City of South Pasadena

Greenhouse Gas Emission Inventory

prepared for

City of South Pasadena
1414 Mission Street
South Pasadena, California 91030
Contact: Arpy Kasparian

prepared with the assistance of

Rincon Consultants, Inc.
250 East 1st Street Suite 301
Los Angeles, California 90012

October 2019

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Table of Contents

Table

Figures

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1 Executive Summary

A greenhouse gas (GHG) emissions inventory identifies the major sources and quantities of GHG emissions produced by City government (municipal) operations and community-wide activities within a jurisdiction's boundaries for a given year. Estimating GHG emissions enables local governments to establish an emissions baseline, track emissions trends, identify the greatest sources of GHG emissions within their jurisdiction, and set targets for future reductions.

This document includes a 2016 baseline inventory of GHG emissions from municipal operations and community-wide activities within the City. It is important to note that the municipal operations inventory is a subset of the community inventory, meaning that the municipal emissions are included within the community-wide inventory.

The inventories are divided into four sectors, or sources of emissions: energy (electricity and natural gas), transportation, solid waste, and water consumption. Like all GHG emissions inventories, this document must rely on the best available data and calculation methodologies. Emissions estimates were calculated using the International Council for Local Environmental Initiatives (ICLEI) methodologies, specifically, the U.S. Community Protocol for Acounting and Reporting Greenhouse Gas Emissions Version 1.2 (Community) is used for community-wide emissions and the Local Government Operations Protocol Version 1.1 (LGOP) is used for municipal emissions. Emissions estimates are subject to change as better data and calculation methodologies become available in the future. Nevertheless, the findings of this analysis provide a solid basis upon which South Pasadena can begin planning and acting to reduce its GHG emissions.

1.1 Municipal Inventory Results

In 2016, the City of South Pasadena's GHG emissions associated with municipal operations totaled 2,755 metric tons of carbon dioxide equivalents (MT of CO_2e).[1] As shown in Figure 1 and Table 1, emissions from the City's energy use were the largest sector (1,613 MT of CO_2e, or 59 percent). The second largest source of emissions (584 MT of CO_2e, or 21 percent) was waste generated by municipal employees and facilities. Transportation associated with the City fleet and employee commuting generated emissions equivalent to 539 MT of CO_2e, or 20 percent. The remaining municipal emissions (19 MT of CO_2e) were from water use and wastewater generation by the City's operations.

[1] According to the United States Environmental Protection Agency (USEPA), "the unit "CO_2e" represents an amount of a GHG whose atmospheric impact has been standardized to that of one-unit mass of carbon dioxide (CO_2), based on the global warming potential (GWP) of the gas." USEPA. October 2014. Pollution Prevention Greenhouse Gas (GHG) Calculator Guidance. https://www.epa.gov/sites/production/files/2014-12/documents/ghgcalculatorhelp.pdf

Figure 1 2016 Municipal Emissions by Sector

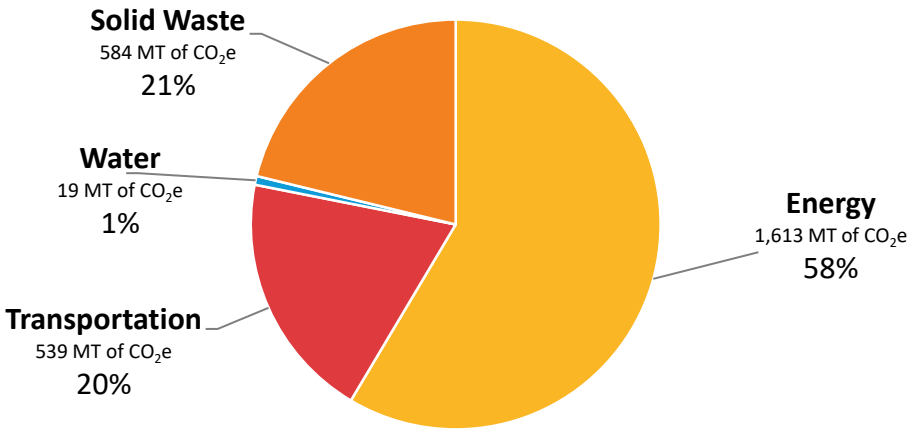

Table 1 Baseline Municipal Emissions Summary by Sector

Sector	GHG Emissions (MT of CO_2e)[1]	Percent of Total Emissions
Energy	**1,613**	**59**
Electricity	1,504	55
Natural Gas	109	4
Transportation	**539**	**20**
Vehicle Fleet	173	6
Employee Commute	366	13
Water and Wastewater	**19**	**1**
Solid Waste	**584**	**21**
Total	**2,755**	**100 %**

MT: Metric tons

1. Emissions have been rounded and therefore sums may not match.

Source: Emissions were calculated following ICLEI LGOP (May 2010) and using data provided and approved by the City.

1.2 Community-wide Inventory Results

In 2016, the South Pasadena community emitted approximately 125,269 MT of CO_2e. As shown in Figure 2 and Table 2, the transportation sector was the largest source of emissions, generating approximately 67,228 MT of CO_2e, or 54 percent of total 2016 emissions. Electricity and natural gas consumption within the residential and commercial sectors were the second largest source of 2016 emissions, generating 49,301 MT of CO_2e, or 39 percent of the total. Waste generation, including processing and transportation resulted in six percent of the City's emissions, while water use, and wastewater generation resulted in the remaining one percent.

Figure 2 2016 Community-wide Emissions by Sector

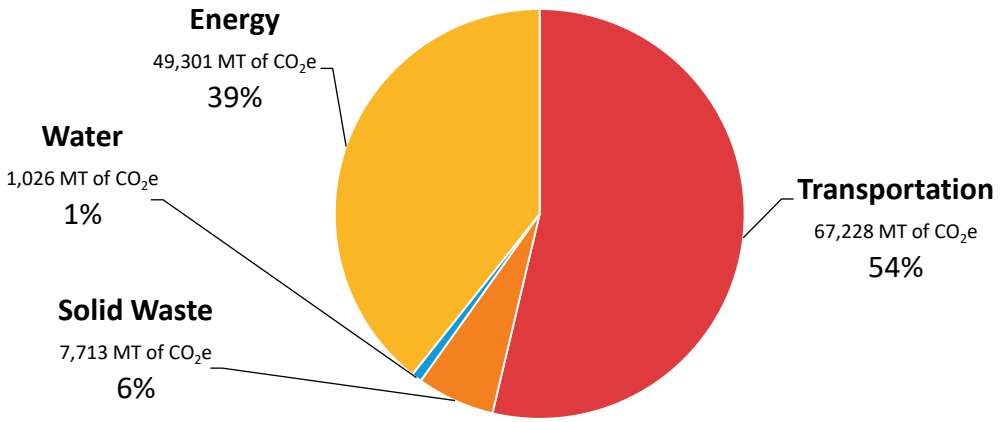

Table 2 Baseline Community-wide Emissions Summary by Sector

Sector	GHG Emissions (MT of CO_2e)	Percent of Total Emissions
Energy	**49,301**	**39**
Electricity	23,987	19
Natural Gas	24,287	19
Electricity Transmission and Distribution Losses	1,027	1
Transportation	**67,228**	**54**
On-road Transportation	65,351	52
Off-road Equipment	829	1
Transit[2]	1,048	1
Water	**1,026**	**1**
Water transport, distribution and treatment	700	1
Wastewater collection and treatment	326	<1
Solid Waste	**7,713**	**6**
Waste Sent to Landfills	7,509	6
Process Emissions	203	<1
Transportation & Collection Emissions[3]	*465*	*0*
Combustion Emissions	1	<1
Total	**125,269**	**100 %**

Notes:
MT: Metric tons
1. Emissions have been rounded and therefore sums may not match.
2. Transit in South Pasadena is provided by Los Angeles Metro.
3. Waste transportation and collection emissions are accounted for in the on-road transportation sector of the inventory and are included here only for informational purposes.
Source: Emissions were calculated following ICLEI LGOP and using data provided and approved by the City.

2 Introduction

Local governments play a fundamental role in reducing GHG emissions. Local government policies can effectively reduce GHG emissions and can prepare their communities for the potential impacts of climate change. Through such efforts, South Pasadena can reduce GHG emissions at both the municipal (local government) and community level.

The City of South Pasadena exercises direct control over its municipal GHG emissions-generating activities. For example, it can reduce energy consumption in municipal buildings, reduce fuel consumption by municipal fleet vehicles, and increase the amount of energy that is obtained from renewable energy sources. The City can also influence community-wide activities that generate GHG emissions, for example, by improving building codes, incentivizing alternative transportation options, and educating community members about their choices as consumers. That influence may be exercised directly through the City's authority over local land use planning and building standards, and indirectly through programs that encourage GHG reducing activities.

By quantifying the GHG emissions from municipal facilities and operations as well as for the community as a whole, this report provides an understanding of where the highest percentages of emissions in South Pasadena originate and where the greatest opportunities for emission reductions exist. It also provides City decision-makers and the community with adequate information to inform policy decisions and provides a baseline against which future progress can be measured.

2.1 Purpose of Emission Inventory

The purpose of the City of South Pasadena GHG Emissions Inventory (Inventory) is to identify the sources and quantities of GHG emissions within the City's jurisdictional boundaries. This baseline Inventory is the first step in addressing GHG emissions and was developed to serve the following purposes:

- Provide an understanding of South Pasadena's major sources of GHG emissions and where the greatest opportunities for GHG emissions reductions exist
- Create a GHG emissions baseline from which South Pasadena can set GHG emissions reductions targets and measure future progress
- Enable the City to understand the scale of emissions from various sources and develop GHG emissions accounting and reporting principles
- Provide best practices to aid in the development of a citywide Climate Action Plan

3 Methodology

This inventory was completed using CAPDash, Rincon's proprietary custom Climate Action Plan (CAP) dashboard tool. CAPDash was designed to use methodologies recommended and supported by the California Air Resources Board (CARB). The local government operations (municipal) component of the GHG emissions inventory follows the ICLEI- Local Government Operations Protocol (LGOP),[2] version 1.1, which was adopted in 2010 by CARB and serves as the national standard for quantifying and reporting GHG emissions from local government operations. The communitywide inventory was developed using the ICLEI- Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol) (2013).[3] Emissions were calculated using the principles and methods of these protocols.

3.1 Baseline Year

The state of California uses 1990 as a reference year to remain consistent with Assembly Bill (AB) 32, which codified the state's 2020 GHG emissions target by directing CARB to reduce statewide emissions to 1990 levels by 2020. However, cities and counties throughout California typically elect to use years later than 1990 as baseline years because of the increased reliability of recordkeeping from those years and the large amount of growth that has occurred since 1990. The year 2016 was selected as the baseline year for South Pasadena's Inventory due to the availability of reliable data. Additionally, it is important to note that in 2016 statewide GHG emissions fell below 1990 levels, generally achieving the goals of AB 32.[4]

3.2 Municipal and Community-wide Inventories

This Inventory is separated into two sections: municipal and community-wide. The municipal inventory includes emissions resulting from facilities that the City owns and/or operates. The community-wide inventory includes all emissions occurring within South Pasadena's geo-political control (i.e., sources of emissions within the City limits over which the City has significant influence or jurisdictional authority). The municipal inventory is a subset of the community inventory, meaning that all municipal operations are included in the commercial/industrial, transportation, solid waste, or water categories of the community-wide inventory. The municipal inventory should not be added to the community analysis; rather, it should be looked at as a portion of the total community emissions. Although municipal operations represent a small portion of the community's overall emissions, a municipal inventory allows the City to track its individual facilities and vehicles and to evaluate the effectiveness of its emissions reduction efforts at a more detailed level. Figure 3 depicts the relationship between the community-wide and municipal inventories.

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[2] ICLEI. 2010. ICELI- Local Government Operations Protocol (LGOP). http://icleiusa.org/ghg-protocols/

[3] ICLEI. 2013. ICELI- Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. http://icleiusa.org/ghg-protocols/

[4] CARB. July 11, 2018. Climate pollutants fall below 1990 levels for first time. https://ww2.arb.ca.gov/news/climate-pollutants-fall-below-1990-levels-first-time

Figure 3 Relationship between Community-wide and Municipal Inventories

Once completed, these inventories provide the basis for policy development, the quantification of GHG emissions reductions associated with proposed measures, and the establishment of an informed emissions reduction target.

3.3 Calculating Emissions

The following section provides background information on applicable GHG emissions and activity data as well as appropriate use of emission factors.

3.3.1 Greenhouse Gases

According to both the LGOP and the Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, local governments should assess emissions of all six internationally recognized GHGs. These gases are outlined in Table 3, which includes their sources and global warming potential (GWP).[5] This inventory was prepared in conformance with ISO 14064-1 and therefore uses the latest 100-year GWP values published in the IPCC Fifth Assessment Report (AR5).[6] The GWP refers to the ability of each gas to trap heat in the atmosphere. For example, one pound of methane has 28 times more heat capturing potential than one pound of carbon dioxide. This report

[5] According to the United States Environmental Protection Agency (USEPA), the GWP was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide (USEPA 2017; https://www.epa.gov/ghgemissions/understanding-global-warming-potentials).

[6] International Organization for Standardization (ISO) published ISO 14064-1 in 2006 (revised 2018) to provide an international standard for the quantification and reporting of GHG emissions.

focuses on the three GHGs most relevant to local government policymaking: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases comprise a large majority of GHG emissions at the community level. The other gases, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluorides are emitted primarily in private sector manufacturing and electricity transmission and are the subject of regulation at the state level and therefore, have been omitted from this inventory. GHG emissions are reported in MT of CO_2e units, per standard practice. When dealing with an array of emissions, the gases are converted to their carbon dioxide equivalents for comparison purposes.

Table 3 Summary of Greenhouse Gas Emission

Greenhouse Gas	Formula	Source	GWP (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, anaerobic decomposition of organic waste (landfills, wastewater treatment plants), fuel handling	28
Nitrous Oxide	N_2O	Combustion and wastewater treatment	265
Hydrofluorocarbons	Various	Leaking refrigerants and fire suppressants	4 – 12,400
Perfluorocarbons	Various	Aluminum production, semiconductor manufacturing, HVAC equipment manufacturing	6,630 – 11,100
Sulfur Hexafluoride	SF_6	Transmission and distribution of power	23,500

Source: Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report AR5, 2014.
GWP: Global Warming Potential

3.3.2 Activity Data and Emission Factors

Emissions are estimated using calculation-based methodologies to derive emissions using activity data and emissions factors. To estimate emissions, the following equation is used:

$$Activity\ Data\ \times Emission\ Factor = Emissions$$

Activity data refer to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Emission factors are used to convert energy usage or other activity data into associated emissions quantities. They are usually expressed in terms of emissions per unit of activity data (e.g., pounds [lbs] of CO_2/kilowatt hour [kWh]).

3.4 Reporting Emissions

The following section discusses emissions by scope and sector.

3.4.1 Emissions by Scope

For municipal and community-wide inventories, emissions sources can be categorized by "scope" according to the entity's degree of control over the emissions source and the location of the source. Emissions sources are categorized as direct (Scope 1) or indirect (Scope 2 or Scope 3), in accordance with the World Resources Institute and the World Business Council for Sustainable Development's Greenhouse Gas Protocol Corporate Standard.

MUNICIPAL SCOPE DEFINITIONS

- **Scope 1:** Direct GHG emissions from sources within a local government's operations that it owns and/or controls. This includes stationary combustion to produce electricity, steam, heat, and power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; and other sources.
- **Scope 2:** Indirect GHG emissions associated with the consumption of electricity, steam, heating, or cooling that are purchased from a utility provider that also provides energy to other jurisdictions and/or is located outside City boundaries.
- **Scope 3:** All other indirect GHG emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the City (e.g., employee commuting and business travel, outsourced activities, waste disposal, etc.).

COMMUNITY-WIDE SCOPE DEFINITIONS

- **Scope 1:** Direct GHG emissions from sources located within the jurisdictional boundaries of the community, including emissions from fuel combustion vehicles[7] in the community and direct emissions from natural gas combustion in homes and businesses within the community.
- **Scope 2:** Indirect GHG emissions associated with the consumption of electricity within the community.
- **Scope 3:** All other indirect or embodied GHG emissions not covered in Scope 2, which occur because of activity within the jurisdictional boundaries (e.g., methane emitted at landfills outside the community resulting from solid waste generated within the community).

3.4.2 Emissions by Sector

In addition to categorizing emissions by scope, ICLEI recommends that local governments examine their emissions in the context of the sector that is responsible for those emissions. Many local governments will find a sector-based analysis more directly relevant to policy making and project management, as it assists in formulating sector-specific reduction measures and climate action plan components.

The municipal and community inventories report emissions by the following sectors:

- Energy
- Transportation
- Water consumption and wastewater treatment
- Solid waste

Table 4 summarizes the scopes of each sector in the municipal and community-wide inventories.

[7] This accounts for GHG emissions from running exhaust, idle exhaust, starting exhaust, diurnal, resting loss, running loss, and hot soak.

Table 4 Emissions by Sector and Scope

Sector	Scope 1	Scope 2	Scope 3
Municipal Inventory			
Energy	Natural Gas	Electricity	N/A
Vehicle Fleet	Gasoline, diesel, CNG, LPG	N/A	Employee Commute
Water consumption	N/A	N/A	Electricity (associated with water conveyance)
Wastewater	N/A	N/A	Electricity (associated with water treatment)
Solid Waste	N/A	N/A	Methane from decomposition and process emission
Community-wide Inventory			
Energy	Natural Gas	Electricity	N/A
Transportation	Gasoline and Diesel	N/A	Transit (i.e. public transit)
Water Consumption	N/A	N/A	Electricity (associated with water conveyance)
Wastewater	N/A	N/A	Electricity (associated with water treatment)
Solid Waste	N/A	N/A	Methane from decomposition and process emissions

CNG: Condensed natural gas; N/A: Not applicable

3.5 Data Sources

The data used to complete this Inventory came from multiple sources, as summarized in Table 5. Sources are further explained in the sector-specific discussions of this Inventory.

Table 5 Emissions Data Sources

Sector	Activity Data	Unit	Data Source
Municipal Inventory			
Energy	Electricity consumption	kWh	SCE - billing history provided by City
	Natural gas consumption	Therms	SCG - Customer Gas Usage and Total Billed Summary for 2016
Transportation	Annual Mileage	Gallon	City provided fleet vehicle list and fuel use data and City employee commuter survey
Water	Water consumption	CCF	City of South Pasadena[1]
Wastewater	Wastewater Collection and Treatment	N/A	Conservatively assumed to be equivalent to municipal water use
Solid Waste	N/A	Tons	Athens Services[2]
Community-wide Inventory			
Energy	Electricity consumption	kWh	SCE
	Natural gas consumption	Therms	SCG
Transportation	Miles traveled	VMT	2016 VMT model, Iteris Traffic Consultants
Water	Water consumption	CCF	City of South Pasadena, Pasadena Water & Power, Metropolitan Water District
Wastewater	Wastewater generation rate = 60 gallons per person per day for residential and commercial activity	gpcd	Los Angeles County Sanitation Districts (LACSD)
Solid Waste	Solid waste tonnage	Tons	CalRecycle[3]

kWh; kilowatt hours; SCE: Southern California Electricity; SCG: Southern California Gas Company; VMT: vehicle miles traveled; gpcd: gallons per capita per day; N/A: not applicable; CCF = 100 cubic feet of gas
1. The City of South Pasadena receives municipal water from City operated wells and a small portion from Metropolitan Water District.
2. Athens Services is the waste hauler for the City of South Pasadena
3. Data obtained from the CalRecycle Disposal Reports by Jurisdiction for South Pasadena. https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility. Accessed on September 27, 2019.

4 Municipal Inventory Results

This section provides a detailed description of the City's GHG emissions from municipal operations in 2016. It also provides details on emissions by scope and by operational sector. In 2016, South Pasadena's municipal GHG emissions totaled 2,755 MT of CO_2e.

4.1 Municipal Emissions by Scope

As shown in Figure 4 and Table 6, Scope 2 sources produced the largest percentage (55 percent) of municipal GHG emissions in 2016, totaling 1,504 MT of CO_2e. Scope 3 emissions produced the second largest amount (35 percent, or 969 MT of CO_2e), and Scope 1 emissions accounted for the remaining ten percent, or 282 MT of CO_2e.

Figure 4 Municipal Emissions by Scope

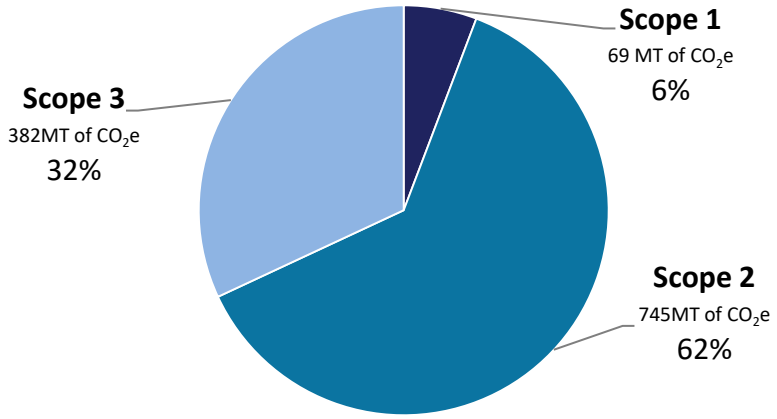


Table 6 Municipal Emissions (MT of CO_2e) Summary by Scope

Sector	Scope 1	Scope 2	Scope 3	Total
Energy	109	1,504	N/A	1,613
Transportation	173	N/A	366	539
Water	N/A	N/A	19	19
Solid Waste	N/A	N/A	584	584
Total Emissions (MT of CO_2e)	**282**	**1,504**	**969**	**2,755**
Percentage of Total by Scope	*10%*	*55%*	*35%*	*100%*

N/A: Not applicable

Source: Emissions were calculated following ICLEI LGOP and using data provided and approved by the City.

The largest portion of Scope 1 emissions resulted from fuel combustion in the City's vehicle fleet. The second largest source of Scope 1 emissions was from use of natural gas in City facilities. These emissions qualify as Scope 1 because they involve the direct combustion of fuels within the jurisdictional boundary of the City. Scope 2 emissions consisted entirely of electricity use for the City's buildings and facilities, parks, water delivery facilties, and to power the City's streetlights and

traffic signals. Emissions from solid waste disposal account for most of the Scope 3 emissions, while water use, wastewater generation, and employee commute generate the remainder of Scope 3 emissions.

4.2 Municipal Emissions by Sector

Reporting emissions by sector provides a useful way to understand the sources of the City's emissions. By better understanding the relative scale of emissions from each sector, the City can more effectively focus strategies to achieve the greatest emissions reductions. The ICLEI LGOP further categorizes sectors by the following sub-sectors for local government operations: 1) buildings and other facilities, 2) streetlights and traffic signals, 3) water delivery facilities, 4) port facilities, 5) airport facilities, 6) vehicle fleet, 7) transit fleet, 8) power generation facilities, 9) solid waste facilities, 10) wastewater facilities, and 11) all processes and fugitive emissions. The City of South Pasadena does not have operational control of a port, airport, transit fleet, power generation facility, or wastewater facility. Additionally, the City does not have an operational landfill[8] within the jurisdictional boundaries. Local government operations are discussed only in terms of sectors and sub-sectors the City has operational control over.

As shown in Figure 5 and Table 7, energy use generated the highest quantity of emissions, resulting in 1,613 MT of CO_2e (59 percent of total municipal emissions) where emissions from natural gas use generated 109 MT of CO_2e (four percent of total municipal emissions), building electricity use generated 238 MT of CO_2e (nine percent of total municipal emissions), the City's streetlights and traffic signals produced 253 MT of CO_2e (nine percent of total municipal emissions), the City's water delivery facilities produced 964 MT of CO_2e (35 percent of total municipal emissions), and electricity for parks and outdoor lighting resulted in the remaining energy related emissions (49 MT of CO_2e or 2 percent of total municipal emissions). The generation of solid waste was the second largest source of emissions, generating 584 MT of CO_2e (21 percent of total municipal emissions). The City's transportation emissions were the third largest source of emissions in 2016, where 366 MT of CO_2e (13 percent of total municipal emissions) was due to employee commute and 173 MT of CO_2e (six percent of total municipal emissions) was from City fleet vehicle use. The remaining City emissions resulted from the consumption of water and generation of wastewater (19 MT of CO_2e or one percent of total municipal emissions).

[8] As mentioned in Section 5.2.4, *Solid Waste*, the City of South Pasadena has a landfill within City jurisdictional boundaries, the South Pasadena City Dump; however, this facility has been closed since 1958, and is excluded from this inventory due to a lack of data.

Figure 5 Municipal Emissions by Sector

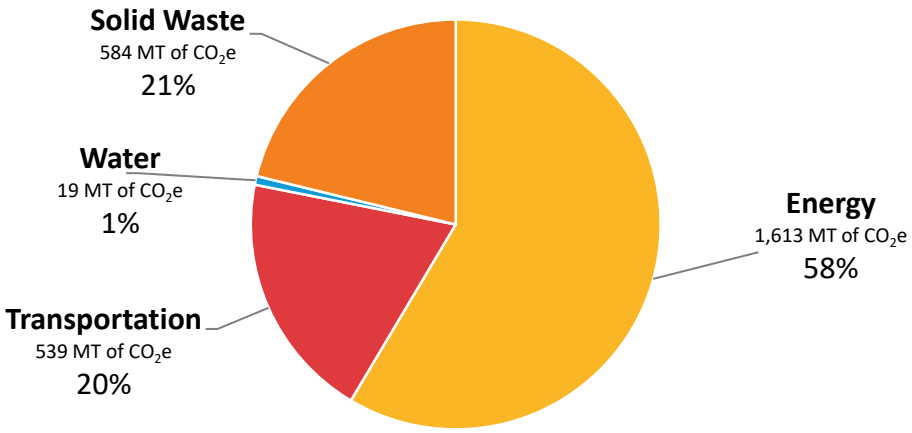


Table 7 Baseline Municipal Emissions Summary by Sector

Sector	GHG Emissions (MT of CO_2e)	Percent of Total Emissions
Energy	**1,613**	**59**
Natural Gas (buildings & facilities)	109	4
Electricity (buildings & facilities)	238	9
Electricity (parks and outdoor lighting)	49	2
Electricity (traffic signals and streetlights)	253	9
Electricity (water delivery facilities)	964	35
Transportation	**539**	**20**
Vehicle Fleet	173	6
Employee Commute	366	13
Water and Wastewater	**19**	**<1**
Water Consumption	12	<1
Wastewater Generation	7	<1
Waste	**584**	**21**
Total Emissions (MT of CO_2e)	**2,755**	**100%**

4.2.1 Energy

The City of South Pasadena is responsible for 109 electricity service accounts which includes usage at City-owned facilities, parks and outdoor lighting, traffic and street lighting, and water delivery facilities. In this inventory, municipal electricity usage is segregated into the following sectors consistent with the ICLEI LGOP: streetlights and traffic signals, buildings and other facilities, and water delivery facilities; with an additional category added for parks and outdoor lighting. The SCE

emissions factor in 2016 (0.529 lbs CO_2e/kWh)[9] was used in this inventory. Electricity usage from City operations resulted in approximately 1,504 MT of CO_2e.

South Pasadena has seven natural gas meters. The 2016 emission factors for natural gas were used in this inventory and are: 53.06 kg CO_2/one million British Thermal Units (mmBtu), 1.0 g CH_4/mmBtu, and 0.1 g N_2O/mmBtu.[10] Therefore, in 2016 natural gas usage at City buildings and facilities generated approximately 109 MT of CO_2e. Table 8 and Figure 6 show the breakdown of energy use and resulting emissions from City operation. As shown in Table 7, most emissions resulted from electricity use (55 percent of total municipal emissions).

Figure 6 Energy Emissions by Source

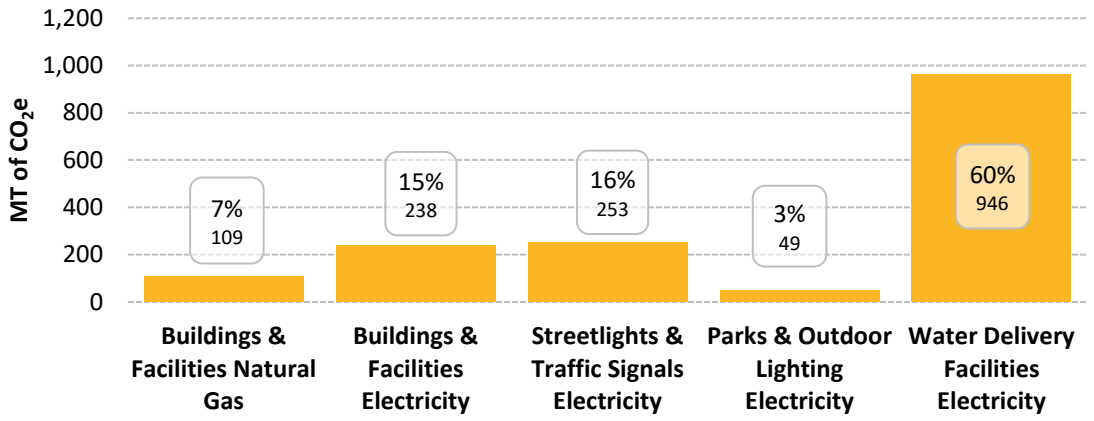


Table 8 Energy Usage by City Facilities and Associated GHG Emissions (2016)

Source	GHG Emissions (MT of CO_2e)	Percent of Sector
Building & Facilities Natural Gas	109	2
Buildings & Facilities Electricity	238	15
Streetlights & Traffic Signals Electricity	253	16
Parks & Outdoor Lighting Electricity	49	3
Water Delivery Facilities Electricity	964	60
	1,613	100%

4.2.2 Transportation

4.2.2.1 Vehicle Fleet Fuel Use

Municipal vehicles and equipment use gasoline, diesel, and compressed natural gas (CNG), which generates emissions. On-road transportation emissions are attributed to trips in City-owned fleet

[9] Edison International 2017 Sustainability Report (p. 10), June 2018. https://www.edison.com/content/dam/eix/documents/sustainability/eix-2017-sustainability-report.pdf

[10] The Climate Registry 2016 Default Emission Factors (Table 12.1 & Table 12.9.1), April 2016. https://www.theclimateregistry.org/wp-content/uploads/2014/11/2016-Climate-Registry-Default-Emission-Factors.pdf

vehicles and employee trips commuting to and from work. The City owns and operates off-road equipment, including a tractor, two backhoes, two trailers, and two air compressors, that also generate transportation emissions from the combustion of fossil fuels, which are included in this sector. In 2015, all of the City-owned landscape equipment used for regular groundswork was converted to electric power, therefore, emissions from these specific pieces of equipment are accounted for under the energy sector and are not discussed further in this sector.

Fuel volume purchases for each gasoline and diesel-powered vehicle owned by the City were tracked for the 2016 calendar year and were provided to Rincon by South Pasadena's Water Conservation and Sustainability Analyst. CNG fueled vehicles did not have fuel volumes tracked for each specific vehicle; however, the total volume of CNG purchased in 2016 was available. Data was also provided for fuel dispensed into gas cans, which is assumed to be used for the off-road equipment listed above and is reflected in the inventory accordingly.

In 2016, City-owned and -operated vehicles and equipment emitted approximately 173 MT of CO_2e. Figure 7 and Table 9 show 2016 emissions from fuel consumption by the City for fleet vehicles and off-road equipment. Since specific fuel volumes were provided for each gasoline and diesel powered vehicle and piece of equipment listed above (tractor, backhoes, trailers, and air compressors), emissions are calculated using ICLEI LGOP Methods 7.1.1 and 7.1.3.2.1, with emission factors obtained from CARB's EMFAC2017[11] model output and USEPA's *Emission Factors for Greenhouse Gas Inventories.*[12] Specifically, each gasoline and diesel fueled on-road vehicle in the fleet was given an emission factor according to the vehicle's year, class, and fuel type. These emission factors were derived from the EMFAC2017 output, where the total statewide emissions of CO_2, CH_4 and N_2O for each vehicle class, year, and fuel were divided by the total fuel use to obtain a vehicle specific emission factor in tons per gallon of fuel. CNG vehicle emissions were calculated using emission factors from USEPA's *Emission Factors for Greenhouse Gas Inventories*, with fuel volumes attributed equally to each vehicle in the fleet, which includes one passenger vehicle and two medium-duty trucks. Emissions for off-road equipment, that have not been converted to electric, were calculated with the emission factors provided for diesel and gasoline fueled construction equipment from the same USEPA source.

[11] CARB 2018. EMFAC2017 v1.0.2. Mobile Source Analysis Branch, Air Quality Planning & Science Division. https://www.arb.ca.gov/emfac/2017/

[12] USEPA. 2018. Emission Factors for Greenhouse Gas Inventories. https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Figure 7 Transportation Emissions by Source

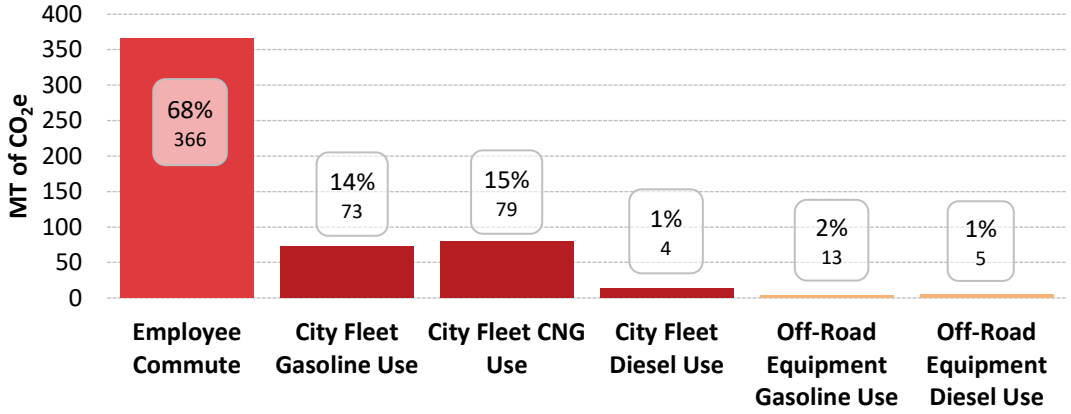


Table 9 Municipal Transportation Emissions by Source

Source	Consumption (gallons)	GHG Emissions (MT of CO_2e)	Percent of Sector
City Fleet Gasoline use	4,985	73	14
City Fleet Diesel use	1,220	13	2
City Fleet CNG use[1]	11,750	79	15
Off-Road Equipment Gasoline use	395	4	1
Off-Road Equipment Diesel use	449	5	1
Employee Commute	N/A	366	68
Total	**22,197**	**539**	**100%**

CNG = compressed natural gas

1. CNG use reported in gallon of gas equivalent (GGE)

4.2.2.2 *Employee Commute*

In 2016, the City of South Pasadena had a total of 152 full-time City employees and 125 part-time employees.[13] Employee commute VMT was calculated using the results of an employee commute survey, issued in September 2019. The survey had 47 respondents who had worked at the City of South Pasadena in 2016, and included each respondents number of days worked in 2016, one-way commute distance and commute mode. Based on the average commute distance and mode for each respondent to the employee commute survey, an annual average employee commute factor was calculated, which equates to each employee traveling an average 4,946 miles by passenger car, 181 miles by motorcycle, 22 miles by bus, and 35 trips by train in 2016. This annual average employee commute factor was applied to the number of City employees in 2016 to estimate travel for each mode for all employee commutes. The number of work days was estimated assuming full-time employees did not work on federal holidays and that full-time employees would take two weeks of vacation. Part-time employees were assumed to work half the time of full-time employees. The average employee commute factor and assumptions above are considered to give a conservative estimate of employee commute patterns. EMFAC2017 emission factors were used to determine employee commute emissions. Given the above assumptions it was estimated that

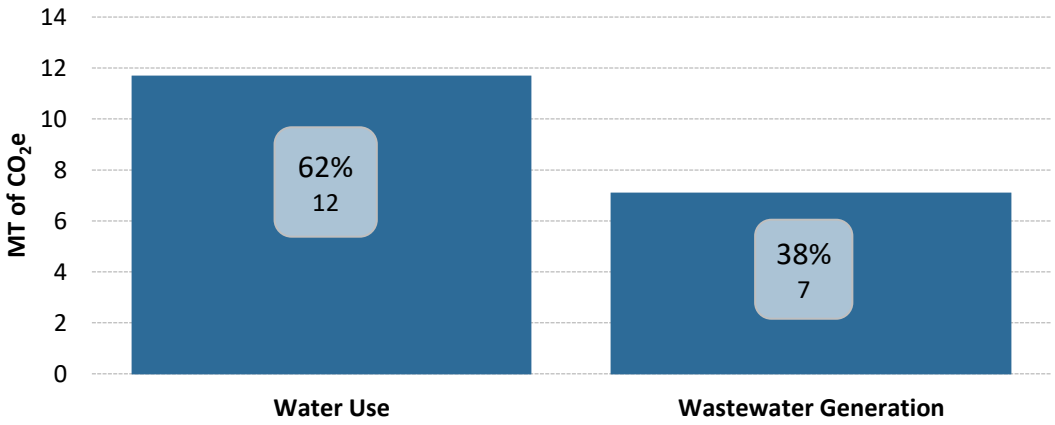
[13] City of South Pasadena provided employee data via email on August 28, 2019.

employee commute contributed approximately 366 MT of CO_2e (68 percent) of municipal transportation emissions.

4.2.3 Water and Wastewater

In 2016, City of South Pasadena used approximately 19 million gallons (MG) of potable water for facilities operations and irrigation of public parks maintained by the City. The City obtains water for use in municipal and irrigation operations through City operated groundwater wells. Wastewater generated by the City is treated by the Sanitation Districts of Los Angeles County (LACSD). Since wastewater generation data was not available for municipal operations, it was conservatively assumed that wastewater generated was equivalent to total water use for municipal operations. Emissions generated from water usage and wastewater generation is due to the indirect electricity use to distribute water and collect and treat wastewater. The energy intensity for water use in the City of South Pasadena was not available, therefore, the energy intensities for water conveyance and distribution for the San Gabriel Water Valley Company (SGWVC) was used as a proxy, since SGWVC's service area is directly adjacent to the City of South Pasadena and SGWVC obtains most of its water from local groundwater pumping[14]. The energy intensity factor used for water use is 2,604 kWh/MG, and is 1,577 kWh/MG[15]for wastewater collection and treatment for LACSD. Because SCE supplies electricity to the City of South Pasadena, the SCE energy emission factor for 2016 of 0.529 lbs CO_2e/kWh was applied to estimated energy use for both water usage and wastewater generation. As such, water usage and wastewater generation by City operations generated approximately 12 MT of CO_2e and 7 MT of CO_2e, respectively, shown below in Figure 8.

Figure 8 Municipal Water and Wastewater Generation by Source



[14] The City of South Pasadena procures water by pumping from the San Gabriel Basin. Water energy intensities for San Gabriel Valley Water Company (SGVWC), as provided in the CPUC *Embedded Energy in water Studies*, were used as a proxy for City of South Pasadena since SGVWC is adjacent to the City of South Pasadena, and pumps groundwater from the San Gabriel Basin.

[15] California Public Utilities Commission (CPUC). 2010. Embedded Energy in Water Studies; Study 2: Water Agency and Function Component Study and Embedded Energy-Water Load Profiles. (http://www.cpuc.ca.gov/general.aspx?id=4388)

4.2.4 Solid Waste

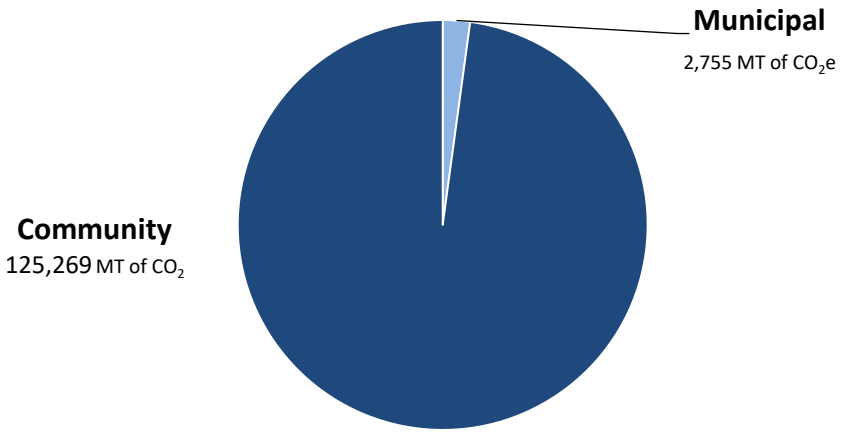
Many local government facilities and operations generate solid waste, much of which is eventually sent to a landfill. Typical sources of solid waste from local government operations include paper and food waste from offices and facilities, construction waste from public works, and plant debris from parks departments. Organic materials generate methane as they decay in the anaerobic environment of a landfill. The City keeps a record of the amount of waste sent to landfills and diverted. In 2016, 1,431 short tons of waste was sent to landfills from City operations and 451 short tons was recycled, resulting in an estimated 584 MT of CO_2e was generated from municipal solid waste generation.[16] Emissions were calculated using ICLEI CP Method SW.4, where the landfill gas capture rate for the facilities for which the communities waste is sent to was estimated at 73 percent efficiency, and the default emission factor of 0.06 tons of CH_4 per ton of waste. The methodology is further detailed in Section 5.2.4 *Solid Waste* section of *Community-wide Inventory Results*.

[16] Based on communication with the Water Conservation and Sustainability Analyst, there was no municipal organic waste materials collected in 2016.

5 Community-wide Inventory Results

In 2016, activities and operations taking place within South Pasadena's jurisdictional boundaries resulted in approximately 125,296 MT of CO_2e. This number includes all Scope 1 emissions from onsite combustion of natural gas in the residential and commercial sectors, as well as from the combustion of gasoline and diesel in vehicles traveling within South Pasadena. This total also includes all Scope 2 emissions associated with electricity consumed within the City and all Scope 3 emissions. Scope 3 emissions included in this inventory are from electricity consumption from water use, electricity consumption and process emission related to wastewater generated by the community, and process emissions associated with waste generated by the community, as well as emissions from public transit occurring within South Pasadena's jurisdictional boundaries. As shown in Figure 9, municipal operations represented two percent of total community-wide emissions in 2016.

Figure 9 Municipal Operations Portion of Community-wide Emissions



5.1 Community-wide Emissions by Scope

As shown in Table 10 and Figure 10, Scope 1 sources produced the largest percentage (72 percent) of community GHG emissions in 2016, totaling 90,167 MT of CO_2e. Scope 2 emissions produced the second-largest amount (19 percent, or 24,287 MT of CO_2e), and Scope 3 emissions accounted for the remaining 9 percent, or 10,815 MT of CO_2e.

Figure 10 Community-wide 2016 Emissions by Scope

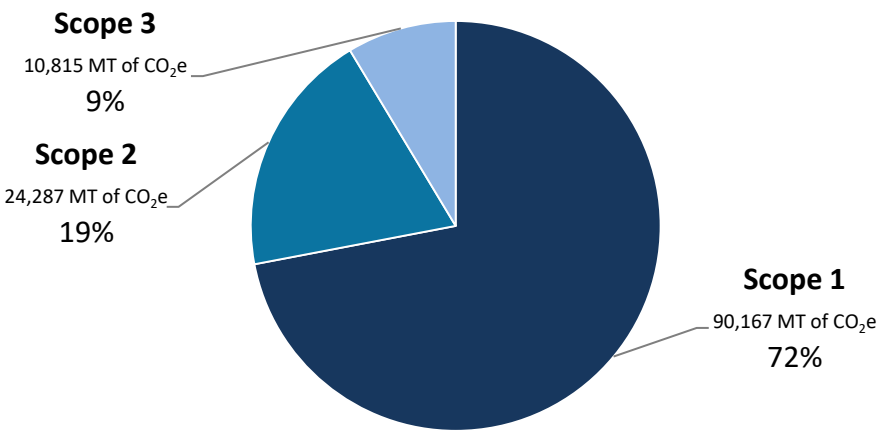


Table 10 Community-wide Emissions (MT of CO_2e) Summary by Scope

Sector	Scope 1	Scope 2	Scope 3	Total
Energy	23,987	24,287	1,027	49,301
Transportation	66,180	N/A	1,048	67,228
Water	N/A	N/A	1,026	1,026
Waste	N/A	N/A	7,713	7,713
Total	**90,167**	**24,287**	**10,815**	**125,269**
Percentage of Total	*72%*	*19%*	*9%*	*100%*

N/A: Not applicable

Source: Emissions were calculated following ICLEI CP and using data provided and approved by the City.

The largest portion of Scope 1 emissions in 2016 came from the transportation sector. These emissions qualify as Scope 1 because they involve the direct combustion of fuel within the jurisdictional boundary of the City. The second-largest source of Scope 1 emissions was commercial and residential energy use. Emissions from solid waste and water use account for the majority of Scope 3 emissions.

5.2 Community-wide Emissions by Sector

By understanding the relative scale of emissions from each primary sector, the City can more effectively focus emission reductions strategies to achieve the greatest emission reductions. As noted above, 125,269 MT of CO_2e were emitted from the community in 2016. Figure 11 and Table 11 show the total community emissions summarized by sector.

Figure 11 2016 Community-wide Emissions by Sector

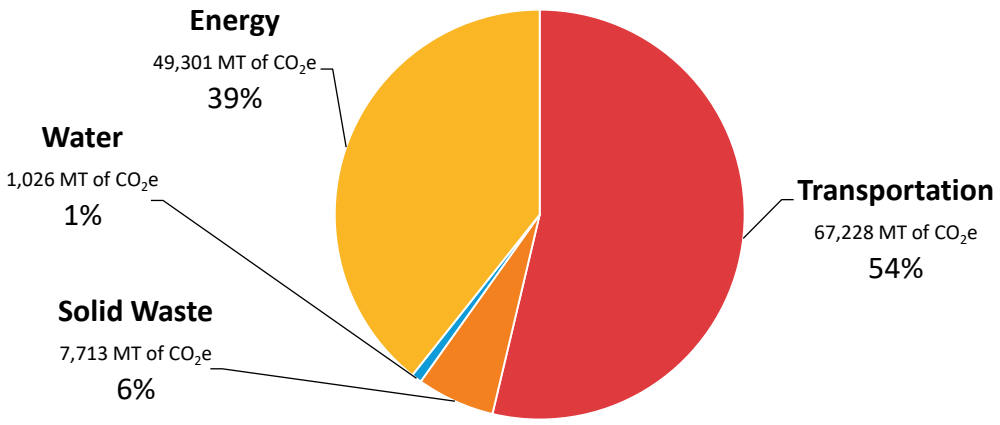


Table 11 Baseline Community-wide Emissions Summary by Sector

Sector	GHG Emissions (MT of CO_2e)	Percent of Total Community Emissions
Energy	**49,301**	**39**
Natural Gas[1]	23,987	19
Electricity[1]	24,287	19
Electricity Transmission and Distribution Losses	1,207	1
Transportation	**67,228**	**54**
On-road	65,351	52
Off-road	829	1
Transit	1,048	1
Water	**1,026**	**1**
Water transport, distribution and treatment	700	1
Wastewater collection and treatment	326	<1
Waste	**7,713**	**6**
Transportation and Collection[2]	465	<1
Waste-in-Place	7,509	6
Process Emissions	203	<1
Combustion of Waste	1	<1
Total	**125,269**	**100%**

1. Includes emissions from commercial and residential land uses.

2. Waste transportation and collection emissions are accounted for in the on-road transportation sector of the inventory and are included here only for informational purposes.

5.2.1 Energy Use

The energy sector includes GHG emissions resulting from electricity and natural gas used in residences and commercial buildings[17][18] throughout the City of South Pasadena. Emissions resulting from electricity consumption were estimated by multiplying annual electricity consumption by the electricity emissions factor. Electricity is supplied to the City of South Pasadena by SCE. The SCE emissions factor in 2016 and used in this inventory is 0.529lbs CO_2e/kWh. As such, 24,287 MT of CO_2e (49 percent of emissions from the energy sector) were generated from electricity use in the community in 2016.

In addition to energy consumption, the amount of emissions generated due to electricity transmission and distribution (T&D) losses were determined. T&D losses occur as electricity as transported from its generation source to its final end use destination. Transmission losses occur in the form of heat as electricity meets the small resitance in wires, and distribution losses occur when electricity is transformed from higher to lower voltage wires. Although emissions generated due to electricity T&D losses are outside of the City's operational control, emissions related to T&D losses are directly related to electricity use within the community and should be included in the community emissions.[19] T&D loss associated emissions were determined by multiplying the total community electricity consumption in 2016 by 4.23 percent, the grid loss factor for the California sub-region (CAMX) most recently determined by the United States Environmental Protection Agency (USEPA) *Emissions and Generating Resource Integrated Databases (eGRID)*.[20] T&D emissions associated with the community electricity use were 1,027 MT of CO_2e (two percent of emissions from the energy sector) in 2016.

Natural gas is provided to the City of South Pasadena by SCG for end-use applications in the residential and commercial sectors.[21] Emissions resulting from the combustion of natural gas were calculated by multiplying annual natural gas consumption by the most recent natural gas emissions factors available, which are 53.06 kg CO_2/mmBtu, 1.0 g CH_4/mmBtu and 0.1 g N_2O/mmBtu, as outlined in Section 4.2.1, *Energy*.[22] Community-wide emissions due to natural gas combustion were calculated to be 23,987 MT of CO_2e (49 percent of emissions from the energy sector) in 2016.

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17 Per the15/20 and 5/25 Aggregation Rules, for residential and commercial data, there were more than fifteen customers and no single customer made up more than 25 percent of the total energy consumption. Therefore, the data is complete and there is no missing data. Additionally, the data was aggregated annually, as required. The industrial and agricultural sectors electricity use did not pass Aggregation Rules due to insufficient customer base.

18 The City of South Pasadena 1998 General Plan Land Use Element Table II-1 *Existing Land Use Statistical Summary* (https://www.southpasadenaca.gov/home/showdocument?id=219) does not include any agricultural land uses and only 0.57 percent of land use is Light Manufacturing. Since the City's industrial and agricultural activities are considered minimal, community electricity use is based solely on residential and commercial designated uses.

19 ICLEI 2019. U.S. Community Protocol for Account and Reproting Greehouse Gas Emissions. Pg. 36.

20 USEPA's 2016 eGRID database, February 2018. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

21 Similar to community electricity usage, there was not a large enough customer base for industrial natural gas usage to pass the 5/25 Aggregation Rule. Therefore, no industrial data was provided. However, given Rincon's understanding of the industrial uses within the community, any associated emissions are minimal. Community natural gas use is based solely on residential and commercial land uses.

22 The Climate Registry 2018 Default Emission Factors (Table 12.1 & Table 12.9.1), May 2018. https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf

In 2016, a total 49,301 MT of CO_2e was generated within the community due to energy use. This represented 39 percent of total community-wide emissions. Table 12 shows the summary of emissions from electricity and natural gas use.

Table 12 Energy Usage and GHG Emissions by Community (2016)

Source	GHG Emissions (MT of CO_2e)	Percent of Sector
Natural Gas	23,987	49
Electricity	25,315	51
Total	**47,243**	**100%**

5.2.2 Transportation

Transportation emissions are generated by the community and the City of South Pasadena through on-road transportation, off-road equipment, and the transit system operated by LA Metro. There are no railroads that run through the City of South Pasadena, and the City does not have operational control of an airport or any marine vessels.

As shown in Table 13 and Figure 12, on-road transportation is the largest emissions contributor to the transportation sector at 97 percent (65,351 MT of CO_2e). Emissions associated with off-road equipment use and transit activities make-up the remaining three percent of transportation sector emissions. The data and methodology for on-road transportation are described in detail below, followed by a description of methods used to estimate off-road equipment and transit emissions within the City's geographic boundary. Table 13 shows the on-road transportation emissions by source while Figure 12 summarizes all the transportation emissions by source.

Figure 12 On-road Transportation Emissions by Source

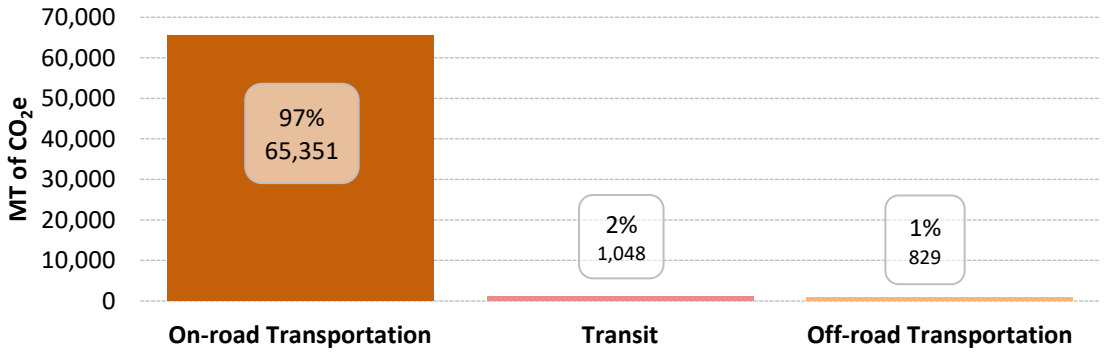


Table 13 Transportation by the Community and Associated GHG Emissions (2016)

Source	GHG Emissions (MT of CO_2e)	Activity Data (Annual VMT or passenger trips)[1]	Percent of Sector
On-road Transportation	***65,351***	***167,596,742***	***97***
Passenger	60,400	164,015,449	90
Light-duty Trucks	847	1,082,987	1
Medium-duty Trucks	836	659,300	1
Heavy-duty Trucks	3,268	1,839,100	5
Off-road Equipment	***829***	***N/A***	***1***
Transit	***1,048***	***N/A***	***2***
LA Metro Bus	435	190,670	1
LA Metro Rail[2]	613	1,375,500	1
Total	**67,228**		**100%**

N/A: Not Applicable

1. On-road transportation and LA Metro Bus activity data are in the units of Annual VMT, while LA Metro Rail is reported in the units of Annual Riders.

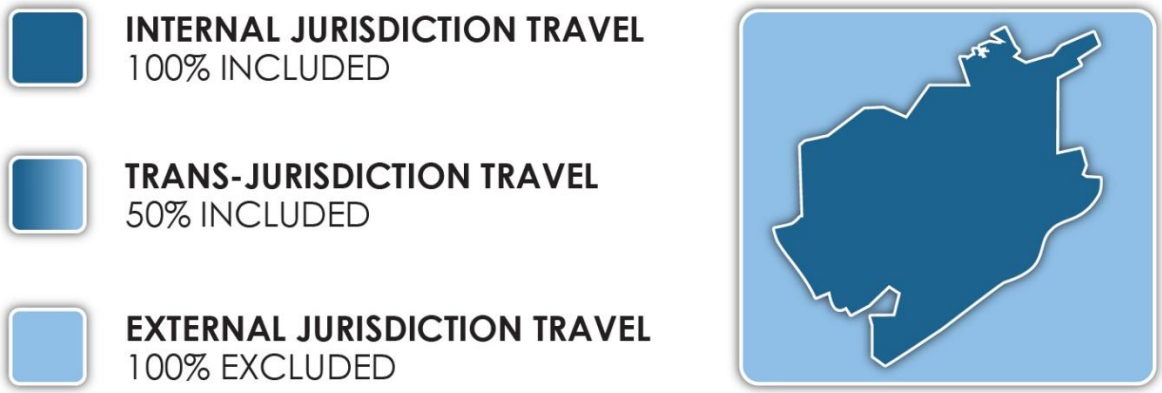
2. Ridership data for LA Metro Rail is for the Mission Station in South Pasadena.

5.2.2.1 On-road Transportation

Emissions from on-road transportation in the City of South Pasadena were estimated based on VMT and emissions rates associated with the vehicle fleet in 2016. Iteris, Inc. (Iteris) used the Trip Based Southern California Association of Governments (SCAG) model, to model traffic volumes and quantify VMT in 2016. VMT was calculated using the origin-destination methodology, which is summarized in Figure 13, recommended by the Regional Targets Advisory Committee (RTAC) pursuant to Senate Bill 375 (SB 375). The origin-destination method includes all trips occurring within the City limits and half of any trips that either originate or terminate within the city limits and excludes VMT from pass-through trips (i.e. not originating or terminating within the city limits). The Trip Based SCAG model utilizes socio-economic data (i.e. population, employment, households, workers, school enrollment, etc.), transportation analysis zones (TAZ), and the highway and transit network to calculate community VMT for the City of South Pasadena. VMT data is based on the assumption that the City's population was 35,919 in 2016.[23] The traffic model does not include transit trips (i.e. public buses) in community VMT calculations.

[23] Population assumptions used are generated from the SCAG Population Synthesizer.

Figure 13 Origin-Destination Attribution of Vehicle Miles Traveled to South Pasadena



Emissions due to passenger vehicle operation were calculated using the ICLEI Method TR.1.A where VMT data was converted into emission data using Equations TR.1.B.2 and TR.1.B.3 and regional emission factors from CARB's most recent EMission FACtors (EMFAC2017) model. EMFAC2017 VMT-based emission rates are dependent on the vehicle class, model years, speed, and fuel type. A fleet-wide emission factor was calculated using the mix of vehicle classes specific to the City of South Pasadena determined via the Trip Based SCAG model. Emissions from freight and service trucks (i.e. medium and heavy-duty trucks) were calculated using ICLEI CP Method TR.2.C, which is similar to assigning passenger emissions. By combining EMFAC2017 emission factors and VMT data, the average emission factors for passenger vehicles (LDA), light-duty trucks (LDT), medium-duty trucks (MHDT), and heavy-duty trucks (HHDT) was 368 grams (g) of CO_2e/mile (mi), 781 g of CO_2e/mi, 1,268 g of CO_2e/mi, and 1,777 g of CO_2e/mi, respectively. Therefore, total emissions from on-road transportation in 2016 was estimated to be 65,351 MT of CO_2e. As shown in Figure 13, passenger vehicles contribute the greatest amount of emissions to the on-road transportation sector at 92 percent (60,400 MT of CO_2e) followed by the contribution from heavy-duty trucks on the road at five percent (3,268 MT of CO_2e).

5.2.2.2 Off-road Equipment Use

Because jurisdiction-specific data was not available to estimate emissions related to off-road equipment use, ICLEI CP Method TR. 8 was used where emissions from use of off-road equipment was calculated based on the CARB's OFFROAD2007 Model and the population of South Pasadena. The OFFROAD2007 model provides emissions data related to various sub-categories and use of off-road equipment, such as construction or lawn and garden equipment, based on county inventories (i.e. Los Angeles). The 2016 emissions from each sub-category applicable to South Pasadena were converted from tons/day to annual emissions by multiplying the daily emissions by 365.25 days per year.[24] The data was scaled by South Pasadena's population. Based on the population scaling factor it was estimated that 0.26 percent of total Los Angeles County emissions from off-road equipment was attributed to the City of South Pasadena. To ensure the emissions were representative of South Pasadena, emissions from off-road equipment that would not be used in South Pasadena were excluded, such as emissions related to railroad activities, airport activities, port activities, and boat

[24] 365.25 days were used to account for leap year, which occurs every four years.

use as there is not a railyard, an airport, a port, or access to a large body of water within South Pasadena. Additionally, emissions from "Transport Refrigeration Units" were excluded due to a lack of specific information related to these types of units within South Pasadena. "Recreational Equipment" emissions was limited to specialty vehicle or golf cart emissions, as South Pasadena has a golf course. All-terrain vehicles (ATVs), off-road motorcycles, minibikes, and snowmobiles were not included as there is no designated open space within South Pasadena's jurisdictional boundaries to use such off-road recreational equipment. Thus, off-road equipment included in the OFFORAD2007 model pertained tio the following sectors: construction, entertainment, lawn and garden, light commercial, and recreational.

The City of South Pasadena converted City operated regular maintenance and grounds equipment from diesel and gas powered to electric, resulting in an annual reduction of off-road equipment emissions of 41 MT of CO_2e per year.[25] Thus, this reduction is subtracted from the OFFROAD2007 output, equating to community-wide off-road transportation emissions totaling 829 MT of CO_2e per year, as shown in Table 13 and Figure 12.

5.2.2.3 Transit

Transit within the City of South Pasadena includes inter-city rail and public buses, both operated by Los Angeles County Metropolitan Transit Authority (LA Metro). The ICLEI Methods TR.4.A and TR.4.B were used to estimate emissions generated from the public buses that operates within South Pasadena based on transit VMT within the City, provided in the Iteris *Traffic Memorandum*, and emission factors from EMFAC2017. Public buses operating in South Pasadena are fueled by condensed natural gas (CNG) and diesel fuel[26]. Since the fuel type for each bus line operating within the City was not known, the EMFAC2017 fleet mix, for Los Angeles County in 2016, was used. The Iteris *Traffic Memorandum* estimated that the four bus routes operating within South Pasadena (routes 79, 176, 258, and 260/762) contribute an annual VMT of 190,670; resulting in an estimated 435MT of CO_2e. Emissions associated with the LA Metro rail were calculated using a modified version of ICLEI Method TR.4.D, which used the annual ridership from the Mission Station located in South Pasadena to estimate emissions associated with electricity use to transport these passengers[27]. Since the LA Metro rail is powered by electricity, a per rider energy intensity of 1.86 kWh per rider was derived from the system total energy use[28] and total system ridership data. This was applied to the estimated 2016 annual ridership from the station (1,375,500 riders) to obtain an annual energy use of 2,554,168 kWh. Because SCE supplies electricity to the City of South Pasadena, the SCE energy emission factor for 2016 of 0.529 lbs CO_2e/kWh was applied to estimated energy use

[25] South Coast Air Quality Management District 2019. Cities in Aciton – South Pasadena. *ADVISOR*. Vol. 26 No.3. May/June 2019.

[26] Page 23 of LA Metro 2016 Energy and Resources Report states that busses in the direct fleet are primarily CNG fueled, while some contracted buses are diesel powered. (https://media.metro.net/projects_studies/sustainability/images/report_sustainability_energyandresource_2016.pdf)

[27] Ridership data for the Mission Station was only available for 2014 in the Metro Active Transport Strategy: South Pasadena Walkshed Analysis performed by Fehr & Peers. 2016 ridership was estimated from the proportion of Mission Station riders to total system riders, from total system ridership data obtained from LA Metro's Interactive Estimated Ridership Stats (http://isotp.metro.net/MetroRidership/IndexRail.aspx)

[28] 2016 rail propulsion energy use determined as a 4.7% increase from 2015 as mentioned in the Sustainability Indicators: Metro's 2017 Energy and Resources Report. (https://media.metro.net/projects_studies/sustainability/images/report_sustainability_energyandresource_2017.pdf)

for rail transit, resulting in an estimated 613 MT of CO_2e. As such, public transit in South Pasadena generated approximately 1,048 MT of CO_2e or two percent of transportation emissions.

5.2.3 Water and Wastewater

The following provides detailed information regarding water and wastewater-generated emissions.

5.2.3.1 Water

Approximately 1,113 MG of potable water was delivered to the South Pasadena community in 2016, with 99.46 percent supplied by well production from the San Gabriel Basin and the remainder purchased from Pasadena Water and Power (PWP) and Metropolitan Water District (0.47 and 0.07 percent, respectively). Water supplied to the community indirectly contributes emissions through the use of energy to extract, convey, treat, and deliver water. The amount of energy required for community water usage was calculated following ICLEI CP Method WW.14, where energy required for each segment of the water cycle was estimated using energy intensities specific to the water segment. Emissions calculated from water usage do not include emissions related to end-use phases such as heating of water. Appropriate ICLEI energy intensities that best represent the City's water conveyance, treatment, and distribution system were determined from the water provider's UWMPs or agency specific energy intensities when available. The energy intensity for the City of South Pasadena was not available, therefore, the energy intensities for water conveyance and distribution for the San Gabriel Water Valley Company (SGWVC) was used as a proxy, since SGWVC's service area is directly adjacent to the City of South Pasadena and SGWVC obtains most of its water from local groundwater pumping.[29] The City of South Pasadena uses chlorination treatment for local groundwater which requires additional energy.[30] For the 5 million gallons of water purchased from Pasadena Water and Power, an energy intensity of 3,428 kWh per MG is used to calculate emissions as obtained from the PWP 2015 UWMP.[31] Since water purchases from Metropolitan Water District are very small, they are considered negligible (<0.1 percent of water) and are not included in the inventory calculations. Table 14 shows the energy intensity per unit of water, annual volume of water used, and the estimated emissions for each segment of the water system. SCE is the electricity provider for South Pasadena; therefore, SCE's energy emission factor of 0.529 lbs CO_2e/kWh was applied to the calculated annual energy electricity consumed. Energy consumption related to water use in the community of South Pasadena resulted in the generation of approximately 700 MT of CO_2e in 2016 (68 percent of water/wastewater emissions). Table 14 and Figure 14 show the community water usage and associated emissions.

[29] San Gabriel Valley Water Company (SGVWC) Energy Intensity values are used as a surrogate for local groundwater because the agency's supply is almost wholly pumped from San Gabriel Basin (CPUC 2010. Embedded Water Study 2. Appendix B, pg. 265. Water Agency and Function Component Study and Embedded Energy-Water Load Profiles). The energy intensities used are the averages of the lower and upper ranges: 2,501.5 kWh/MG for groundwater conveyance, and 93.5 kWh/MG for booster and raw water pumps.

[30] Treatment for City of South Pasadena water is chlorination. According to *Energy requirements of water production, treatment, end use, reclamation and disposal* published in Renewable and Sustainable Energy Review 2012, energy intensity of chlorination treatment is 0.0024 kWh per cubic meter, which equates to 9.0. kWh per Million Gallons.

[31] PWP receives water from State Water Project and the Colorado River, as well as local ground water. The PWP 2015 UWMP provides the total energy intensity for treated water delivered in the service area in Table 9-2. This value includes extraction and diversion, storage, treatment and distribution.

Figure 14 Water and Wastewater Generated Emissions by Source

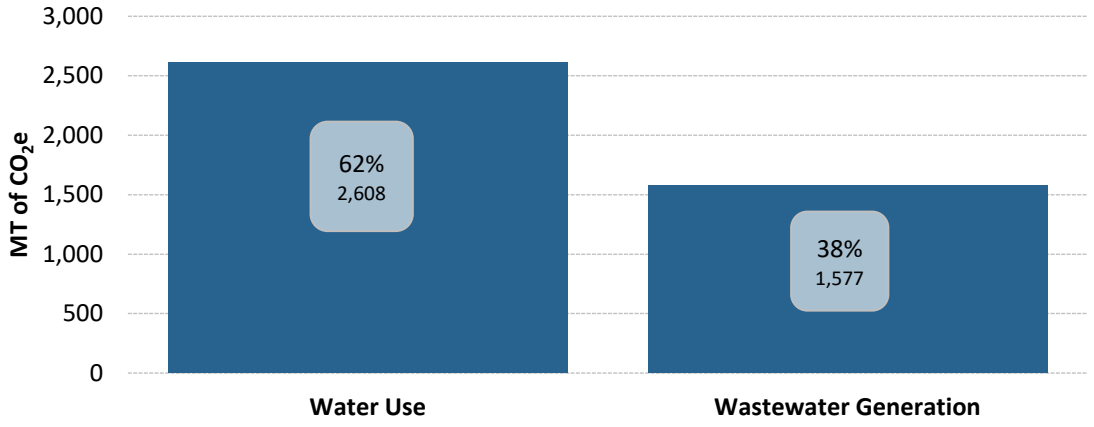


Table 14 Water Usage and Wastewater Generation Associated GHG Emissions (2016)

Source	MG	kWh/MG	GHG Emissions (MT of CO_2e)	Percent of Sector Emissions
Water Use	***1,118***	***2,608***	***700***	***68***
City of South Pasadena	**1,113**	2,604	696	68
Pasadena Water and Power	5	3,428	4	<1
Wastewater Generation	***570***	***1,577***	***326***	***32***
Collection and Conveyance	**570**	1,577	216	21
Wastewater Process Emissions[1]	N/A	N/A	111	11
Total[2]			**1,026**	**100%**

MG: million gallons; kWh: kilowatt hour; MT: metric tons; CO_2e: carbon dioxide equivalent

1. The processing of wastewater releases GHG emissions. Emissions associated with South Pasadena's wastewater generation were estimated based on LACSD operational information for wastewater treatment plants and the methodology described in ICELI CP (https://www.lacsd.org/wastewater/wwfacilities)

2. Numbers may not add up due to rounding.

5.2.3.2 Wastewater

Wastewater generated in the City of South Pasadena is collected in local sewer lines that ultimately discharge into regional treatment and disposal facilities managed by the Los Angeles County Sanitation Districts (LACSD). Community-wide generated wastewater is accounted for as a per capita generation rate (PCGR) and includes both residential and commercial wastewater flows. In 2016, the PCGR was 60 gallons per day.[32] Rincon used a population estimate for 2016 of 26,018 as provided by the Department of Finance to estimate the total wastewater generated in South Pasadena[33]. The City of South Pasadena does not operate a wastewater facility nor is there one

[32] City of South Pasadena 2015 UWMP. Pg. 6-15. (https://www.southpasadenaca.gov/home/showdocument?id=2905).

[33] Department of Finance. E-5 Population and Housing Estimates for Cities, Counties, and the State, 2011-2019 with 2010 Census Benchmark. (http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-5/)

within the city boundaries. According to the City of South Pasadena 2015 UWMP, generated wastewater entering the sewer system is conveyed to the Whittier Narrows Water Reclamation Plant (WNWRP) where primary, secondary, and tertiary treatment is provided. WNWRP treats an average flow of 7.4 million gallons of wastewater per day; which is primarily discharged to the San Gabriel and Rio Hondo rivers for groundwater recharge purposes.[34,35] Primary and secondary biosolids generated from processing at WNWRP are returned to the LACSD outfall system and are pumped to anaerobic digestors at the Joint Waters Pollution Control Plant (JWPCP).[36] Since separate phases of the wastewater treatment occur at separate facilities, ICLEI Method WW.13 was used to attribute these emissions to the plant associated with the emission sources, scaled by the population of South Pasadena relative to the total population served by the plant. Accordingly, emissions associated with anaerobic digester were attributed to the JWPCP facility, and fugitive emissions associated with the nitrification-denitrification process and effluent discharge from the plant were attributed to the WNWRP. As shown in Table 14, approximately 570 MG of wastewater was generated in South Pasadena in 2016, resulting in 216 MT of CO_2e (21 percent of water/wastewater missions) attributed to process emissions and fugitive emissions. Energy-related emissions associated with the collection and treatment of wastewater generated in South Pasadena were calculated using ICLEI Method WW.15 where emissions are due to the amount of energy required to collect and treat generated wastewater. LACSD-specific energy intensity factors for wastewater collection and treatment were used to calculate emissions due to energy consumption for wastewater.[37] Because SCE is the electricity provider to South Pasadena, SCE's energy emission factor of 0.529 lbs CO_2e/kWh was applied to the calculated annual energy electricity consumed to estimate emissions generated. As shown in Figure 14 and Table 14, the energy associated with the treatment of wastewater resulted in 111 MT of CO_2e or 11 percent of emissions from the water/wastewater sub-sector. The total emissions associated with wastewater generation in South Pasadena in 2016 was 326 MT of CO_2e.

5.2.4 Solid Waste

The solid waste sector totaled of approximately six percent of total community-wide emissions in 2016. Emissions associated with the solid waste sector result from: the collection and transport of waste to landfills, the decomposition of waste at a landfill, combustion of waste, and waste processing equipment. The City of South Pasadena has a landfill within City jurisdictional boundaries, the South Pasadena City Dump; however, this facility has been closed since 1958, and is excluded from this inventory due to a lack of data. In 2016, the community disposed of 18,484 tons of solid waste with nearly all (18,481 tons, >99 percent) waste disposed of at a landfill with a landfill

[34] Whittier Narrows average treatment: City of El Monte Downtown Main Street TOD Specific Plan Final EIR. Update of the EIR. 2017. Pg. 42. http://www.elmonteca.gov/DocumentCenter/View/1420/Final-EIR-and-Responses-to-Comments-March-2017?bidId=

[35] Sanitation District of Los Angeles. 2012. Joint Outfall Systems 2010 Master Facilities Plan Final EIR/EIS. Chapter 2. Pg. 2-17. https://www.lacsd.org/civicax/filebank/blobdload.aspx?blobid=3258

[36] Sanitation District of Los Angeles. 2012. Joint Outfall Systems 2010 Master Facilities Plan Final EIR/EIS. Chapter 2. Pg. 2-12. https://www.lacsd.org/civicax/filebank/blobdload.aspx?blobid=3258

[37] California Public Utilities Commission (CPUC). 2010. Embedded Energy in Water Studies; Study 2: Water Agency and Function Component Study and Embedded Energy-Water Load Profiles. (http://www.cpuc.ca.gov/general.aspx?id=4388)

gas collection system.[38] A small amount of South Pasadena waste (three tons) was also sent to a waste combustion facility. The 2016 CalRecycle Disposal Reports by Jurisdiction was used to determine the proportion of South Pasadena's waste that was distributed to each landfill. Emissions associated with community-generated waste disposed of at a landfill (i.e. waste-in-place) were calculated using ICLEI CP Method SW.4. The specific mix of waste generated in the community was not available; therefore, the default emission factor for mixed-waste, 0.06 MT CH_4/short ton, was multiplied by the total waste disposed from the community. Based on the ICLEI protocol and landfill operations a 10 percent oxidation rate was assumed. A landfill gas capture rate of 73 percent was assumed, derived by taking the average landfill gas capture rate, according to USEPA's Landfill Methane Outreach Program database, of the facilities that received waste from South Pasadena, weighted by the mass of waste sent to each facility. As such, emissions from waste disposal by South Pasadena at landfills generated approximately 7,509 MT of CO_2e in 2016. As shown in Figure 15 and Table 15 emissions from waste sent to landfills made up 97 percent of the community waste sector emissions. However, it is important to note that emissions generated from waste sent to a landfill are not all generated in the base year of 2016, but will result from the decomposition of 2016 waste over the full 100-plus year cycle of decomposition.

Emissions generated at the landfill facilities from waste processing equipment was estimated using ICLEI Method SW.5, where the total tonnage of waste disposed was multiplied by the natural gas default factor of 0.011 MT of CO_2e/waste tonnage. The 203 MT of CO_2e generated from the processing of waste makes up three percent of the emissions from the waste sector. It was assumed that haul trucks were fueled by diesel and therefore diesel emission factors were used for the collection and transportation of waste in South Pasadena. Emissions generated from waste collection was calculated using ICLEI Method SW.6 by multiplying the total tonnage generated in the City by the emission factor for waste collection, 0.017 MT of CO_2e/tonnage. Emissions generated from the transport of waste to landfills was also estimated using ICLEI Method SW.6 where the proportion of waste sent to a particular landfill was multiplied by the distance to the landfill and the emission factor of 0.00012 MT CO_2e/tonnage/mile.[39] Collectively, the collection and transportation of waste generated 96 MT of CO_2e. However, emissions generated from the collection and transportation of waste are solely reported here as an indicator and have not been included as part of the inventory as they are included in the on-road transportation sector emissions. In 2016 a small amount of waste generated in South Pasadena was sent to a waste combustion facility in addition to landfills. Emissions generated from the combustion of waste was calculated using ICLEI Method SW.7, where the emissions associated with the combustion of waste from South Pasadena was determined by applying the ratio of South Pasadena's waste to the overall amount of waste combusted at the facility to the facility's overall reported emissions.[40] As such, combustion of waste from South Pasadena only resulted in an estimated 1 MT of CO_2e, less than one percent of the total amount of emissions from the waste sector. Figure 15 and Table 15 provide a summary of the breakdown of emissions associated with solid waste generation in the community by source.

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[38] CalRecycle 2016 Disposal Reports by Jurisdiction (https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility) was used to determine the landfills that received South Pasadena community waste. Additionally, the USEPA's Landfill Methane Outreach Program ([LMOP], https://www.epa.gov/lmop) database was used to identify whether the landfills had a landfill gas collection system or not.

[39] Transport distance was calculated using Google Maps by querying the directions from the center of South Pasadena to each facility.

[40] GHG emissions generated at the combustion facility were reported to EPA's GHG Reporting Program at https://ghgdata.epa.gov/ghgp/main.do.

Figure 15 Waste Emissions by Source

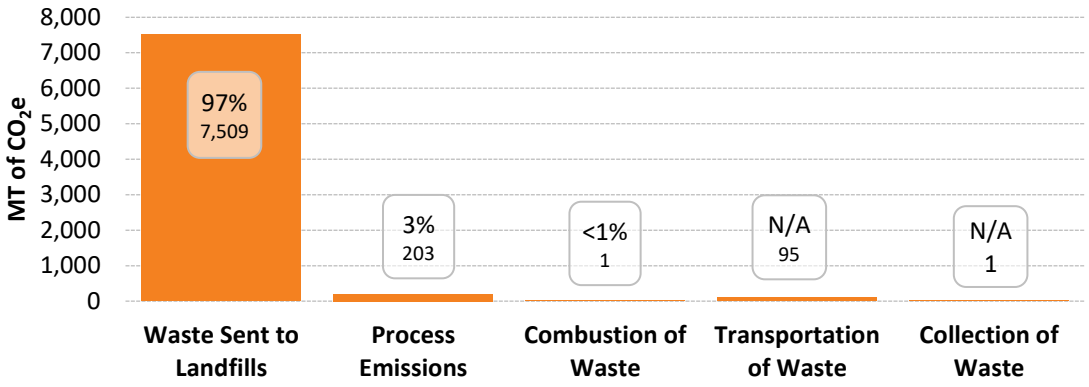

Table 15 Solid Waste Emission Sources

Source	GHG Emissions (MT of CO_2e)	Percentage of Sector Total
Waste Sent to Landfills	*7,509*	*97*
Process Emissions	*203*	*3*
Combustion of Waste	*1*	*<1*
Collection of Waste [1]	1	N/A
Transportation of Waste[1]	*95*	*N/A*
Total	7,713	100%

1. Emissions generated from waste transportation and collection activities have been included here just as an indicator and are excluded from the inventory calculation since they are included in the on-road transportation sector emissions.

6 Conclusion

This Inventory is intended to provide data that can assist decision makers and stakeholders in identifying opportunities to reduce GHG emissions throughout the City of South Pasadena. It also provides an emissions baseline that the City can use to set future emissions reduction targets. As previously detailed, the City emitted approximately 125,269 MT of CO_2e in 2016. Municipal GHG emissions totaled 2,755 MT of CO_2e, or two percent of that total.

Programs and policies are already underway to help South Pasadena reduce its GHG emissions consistent with AB 32 and SB 32. Such programs include the City's membership in the Clean Power Alliance, water conservation initiates, and composting programs, as well as rebates provided from local entities and utility providers such as the Southern California Gas Company, Southern California Edison, City of South Pasadena, California Solar Initiative, Metropolitan Water District, and San Gabriel Valley Council of Government.