The City of SAN DIEGO

Climate Action Plan 2018 Annual Report Appendix

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Introduction

This appendix to the 2018 Annual Report of the City of San Diego's Climate Action Plan (CAP) provides additional information and a comprehensive review of the data presented. This appendix includes an overview of the 2017 greenhouse gas (GHG) emissions inventory, status updates for the five strategies found within the CAP, method differences and data refinement and an analysis of jobs associated with the five CAP strategies.

The 2017 total GHG emissions in the City of San Diego (City) were calculated to be 10.2 million metric tons of carbon dioxide equivalent (MMT CO_2e) approximately the same as the corrected previous year 2016 GHG emissions (10.2 MMT CO_2e).

As detailed in the CAP this Appendix relates to the first phase (January 1, 2016 - December 31, 2017) of CAP implementation. Continued monitoring of the implementation process of the CAP strategies as well as tracking the impact of federal and state policies and mandates ensures that the City remains on track to achieve its emission reduction targets.

In preparation for the 2018 Annual Report and 2017 GHG emissions inventory, revisions and refinements were made to the 2016 Citywide GHG emissions and CAP strategies performance metrics presented in the previous 2017 CAP annual report,[1] to reflect updated data supplied by agencies not managed by the City, and to ensure consistency with the 2017 GHG emissions estimates. This change follows the California Air Resources Board (CARB)'s California statewide inventory method updates to incorporate new methods or reflect updated data, based on Intergovernmental Panel on Climate Change (IPCC) recommendations to maintain a consistent time-series when developing GHG inventories.[2] The updates to 2016 Citywide emissions consist of revisions in the transportation, energy and water sectors. The method differences and data refinements of the GHG emissions inventory updates are discussed briefly in the Methodology Differences and Data Refinement section of this appendix and detailed of the *City of San Diego 2016-2017 Greenhouse Gas Emissions Inventory* supplemental document at the end of this appendix. The updates to the CAP strategies 2016 performance metrics are given in the 2017 Climate Action Plan Strategy Updates section along with the 2017 performance metrics and revisions are identified in the applicable section below.

The five CAP strategies 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 2017 is presented first followed by updates of each action. Comparisons of the current status in 2017 to 2016 and the baseline estimates in 2010 are provided where possible.

[1] City of San Diego (2017): Climate Action Plan 2017 Annual Report Appendix.

[2] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2016. Trends of Emissions and Other Indicators, p. 16 Additional Information (2018), accessed August 15, 2018.

2017 Greenhouse Gas (GHG) Emissions

GHG EMISSIONS INVENTORY

The emissions source categories included in this update have remained consistent with the previous CAP Annual Reports: electricity, natural gas, on-road transportation, water, and, wastewater and solid waste. As in the past 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 jurisdiction's inventory.[3] 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 2017 and revised 2015 and 2016 GHG emissions inventory results are shown in Table 1. The methods, data availability and sources used to calculate GHG emissions have been updated since the development of 2010 baseline emissions in the CAP. A supplement document, *City of San Diego 2016-2017 Greenhouse Gas Emissions Inventory*, has been developed with the most recent GHG inventory methodology and discussed the updates to the GHG emissions inventory since the 2017 CAP Annual Report. A brief discussion regarding the differences in methods and data sources are provided in the Methodology Differences and Data Refinement section of this appendix.

TABLE 1 CITY OF SAN DIEGO GREENHOUSE GAS EMISSIONS (2015-2017)

Emissions Category	2015 Emissions (reported in 2017 annual report) (MT CO_2e)	2016 Emissions (reported in 2017 annual report) (MT CO_2e)	2015 Emissions Revised* (MT CO_2e)	2016 Emissions Revised* (MT CO_2e)	2017 Emissions (MT CO_2e)	2016 Revised – 2017 % Changes
On-Road Transportation**	5,771,317	5,677,559	5,541,000	5,571,000	5,525,000	-0.8%
Electricity	2,598,196	2,326,138	2,474,000	2,203,000	2,187,000	-0.7%
Natural Gas	2,090,718	2,097,685	2,016,000	2,052,000	2,095,000	2%
Wastewater & Solid Waste	286,573	277,237	286,000	276,000	285,000	3%
Water	91,491	88,643	75,000	73,000	67,000	-8%
Total	10,838,295	10,467,262	10,392,000	10,175,000	10,158,000	-0.2%

*Revised values reflect updated data and information.

**Based on provisional vehicle miles traveled (VMT) estimates.

2015 Revised, 2016 Revised and 2017 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 CO2e = metric tons of carbon dioxide equivalent.

Sources: Energy Policy Initiatives Center, 2018

The 2015, revised, 2016 revised emissions and 2017 emissions shown in Table 1 are calculated based on the same methods and data sources, and can be compared directly. Using the same methods and data sources for the period 2015 to 2017, the 2015 citywide GHG emissions were re-estimated at 10.4 MMT CO_2e. The 2017 total GHG emissions are approximately at the same level as the 2016 revised total GHG emissions. The waste and water related emissions have the largest changes from 2016 to 2017 compared

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

with the other emission categories. An 8% decrease in water-related emissions between 2016 revised and 2017 may reflect greater local water supply in 2017 than in 2016 that reduced imported water from San Diego County Water Authority (SDCWA) and the energy and GHG emissions associated with imported water. The waste-related emissions in 2017 is 3% higher than that in 2016. The City has maintained 66% waste diversion rate in 2017, the same as the diversion rate in 2016, however, the waste disposed at landfill in 2017 is higher than in 2016.

LOW CARBON ECONOMY

The GHG intensity is the level of GHGs per unit of economic activity denominated as the Gross Domestic Product (GDP). The GDP is normally a national unit of economic activity, but can also be applied at the state, regional or city level. National GDP is measured as household expenditures on goods and services plus business investment, government expenditures and net exports. State GDP is measured by income (labor and capital minus business taxes) earned and costs of production in that state. The US Bureau of Economic Affairs has developed GDPs for regions such as San Diego County based on local personal income and industry. IMPLAN, an economic impact model, has been used to develop city-level GDPs[4].

GHG intensity is independent of total emissions and indicates how dependent economic activity is on GHG producing activities. Economic productivity is said to be more efficient, as economic growth then consumes less carbon-based fuels. If GHG emissions remained constant or decreased over time while the GDP increased, the result would be that GHG intensities would decrease. As mentioned above, the GHG emissions for the City of San Diego excludes specific emission sources, for example, emissions from air travel, shipping, off-road vehicles and equipment, or other high global warming potential gases in use in the city. Therefore, a limitation of applying this method to community-wide GHG emissions is that not all economic sectors and GHG-emitting categories are included in the inventory, and the GHG intensity is lower than it actually is. However, since the categories inventoried each year are the same, GHG intensities can be compared for the City across the years.

The City of San Diego's GHG intensity was 79 MT CO_2e /$ million in 2017 and 82 MT CO_2e /$ million in 2016 (Table 2).

TABLE 2 2016 AND 2017 GHG INTENSITY (MT CO_2E/$ MILLION GDP)

Year	2016 (reported in 2017 Annual Report)	2016 Revised*	2017
Total Emissions (Million MT CO_2e)	10.5	10.2	10.2
GDP ($ billion)	124	124	129
GHG Intensity (MT CO_2e/$million GDP)	84	82	79

*Revised values reflect updated information.

GDP = gross domestic product, MT CO_2e = metric tons of carbon dioxide equivalent

Sources: GDP estimated by Kelly Cunningham, National University System, based on Bureau of Economic Analysis, U.S. Department of commerce, 2017. 2017 GDP is a forecasted value developed in 2017.

Energy Policy Initiatives Center, 2018.

[4] National University's Kelly Cunningham, Senior Economist, developed and provided the estimate based on the IMPLAN model for the City of San Diego using the city's zip code information and the current data available from the U.S. Department of Commerce's Bureau of Economic Analysis. The 2017 GDP estimate is a forecast value developed in 2017 and is subject to revision with new data and information available from U.S. Department of Commerce.

PER CAPITA GHG EMISSIONS

The 2016 and 2017 per capita GHG emissions in City of San Diego are given in Table 3. This is based only on the five emission categories analyzed. The 2017 per capital GHG emissions is approximately at the same level as the 2016 per capita GHG emissions.

TABLE 3 2010 AND 2015 PER CAPITA GHG EMISSIONS (MT CO_2E PER CAPITA)

Year	2016 (reported in 2017 Annual Report)	2016 Revised*	2017
Total emissions (Million MT CO_2e)	10.5	10.2	10.2
Total Population	1,391,676	1,387,362	1,399,924
Per capita GHG emissions (MT CO_2e per capita)	7.5	7.3	7.3

*Revised values reflect updated information from sources.

MT CO_2e = metric tons of carbon dioxide equivalent

Per capita emissions based on five emission categories only, cannot be compared with California statewide per capita emissions or per capita emissions target.

Sources: 2016 Revised and 2017 population based on California Department of Finance, E-1 Population Estimates for Cities, Counties and the State (May 2018). SANDAG's Demographic & Socio-Economic Estimates 2018 version (for data year 2017) were not available as of August 2018.

Energy Policy Initiatives Center, 2018.

It is important to note, as mentioned above, that GHG emissions for the City of San Diego do not include emissions from all economic sectors, and excludes emissions, for example, from air travel, shipping, off-road vehicles and equipment, or other high global warming potential gases in use in the city. Therefore, the estimated City of San Diego per capita emissions cannot be directly compared with the California statewide per capita emissions or per capita emissions target calculated using the CARB statewide inventory or statewide emissions target, which includes all economic sectors and additional emissions categories.

2017 Climate Action Plan Strategy Updates

STRATEGY 1: ENERGY AND WATER EFFICIENCY BUILDINGS

Energy (fossil-fuel based electricity and natural gas consumption) and water-related emissions account for 43% of 2017 Citywide GHG emissions. The Energy and Water Efficiency Buildings strategy has targets to reduce citywide per capita water use, energy use in residential buildings and energy use in city 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 2016 and 2017 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 ELECTRICITY USE (GRID-SUPPLY ONLY)

Year	2010 (Baseline)	2016 (reported in 2017 Annual Report)	2016 Revised*	2017	2010-2017 % Change	2016 Revised – 2017 % Change
Electricity (MWh)	8,572,155	8,290,454	7,832,166	7,738,649	-10%	-1%
Emissions from Electricity (MT CO_2e)	3,138,613	2,326,138	2,203,000	2,187,000	-30%	-1%

* 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 photovoltaic (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.

2016 Revised and 2017 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.

Sources: SDG&E, 2017 and 2018; Energy Policy Initiatives Center, 2018.

Table 5 provides a breakdown of electricity use by customer class in 2017.

TABLE 5 ELECTRICITY USE BY CUSTOMER CLASS

Customer Class	Breakdown of Electricity Use in 2017
Residential	29%
Commercial	45%
Industrial	24%
Agricultural and Pumping	1.2%
Lighting (traffic lighting and traffic lights)	0.6%
Total	100%

Source: SDG&E 2018.

In 2017, 31% natural gas use was from the residential class, 26% from the commercial class and the rest from the industrial class (including electricity generation using natural gas). Table 6 provides natural gas end use in 2016 and 2017.

TABLE 6 TOTAL NATURAL GAS USE (UTILITY ONLY)

Year	2016 (reported in 2017 Annual Report)	2016 Revised*	2017	2016 Revised – 2017 % Changes
Natural Gas Use (million therms)	385	377	384	2.1%

* 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, military.

Sources: SDG&E, 2017 and 2018; Energy Policy Initiatives Center, 2018.

Table 7 provides the electricity and natural gas end use in million British thermal units (MMBtu). MMBtu is the common unit of energy used to compare the energy content of different fuel types. In this case, MMBtu is used to convert electricity in kilowatt-hours (kWh) and natural gas in units of therms to the same unit. Natural gas constituted 59% of the total end use energy in 2016.

TABLE 7 TOTAL ENERGY (ELECTRICITY + NATURAL GAS) USE (GRID-SUPPLY ONLY)

Year	2016 (reported in 2017 Annual Report)	2016 Revised*	2017	2016 Revised – 2017 % Changes
Electricity (million MMBtu)	28.3	26.7	26.4	-1%
Natural Gas (million MMBtu)	38.5	37.7	38.4	2%
Energy (million MMBtu)	66.8	64.4	64.8	0.7%

* Revised values reflect updated information from sources.

MMBtu = million British Thermal Unit

Conversion factors 293 kWh/MMBtu and 10 therms/MMBtu are used to covert electricity and natural gas to the same unit.

Sources: SDG&E, 2017 and 2018; Energy Policy Initiatives Center, 2018.

Since the development of the 2015 City of San Diego emissions inventory (2016 CAP Annual Report), EPIC submits annual requests of the City of San Diego electricity and natural gas data to SDG&E in order to calculate the emissions from electricity and natural gas use. In the data request for City of San Diego's 2017 energy data, the jurisdictional boundary is defined as "use two-digit town code to determine the City of San Diego". According to SDG&E, town code is used to associate premises within the City boundary for tax purposes.

Previously, in the data request for 2016 energy data (requested in 2017), a combination of town code and service address in the city was used to define the jurisdictional boundary based on SDG&E's recommendation. That is, for the metered energy use to be included as City of San Diego's energy use, both the service address and the town code of the account or meter had to be City of San Diego. This approach excluded those entities with an account in the City of San Diego but with the service address in another jurisdiction. However, during the development of the SANDAG ReCAP (2018), it was indicated by

SDG&E that service address city is closely tied to the Postal Service's definition of "city" which is different from the actual jurisdiction boundary, and that therefore only the town code itself should be used. In order to include more accurate data and to be consistent with the SANDAG ReCAP inventory methodology, 2015 and 2016 energy data were re-requested under the same criteria as for 2017 energy data.

Both the data requests made in 2017 and 2018 include the request to separate out the following entities' electricity and natural gas use:

- San Diego County Regional Airport Authority (referred to as San Diego International Airport in 2017 data request);
- San Diego Unified Port District (referred to as Port of San Diego in 2017 data request); and
- Military (referred to as U.S. military, navy and air force in 2017 data request).

The 2018 data request also includes the request to provide the sum of "exclusion" category. For the 2017 data request, the "exclusion" category was not part of the request and was therefore not provided.

Action & Progress: Reduce Energy Use in Residential Housing Units

Total residential electricity use includes both electricity provided by SDG&E and electricity generated from behind-the-meter photovoltaic (PV) systems. Residential PV systems increased to 193 megawatts (MW) in 2017. Combining both electricity and natural gas use, energy use per home in 2017 is approximately at the same level as 2016 (Table 8).

TABLE 8 RESIDENTIAL ENERGY (ELECTRICITY + NATURAL GAS) USE

Year	2010 Baseline	2016 (reported in 2017 Annual Report)	2016 Revised*	2017	2010-2017 % Change	2016 Revised-2017 % Change
Electricity (MWh) - utility	2,498,471	2,161,017	2,324,307	2,281,973	-9%	-2%
Electricity (MW) – PV*	15	161	160	193	1324%	20%
Electricity (MWh) – PV**	26,251	281,716	281,001	338,589	1324%	20%
Total Electricity (MWh)	2,524,722	2,442,733	2,605,308	2,620,562	4%	0.6%
Total Electricity (MMBtu)	8,608,065	8,328,526	2,758,712	2,771,173	4%	0.5%
Natural Gas (million therms)	138	108	117	119	-14%	1.4%
Natural Gas (MMBtu)	13,781,505	10,799,970	11,742,133	11,910,251	-14%	1.4%
Total Energy (MMBtu)	22,389,570	19,128,495	20,624,958	20,845,086	-7%	1.1%
Total # of occupied units***	483,092	501,757	502,780	505,531	5%	0.5%
Energy use per home (MMBtu/home)	46.3	38.1	41.0	41.2	-11%	0.5%

*Revised values reflect updated information from sources.

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

Sources:

*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 (April 30, 2018 version). It is based on the date of interconnection application approval. **Capacity is converted to electricity using an average PV system capacity factor of 20%. ***Occupied housing units are from the California Department of Finance, E-1 Population Estimates for Cities, Counties and the State (May 2018 Edition), and includes single detached, single attached, two to four, five plus, and mobile homes

Energy Policy Initiatives Center, 2018.

In 2017, approximately 5,700 new residential solar PV systems (97% of the total new systems) were approved for interconnection in the City for an additional 33 MW of new behind-the-meter PV capacity.

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

Municipal operations energy use (grid purchases) in 2017 was 3% higher than in 2016 (Table 9).

TABLE 9 ENERGY USE FOR MUNICIPAL OPERATIONS (SDG&E ONLY)

Energy Use	2010 Baseline	2016 (reported in 2017 Annual Report)	2016 Revised*	2017	2010-2017 (% Change)	2016 Revised - 2017 (% Change)
Electricity (MWh)	205,787	184,033	183,873	190,351	-8%	4%
Electricity (MMBtu)	701,633	627,461	626,916	649,004	-8%	4%
Natural Gas (Million Therms)	3.4	3.6	3.6	3.6	8%	2%
Natural Gas (MMBtu)	335,723	356,690	356,384	362,016	8%	2%
Total energy (MMBtu)	1,037,357	984,151	983,300	1,011,019	-3%	3%

*Revised values reflect updated information from sources.

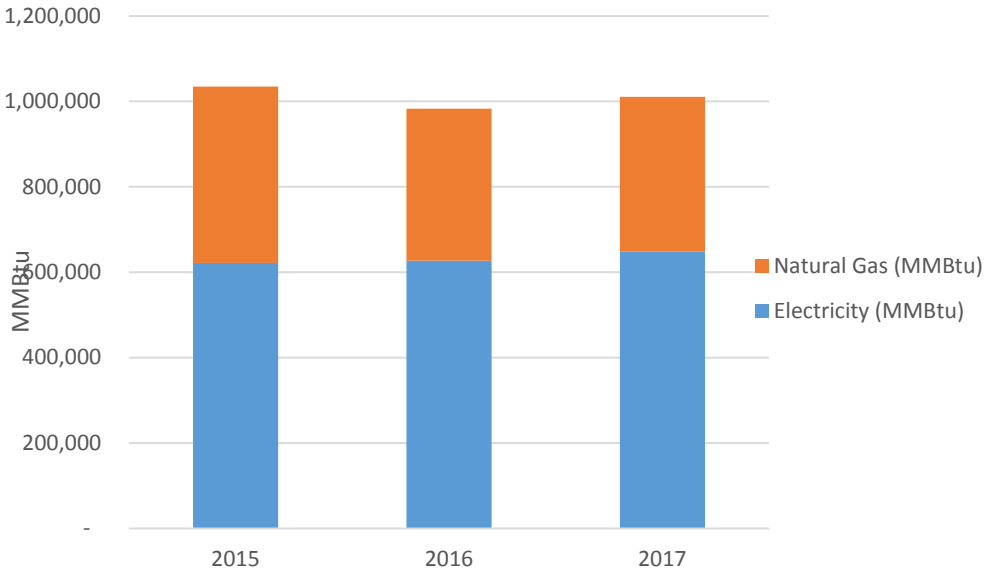
Grid purchases only, does not include on-site renewable generation.

MWh = megawatt hour, MMBtu = million British Thermal Unit

Sources: City of San Diego's Environmental Services Department 2018, converted to MMBtu using 293 kWh/MMBtu and 10 therms/MMBtu. Natural gas consumption includes gas use for space heating/cooling and electric generation.

A comparison of the energy use for municipal operations from 2015-2017 are given in Figure 1 below.

FIGURE 1 MUNICIPAL ENERGY USE (2015-2017)



Source: City of San Diego Environmental Services Department, 2016-2018
SDG&E grid purchase only. Does not include on-site renewable generation.

The City has experienced an uptick in electricity consumption during 2016-2017, which is likely attributed to the following:

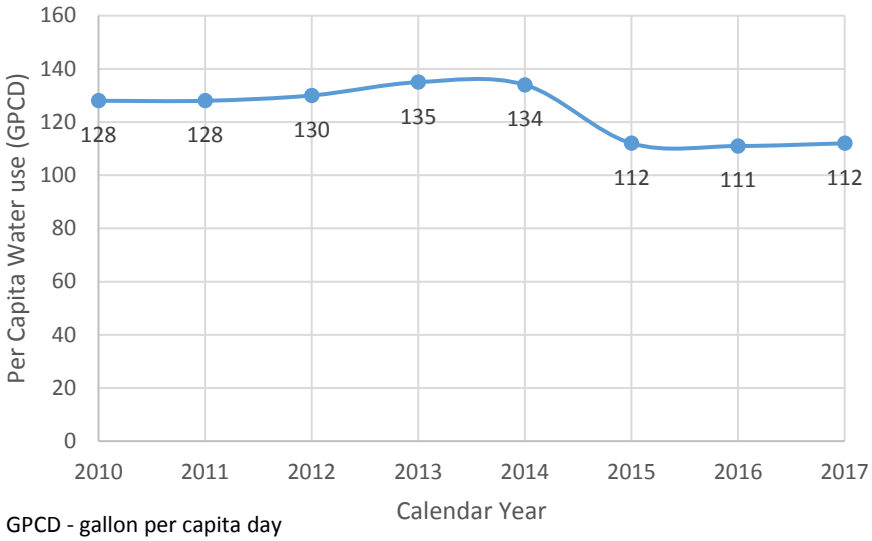
- Additional consumption from new City assets and added loads, including acquisition of 101 Ash Street building;
- Increased consumption from City facilities that were not fully staffed and/or operational in the previous year;
- The natural gas driven pump for Municipal Waste Water District Pump Station 2 was down for a long period and an electric motor driven pump was used, increasing electricity consumption;
- Maintenance of the reservoirs in 2017 contributed to an increase in electricity use; and
- Many of the City's highest energy consuming facilities consume more or less electricity because of operational changes and decisions made by operators on how to best use the equipment to meet the community's needs.

Action & Progress: Reduce Daily per Capita Water Consumption

Per capita water use (gallon per capita per day – GPCD) decreased substantially from 2010 to 2017 beyond what was projected in the CAP for 2020 (Figure 2). Governor Brown issued Executive Order B-29-2015 imposing a 25% statewide potable water reduction in April 2015. The drought emergency declaration was lifted by the Governor in April 2017, while retaining prohibition on wasteful practice. The per capita water use in the City of San Diego has remained at a similar level since 2015.

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 the 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 2 PER CAPITA WATER USE (2010-2017)



GPCD - gallon per capita day

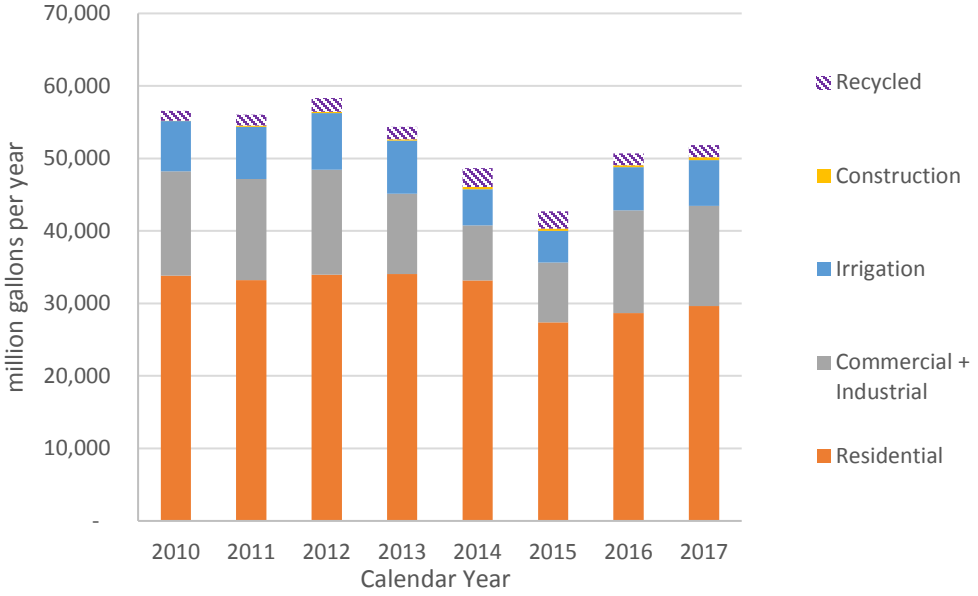
The amount of recycled water and water used for irrigation from 2010 to 2017 are provided in Table 10 and Table 11.

TABLE 10 METERED RECYCLED WATER CONSUMPTION	
Year	**Recycled Water Sales (million gallons)**
2010	1,350
2011	1,524
2012	1,867
2013	1,691
2014	2,588
2015	2,370
2016	1,637
2017	1,691
Sources: The total metered recycled water sales (delivered) in the City from 2010 to 2017 were provided by City of San Diego Public Utilities Department.	

TABLE 11 METERED IRRIGATION WATER USE (AGRICULTURAL AND LANDSCAPE)	
Year	**Metered Irrigation Water Use (million gallons)**
2010	6,923
2011	7,193
2012	7,812
2013	7,336
2014	4,977
2015	4,378
2016	5,943
2017	6,302
Metered irrigation water, including agricultural and landscape water use, delivered by the 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 3.

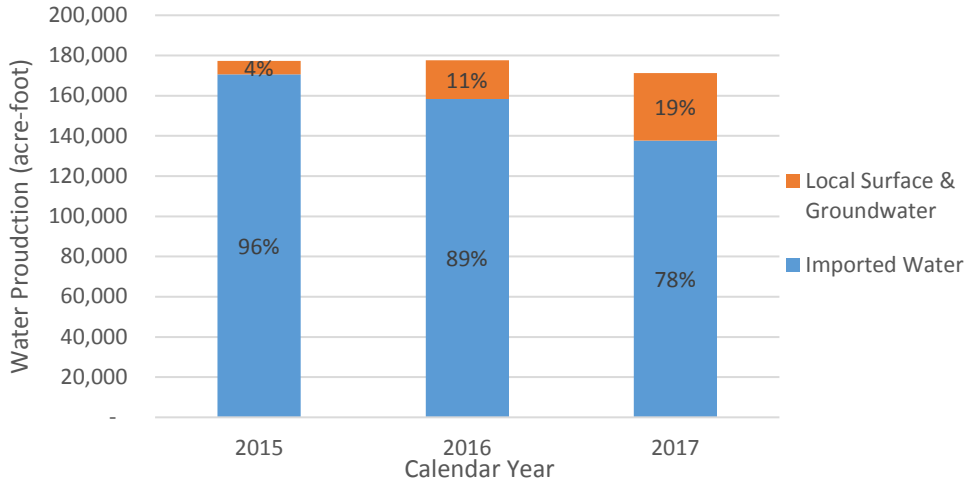
FIGURE 3 WATER SALES BY SECTOR (2010-2017)



Source: City of San Diego Public Utilites Department, 2016-2018
Sales within City of San Diego only. Does not include sales to other agencies.

From 2015 to 2017, local water supply increased from 4% in 2015 to 19% in 2017 that reduced imported water from SDCWA and the energy and GHG emissions associated with the imported water, as shown in Figure 4.

FIGURE 4 WATER MIX (2015-2017)



Water production includes water delivered within City of San Diego and sales to other agencies
Source: City of San Diego Public Utilities Department, 2016-2018

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 SDG&E's electricity supply, behind-the-meter renewable supply (including rooftop PV) and the renewable content in a Community Choice Aggregation or similar program. In 2017, SDG&E achieved 44% renewable in its electricity supply, higher than the state Renewable Portfolio Standard target for 2020, and citywide, total behind-the-meter PV systems increased 272 MW 2017.[5]

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

SDG&E's renewable electricity supply increase from 11% in 2010 to 44% in 2017 (Table 12).[6]

TABLE 12 PERCENTAGE OF RENEWABLES IN SDG&E ELECTRICITY SUPPLY

Year	Renewables in SDG&E Electricity Supply
2010	11.0%
2011	15.7%
2012	19.2%
2013	24.0%
2014	32.2%
2015	35.5%
2016	43.0%
2017	44.3%

The 2010-2016 percent renewable in SDG&E electricity supply is based on SDG&E's 2010-2016 annual power content label. The 2017 percent renewable is based on SDG&E's 2017 power source disclosure report submitted to the California Energy Commission in June 2018. 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.

Source: California Energy Commission, 2018.

In 2017, approximately 5,700 out of 5,900 new PV systems added (33 MW out of 48 MW) in the City were from residential customers (Table 13). The cumulative net energy metered (NEM) PV capacity from the current interconnected systems installed between 1999 and the end of 2017 was 272 MW in the City. Assuming that solar PV systems have a capacity factor of 20% and an annual system degradation rate of 1%, the electricity generated from rooftop solar was estimated at 468,000 MWh in 2017, accounting for approximately 5% of the total electricity consumption. The vast majority of this PV electricity was at the residential customer class level.

[5] Only accounts for the behind-the-meter PV systems that are ones currently interconnected to the grid and net-metered with historical installation years. NEM Interconnection Data Set (current as of April 30, 2018), download date: June 9, 2018. Service cities include San Diego, La Jolla and San Ysidro. Based on the date of NEM interconnection applications approved and the Permission to Operate letter were issued to the customers. Solar capacities are reported in direct current (DC).

[6] CEC Power Source Disclosure Program under Senate Bill 1305. The 2017 SDG&E annual power source disclosure report was provided by CEC staff to EPIC on June 20, 2018.

TABLE 13 NUMBER AND CAPACITY OF INSTALLED BEHIND-THE-METER PHOTOVOLTAIC (PV) SYSTEMS			
Year	**Number of New PV Systems Approved (reported in 2017 Annual Report)**	**Number of New PV Systems Approved (Revised)***	**New PV System Capacity (kW)**
2010	1,063	1,054	9,223
2011	1,161	1,159	14,454
2012	1,585	1,562	12,141
2013	3,243	3,210	21,492
2014	4,490	4,469	30,644
2015	8,436	8,406	55,265
2016	9,103	9,271	62,834
2017	--	5,920**	48,496

For 2010-2017, the number of systems and system capacity in the City of San Diego are based on the approved date of interconnection as available in the California Distributed Generation Statistics database. Both the number of systems and capacity in a given year are new, not cumulative. The 2014 and after system capacity is reported as direct current (DC) in kW. The 2010-2013 capacity is converted to DC from alternating current (AC), as the number of systems reported in AC and DC are inconsistent before 2014 in the database.

*Revised values reflect updated information from sources.

**The number of new PV systems approved in 2017 is different from the total number of permits issued by the City. According to the City's Open Data Portal, a total of 6,178 permits were issued in 2017. The Open Data Portal does not track the system capacity associated with the permit, therefore the California Distributed Generation Statistics database was used to track both the number of new systems and the system capacity.

Sources:

California Distributed Generation Statistics, 2018; Energy Policy Initiatives Center, 2018.

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. Two of the largest PV systems, at Alvarado Water Treatment Plant and Otay Water Treatment Plant, produced a combined 2,800 MWh of electricity on-site in 2017. The estimated total renewable generation at city facilities in 2017 was 168,307 MWh, either consumed by municipal operations or sold back to the grid.[7]

The estimated electric vehicle (EV) rebates through the Clean Vehicle Rebate Program (CVRP) continues to increase in City of San Diego. The total rebates EVs since 2010 in City of San Diego is estimated at 8,190 EVs or 58 EVs per 10,000 capita in 2017. The new CVRP rebates saw an increase of 6% from 2016 to 2017, as shown in Table 14.[8]

[7] Renewable generation at the City's Public Utilities Department (PUD)'s facilities are summed up using metered monthly data. The renewable generation at non-PUD facilities are collected either based on metered data or estimated using National Renewable Energy Lab (NREL) PV generation model if not metered.

[8] CVRP rebated EVs in San Diego cities through 2017 was provided by Center for Sustainable Energy to EPIC on June 29, 2018, the same as reported on the Equinox Quality of Life Dashboard. Different from the past years, Only the number of CVRP rebated EVs was reported, the EV sales estimates were no long reported since the participation rate assumption (77% of EV sales received CVRP rebates) based on previous studies was likely changed due to new rebates criteria.

TABLE 14 ESTIMATED CLEAN VEHICLE REBATE PROGRAM REBATED ELECTRIC VEHICLES	
Year	**Estimated Clean Vehicle Rebate Program Rebated Electric Vehicles**
2010	3
2011	628
2012	356
2013	1,016
2014	1,361
2015	1,390
2016	1,669
2017	1,767
Total	8,190
*Totals may differ from those reported previously due to data settling (i.e., vehicles returned, rebate processing) and zip code aggregation. Zip codes may not match jurisdictional boundaries. Rebated electric vehicles include plug-in hybrids and battery electric vehicles, excludes electric motorcycles, neighborhood EVs, and commercial EVs. The number of electric vehicles receiving rebates is likely lower than the actual number of electric vehicle sales. Source: Center for Sustainable Energy, 2018	

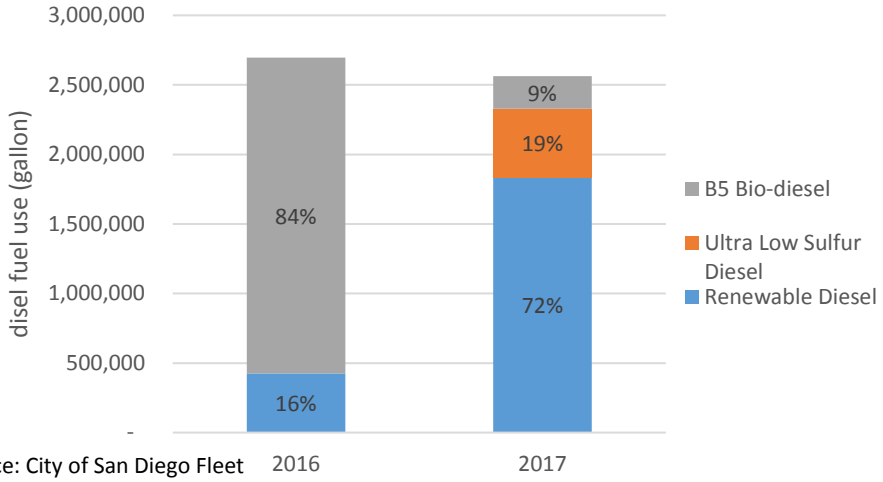
Action & Progress: Increase Municipal Zero Emissions Vehicles

As of 2017, the City operations had 4,398 vehicles, including 25 compressed natural gas (CNG) waste trucks, 90 electric vehicles and 42 hybrid vehicles. The 2010 to 2017 city fleet gasoline consumption is given in Table 15.

TABLE 15 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
Source: City of San Diego Fleet Services Department, 2016-2018	

In 2016, the City municipal fleet transitioned to 100% renewable diesel to help meet the CAP goal of reducing municipal fleet GHG emissions. The percentage of renewable diesel in total diesel use increased from 16% in 2016 to 72% in 2017 (Figure 5).

FIGURE 5 MUNICIPAL FLEET DIESEL FUEL USE BY FUEL TYPE (2016 AND 2017)



Source: City of San Diego Fleet
B5 Bio-diesel also includes off-road equipment fuel use.

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 GHG emissions avoided was calculated based on the difference between the non-biogenic (CH_4 and N_2O) emissions from renewable diesel and GHG emissions if the fuel use were B5 bio-diesel instead of renewable diesel. The transition to renewable diesel avoided approximately 16,000 metric tons CO_2e in 2017, as shown in Table 16.

TABLE 16 GHG EMISSIONS AVOIDED BY TRANSITION FROM B5 BIO-DIESEL TO RENEWABLE DIESEL

Biogenic GHG Content (g CO2/gallon) - information only		Non-biogenic GHG Content (g CO2e/gallon)		Renewable Diesel Consumption (gallon)	Non-biogenic GHG Emissions from Renewable Diesel (MT CO2e)	Non-biogenic GHG Emissions from B5 Bio-diesel (MT CO2e)	GHG Emissions Avoided (MT CO2e)
Renewable Diesel	B5 Bio-diesel	Renewable Diesel	B5 Bio-diesel	1,836,665	882	16,956	16,075
10,206	1,251	480	9,232				

Biogenic GHG content is provided for information only, not used for the GHG emission calculation.

Source: City of San Diego Fleet Department, 2017 and 2018; CARB Statewide GHG Emissions Inventory – 2018 Edition, Energy Policy Initiatives Center, 2018

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

In 2017, the City has 24 CNG waste collection trucks in service and in total displaced the equivalent of 275,842 gallons of diesel, significantly higher than diesel fuel displaced by CNG trucks in 2016 (11,208 gallons of diesel), ahead of the scheduled implementation of the measure.

STRATEGY 3: BICYCLING, WALKING, TRANSIT AND LAND USE

In 2017, transportation accounted for 54% of all GHG emissions within the City of San Diego. This strategy 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.

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

The 2017 vehicle miles travelled (VMT) and on-road transportation emissions in the City of San Diego are shown in Table 17. The data sources and method to calculate on-road transportation emissions are provided in a supplement document of the Appendix, *City of San Diego 2016-2017 Greenhouse Gas Emissions Inventory.*

TABLE 17 2017 VEHICLE MILES TRAVELLED (VMT)	
Total VMT (million miles/year)	13,012
San Diego Regional Average Vehicle Emission Rate (g CO_2e/mile)	425
GHG Emission (MT CO_2e)	5,525,000
The 2017 VMT were estimates based on 2012 City of San Diego VMT estimates from SANDAG's Travel Demand Model (Series 13, version 13.3.0) and 2012-2017 San Diego regional VMT annual rates of increase from California Department of Transportation Highway Performance Monitoring System public road data. Sources: CARB mobile emissions inventory EMFAC2017, Energy Policy Initiatives Center 2018	

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 modeshares and commute trip length have evolved. Baseline modeshares were determined through multiple sources of data as listed below in Table 18. 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 modeshare results comprised of the most up-to-date techniques and information.

SANDAG, the regional transportation agency, is currently the best source for transportation data in the region. SANDAG is transitioning 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, Caltrans, and the federal government.

The results presented below in Table 19 utilize the SANDAG Series 13 ABM, SANDAG no longer maintains or allows modification to prior data series (e.g. Series 12) or the 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 18 SUMMARY OF BASELINE MODESHARES AND VEHICLE COMMUTE DISTANCE

Mode	Baseline Modeshare (%) 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 19 SUMMARY OF BASELINE MODESHARES AND VEHICLE COMMUTE DISTANCE

Mode	2012 Series 13 Base Year Modeshare (%)	Modeled Modeshare (%) 2017[9]	2035 with CPUs Modeshare (%)	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 of achieving the CAP goals.

[9] The 2017 modeshare 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.

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.

In 2017, the City constructed 6,800 linear feet of sidewalk, approximately 12 city blocks (one city block is about 600 ft.).

The bicycle facility improvements are shown in Table 18.

TABLE 20 BICYCLE FACILITIES IMPROVEMENTS AND ESTIMATED VMT REDUCTIONS SINCE 2013

Year	2013	2014	2015	2016	2017	Since 2013
New Class I Bike Lane Added					2.1	2.1
New Class II Bike Lane Miles Added	6.9	10.5	14.6	12.7	7.9	52.6
Existing Bike Lane Miles Improved	35.7	51.7	42.2	43.6	21.4	194.6
Existing Bike Lane Miles Replaced	1.3	1.6	-	-	-	2.9
Total Added or Improved Miles	43.9	63.8	56.8	56.8	31.4	252.7

Source: City of San Diego Transportation & Storm Water Department 2016-2018

Action & Progress: Roundabouts and Traffic Signal Re-timing

The city re-timed 70 traffic signals that led to reduced emissions from improvements to traffic flow and subsequent fuel reductions. Reductions from these measures are provided in Table 19.

TABLE 21 ROUNDABOUTS INSTALLED AND TRAFFIC SIGNALS RETIMED IN 2016 AND 2017

Year	2016	2017
Roundabouts Installed	2	0
Traffic Signals Retimed	60	70

Source: City of San Diego Transportation & Storm Water Department 2017 and 2018

STRATEGY 4: ZERO WASTE

In 2017, 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 2015-2017 waste disposed and diversion rates in the City are shown in Table 20. The waste diversion rate in 2017 was the same as in 2016 however the waste disposal increased by 3%.

TABLE 22 WASTE DIVERSION RATE AND DISPOSED TONNAGE

Year	2015	2016	2017
Waste Disposed in Landfills (tons)	1,583,833	1,521,363	1,576,105
Waste Diversion Rate (%)	64%	66%	66%

Tonnages were adjusted/corrected from tonnages reported in the CalRecycle database based on City information
Source: City of San Diego Environmental Service Department 2016-2018

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

Increasing urban tree canopy coverage in the city 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 FITURE 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 23 TREE PLANTING AND MAINTENANCE

CALENDAR YEAR 2017

Month	January to June	July	August	September	October	November	December	Totals
Trees Planted (Transportation Street Division)	Unavailable Data			115	39	53	100	**307**
Trees Trimmed (Street Division - Palms Trees)	Unavailable Data	2,472	7,623	2,593	1,798	-	2,726	**17,212**

In addition, 500 trees were planted in Spring 2017 under the CalFire Grant awarded previously. The City has also started to inventory over 58,000 trees and potential tree planting locations starting in 2017.

METHODOLOGY DIFFERENCES AND DATA REFINEMENT

The method differences and data refinement between previous 2016 and current GHG inventory calculations are given in Table 22, the differences include updated and more accurate data source, updated standards and protocols and etc.

TABLE 24 METHODOLOGY DIFFERENCES AND DATA REFINEMENT OF GHG INVENTORY

Category	Category Detail	2016 Inventory (Published in 2017 Annual Report)	2016 Revised Inventory	2017 Inventory
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 as well as City of San Diego as service address city	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code no longer including City of San Diego as service address city	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code no longer including City of San Diego as service address city
	Emission Factor (lbs CO_2e/MWh)	Created a weighted average emission factor based on SDG&E kWh procured from each fuel type at each facility/power plant and emission factor of electricity generation at each facility/power plant (EPA eGRID2014 v2 database specific plant level emission factor)	Created a weighted average emission factor based on SDG&E kWh procured from each fuel type at each facility/power plant and emission factor of electricity generation at each facility/power plant (EPA eGRID2016 database specific plant level emission factor)	Created a weighted average emission factor based on SDG&E kWh procured from each fuel type at each facility/power plant and emission factor of electricity generation at each facility/power plant (EPA eGRID2016 database specific plant level emission factor)
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 as well as City of San Diego as service address city	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code no longer including City of San Diego as service address city	Requested data from SDG&E by customer class, service provider, and rate schedule for customers with City of San Diego town code no longer including City of San Diego as service address city

TABLE 24 METHODOLOGY DIFFERENCES AND DATA REFINEMENT OF GHG INVENTORY				
Category	**Category Detail**	**2016 Inventory (Published in 2017 Annual Report)**	**2016 Revised Inventory**	**2017 Inventory**
	Emission Factor (MT CO_2e/therm)	Natural gas emission factor in California based on California Air Resources Board statewide inventory	Natural gas emission factor in California based on California Air Resources Board statewide inventory	Natural gas emission factor in California based on California Air Resources Board statewide inventory
Transportation	Activity (VMT)	Interpolated from 2014 and 2020 total City of San Diego VMT provided by SANDAG using Series 13 Activity Based Model 13.3.0	Applied 2012-2016 annual average VMT rate of increase from CalTrans Highway Performances Monitoring System (HPMS) data to 2012-2016 VMT estimates provided by SANDAG using Series 13 Activity Based Model 13.3.0	Applied 2012-2017 annual average VMT rate of increase from CalTrans Highway Performances Monitoring System (HPMS) data to 2012-2017 VMT estimates provided by SANDAG using Series 13 Activity Based Model 13.3.0
	Emission Factor (g CO_2e/mile)	2016 San Diego region emission rate per vehicle class from EMFAC2014, converted to average vehicle emission rate using VMT distribution by vehicle class	2016 San Diego region emission rate per vehicle class from EMFAC2017 with model default assumptions on vehicle mix, travel activities and etc.	2017 San Diego region emission rate per vehicle class from EMFAC2017 with model default assumptions on vehicle mix, travel activities and etc.
Water	Activity (gallons)	2016 potable and recycled water supplied to City of San Diego (water production) breakdown by wholesale water (from San Diego County Water Authority) and local water (surface and groundwater) Removed water purchased by Del Mar and CalAm service area as not in the City	2016 potable and recycled water supplied to City of San Diego (water production) breakdown by 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	2017 potable and recycled water supplied to City of San Diego (water production) breakdown by 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

TABLE 24 METHODOLOGY DIFFERENCES AND DATA REFINEMENT OF GHG INVENTORY				
Category	**Category Detail**	**2016 Inventory (Published in 2017 Annual Report)**	**2016 Revised Inventory**	**2017 Inventory**
	Emission Factor (energy intensity - kWh/gallon)	- local energy intensity based on 2016 water treatment plants and lake pump station 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; eGRID2014 California average (CAMX)	- local energy intensity based on 2016 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; eGRID2016 California average (CAMX)	- local energy intensity based on 2017 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; eGRID2016 California average (CAMX)
Wastewater	Activity (gallons)	Estimated based on 2016 total wastewater flow into Point Loma WWTP, South Bay WRP and North City WRP, and ratio of City of San Diego's share of total flow enters into Metropolitan Sewerage System Metropolitan Sewerage System	City of San Diego's 2016 annual average flow (MGD) enters into Metropolitan Sewerage System (include Point Loma WWTP, South Bay WRP and North City WRP)	City of San Diego's 2017 annual average flow (MGD) enters into Metropolitan Sewerage System (include Point Loma WWTP, South Bay WRP and North City WRP)
	Emission Factor (MT CO_2/gallon)	Calculated by dividing 2016 Point Loma WWTP and North City WRP GHG Emission reported in ARB MRR by 2015 Point Loma WWTP and North City WRP total flow	Calculated by dividing 2016 Point Loma WWTP and North City WRP GHG Emission reported in ARB MRR by 2015 Point Loma WWTP and North City WRP total flow	Calculated by dividing 2017 Point Loma WWTP and North City WRP GHG Emission reported in ARB MRR by 2015 Point Loma WWTP and North City WRP total flow

TABLE 24 METHODOLOGY DIFFERENCES AND DATA REFINEMENT OF GHG INVENTORY				
Category	**Category Detail**	**2016 Inventory (Published in 2017 Annual Report)**	**2016 Revised Inventory**	**2017 Inventory**
Solid Waste	Activity	2016 waste disposed tonnage provided by City of San Diego Environmental Services Department	2016 waste disposed tonnage provided by City of San Diego Environmental Services Department	2017 waste disposed tonnage provided by City of San Diego Environmental Services Department
	Emission Factor (MT CH_4/tons)	Emission factor for each waste component from EPA WARM Model 2016 version and waste components from City of San Diego waste characterization study 2012-2013	Emission factor for each waste component from EPA WARM Model 2016 version and waste components from City of San Diego waste characterization study 2012-2013	Emission factor for each waste component from EPA WARM Model 2016 version and waste components from City of San Diego waste characterization study 2012-2013

Analysis on Jobs

To objectively identify a baseline of jobs and trends associated with these five strategies, a qualitative review of industry reports associated with these sectors was conducted, as well as a quantitative analysis of job growth within associated industry sectors during 2010–15 with an update to job numbers between 2015 and 2016 and between 2016 and 2017.

Our quantitative analysis also included additional data due to the discrepancy in the number of industries included in each sector. The number of jobs per industry in each sector was calculated for comparison (Table 2) and is included in the strategy-by-strategy analysis below.

STRATEGY 1: ENERGY AND WATER EFFICIENT BUILDINGS

In San Diego, the energy and water efficiency sector is a priority for training and job growth. The City of San Diego ranked 13th for energy efficiency in the nation in 2016, which is a jump up from 27th place, according to the American Council for an Energy-Efficient Economy's biennial City Energy Efficiency Scorecard that ranks cities based on their comprehensive energy efficiency policies and programs.[10] In addition, according to the Energy Futures Initiative and National Association of State Energy Officials' 2018 Energy Employment By State report, California is ranked first out of all 50 states for energy efficiency jobs.[11]

According to the U.S. Census Bureau, during 2010–17, Energy and Water Efficient Buildings had the third highest increase in jobs at 15.1 percent. During 2016–17 there was an estimated decrease in the number of jobs, by 1.9 percent. In 2017, Energy and Water Efficient Buildings had the most jobs per industry at 3,415. Twenty industries were identified in this CAP sector, which included 540 occupations, the highest of the five CAP sectors. In 2017, this sector continued to have the highest amount of total jobs out of the five CAP sectors.

STRATEGY 2: CLEAN AND RENEWABLE ENERGY

The City of San Diego has committed to a 100% renewable electricity target in the next two decades.[12] San Diego ranks fourth in the nation for cleantech leadership as of 2017, moving down one place from 2016.[13] The ranking is based on four broad categories: green buildings, advanced transportation, climate and carbon management, and clean-tech investment, innovation and workforce. The San Diego Workforce Partnership Clean Energy Industry Overview indicates the clean energy industry in San Diego includes 10,107 businesses and 107,333 individual jobs in San Diego County.[14] Additionally, the Cleantech Industry Economic Impact Analysis conducted by the San Diego Regional Economic Development Corporation shows that the San Diego region's cleantech job concentration is 2.05 times the national job concentration in 2016.[15]

Per U.S. Census data, during 2010–17 Clean and Renewable Energy had an increase in the number of jobs of 2.5 percent. During 2016–17 Clean and Renewable Energy is estimated to have had the second most job growth with a 0.1 percent increase. In 2017, Clean and Renewable Energy had 1,264 jobs per industry. There were 21 industries identified, which included 412 occupations, the second highest of the five CAP sectors. In 2017, this sector continued to have the second highest total number of jobs out of the five CAP sectors.

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[10] The City Energy Efficiency Scorecard

[11] 2018 US Energy and Employment Report State Charts

[12] City of San Diego Climate Action Plan

[13] 2017 U.S. Clean Tech Leadership Index

[14] San Diego Workforce Partnership Clean Energy Labor Market Analysis

[15] The San Diego Regional Economic Development Corporation's Cleantech Industry Economic Impact Analysis, July 2017

STRATEGY 3: TRANSPORTATION

San Diego is a leading region in advanced vehicles, electric vehicles and electric vehicle infrastructure; smart charging infrastructure and employment is a crucial part of that planning. San Diego has significant advanced transportation cluster employment and sales revenue – making it a primed market for transportation and transit-oriented job growth in sales, manufacturing, logistics and repair/maintenance.[16]

Per U.S. Census data, during 2010–17, Transportation had the highest job growth out of the five CAP categories with an increase of 26.9 percent. During 2016–17, job growth is estimated to have increased by 1.7 percent. In 2017, Transportation had the lowest amount of jobs per industry of the five CAP sectors at 536. Furthermore, Transportation had 13 industries identified with the lowest amount of occupations assigned to the sector at 243 occupations. Transportation also had the lowest amount of total jobs in 2017.

STRATEGY 4: ZERO WASTE

Zero waste and waste diversion are proven as an effective method to reduce and curb landfill use. The City of San Diego has a Zero Waste Plan that is in action and it requires the city to achieve 75 percent waste diversion of discarded materials from landfills by 2020 and to achieve zero waste by 2040. The Zero Waste sector has a lot of job growth opportunity due to the amount of jobs needed to divert and reduce waste in innovative ways.

According to U.S. Census data, during 2010–17, Zero Waste had the second largest job growth at 18.6 percent. During 2016–17, the sector is estimated to have decreased by 0.7 percent. In 2017, Zero Waste had the second lowest amount of jobs per industry at 603. Furthermore, Zero Waste had the second lowest number of industries at 12 industries with 292 occupations. In 2017, it also had the second lowest amount of total jobs out of the five CAP sectors.

STRATEGY 5: CLIMATE RESILIENCY

Climate Resiliency encompasses programs that prepare the region for success as threats from climate change become a reality. From protecting the coast from the detriments of erosion to setting up tree-planting programs, climate resiliency is a critical component to help governments and companies shift the energy landscape to make the city more resilient. Jobs in climate resiliency are expected to grow as landscaping, infrastructure and city planning align with CAP goals.[17]

According to U.S. Census data, during 2010–17, jobs related to Climate Resiliency grew by 13.6 percent. However, during 2016–17 job growth is estimated to have decreased by 0.4 percent. In 2017, Climate Resiliency had the second highest number of jobs per industry at 2,044, but also the lowest number of industries identified at eight industries and 401 occupations. In 2017, the total number of jobs came in third out of the five CAP sectors.

[16] City of San Diego Climate Action Plan

[17] City of San Diego Climate Action Plan

QUALITATIVE SOURCES

The San Diego Regional Economic Development Corporation's Cleantech Industry Economic Impact Analysis

- This is Advanced Energy
- California's Golden Energy Efficiency Opportunity: Ramping up Success to Save Billions and Meet Climate Goals
- Regional Planning Unit Summary: Southern Border
- Small Businesses: Workforce Needs of Small Businesses in San Diego
- Priority Sectors: Workforce Initiatives in San Diego County
- City of San Diego Zero Waste Plan

QUANTITATIVE METHODS

Data source: Economic Modeling Specialists International (EMSI, 2018.3) www.economicmodeling.com
(EMSI data was provided by the San Diego Regional Economic Development Corporation)

Summary: EMSI identifies 1,001 industries within the San Diego Region. Seventy-four industries were categorized into five CAP sectors and grouped within EMSI. From those groups, EMSI output the jobs per occupations in the total of all the industries identified per CAP sector during 2010-17. These job totals were then used to identify the growth per CAP sector between 2010 and 2017. EMSI outputs <10 jobs for the occupations data, in order to process the data all <10 results were replaced with 10 jobs.

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 sector were identified (Table 1). No one industry was categorized into multiple CAP sectors. Overall, 74 industries were categorized into the five sectors; 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 sector industries were identified and then the individual jobs within these occupations were totaled for each year between 2010 and 2017.

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 and Current Employment Statistics.
(2) Non-QCEW employee 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, Non-employer 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.

Occupation Data: Emsi occupation employment data are based on final Emsi industry data and final Emsi staffing patterns.

TABLE 25 INDUSTRIES WITHIN EACH CAP SECTOR				
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 Installation Contractors	Sewage Treatment Facilities	Interurban and Rural Bus Transportation	Other Nonhazardous Waste Treatment and Disposal
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

TABLE 25 INDUSTRIES WITHIN EACH CAP SECTOR				
Energy and Water Efficient Buildings	**Clean and Renewable Energy**	**Climate Resiliency**	**Transportation**	**Zero Waste**
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			
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 26 NUMBER OF JOBS/INDUSTRY PER CAP SECTOR 2010 TO 2017					
	Energy and Water Efficient Buildings	**Clean and Renewable Energy**	**Climate Resiliency**	**Transportation**	**Zero Waste**
2010	2,968	1,233	1,799	422	509
2011	2,899	1,242	1,796	390	490
2012	2,956	1,224	1,848	432	497
2013	3,101	1,191	1,883	448	536
2014	3,183	1,155	1,969	468	569
2015	3,347	1,173	2,020	450	615
2016	3,480	1,263	2,051	527	608
2017	3,415	1,263	2,044	536	603

TABLE 27 NUMBER OF INDUSTRIES AND OCCUPATIONS PER CAP SECTOR					
	Energy and Water Efficient Buildings	**Clean and Renewable Energy**	**Climate Resiliency**	**Transportation**	**Zero Waste**
Industries	20	21	8	13	12
Occupations	540	412	401	243	292

TABLE 28 PERCENT CHANGE IN JOBS FROM 2010 TO 2017					
	Energy and Water Efficient Buildings	**Clean and Renewable Energy**	**Climate Resiliency**	**Transportation**	**Zero Waste**
2010–11	-2.32	0.67	-0.17	-7.62	-3.57
2011–12	1.96	-1.45	2.92	10.69	1.41
2012–13	4.92	-2.70	1.90	3.71	7.73
2013–14	2.64	-2.97	4.53	4.62	6.24
2014–15	5.13	1.53	2.60	-3.83	7.99
2015–16	3.98	7.67	1.57	17.03	-1.17
2016–17	-1.86	0.09	-0.38	1.66	-0.69
2010–17	15.1	2.5	13.6	26.9	18.6

Supplemental Documentation

CITY OF SAN DIEGO GREENHOUSE GAS EMISSIONS INVENTORY METHODOLOGY AND UPDATES

City of San Diego Greenhouse Gas Emissions Inventory Methodology and Updates

October 2018

Prepared for

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 USD 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 educating 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 estimate for the City of San Diego (referred to as San Diego or the City) in calendar years 2016 and 2017 and the methods used. This is a supplement to the City's Climate Action Plan (CAP) 2018 Annual Report and its appendix.

In preparation for the 2018 Annual Report and 2017 GHG emissions inventory, revisions and refinements were made to the 2016 GHG emissions presented in the previous 2017 CAP Annual Report[1] to reflect updated data supplied by agencies not managed by the City, and to ensure consistency with the 2017 GHG emissions estimates. This approach follows the approach used by the California Air Resources Board (CARB) when updating its California statewide inventory, and based on the Intergovernmental Panel on Climate Change (IPCC) recommendations to maintain a consistent time-series when developing GHG inventories.[2] Similarly, the 2017 GHG emissions reported in this document are subject to change when updated data and information become available in the following years.

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 2016 and 2017 GHG emissions inventory results summary;
- Section 4 provides the methods used to prepare each category of the inventory; and,
- Section 5 discusses the updates to the GHG emissions inventory since the 2017 CAP Annual Report.

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). The 100-year GWPs reported by the IPCC from the IPCC Fourth Assessment Report (AR4) are used to estimate GHG emissions and provided in Table 1.[3] 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 Climate Action Plan 2017 Annual Report and Appendix (2017), accessed August 15, 2018.
[2] California Air Resources Board (CARB): California Greenhouse Gas Emissions for 2000 to 2016. Trends of Emissions and Other Indicators, p. 16 Additional Information (2018), accessed August 15, 2018.
[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 a 20-year GWPs because the SLCP has greater climate impact in the near-term compared to the long-lived GHGs. CARB: Reduce Short-Lived Climate Pollutants in California, accessed August 15, 2018.

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

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

2.2 Categories of Emissions

The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol), developed by ICLEI USA, requires a minimum of five basic emissions-generating activities to be included in a Protocol-compliant community-scale GHG inventory.[5] These categories are: built environment (electricity and 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) and an emission factor (e.g., pounds of CO_2e per unit of electricity). For these categories, methods used in this inventory were based on the U.S. Community Protocol standard methods and modified with regional- or City-specific data when available.

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

2.3 Demographics

California Department of Finance publishes annual population and housing estimates for cities, counties, and the State.[6] The San Diego citywide population and housing estimates for 2016 and 2017 used in this inventory are provided in Table 2.[7]

Table 2 Population and Housing Estimates (San Diego, 2016 and 2017)

Year	Population Estimates	Housing Estimates (Units)	
		Total	Occupied
2016	1,387,362	530,303	502,780
2017	1,399,924	535,179	505,531
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, 2018			

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

[6] The Department of Finance's annual population and housing estimates include revised estimates for previous years and provisional (to be revised in future editions) estimates for the current year. The San Diego Association of Governments (SANDAG) also estimates and forecasts population and employment for all jurisdictions in the San Diego region, which is a preferred source for the local GHG emissions inventory development. However, SANDAG's 2017 population and housing estimates were not available as of August 2018.

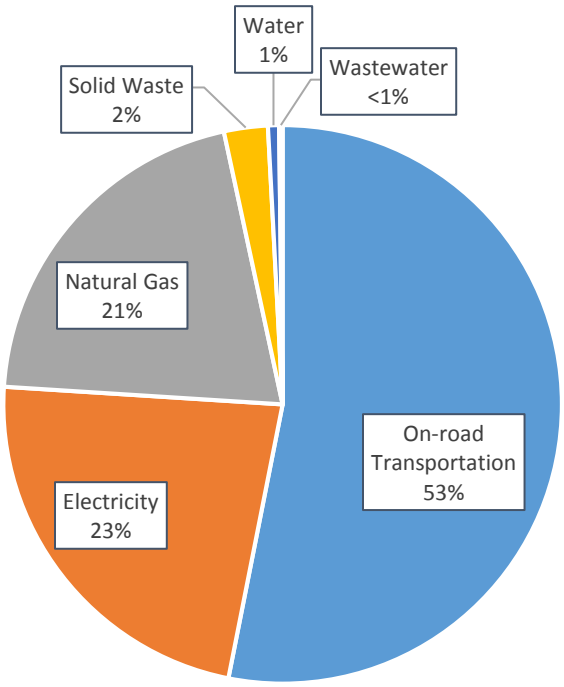
[7] California Department of Finance: E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2011-2018 (2018), accessed June 28, 2018.

2.4 Rounding of Values in Tables and Figures

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

3 SUMMARY OF 2017 GHG EMISSIONS INVENTORY

The total GHG emissions from San Diego in 2017 were estimated at 10.2 million metric tons CO_2e (MMT CO_2e), distributed into categories as shown in Figure 1.



Percentage may not add to totals due to rounding.
Energy Policy Initiatives Center, 2018

Figure 1 Breakdown of GHG Emissions in San Diego (2017)

The largest categories of emissions are on-road transportation, electricity, and natural gas, which represent most emissions. The totals and a breakdown of emissions by category for 2016 and 2017 are presented in Table 3.

Table 3 Total and Breakdown of GHG Emissions Estimates in San Diego (2016 and 2017)

Emissions Category	2016 GHG Emissions (MT CO_2e)	2017 GHG Emissions (MT CO_2e)
On-Road Transportation*	5,571,000	5,525,000
Electricity	2,203,000	2,187,000
Natural Gas	2,052,000	2,095,000
Solid Waste	255,000	264,000
Water	73,000	67,000
Wastewater	21,000	21,000
Total	**10,175,000**	**10,158,000**

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.
* Based on SANDAG's modeled vehicle miles traveled (VMT) estimates adjusted to account for regional VMT growth as reflected in the California Highway Performance Monitoring System.
Energy Policy Initiatives Center, 2018.

4 METHODS TO CALCULATE EMISSIONS INVENTORY

4.1 On-Road Transportation

The emissions associated with on-road transportation are calculated by multiplying the estimated City of San Diego vehicle miles traveled (VMT, the activity) and the average vehicle emission rate in the San Diego region in a given year.

4.1.1 Vehicle Miles Traveled (VMT)

Annual VMT were estimated based on the average weekday VMT data for the City provided by SANDAG using its activity-based model (ABM). [8] SANDAG provided estimates for 2012. The 2012 VMT provided the starting point for the 2015, 2016 and 2017 VMT values, which were estimated using annual VMT growth rates from California's public road data for the region derived from Highway Performance Monitoring System (HPMS)[9] as explained further, below.

SANDAG uses the ABM to support development of the Regional Transportation Plan (RTP) 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, and employment growth for the San Diego region. SANDAG updates the ABM with inputs from the Regional Growth Forecast and performs various model calibrations. Each Regional Growth Forecast is named a new Series. As of August 2018, the most recent forecast is the Series 13 2050 Regional Growth Forecast with a base year of 2012. SANDAG is in the process of the developing the next Series 14 VMT estimate with a base year of 2016 for the 2019 RTP, which is scheduled for SANDAG Board adoption in October 2019.

[8] SANDAG (2015): San Diego Forward: The Regional Plan. Appendix T Travel Demand Model Documentation.
[9] California Department of Transportation: Highway Performance Monitoring System (HPMS).

SANDAG allocates the VMT derived from the ABM to the City of San Diego using the Origin-Destination (O-D) method.[10] 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 2).[11]

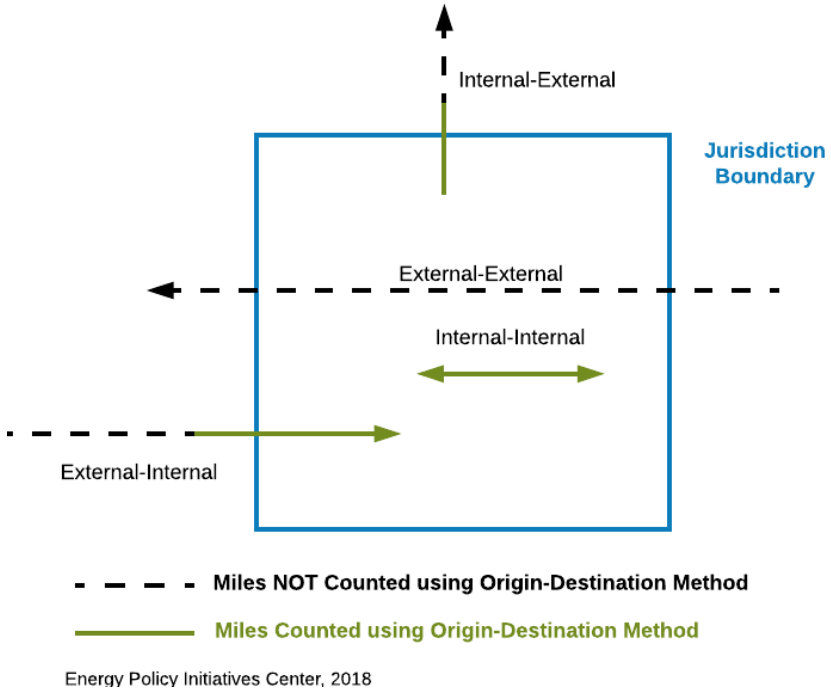


Figure 2 Components of O-D Method for VMT Calculation

O-D VMT allocated to San Diego include 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 the 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.[12]

The average weekday Series 13 O-D VMT estimates for each trip type in 2012 and 2014 provided by SANDAG and the total City VMT are given in Table 4.[13]

[10] SANDAG (2013): Vehicle Miles Traveled Calculation Using the SANDAG Regional Travel Demand Model. Technical White Paper.
[11] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix D: Transportation and Other Mobile Emission Activities and Sources.
[12] 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).
[13] Series 13 2012 (Base Year) and 2014 average weekday VMT estimates, and 2020 and 2035 VMT were provided by SANDAG (October 28, 2016). Original data tables provided by SANDAG are in Appendix A.

Table 4 O-D VMT Estimates by Trip Types and Total VMT (San Diego, 2012 and 2014)

Year	VMT by Trip Type (Miles/Weekday)			Total City VMT (100% * I-I + 50% * I-E/E-I) (Miles/Weekday)	Total City VMT (Miles/Year)
	Internal-Internal (I-I) Trips	External-Internal/Internal-External (I-E/E-I) Trips	External-External Trips (Information only, excluded from City VMT)*		
2012	20,973,735	28,234,954	2,957,344	35,091,212	12,176,650,491
2014	21,258,540	29,456,978	3,251,166	35,987,029	12,487,499,144

*Miles from External-External trips (pass-through trips) are the portion within the City boundary, not the entire trip.
Based on SANDAG Series 13 VMT estimates. 2012 is the Series 13 Base Year.
The conversion factor from miles/weekday to miles/year is 347.
SANDAG, 2016; Energy Policy Initiatives Center, 2018.

While the SANDAG ABM can provide projections starting from the Series base year up to 2050 for planning purposes, more current or dynamic monitoring of VMT at a regional level by other sources on an annual or quarterly basis indicate differences from the projected VMT as the amount of time from the starting base year increases. This inventory is for 2017, 5 years from the Series 13 base year 2012. To better reflect VMT changes since 2012 for the year 2017, the City of San Diego's O-D VMT were adjusted by annual rates of increase from 2012 to 2017 shown by the State public road VMT monitoring system (CalTrans HPMS). Annual Caltrans HPMS VMT for the San Diego region were used to estimate VMT growth rates for the region. The rates were applied to the City of San Diego 2012 Series 13 O-D VMT data as a reasonable approximation of VMT growth since 2012. 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 from 2012-2017 based on CalTrans HPMS data are given in Table 5.[14]

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

Year	San Diego Region Daily VMT (thousand miles/day)	Annual Rate of Increase (%)
2012	75,652	-
2013	77,035	1.8%
2014	77,484	0.6%
2015	77,951	0.6%
2016	79,622	2.1%
2017*	80,205	1.5%

*2017 CalTrans HPMS data were yet available as of August 2018. The 2017 VMT is expected at the end of 2018. Therefore the 2017 daily VMT were linearly projected from 2012-2016.
CalTrans, 2013-2018; Energy Policy Initiatives Center, 2018.

Using these annual rates of increase, the estimated 2016 and 2017 VMT for the City of San Diego are provided in Table 6. It is assumed that the 2012-2017 City of San Diego VMT growth follows the pattern

[14] California Department of Transportation: HPMS Data Library California Public Road Data 2012-2016, accessed March 28, 2018.

of the San Diego regional VMT growth shown in the CalTrans HPMS data. 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 EMFAC2017 developed by CARB.[15]

EMFAC2017 was run in the default activity mode to generate the total VMT and total vehicle GHG emissions for the San Diego region, including all vehicles model years, classes, and fuel types.[16] The average emission rates (g CO_2e/mile) were calculated by dividing the total vehicle GHG emissions by total VMT. This document assumes that the City of San Diego has the same distribution of vehicle types as the San Diego region. The 2016 and 2017 emission rates are provided in Table 6.

4.1.3 Total Emissions from On-Road Transportation

Total estimated VMT, average vehicle emission rates, and corresponding GHG emissions from the on-road transportation category for 2016 and 2017 are given in Table 6.

Table 6 VMT, Emission Rate, and GHG Emissions from the On-Road Transportation Category (San Diego, 2016 and 2017)

Year	Total VMT (Miles/year)	Average Vehicle Emission Rate (g CO_2e/mile)	GHG Emissions (MT CO_2e)
2016	12,815,646,188	435	5,571,000
2017	13,011,847,715	425	5,525,000
GHG emissions for each category are rounded to the nearest thousand. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, 2018.			

4.2 Electricity

Emissions from electricity in San Diego were estimated using the Built Environment (BE.2) method from the U.S. Community Protocol, by multiplying the electricity use (the activity) and the City-specific electricity emission factor in a given year.[17]

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).[18] 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 were

[15] CARB: EMission FACtors model, EMFAC2017 (2018).
[16] The EMFAC2017 v.1.0.2 was run by EPIC on March 20, 2018 using default activity mode (not custom activity mode). The outputs of the model run include 2000-2050 San Diego region (SANDAG area) total VMT (miles/day), CO_2e emissions (short tons/day), vehicle population and number of trips.
[17] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix C: Built Environment Emission Activities and Sources.
[18] 2015–2017 metered electricity sales were provided by SDG&E to EPIC (August 16, 2018).

then adjusted by 1) a loss factor[19] of 1.07[20] 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 (more detail provided in Section 4.5).

The adjusted net energy for load (electricity sales + losses) is provided in Table 7.

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 power mix of bundled power[21] and Direct Access (DA) power[22] in the City and their respective emission factors. The SDG&E bundled emission factors are calculated using Federal Energy Regulatory Commission (FERC) Form 1[23] data, the California Energy Commission (CEC) Power Source Disclosure Program[24] data on SDG&E-owned and purchased power, and U.S. EPA Emissions and Generating Resource Integrated Database (eGRID) 2016 Edition[25] on specific power plant emissions. The DA emission factor is based on California Public Utilities Commission (CPUC) Decision D.14-12-037.[26]

The differences in the City-specific electricity emission factors reflect the changes in the percentages of electricity sales to SDG&E bundled and DA customers, and the change in the electricity power mix in the City and in SDG&E's service territory. The City-specific electricity emission factors are provided in Table 7.

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 the years 2016 and 2017 are shown in Table 7.

[19] 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).
[20] 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.
[21] SDG&E bundled power includes the electricity from SDG&E-owned power plants and the electricity from its net procurements.
[22] The SDG&E Direct Access Program includes electricity that customers purchased from non-SDG&E electric service providers (ESPs), but SDG&E still provides transmission and distribution services.
[23] FERC: Form 1- Electricity Utility Annual Report, download date: July 20, 2015.
[24] CEC Power Source Disclosure Program under Senate Bill 1305. The SDG&E annual power source disclosure report (2016 and 2017) was provided by CEC staff to EPIC.
[25] U.S. EPA. eGRID 2016 Edition, released February 15, 2018, accessed June 29, 2018.
[26] 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).

Table 7 Net Energy for Load, Emission Factor and GHG Emissions from Electricity Category (San Diego, 2016 and 2017)

Year	Net Energy for Load (electricity sales + losses) (MWh)	City-Specific Emission Factor (lbs CO_2e/MWh)	GHG Emissions (MT CO_2e)
2016	8,357,105	581	2,203,000
2017	8,249,073	584	2,187,000
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 military. 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 to the nearest thousand. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, 2018.			

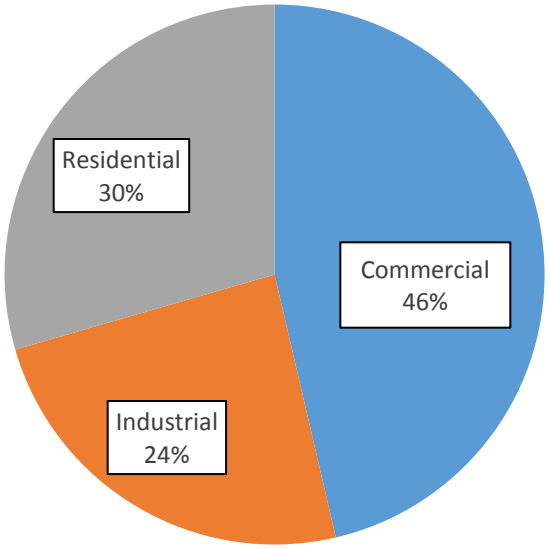
The net energy for load does not include self-serve renewable supply such as customer-owned behind-the-meter photovoltaic (PV) systems, or self-serve non-renewable supply. Electricity generation from behind-the-meter PV systems is considered renewable and assumed to have no associated GHG emissions. The newly installed and total behind-the-meter PV systems in the City for 2016 and 2017 and estimated solar generation are shown in Table 8.[27]

Table 8 Behind-the-meter PV Systems and Electricity Generation (San Diego, 2016 and 2017)

Year	New PV Systems		Cumulative PV Systems since 1999		Estimated Behind-the-meter Solar Generation (MWh)
	Number of Systems	Capacity (MW_{dc})	Number of Systems	Capacity (MW_{dc})	
2016	9,271	63	32,111	226	387,113
2017	5,920	48	38,031	271	468,206
The PV systems included here are those currently interconnected to the grid. Estimated electricity generation is converted from capacity using an average solar PV system capacity factor of 20% and an annual system degradation rate of 1%. California Distributed Generation Statistics, 2018; Energy Policy Initiatives Center, 2018.					

The emissions from the electricity category can be broken down further into residential, commercial and industrial customer classes. In 2017, 46% of the emissions were attributed to commercial electricity use, 30% were attributed to residential electricity use, and the rest were attributed to industrial electricity use, as shown in Figure 3.

[27] NEM Interconnection Data Set (current as of April 30, 2018), download date: June 9, 2018. Service cities include San Diego, La Jolla and San Ysidro. Based on the date of NEM interconnection applications approved and the Permission to Operate letters issued to the customers. Solar capacities are reported in direct current (DC). The 2010–2013 capacity is converted to DC from alternating current (AC), because the number of systems reported in AC and DC are inconsistent before 2014. Estimated electricity generation is converted from capacity using an average solar PV system capacity factor of 20% and an annual system degradation rate of 1%.



Energy Policy Initiatives Center, 2018

Figure 3 Electricity Emissions by Customer Class (San Diego, 2017)

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. [28]

4.3.1 Natural Gas Use

Annual natural gas sales were provided by SDG&E, broken down by residential, commercial and industrial customer class.[29] The natural gas sales data do not include the sales to San Diego County Regional Airport Authority, San Diego Unified Port District, and military. The natural gas uses are given in Table 9.

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.[30] The natural gas emission factors are given in Table 9.

4.3.3 Total Emissions from Natural Gas

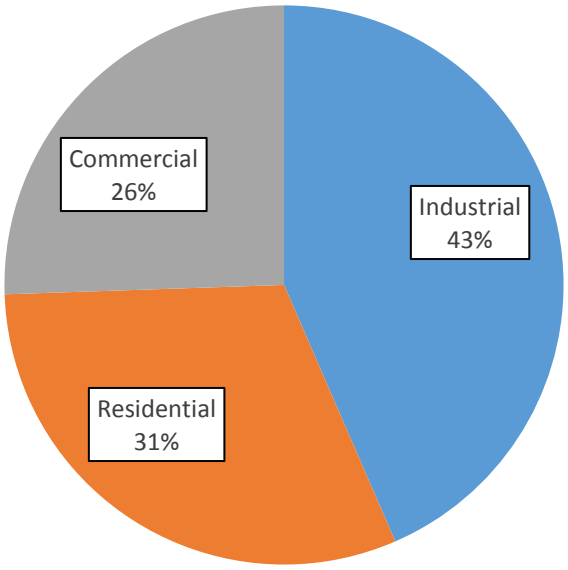
To estimate emissions from the combustion of natural gas, fuel use was multiplied by the emission factor. The total natural gas use and corresponding GHG emissions from the natural gas category for the years 2016 and 2017 are given in Table 9.

[28] ICLEI– Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix C: Built Environment Emission Activities and Sources.
[29] 2015–2017 metered natural gas sales were provided by SDG&E to EPIC (August 16, 2018).
[30] CARB: Documentation of California's GHG Inventory – Index.

Table 9 Natural Gas Use and GHG Emissions from Natural Gas Category (San Diego, 2016 and 2017)

Year	Natural Gas Use (Million Therms)	Natural Gas Emission Factor (Million MT CO_2e/Million Therms)	GHG Emissions (MT CO_2e)
2016	377	0.0545	2,052,000
2017	384	0.0545	2,095,000
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, 2018; Energy Policy Initiatives Center, 2018.			

The emissions from the natural gas category can be broken down further into residential, commercial and industrial customer classes. In 2017, 43% of the emissions were attributed to industrial electricity use, 31% were attributed to residential electricity use, and the rest were attributed to commercial electricity use as shown in Figure 4.



Energy Policy Initiatives Center, 2018

Figure 4 Natural Gas Emissions by Customer Class (San Diego, 2017)

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 a given year and an emission factor for mixed solid waste. [31]

[31] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix E: Solid Waste Emission Activities and Sources.

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.[32] The total and per-capita solid waste disposal are given in Table 11.[33]

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.[34] 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 mixed solid waste emission factor is given in Table 10.

Table 10 Mixed Solid Waste Emission Factor

Waste Component	Waste Distribution (%)[1]	Landfill Gas Emissions	
		CH_4 without Landfill Gas Recovery (MT CO_2e/short ton)	Source[2]
Paper	16.8%	-	-
Corrugated Containers/Cardboard	*5.0%*	2.36	Exhibit 3-27, WARM v14 Containers /Packaging
Newspaper	*0.8%*	0.95	Exhibit 3-27, WARM v14 Containers /Packaging
Magazine	*0.6%*	1.08	Exhibit 3-27, WARM v14 Containers /Packaging
Mixed Paper (general)	*10.4%*	2.14	Exhibit 3-27, WARM v14 Containers /Packaging
Plastic	8.9%	-	-
Glass	1.7%	-	-
Metal	3.5%	-	-
Organics	38.9%	-	-
Food	*15%*	1.57	Exhibit 1-49, WARM V14 Organic Materials
Tree	*5.3%*	0.77	Exhibit 2-11 WARM V14 Organic Materials
Leaves and Grass	*6.8%*	0.59	Exhibit 2-11 WARM V14 Organic Materials
Trimmings	*3.5%*	0.59	Exhibit 2-11 WARM V14 Organic Materials
Mixed Organics	*8.3%*	0.53	Exhibit 2-11 WARM V14 Organic Materials
Electronics	0.6%	-	-

[32] CalRecycle: Disposal Reporting System (DRS): Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility, accessed July 8, 2018.
[33] 2016 and 2017 waste disposal were provided by City of San Diego Environmental Services Department (August 2017 and July 2018).
[34] City of San Diego (2014): *Waste Characterization Study 2012–2013 Final Report*.

Waste Component	Waste Distribution (%)[1]	Landfill Gas Emissions	
		CH_4 without Landfill Gas Recovery (MT CO_2e/short ton)	Source[2]
Construction & Demolition	24.6%	-	-
Household Hazardous Waste	0.2%	-	-
Special Waste	3.1%	-	-
Mixed Residue	1.6%	0.53	
Mixed Waste Emission Factor		**0.744**	
Source: 1) City of San Diego 2014. 2) EPA Waste Reduction Model (WARM) Version 14 (2016)			

4.4.3 Total Emissions from Solid Waste

The mixed waste emission factor given in Table 10 is the emission factor without landfill gas collection at the landfills. The default capture rate of CH_4 emissions from landfills, 75%, is applied in the emissions calculation, based on the default rate in the U.S. Community Protocol. The total and per-capita solid waste disposal and the corresponding GHG emissions for the years 2016 and 2017 are given in Table 11.

Table 11 Solid Waste Disposal and GHG Emissions from Solid Waste Category (San Diego, 2016 and 2017)

Year	Solid Waste Disposed			GHG Emission Factor (MT CO_2e/Short Ton)	Oxidation Rate**	Total GHG Emissions (MT CO_2e)	Default CH_4 Capture Rate	Remaining Emissions (MT CO_2e)
	City-wide (Short Tons/Year)	City-wide (Metric Tons/Year)	Per Capita Solid Waste Disposal (kg/person/day) *					
2016	1,521,363	1,380,158	2.7	0.744	10%	1,018,965	75%	255,000
2017	1,576,105	1,429,819	2.8	0.744	10%	1,055,629	75%	264,000

GHG emissions for each category are rounded to the nearest hundred. Values are not rounded in the intermediary steps in the calculation.
* Informational, based on total waste disposal and population estimates (Table 2). Used in projections.
**Oxidation rate is the default amount of methane that is oxidized and not emitted, therefore only 90% of total methane emissions are emitted.
City of San Diego, 2014, 2017 and 2018; Energy Policy Initiatives Center, 2018.

4.4.4 Alternative Method to Estimate Emissions from Solid Waste (Not Reported in Inventory)

The Community Protocol recognizes that there is another method to estimate emissions from solid waste disposal that accounts for waste previously disposed of in landfills located within the City boundary. This method, which is similar to how landfills themselves report emissions, estimates the emissions in a given year from waste already in the landfill, including that disposed of in the current inventory year. The City of San Diego currently has two active landfills and four closed landfills within its boundary. In addition to including emissions from waste disposal by the city in total GHG emissions as one of the five basic emission-generating activities recommended by U.S. Community Protocol, emissions from in-boundary sources can be reported optionally. 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.

Using this method, for the landfills that are required to report GHG emissions through Environmental Protection Agency's Mandatory Greenhouse Gas Reporting Program (EPA MRR), the reported values can be used an emissions estimate. As of August 2018, the 2017 reported emissions are not available. For the landfills that are not subject to EPA MRR, emissions were calculated based on waste-in-place in the landfill and the Landfill Emissions Tool developed by CARB using the first order decay model recommended by the IPCC.[35] Emissions from in-boundary landfills cannot be compared with or directly added to emissions from solid waste disposed in the current year. This is because emissions from solid waste disposal are calculated to include the projected future GHG emissions associated the waste generated 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.

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

Table 12 Emissions from In-Boundary Landfills (Not Reported in GHG Inventory)

Landfill	Status	2016 Landfill Emissions (MT CO_2e)	2017 Landfill Emissions (MT CO_2e)	Source
West Miramar Sanitary Landfill	Active	215,143	n/a	EPA MRR
Sycamore Landfill	Active	82,018	n/a	EPA MRR
North Miramar Sanitary Landfill	Closed in 1983	2,522	n/a	EPA MRR
South Chollas Sanitary Landfill	Closed in 1981	n/a	n/a	Discontinued reporting to EPA MRR in 2015
Arizona Street Landfill	Closed in 1974	11,062	10,843	CARB Landfill Emission Tool (CARB LET) result using waste received before closing
Mission Bay Landfill #1	Closed in 1959	6,308	6,253	CARB LET result using operational period 1952-1959 and waste-in-place at the end of 1990
Total	-----	317,053	n/a	-

n/a = not available as of August 2018.
Landfill emissions reported in EPA MRR were estimated from methane recovery, destruction and other factors. The emissions may differ from modeled methane generation.
Source:
CARB; EPA, 2017; Energy Policy Initiatives Center, 2018.

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 shown in Figure 5. The energy required to move water is primarily electricity but may include natural gas or other fuels.

[35] CARB: Landfill Gas Tool v1.3, released on November 14, 2011, download date: May 19, 2016. The tool reports CO_2e of CH_4 using 21 as CH_4 GWP, recalculated using 25 as CH_4 GWP.

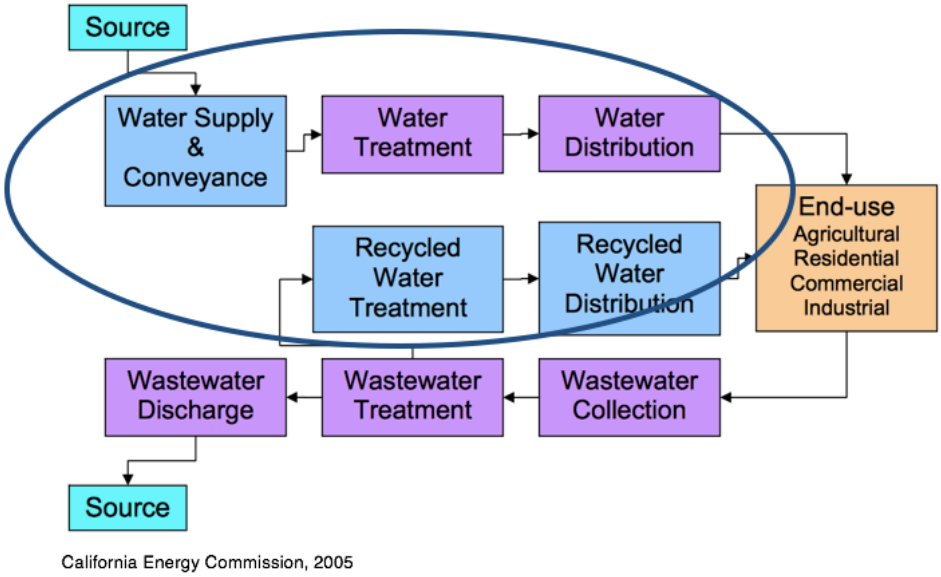


Figure 5 Segments of the Water Cycle

Emissions from water were estimated using the method Wastewater and Water (WW.14) from the U.S. Community Protocol.[36] Emissions associated with water end-use, such as water heating and cooling, are included in the electricity and natural gas category (Section 4.2 and Section 4.3), not in this water category, as data are not available to separate out those values.

4.5.1 Water Use

City of San Diego is one of the member agencies of the water wholesaler in the San Diego region, the San Diego County Water Authority (SDCWA). 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 and California American Water Company (CalAm).[37]

The potable water supply sources for 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.[38] 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.

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.[39]

[36] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix F: Wastewater and Water Emission Activities and Sources.
[37] 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).
[38] City of San Diego, 2015 Urban Water Management Plan, Section 6 System Water Supplies (2016).
[39] 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 in April 2017 and July 2018. Water sales to City of Del Mar is from the imported raw water treated in City of San Diego's WTPs. The water sales to CalAm (excluding CalAm's service area in City of San Diego's South Bay area) is from local water treated in WTPs. Recycled water was produced at the City's North City Water Reclamation Plant and provided to City customers only.

Table 13 Water Supplied and Supply Source (San Diego, 2016 and 2017)

Year	Potable Water Supplied					Recycled Water Supplied (Acre-Feet)
	Imported SDCWA Treated *	Imported SDCWA Untreated	Local Surface Reservoir	Local Groundwater Basin	Potable Water Supplied (Acre-Feet)	
2016	8%	84%	8%	0.3%	170,632	5,024
2017	12%	71%	16%	0.3%	164,226	5,189

Potable water supplied (acre-feet) is the City of San Diego's water production excluding sales to other water agencies in a given year.
* Desalinated water, about 9% of total SDCWA water since 2016, is considered imported treated water.
City of San Diego, 2017 and 2018. Energy Policy Initiatives Center, 2018.

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).[40]

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 is 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.

[40] 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, 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 water treatment plant (WTP). 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 with 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, 2016 and 2017)

Combined Miramar, Otay and Alvarado WTPs	CY2016	CY2017	Description
Water Treated (Acre-feet)	163,823	151,181	Total water treated at three WTPs
Total Treatment + Conveyance Energy Use (kWh)	11,168,268	14,260,711	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)	68	94	Total energy Intensity (total electricity divided by water treated)
Solar Production (kWh)	2,502,592	2,102,587	Annual electricity generated Alvarado and Otay on-site PV systems
Net Treatment + Conveyance Energy Use (kWh)	9,151,144	12,167,796	Net electricity purchase from the grid (SDG&E). Total electricity consumption minus solar production.
Net Treatment + Conveyance Energy Intensity (kWh/Acre-foot)	**56**	**80**	**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, 2017 and 2018. Energy Policy Initiatives Center, 2018.

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 intensities are given in Table 16.

Table 16 Local Water Distribution Energy Intensity (San Diego, 2016 and 2017)

Citywide Water Distribution	CY2016	CY2017	Description
Total Water Moved (Acre-feet)	177,684	171,287	Total City of San Diego water production from all water sources (including sales to other water agencies)
Distribution Pump Stations Energy Use (kWh)	20,819,977	25,498,820	Electricity use at water pump stations excluding lake pump stations
Water Distribution Energy Intensity (kWh/Acre-foot)	**117**	**149**	**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, 2017 and 2018. Energy Policy Initiatives Center, 2018.

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 both 2016 and 2017.[41] The intensity includes energy use for tertiary treatment at WRPs 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. [42] For local energy use, including potable water conveyance and treatment, distribution, and recycled water treatment and distribution, SDG&E bundled electricity emission factor is applied because SDG&E is the electricity supplier. The electricity emission factors are given in Table 17.

Table 17 Electricity Emission Factors for Water-Energy Intensities

Year	Electricity Emission Factors for Water-Energy Intensities (lbs CO_2e/MWh)	
	Upstream (Average California)	Local (SDG&E)
2016	530	527
2017		531
EPA, 2018; Energy Policy Initiatives Center, 2018.		

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.

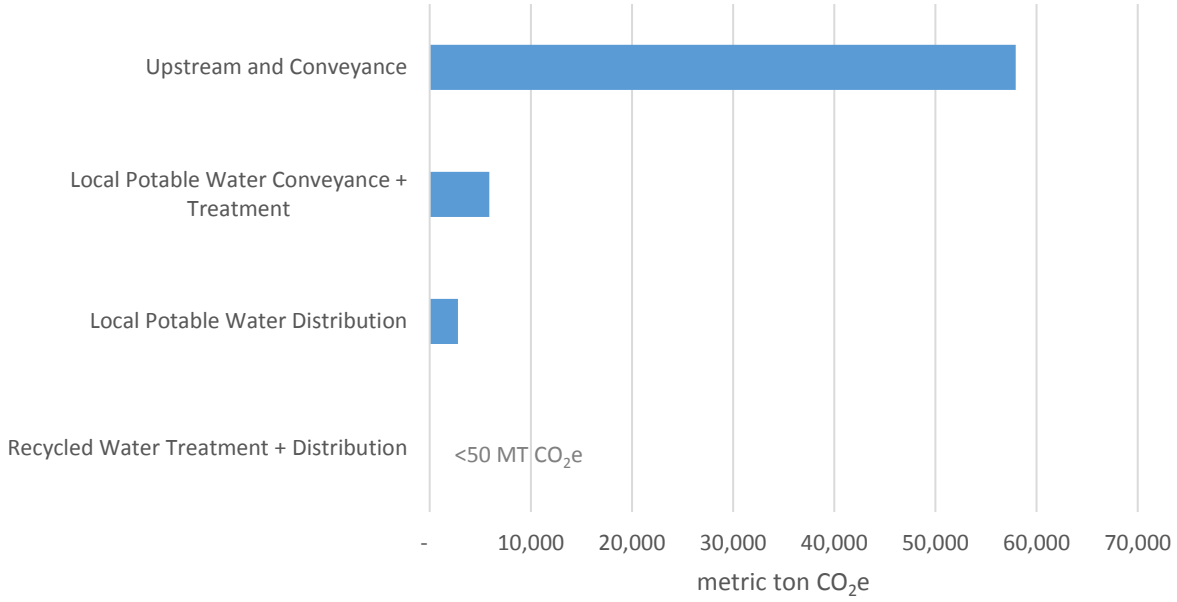
For local conveyance and treatment emissions, the volume of water treated at three WTPs and delivered within the City (excluding sales to other agencies) was multiplied by the net water treatment energy intensity (Table 15) and local SDG&E's electricity emission factor (Table 17). Because WTPs are located 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 SDG&E's 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.

[41] City of San Diego, 2015 Urban Water Management Plan, Table 10-4 Energy Intensity for Wastewater and Recycled Water.
[42] The Western Electricity Coordinating Council (WECC) CAMX (eGRID Subregion) emission rate (530 lbs CO_2e/MWh) from eGRID was used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID 2016 Edition. Released February 15, 2018, accessed June 29, 2018.

For recycled water treatment and distribution emissions, total recycled water supplied was multiplied by the recycled water energy intensity (38 kWh/Acre-foot) and local SDG&E's 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.

In 2017, 87% of the GHG emissions in the water category were from upstream supply and conveyance. The breakdown of emissions for the water category is given in Figure 6.



Energy Policy Initiatives Center, 2018

Figure 6 Emissions from the Water Category by Water System Segment (San Diego, 2017)

The total potable and recycled water supplied and the corresponding GHG emissions from the water category for 2016 and 2017 are given Table 18.

Table 18 Water Supplied and GHG Emissions from the Water Category (San Diego, 2016 and 2017)

Year	Potable Water Supplied (Acre-Feet)	Recycled Water Supplied (Acre-Feet)	GHG Emissions (MT CO_2e)
2016	170,631	5,024	73,000
2017	164,226	5,189	67,000
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, 2018.			

4.6 Wastewater

The emissions from wastewater generated by San Diego were estimated by multiplying the total amount of wastewater generated in a given year 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 "*process, stationary and fugitive GHG emissions,*" as described in U.S Community Protocol 'WW.1 – WW.14.'[43]

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 the and 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.[44]

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, 2016 and 2017)

Year	% of Wastewater Treated at Each WWTP			Wastewater Flow to Metro System	
	Point Loma WWTP	South Bay WRP	North City WRP	Average Million Gallon per Day (MGD)	Million Gallon per Year
2016	85%	5%	10%	101	36,719
2017	86%	5%	10%	103	37,632

WWTP – wastewater treatment plant; WRP – water reclamation plant.
City of San Diego, 2017 and 2018. Energy Policy Initiatives Center, 2018.

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.[45] 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 from 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 gallon) at Point Loma WWTP and North City WRF are calculated by dividing the reported GHG emissions by the plants' wastewater flows, as shown in Table 20.[46]

[43] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix F: Wastewater and Water Emission Activities and Sources.
[44] 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.
[45] CARB: Mandatory GHG Reporting – Reported Emissions. CARB MRR uses 21 as CH_4 GWP, CO_2e of CH_4 is recalculated using 25 as CH_4 GWP to be consistent with other categories in the inventory.
[46] Point Loma WWTP and North City WRP GHG Reports and the wastewater flow into each facility are provided by City of San Diego in August 2017 and July 2018.

Table 20 Emission Factors at Wastewater Treatment Plant (San Diego, 2016 and 2017)

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)
2016	48,834	22,584	0.46	5,756	7,283	1.27
2017	51,027	22,102	0.43	5,749	7,434	1.29

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.
City of San Diego, 2017 and 2018. Energy Policy Initiatives Center, 2018.

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.[47]

Table 21 Wastewater Generated and GHG Emissions from Wastewater Category (San Diego, 2016 and 2017)

Year	Total Wastewater Generated (Million Gallons/year)	Wastewater Emission Factor (MT CO_2e/ Million Gallon)	GHG Emissions (MT CO_2e)
2016	36,719	0.58	21,000
2017	37,632	0.56	21,000

GHG emissions for each category are rounded to the nearest thousand. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

5 INVENTORY UPDATES

In preparing the 2018 CAP Annual Report and 2017 GHG emissions inventory, revisions and refinements were made to the 2016 GHG emissions presented in the previous 2017 CAP Annual Report to reflect updated data supplied by agencies not managed by the City, and to ensure consistency with the 2017 GHG emissions estimates. This section provides descriptions of the inventory updates since the 2017 CAP Annual Report.

This approach to update inventories follows the procedures used by CARB for the California statewide inventory, and is based on IPCC recommendations to maintain a consistent time-series when developing GHG inventories.[48] CARB publishes annually a supplement summarizing GHG inventory revisions along with the statewide GHG inventory.[49]

[47] 2010–2016 wastewater (million gallons per day) flow from San Diego to the Metropolitan Sewerage System were provided by the City of San Diego through a Public Records Request in July 2017 and converted to million gallons per year.
[48] CARB: California Greenhouse Gas Emissions for 2000 to 2016. Trends of Emissions and Other Indicators, p. 16. Additional Information (2018), accessed August 15, 2018.
[49] CARB: 2000-2016 Inventory Updates Documentation (2018), accessed August 15, 2018.

5.1 On-Road Transportation: Vehicle Miles Traveled Adjustment

In this inventory update, VMT were estimated based on the Series 13 2012 average weekday VMT data provided by SANDAG. VMT estimates for 2012-2017 were derived by applying the San Diego region's annual rates of VMT increase from CalTrans HPMS public road data to the SANDAG Series 13 2012 VMT estimate.

Previously, no adjustments were made to City of San Diego VMT provided by SANDAG, except to convert average weekday VMT to average annual VMT. In the past, 2016 VMT were developed by interpolating linearly between the 2014 VMT provided by SANDAG (Series 13 estimates) and the 2020 VMT projection provided by SANDAG (Series 13 forecast), which are based on the transportation network scenarios adopted in San Diego Forward: The 2015 Regional Plan. [50]

The conversion factor between average weekday VMT and average annual VMT is also updated to 347 weekdays per year from 350 weekdays per year, to reflect a more recent data source used in the California statewide GHG inventory.[51] This adjustment is consistent with the SANDAG Regional Climate Planning Framework (SANDAG ReCAP) methodology.[52]

As the result of these two adjustments, the 2016 annual average VMT reported in this document is less than 1% higher than the 2016 annual average VMT reported in the 2017 CAP Annual Report appendix.

SANDAG is in the process of the developing the next Series 14 VMT estimate with a base year of 2016 for the 2019 RTP, which is scheduled for SANDAG Board adoption in October 2019. The 2016 and 2017 VMT estimates will be updated once the Series 14 VMT become available.

5.2 On-Road Transportation: Updated EMFAC Model

CARB released the latest on-road transportation emissions model EMFAC2017 in December 2017, replacing the previous version EMFAC2014. Previous City of San Diego 2015 and 2016 inventories were developed using vehicle emission rates derived from EMFAC2014.

The EMFAC2017 model incorporates an updated vehicle fleet mix, vehicle travel activities, and better tailpipe emissions testing data. Historical data has been used through year 2016. In addition, for the first time, the output includes a GHG module with CO_2, CH_4, and N_2O emissions and emission rates.[53] The previous EMFAC2014 model output only included a CO_2 emissions and emission rate. In order to account for total GHG emissions as the sum of CO_2, CH_4, and N_2O, an off-model adjustment had to be made in previous inventories.[54] This adjustment is no longer needed.

[50] San Diego Forward: The 2015 Regional Plan was adopted by the SANDAG Board of Directors on October 9, 2015.
[51] 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).
[52] SANDAG Regional Climate Action Planning Framework (ReCAP). Technical Appendix I: Section 3.5 (2018), accessed August 17, 2018.
[53] CARB:EMFAC2017 Volume III – Technical Documentation Section 1.3 New Features (2018), accessed August 16, 2018.
[54] Previously, the conversion factor, 1.01, was calculated based on the ratio of CO_2 emissions to total GHG emissions (CO_2, CH_4 and N_2O expressed as CO_2e) using methods from EPA GHG Equivalencies Calculations and References. Emissions were from mobile fossil fuel combustion in the transportation end-use category in 2013 (the latest available data year), on-road emissions. EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013* (2015), Table 3-12 to 3-14.

As the result of the EMFAC model updates, the San Diego regional average vehicle emission rates (g CO_2e/mile) in EMFAC2017 for 2011-2017 are lower than those in EMFAC2014 (Table 22).[55] On average, the emission rates for the same years in EMFAC2017 are approximately 3% lower than in EMFAC2014.

Table 22 Average Vehicle Emission Rates Comparison (EMFAC2014 and EMFAC2017)

Year	San Diego Regional Average Vehicle Emission Rates (g CO_2e/mile)		Percent Difference Between EMFAC Models
	Based on EMFAC2014*	Based on EMFAC2017	
2010	489	488	-0.2%
2011	489	480	-1.8%
2012	483	472	-2.3%
2013	476	461	-3.1%
2014	467	451	-3.6%
2015	458	442	-3.5%
2016	446	435	-2.6%
2017	434	425	-2.3%

*Off-model adjustment was made to convert g CO_2/mile EMFAC2014 output to g CO_2e/mile
CARB 2015, 2017; Energy Policy Initiatives Center, 2018.

CARB updates the EMFAC model every three to four years. 2017 is not a historical year in the EMFAC2017 model. The 2017 average vehicle emission rate may be adjusted again with new vehicle fleet characteristics, travel activities and emissions testing data once CARB makes a new update to the EMFAC model.

5.3 Electricity: Updated Electricity Emission Factor

EPA released the 2016 edition of the electric power generation emissions database eGRID (eGRID2016) in February 2018, with the latest 2016 emissions from specific power plants.[56] eGRID2016 is used to develop emission factors for the power plants from which SDG&E purchased electricity in 2016 and 2017.

In the previous 2016 GHG emissions inventory, the previous 2014 edition of eGRID (with 2014 as the latest data year) was used to develop power plant emission factors from 2014 to 2016. The change in the estimated SDG&E electricity emission factor is less than 1% due to the eGRID version updates, therefore, does not materially affect the emissions calculation.

EPA updates eGRID every two to three years. The 2017 electricity emission factor was estimated based on the 2016 data from eGRID2016, which may be updated once a new edition of eGRID becomes available.

[55] 2010-2016 are historical years in EMFAC2017 model with actual vehicle registration data from California Department of Motor Vehicles (DMV) that reflects most recent vehicle fleet characteristics in California. In EMFAC2014 the most recent actual data from the DMV were for year 2012. In both model versions, 2017 is not a historical year. The 2017 and onward emissions profile may be adjusted again with new vehicle fleet characteristics, travel activities and emissions testing data once CARB makes a new update to the EMFAC model. EMFAC2017 Volume III – Technical Documentation Section 1.4 Overview of Changes Associated with This Update (2018), accessed August 17, 2018.
[56] U.S. EPA. eGRID 2016 Edition, released February 15, 2018, accessed June 29, 2018.

5.4 Electricity and Natural Gas: Updated Energy Data Request

Since the development of the 2015 City of San Diego emissions inventory (2016 CAP Annual Report), based on a recommendation by SDG&E, EPIC has updated the way it requests the City of San Diego electricity and natural gas data needed to calculate GHG emissions from electricity and natural gas use. Previous data requests, including for 2016 energy data (requested in 2017), used a combination of town code and service address to define the jurisdictional boundary of a city. That is, only energy associated with meters or accounts for which the City of San Diego was both the service address city and the town code was included. It was determined that this approach could be restrictive and inadvertently exclude entities with an account in the City of San Diego but a service address in another jurisdiction.

Further, during the development of the SANDAG ReCAP (2018), SDG&E indicated that the service address city is similar to the Postal Service's definition of "city", which can differ from the actual jurisdiction boundary; therefore, for purposes of estimating total energy use, it is more accurate to use only the town code to determine the geographical boundary of the City. As a result, the data request for City of San Diego's 2017 energy data used the "two-digit town code to determine the City of San Diego" jurisdictional boundary. In order to include more accurate data, to be consistent with the SANDAG ReCAP inventory methodology, and to facilitate comparison across years, 2015 and 2016 energy data were requested again using the same criteria (town code only) as for 2017 energy data.

Both the data requests made in 2017 and 2018 also include the request to separate out the following entities' electricity and natural gas use:

- San Diego County Regional Airport Authority (referred to as San Diego International Airport in 2017 data request);
- San Diego Unified Port District (referred to as Port of San Diego in 2017 data request); and
- Military (referred to as U.S. military, navy and air force in 2017 data request).

The 2018 data request also includes the request to provide the sum of "exclusion" category. For the 2017 data request, the "exclusion" category was not part of the request, and was therefore not provided.

5.5 Water: Updated Electricity Emission Factor for Water-Energy Intensity

Similar to Section 5.3, the 2016 SDG&E electricity emission factor and California average emission factor have been updated to reflect the latest eGRID2016. In the previous 2016 GHG emissions inventory, the California average emission factor, 653 lbs CO_2e/MWh, the latest year with data available from eGRID2014 was used to convert the upstream energy use to GHG emissions. The latest 2016 California average electricity emission factor is 530 lbs CO_2e/MWh based on eGRID2016, 19% lower than the 2014 California average electricity emission factor. Because the majority of the emissions from water are from upstream water supply and conveyance, as the result of the update, the 2016 emissions from water reported in this document are 17% lower than the 2016 estimate reported in the 2017 CAP Annual Report appendix.

EPA updates eGRID every two to three years. The 2017 electricity emission factor was estimated based on the 2016 data from eGRID2016, which may be updated once a new edition of eGRID becomes available.

5.6 Wastewater: City's Wastewater Flow

In the previous 2016 GHG emissions inventory, the City of San Diego's wastewater flow was estimated based on 2016 total wastewater flow into the Metro System (including City of San Diego and other partner

agencies), and fiscal year 2016's ratio of City of San Diego's share of total flow enters into Metropolitan Sewerage System. In this inventory update, the actual calendar year 2016 and 2017 City of San Diego's wastewater flow were provided, therefore, no estimation was needed.

Appendix A. SAN DIEGO VMT BY TRIP TYPE

Average weekday VMT data tables were provided by SANDAG (from SANDAG ABM Series 13, Release 13.3.0). Emphasis (red squares and text) was added by EPIC. Revenue Constrained refers to the transportation network scenario adopted in San Diego Forward: The 2015 Regional Plan.[57]

2012 (576)

JURISDICTION	TOTAL VMT	TOTAL City of San Diego VMT	Two Trip End City of San Diego VMT	One Trip End City of San Diego VMT	NON-City of San Diego VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,112,152	776,837	-	776,837	2,335,315
CHULA VISTA TOTAL	3,516,790	1,713,977	-	1,713,977	1,802,813
CORONADO TOTAL	403,272	256,267	-	256,267	147,005
DEL MAR TOTAL	77,408	53,724	-	53,724	23,684
EL CAJON TOTAL	1,895,381	731,410	-	731,410	1,163,971
ENCINITAS TOTAL	1,798,580	940,100	-	940,100	858,480
ESCONDIDO TOTAL	2,644,325	977,141	-	977,141	1,667,184
External TOTAL	173,565	80,934	-	80,934	92,631
IMPERIAL BEACH TOTAL	92,302	44,174	-	44,174	48,128
LA MESA TOTAL	1,529,813	977,973	-	977,973	551,840
LEMON GROVE TOTAL	790,802	494,265	-	494,265	296,537
NATIONAL CITY TOTAL	1,545,814	1,133,425	-	1,133,425	412,389
OCEANSIDE TOTAL	2,675,329	319,773	-	319,773	2,355,556
POWAY TOTAL	868,020	493,398	-	493,398	374,622
SAN DIEGO TOTAL	36,928,711	33,971,367	20,973,735	12,997,632	2,957,344
SAN MARCOS TOTAL	1,838,277	249,195	-	249,195	1,589,082
SANTEE TOTAL	947,195	466,082	-	466,082	481,113
SOLANA BEACH TOTAL	603,987	439,718	-	439,718	164,269
Unincorporated TOTAL	16,372,880	4,986,633	-	4,986,633	11,386,247
VISTA TOTAL	1,610,610	102,296	-	102,296	1,508,314
REGIONWIDE TOTAL	79,425,213	49,208,689	20,973,735	28,234,954	30,216,524

Figure A-1 Estimated San Diego 2012 VMT by Trip Type

2014 (554)

JURISDICTION	TOTAL VMT	TOTAL City of San Diego VMT	Two Trip End City of San Diego VMT	One Trip End City of San Diego VMT	NON-City of San Diego VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,203,491	821,050	-	821,050	2,382,441
CHULA VISTA TOTAL	3,692,961	1,767,823	-	1,767,823	1,925,138
CORONADO TOTAL	411,735	261,076	-	261,076	150,659
DEL MAR TOTAL	78,339	54,708	-	54,708	23,631
EL CAJON TOTAL	1,995,801	753,648	-	753,648	1,242,153
ENCINITAS TOTAL	1,847,344	969,706	-	969,706	877,638
ESCONDIDO TOTAL	2,773,377	1,061,151	-	1,061,151	1,712,226
External TOTAL	207,246	96,674	-	96,674	110,572
IMPERIAL BEACH TOTAL	92,994	45,391	-	45,391	47,603
LA MESA TOTAL	1,574,971	997,628	-	997,628	577,343
LEMON GROVE TOTAL	826,372	511,503	-	511,503	314,869
NATIONAL CITY TOTAL	1,587,711	1,155,762	-	1,155,762	431,949
OCEANSIDE TOTAL	2,812,768	349,286	-	349,286	2,463,482
POWAY TOTAL	875,032	500,757	-	500,757	374,275
SAN DIEGO TOTAL	37,907,330	34,656,164	21,258,540	13,397,624	3,251,166
SAN MARCOS TOTAL	1,896,887	258,902	-	258,902	1,637,985
SANTEE TOTAL	973,960	470,101	-	470,101	503,859
SOLANA BEACH TOTAL	623,215	449,952	-	449,952	173,263
Unincorporated TOTAL	17,593,148	5,424,990	-	5,424,990	12,168,158
VISTA TOTAL	1,667,845	109,246	-	109,246	1,558,599
REGIONWIDE TOTAL	82,642,527	50,715,518	21,258,540	29,456,978	31,927,009

Figure A-2 Estimated San Diego 2014 VMT by Trip Type

[57] San Diego Forward: The 2015 Regional Plan was adopted by the SANDAG Board of Directors on October 9, 2015.

2020 Revenue Constrained

JURISDICTION	TOTAL VMT	TOTAL City of San Diego VMT	Two Trip End City of San Diego VMT	One Trip End City of San Diego VMT	NON-City of San Diego VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E-E
CARLSBAD TOTAL	3,201,740	753,392	-	753,392	2,448,348
CHULA VISTA TOTAL	3,891,300	1,823,469	-	1,823,469	2,067,831
CORONADO TOTAL	412,765	265,460	-	265,460	147,305
DEL MAR TOTAL	75,200	53,633	-	53,633	21,567
EL CAJON TOTAL	1,999,464	757,419	-	757,419	1,242,045
ENCINITAS TOTAL	1,758,265	922,481	-	922,481	835,784
ESCONDIDO TOTAL	2,800,471	1,030,254	-	1,030,254	1,770,217
External TOTAL	175,542	75,423	-	75,423	100,119
IMPERIAL BEACH TOTAL	91,846	44,030	-	44,030	47,816
LA MESA TOTAL	1,599,582	1,008,187	-	1,008,187	591,395
LEMON GROVE TOTAL	819,429	510,757	-	510,757	308,672
NATIONAL CITY TOTAL	1,620,325	1,178,665	-	1,178,665	441,660
OCEANSIDE TOTAL	2,835,226	347,447	-	347,447	2,487,779
POWAY TOTAL	925,981	526,772	-	526,772	399,209
SAN DIEGO TOTAL	38,819,499	35,653,323	22,196,692	13,456,631	3,166,176
SAN MARCOS TOTAL	1,958,332	251,405	-	251,405	1,706,927
SANTEE TOTAL	1,019,014	498,934	-	498,934	520,080
SOLANA BEACH TOTAL	618,370	450,978	-	450,978	167,392
Unincorporated TOTAL	17,403,643	5,368,916	-	5,368,916	12,034,727
VISTA TOTAL	1,666,369	102,031	-	102,031	1,564,338
REGIONWIDE TOTAL	83,692,363	51,622,976	22,196,692	29,426,284	32,069,387

Figure A-3 Estimated San Diego 2020 VMT by Trip Type