2020 UWMP**, **Santa Fe Irrigation District 2020 UWMP**, **San Dieguito Water District 2020 UWMP**.

### Table G.27: 2022 Emissions from Local Water Treatment

| Water Treatment Plant | Plant Operator | Water Treated (Acre-feet) | Water Treatment Energy Intensity (kWh/Acre-foot) | Water Treatment Electricity Use (kWh) |
|---|---|---|---|---|
| R.M Levy WTP | Helix WD | 29,117 | 48 | 2,322,000 |
| R.E. Badger Filtration Plant | Santa Fe ID | 14,736 | 4.1 | 60,417 |
| Combined Miramar, Otay and Alvarado WTP* | City of San Diego | 162,302 | 24 | 3,246,153 |
| Escondido-Vista WTP | Escondido + Vista ID | 34,907 | 297 | 10,367,498 |
| David C. McCollum WTP | Olivenhain MWD | 16,900 | 139 | 2,349,128 |
| Richard A. Reynolds Ground Water Desalination Facility | Sweetwater Authority | 4,563 | 920 | 4,199,237 |
| Robert A. Perdue WTP | Sweetwater | 8,169 | 920 | 7,517,931 |
| Lester J. Berglund WTP | City of Poway | 9,850 | 313 | 3,085,942 |
| Robert A. Weese WFP | City of Oceanside | 14,396 | 279 | 4,016,345 |
| Mission Basin Groundwater | City of Oceanside | 2,373 | 279 | 661,928 |
| Twin Oaks Valley WTP | SDCWA | 24,296 | 112 | 2,723,244 |
| Carlsbad Desalination Plant** | SDCWA | 46,778 | 5,005 | 280,320,000 |
| Total Water Treatment Electricity Use (kWh) | | | | 320,869,821 |
| Transmission and Distribution Loss Factor | | | | 1.082 |
| **Local Treatment GHG Emissions (MT $CO_2e$)** | | | | **73,881** |

*Notes: ID: irrigation district, WD: water district, WFP: water filtration plant, WTP: water treatment plant; *The electricity use and energy intensity include both water treatment and conveyance from nearby reservoirs for City of San Diego WTPs and both water extraction and treatment for Sweetwater Authority's brackish water desalination plant. The data associated with water treatment cannot be separated out; **The water treated at the plant includes SDCWA wholesale water and local supply for individual SDCWA member agencies that have separate contracts with the plant. The energy intensity is the high efficiency estimate from the Plant's Environmental Impact Report (2008); All WTPs are assumed to use SDG&E Bundled electricity aside from the following known sources: City of San Diego WTPs use SDCP Power On, R.M. Levy WTP uses SDG&E DA. Electricity emission factors can be found in Table G.9; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

Combining the upstream and local emissions, the total 2022 emissions from water are shown in Table G.28.

### Table G.28: 2022 GHG Emissions from Water Supply and Treatment

| Emissions Source | MT $CO_2e$ |
|---|---|
| Upstream GHG Emissions (MT $CO_2e$) | 167,600 |
| Local Treatment GHG Emissions (MT $CO_2e$) | 80,000 |
| Total (Upstream + Local) GHG Emissions (MT $CO_2e$) | 247,600 |
| **Total (Upstream + Local) GHG Emissions (MMT $CO_2e$)** | **0.25** |

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

*Source: EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

To project emissions for the water category, 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 Difference from Previous 2016 Inventory

Methods to estimate emissions from passenger cars and light-duty vehicles are the same in 2016 and 2022 regional GHG inventories. However, the previous version of the SANDAG ABM (ABM2+) was used to calculate the 2016 GHG emissions. ABM15.2.1 is used for analysis related to the 2025 Regional Plan (additional information included in Appendix M). Additionally, the previous projected emissions from passenger vehicles included two different variations: one that analyzed the anticipated emissions impact with the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rules and one that omitted the anticipated increase in emissions from SAFE Vehicle Rules. As the National Highway Traffic Safety Administration repealed the SAFE rule in 2022, only one projection is provided in this analysis.

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. 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.

SDCWA's 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).[61] 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. As no forecast was available after 2045, EPIC used the average demand increase from 2040–2045 to project values for 2046-2050. Assuming the water-energy intensities are fixed, the projected emissions are shown in Table G.29.

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.

[61] 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 G.29: Projected GHG Emissions from Water

| Projection Year | 2035 | 2050 |
|---|---|---|
| **Projected Upstream Emissions** | | |
| Imported Treated Water (Acre-feet) | 112,689 | 129,277 |
| Imported Raw Water (Acre-feet) | 245,436 | 281,566 |
| 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 | 354,225 |
| 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** | **0.0** |

*Notes: *Assume upstream energy intensities 1,862 kWh/acre-foot for imported treated water and 1,817 kWh/acre-foot for imported untreated water remain unchanged (Table G.29); **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 EPIC); ***Assume energy intensities at local water treatment plants remain unchanged (Table G.27); Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

#### Difference from Previous 2016 Inventory

The methods to calculate water emissions are the same in 2016 and 2022.

### Agriculture

The GHG emissions from agriculture are broken down into four sub-categories: agricultural equipment, enteric fermentation, manure management, and soil management. Enteric fermentation is a microbial fermentation process that occurs in the stomach of ruminant animals, producing $CH_4$ that is released through flatulence and eructation. Manure management is the process by which manure is stabilized or stored. $CH_4$ and $N_2O$ emissions result from livestock manure, and the amount of gas produced depends on the manure management system involved. Emissions from soil management include emissions from fertilizer use and crop residues. Emissions from fertilizers and crop residue management include direct $N_2O$ emissions, indirect $N_2O$ emissions from nitrogen volatilization, leaching, and runoff as well as $CO_2$ emissions from urea and lime application. Finally, emissions from equipment and fuel use include emissions from mobile and on-site combustion sources. Emissions from electricity use is excluded from this sector but included in the Electricity sector.

The total emissions from the agriculture sector are shown in Table G.30 and are 0.8% of total regional emissions in 2022 and 1.2% of the 2050 projection.

## Table G.30: 2022 GHG Emissions from Agriculture

| Agricultural Emissions Category | MT $CO_2e$ |
|---|---|
| Agricultural Equipment | 73,300 |
| Enteric Fermentation | 36,000 |
| Manure Management | 41,100 |
| Soil Management | 33,800 |
| Total GHG Emissions (MT $CO_2e$) | 184,100 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.18** |

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

### Method Used to Estimate 2022 Emissions

*Agricultural Equipment*

Agricultural equipment includes fuel combustion emissions from off-road mobile agriculture equipment. Non-mobile, stationary equipment is not included in this category, but would be included in the Other Fuels category. CARB released the 2021 Agricultural Equipment Emissions Inventory with the latest available data on farm acreage, equipment population, activity, and overall sector fuel consumption.62 The results were incorporated into OFFROAD2021, an online emissions inventory database for off-road equipment and vehicles, discussed in more detail in the Difference from Previous 2016 Inventory

Methods to estimate emissions from other fuels are the same in both the 2016 and 2022 inventories. However, the 2022 inventory categorization follows the CARB 2022 statewide inventory, which reflects recategorization of several sectors, including previously termed energy and manufacturing categories into industrial.

Off-Road Transportation section. The total emissions from the agriculture sector are shown in Table G.31.

## Table G.31: 2022 GHG Emissions from Agricultural Equipment

| Fuel Type | MT $CO_2e$ |
|---|---|
| Diesel Equipment (MT $CO_2e$) | 70,800 |
| Gasoline Equipment (MT $CO_2e$) | 2,500 |
| Total GHG Emissions (MT $CO_2e$) | 73,300 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.07** |

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

*Source: CARB 2021; EPIC, USD 2025*

[62] CARB: 2021 Agriculture Equipment Emission Inventory (August 2021). The types of agriculture equipment are shown in Table 16 of the CARB 2021 Agriculture Equipment Inventory.

### *Enteric Fermentation*

The GHG emissions from enteric fermentation, a process that occurs in the stomach of ruminant animals that produces and releases $CH_4$, were estimated using method *A.1, Enteric Fermentation from Domesticated Animal Production*, from the U.S. Community Protocol.[63] This method multiplies animal-specific $CH_4$ emission factors with the specific livestock population to estimate the total emissions from enteric fermentation.

The livestock population was obtained from the 2022 Crop Statistics and Annual Report for the San Diego region.[64] Animal-specific $CH_4$ emission factors in California were obtained from the EPA 2022 U.S. Greenhouse Gas Inventory Report.[65]

Livestock population in the San Diego region, animal-specific $CH_4$ emission factors, and emissions from enteric fermentation are provided in Table G.32.

### Table G.32: Key Inputs and 2022 GHG Emissions from Enteric Fermentation

| Animal Type | Population (Head) | Emission Factor (kg $CH_4$/head/year) | GHG Emissions (MT $CO_2$e) |
|---|---|---|---|
| Dairy Cow | 5,505 | 146 | 20,100 |
| Beef Cow | 4,046 | 100 | 10,100 |
| Other Cattle | 3,749 | 54 | 5,000 |
| Sheep and Lamb | 923 | 9 | 200 |
| Goats | 1,909 | 9 | 400 |
| Hogs and Pigs | 1,546 | 1.5 | 100 |
| Total GHG Emissions (MT $CO_2$e) | | | 36,000 |
| **Total GHG Emissions (MMT $CO_2$e)** | | | **0.04** |

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

*Source: EPA Annexes to the US GHG Inventory; EPIC, USD 2025*

[63] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019). Appendix G: Agricultural Livestock Emission Activities and Sources.

[64] County of San Diego Department of Agriculture, Weights and Measures. 2022 Crop Statistics and Annual Report.

[65] EPA: Annexes to the Inventory of U.S. GHG Emissions and Sinks 1990–2019 (April 2021), accessed June 10, 2021. Table A-159 Emission Factors for Cattle by Animal Type and State, and Table A-162 Emission Factors for Other livestock. CARB's California statewide inventory refers to the EPA U.S. GHG Emissions Inventory for the California emission factors.

*Manure Management*

Manure, the natural byproduct of livestock, creates both $CH_4$ and $N_2O$ emissions as it biodegrades. The emissions from manure management, including from stabilizing and storing manure, were estimated using methods A.2.1 ($CH_4$), A.2.3 (direct $N_2O$), and A.2.4 (indirect $N_2O$) from the U.S. Community Protocol.[66] These methods use a combination of livestock population, animal type, and animal-specific manure management systems to estimate the emissions from manure management.

Livestock population and the type are the same as discussed in the Enteric Fermentation section above. Animal-specific manure management systems in California were obtained from the EPA 2019 U.S. Greenhouse Gas Inventory Report for each animal type.[67] The sub-sections below describe methods to estimate emissions for manure management by emission type $CH_4$ and $N_2O$, and the total emissions from manure management, combining $CH_4$, direct $N_2O$, and indirect $N_2O$ emissions, are provided in Table G.31.

Under method A.2.1, $CH_4$ emissions from manure management, the amount of methane produced depends on the type of animal, the animal's diet and the manure management system. As the manure management systems used throughout the San Diego region are not known, the distribution of various manure management systems is estimated using the statewide distribution.[68] Methane emissions from each management system for each animal population are calculated separately by multiplying the maximum $CH_4$ producing capacity per pound of manure by the $CH_4$ conversion factor for each management system. The maximum $CH_4$ producing capacity depends on the volatile solids in manure managed. For cattle, the amount of volatile solids produced is based on the number of cattle; for other animals, it is based on animal weight.

### Table G.33: 2022 GHG Emissions from Manure Management

| Animal Type | $CH_4$ Emissions (MT $CO_2e$) | Direct $N_2O$ Emissions (MT $CO_2e$) | Indirect $N_2O$ Emissions (MT $CO_2e$) | GHG Emissions (MT $CO_2e$) |
|---|---|---|---|---|
| Dairy Cow | 27,400 | 900 | 2,000 | 30,200 |
| Beef Cow | 800 | 2,100 | 1,500 | 4,300 |
| Other Cattle | 200 | 2,10<100 | 1,500 | 3,800 |
| Sheep and Lamb | 100 | <100 | <100 | 100 |
| Goats | 300 | <100 | <100 | 300 |
| Hogs and Pigs | 2,400 | <100 | <100 | 2,400 |
| Total GHG Emissions (MT $CO_2e$) | 31,000 | 5,100 | 4,900 | 41,100 |
| **Total GHG Emissions (MMT $CO_2e$)** | | | | **0.04** |

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

*Source: EPA Annexes to the U.S. GHG Inventory; EPIC, USD 2025*

[66] ICLEI – Local Governments for Sustainability USA: **U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions**, Version 1.2 (2019). Appendix G: Agricultural Livestock Emission Activities and Sources.
[67] EPA: **Annexes to the Inventory of U.S. GHG Emissions and Sinks 1990–2019** (April 2021), accessed June 10, 2021
[68] CARB: **2024 GHG Inventory Documentation**

*Soil Management*

EPIC followed the IPCC method to calculate the direct and indirect nitrogen (N) resulting $N_2O$ emissions, and $CO_2$ emissions from managed soils.[69] The IPCC method includes emissions from crop burning activities. Because the San Diego region does not have data on agricultural burning activities, these potential emissions are not considered.

To calculate the direct and indirect $N_2O$ emissions from fertilizer applications for both farm and non-farm activities, EPIC used the tonnage of nitrogen applied as reported to the California Department of Food and Agriculture (CDFA) fertilizer tonnage reports.[70] The $CO_2$ emissions from urea application and from liming are based on the total quantities of urea and lime applied and their respective emission factors. Among the crops that have nitrogen content in their residue, only oats and hay are grown in the San Diego region. EPIC calculated the emissions from crop residue using the total nitrogen content in the crop residue based on the acres of crop cultivated.[71]

Application of synthetic and organic fertilizer on agricultural land and nitrogen content in crop residue produces $N_2O$ emissions in two ways: (1) direct $N_2O$ emissions from the soils, and (2) indirect $N_2O$ emissions from volatilization and leaching/runoff from land. In addition, urea fertilizer and liming applied to soil to reduce soil acidity and improve plant growth, produce $CO_2$ emissions. Table G.34 shows the key inputs and results for soil management emissions.

### Table G.34: 2022 GHG Emissions from Nitrogen Inputs to Soil: Fertilizer and Crop Residues

| Emission Type | Tons N Directly Applied | Indirect $N_2O$ from N Inputs | MT $CO_2e$ from Direct $N_2O$ | MT $CO_2e$ from N Volatilization | MT $CO_2e$ from N Leaching and Runoff |
|---|---|---|---|---|---|
| Synthetic Fertilizer Nitrogen Applied to Soils | 7,099 | 9,802 | 100 | 3,000 | 6,800 |
| Organic Fertilizer Nitrogen Applied to Soils | 53 | 96 | <1 | 100 | 100 |
| Nitrogen in Crop Residues | 1,125 | 4,322 | 19,200 | 0 | 4,300 |
| Total GHG Emissions (MT $CO_2e$) | 19,300 | 19,300 | 19,300 | 3,100 | 11,200 |
| **Total GHG Emissions from All Soil N Inputs (MMT $CO_2e$)** | | | **0.03** | | |

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

*Source: EPIC, USD 2025*

[69] IPCC: **N₂O emissions from managed soils and CO₂ emissions from Urea and Lime application**

[70] California Department of Food & Agriculture: **2022 Fertilizing Material Tonnage Report**, accessed October 2024.

[71] California Department of Agriculture Weights & Measures: **2022 County of San Diego Crop Statistics and Annual report**, accessed on October 2024.

Liming is used to reduce soil acidity and improve plant growth on agricultural land. Adding carbonates to soils in the form of lime leads to $CO_2$ emissions as the carbonated lime dissolves and releases bicarbonate, which evolves into $CO_2$ and water. Similarly, adding urea ($CO(NH_2)_2$) to soils during fertilization releases bicarbonate and later evolves into $CO_2$ and water.

The $CO_2$ emissions from urea application and from liming are based on the total quantities of urea and lime applied and their respective emission factors. $CO_2$ emissions from liming material are calculated by multiplying the tonnage of liming material, emission factor of carbon (C) of liming material, and the resulting $CO_2$ to C conversion factor. Similarly, $CO_2$ emissions from urea are calculated by multiplying the tonnage of urea, the emission factor of C to urea, and the $CO_2$ to C conversion factor. The $CO_2$ emissions are shown in Table G.35.

### Table G.35: 2022 GHG Emissions from Carbon Inputs to Soil: Lime and Urea Application

| Key Inputs and Emissions | 2022 Results |
|---|---|
| Liming Material (tons) | 215 |
| Emission Factor (tons of C / tons of liming material) | 0.125 |
| $CO_2$ emissions from liming material (MT $CO_2e$) | 100 |
| Urea (tons) | 234 |
| Emission Factor (tons of C / tons of liming material) | 0.2 |
| $CO_2$ emissions from urea material (MT $CO_2e$) | 200 |
| Total GHG Emissions (MT $CO_2e$) | 300 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.0003** |

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

*Source: EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

This inventory uses the Microsoft Excel GROWTH function to estimate the cattle population using historical cattle population data from 2016 – 2022.[72] 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 Difference from Previous 2016 Inventory

Methods to estimate emissions from other fuels are the same in both the 2016 and 2022 inventories. However, the 2022 inventory categorization follows the CARB 2022 statewide inventory, which reflects recategorization of several sectors, including previously termed energy and manufacturing categories into industrial.

[72] USDA. Total Head of Cattle in San Diego County. National Agricultural Statistics Service.

Off-Road Transportation section. Emissions from soil management were projected using the Series 15 Regional Forecast of agricultural acreage.[73] Projected emissions are shown in Table G.36.

### Table G.36: Projected Emissions from Agriculture

| Projection Year | 2035 | 2050 |
|---|---|---|
| Enteric Fermentation | 37,200 | 39,900 |
| Manure Management | 42,500 | 45,600 |
| Agricultural Equipment | 68,200 | 60,800 |
| Soil Management (Nitrogen and Carbon Inputs) | 54,400 | 57,500 |
| Total GHG Emission | 202,300 | 203,900 |
| **Total GHG Emission (MMT $CO_2e$)** | **0.20** | **0.20** |

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

*Source: EPIC, USD 2025*

### Difference from Previous 2016 Inventory

Methods to estimate emissions from livestock, off-road agricultural equipment, and soil management are the same in both the 2016 and 2022 inventories. However, to align with the County of San Diego's GHG inventory sectors, emissions from livestock, agricultural equipment, and soil management are captured in the agriculture category.

## Marine Vessels

The GHG emissions from marine vessels in the San Diego region are largely attributed to the Port of San Diego, which serves as a transshipment facility for San Diego, Orange, Riverside, San Bernardino, and Imperial Counties, as well as northern Baja California, Mexico, and Arizona. The GHG emissions from marine vessels account for 0.5% of total emissions in the 2022 inventory and 1.1% in the 2050 projection.

The emissions are from the following subcategories:

- **Ocean-Going Vessels (OGV):** These include auto carriers, bulk carriers, passenger cruise vessels, general cargo vessels, refrigerated vessels (reefers), roll-on roll-off vessels, and tankers for bulk liquids.
- **Commercial Harbor Craft (CHC):** These include tugboats, towboats, pilot boats, work boats, ferries, and sports and commercial fishing vessels.
- **Recreational Vessels:** Includes recreational vessel activity associated with marinas, private slips, and public boat launch ramps in the San Diego Bay, based on fuel sales and other broad assumptions.

Emissions from marine vessels beyond the Port's landside and waterside boundary (40 nautical miles from the coastline) are not included in the 2022 inventory.

[73] SANDAG. Series 15 Regional Forecast.

### Method Used to Estimate 2022 Emissions

EPIC used the marine vessel emissions reported in the Port of San Diego 2022 Maritime Air Emissions Inventory, developed by the San Diego Unified Port District.[74] The 2022 emissions are shown in Table G.37.

## Table G.37: 2022 GHG Emissions from Marine Vessels

| Marine Vessels | 2022 Results |
|---|---|
| Total GHG Emissions (MT $CO_2e$) | 113,000 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.11** |

*Notes: Values reflect preliminary results from Port of San Diego 2022 Maritime Air Emissions Inventory (MAEI). Results are subject to change in the Final Regional Plan in accordance with the Port's final MAEI; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: San Diego Unified Port District 2025*

### Method Used to Develop Emissions Projections

To project emissions for the marine vessel category, EPIC used the rate of change from OGV and CHC emissions in the San Diego region as projected from the CARB OFFROAD2021 database.[75] 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

Because the boundaries are different for the OGV and CHC emissions reported by the San Diego Unified Port District 2022 maritime air emissions and the OFFROAD2021 database, EPIC applied the rate of increase of the projected emissions in the OFFROAD2021 database to the 2022 Port District-calculated maritime emissions. The projected emissions are shown in Table G.38.

[74] Data provided by San Diego Unified Port District in March 2024 before inventory has been published. Figures subject to change in the final Regional Plan.
[75] CARB: Emissions Inventory Offroad Emissions, accessed January 2025.

### Table G.38: Projected GHG Emissions from Marine Vessels

| Year | 2035 | 2050 |
|---|---|---|
| Percent Change in Ocean-Going Vessel Emissions from OFFROAD Compared with 2022* | 31% | 110% |
| Percent Change in Commercial Harbor Craft Emissions from OFFROAD Compared with 2022* | -1% | -2% |
| Percent Change in Recreational Vessels Emissions from OFFROAD Compared with 2022** | 8% | 38% |
| Total GHG Emissions (MT $CO_2e$) | 134,000 | 180,600 |
| **Total GHG Emissions (MMT $CO_2e$)** | **0.13** | **0.18** |

*Notes: *San Diego region only. Emissions in OFFROAD2021 database are reported in tons per day; ** Recreational vessels are termed 'Pleasure Craft' in OFFROAD 2021; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: OFFROAD2021, Port of San Diego 2025, EPIC, USD 2025*

### Difference from Previous 2016 Inventory

In both the 2016 and 2022 inventories, emissions from the Port of San Diego Maritime Air Emissions Inventories are used directly. The Port refined its emissions inventory to include up to 40 nautical miles past the coastline, a change from 24 nautical miles in the 2016 inventory. The Port also added recreational vessels to its inventory. To be consistent with the Port's efforts, this inventory moved recreational vessels from the Offroad category in 2016 to the Marine category in 2022.

## Wastewater

This category presents emissions from community-generated wastewater treated at centralized wastewater treatment plants. Emissions associated with the energy used to collect and treat wastewater are not included in this category but are captured in the electricity and natural gas category. The GHG emissions from domestic wastewater treatment account for 0.2% of total emissions in the 2022 inventory and 0.3% of the 2050 projection.

### Method Used to Estimate 2022 Emissions

California's Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR) requires industrial facilities that emit over 10,000 MT $CO_2e$ per year to report emissions annually to CARB. The three largest wastewater treatment facilities in the San Diego region fall into this reporting requirement. Those facilities, Encina Water Pollution Control Facility, North City Water Reclamation Plant, and Point Loma Wastewater Treatment Plant, treat 70% of the wastewater influent for the region.[76] Emissions reported to the MRR for those facilities were used directly. The remaining emissions were estimated by assuming the same emission factor ($CO_2e$ per unit influent) for all the smaller non-reporting wastewater facilities in the region, and scaling emissions up to account for all influent requiring treatment in the region. Emissions from wastewater are shown in Table G.39.

[76] Influent treatment data received from the San Diego Regional Water Quality Control Board October 2024.

### Table G.39: Key Inputs and 2022 GHG Emissions from Wastewater

| Key Inputs and Emissions | 2022 Values |
|---|---|
| Total Influent from San Diego region (Gallons per day) | 247,172,267 |
| **Encina Water Pollution Control Facility** | |
| Total Influent Treated (Gallons per day) | 21,897,812 |
| Annual Emissions (MT CO2e) | 15,300 |
| **North City Water Reclamation Plant** | |
| Total Influent Treated (Gallons per day) | 11,801,466 |
| Annual Emissions (MT CO2e) | 3,800 |
| **Point Loma Wastewater Treatment Plant** | |
| Total Influent Treated (Gallons per day) | 138,862,877 |
| Annual Emissions (MT CO2e) | 15,100 |
| Percent of Influent to MRR disclosing Facility | 70% |
| Regional Wastewater Emission Factor (MT $CO_2$e / Million Gallons) | 0.54 |
| **Total Annual Regional Emissions** (Encina, North City, Point Loma, and an additional 30% for other WWTPs) **(MT $CO_2$e)** | **49,000** |
| **Total Annual Regional Emissions** (Encina, North City, Point Loma, and an additional 30% for other WWTPs) **(MMT $CO_2$e)** | **0.05** |

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

*Source: San Diego Regional Water Control Board 2025, CARB 2024, EPIC, USD 2025*

#### Method Used to Develop Emissions Projections

To project emissions for the wastewater category, EPIC applied the population rate of increase from 2022 to 2050 to the 2022 wastewater emissions. The projected emissions are shown in Table G.40.

### Table G.40: Projected GHG Emissions from Wastewater

| Year | 2035 | 2050 |
|---|---|---|
| San Diego Region Population* | 3,404,362 | 3,400,250 |
| Population Increase Compared with 2022 (%) | 3.6% | 3.4% |
| Total GHG Emissions (MT $CO_2$e) | 50,800 | 50,700 |
| **Total GHG Emissions (MMT $CO_2$e)** | **0.05** | **0.05** |

*Notes: *Population forecast is from SANDAG Series 15 Growth Forecast, as shown in Table G.2; Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2021*

### Difference from Previous 2016 Inventory

The methods to calculate wastewater emissions are different from those used in the previous 2016 inventory. For the 2016 inventory, SANDAG, in collaboration with local jurisdictions, prepared the 2016 Regional Climate Action Planning Framework (ReCAP) Snapshots to assist local jurisdictions with monitoring community-wide GHG emissions and Climate Action Plan (CAP) implementation.[77] EPIC calculated the 2016 community-wide GHG emissions inventories for 16 (out of 19) jurisdictions in the San Diego region and used the wastewater emissions from these 16 GHG inventories directly in this category.

## Rail

The rail category includes GHG 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 locomotives 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). Emissions from rail contribute to 0.1% of total emissions in the 2022 inventory and 0% of the 2050 projection.

### Method Used to Estimate 2022 Emissions

Emissions from freight, line haul, and other inter-regional locomotives were sourced from the CARB OFFROAD2021 model. More information on the OFFROAD model can be found in the Difference from Previous 2016 Inventory

Methods to estimate emissions from other fuels are the same in both the 2016 and 2022 inventories. However, the 2022 inventory categorization follows the CARB 2022 statewide inventory, which reflects recategorization of several sectors, including previously termed energy and manufacturing categories into industrial.

Off-Road Transportation section. Fuel use from diesel and electric propulsion MTS and NCTD light rail and trolley is used to estimate emissions for in-region light rail systems from the National Transit Database.[78] Key inputs and GHG emissions from rail are listed in Table G.41.

### Table G.41: Key Inputs and 2022 GHG Emissions from Rail

| Key Inputs and Emissions | 2022 Values |
| --- | --- |
| Freight and Other Inter-Regional Rail (OFFROAD) (MT $CO_2$e) | 2,200 |
| Intra-Regional Light Rail – Diesel Fuel Consumption (gallons) | 1,280,613 |
| Intra-Regional Light Rail – Electric Energy Consumption (kWh) | 56,896,708 |
| Diesel Emission Factor (kg $CO_2$ per gallon)* | 10.21 |
| Total Intra-Regional Rail Emissions (MT $CO_2$e) | 26,200 |
| Total Rail Emissions (MT $CO_2$e) | 28,400 |
| **Total Rail Emissions in San Diego (MMT $CO_2$e)** | **0.03** |

*Notes: *EPA Emission Factor Hub 2024;Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values equated from tables or figures.*

*Source: EPIC, USD 2025*

[77] SANDAG: Climate Action. November 2019 ReCAP Snapshots (with 2016 GHG Emissions Inventories).
[78] National Transit Database (2022). Fuel and Energy Data.

### Method Used to Develop Emissions Projections

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, 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 G.42. 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 G.42: Projected GHG Emissions from Rail

| Projection Year | 2035 | 2050 |
|---|---|---|
| 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% | 82% |
| Intra-Regional Diesel Light Rail (MT $CO_2e$) | 4,900 | 0 |
| Intra-Regional Electric Light Rail (MT $CO_2e$) | 3,000 | -- |
| Percent of Passenger Rail Population Electrified (OFFROAD) | 14% | 64% |
| Total Emissions from Rail (MT $CO_2e$) | 8,900 | 600 |
| **Total Emissions from Rail (MMT $CO_2e$)** | **0.01** | **0.001** |

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

*Source: CARB 2021, EPIC, USD 2025*

### Difference from Previous 2016 Inventory

The 2022 inventory uses a different methodology from the 2016 regional inventory. In 2016, EPIC scaled the emissions from the CARB statewide inventory to the San Diego region, based on the ratio of 2016 County Business Pattern establishments for support activities for rail transportation to that of the state.[79] Because the rail category in CARB's statewide inventory is not separated into freight and passenger rail subcategories, EPIC used the number of support establishments for rail in the San Diego region to capture both freight and passenger rail activities.

[79] CARB: CARB GHG Emission Inventory – Query Tool, accessed on October 25, 2020. U.S. Census Bureau: 2016 County Business Patterns, accessed on October 25, 2020. The NAICS Code for rail transportation support activities is 4882.