The City *of*
SAN DIEGO

2015 Climate Action Plan
Final Report
Appendix

March 2023

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Introduction

The City of San Diego adopted an updated Climate Action Plan (CAP) in 2022 with new sets of targets, measures, and actions.[1] This will be the final annual report of the 2015 CAP. This report relates to final phase of the 2015 CAP, the 2021- 2035 Long-Term Action Phase. This phase includes continued monitoring of the implementation of the CAP strategies as well as the impact of federal and California state policies and mandates to determine whether the City is on track to achieve its emission reduction targets.[2] Although the 2015 CAP has been superseded by the 2022 update, the principals of ongoing monitoring and improvements have been incorporated, both in the updated CAP and an increased City-wide focus on climate action.

The City of San Diego's 2015 Climate Action Plan Final Report (this report) provides additional information and data in the following three sections:

- Section A: Overview of 2020–2021 Greenhouse Gas (GHG) Emissions;
- Section B: 2015 Climate Action Plan Strategy Updates; and
- Section C: Methodology Differences and Data Refinement.

The 2020 total GHG emissions in the City of San Diego (the City) were estimated at 9.21 million metric tons of carbon dioxide equivalent (MMT CO_2e), approximately 13% lower than the 2019 GHG emissions estimate of 10.5 MMT CO_2e. The 2021 total GHG emissions, 9.24 MMT CO_2e, were approximately the same as 2020 total GHG emissions.

The five strategies in the 2015 CAP are: (1) energy and water efficient buildings; (2) clean and renewable energy; (3) bicycle, walking, transit, and land use; (4) zero waste; and (5) climate resilience. Under each strategy, the current state in 2020–2021 is presented first followed by updates of each action. Comparisons of the in 2020, 2021 status and the baseline estimates from 2010 are provided where possible.

In preparation for this report and the 2020–2021 GHG emissions inventory, revisions and refinements were made to the 2019 GHG emissions estimates in the previous 2020 Annual Report and the CAP adopted in 2022, to reflect updated data supplied by agencies not managed by the City, and to ensure consistency with the 2020–2021 GHG emissions estimates.[3] The updates to the 2019 citywide emissions are related to revisions in the transportation, electricity, and water emissions categories. This approach follows the approach used by the California Air Resources Board (CARB) when updating the California statewide inventory, and based on the Intergovernmental Panel on Climate Change (IPCC) recommendations to maintain a consistent time-series

[1] City of San Diego: 2022 Climate Action Plan.

[2] City of San Diego: Climate Action Plan, adopted December 2015. Chapter 3 – Implementation and Monitoring.

[3] City of San Diego: 2022 Climate Action Plan, Climate Action Plan 2020 Annual Report and Appendix.

when developing GHG inventories.[4] These revisions are discussed briefly in *Section C: Methodology Differences* and Data Refinement of this report. The updates to the CAP strategies performance metrics are described in *Section B: 2015 Climate Action Plan Strategy Updates.*

Section A: Overview of 2020–2021 Greenhouse Gas (GHG) Emissions

GHG EMISSIONS INVENTORY

The emissions source categories included in this update have remained consistent with the previous 2015 CAP Annual Reports: on-road transportation, electricity, natural gas, water, and wastewater and solid waste. As in the previous years, these reflect the five categories of emissions that are recommended in the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol) to be routinely included in a citywide inventory.[5] GHG emissions from sources such as air travel, shipping, off-road vehicle and equipment or other high global warming potential gases in use in the City are not included.

The 2020, 2021, and revised 2019 GHG emissions inventory results are shown in Table 1.

TABLE 1 CITY OF SAN DIEGO GREENHOUSE GAS EMISSIONS

Emissions Category	2019 Emissions (Reported in 2020 Annual Report, MT CO_2e)	2019 Emissions (Reported in 2022 CAP, MT CO_2e)*	2019 Emissions Revised (MT CO_2e)	2020 Emissions (MT CO_2e)	2021 Emissions (MT CO_2e)
On-Road Transportation	5,296,000	5,805,000	5,854,000	4,650,000	5,239,000
Electricity	2,069,000	2,375,000	2,398,000	2,368,000	1,725,000
Natural Gas	1,911,000	1,911,000	1,912,000	1,827,000	1,918,000
Wastewater & Solid Waste	303,000	277,000	303,000	296,000	296,000
Water	67,000	68,000	61,000	70,000	70,000
Total	**9,646,000**	**10,436,000**	**10,528,000**	**9,210,000**	**9,248,000**

*The 2019 emissions inventory in the 2022 CAP include construction emissions, however, for comparison purposes, construction emissions are not included here

The revision to 2019 emissions reflects updated data and models supplied by agencies not managed by the City, and which became available after the release of 2020 Annual Report in November 2020.

GHG emissions for each category and the totals are rounded to the nearest thousands. Sums may not add up to totals due to rounding.

MT CO_2e = metric tons of carbon dioxide equivalent.

Energy Policy Initiatives Center, University of San Diego 2023

[4] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2020. Trends of Emissions and Other Indicators, p. 28 Additional Information (2020).

[5] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012).

The methods, data availability, and sources used to calculate GHG emissions have been updated since the development of the 2010 baseline emissions in the CAP. A brief discussion of the differences in methods and data sources is provided in Section C (*Section C: Methodology Differences* and Data Refinement). A comparison of the 2020, 2021, and revised 2019 GHG emissions inventory with 2010 emissions is shown in Table 2.

TABLE 2 CITY OF SAN DIEGO GREENHOUSE GAS EMISSIONS COMPARISON

Emissions Category	2010 Emissions* (Reported in the 2015 CAP, MT CO_2e)	2019 Emissions Revised (MT CO_2e)	2020 Emissions (MT CO_2e)	2021 Emissions (MT CO_2e)	2020 – 2021 % Changes	2010 - 2020 % Changes	2010 – 2021 % Changes
On-Road Transportation	7,086,297	5,854,000	4,650,000	5,239,000	8%	-34%	-26%
Electricity	3,138,613	2,398,000	2,368,000	1,725,000	-20%	-25%	-45%
Natural Gas	2,098,983	1,912,000	1,827,000	1,918,000	4%	-13%	-9%
Wastewater & Solid Waste	383,172	303,000	296,000	296,000	-	-23%	-23%
Water	277,927	61,000	70,000	70,000	-	-75%	-75%
Total	12,984,993	10,528,000	9,210,000	9,248,000	0.3%	-29%	-29%

2010 emissions are not rounded and the methods, data availability, and sources used to calculate GHG emissions have been updated since the development of the 2010 emissions inventory

GHG emissions for each category and the totals are rounded to the nearest thousands. Sums may not add up to totals due to rounding.

MT CO_2e = metric tons of carbon dioxide equivalent.

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The 2019 revised, 2020 and 2021 emissions shown in Table 2 are calculated based on the same methods and data sources and can be compared directly. The total emissions in 2020, 9.2 MMT CO_2e, were 13% lower than the total emissions in 2019. The decrease was mainly due to a decrease in emissions from the on-road transportation category. The emissions from on-road transportation in 2020 were 21% lower than the emissions in 2019. The impact of the COVID-19 pandemic on 2020 VMT was estimated from 2016 VMT and using 2016–2020 regional public road VMT monitoring data, which showed that the decrease was most likely from light-duty vehicles after shelter-in-place orders were enacted in response to the COVID-19 pandemic. The California 2020 statewide GHG inventory shows similar impact, as the transportation sector emissions declined by 16% in 2020 compared with 2019.[6]

The total emissions in 2021 were approximately the same as the total emissions in 2020; 9.24 MMT CO_2e and 9.21 MMT CO_2e, respectively.. However, the emissions from on-road transportation in 2021 were 13% higher than the emissions in 2020, showing

[6] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2020. Trends of Emissions and Other Indicators, p. 28 Additional Information (2020).

that the impact of the COVID-19 pandemic on driving may not be sustained long term. The emissions from electricity in 2021 were 27% lower than the emissions in 2020 for two reasons. First, San Diego Gas & Electric (SDG&E) had 44.5% renewable content in its power mix in 2021, higher than the renewable content of 31% in 2020, which lowered the emissions from electricity. Second, in March 2021, eligible commercial and industrial customers were enrolled in San Diego Community Power, a community choice energy provider, which provided more renewable and GHG-free content (55% renewable and 67% GHG free) with lower GHG emissions than SDG&E supply.

PER CAPITA GHG EMISSIONS

The 2019–2021 per capita GHG emissions in the City of San Diego are given in Table 3. This is based only on the five emission categories analyzed. The 2020 per capital GHG emissions are estimated at 6.7 MT CO_2e per capita, approximately the same as 2021 per capita GHG emissions.

TABLE 3 2019-2021 PER CAPITA GHG EMISSIONS (MT CO_2E PER CAPITA)

Year	2010 Baseline (Reported in the 2015 CAP)	2019 Revised	2020	2021	2020 - 2021 % Change
Total emissions (Million MT CO_2e)	13.0	10.5	9.2	9.2	0.3%
Total Population	1,301,617	1,420,571	1,380,448	1,371,832	-0.7%
Per capita GHG emissions (MT CO_2e per capita)	10.0	7.4	6.7	6.7	0.7%

The methods, data availability, and sources used to calculate GHG emissions have been updated since the development of the 2010 emissions inventory.

Revised values reflect updated information from sources.

2019 population and housing estimates are based on the 2010 census benchmark, and 2020 and 2021 population and housing estimates are based on the 2020 census benchmark.

MT CO_2e = metric tons of carbon dioxide equivalent

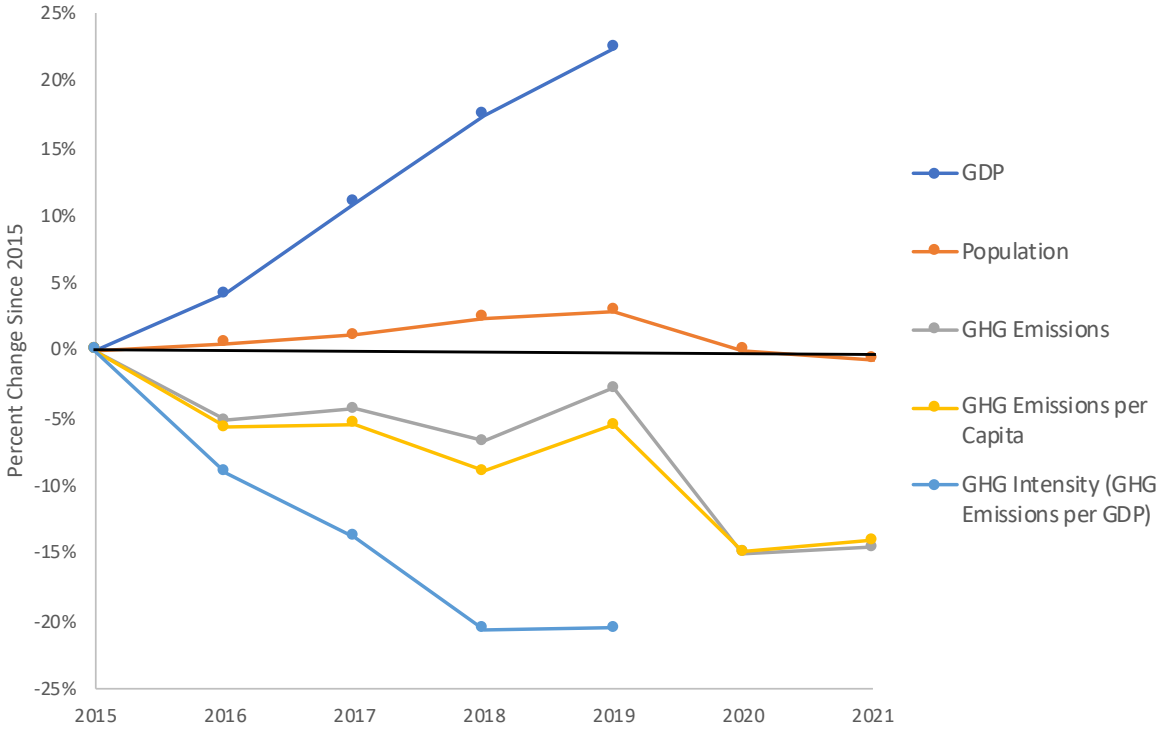
Per capita emissions based on five emission categories only and cannot be compared with California statewide per capita emissions or per capita emissions targets. 2019 population is based on 2010 census benchmark, and 2020 and 2021 population and housing estimates are based on 2020 census benchmark.

Energy Policy Initiatives Center, University of San Diego 2023

As mentioned above, the GHG emissions categories, and inventory methodology for the City of San Diego are based on the U.S. Communities Protocol. The U.S. Communities Protocol requires five basic emissions-generating activities to be included in a GHG inventory. These categories are generally recognized as being under the collective control and management of the community whereas other emissions-generating activities such as air travel, shipping, off-road vehicles and equipment, or high global warming potential gases are not considered as such. Therefore, allocating emissions from such categories to cities is either not possible due to lack of data or lack of proxy data, is challenging, or is better handled at a higher level of aggregation. In contrast,

the California statewide GHG emissions inventory includes all economic sectors of the state. Therefore, the estimated City per capita emissions cannot be compared directly with the California statewide per capita emissions or per capita emissions targets calculated using the CARB statewide inventory or statewide emissions targets, which include all economic sectors and additional emissions categories.

Figure 1 below shows the growth in City of San Diego (estimated GDP and population) alongside GHG emissions since 2015, when the 2015 CAP annual reporting process started. From 2015 to 2021, the per capita GHG emissions dropped by 14%, while the population remained largely stable.



Post 2019 GDP data are not available.
2020 and 2021 population data are benchmarked with 2020 Census.

FIGURE 1 CHANGES IN SAN DIEGO GDP, POPULATION, AND GHG EMISSIONS SINCE 2015

Section B: 2015 Climate Action Plan Strategy Updates

STRATEGY 1: ENERGY AND WATER EFFICIENT BUILDINGS

Energy (fossil-fuel based electricity and natural gas consumption) and water-related emissions accounted for 46% of 2020 citywide GHG emissions and 40% of 2021 citywide GHG emissions (Table 1). The Energy and Water Efficient Buildings strategy has targets to reduce citywide per capita water use, energy use in residential buildings, and energy use in municipal operations. Water treatment and distribution to residents

and businesses in the City require energy; therefore, reducing water use will also have an impact on the associated energy use.

Baseline and Current State of Energy and Water Use in the City of San Diego

The 2020 and 2021 grid supplied electricity is provided in Table 4. For electricity users with on-site electric generation, only the net electricity from the grid has been included.

TABLE 4 GRID-SUPPLIED ELECTRICITY USE IN CITY OF SAN DIEGO

Year	2010 (Reported in 2015 CAP)	2019 (Reported in 2020 Annual Report)	2019 Revised*	2020	2021	2020 - 2021 % Change	2010 - 2020 % Change	2010 - 2021 % Change
Electricity (MWh)	8,572,155	7,312,722	7,312,722	7,198,617	6,957,279	-3%	-16%	-19%
Emissions from Electricity (MT CO_2e)	3,138,613	2,069,000	2,398,000	2,368,000	1,725,000	-27%	-25%	-45%

Revised values reflect updated information from data sources.

MWh = megawatt hour, MT CO_2e = metric tons of carbon dioxide equivalent

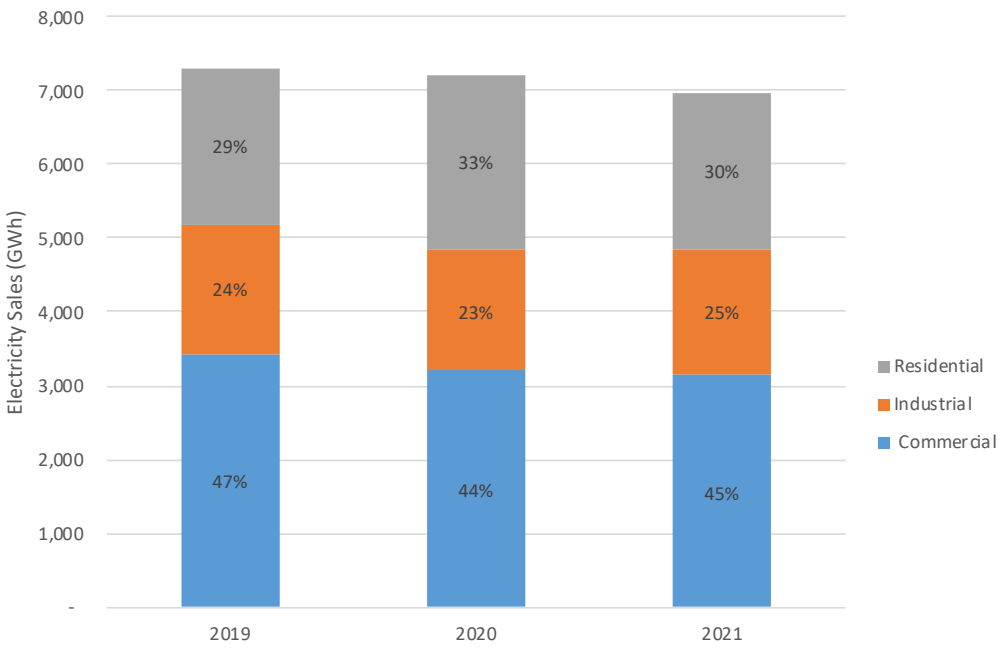
The MWhs do not include transmission and distribution losses, or self-serve behind-the-meter electricity generation (i.e., rooftop PV systems). The electricity sales data do not include the electricity sales to San Diego County Regional Airport Authority, San Diego Unified Port District and military. The emissions calculation includes the electricity transmission and distribution losses.

GHG emissions are rounded to the nearest thousands. The emissions from electricity were calculated based on City of San Diego's grid supply and power mix specifically, which may differ from other jurisdictions in San Diego region. The GHG emissions include emissions from transmission and distribution losses.

SDG&E 2022, Energy Policy Initiatives Center, University of San Diego 2023

A comparison of the grid-supplied electricity use by customer class in 2019–2021 is shown in Figure 2.

FIGURE 2 GRID-SUPPLIED ELECTRICITY USE BY CUSTOMER CLASS IN CITY OF SAN DIEGO



SDG&E's electricity sales in City of San Diego. Sales do not include transmission and distribution losses, and exclude sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military. Percentages may not sum up to totals due to rounding.
SDG&E 2020-2022

In 2020, 39% of natural gas use was from the residential class, 27% from the commercial class and the rest from the industrial class (including electric generation using natural gas). In 2021, 38% of natural gas use was from the residential class, 25% from the commercial class and the rest from the industrial class,including electric generation using natural gas. Table 5 provides natural gas end use in 2019–2021.

TABLE 5 TOTAL NATURAL GAS DELIVERED BY SDG&E IN CITY OF SAN DIEGO

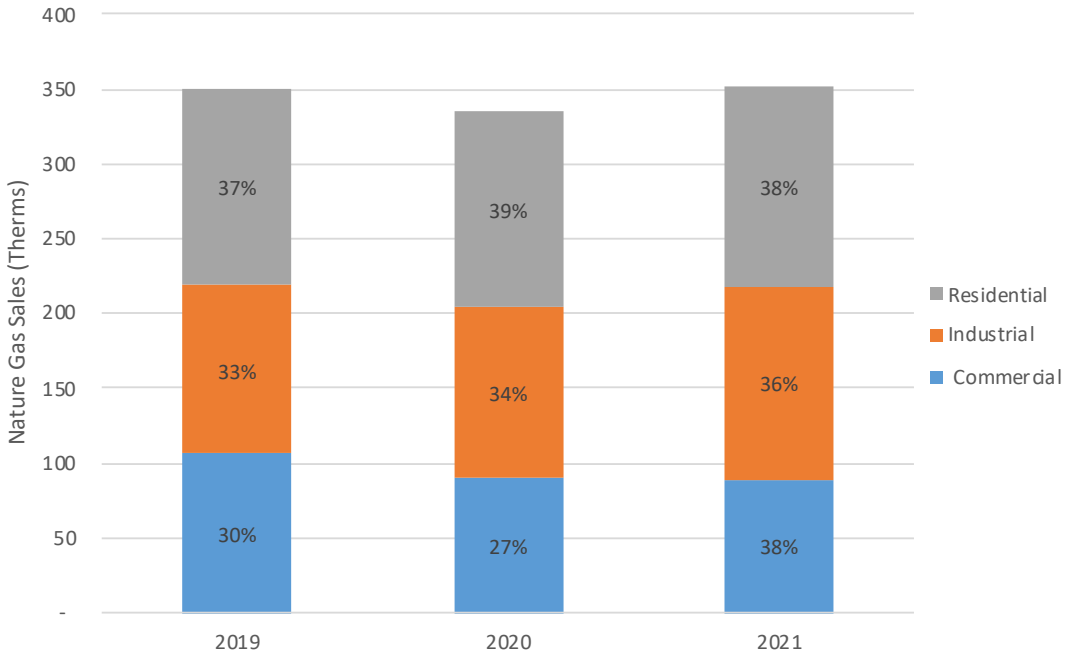
Year	2019 (Reported in 2020 Annual Report)	2019 Revised*	2020	2021	2019 Revised - 2020 % Change	2020 - 2021 % Change
Natural Gas Use (million therms)	351	351	335	352	-5%	5%

Revised values reflect updated information from sources.

The natural gas sales data do not include the sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and military.SDG&E 2022, Energy Policy Initiatives Center, University of San Diego 2023

A 5% increase in natural gas end-use emissions between 2020 and 2021 is mainly due to an increase in residential and industrial use. A comparison of the natural gas end-use by customer class in 2019–2021 is shown in Figure 3.

FIGURE 3 NATURAL GAS END-USE BY CUSTOMER CLASS IN CITY OF SAN DIEGO



SDG&E's natural gas sales in City of San Diego. Sales do not include transmission and distribution losses, and exclude sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military.
Percentages may not sum up to totals due to rounding.
SDG&E 2020-2022

Table 6 provides the electricity and natural gas end-use in million British Thermal Units (MMBtu). MMBtu is a common unit of energy used to enable comparison of the energy content of different fuel types. In this case electricity in kilowatt-hours (kWh) and natural gas in units of therm are converted to the same MMBTU unit. Natural gas constituted 58% of the total end-use energy in 2020, and 60% of total end-use energy in 2021.

TABLE 6 TOTAL ELECTRICITY AND NATURAL GAS DELIVERED BY SDG&E IN CITY OF SAN DIEGO

Year	2019 (Reported in 2020 Annual Report)	2020	2021	2019 - 2020 % Change	2020 - 2021 % Change
Electricity (Million MMBtu)	24.9	24.5	23.7	-2%	-3%
Natural Gas (Million MMBtu)	35.1	33.5	35.2	-5%	5%
Energy (million MMBtu)	60.0	58.0	58.9	-3%	2%

MMBtu = million British Thermal Units
Conversion factors are 293 kWh/MMBtu and 10 therms/MMBtu.

SDG&E 2022, Energy Policy Initiatives Center, University of San Diego 2023

Table 7 provides the electricity and natural gas saved from utility (SDG&E)'s energy efficiency program from 2016 to 2018.

TABLE 7 ENERGY SAVINGS FROM UTILITY ENERGY EFFICIENCY PROGRAM

Year	2016	2017	2018
Electricity Savings (MWh)	8,220	11,900	10,365
Electricity Savings (MMBtu)	280,275	405,724	353,403
Natural Gas Savings (Therms)	1,011,251	382,077	(453,270)
Natural Gas Savings (MMBtu)	101,125	38,208	(45,327)
Net Electricity and Natural Gas Savings (MMBtu)	381,400	443,931	308,076
Net Electricity and Natural Gas Savings as a Percentage of Energy Use (%)	0.6%	0.7%	0.5%

MWh = megawatt hour, MMBtu = Million British Thermal Units
KWh and therms are converted to MMBtu using 99,976 btu/therm and 3,412 btu/kWh.

The annual data provide the energy efficiency savings credited for that year. The energy savings are from SDG&E energy efficiency program participants only. These includes all customer classes (residential, commercial, and industrial). The savings are estimates comparing the energy use with and without the energy efficiency projects. A negative natural gas value means additional natural gas is used. Net energy savings means the net of electricity and natural gas savings.

SDG&E 2019, Energy Policy Initiatives Center, University of San Diego 2019

Action & Progress: Reduce Energy Use in Residential Housing Units

Total residential electricity use includes both electricity provided by the grid and electricity generated from behind-the-meter PV systems. Residential PV capacity increased 16% from 291 Megawatts (MW) in 2019 to 388 MW in 2020 while grid-supply increased by 11% in the same period. Together, grid-supply with behind-the-meter PV increased 11% from 2019 to 2020. Residential natural gas decreased by 1% from 2019 to 2020. Therefore, combining both electricity and natural gas use, energy use per home in 2020 was approximately 2% higher than in 2019, mainly due to the increase in electricity use. Residential PV capacity increased 15% to 389 MW in 2021, combined with a decrease in grid-supply electricity, the total residential electricity use decreased by 6% from 2020 to 2021. Residential natural gas use increased by 4% in the same period. Therefore, combining both electricity and natural gas use, energy use per home in 2021 was approximately the same as in 2020. Table 8 shows a comparison of 2020 and 2021 residential energy use with the CAP baseline year 2010.

TABLE 8 RESIDENTIAL ENERGY (ELECTRICITY + NATURAL GAS) USE						
Year	**2010 (Reported in CAP)**	**2019 (Reported in 2020 Annual Report)**	**2020**	**2010-2020 % Change**	**2021**	**2010-2021 % Change**
Electricity (MWh, grid-supply)	2,498,471	2,117,782	2,340,171	-6%	2,096,382	-16%
Electricity (MW of PV[1])	15	291	338	2399%	389	2776%
Electricity (MWh of PV[2])	26,251	494,867	571,525	2311%	654,758	2663%
Total Electricity (sum of utility + estimated PV, MWh)	2,524,722	2,612,649	2,911,696	15%	2,751,140	9%
Total Electricity (sum of utility + estimated PV, MMBtu)	8,608,065	8,907,854	9,927,457	15%	9,380,040	9%
Natural Gas (Million Therms)	138	131	130	-6%	134	-2%
Natural Gas (MMBtu)	13,781,505	13,058,203	12,978,130	-6%	13,445,646	-2%
Total Energy (MMBtu)	22,389,570	21,966,057	22,905,587	2%	22,825,686	2%
Total # of occupied units[3]	483,092	505,736	515,676	7%	514,964	7%
Energy use per home (MMBtu/home)	46.3	43.4	44.4	-4.1%	44.3	-4.3%

MW = megawatt, MWh = megawatt hour, MMBtu = million British Thermal Unit

[1]Behind-the-meter PV capacity is obtained from the California Distributed Generation Statistics database, net energy metering (NEM) interconnection dataset for SDG&E - City of San Diego residential customers (July 31, 2022 version). It is based on the date of interconnection application approval.

[2]Capacity is converted to electricity using an average PV system capacity factor of 20% and annual degradation factor of 1%.

[3]2020 and 2021 occupied housing units are from California Department of Finance population and housing estimates, with 2020 Census benchmark.

Energy Policy Initiatives Center, University of San Diego 2023

Action & Progress: Reduce Municipal (City Operations) Energy Use

Municipal operations energy use in 2020 was 5% lower than that in 2019; but the energy use in 2021 was 3% higher than that in 2020 (Table 9).

TABLE 9 ENERGY (ELECTRICITY + NATURAL GAS) USE FOR MUNICIPAL OPERATIONS (SDG&E ONLY)							
Energy Use	**2010 Baseline**	**2019 (Reported in 2020 Annual Report)**	**2019 Revised***	**2020**	**2010-2020 % Change**	**2021**	**2010-2021 % Change**
Electricity (MWh)	205,787	180,200	210,794	203,900	-1%	190,152	-9%
Electricity (MMBtu)	701,633	614,394	718,704	695,198	-1%	648,326	-9%
Natural Gas (Million Therms)	3.4	4.7	4.6	4.3	29%	5.1	45%

TABLE 9 ENERGY (ELECTRICITY + NATURAL GAS) USE FOR MUNICIPAL OPERATIONS (SDG&E ONLY)

Energy Use	2010 Baseline	2019 (Reported in 2020 Annual Report)	2019 Revised*	2020	2010-2020 % Change	2021	2010-2021 % Change
Natural Gas (MMBtu)	335,723	470,000	462,934	431,642	29%	514,442	45%
Total energy (MMBtu)	1,037,357	1,084,394	1,181,639	1,126,839	9%	1,162,768	13%

Revised values reflect updated information from sources.
Grid purchases only, does not include on-site renewable generation. Natural gas consumption includes gas use for space heating/cooling and electric generation.

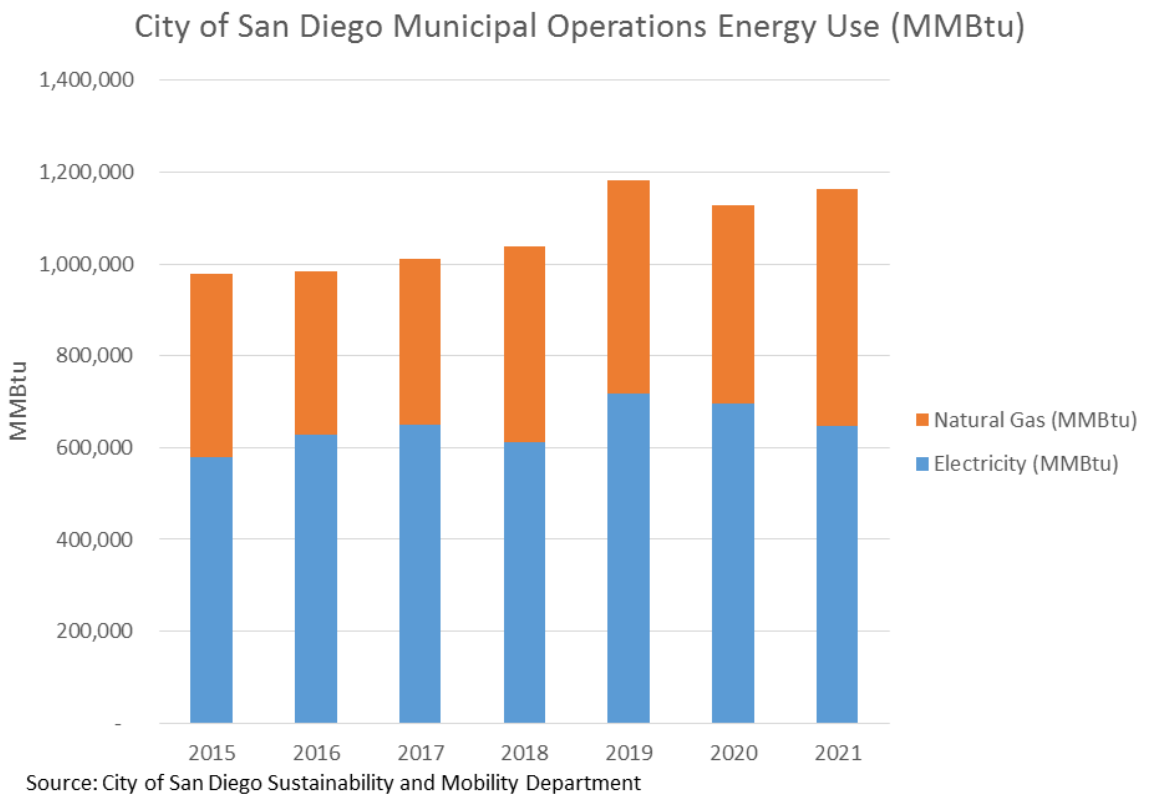
MWh = megawatt hour, MMBtu = million British Thermal Units.

KWh and therms are converted to MMBtu using 99,976 btu/therm and 3,412 btu/kWh factors.

City of San Diego Sustainability & Mobility Department 2023

The trend in energy use for municipal operations from 2015 to 2021 is given in Figure 4 below.

FIGURE 4 MUNICIPAL ENERGY USE (2015–2021)



Source: City of San Diego Sustainability and Mobility Department
SDG&E grid purchase only. Does not include on-site renewable geneartion.

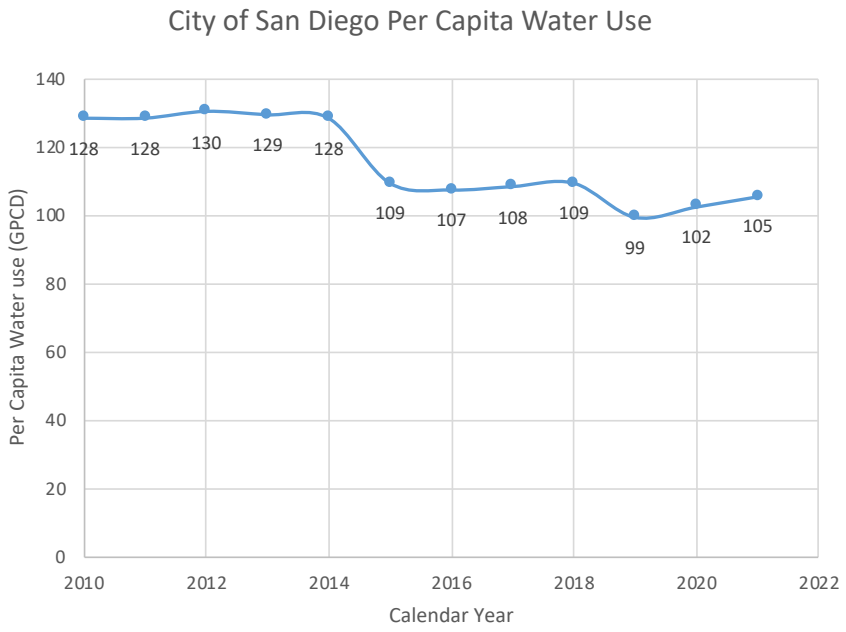
The municipal operations energy use increase in recent years was partially due to additional natural gas use from the compressed natural gas (CNG) waste collection trucks. Discussed in more detail under Strategy 2, the City is ahead of the schedule in the transition to CNG waste collection trucks from diesel trucks.

Action & Progress: Reduce Daily per Capita Water Consumption

Per capita water use (gallons per capita per day – GPCD) decreased substantially from 2010 to 2021 (Figure 5). Governor Brown issued Executive Order B-29-2015 imposing a 25% statewide potable water reduction in April 2015. This drought emergency declaration was lifted by the Governor in April 2017, while retaining a prohibition on wasteful practice. The per capita water use in the City of San Diego has remained below 2015 level in recent years.

The GPCD calculation method (volume of water entering City of San Diego's distribution system divided by distribution system population) is consistent with the GPCD definition in SB X7-7 (the Water Conservation Act of 2009) and the City of San Diego 2015 Urban Water Management Plan (June 2016 final version). However, to be consistent with the CAP, the GPCD is reported by calendar year in this CAP Annual Report, while the GPCD in the Urban Water Management Plan and SB X7-7 are by fiscal year. Therefore, the GPCD reported here cannot be directly compared with the SB X7-7 GPCD target for 2020.

FIGURE 5 PER CAPITA WATER USE (2010–2021)



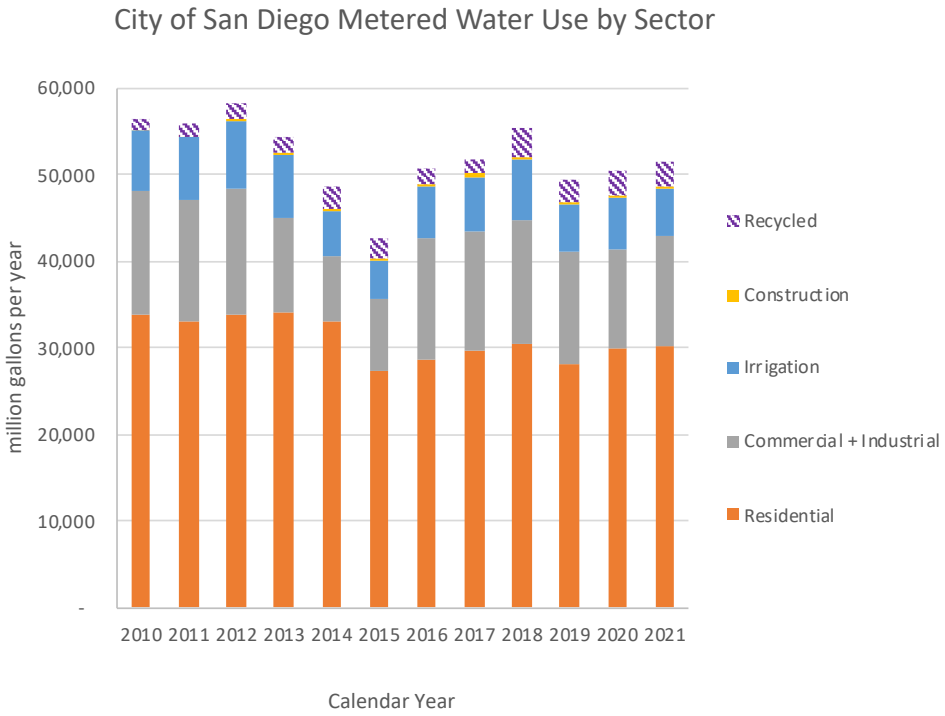
GPCD - gallon per capita per day
Source: City of San Diego Public Utilities Department

The amount of recycled water and water used for irrigation from 2010 to 2021 are provided in Table 10.

TABLE 10 METERED RECYCLED AND IRRIGATION WATER USE		
Year	**Recycled Water Sales (million gallons)**	**Metered Irrigation Water Use (million gallons)**
2010	1,350	6,923
2011	1,524	7,193
2012	1,867	7,812
2013	1,691	7,336
2014	2,588	4,977
2015	2,370	4,378
2016	1,637	5,943
2017	1,691	6,302
2018	3,265	7,092
2019	2,606	5,631
2020	2,881	5,988
2021	2,798	5,661
Metered irrigation water, including agricultural and landscape water use. City of San Diego Public Utilities Department		

The breakdown of City of San Diego's water sales by sector including recycled water is given in Figure 6.

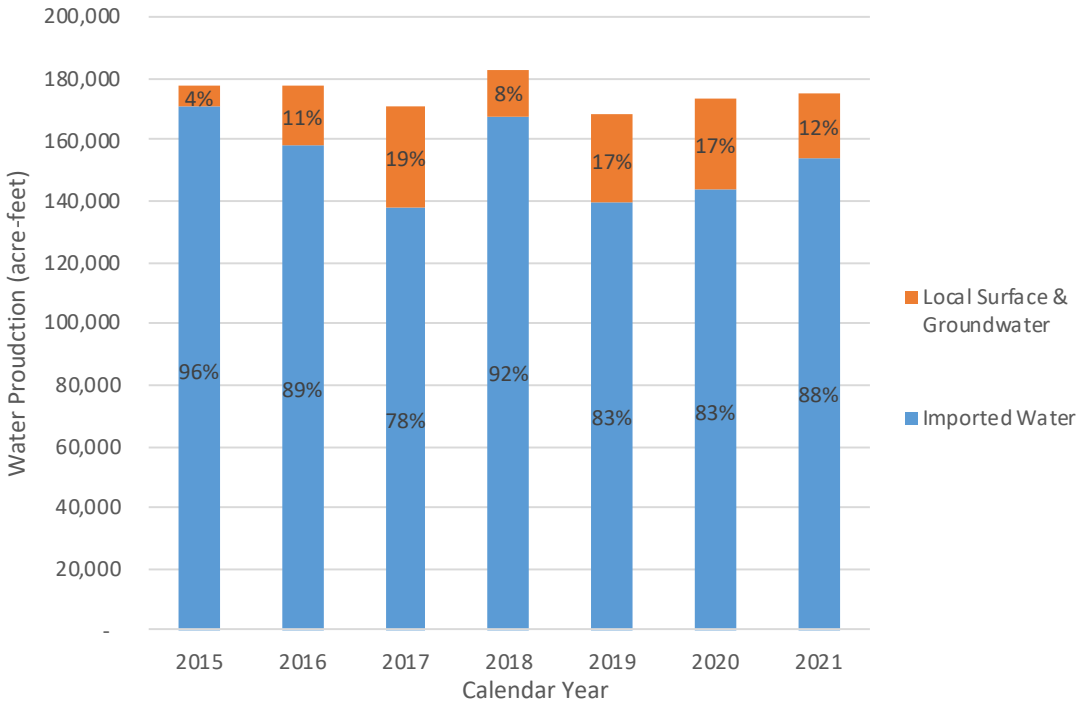
FIGURE 6 WATER SALES BY SECTOR (2010–2021)



Source: City of San Diego Public Utilities Department
Sales within City of San Diego only. Do not include sales to other agencies.

The percentage of local water supply to total water supply has been fluctuating in recent years, as shown in Figure 7. The availability of local water generally depends on rainfall and runoff in the City reservoirs in the year. In 2020 17% of total water supply was from local surface and groundwater; while in 2021 12% was from local supply. A higher percentage of local water supply reduces the need to import water from San Diego County Water Authority, and reduces the energy and GHG emissions associated with imported water.

FIGURE 7 WATER MIX (2015–2021)



Water production include water delivered within City of San Diego and sales to other agencies.
Source: City of San Diego Public Utilities Department

STRATEGY 2: CLEAN AND RENEWABLE ENERGY

The City of San Diego has a long-term goal of reaching 100% renewable electricity supply in 2035. Several key categories contribute to the 100% renewable goal including the renewable content in the grid electricity supply, and behind-the-meter renewable supply (including rooftop PV).

Baseline and Current State of Clean and Renewable Energy in the City of San Diego

SDG&E's renewable electricity supply increased from 11% in 2010 to 44.6% in 2021, the highest since 2010 (Table 11). In March 2021, San Diego Community Power (SDCP), a community choice energy provider, started serving jurisdictions in the San Diego region, including the City of San Diego. By the end of 2021, eligible SDG&E bundled commercial and industrial customers were enrolled in SDCP automatically with the option to opt-out (return to SDG&E) or opt-up to a SDCP product with higher renewable electricity.

TABLE 11 PERCENTAGE OF RENEWABLES IN GRID ELECTRICITY SUPPLY	
Year	**Renewables in Grid Electricity Supply**
2010	11% (SDG&E)
2011	16% (SDG&E)
2012	19% (SDG&E)
2013	24% (SDG&E)
2014	32% (SDG&E)
2015	36% (SDG&E)
2016	43% (SDG&E)
2017	44% (SDG&E)
2018	43% (SDG&E)
2019	31% (SDG&E)
2020*	31% (SDG&E)
2021**	44.5% (SDG&E) 54.9% (San Diego Community Power)

The percent renewable is for the electricity SDG&E supplied to its bundled customers; it does not represent the renewable content of the electricity supplied to SDG&E's Direct Access customers and does not account for behind-the-meter renewable supply.

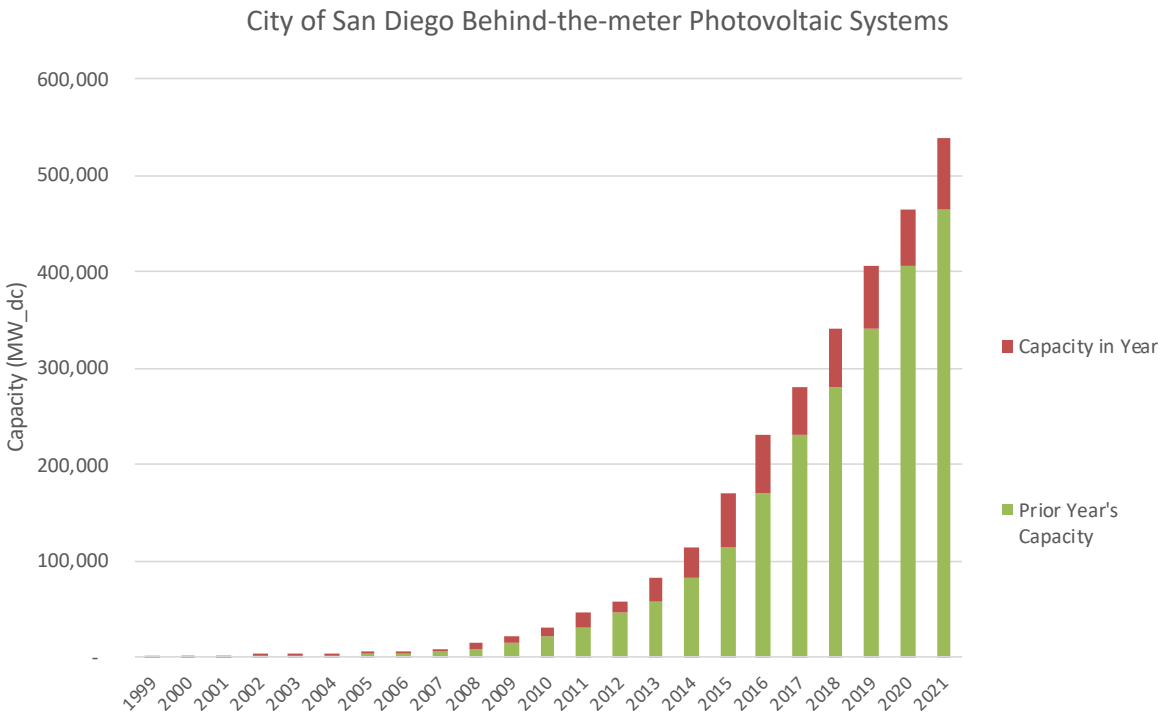
* The California Energy Commission has updated the method to report renewable content in the Power Source Disclosure Program. The percentage starting 2022 does not reflect the supplier's Renewables Portfolio Standard compliance, and does not include unbundled renewable energy credits.

** San Diego Community Power started serving jurisdictions in the San Diego region, including the City of San Diego, in March 2021.

California Energy Commission 2022

In 2020, approximately 8,500 out of 8,600 new PV systems added (nearly 98% of total installations) in the City were from residential customers. This represented about 70% of the total installed capacity in 2020 (46 MW out of 60 MW). The percentages in 2021 were similar, with 51MW out 74MW total installed capacity in 2021 from residential PV systems. The cumulative net energy metered (NEM) PV capacity from the interconnected systems installed between 1999 and the end of 2021 was 540 MW in the City. Figure 8 shows the new capacity added in a year and prior year's capacity.

FIGURE 8 BEHIND-THE-METER PV IN CITY OF SAN DIEGO (1999–2021)



California Distributed Generation Statistics database, net energy metering (NEM) interconnection dataset, July 31, 2022 version.
Energy Policy Initiatives Center University of San Diego, 2023

The City also has numerous facilities with on-site renewable generation, including: (1) combined heat and power generation using landfill gas or digester gas at Metropolitan Biosolids Center, Point Loma Wastewater Treatment Plant and North City Water Reclamation Plant; (2) hydroelectric generation at Point Loma Wastewater Treatment Plant ocean outfall; and (3) PV systems at water treatment facilities, libraries, recreation centers and fire stations.

Electric Vehicles and Infrastructure in the City of San Diego

The impact of zero-emission vehicles (ZEVs) policies and programs in avoiding GHG emissions is calculated as the impact of State polices and actions, not as a result of a particular CAP strategy. However, the impact is reflected at the local level.

The total number of registered EVs citywide, including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), at the beginning of 2018–2020 are shown in Table 12.

TABLE 12 NUMBER OF REGISTERED ELECTRIC VEHICLES					
Number of Vehicles	**As of January 1, 2018**	**As of January 1, 2019**	**2018 – 2019 % Change**	**As of January 1, 2020**	**2019 – 2020 % Change**
Number of Battery Electric Vehicles (BEVs)	7,712	8,311	8%	15,005	81%
Number of Plug-in Hybrid Electric Vehicles (PHEVs)	4,701	5,194	10%	7,999	54%
Total Number of Electric Vehicles (BEVs + PHEVs)	12,413	13,505	9%	23,004	70%
Total Number of Registered Vehicles	1,100,805	1,108,667	1%	1,104,691	-0.4%
Percent of Electric Vehicles to All Registered Vehicles	1.1%	1.2%	8%	2.1%	71%
Department of Motor Vehicles 2019–2021					

The number of ZEVs has increased significantly, almost doubled, during 2019. At the beginning of 2020, approximately 2% of all registered vehicles in the City were ZEVs, which is similar to the percentage of San Diego region-wide ZEVs to all registered vehicles. The percentage does not represent ZEV market share, the percentage of new ZEVs of new vehicles sales. ZEVs accounted for approximately 8% of market share in the state in 2020, and 12% in 2021.

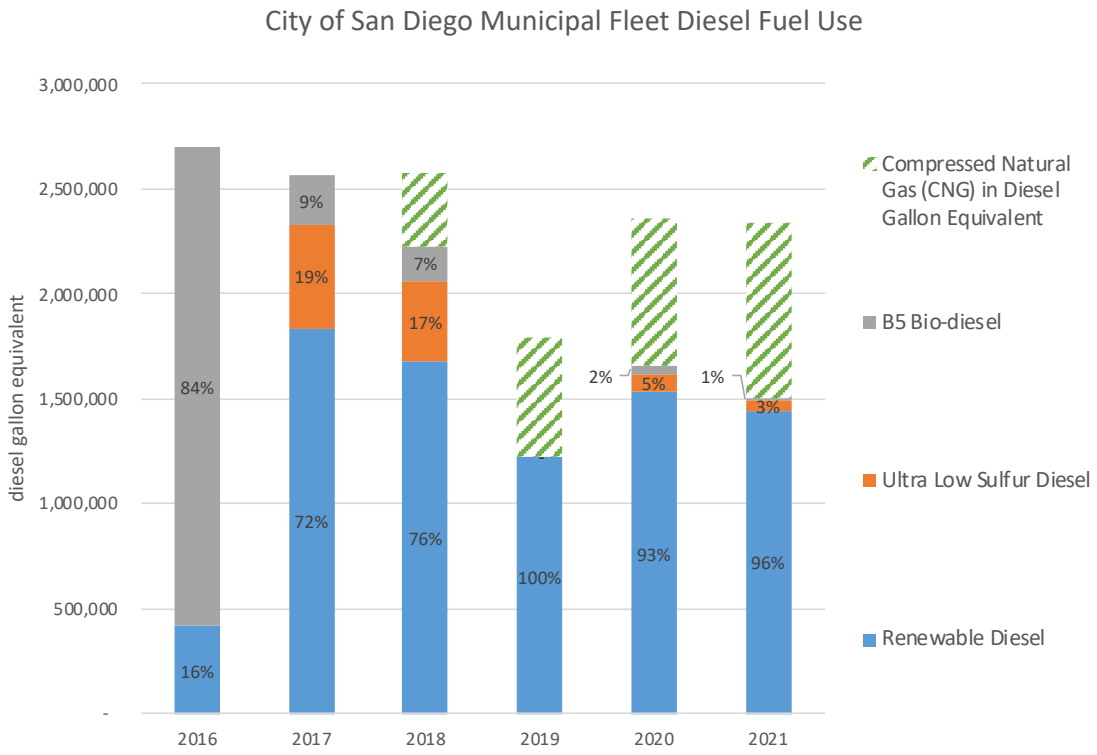
The increasing number of EVs leads to increasing demand for EV charging. Table 13 below shows the number of public electric vehicle charging stations (EVCSs) and the number of EVCSs offered through SDG&E's Power Your Drive program at multi-family buildings and workplaces within the City.

TABLE 13 ESTIMATED NUMBER OF ELECTRIC VEHICLE CHARGING STATIONS	
Number of Charging Sites or Chargers	**Open as of 2020**
Number of Public Level 2 EVCSs at all Sites	932
Number of Public DC Fast EVCSs at all Sites	230
Number of SDG&E Power Your Drive EVCSs	1,755
EVCS = electric vehicle charging station Number of EVCSs are the number of nozzles or plugs. One site may have more than one nozzle or plug. EVCSs installed through SDG&E's Power Your Drive program are not considered public chargers as they are installed primarily at workplaces (including municipal facilities) and multi-family buildings (apartments and/or condo buildings). Data do not include other private workplace or in-home (e.g. single-family homes) charging stations. Alternative Fuels Data Center 2023, SDG&E 2019, Energy Policy Initiatives Center, University of San Diego 2023	

Action & Progress: Increase Municipal Zero Emissions Vehicles

As of 2021, City operations had 4,297 vehicles, including 114 BEVs and 105 PHEVs. The City also had 220 regular hybrids and 95 CNG waste trucks. In 2016, the City municipal fleet started the transition to 100% renewable diesel to help meet the CAP goal of reducing municipal fleet GHG emissions. The percentage of renewable diesel increased from 16% in 2016 to 100% in 2019 (Figure 9).

FIGURE 9 MUNICIPAL FLEET COMPRESSED NATURAL GAS AND DIESEL FUEL USE BY TYPE (2016–2021)



B5 Bio-diesel and renewable diesel also includes off-road equipment fuel use.
Percentages are calculated based on the sum of bio-diesel, ultra low surfur diesel, and renewable diesel, not including compressed natural gas.
Source: City of San Diego Fleet Operations Department

Consistent with the CARB statewide GHG Inventory and the IPCC Guidelines, the CO_2 emissions from biofuel (e.g., ethanol, biodiesel, and renewable diesel) are classified as "biogenic CO_2" and not included in the GHG inventory. Only the CH_4 and N_2O emissions from biofuel are accounted for in the GHG inventory. For regular diesel, all CO_2 CH_4 and N_2O emissions are accounted for in the GHG inventory.

The 2010 to 2021 city fleet gasoline consumption is given in Table 14.

TABLE 14 CITY FLEET GASOLINE CONSUMPTION	
Year	**Total Gasoline (gallons)**
2010	1,337,869
2011	2,155,962
2012	2,267,693
2013	2,277,559
2014	2,268,104
2015	2,262,114
2016	2,344,552
2017	2,275,635
2018	2,199,146
2019	2,047,504
2020	2,222,688
2021	2,181,940
City of San Diego Fleet Operations Department	

Action & Progress: Convert Municipal Waste Collection Trucks to Low-Emissions Fuel

In 2021, the City had 95 compressed natural gas (CNG) waste collection trucks in service versus 91 in 2020, and 68 in 2019. This represents more than 70% of the waste collection truck fleet, ahead of the scheduled implementation of the measure (100% conversion by 2035). CNG is a low emission fuel compared with diesel. CNG has displaced diesel fuel use as shown in Figure 9.

STRATEGY 3: BICYCLING, WALKING, TRANSIT AND LAND USE

Transportation accounted for 50% of all GHG emissions within the City of San Diego in 2020, and 57% in 2021. Strategy 3 aims at reducing commuter vehicle driving by increasing the use of mass transit, bicycling and walking in the city's Transit Priority Areas (TPA). TPAs are defined as the areas within half a mile of existing or planned major transit stops.

State of and current state of transportation in the City of San Diego

The 2020 and 2021 vehicle miles travelled (VMT) and on-road transportation emissions in the City of San Diego are shown in Table 15. The impact of the COVID-19 pandemic on vehicle miles traveled (VMT) in 2020 and 2021 was estimated from 2016 VMT using the 2016–2021 regional public road VMT monitoring data, which showed that the decrease was mostly likely from light-duty vehicles after shelter-in-place orders were enacted in 2020. However, the emissions from on-road transportation in 2021 were 13% higher than the emissions in 2020, showing that the impact of the COVID-19 pandemic on driving may not be sustained long term. The data sources and method to calculate on-road transportation emissions are provided in the supplemental inventory documentation to this report.

TABLE 15 2020 AND 2021 VEHICLE MILES TRAVELLED (VMT)

Year	2020	2021
Total VMT (million miles/year)	10,891	12,628
San Diego Regional Average Vehicle Emission Rate (g CO_2e/mile)	427	415
GHG Emissions (MT CO_2e)	4,650,000	5,239,000

The 2019 VMT are estimates based on the 2016 City of San Diego VMT estimates from SANDAG's Activity Based Mode l (ABM2+) and Final 2021 Regional Plan, multiplied by the 2016-2021 San Diego regional VMT annual rates of growth. Annual rates of growth are estimated from the annual California Department of Transportation (CalTrans) Highway Performance Monitoring System public road data and Performance Measure System freeway data.

SANDAG 2021, CalTrans, CARB2021, Energy Policy Initiatives Center, University of San Diego 2023

Action & Progress: Walking, Biking, Transit and Vehicle Commute Distance

Since the adoption of the CAP in 2015 the availability and type of data for tracking progress on mode shares and commute trip length have progressed. Baseline mode shares were determined through multiple sources of data as listed below in Table 16. To provide a more consistent evaluation of progress and ensure the utilization of the best available data, the City of San Diego worked with a transportation consulting firm, Fehr & Peers, to present updated mode share results comprised of the most up-to-date techniques and information at the time. This information was originally reported in the 2018 CAP Appendix. There have been no significant changes to the modeling inputs since last year's report as SANDAG is currently in the process of updating the 2021 Regional Transportation Plan.

SANDAG, the regional transportation agency, is currently the best source for transportation data in the region. SANDAG has transitioned from an enhanced four-step transportation model to an activity-based model (ABM). ABMs allow for a more nuanced analysis of complex policies and projects and strive to be as behaviorally realistic as possible by simulating individual and household transportation decisions that compose their daily travel itinerary. The ABM is based on empirical data collected by SANDAG, California Department of Transportation (Caltrans), and the federal government.

The results presented below in Table 16 utilize the SANDAG Series 13 ABM, which is different from the ABM used to develop the VMT data used for the GHG inventory (Series 14 ABM version 14.0.1). SANDAG no longer maintains or allows modification to prior data series (e.g. Series 12) or the previously used four-step transportation model. The following model years and scenarios were used:

- Series 13 Base Year (2012) Model Run: The base year model run represents the land use and transportation network for year 2012. The full model output was provided by SANDAG and post processed to obtain 2012 mode share and commute trip length information. No land use or transportation network adjustments were made to the base year model run.

- Series 13 2035 with community plan updates (CPU) Model Run: The 2035 model run was developed before several community plan updates (CPUs) were completed. The unadjusted 2035 model run from SANDAG does not include land use from the recently approved CPUs. The 2035 model was adjusted to reflect the CPU land use for Uptown, North Park, Golden Hill, Navajo, San Ysidro, Southeastern, and Encanto. The full model output was post processed by Fehr & Peers to obtain forecasts for 2035 mode share and commute trip length information.

TABLE 16 SUMMARY OF 2010 (CAP BASELINE YEAR) MODESHARE ESTIMATES AND VEHICLE COMMUTE DISTANCE

Mode	Baseline Mode Share (%) 2010	Baseline Source Data
Transit	4%	American Community Survey Briefs 2008 and 2009 (Table 2), for San Diego-Carlsbad-San Marcos area
Walking	3.5%	City of San Diego Pedestrian Master Plan of 2006, Appendix D
Bicycling	2%	City of San Diego Bicycle Master Plan, Table 5.12
Vehicle Commute Distance	25 miles per day (Regional)	SANDAG, 2010

TABLE 17 SUMMARY OF BASELINE MODESHARES AND VEHICLE COMMUTE DISTANCE				
Mode	**2012 Base Year Mode Share (%)**	**Modeled Mode Share (%) 2017[7]**	**2035 with CPUs Mode Share (%)**	**Modeled Source Data**
Transit	5.9%	7.6%	12.7%	SANDAG series 13 regional travel demand model base year (2012) run and SANDAG Series 13 regional travel demand model run 2035 with community plan updates.
Walking	2.7%	3.0%	4.0%	
Bicycling	1.6%	1.8%	2.3%	
Drive	89.8%	87.6%	81.0%	
Drive Alone	80.4%	78.1%	71.3%	
Regional Vehicle Commute Distance (miles)	20.11	19.95	19.41	
City Vehicle Commute Distance (miles)	17.05	16.97	16.71	
Source: Fehr & Peers, 2018				

This analysis does not account for citywide regulations, programs and policies that would be implemented throughout the life of the community plans, such as additional bicycle and pedestrian improvements whenever street resurfacing occurs, as feasible; highest priority bicycle and pedestrian improvements that align with "Vision Zero"; regional improvements that promote alternative modes of transportation, such as mobility hubs; innovative mobility options (e.g., dockless vehicles, micro transit, etc.), bicycle and car sharing programs; the CAP consistency checklist for new development; and, improvements to enhance transit accessibility. The mode share information provided in this annual report reflect the land use contribution to shift the citywide mode share in continued progress to achieve the CAP goals.

As transportation modeling efforts continue to improve, the information presented in this and future CAP annual reports will reflect results based on the best available data.

The bicycle facility improvements since 2013 are shown in Table 18 Bicycle Facilities Improvements since 2013.

TABLE 18 BICYCLE FACILITIES IMPROVEMENTS SINCE 2013										
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Since 2013**
New Class I Bike Lane Miles Added	-		-	-	2.1	-	-	-	-	2.1

[7] The 2017 mode share values were calculated using a straight-line interpolation between the 2012 SANDAG series 13 base year and the 2035 SANDAG series 13 with CPUs mode share values.

TABLE 18 BICYCLE FACILITIES IMPROVEMENTS SINCE 2013										
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Since 2013**
New Class II Bike Lane Miles Added	6.9	10.5	14.6	12.7	7.9	11.5	10.8	2.2	17.4	94.5
New Class IV Bike Lane Miles Added	-	-	-	-	-	-	2	3.7	34.2	39.9
Existing Bike Lane Miles Improved	35.7	51.7	42.2	43.6	21.4	2.3	34.6	81.6	65.3	378.4
Existing Bike Lane Miles Replaced	1.3	1.6	-	-	-	27.9	-	-	-	30.8
Total Added or Improved Miles	43.9	63.8	56.8	56.8	31.4	41.7	47.4	87.5	103.6	532.9
City of San Diego Transportation & Storm Water Department										

Action & Progress: Roundabouts and Traffic Signal Re-timing

The city re-timed 75 traffic signals in 2020 and 60 traffic signals in 2021 that led to traffic flow improvements and subsequent fuel reductions, as shown in Table 19.

TABLE 19 ROUNDABOUTS INSTALLED AND TRAFFIC SIGNALS RETIMED						
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Roundabouts Installed	2	0	0	0	0	0
Traffic Signals Retimed	60	70	52	64	75	60
City of San Diego Transportation & Storm Water Department						

STRATEGY 4: ZERO WASTE

In 2020 and 2021, solid waste and wastewater emissions accounted for about 3% of the total citywide emissions. The City has a Zero Waste strategy with actions to divert waste from landfills and capture and utilize the methane from wastewater treatment.

Action & Progress: Enact Zero Waste and Divert Trash and Capture GHG Emissions from Landfills

The 2015–2020 waste disposed and diversion rates in the City are shown in Table 20. The waste disposal and diversion rates in recent year relatively consistent. The 2021 waste disposal and diversion rate are not available as of January 2023. Assembly Bill 1383 revised reporting requirements of organics, recyclable material, and solid waste, which affects the waste diversion rate calculation.

TABLE 20 WASTE DIVERSION RATE AND DISPOSED TONNAGE						
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Waste Disposed in Landfills (tons)	1,583,833	1,521,363	1,576,105	1,639,817	1,569,447	1,543,627
Waste Diversion Rate (%)	64%	66%	66%	65%	66%	67%
Tonnages were adjusted or corrected from tonnages reported in the CalRecycle database based on City information City of San Diego Environmental Service Department						

Action & Progress: Capture Methane from Wastewater Treatment

The City of San Diego's Point Loma Wastewater Treatment Plant (Point Loma WWTP) is self-sufficient with on-site renewable electricity production using biogas (captured methane from wastewater treatment) and hydropower. The excess renewable electricity generated at the Point Loma WWTP is exported back to the grid. The digester capture rate at Point Loma WWTP is now 99.9%.

STRATEGY 5: CLIMATE RESILIENCE

The City of San Diego has committed itself to increasing the urban tree canopy from 7% total coverage in 2010 baseline to 15% by 2020 and 35% by 2035. Increasing urban tree canopy contributes to the capture and storage of carbon, as well as other benefits including storm water management, improved air quality, increased property values, etc.

Action & Progress: Increase Urban Tree Canopy Coverage

The updated urban tree canopy coverage in 2015 was 13% in the City of San Diego, based on the Urban Tree Canopy Assessment preliminary results developed by the University of Vermont and the USDA Forest Service, funded by California Department of Forestry and the Fire Protection (CalFire) for the City of San Diego. The City is tracking the number of new trees planted and tree maintenance (trimmed, pruned and or removed) by City departments (Table 21).

TABLE 21 TREE PLANTING AND MAINTENANCE		
Tree Planting and Maintenance Year	**2020**	**2021**
Trees Planted[1]	1,863	1,707
Trees Trimmed[2]	33,254	35,206
Trees Removed[1]	1,824	2,151
Trees Evaluated[3]	5,316	6,372
[1]Planted or removed by the Transportation Street Division and Parks and Recreation Department; [2]Includes shade trees and palms trees; [3]Trees are evaluated for species type, tree condition, diameter, and defects to determine the amount of corrective tree work that may be needed for the health of the tree and/or to address public safety adjacent to the tree. City of San Diego Transportation & Storm Water Department		

Section C: Methodology Differences and Data Refinement

The method differences and data refinements between the previous and current GHG inventory calculations are given in **Error! Reference source not found.**. The differences are primarily from updated and more accurate data sources. "No change" means no method differences or data refinements since the 2020 Annual Report, or the 2022 CAP.

TABLE 22 METHODOLOGY DIFFERENCES AND DATA REFINEMENTS OF GHG INVENTORY

Category	Category Detail	2019 Inventory (Published in 2020 Annual Report)	2019 Inventory (Used for 2022 CAP)	2019–2021 Inventory (This Annual Report)
Electricity	Activity (kWh)	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code	No change	2019–2020: No change 2021: Data requested from SDG&E by customer class within City of San Diego town code. No service provider or rate schedule available. Direct access and San Diego Community Power customer electricity use were estimated.
	Emission Factor (lbs CO2e/MWh)	The same as 2018, due to a delay in CEC power source disclosure program as a result of the COVID-19 pandemic	Created a weighted average emission factor based on a) SDG&E kWh procured from each fuel type at each facility/power plant and the emission factor of electricity generation at each facility/power plant (EPA eGRID2019 database specific plant level emission factor) for SDG&E's purchased power.	2019: No change 2020-2021: Used the SDG&E and San Diego Community Power emission factors reported under CEC's power source disclosure program.

TABLE 22 METHODOLOGY DIFFERENCES AND DATA REFINEMENTS OF GHG INVENTORY				
Category	**Category Detail**	**2019 Inventory (Published in 2020 Annual Report)**	**2019 Inventory (Used for 2022 CAP)**	**2019–2021 Inventory (This Annual Report)**
Natural Gas	Activity (Therms)	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code	No change	2019–2020: No change 2021: Data requested from SDG&E by customer class within City of San Diego town code. No service provider or rate schedule available.
	Emission Factor (MT CO_2e/Therm)	Natural gas emission factor in California based on California Air Resources Board statewide inventory	No change	
Transportation	Activity (VMT)	Applied annual average VMT rate of increase from HPMS data to 2016 VMT estimates. 2018 to 2019 HPMS rate of increase was the average of 2016-2018 annual rate of increase, due to a delay in HPMS data. 2016 VMT estimates were provided by SANDAG using Series 14 Forecast and ABM2 from the 2019 Federal Regional Transportation Plan	Applied annual average VMT rate of increase from 2016-2019 HPMS data to 2016 VMT estimates. 2016 VMT estimates were provided by SANDAG using Series 14 Forecast and ABM2+ from the Draft 2021 Regional Plan	2019–2020: Applied annual average VMT rate of increase from 2016–2019 HPMS data to 2016 VMT estimates provided by SANDAG using Series 14 Forecast and ABM2+ from the Final 2021 Regional Plan 2021: Applied the VMT 2019 to 2021 percent increase from PeMS data to 2019 VMT estimates, due to a delay in HPMS data

TABLE 22 METHODOLOGY DIFFERENCES AND DATA REFINEMENTS OF GHG INVENTORY				
Category	**Category Detail**	**2019 Inventory (Published in 2020 Annual Report)**	**2019 Inventory (Used for 2022 CAP)**	**2019–2021 Inventory (This Annual Report)**
	Emission Factor (g CO2e/mile)	San Diego region emission rate per vehicle class from EMFAC2017 with model default assumptions on vehicle mix, travel activities, etc.	San Diego region emission rate per vehicle class from EMFAC2021 with model default assumptions on vehicle mix, travel activities, etc.	No change
Water	Activity (acre-feet)	Potable and recycled water supplied to City of San Diego (water production) separated into wholesale water (from San Diego County Water Authority) and local water (surface and groundwater) Removed water purchased by Del Mar and CalAm service area not in the City	No change	2019–2020: No change 2021: Removed water purchased by Del Mar, CalAm service area not in the City, and South Bay Irrigation District
	Emission Factor (energy intensity - kWh/acre-foot)	Local energy intensity based on water treatment plants and lake pump stations electricity consumption, all other water pump stations and facilities electricity consumption Upstream supply energy intensity calculated based on Metropolitan Water District and SDCWA 2015 Urban Water Management Plan	No change	

TABLE 22 METHODOLOGY DIFFERENCES AND DATA REFINEMENTS OF GHG INVENTORY				
Category	**Category Detail**	**2019 Inventory (Published in 2020 Annual Report)**	**2019 Inventory (Used for 2022 CAP)**	**2019–2021 Inventory (This Annual Report)**
	Electricity Emission Factor (lbs CO2e/MWh)	Upstream: eGRID 2016	No change	2019: eGRID2019 2020: eGRID2020 2021: eGRID2021
Wastewater	Activity (gallons)	City of San Diego's annual average flow (MGD) entering into Metropolitan Sewerage System (include Point Loma WWTP, South Bay WRP and North City WRP)	No change	
	Emission Factor (MT CO_2/gallon)	Calculated by dividing Point Loma WWTP and North City WRP GHG Emission reported in CARB Mandatory GHG Reporting by 2015 Point Loma WWTP and North City WRP total flow	No change	
Solid Waste	Activity (tons)	Annual waste disposed tonnage provided by City of San Diego Environmental Services Department	No change	2019–2020: No change 2021: Used 2020 waste tonnage due to a delay in reported data

TABLE 22 METHODOLOGY DIFFERENCES AND DATA REFINEMENTS OF GHG INVENTORY				
Category	**Category Detail**	**2019 Inventory (Published in 2020 Annual Report)**	**2019 Inventory (Used for 2022 CAP)**	**2019–2021 Inventory (This Annual Report)**
	Emission Factor (MT CH_4/tons)	Emission factor for each waste component from EPA WARM Model Version 15 (2019 version) and waste components from City of San Diego waste characterization study 2012–2013	No change	

Jobs Analysis

Addressing climate change has created an opportunity for San Diego to support our environment while also boosting our economy. The CAP's five strategies could impact certain industry groupings in San Diego's job market. Each will ideally have a positive impact on the local and regional economy. Jobs in the fields related to the CAP strategies were estimated and industry reports from related fields were also consulted to estimate a baseline from which to measure future progress.

Utilizing data from the Bureau of Labor Statistics (BLS), 74 industries in San Diego County were categorized into the five CAP strategies. These results are presented in Figure 1, showing the total jobs and cumulative growth rates for each group by year. The BLS estimate of San Diego's jobs in the industry groups related to the CAP grew 20.3 percent from 2010 to 2019, adding 24,156 jobs. The Energy and Water Efficient Buildings group contributed nearly 71 percent of the cumulative job growth. Between 2018 and 2019, the five CAP-related industry groups added 2,144 jobs, an increase of 1.5 percent. More than four out of five new jobs came from the Energy and Water Efficient Buildings group, which grew by 2.2 percent in 2019. Meanwhile, the Clean and Renewable Energy group shed 273 jobs in 2019, down 1.0 percent. Data sources and raw figures can be found in Appendix A.

According to the Cleantech Industry Cluster Economic Impact Analysis conducted by the San Diego Regional Economic Development Corporation, the San Diego region's Cleantech Industry Cluster added 278 jobs in 2019, an increase of 2.9 percent. Regional employment concentration in the cluster remains more than double the national average. Furthermore, earnings and average wages increased in 2019.[8]

According to a separate report by The Solar Foundation's 2019 National Solar Jobs Census, solar installations employment declined again in 2019 both in California and in San Diego, with 152 jobs being shed in the region.[9] Despite these declines, overall solar job growth continues to rise nationwide and California remains home to the largest number of solar jobs with more than 74,000 jobs.

[8] The San Diego Regional Economic Development Corporation's Cleantech Industry Cluster Economic Impact Analysis, November 2020

[9] The Solar Foundation's 2019 National Solar Jobs Census

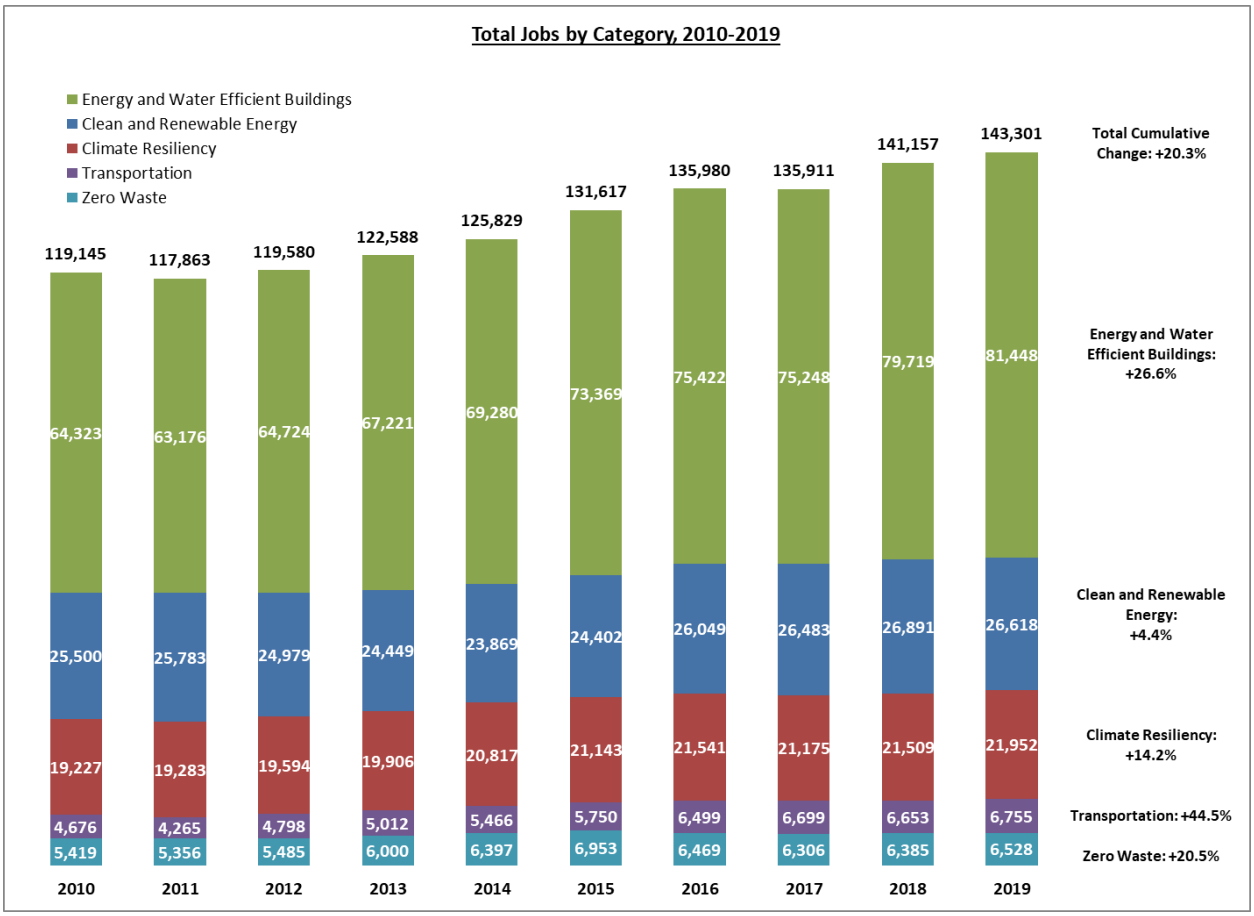


FIGURE 10 ESTIMATED TOTAL SAN DIEGO JOBS BY CAP CATEGORY, 2010–2019

"GREEN" JOBS – APPENDIX A

Economic Modeling Specialists International (Emsi, 2020.4) www.economicmodeling.com

Summary: Emsi identifies 1,000+ industries within the San Diego Region. Seventy-four industries were categorized into five CAP industry groups and grouped within Emsi. From those groups, Emsi output the jobs per occupations in the total of all the industries identified per CAP industry group during 2010-19. These job totals were then used to identify the growth per CAP industry group between 2010 and 2019.

In order to identify a baseline of total jobs within the CAP strategies over the past five years, first the industries that corresponded with each CAP industry group were identified (Table 1). No one industry was categorized into multiple CAP industry groups. Overall, 74 industries were categorized into the five industry groups; 20 industries in Energy and Water Efficient Buildings, 21 industries in Clean and Renewable Energy, eight industries in Climate Resiliency, 13 industries in Transportation and 12 industries in Zero Waste. The occupations within the corresponding CAP industry groups were identified and then the individual jobs within these occupations were totaled for each year between 2010 and 2019.

Industry Data: Emsi industry data have various sources depending on the class of worker. (1) For QCEW Employees, Emsi primarily uses the QCEW (Quarterly Census of Employment and Wages), with supplemental estimates from County Business Patterns. (2) Non-QCEW employees data are based on a number of sources including QCEW, Current Employment Statistics, County Business Patterns, BEA State and Local Personal Income reports, the National Industry-Occupation Employment Matrix (NIOEM), the American Community Survey, and Railroad Retirement Board statistics. (3) Self-Employed and Extended Proprietor classes of worker data are primarily based on the American Community Survey, Nonemployer Statistics, and BEA State and Local Personal Income Reports. Projections for QCEW and Non-QCEW Employees are informed by NIOEM and long-term industry projections published by individual states.

This report uses state data from the following agencies: California Labor Market Information Department, U.S. Bureau of Labor Statistics. This report uses state data from the following agencies: California Labor Market Information Department.

TABLE 23 INDUSTRIES WITHIN EACH CAP INDUSTRY GROUP

Energy and Water Efficient Buildings	Clean and Renewable Energy	Climate Resiliency	Transportation	Zero Waste
Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	Biomass Electric Power Generation	Environment, Conservation and Wildlife Organizations	All Other Transit and Ground Passenger Transportation	All Other Miscellaneous Waste Management Services
Architectural Services	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	Forest Nurseries and Gathering of Forest Products	Bus and Other Motor Vehicle Transit Systems	Hazardous Waste Collection
Automatic Environmental Control Manufacturing for Residential, Commercial and Appliance Use	Electric Bulk Power Transmission and Control	Landscape Architectural Services	Commuter Rail Systems	Hazardous Waste Treatment and Disposal
Building Inspection Services	Electric Power Distribution	Landscaping Services	Highway, Street and Bridge Construction	Materials Recovery Facilities
Commercial and Institutional Building Construction	Electrical Contractors and Other Wiring	Sewage Treatment Facilities	Interurban and Rural Bus Transportation	Other Nonhazardous Waste Treatment and Disposal

Energy and Water Efficient Buildings	Clean and Renewable Energy	Climate Resiliency	Transportation	Zero Waste
	Installation Contractors			
Engineering Services	Environmental Consulting Services	Soil Preparation, Planting and Cultivating	Mixed Mode Transit Systems	Other Waste Collection
Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing	Geothermal Electric Power Generation	Water and Sewer Line and Related Structures Construction	Other Support Activities for Road Transportation	Recyclable Material Merchant Wholesalers
Industrial Building Construction	Hydroelectric Power Generation	Water Supply and Irrigation Systems	Other Urban Transit Systems	Remediation Services
Industrial Design Services	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals		Rail transportation	Solid Waste Collection
New Housing For-Sale Builders	Mechanical Power Transmission Equipment Manufacturing		School and Employee Bus Transportation	Solid Waste Combustors and Incinerators
New Multifamily Housing Construction (except For-Sale Builders)	Natural Gas Distribution		Support Activities for Rail Transportation	Solid Waste Landfill
New Single-family Housing Construction (except For-Sale Builders)	Nuclear Electric Power Generation		Taxi Service	Used Merchandise Stores
Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	Other Electric Power Generation		Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers	
Plumbing, Heating and Air-Conditioning Contractors	Pipeline Transportation of Natural Gas			

Energy and Water Efficient Buildings	Clean and Renewable Energy	Climate Resiliency	Transportation	Zero Waste
Relay and Industrial Control Manufacturing	Power and Communication Line and Related Structures Construction			
Research and Development in the Physical, Engineering and Life Sciences (except Biotechnology)	Power, Distribution and Specialty Transformer Manufacturing			
Residential Electric Lighting Fixture Manufacturing	Semiconductor and Related Device Manufacturing			
Residential Remodelers	Solar Electric Power Generation			
Steam and Air-Conditioning Supply	Storage Battery Manufacturing			
Warm Air Heating and Air-Conditioning Equipment and Supplies Merchant Wholesalers	Turbine and Turbine Generator Set Units Manufacturing			
	Wind Electric Power Generation			

TABLE 24 NUMBER OF JOBS/INDUSTRY PER CAP INDUSTRY GROUP, 2010–2019

Year	Clean & Renewable Energy	Climate Resiliency	Energy & Water Efficient Buildings	Transportation	Zero Waste
2010	25,500	19,227	64,323	4,676	5,419
2011	25,783	19,283	63,176	4,265	5,356
2012	24,979	19,594	64,724	4,798	5,485
2013	24,449	19,906	67,221	5,012	6,000
2014	23,869	20,817	69,280	5,466	6,397
2015	24,402	21,143	73,369	5,750	6,953
2016	26,049	21,541	75,422	6,499	6,469

Year	Clean & Renewable Energy	Climate Resiliency	Energy & Water Efficient Buildings	Transportation	Zero Waste
2017	26,483	21,175	75,248	6,699	6,306
2018	26,891	21,509	79,719	6,653	6,385
2019	26,618	21,952	81,448	6,755	6,528

TABLE 25 PERCENT CHANGE IN JOBS, 2010–2019

Year	Clean & Renewable Energy	Climate Resiliency	Energy & Water Efficient Buildings	Transportation	Zero Waste
2010-11	1.1%	0.3%	-1.8%	-8.8%	-1.2%
2011-12	-3.1%	1.6%	2.5%	12.5%	2.4%
2012-13	-2.1%	1.6%	3.9%	4.5%	9.4%
2013-14	-2.4%	4.6%	3.1%	9.1%	6.6%
2014-15	2.2%	1.6%	5.9%	5.2%	8.7%
2015-16	6.7%	1.9%	2.8%	13.0%	-7.0%
2016-17	1.7%	-1.7%	-0.2%	3.1%	-2.5%
2017-18	1.5%	1.6%	5.9%	-0.7%	1.3%
2018-19	-1.0%	2.1%	2.2%	1.5%	2.2%
2010-19	4.4%	14.2%	26.6%	44.5%	20.5%

Supplemental Documentation

CITY OF SAN DIEGO GREENHOUSE GAS EMISSIONS INVENTORY METHODOLOGY AND UPDATES (FEBRUARY 2023)

City of San Diego Greenhouse Gas Emissions Inventory Methodology and Updates

February 2023

Prepared for the City of San Diego

The City of SAN DIEGO

Prepared by the Energy Policy Initiatives Center

EPIC
ENERGY POLICY INITIATIVES CENTER
UNIVERSITY OF SAN DIEGO SCHOOL OF LAW

About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the University of San Diego School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educate law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

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1 OVERVIEW

This document presents a summary of the greenhouse gas (GHG) emissions estimates for the City of San Diego (referred to as San Diego or the City) in calendar years 2019–2021, and the methods used. This is a supplement to the City's Final 2015 Climate Action Plan (CAP) Annual Report and its appendix.

In preparation for this Annual Report and the 2020–2021 GHG emissions inventory, revisions and refinements were made to the 2019 GHG emissions estimates in the previous 2020 Annual Report and the updated CAP adopted in 2022, to reflect updated data supplied by agencies not managed by the City, and to ensure consistency with the 2020–2021 GHG emissions estimates.[1] This approach follows that used by the California Air Resources Board (CARB) when updating its California statewide inventory, and is based on the Intergovernmental Panel on Climate Change (IPCC) recommendations to maintain a consistent time-series when developing GHG inventories.[2]

This document includes the following sections:

- Section 2 describes the background sources and common assumptions used for the GHG emissions inventory;
- Section 3 provides the 2019–2021 GHG emissions inventory results summary; and
- Section 4 provides the methods used to prepare each category of the inventory.

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

2 BACKGROUND

2.1 Greenhouse Gases

The primary GHGs included in the emissions estimates presented here are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). 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). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate GHG emissions. The GWPs used in this inventory are from the IPCC Fourth Assessment Report (AR4),[3] provided in Table 1. The GWPs used in this inventory are consistent with the California statewide GHG inventories and the national GHG inventories.[4]

[1] City of San Diego: 2022 Climate Action Plan, Climate Action Plan 2020 Annual Report and Appendix.
[2] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2020. Trends of Emissions and Other Indicators, p. 28 Additional Information (2020).
[3] IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials (2013).
[4] Some CARB programs, other than the statewide GHG inventory, may use different GWPs. For example, the short-lived climate pollutants (SLCP) strategy uses the 20-year GWP because the SLCP has greater climate impacts in the near-term compared to the long-lived GHGs.

Table 1 Global Warming Potentials Used in San Diego GHG Emission Inventory & Projections

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
IPCC 2013.	

2.2 Demographics

California Department of Finance develops population and housing estimates for cities and counties in the State. The population and housing estimates are provided in Table 2.[5]

Table 2 Population, Housing, and Jobs Estimates (San Diego, 2019–2021)

Year	Population Estimates	Housing Estimates (Units)	
		Total	Occupied
2019	1,420,571	545,645	514,548
2020	1,380,448	548,934	515,676
2021	1,371,832	552,410	514,964
2019 population and housing estimates are based on the 2010 census benchmark, and 2020 and 2021 population and housing estimates are based on the 2020 census benchmark. Housing unit types include single detached units, single attached units, two to four units, five plus, or apartment units, and mobile homes. California Department of Finance 2021, 2022.			

3 SUMMARY OF 2019–2021 GHG EMISSIONS INVENTORY

GHG emissions by category from San Diego in 2019–2021 are shown in Table 3.[6]

[5] California Department of Finance: E-4 Population Estimates for Cities, Counties, and the State, 2021-2022 with 2020 Census Benchmark (May 2022), accessed January 6, 2023. E-4 Population Estimates for Cities, Counties, and the State, 2011-2020 with 2010 Census Benchmark (May 2021), accessed January 6, 2023.

[6] The 2019 GHG emissions inventory in this document updated from the 2019 inventory in the CAP Annual Report 2020, due to updated data sources after the Annual Report release: (1) 2019 electricity emissions factor became available in December 2020; and (2) new mobile sources emissions inventory (EMFAC2021) became available in 2021.

Table 3 GHG Emissions by Category from City of San Diego (2019–2021)

Emissions Category	2019 Inventory***		2020 Inventory		2021 Inventory	
	GHG Emissions (MT CO_2e)	Distribution (%)	GHG Emissions (MT CO_2e)	Distribution (%)	GHG Emissions (MT CO_2e)	Distribution (%)
On-Road Transportation*	5,854,000	56%	4,650,000	50%	5,239,000	57%
Electricity	2,398,000	23%	2,368,000	26%	1,725,000	19%
Natural Gas	1,912,000	18%	1,827,000	20%	1,918,000	21%
Solid Waste**	277,000	3%	273,000	3%	273,000	3%
Water	61,000	1%	70,000	1%	70,000	1%
Wastewater	26,000	0.2%	23,000	0.2%	24,000	0.3%
Total	**10,528,000**	**100%**	**9,210,000**	**100%**	**9,248,000**	**100%**

Sums may not add up to totals due to rounding. GHG emissions for each category are rounded to the nearest thousand. Values are not rounded in the intermediary steps in the calculation.

*Emissions are based on SANDAG's Series 14 modeled vehicle miles traveled (VMT) estimates, and 2019 and 2020 VMT are based on 2016 VMT adjusted to account for regional VMT growth, as reflected in the California Highway Performance Monitoring System (HPMS) from 2016 to 2019 and to 2020. 2021 VMT are based on 2019 VMT adjusted to account for regional freeway VMT difference between 2019 and 2020 in the California Performance Measurement System (PeMS), due to a delay in HPMS data. 2016 VMT is the output from SANDAG's Final 2021 Regional Plan and activity-based model (ABM2+).

**2020 waste tonnage was used to calculate 2021 emissions from waste due to a delay in reported waste data

*** Revised

Energy Policy Initiatives Center, University of San Diego 2023

Total emissions in 2020, 9.2 MMT CO_2e, were 13% lower than in 2019. The decrease was mainly due to a decrease in emissions from the on-road transportation category. The emissions from on-road transportation in 2020 were 21% lower than the emissions in 2019. The impact of the COVID-19 pandemic on vehicle miles traveled (VMT) in 2020 was estimated from 2016 VMT using the 2016–2020 regional public road VMT monitoring data, which showed that the decrease was likely from light-duty vehicles after shelter-in-place orders were enacted. The California 2020 statewide GHG inventory shows similar impact, as the transportation sector emissions declined by 16% in 2020 compared with 2019.[7]

The total emissions in 2021 were approximately the same as the total emissions in 2020. However, the emissions from on-road transportation in 2021 were 13% higher than the emissions in 2020, showing that the impact of the COVID-19 pandemic on driving may not be sustained long term. The emissions from electricity in 2021, were 27% lower than the emissions in 2020 for two reasons. First, San Diego Gas & Electric (SDG&E) had 44.5% renewable content in its power mix in 2021, higher than the renewable content in 2020, of 31%, which lowered the emissions from electricity. Second, in March 2021, eligible commercial and industrial customers were enrolled in San Diego Community Power, a community choice energy provider, which provided more renewable and GHG-free electricity (55% renewable and 67% GHG free) than SDG&E.

[7] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2020. Trends of Emissions and Other Indicators, p. 28 Additional Information (2020).

4 METHOD TO CALCULATE GHG EMISSIONS INVENTORY

The CAP follows the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol),[8] developed by ICLEI USA. It requires a minimum of five basic emissions-generating activities to be included in a Protocol-compliant community-scale GHG inventory. These categories are: electricity, natural gas, on-road transportation, water and wastewater, and solid waste. GHG emissions are calculated by multiplying activity data (e.g., kilowatt-hours of electricity, tons of solid waste) by an emission factor (e.g., pounds of CO_2e per unit of electricity). For these five categories, methods based on the U.S. Community Protocol were modified with regional- or City-specific data when available.

The U.S. Community Protocol is the rulebook for developing community-scale inventories. Protocols and guidance for reporting GHG emissions for entities, such as corporations and public agencies, are different from those for communities. The Local Government Operations Protocol, developed by ICLEI, CARB, and the Climate Registry (TCR), and the General Reporting Protocol, developed by TCR, are widely used to develop GHG inventories for local governments and public agencies.[9] The method to determine boundaries in the U.S. Community Protocol is different from the method in the Local Government Operations Protocol or the General Reporting Protocol, which depends on the entity's financial or operational control. This inventory accounts for the emission generating activities in the City of San Diego, not based on City's financial or operational control.

All activity data and GHG emissions reported in this document are annual values, and all emission factors reported in this document are annual average values, unless stated otherwise.

4.1 On-Road Transportation

The emissions associated with on-road transportation are calculated by multiplying the estimated City of San Diego VMT and the average vehicle emission rate in the San Diego region from 2019 to 2021, from the statewide mobile source emissions model.

4.1.1 Vehicle Miles Traveled (VMT)

SANDAG uses an activity-based model (ABM) to support development of Regional Transportation Plans and generate outputs related to the transportation system performance, including VMT. Every three to five years, SANDAG produces the Regional Growth Forecast, a long-range forecast of population, housing employment growth, and produces VMT for the San Diego region, and by jurisdiction. As of the annual report development, the most recent forecast is the Series 14 Growth Forecast with a base year of 2016. This Forecast was used in SANDAG's Final 2021 Regional Plan with the most recent version of the ABM model, ABM2+.

SANDAG provided VMT estimates for the City of San Diego for year 2016.[10] However, 2017–2021 VMT data from Series 14 are not available at the jurisdictional level. Therefore, for the City of San Diego, post-

[8] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019).
[9] CARB, ICLEI, and The Climate Registry: Local Government Operations Protocol; the Climate Registry: General Reporting Protocol Version 3.0.
[10] 2016 VMT was provided by SANDAG to City of San Diego (January 2022). SANDAG Activity Based Model 2+ Release v14.2.2, Final 2021 Regional Plan Networks, Policies, and Assumptions, Year 2016, Reference Scenario 458. The forecast in the Final 2021 Regional Plan was based on the Sustainable Communities Strategy land use pattern, which may be different from jurisdictions' general plan land use pattern.

2016 VMT data were estimated using the Series 14 2016 VMT adjusted using VMT monitoring data for 2017–2021 from other sources. The two sources available are public road and freeway data in the San Diego region derived from the California Department of Transportation (Caltrans) Highway Performance Monitoring System (HPMS) and Performance Measurement System (PeMS).[11].

SANDAG allocates the VMT derived from ABM2+ to a jurisdiction using the Origin-Destination (O-D) method.[12] The O-D VMT method is the preferred method proposed by the U.S Community Protocol in *"TR.1 Emissions from Passenger Vehicles"* and *"TR.2 Emissions from Freight and Service Trucks"* that estimates miles traveled based on where a trip originates and where it ends to attribute on-road emissions to cities and regions (Figure 1).[13]

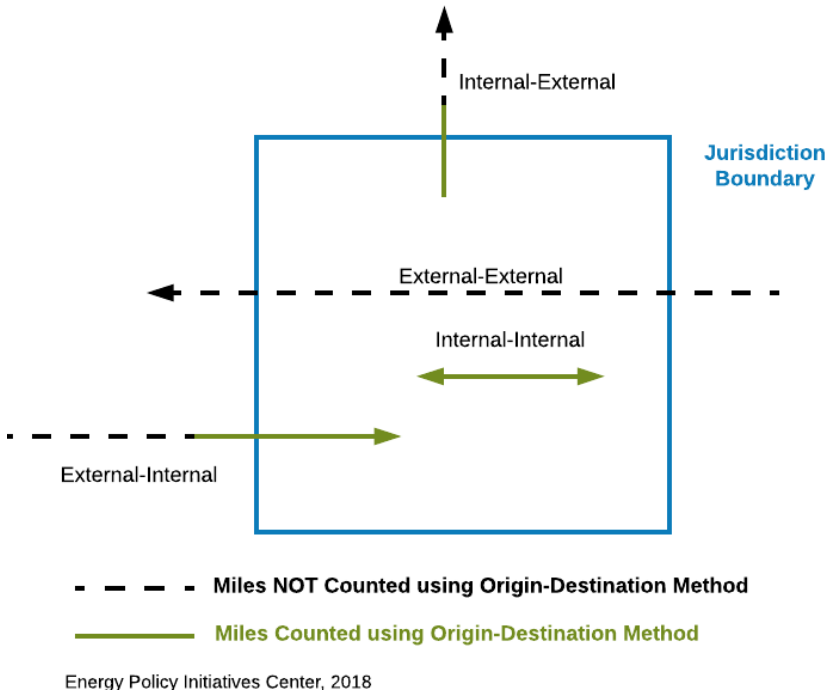


Figure 1 Components of O-D Method for VMT Calculation

O-D VMT allocated to San Diego includes all miles traveled for trips that originate and end within San Diego city limits (referred to as Internal-Internal), and half of the miles traveled for trips that either begin within San Diego and end outside the City (referred to as Internal-External), or vice versa (referred to as External-Internal). In accordance with the methodology, VMT from trips that begin and end outside San Diego that only pass through the City limits (referred to as External-External) are not included in the total City VMT. The total average weekday VMT were multiplied by 347 to adjust from average weekday VMT to average annual VMT, which includes weekends.[14]

[11] California Department of Transportation: Highway Performance Monitoring System (HPMS) Data.
[12] SANDAG (2013): Vehicle Miles Traveled Calculation Using the SANDAG Regional Travel Demand Model. Technical White Paper.
[13] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix D: Transportation and Other Mobile Emission Activities and Sources.
[14] The conversion of 347 weekdays to 365 days per year as used by CARB. CARB: California's 2000–2014 Greenhouse Gas Emission Inventory Technical Support Document (2016 Edition), p. 41 (September 2016).

The average weekday Series 14 O-D VMT estimates for each trip type in 2016 provided by SANDAG and the total VMT allocated to the City based on the ICLEI methodology described above are given in Table 4.[15]

Table 4 2016 O-D VMT Estimates by Trip Types and Total VMT provided by SANDAG (San Diego, 2016)

Year	VMT by Trip Type (Miles/Weekday)			Total City VMT (100% * I-I + 50% * I-E/E-I) (Miles per Weekday)	Total City VMT (Miles per Year)
	Internal-Internal (I-I) Trips	External-Internal/Internal-External (I-E/E-I) Trips	External-External Trips (Information only, excluded from City VMT)*		
2016	22,264,735	28,279,389	32,824,891	36,404,429	12,632,336,902

*Though excluded from this analysis, miles from External-External trips (pass-through trips) shown here are the portion only within the City boundary, not from the entire trip.
Based on SANDAG Series 14 (Final 2021 Regional Plan) and ABM2+ VMT estimates. The conversion factor from miles per weekday to miles per year is 347.

SANDAG 2022, Energy Policy Initiatives Center, University of San Diego 2023

Historical year data from other than the 2016 base year are not available under SANDAG ABM2+. Therefore, to estimate 2020 O-D VMT, the 2016 O-D VMT was adjusted by the annual rates of increase from 2016 to 2020, as indicated by the State public road VMT monitoring system (Caltrans HPMS). Annual Caltrans HPMS VMT was used to estimate annual VMT growth rates for the San Diego region. These growth rates were applied to the City of San Diego's 2016 O-D VMT data (Table 4) as an approximation of VMT growth since 2016. The Caltrans HPMS VMT estimate for the San Diego region is based on daily monitoring on all public roads, including city streets, county roads, state highways, roads maintained by state and federal agencies, freeways, etc. The estimated daily VMT and annual rate of increase or decrease from 2016 to 2020 with Caltrans HPMS data are given in Table 5.[16]

Table 5 San Diego Region Daily VMT Derived from the Caltrans Highway Performance Monitoring System

Year	San Diego Region Daily VMT (Thousand miles per day)	Annual Rate of Increase (%)
2016	79,622	-
2017	81,253	2.0%
2018	82,618	1.7%
2019	86,136	4.3%
2020	68,650	-20.3%

Caltrans 2021, Energy Policy Initiatives Center, University of San Diego 2023

[15] The 2016 data used here are different from (1-3% lower) the 2016 data used in the San Diego Climate Action Plan update 2022, which were from SANDAG ABM2+ Release v14.2.1, Draft 2021 Regional plan (October 2020).
[16] Caltrans: HPMS Data, accessed January 18, 2023.

The 2020 San Diego regional daily VMT was 20% lower than in 2019, which reflects the travel pattern change due to the COVID-19 pandemic. Statewide, 2020 VMT showed an average decline of 15% compared with 2019.[17]

2021 HPMS data were not available as of January 2023, therefore, annual San Diego regional freeway VMT from Caltrans freeway monitoring system (Caltrans PeMS) was used to estimate the VMT growth rate from 2019 to 2021. While the freeway monitoring method did not change during the COVID-19 pandemic, 2020 is skipped in estimating VMT growth rate due to the anomaly. The estimated daily freeway VMT and the rate of increase from 2019 to 2021 with Caltrans PeMS data are given in Table 6.[18]

Table 6 San Diego Region Freeway Daily VMT Derived from the Caltrans Performance Measurement System

Year	San Diego Region Freeway VMT (Billion miles per year)	Differences (%)
2019	14.6	-
2021	13.5	-7.6%
San Diego regional freeway miles only, not all miles. Caltrans 2023, Energy Policy Initiatives Center, University of San Diego 2023		

Using these annual rates of change, the estimated 2020 and 2021 VMT for the City of San Diego are provided in Table 7. It is assumed that the City of San Diego VMT growth follows the pattern of the San Diego regional VMT growth. The adjustment method may change if better information becomes available on City of San Diego VMT and travel patterns.

4.1.2 Average Annual Vehicle Emission Rate

The average annual vehicle emission rate expressed in grams of CO_2e per mile driven (g CO_2e/mile) is derived from the statewide mobile source emissions model EMFAC2021 developed by CARB.[19]

EMFAC2021 was run in the default activity mode to generate the total VMT and total vehicle GHG emissions for the San Diego region, including all vehicle model years, classes, and fuel types.[20] This document assumes that the City of San Diego has the same distribution of vehicle types as the San Diego region.

4.1.3 Total Emissions from On-Road Transportation

Total estimated VMT, average vehicle emission rates, and corresponding GHG emissions from on-road transportation from 2019–2021 are given in Table 7.

[17] Caltrans: California Public Road Data 2020. Statistical Information Derived from the Highway Performance Monitoring System (Released December 2021).
[18] Caltrans: PeMS, accessed January 18, 2023.
[19] CARB: EMission FACtors model, EMFAC2021 v1.0.1, released on April 30, 2021, downloaded on August 30, 2021. CARB published an updated version, EMFAC2021 v1.0.2, on May 2, 2022. The updates fixed bugs that were not related to GHG emissions.
[20] *Id.*

Table 7 VMT, Emission Rate, and GHG Emissions from On-Road Transportation (San Diego, 2019–2021)

Year	Total VMT (Miles/year)	Average Vehicle Emission Rate (g CO_2e/mile)	GHG Emissions (MT CO_2e)
2019	13,665,761,758	428	5,854,000
2020	10,891,617,313	427	4,650,000
2021	12,628,134,076	415	5,239,000
GHG emissions for each category are rounded. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, University of San Diego 2023.			

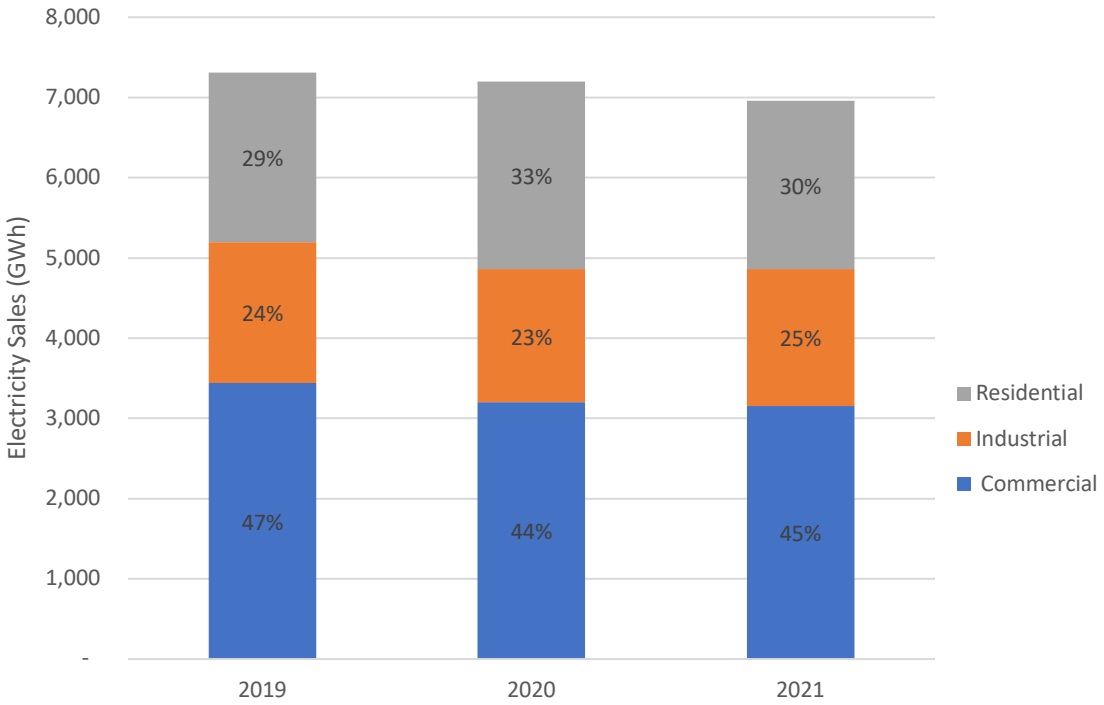
4.2 Electricity

Emissions from electricity in the City of San Diego were estimated using the Built Environment (BE.2) method from the U.S. Community Protocol, by multiplying electricity use by the City-specific electricity emission factor in a given year.[21]

4.2.1 Electricity Use

Annual metered electricity sales data within the City were provided by the local utility, San Diego Gas & Electric (SDG&E).[22] The electricity sales data do not include the electricity sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military. The electricity sales from 2019 to 2022 by customer class are shown in Figure 2.

[21] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix C: Built Environment Emission Activities and Sources.
[22] 2020 and 2021 metered electricity sales were provided to EPIC by SDG&E (March 16, 2021, and October 31, 2022).



SDG&E's electricity sales in City of San Diego. Sales do not include transmission and distribution losses, and exclude sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military.
Percentages may not sum up to totals due to rounding.

Figure 2 SDG&E Electricity Sales to City of San Diego by Customer Class (2019–2021)

The percentage of electricity use from each customer class (residential, commercial, and industrial) was similar in each of the three years. In 2020, a higher percentage of electricity use, 33%, was from residential customers, potentially due to the COVID stay-at-home order in 2020.

In 2019 and 2020, the electricity sales included the sales to SDG&E bundled customers[23] and Direct Access (DA) customers.[24] In March 2021, San Diego Community Power (SDCP), a community choice energy provider, started serving jurisdictions in the San Diego region, including the City of San Diego. By the end of 2021, eligible SDG&E bundled commercial and industrial customers were enrolled in SDCP automatically with the option to opt-out (return to SDG&E) or opt-up to a SDCP product with higher renewable electricity. The participation rate as of January 9, 2022 of the City's eligible customers was 98%.[25] Residential accounts were not enrolled in SDCP until 2022.

The 2019 and 2020 electricity use per customer class provided by SDG&E have the same format, with bundled and DA customers' electricity use identified separately. However, for 2021, only total electricity use per customer class was provided by SDG&E. To estimate the 2021 electricity use by DA customers in

[23] SDG&E bundled power includes the electricity from SDG&E-owned power plants and the electricity from its net procurements.
[24] Direct Access refers to electricity that customers purchase from non-SDG&E electric service providers (ESPs), but SDG&E still provides transmission and distribution services. See SDG&E Direct Access Program.
[25] San Diego Community Power: January 20, 2022 Board of Directors Meeting, Item 5 Staff Report, accessed January 5, 2023.

each customer class, the ratio of 2020 DA customers to total electricity use was applied to the total 2021 electricity use in each customer class. Based on the SDCP participation rate, 98% of the remaining 2021 commercial and industrial electricity use was assumed to be from SDCP commercial and industrial customers.[26] The remaining commercial and industrial electricity use, and residential use, were assumed to be from SDG&E customers.

The electricity sales were then adjusted by 1) a loss factor[27] of 1.082[28] to account for transmission and distribution losses; and 2) subtracting electricity use associated with moving water within the City limits, which is allocated to the water category emissions.

The adjusted net energy for load (electricity sales + losses) is provided in Table 8.

4.2.2 City-Specific Electricity Emission Factor

For a given year, the City-specific electricity emission factor, expressed in pounds of CO_2e per Megawatt-hour (lbs CO_2e/MWh), is estimated based on the specific mix of bundled power, DA power, and SDCP power, if any, in the City and their respective emission factors.

The 2019 SDG&E bundled emission factors are calculated using Federal Energy Regulatory Commission (FERC) Form 1[29] data, the California Energy Commission (CEC) Power Source Disclosure (PSD) Program[30] data on SDG&E-owned and purchased power, and U.S. EPA Emissions and Generating Resource Integrated Database (eGRID) 2019 Edition[31] on specific power plant emissions. The 2019 SDG&E bundled emission factor calculated using the sources above is 633 lbs CO_2e/MWh, with 31% eligible renewable.

The CEC PSD Program, under the requirements of Assembly Bill (AB) 1110 (Ting, Chapter 656, Statutes of 2016), requires retail electric providers to disclose GHG emissions intensity (i.e., electricity emission factor) separately from unbundled renewable energy credits, starting in 2021 for 2020 procurements. So the 2020 and 2021 SDG&E bundled emission factors, 636 and 504 lbs CO_2e/MWh, respectively, are provided directly in the power content labels reported under the CEC PSD Program.[32] Similarly, the 2021 SDCP emission factor, 378 lbs CO_2e/MWh, is provided in its 2021 power content label.[33]

[26] The participation rate is the rate by number of accounts, not by electricity use. Due to lack of data, the number of accounts is used as a proxy to estimate the SDCP commercial and industrial electricity use.
[27] The transmission and distribution loss factor is used to scale end-use demand or retail sales to produce net energy for load. L. Wong, *A Review of Transmission Losses In Planning Studies*, CEC Staff Paper (August 2011).
[28] California Energy Commission (CEC): *California Energy Demand 2015–2025 Final Forecast Mid-Case Final Baseline Demand Forecast Forms*, SDG&E Mid. The transmission and distribution loss factor is calculated based on the ratio of net energy for load (total sales + net losses) and total sales from SDG&E Form 1.2 Mid.
[29] FERC: Form 1 – Electric Utility Annual Report.
[30] CEC: Power Source Disclosure Program under Senate Bill 1305. The SDG&E annual power source disclosure reports in 2019 were provided to EPIC by CEC staff. SDG&E 2019 Power Content Label, version October 2020. The CEC PSD Program, under the requirements of Assembly Bill (AB) 1110 (Ting, Chapter 656, Statutes of 2016), requires retail electric providers to disclose GHG emissions intensity (i.e., electricity emission factor) and unbundled renewable energy credits, starting in 2021 for 2020 procurements. Starting in 2021, the GHG emissions intensity reported by retail electric providers for the PSD Program will be used directly to calculate GHG emissions from the electricity category.
[31] U.S. EPA. eGRID 2019 Edition, released on February 23, 2021.
[32] SDG&E: 2020 Power Content Label (September 2021), and 2021 Power Content Label (September 2022).
[33] SDCP: 2021 Power Content Label.

The DA emission factor, 836 lbs CO_2e/MWh, is based on California Public Utilities Commission (CPUC) Decision D.14-12-037.[34] The City-specific electricity emission factors are provided in Table 8.

4.2.3 Total Emissions from Electricity

Emissions are calculated by multiplying the adjusted net energy for load (electricity sales + losses) and the corresponding City-specific electricity emission factor. The net energy for San Diego's load (electricity sales + losses), electricity emission factors, and corresponding GHG emissions from the electricity category for 2019-2021 are shown in Table 8.

Table 8 Net Energy for Load, Emission Factor, and GHG Emissions from Electricity Category (San Diego, 2019–2021)

Year	Net Energy for Load (electricity sales + losses)[1] (MWh)	City-Specific Emission Factor (lbs CO_2e/MWh)[2]	GHG Emissions (MT CO_2e)
2019	7,912,365	668	2,398,000
2020	7,788,903	670	2,368,000
2021	7,527,776	505	1,725,000

[1]The net energy for load does not include the net energy for load from San Diego County Regional Airport Authority, San Diego Unified Port District, and the military.
[2]City-Specific emission factors are for City of San Diego only and do not represent the emission factors of SDG&E bundled electricity or of other jurisdictions in the San Diego region.

GHG emissions for each category are rounded. Values are not rounded in the intermediary steps in the calculation.

Energy Policy Initiatives Center, University of San Diego 2023

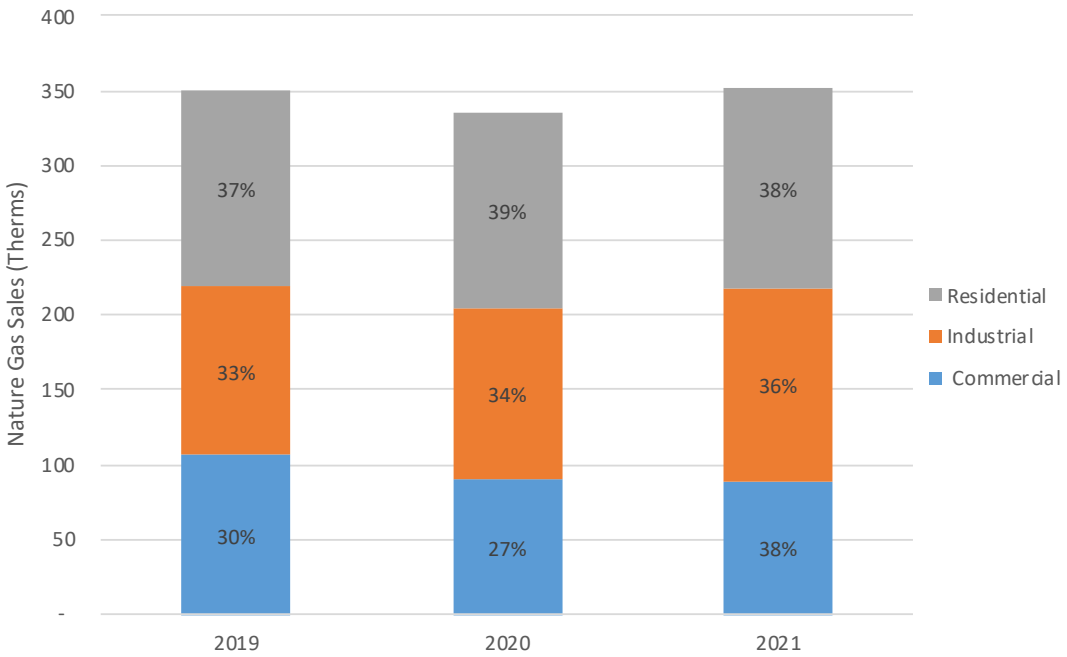
4.3 Natural Gas

Emissions from natural gas use in San Diego were estimated using method Built Environment (BE.1) from the U.S. Community Protocol, by multiplying the natural gas use (the activity) and the natural gas emission factor in a given year.[35]

4.3.1 Natural Gas Use

Annual natural gas sales were provided by SDG&E, broken down by residential, commercial and industrial customer class.[36] The natural gas sales data do not include the sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military. The natural gas sales from 2019 to 2021 by customer class are show in Figure 3.

[34] CPUC: Decision 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). The recommended emission factor has not changed since 2014. However, all electric service suppliers must meet the Renewables Portfolio Standards in the target years.
[35] ICLEI– Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix C: Built Environment Emission Activities and Sources.
[36] 2020 and 2021 metered electricity sales were provided to EPIC by SDG&E (March 16, 2021, and October 31, 2022).



SDG&E's natural gas sales in City of San Diego. Sales do not include transmission and distribution losses, and exclude sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military.
Percentages may not sum up to totals due to rounding.
SDG&E 2020-2022

Figure 3 SDG&E Natural Gas Sales to City of San Diego by Customer Class (2019–2021)

The natural gas end-use in 2020 was approximately 4% lower than the end-use in 2019, but the 2021 end-use is similar to the 2019 end-use.

4.3.2 Natural Gas Emission Factor

The natural gas emission factor is based on the heat content of the fuel and the fuel's CO_2, CH_4, and N_2O emissions. The heat content of fuel and the emissions from CO_2, CH_4, and N_2O were based on the CARB statewide inventory.[37] The natural gas emission factor is given in Table 9.

4.3.3 Total Emissions from Natural Gas

To estimate emissions from the combustion of natural gas, end-use was multiplied by the emission factor. The total natural gas end-use and corresponding GHG emissions from the natural gas category for 2019-2021 are given in Table 9.

[37] CARB: GHG Current California Emission Inventory Data.

Table 9 Natural Gas End-Use and GHG Emissions from Natural Gas Category (San Diego, 2019-2021)

Year	Natural Gas End-Use (Million Therms)	Natural Gas Emission Factor (Million MT CO_2e/Million Therms)	GHG Emissions (MT CO_2e)
2019	351	0.00545	1,912,000
2020	335	0.00545	1,827,000
2021	352	0.00545	1,918,000

The natural gas sales do not include the sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and the military.

GHG emissions for each category are rounded to the nearest thousand. Values are not rounded in the intermediary steps in the calculation.

SDG&E 2020-2022, Energy Policy Initiatives Center, University of San Diego 2023

4.4 Solid Waste

Emissions from the decomposition of organic material in waste disposed at landfills were estimated using method Solid Waste (SW.4) from the U.S. Community Protocol, by multiplying the amount of waste disposed by the City in 2019 and an emission factor for mixed solid waste. [38] This represents the immediate and all future emissions from decay of this waste.

4.4.1 Solid Waste Disposal

Solid waste disposal is the waste disposed by the City in landfills, regardless of whether the landfills accepting the waste are located inside or outside of the City boundary. The majority of the waste from the City is disposed at West Miramar Sanitary Landfill, Otay Landfill, and Sycamore Landfill.[39]

The total waste disposal from the City was 1,543,627 short tons (1,400,355 MT) in 2020, 2% lower than the waste disposal in 2019. The total waste disposal from the City in 2021 was not available as of January 2023, therefore, 2020 waste disposal was used as a proxy. The total and per-capita solid waste disposal are given in Table 11.[40]

4.4.2 Mixed Solid Waste Emission Factor

The emission factor of mixed solid waste depends on the percentage of each waste type within the waste stream disposed in a landfill. The City of San Diego's 2012–2013 Waste Characterization Study, conducted at Miramar Landfill, was used as a proxy for San Diego's solid waste composition.[41] Only the CH_4 emissions from waste degradation are considered non-biogenic and included in this category. The CO_2 emissions from waste degradation are considered biogenic and not included in this category.

The EPA Waste Reduction Model (WARM) is used to determine the emission factor of each waste type. WARM is a life-cycle GHG model to assess and compare waste management options (e.g., landfilling, recycling, source reduction, composting), through the life-cycle of waste materials (from material

[38] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix E: Solid Waste Emission Activities and Sources.
[39] CalRecycle: Disposal Reporting System (DRS): Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility.
[40] 2020 waste disposal was provided by City of San Diego to EPIC in November 2022.
[41] City of San Diego: Waste Characterization Study 2012–2013 Final Report (2014), accessed November 4, 2019.

extraction to disposal). However, under the U.S Community Protocol, only emissions from the disposal and associated degradation of waste are included. Therefore, only the landfill emission factors in EPA WARM are used in the calculation. WARM reports the landfill CH_4 emission factor of each waste material in MT CO_2e/short ton, with and without Landfill Gas (LFG) recovery.

The mixed solid waste emission factor is given in Table 10. The landfill emission factors without LFG recovery are identified here; and the LFG recovery is applied later.

Table 10 Mixed Solid Waste Emission Factor

Waste Component	Waste Distribution (%)[1]	Landfill Gas Emission Factors	
		CH_4 without Landfill Gas Recovery (MT CO_2e/short ton disposed)	Source[2]
Paper	16.8%		
Corrugated Containers/Cardboard	*5.0%*	2.36	Exhibit 3-27, WARM v15 Containers /Packaging
Newspaper	*0.8%*	0.94	Exhibit 3-27, WARM v15 Containers /Packaging
Magazine	*0.6%*	1.08	Exhibit 3-27, WARM v15 Containers /Packaging
Mixed Paper (general)	*10.4%*	2.14	Exhibit 3-27, WARM v15 Containers /Packaging
Plastic	8.9%	0	-
Glass	1.7%	0	-
Metal	3.5%	0	-
Organics	38.9%		
Food	*15%*	1.62	Exhibit 1-49, WARM V15 Organic Materials
Tree (Branches)	*5.3%*	1.3	Exhibit 2-13 WARM V15 Organic Materials
Leaves and Grass	*6.8%*	0.59 (leaves)	Exhibit 2-13 WARM V15 Organic Materials
Trimmings	*3.5%*	0.73	Exhibit 2-13 WARM V15 Organic Materials
Mixed Organics	*8.3%*	0.53	Exhibit 1-48 WARM V15 Organic Materials
Electronics	0.6%	0	-
Construction & Demolition	24.6%	0	-
Household Hazardous Waste	0.2%	0	-
Special Waste	3.1%	0	-
Mixed Residue	1.6%	0.53	
Mixed Waste Emission Factor		**0.785**	

Source: [1] City of San Diego 2014. [2]EPA Waste Reduction Model (WARM) Version 15 (May 2019)

4.4.3 Total Emissions from Solid Waste Disposed in Landfills

The mixed waste emission factor given in Table 10 is the emission factor without landfill gas collection. The 75% default capture rate of CH_4 emissions from landfills, from the U.S. Community Protocol, is applied in the emissions calculation. The total and per-capita solid waste disposal and the corresponding GHG emissions for 2019 are given in Table 11.

Table 11 Solid Waste Disposal into Landfills and Associated GHG Emissions (San Diego, 2019–2021)

Year	Solid Waste Disposed			GHG Emission Factor (MT CO_2e/Short Ton)	Oxidation Rate[2]	Total GHG Emissions (MT CO_2e)	Default CH_4 Capture Rate	Remaining Emissions (MT CO_2e)
	Citywide (Short Tons/Year)	Citywide (MT/Year)	Per Capita Solid Waste Disposal (kg/person/day)[1]					
2019	1,569,447	1,423,779	2.7	0.785	10%	1,108,249	75%	277,000
2020	1,543,627	1,400,355	2.8	0.785	10%	1,090,017	75%	273,000
2021	1,543,627	1,400,355	2.8	0.785	10%	1,090,017	75%	273,000

GHG emissions for each category are rounded. Values are not rounded in the intermediary steps in the calculation.
[1] Informational, based on total waste disposal and population estimates. 2019 population is based on 2010 census benchmark, and 2020 and 2021 population are based on 2020 census benchmark.
[2] The oxidation rate is the default amount of methane that is oxidized and not emitted, therefore only 90% of total methane emissions are produced.

The total waste disposal from the City in 2021 was not available as of January 2023, therefore, 2020 waste disposal was used as a proxy.

Energy Policy Initiatives Center, University of San Diego 2023

4.4.4 Estimating Emissions from Previously Disposed Solid Waste (Not Reported in Inventory)

The Community Protocol recognizes that there are emissions from waste previously disposed in landfills located within the City boundary. The emissions from waste-in-place can be reported optionally in additional to waste disposal. The Protocol provides a separate method to estimate emissions from past disposal. The City of San Diego has two active landfills and four closed landfills within its boundary. Emissions from waste already in place in City landfills are tracked separately here and are not included in the reported value for solid waste emissions in the City GHG emissions total.

For landfills that are required to report GHG emissions through the Environmental Protection Agency's Mandatory Greenhouse Gas Reporting Program (EPA MRR), the reported values are used directly.[42] For the landfills not subject to EPA MRR, emissions were calculated based on the Landfill Emissions Tool developed by CARB using the first order decay model recommended by the IPCC.[43]

Emissions from in-boundary landfills cannot be directly added to emissions from solid waste disposed in the current year. This is because emissions from solid waste disposal from the method provided in Section 4.4.3 are calculated to include the projected future GHG emissions from the waste disposed in the current year, regardless of disposal location, while emissions from in-boundary landfills are emissions in the current year from waste that has already been in place at the landfills, regardless of where the waste was generated.

[42] EPA: 2019 Greenhouse Gas Emissions from Large Facilities, accessed November 10, 2020.
[43] CARB: Landfill gas tool, released September 24, 2021, download date: January 9, 2023. Results may differ from the previous v1.3 tool released in 2011. tool reports CO_2e of CH_4 using 21 as CH_4 GWP, recalculated using 25 as CH_4 GWP.

The emissions from San Diego landfills are given in Table 12.

Table 12 Emissions from In-boundary Landfills (Information Only, Not Reported in GHG Inventory)

Landfill	Status	2019 Landfill Emissions (MT CO_2e)	2020 Landfill Emissions (MT CO_2e)	2021 Landfill Emissions (MT CO_2e)	Source
West Miramar Sanitary Landfill	Active	154,932	198,685	152,566	EPA MRR
Sycamore Landfill	Active	86,057	87,168	107,175	EPA MRR
North Miramar Sanitary Landfill	Closed in 1983	2,974	2,211	3,420	EPA MRR
South Chollas Sanitary Landfill	Closed in 1981	n/a	n/a	n/a	Discontinued reporting to EPA MRR in 2015
Arizona Street Landfill	Closed in 1974	9,598	9,408	9,222	CARB Landfill Emission Tool (CARB LET) result using waste received before closing
Mission Bay Landfill #1	Closed in 1959	5,530	5,420	5,313	CARB LET result using operational period 1952-1959 and waste-in-place at the end of 1990
Total	-----	259,091	302,892	277,696	-

n/a = not available
Landfill emissions reported in EPA MRR were estimated from methane recovery, destruction and other factors. The emissions may differ from modeled methane generation and from previous versions.
CARB 2021, EPA 2022, Energy Policy Initiatives Center 2023.

4.5 Water

Emissions from water use in a jurisdiction result from the energy required to move water from origin sources to end-use customers, including upstream supply and conveyance, water treatment, and water distribution, as circled in Figure 4. The energy required to move water is primarily electricity but may include natural gas or other fuels.

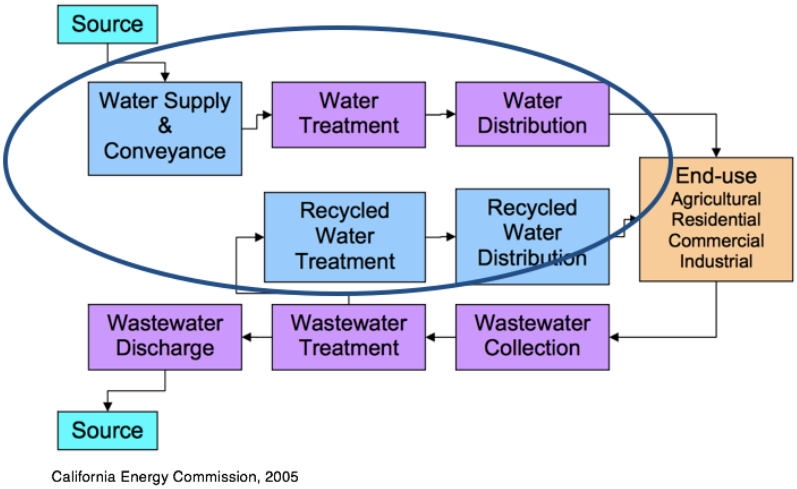


Figure 4 Segments of the Water Cycle

Emissions from water were estimated using the method Wastewater and Water (WW.14) from the U.S. Community Protocol.[44] Emissions associated with water end-use, such as water heating and cooling, are included in the electricity and natural gas category, not in this water category, as data are not available to separate out those values.

Water agencies developing their own GHG inventories would not follow the U.S. Community Protocol because the U.S. Community Protocol is specifically for community-wide inventories, not for other types of entities. Therefore the scope and boundary of emissions included in this sector are different from those of a water agency's GHG inventory. For example, the water agencies may account only the emission generating activities within their operational or financial control in their GHG inventories.

4.5.1 Water Use

The City of San Diego a member agency of the water wholesaler in the San Diego region, the San Diego County Water Authority (SDCWA). The City of San Diego delivers potable and recycled water within the City boundary, and also sells water to or treats water for neighboring water agencies and cities, such as the City of Del Mar, South Bay Irrigation Water District, and the California American Water Company (CalAm).[45]

The potable water supply sources for the City of San Diego include: 1) imported untreated water from SDCWA; 2) imported treated water from SDCWA; 3) surface water from local reservoirs; and 4) groundwater from the Santee-El Monte Basin.[46] Recycled water is produced at the City's North City Water Reclamation Plant (North City WRP) and South Bay Water Reclamation Plant (South Bay WRP) and is used for non-potable use, such as landscape irrigation.

[44] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix F: Wastewater and Water Emission Activities and Sources.
[45] California American Water Company (CalAm)'s service area in San Diego region includes Cities of Imperial Beach and Coronado, and portions of the City of Chula Vista. California American Water: 2015 Urban Water Management Plan, Southern Division – San Diego County District (2016).
[46] City of San Diego, 2015 Urban Water Management Plan, Section 6 System Water Supplies (2016).

The potable water supplied within City of San Diego (excluding sales to other water agencies) and the percentage of water from each source, and the recycled water are given in Table 13.[47]

Table 13 Water Supplied and Supply Source (San Diego, 2019–2021)

Year	Potable Water Supply					Recycled Water Supply (Acre-Feet)
	Imported SDCWA Treated	Imported SDCWA Untreated	Local Surface Reservoir	Local Groundwater Basin	Potable Water Supplied (Acre-Feet)	
2019	10%	77%	14%	0.1%	161,472	7,999
2020	12%	73%	14%	0.1%	166,742	8,842
2021	8%	84%	7%	0.3%	161,995	8,586

Percentages may not add up to totals due to rounding. Potable water supplied (acre-feet) is the City of San Diego's water production excluding sales to other water agencies.

City of San Diego 2020, Energy Policy Initiatives Center, University of San Diego 2020

4.5.2 Energy Intensity of Water

The energy used to produce and distribute water from each source is different due to the different raw source type and its location. The energy intensity of water, or the energy needed to move one unit of water through each segment of the water-use cycle (water supply and conveyance, water treatment, and water distribution) individually, expressed in kWh per acre foot (kWh/Acre-foot), are described below.

Upstream Supply and Conveyance – This is defined as supply and conveyance of water from the raw sources to the local service area. The upstream supply and conveyance energy use for SDCWA untreated water consists of conveyance of water from the State Water Project and the Colorado River through Metropolitan Water District (MWD)'s and SDCWA's service area. The upstream supply and conveyance energy use for SDCWA treated water consists of that associated with SDCWA untreated water and the water treatment energy use before the water is delivered to City of San Diego's service area. The water may be treated at MWD or SDCWA's water treatment plants (WTPs).[48] The City does not have operational control over the upstream supply and conveyance.

Water suppliers have begun to voluntarily report the energy intensity in their service areas in Urban Water Management Plans (UWMPs). SDCWA's and MWD's 2015 UWMP voluntary energy intensity reporting are used to calculate the upstream supply energy intensity for SDCWA's member agencies. The energy intensity is based on the average of fiscal years 2013 and 2014 is shown in Table 14.

[47] Recycled water sales, water production at each of City's water treatment plants (WTPs) from each water source and sales to other agencies (City of Del Mar and CalAm) were provided by City of San Diego from 2017 to 2019. Water sale to City of Del Mar is from the imported raw water treated in City of San Diego's WTPs. The water sale to CalAm (excluding CalAm's service area in City of San Diego's South Bay area) is from local water treated in WTPs. Starting in 2021, water sales to South Bay Irrigation District is from a mixture of local supply and imported water treated in Otay WTP. Recycled water was produced at the City's North City Water Reclamation Plant and provided to City customers only.

[48] SDCWA 2016: Urban Water Management Plan 2015, Metropolitan Water District of Southern California, Urban Water Management Plan 2015.

Table 14 Components of Average Upstream Energy Intensity for SDCWA Member Agencies

Water System Segment	FY 2013 and 2014 Average Energy Intensity (kWh/Acre-Foot)	Data Source
MWD delivered untreated*	1,817	MWD UWMP 2015 Appendix 9
SDCWA conveyance**	-62	SDCWA UWMP 2015 Appendix K
SDCWA Untreated Subtotal	**1,755**	
SDCWA treatment	60	SDCWA UWMP 2015 Appendix K
SDCWA distribution***	1.1	SDCWA UWMP 2015 Appendix K
SDCWA Treated Total	**1,816**	

MWD - Metropolitan Water District, SDCWA – San Diego County Water Authority, UWMP - Urban Water Management Plan.
*Includes conveyance from the State Water Project & Colorado River water to MWD's distribution system, and distribution from MWD to MWD's member agencies.
**Conveyance of raw water supplies to the water treatment plants or to member agency connections (negative value means hydro-electric generation by SDCWA).
*** Distribution of treated water from SDCWA's Twin Oaks Water Treatment Plant to SDCWA's member agencies.
"Upstream" refers to moving water from the original source to SDCWA's member agency's service area or first connection point
MWD 2016, SDCWA 2016, Energy Policy Initiatives Center, University of San Diego 2018

Local Supply and Conveyance – This is defined as supply and conveyance of local surface and groundwater within the water agency service area to water treatment plants, such as pumping water from local surface water reservoirs to nearby water treatment plants. Due to the way data is provided, the local supply and conveyance energy intensity is combined with local water treatment energy intensity.

Local Potable Water Treatment – This is the energy used for water treatment plant operations. The energy intensity depends on the source water quality, the treatment level, and capacity and efficiency of the associated WTP. The City of San Diego owns three WTPs: Alvarado, Miramar, and Otay WTP that treat raw water to potable levels. The WTPs treat both imported untreated SDCWA water and local water. Both Alvarado and Otay WTP have on-site behind-the-meter PV systems. The PV systems are connected to the raw water pump stations at Alvarado and Otay WTP that pump water to and from the WTPs to the nearby reservoirs. Because the water conveyance and treatment operations are connected, the local water conveyance and treatment energy intensity are combined and given in Table 15.

Table 15 Local Water Conveyance and Treatment Energy Intensity (San Diego, 2019–2020)

Combined Miramar, Otay and Alvarado WTPs	2019	2020	Description
Water Treated (Acre-Feet)	152,586	153,389	Total water treated at three WTPs
Total Treatment + Conveyance Energy Use (kWh)	11,519,163	7,747,558	Total electricity consumption including treatment plant operation, lake pump stations and electricity generated at Alvarado and Otay on-site PV systems
Total Treatment + Conveyance Energy Intensity (kWh/Acre-Foot)	75	51	Total Energy Intensity (total electricity divided by water treated)
Solar Production (kWh)	2,272,785	2,172,498	Annual electricity generated Alvarado and Otay on-site PV systems
Net Treatment + Conveyance Energy Use (kWh)	9,255,955	9,279,866	Net electricity purchase from the grid (SDG&E). Total electricity consumption minus solar production.
Net Treatment + Conveyance Energy Intensity (kWh/Acre-Foot)	**61**	**60**	**Net Energy Intensity (net energy divided by water treated)**

WTP – Water Treatment Plant
The energy intensities are the average of all three City of San Diego WTPs, do not represent the energy intensity of each individual WTP.
City of San Diego 2022, Energy Policy Initiatives Center, University of San Diego 2022

Starting in March 2019, not all the solar generated at Otay Lake Pump Station (OLPS) is used solely by the pump station anymore. The excess solar generation goes to the grid and is shared with other Otay accounts. The solar generation share allocated to the OLPS is available for 2020 but not for 2021, therefore, the 2020 energy intensity is used as a proxy for 2021.

Local Potable Water Distribution – This is defined as the energy required to move treated water from water treatment plants to end-use customers. Distribution energy use includes energy use for water pump stations and/or pressure reduction stations, water storage tanks, etc. Local distribution energy intensity depends on the service area's geological conditions, such as the elevation the water is pumped to/from, the pump station's energy efficiency, and whether a pump station is offline for maintenance or repair, which would cause water to be pumped to other pressure zones and rerouted back. The City of San Diego's water service area has some areas with gravity-fed system (no energy needed) and some areas that need water pumping. The citywide water distribution energy intensity is given in Table 16.

Table 16 Local Water Distribution Energy Intensity (San Diego, 2019–2021)

Citywide Water Distribution	2019	2020	2021	Description
Total Water Moved (Acre-Feet)	168,014	173,787	174,952	Total City of San Diego water production from all water sources (including sales to other water agencies)
Distribution Pump Stations Energy Use (kWh)	25,340,506	26,614,233	27,273,076	Electricity use at water pump stations excluding lake pump stations
Water Distribution Energy Intensity (kWh/Acre-Foot)	**151**	**153**	**156**	**Citywide water distribution energy intensity**
The energy intensities are the citywide water distribution system energy intensities, do not represent the energy intensity of a specific area or pressure zone within the City. City of San Diego 2022, Energy Policy Initiatives Center, University of San Diego 2022				

Local Recycled Treatment and Distribution – This is energy required to treat recycled water (tertiary treatment, in addition to conventional wastewater treatment) and deliver it to end-use customers. In the City, the recycled water is delivered to customers in purple pipes, separated from the potable water distribution system. The recycled water energy intensity from the City's 2015 UWMP voluntary reporting, 38 kWh/Acre-Foot, is used for all years.[49] The intensity includes energy use for tertiary treatment at WTPs and for recycled water distribution.

4.5.3 Total Emissions from Water

To convert the energy intensity of water to GHG emissions per unit of water, the electricity emission factor associated with the energy use is applied. For upstream energy use, a California-wide average emission factor from EPA eGRID is applied.[50] For local energy use, including potable water conveyance and treatment, distribution, and recycled water treatment and distribution, SDG&E's bundled electricity emission factor is applied for 2019 and 2020 because SDG&E was the electricity supplier. SDCP's default electricity emission factor is applied for 2021 because the municipal accounts were switched to SDCP. The electricity emission factors are given in Table 17.

Table 17 Electricity Emission Factors for Water-Energy Intensities (2019–2021)

Year	Electricity Emission Factors for Water-Energy Intensities (lbs CO_2e/MWh)	
	Upstream (WECC-California from eGRID)	Local (SDG&E or SDCP)*
2019	455	633 (SDG&E bundled)
2020	515	636 (SDG&E bundled)
2021	534	378 (SDCP)
*SDG&E bundled emission factor is different from City-specific electricity emission factor, which is based on percentages of electricity sales to SDG&E bundled and DA customers, SDG&E and DA emission factors. SDCP EPA 2023, Energy Policy Initiatives Center, University of San Diego 2023		

[49] City of San Diego, 2015 Urban Water Management Plan, Table 10-4 Energy Intensity for Wastewater and Recycled Water.
[50] The Western Electricity Coordinating Council (WECC) CAMX (eGRID Subregion) emission rates from eGRID were used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID2019, released February 23, 2021; eGRID2020, re-released January 30, 2023; eGRID2021, released January 30, 2023.

For upstream supply and conveyance emissions, the volume of water from SDCWA (treated and untreated) was multiplied by the upstream energy intensities (Table 14) and the upstream electricity emission factor (Table 17). Because the electricity use and GHG emissions associated with upstream supply and conveyance are outside the City boundary and would not be included in the electricity category, they are accounted for in the water category.

For local conveyance and treatment emissions, the volume of water treated at three WTPs and delivered within the City (excluding sales to other agencies) was multiplied by the net water treatment energy intensity (Table 15) and local grid electricity emission factor (Table 17). Because WTPs are located within San Diego, the electricity use associated with water treatment is included in the electricity category for San Diego. Therefore, electricity and GHG emissions associated with water treatment occur within the City boundary and have been subtracted from the electricity category, as they are accounted for in the water category.

For local water distribution emissions, total water within the City (excluding sales to other agencies) was multiplied by the water distribution energy intensity (Table 16) and local grid electricity emission factor (Table 17). Electricity and GHG emissions associated with water distribution occur within the City boundary and have been subtracted from the electricity category, as they are accounted for in the water category.

For recycled water treatment and distribution emissions, total recycled water supplied was multiplied by the recycled water energy intensity (38 kWh/Acre-Foot, Table 16) and local grid electricity emission factor (Table 17). Electricity and GHG emissions associated with recycled water treatment and distribution occur within the City boundary and have been subtracted from the electricity category, as they are accounted for in the water category.

The total potable and recycled water supplied and the corresponding GHG emissions from the water category in 2019 are given in Table 18.

Table 18 Water Supplied and GHG Emissions from the Water Category (San Diego, 2019–2021)

Year	Potable Water Supplied (Acre-Feet)	Recycled Water Supplied (Acre-Feet)	GHG Emissions (MT CO_2e)
2019	161,472	7,999	61,000
2020	166,742	8,842	70,000
2021	161,995	8,586	70,000

GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, University of San Diego 2023

4.6 Wastewater

The emissions from wastewater generated by San Diego were estimated by multiplying the total amount of wastewater generated in 2019 and the emission factor of the wastewater treatment processes. Unlike the water category, in which the GHG emissions result from the energy used to move and treat

water, wastewater-related GHG emissions include only "*process, stationary and fugitive GHG emissions,*" as described in U.S Community Protocol "WW.1 – WW.14."[51]

4.6.1 Wastewater Generation

Wastewater generated in the City of San Diego is conveyed to the City of San Diego Metropolitan Sewerage System (Metro System). The Metro System collects and treats wastewater from 12 partner agencies. Wastewater collected by the Metro System is treated at one of the three wastewater treatment plants (WWTPs): Point Loma WWTP, North City WRP, and South Bay WRP.[52]

It is assumed the percentage of City of San Diego's wastewater treated at each WWTP is the same as that of the entire Metro System. The City's wastewater generation and the percentage treated at each WWTP are given in Table 19.

Table 19 City of San Diego Wastewater Generation (San Diego, 2019–2021)

Year	% of Wastewater Treated at Each WWTP			Wastewater Flow to Metro System	
	Point Loma WWTP	South Bay WRP	North City WRP	Average Million Gallons per Day (MGD)	Million Gallons per Year
2019	86%	4%	10%	105	38,241
2020	86%	4%	10%	105	38,192
2021	87%	4%	9%	103	37,591

Sum may not add up to totals due to rounding.
WWTP – wastewater treatment plant; WRP – water reclamation plant.
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4.6.2 Wastewater Emission Factor

Point Loma WWTP and North City WRP both report plant operation GHG emissions to CARB under the Mandatory GHG Reporting Regulation (MRR) program.[53] The reported GHG emissions include three components: (1) direct CO_2 from combustion of anaerobic digester gas; (2) CH_4 and N_2O emissions from digester gas combustion; and (3) operational fossil fuel emissions assuming complete combustion. The direct CO_2 from combustion of anaerobic digester gas is considered biogenic, while the other two components of CO_2 emissions are considered non-biogenic emissions.

The wastewater treatment emission factor (MT CO_2e/million gallons) at Point Loma WWTP and North City WRP are calculated by dividing the reported GHG emissions by the plants' wastewater flows, as shown in Table 20.[54]

[51] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2 (2019), Appendix F: Wastewater and Water Emission Activities and Sources.
[52] City of San Diego, 2015 Urban Water Management Plan, Section 3 Description of Existing Water System. Some of the North City WRP's flow (non-tertiary flow) is conveyed to Point Loma WWTP for discharge.
[53] CARB: Mandatory GHG Reporting – Reported Emissions. 2020 and 2021 GHG emissions data, current as of November 4, 2022. CARB MRR uses 21 as the CH_4 GWP, therefore the CO_2e for CH_4 in this report is recalculated using 25 as the CH_4 GWP to be consistent with other categories in the inventory.
[54] Point Loma WWTP and North City WRP GHG Reports are from CARB Mandatory GHG Reporting. Wastewater flow into each facility was provided by City of San Diego to EPIC in November 2022.

Table 20 Emission Factors at Wastewater Treatment Plant (San Diego, 2019–2021)

Year	Point Loma WWTP			North City WRP		
	Annual Flow (million gallons)	GHG Emissions (MT CO_2e)	Wastewater Emission Factor (MT CO_2e/million gallon)	Annual Flow (million gallons)	GHG Emissions (MT CO_2e)	Wastewater Emission Factor (MT CO_2e/million gallon)
2019	52,571	15,955	0.30	52,571	15,955	0.30
2020	52,122	17,403	0.33	52,122	17,403	0.33
2021	51,556	17,289	0.34	51,556	17,289	0.34

WWTP – wastewater treatment plant; WRP – water reclamation plant.
On average 99% of the emissions from Point Loma WWTP and 98% of emissions from North City WRP are biogenic.
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4.6.3 Total Emissions from Wastewater

For the GHG emissions calculation, the wastewater emission factor derived from Point Loma WWTP was applied to the wastewater flow into Point Loma WWTP and the emission factor derived from North City WRP was applied to the flow into both North City WRP and South Bay WRP. The total wastewater flow, the citywide weighted average wastewater emission factors, as well as the corresponding GHG emissions are given in Table 21.

Table 21 Wastewater Generated and GHG Emissions from Wastewater Category (San Diego, 2019–2021)

Year	Total Wastewater Generated (Million Gallons/year)	Wastewater Emission Factor[1] (MT CO_2e/ Million Gallon)	GHG Emissions (MT CO_2e)
2019	38,241	0.67	26,000
2020	38,192	0.60	23,000
2021	37,591	0.63	24,000

[1]Weighted average emission factor of wastewater treated at three wastewater treatment plants in City of San Diego.

GHG emissions for each category are rounded to the nearest thousand. Values are not rounded in the intermediary steps in the calculation.
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