City of Laguna Beach

Greenhouse Gas Emission Inventory

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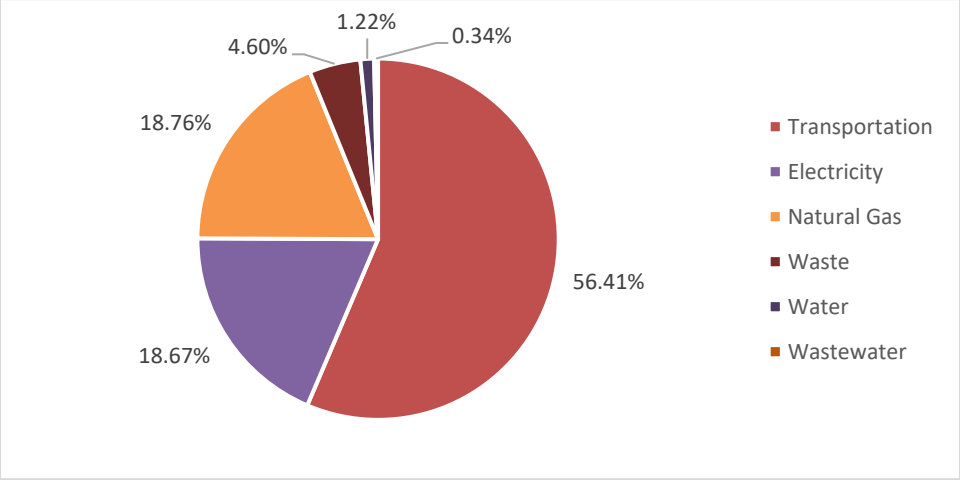
1 Executive Summary

This report quantifies greenhouse gas (GHG) emissions from municipal facilities and operations as well as for the community as a whole for the City of Laguna Beach. The inventory identifies the major sources of GHG emissions generated in 2018. The intent of this document is to provide City decision-makers and the community at large with the necessary detail to inform climate-related policy decisions, and to provide a baseline against which future emission reduction progress can be measured. Completing a baseline inventory is a local jurisdiction's first step in tracking emissions trends and setting targets for future reductions.

The City of Laguna Beach's primary sectors/sources of emissions in 2018 were related to transportation, electricity, and natural gas,[1] as shown in Figure 1. Water, waste, and wastewater accounted for approximately 6 percent of community emissions.

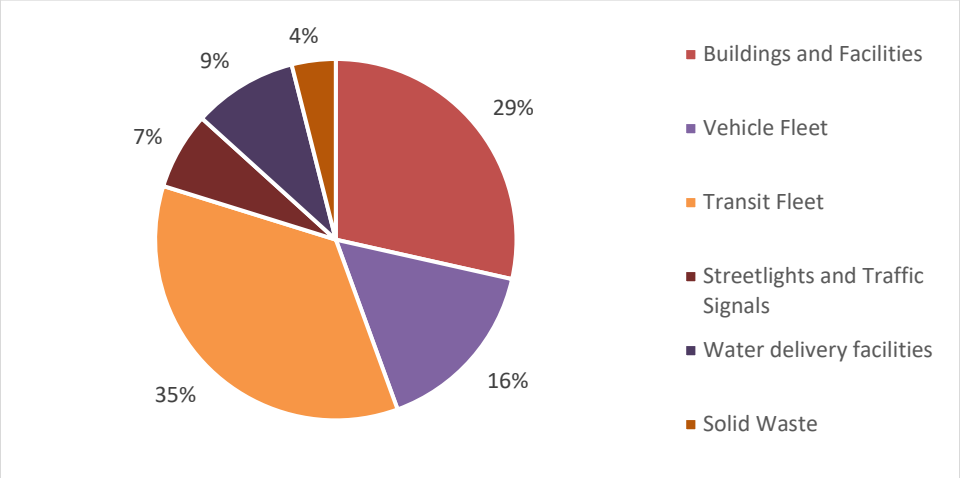
Figure 1 2018 Community GHG Inventory by Sector



For municipal operations, the City of Laguna Beach's primary sectors/sources of emissions were generated by its vehicle fleet, buildings, and facilities, as shown in Figure 2. The remaining sources of municipal emissions included streetlights, water delivery, and solid waste.

[1] Electricity and natural gas emission sources when combined result in the total community "Energy" sector emissions.

Figure 2 2018 Municipal GHG Inventory by Sector



2 Introduction

The State of California considers GHG emissions and the impacts of climate change to be a serious threat to public health, the environment, economic well-being, and the natural resources of the state. In response, the state has established two major GHG-related goals in Assembly Bill (AB) 32 and Senate Bill (SB) 32. AB 32 required state agencies to reduce GHG emissions in California to 1990 levels by 2020, while SB 32 requires a 40 percent reduction below 1990 levels by 2030. The goals set by AB 32 were achieved by the state in 2016[2] and many jurisdictions are completing local GHG inventories to quantify progress toward their own 2020 goals.

Local governments play a fundamental role in reducing state-level and local GHG emissions. Local government policies can influence high-emission behaviors, mitigate climate change effects, and prepare the community for a more resilient future. Through such efforts, the City of Laguna Beach can achieve GHG emission reductions at both the municipal and community level. Estimating GHG emissions in a GHG inventory enables local governments to quantify the major sources of GHG emissions produced by community-wide activities, establish an emissions baseline, track emissions trends, and identify the greatest sources of GHG emissions within their jurisdiction. The inventory can also serve as the basis for climate action planning.

The City of Laguna Beach exercises direct control over its municipal GHG emissions-generating activities. For example, it can reduce or offset energy consumption with renewable energy in municipal buildings, reduce or offset fuel consumption in the municipal vehicle fleet, and increase the amount of energy that is obtained from renewable energy sources. At the community level, the City can exercise its influence through local land use planning, building standards, and public and private partnerships to develop behavior-changing policies. Through its influence, the City can improve building codes, incentivize alternative transportation options, expand options for waste stream diversion and renewable energy sources, and educate community members about their choices as consumers.

In order to support the City of Laguna Beach in developing an emissions baseline and set the foundation to establish climate action policies, this document includes a 2018 baseline inventory of GHG emissions for the City. This baseline GHG inventory is a significant step to understanding the GHG emissions within the City and was specifically developed to serve the following purposes:

- Provide an understanding of where the highest sources of emissions in the City of Laguna Beach originate and where the greatest opportunities for emission reductions exist.
- Create a GHG emissions baseline from which the City can establish GHG emissions reduction targets and evaluate future progress.
- Enable the City to understand the scale of GHG emissions from various sources and develop improved GHG emissions accounting and reporting principles.
- Aid in the future development of a citywide Climate Action Plan.

[2] Statewide GHG emissions fell below 1990 levels in 2016, generally achieving the goals of AB 32. Please refer to: 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

3 Methodology

This inventory was completed using the International Council for Local Government Initiatives (ICLEI) protocols. Specifically, the *U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions Version 1.2* (ICLEI CP) was used for calculating community-wide emissions and the *Local Government Operations Protocol Version 1.1* (ICLEI LGOP) was used for calculating municipal emissions. Like all emissions inventories, this document relies on the best available data and calculation methodologies at the time of analysis. Emissions estimates are subject to change as better data and calculation methodologies become available in the future.

The 2018 inventory includes quantification of GHG emissions from (1) community-wide activities within the City of Laguna Beach, and (2) City government (municipal) operations, a subset of community-wide activities. Importantly, as the municipal inventory is a subset of the community inventory, the municipal emissions are included within the community-wide inventory.

3.1 Baseline Year

The State of California uses 1990 as a reference year to remain consistent with AB 32, which codified the state's 2020 GHG emissions target by directing the California Air Resources Board (CARB) to reduce statewide emissions to 1990 levels by 2020. However, cities and counties throughout California typically elect to use years later than 1990 to conduct a baseline inventory because of the increased reliability of recordkeeping from later years and the large amount of growth that has occurred since 1990. The year 2018 was selected as the baseline year for the City's inventory due to the availability of reliable data in that year.

3.2 Community-wide and Municipal Inventories

The community inventory includes all emissions occurring within Laguna Beach'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 includes emissions resulting from facilities that the City owns and/or operates. The municipal inventory is a subset of the community inventory, meaning that all municipal operations are included in the community inventory. The municipal inventory should not be added to the community inventory; rather, it should be considered a portion of the total community emissions, as demonstrated in Figure 3. Although municipal operations represent only a small portion of the community's overall emissions, a municipal inventory allows the City to develop and track municipal-specific emissions and emission reduction measures, setting an example for the community at large and actively reducing its fair share of emissions.

Figure 3 Relationship Between Community-wide and Municipal Inventories

3.3 Emissions by Scope and Sector

Community and municipal emissions can be categorized by "scope" or by "sector." Scope refers to jurisdictional degree-of-control over the emissions source and the location of the source. Emission 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.

ICLEI recommends that local governments examine their emissions by sector, in addition to scope. Sector refers to the high-level activity that generates the emissions. Emissions inventories can consider many different sectors; the most common examples are energy (i.e., electricity and natural gas) and transportation (i.e., vehicle miles travelled). 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, typical in climate action planning. The scopes and sectors considered in community inventories are slightly different than those considered in municipal inventories, as detailed in Table 1.

Table 1 Emission Scopes and Sectors for Community and Municipal Inventories

Emissions Category	Definition[1]
Scope	
Community Scope Definitions	
Scope 1	Direct GHG emissions from sources located within the jurisdictional boundaries of the community, including emissions from fuel combustion vehicles 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).
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.).
Sector	
Community Sector Definitions	
Energy	GHG emissions associated with the consumption of energy for residential and commercial buildings in the City. Types of energy considered are natural gas, diesel, and propane (scope 1), and electricity (scope 2).
Transportation	GHG emissions associated with the operation of passenger and commercial vehicles within the City (scope 1). Transportation data is typically modeled and characterized by vehicle-miles-travelled for different types of vehicles.
Waste	GHG emissions associated with decomposition of municipal solid waste generated by the City in a landfill (scope 3).
Water	GHG emissions associated with the electricity used for acquisition, distribution, and treatment of water (scope 3).
Wastewater	GHG emissions associated with wastewater treatment processes, as well as the acquisition, distribution, and treatment of water (scope 3).

Municipal Sector Definitions	
Buildings & facilities	GHG emissions associated with the operation of City-owned and operated buildings and facilities. This typically includes the electricity natural gas, diesel, and propane (scope 1) and electricity (scope 2) used for these purposes, similar to the energy sector of the community inventory.
Vehicle fleet	GHG emissions associated with the vehicle fleet owned and operated by the City and its departments (scope 1). This may include personally-owed vehicles of City employees (scope 3).
Transit fleet	GHG emissions associated with transit fleet vehicles owned and operated by the City and its departments (scope 3).
Streetlights & traffic signals	GHG emissions associated with the electricity used for operation of streetlights within the City (scope 3).
Water delivery facilities	GHG emissions associated with electricity used for water conveyance and stormwater drainage associated with City operations (scope 3).
Solid waste	GHG emissions associated with municipal solid waste generated by City employees (scope 3). If the City operates a landfill, process emissions from the landfill may be included in this category as well. The City of Laguna Beach does not have a landfill and therefore these emissions are not included in this analysis.

[1] Scope and sector definitions in this table are from the ICLEI CP

The emissions inventory excludes some community and municipal sectors from consideration, as they were either not under the jurisdicational control of the City, or were not considered relevant emissions sources for the inventory. Community sectors considered outside of jurisdictional control included consumption-based emissions and irrelevant sectors included natural and working lands, industrial, and agricultural emissions. Municipal sectors considered outside of jurisdictional control included process and fugitive emissions, while irrelevant sectors included port facilities, airport facilities, power generation facilities, and wastewater facilities.

3.4 Greenhouse Gases

The ICLEI CP and LGOP suggest local governments assess emissions associated with the six internationally-recognized GHGs, as outlined in Table 2. This inventory 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, are the subject of regulation at the state level and are therefore omitted from this inventory. Table 2 also includes the global warming potentials (GWP) for each gas. 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).[3] The GWP refers to the ability of each gas to trap heat in the atmosphere.[4] For example, one pound of methane gas has 28 times more heat capturing potential than one pound of carbon

[3] 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.

[4] 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).

dioxide gas. GHG emissions are reported in metric tons of CO_2 equivalent (MT CO_2e), per standard practice.

Table 2 Greenhouse Gases

Greenhouse Gas	Source	GWP
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	Leaking refrigerants and fire suppressants	4 - 12,400
Perfluorocarbons	Aluminum production, semiconductor manufacturing, HVAC equipment manufacturing	6,630 - 11,100
Sulfur Hexafluoride (SH_6)	Transmission and distribution of power	23,500

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

3.5 Activity Data and Emission Factors

Emissions are calculated using activity data and emission factors according to the following equation:

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

Activity data refer to the relevant measured or estimated energy use or other GHG-generating process such as fuel consumption by fuel type, metered annual electricity consumption, or annual vehicle miles travelled. Activity data is geographically and temporally bounded by the inventory year (2018) and location (City of Laguna Beach). Emission factors are observation-based conversion factors used to equate activity data to generated emissions. Emission factors are activity data-specific, and are usually expressed in terms of emissions per unit of activity data (e.g., pounds of CO_2e per megawatt-hour). The data used to complete this inventory are summarized, by sector, in Table 3. Unless otherwise specified, data was collected for the year 2018, within the geographical boundary of the City of Laguna Beach. Emission factors used and their sources are detailed in the sections specific to each sector.

Table 3 Activity Data and Sources

Sector	Activity Data and Source	Unit	Data Source
Community Inventory			
Energy	Electricity usage (commercial, residential)	kWh	Southern California Edison (SCE) and San Diego Gas and Electric Company (SDG&E)
	Natural gas usage (commercial, residential)	therms	Southern California Gas Company (SCG)
Transportation	Vehicle miles traveled by vehicle type	miles	Iteris, Inc. Traffic Consultants – 2016 VMT model
Waste	Solid waste landfilled	tons	City of Laguna Beach Tonnage/Diversion Report - 2018
Water	Volume of water consumed	gallons	South Coast Water District (SCWD) and Laguna Beach County Water District (LBCWD)
Wastewater	Volume of water treated	gallons	South Orange County Water Agency (SOCWA)
Municipal Inventory			
Buildings & facilities	Municipal electricity usage – buildings and facilities	kWh	SCE and SDG&E billing history from City
	Municipal natural gas usage	therms	SCG billing history from City
Vehicle fleet	Annual 2019 mileage for all City-owned vehicles[1]	miles	Fleet vehicle list and mileage data
Transit fleet	Annual 2019 mileage for all City-owned transit vehicles	miles	Fleet vehicle list and mileage data
Streetlights & traffic signals	Municipal electricity usage - streetlights	kWh	SCE and SDG&E billing history from City
Water delivery facilities	Municipal electricity usage – water, sewer, and wastewater accounts	kWh	SCE and SDG&E billing history from City
	Municipal natural gas usage – sewer accounts	therms	SCG billing history from City
Solid Waste	Solid waste landfilled in Laguna Beach[2]	tons	City of Laguna Beach Tonnage/Diversion Report - 2018
Additional Data			
Demographic Data	City population, County population, City's resident workers	persons	Southern California Association of Governments

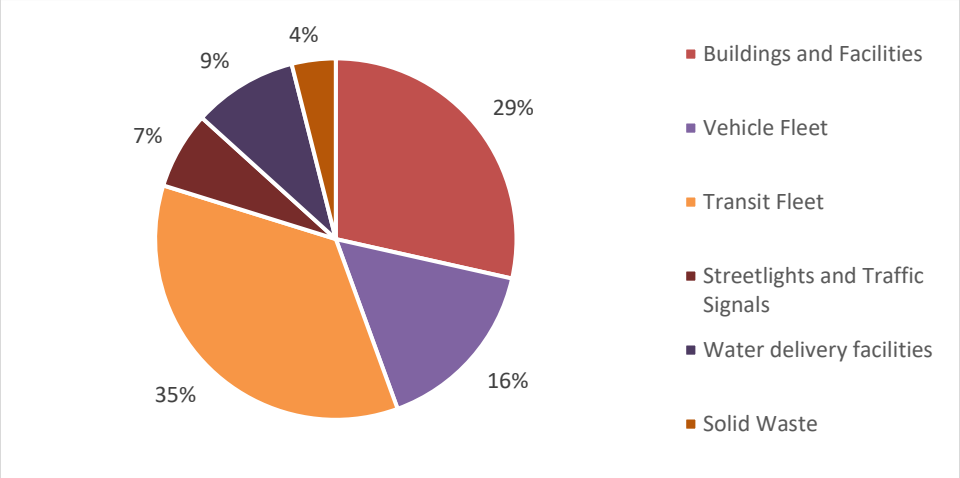
[1] 2018 data not available; 2019 data used as proxy

[2] Total waste divided by service person (population + employees) to create efficiency metric

4 Municipal GHG Inventory

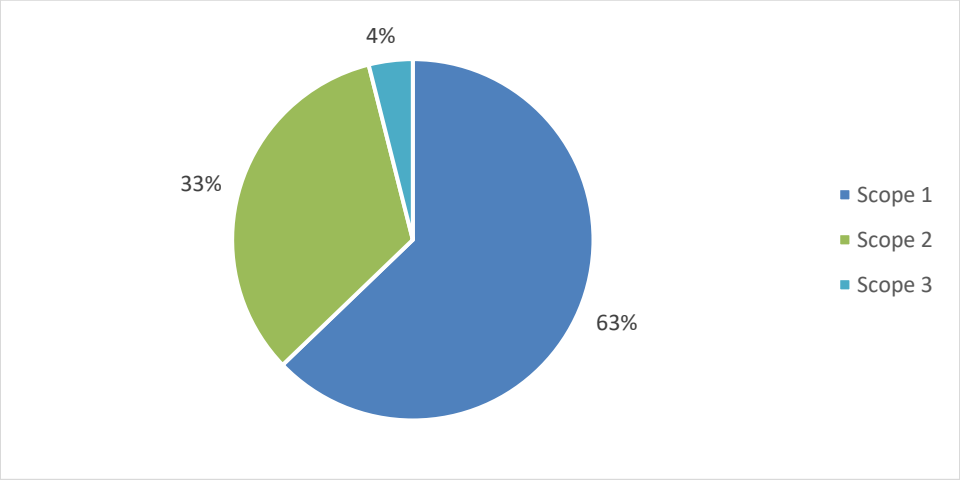
Municipal emissions are presented by scope and sector. By sector, vehicle fleet emissions are the greatest source, consisting of emissions from on-road and off-road vehicles and public trolleys, as shown in Figure 4. Building and facility emissions from electricity and natural gas usage are the second greatest emission sector. The smallest emissions sources are water (electricity and natural gas usage), streetlights (electricity usage), and solid waste.

Figure 4 Municipal GHG Emissions by Sector



When compared by scope (Figure 5), scope 1 emissions are the largest and include vehicle fleet emissions, building and facility emissions from natural gas usage, and water emissions from natural gas usage. Scope 2 emissions are the second largest source, which include electricity usage by buildings and facilities, streetlights, and water usage. Scope 3 is the smallest emissions source, and consists of emissions from waste.

Figure 5 Municipal GHG Emissions by Scope



All emissions by both scope and sector are included in Table 4.

Table 4 Municipal GHG Emissions by Scope and Sector (MT CO_2e)

Sector	Subsector	Scope 1	Scope 2	Scope 3	Total
Buildings & facilities	Electricity	-	459	-	**459**
Buildings & facilities	Natural Gas	311	-	-	**311**
Vehicle fleet	On-road	421	-	-	**421**
Vehicle fleet	Off-road	9	-	-	**9**
Transit fleet	Public trolleys	955	-	-	**955**
Streetlights & traffic signals	Electricity	-	187	-	**187**
Water delivery facilities	Electricity	-	252	-	**252**
Water delivery facilities	Natural Gas	1	-	-	**1**
Solid Waste	N/A	-	-	106	**106**
Total		**1,697**	**898**	**106**	**2,702**

N/A = Not applicable

4.1 Buildings and Facilities

The City of Laguna Beach has electricity service accounts with Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E)[5] to provide electricity to various City buildings, including animal services, fire stations, parking lots, parks, police stations, and transit buildings. Energy data for the Laguna Beach Library is not included, as it is owned and operated by Orange County. Electricity used for streetlights and water delivery facilities was accounted for separately under the streetlights and water delivery sectors. The City also has natural gas service accounts with Southern California Gas (SCG), used primarily to provide heating to various buildings and facilities, including the community center, high school and community pool, fire stations, and Marine Mammal Center, among others. The data and emission factors used to conduct emissions calculations for the buildings and facilities sector are included in Table 5.

Table 5 Municipal Buildings and Facilities Data and GHG Emission Factors

Emissions Source (Unit)	Activity Data	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
SCE Electricity (kWh)	1,923,115	0.0002330[1]	448
SDG&E Electricity (kWh)	41,524	0.0002735[2]	11
SCG Natural Gas (therms)	58,504	0.005311[3]	311
Total	**N/A**	**N/A**	**770**

N/A = Not applicable
[1] https://www.edison.com/content/dam/eix/documents/sustainability/eix-2018-sustainability-report.pdf
[2] https://www.sdge.com/sites/default/files/regulatory/R.18-07-003%20SDGE%20Final%202018%20RPS%20Public%20Version.pdf
[3] https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

4.2 Vehicle Fleet and Transit Fleet

The municipal vehicle fleet consisted of gasoline and diesel-powered vehicles in 2019. The transit fleet consisted of City-owned and operated propane-powered Molly trolleys and Hometown trolleys in 2019. As previously noted, the vehicle fleet data for 2019 was used rather than 2018 because only

[5] No natural gas is provided to the City of Laguna Beach from SDG&E.

quality 2019 data was available.[6] A full inventory of City-owned vehicles, including the fuel type, make, model, year, and annual mileage for 2019 were provided. Rincon used the CARB Emission Factor (EMFAC) model to estimate an emission factor (CO_2e per mile) for each of the 31 EMFAC2007 vehicle categories.[7] City-owned vehicles were classified based on EMFAC2007 vehicle classes in order to assign emission factors to each vehicle.[8] The propane-fueled Hometown Trolleys and Molly Trolleys (i.e., transit fleet) used within the City as a local public transportation option, were analyzed separately, as propane-fueled vehicles are not included within the CARB EMFAC model. Instead, all trolleys were estimated to have an average mileage of 5.91 miles per gallon based on a 2006 study from Penn State[9] and a default emission factor for propane provided by the United States Environmental Protection Agency (U.S. EPA) was used. Off-road vehicle data was provided in gallons of diesel used and a default emission factor for diesel provided by the U.S. EPA was used. The data and emission factors used to conduct emission calculations for the vehicle fleet sector are included in Table 6.

Table 6 Municipal Vehicle and Transit Fleet Data and GHG Emission Factors

Vehicle Class	Activity Data	EF (MT CO_2e/unit)	Emissions (MT CO_2e)
Vehicle Fleet - On-Road Vehicles (activity data in miles)[1]			
HHDT	35,755	0.02941	63
LDA	71,504	0.00426	20
LDT1	15,142	0.00094	5
LDT2	435,556	0.01629	149
MCY	11,000	0.00072	3
MDV	121,955	0.01538	52
MHDT	7,477	0.00842	7
UBUS	57,308	0.01718	123
Vehicle Fleet - Off-Road Vehicles (Activity data in gallons)			
Diesel	895	0.01024[2]	9
Transit Fleet - Trolleys (Activity data in miles)			
Molly trolleys and Hometown trolleys	204,858	0.00466[3]	955
Total	**N/A**	**N/A**	**1,386**

N/A = Not applicable

[1] Emission factors for on-road vehicles derived from CARB EMFAC2007 model; HHDT = heavy-heavy duty trucks, LDA = passenger cars, LDT1 = light light-duty trucks, LDT2 = heavy light-duty trucks, MCY = motorcycles, MDV = medium-duty trucks, MHDT = medium-heavy-duty trucks, UBUS = urban bus

[2] Diesel emission factor derived based on default values from EPA: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

[3] Propane emission factor derived based on default values from EPA: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

[6] Rincon confirmed with the City of Laguna Beach that no major changes in operations occurred with the vehicle fleet between 2018 and 2019 and 2019 data is generally representative of 2018 data.

[7] https://arb.ca.gov/emfac/2014/

[8] https://ww3.arb.ca.gov/msei/onroad/downloads/docs/user_guide_emfac2007.pdf

[9] http://apps.altoonabustest.psu.edu/buses/120

4.3 Streetlights and Traffic Signals

The streetlights and traffic signals sector is characterized solely by electricity used to power streetlights and traffic signals within the City. Electricity for streetlights in Laguna Beach comes from both SCE and SDG&E, as summarized in Table 7. Emission factors used for SCE and SDG&E were the same as under the buildings and facilities sector.

Table 7 Municipal Streetlights and Traffic Signals Data and GHG Emission Factors

Emissions Source	Activity Data (kWh)	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
SCE Electricity	740,622	0.0002330	173
SDG&E Electricity	52,425	0.0002735	14
Total	**N/A**	**N/A**	**187**

N/A = Not applicable

4.4 Water Delivery Facilities

Emissions for water delivery facilities come from electricity and natural gas usage to power water delivery pumps, sewage pumps, and the sewer pump station within Laguna Beach, and are summarized in Table 8. Electricity for water delivery infrastructure in Laguna Beach comes from both SCE and SDG&E and was separated from the data for the energy sector into the water delivery facilities sector. Emission factors used for the water delivery activity data were the same as described for the buildings and facilities sector.

Table 8 Municipal Water Delivery Facilities Data and GHG Emission Factors

Emissions Source (Unit)	Activity Data	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
SCE Electricity (kWh)	1,075,870	0.0002330	251
SDG&E Electricity (kWh)	4,675	0.0002735	1
SCG Natural Gas (therms)	109	0.0053115	1
Total	**N/A**	**N/A**	**253**

N/A = Not applicable

4.5 Solid Waste

Solid waste is generated by municipal employees as part of regular municipal operations. However, waste generated by employees for municipal operations is not tracked by the City. Rincon used employee counts for 2018 and a waste generation rate (in tons of waste per employee per year) from CalRecycle to estimate total waste generated by municipal employees in 2018. Emissions associated with the estimated employee-generated solid waste were calculated using ICLEI CP equation SW.4. The details of the calculation and the assumptions made for this sector are included in Table 9.

Table 9 Municipal Solid Waste Data and GHG Emission Factors

Emissions Source	Activity Data	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
Employees[1]	477	N/A	-
Waste generation rate (tons/employee/year)[2]	0.59	N/A	-
Municipal employee waste (tons)[3]	281	0.378	106

N/A = Not applicable

[1] Employees were calculated based on the number of full-time, part-time, and seasonal employees in 2018. Part-time employees were calculated as half employees and seasonal employees were calculated as quarter employees.

[2] https://www2.calrecycle.ca.gov/WasteCharacterization/General/Rates

[3] Emissions calculated using ICLEI CP default emission factor and equation SW.4

5 Community GHG Inventory

Community GHG emissions are presented by scope and sector. As shown in Figure 6, transportation emissions are the largest source by sector, followed by energy (electricity and natural gas), waste, water, and wastewater.

Figure 6 Community Emissions by Sector

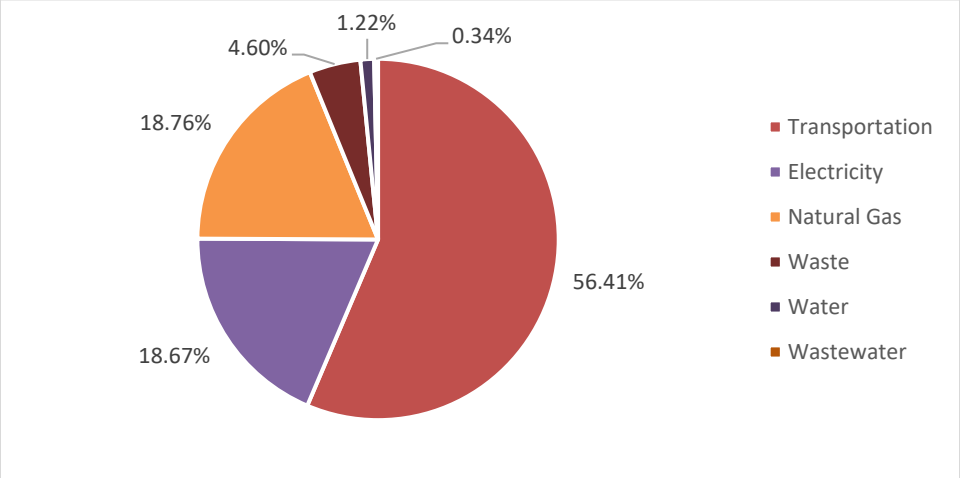
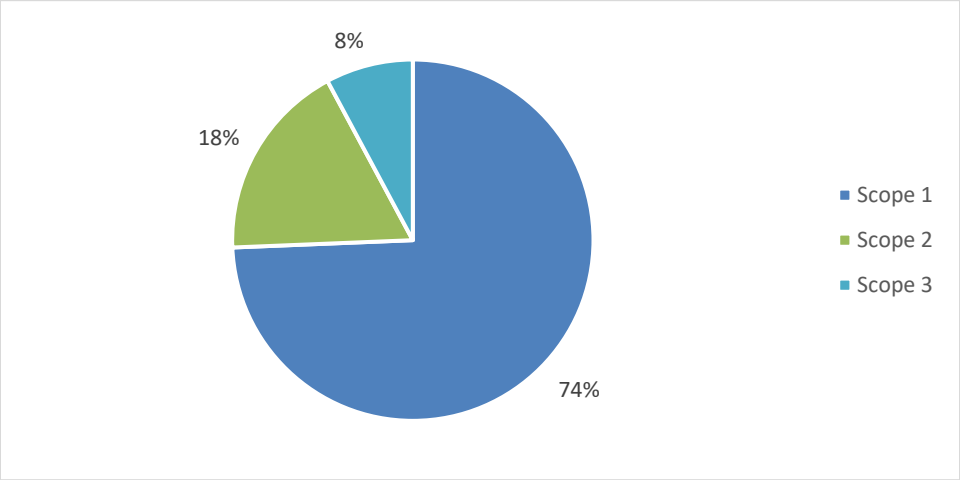


Figure 7 demonstrates that scope 1 GHG emissions are the greatest, consisting of residential and commercial natural gas usage, and fuels used by on-road vehicles. Scope 1 GHG emissions are followed by scope 2 GHG emissions, which include residential and commercial electricity usage. Scope 3 emissions result in the smallest source of emissions, and account for GHG emissions from electricity transmission and distribution losses, public transit, waste, wastewater, and water.

Figure 7 Community Emissions by Scope



All emissions by both scope and sector are summarized in Table 10.

Table 10 Community Emissions by Scope and Sector (MT CO_2e)

Sector	Subsector	Scope 1	Scope 2	Scope 3	Total
Energy	Residential Natural Gas	23,114	-	-	**23,114**
Energy	Commercial Natural Gas	9,175	-	-	**9,175**
Energy	Residential Electricity	-	19,407	-	**19,407**
Energy	Commercial Electricity	-	11,246	-	**11,246**
Energy	Electricity Transmission and Distribution Losses	-	-	1,471	**1,471**
Transportation	Passenger Vehicles	82,466	-	-	**82,466**
Transportation	Light/Medium-Duty Vehicles	3,768	-	-	**3,768**
Transportation	Heavy-Duty Vehicles	9,440	-	-	**9,440**
Transportation	Public Transit	-	-	1,403	**1,403**
Waste	Waste Sent to Landfill	-	-	7,688	**7,688**
Waste	Landfill Process Emissions	-	-	224	**224**
Wastewater	Wastewater Collection & Treatment	-	-	179	**179**
Wastewater	Wastewater Process and Fugitive Emissions	-	-	413	**413**
Water	Water Transport, Distribution, and Treatment	-	-	2,102	**2,102**
Total		**127,963**	**30,653**	**13,481**	**172,097**

5.1 Energy

The energy sector includes GHG emissions resulting from electricity and natural gas used in residences and commercial buildings throughout the City of Laguna Beach. Industrial accounts were not included, as industrial emissions are tracked and controlled at the state level through the California cap and trade program. The City gets electricity from both SCE and SDG&E.[10] Natural gas is provided by SCG. Activity data for all commercial and residential accounts within the City were provided by SCE, SDG&E, and SCG.

Total electricity usage includes electricity from transmission and distribution (T&D) losses. T&D losses occur as electricity is transported from its generation source to its final end use destination. Although emissions generated due to T&D losses are outside the City's operational control, they are directly related to magnitude of electricity usage within the community and should be included in the community emissions.[11] T&D losses were calculated as a percentage of community electricity usage, using a grid loss factor of 4.8 percent for the California sub-region (CAMX) from the U.S EPA's Emissions and Generating Resource Integrated Databases (eGRID).[12] Activity data and emission factors used for energy sector calculations are included in Table 11.

[10] No natural gas is provided by SDG&E to the City of Laguna Beach.

[11] ICLEI 2019. U.S. Community Protocol for Account and Reporting Greenhouse Gas Emissions. Pg. 36.

[12] https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf

Table 11 Community Energy Data and GHG Emission Factors

Emissions Source	Activity Data	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
SCE Electricity (kWh)	123,271,005	0.0002330[1]	28,722
SDG&E Electricity (kWh)	12,440,600	0.0002735[2]	3,403
SCG Natural Gas (therms)	6,079,130	0.0053115[3]	32,289
Total	**N/A**	**N/A**	**64,414**

N/A: Not applicable
[1] https://www.edison.com/content/dam/eix/documents/sustainability/eix-2018-sustainability-report.pdf
[2] https://www.sdge.com/sites/default/files/regulatory/R.18-07-003%20SDGE%20Final%202018%20RPS%20Public%20Version.pdf
[3] https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

5.2 Transportation

Transportation GHG emissions are generated by the community through on-road transportation and the public transit system operated by the Orange County Transportation Authority (OCTA), which is summarized in Table 12. There are no railroads that run through the City and the City does not have operational control of an airport or marine vessels.

Table 12 Community Transportation Data and GHG Emission Factors

Emissions Source	Activity Data	EF (g CO_2e/Unit)	Emissions (MT CO_2e)
On-road Transportation (Annual VMT)			
Auto	247,970,017	333	82,466
Light-Heavy Trucks	2,327,676	717	1,668
Medium-Heavy Trucks	1,767,271	1,188	2,099
Heavy-Heavy Trucks	5,644,996	1,672	9,440
OCTA Public Transit (Annual VMT)			
Route 1	125,343	2,343	294
Route 89	65,892	2,343	154
Public Trolleys[1]	204,858	4,660	955
Total	**N/A**	**N/A**	**97,077**

Notes: N/A = Not Applicable; values may not add up due to rounding
1. The emissions calculations for the public trolleys are detailed in Section 4.2 and although these vehicles are owned by the City, they are available for public use and the emissions are included in the community inventory because they are a part of overall community GHG emissions.

On-road transportation is the largest contributor to GHG emissions in the transportation sector. On-road activity data were modelled by Iteris, Inc. (Iteris) using a zone-based, origin-destination methodology, as recommended by the Regional Targets Advisory Committee (RTAC) pursuant to Senate Bill 375, and characterized as vehicle miles travelled or VMT. The zone-based methodology identifies the total number of trips produced by, or attracted to, a zone (area of the City) and multiplies it by the full length of the trip from its origin to destination. The origin-destination methodology includes all trips occurring within the City limits and half of any trips that originate or terminate within City limits, and excludes pass-through trips that neither originate nor terminate within the City. The number of trips and the length of the trip was calculated using the Southern California Associated of Governments (SCAG) Regional Transportation Plan (RTP) traffic model. The SCAG RTP traffic model utilizes socio-economic data (e.g., population, employment, households, workers, school enrollment, etc.), transportation analysis zones, and the highway and transit

network for calculations. The traffic model does not include transit trips in community VMT calculations.

Emissions due to on-road transportation were calculated using the ICLEI CP method TR.1.A where VMT data is converted into GHG emissions using Equations TR.1.B.2 and TR.1.B.3 and regional emission factors from CARB's most recent EMFAC model, EMFAC2017. 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 Laguna Beach 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.

Transit within the City of Laguna Beach includes two public buses (Route 1 and Route 89), both operated by OCTA. 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 by Iteris, and emission factors from EMFAC2017. Municipally-owned public trolleys, as described in Section 4.2, were also included in the transit fleet calculations, as these vehicles are a part of overall community GHG emissions.

5.3 Water

Water was provided to the community by the South Coast Water District (SCWD) and the Laguna Beach County Water District (LBCWD). Water supplied to the community indirectly contributes GHG 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 step of the water delivery process was estimated using energy intensities specific to that step. GHG emissions calculated from water usage do not include emissions related to end-use phases such as heating of water.[13] Appropriate ICLEI energy intensities that best represent the City's water extraction, conveyance, treatment, and distribution system were determined based on best available data, including default intensity values from ICLEI CP, relevant Urban Water Management Plans (UWMP), and proxy values from similar water supply systems.

Community-wide water usage data in 2018 from SCWD and LBCWD was apportioned into three categories – groundwater, recycled, and imported – based on supply breakdown information in each water District's UWMP. Both water districts import water from Metropolitan Water District (MWD); therefore, energy intensities from MWD's UWMP were used for imported water. SCWD and LBCWD did not provide water intensities for groundwater or recycled water; therefore, a default ICLEI CP energy intensity was used for groundwater, and a proxy energy intensity from nearby Orange County Water District (OCWD) was used for recycled water. Rincon used ICLEI CP default energy intensities for imported water conveyance, local water conveyance, and water treatment. Due to the fact that a majority of the energy being used for water is associated with imports from MWD, a state-level electricity emission factor from CAMX was used to convert electricity usage to GHG emissions. Further details on the data used for water calculations are provided in Table 13.

[13] Emissions from heating water are included in the energy sector.

Table 13 Community Water Data and GHG Emission Factors

Emissions Source	Activity Data (MG)	Extraction Energy Intensity (kWh/MG)	Conveyance Energy Intensity (kWh/MG)	Treatment Energy Intensity (kWh/MG)	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
Laguna Beach County Water District						
Imported Water	671	1,786[1]	5,300[4]			1,273
Groundwater	340	2,270[2]	330[5]	1,300[6]	0.0002262[7]	300
Recycled Water	12	1,122[3]				7
South Coast Water District						
Imported Water	241	1,786[1]	5,300[4]			457
Groundwater	40	2,270[2]	330[5]	1,300[6]	0.0002262[7]	35
Recycled Water	48	1,122[3]				30
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**2,102**

N/A = Not applicable
[1] MWD UWMP Table A.9-2
[2] ICLEI CP Appendix F Table WW.14.2
[3] ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Water%20Studies%202/Study%202%20-%20FINAL.pdf
[4] ICLEI CP Appendix F Table WW.14.3
[5] ICLEI CP Appendix F Table WW.14.3
[6] ICLEI CP Appendix F Table WW.14.4
[7] https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf

5.4 Wastewater

Wastewater generated in the City of Laguna Beach is collected in local sewer lines that ultimately discharge into the South Orange County Water Authority's (SOCWA) Coastal Treatment Plant (CTP), located in Laguna Niguel. Community-generated wastewater includes both residential and commercial wastewater. Community-generated wastewater data for 2018 was supplied by SOCWA, and operational information about the CTP was supplied by the CTP Director of Operations. The CTP uses anaerobic digestion, does not perform nitrification/denitrification, and produces effluent discharge to the ocean. Rincon therefore used the following methods from the ICLEI CP:

- WW.1 and WW.2 to characterize stationary methane emissions from the combustion of natural gas associated with anaerobic digestion
- WW.8 to characterize process carbon dioxide emissions from wastewater treatment plants without nitrification or denitrification
- WW.12a to characterize fugitive nitrous oxide emissions from effluent discharge to the ocean
- WW.15 to characterize energy-related emissions associated with wastewater collection and treatment

The CTP is a regional plant that serves the City of Laguna Beach, Emerald Bay Services District, and a portion of the South Coast Water District. Rincon therefore used ICLEI CP method WW.13 for atttribution of wastewater emissions outside of operational control, which assigns emissions from the wastewater treatment plant to Laguna Beach based on the portion of Laguna Beach residents served (i.e., population of Laguna Beach) relative to the entire population served. The entire

population served was estimated as a sum of the population of Laguna Beach, the population of Emerald Bay Services District,[14] and 30 percent of the population served by the SCWD.[15]

Table 14 Community Wastewater Data and Emission Factors

Emissions Source	Activity Data	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
Anaerobic Digestion	N/A	N/A	163
Process Emissions	N/A	N/A	20
Fugitive Emissions	N/A	N/A	230
Treatment (MG)	585	0.306162[1]	179
Total	**-**	**-**	**592**

N/A = Not applicable

[1] Calculated as energy intensity times emission factor for electricity. Energy intensity used was a proxy value from nearby Orange County Sanitation District (1,314 kWh/MG). Electricity emission factor used was SCE emission factor (0.000233 MT CO_2e/kWh).

5.5 Waste

GHG emissions associated with the waste sector result from the collection and transportation of waste to landfills, the decomposition of waste at a landfill, combustion of waste, and waste processing equipment, as summarized in Table 15. The City of Laguna Beach does not have a landfill within its boundaries, but rather exports its waste primarily to Frank R. Bowerman Sanitary Landfill, Prima Deshecha Landfill, Olinda Alpha Landfill, and Azusa Land Reclamation Co. Landfill. All four landfills operate a landfill gas collection system, which lowers landfill emissions by collecting a portion of the emissions generated by the landfill, instead of releasing them to the atmosphere. Total tons of solid waste generated by the community were provided by the City of Laguna Beach and used in the emission calculations. GHG emissions associated with community-generated waste disposed at a landfill (i.e., waste-in-place) were calculated using ICLEI CP method SW.4, using the default emission factor for mixed waste. Based on the ICLEI CP and landfill operations, a 10 percent oxidation rate and 75 percent landfill gas capture rate were assumed. GHG emissions generated at the landfill facilities from waste processing equipment was estimated using ICLEI CP method SW.5, where total tonnage of waste disposed is multiplied by the default emissions factor for natural gas equipment. Emissions associated with waste collection and transportation are included under the transportation sector and were not recalculated here.

Table 15 Community Waste Data and GHG Emission Factors

Emissions Source	Activity Data (tons)	EF (MT CO_2e/Unit)	Emissions (MT CO_2e)
Waste-in-place	20,339	0.378	7,688
Processing equipment		0.011	224
Total	**N/A**	**N/A**	**7,912**

N/A = Not applicable

[14] The Emerald Bay Services District provided a population estimate of 1,5000

[15] SCWD owns 30 percent of the capacity of the CTP, as provided by the SCWD's UWMP. The SCWD UWMP estimates its service population to be 37,062

6 Conclusion

This Inventory is intended to assist decision-makers and stakeholders in identifying opportunities to reduce GHG emissions throughout the City of Laguna Beach. It also provides an emissions baseline that the City can use to set future emissions reduction targets. Like many other California communities, the largest sources of emissions in Laguna Beach, at both the community and municipal level, are on-road transportation, natural gas, and electricity usage. Rincon recommends Laguna Beach develop climate action policies that focus on these emission sources for greatest success in reducing community-wide and municipal emissions. Future inventory updates can be used to determine Laguna Beach's success in reducing GHG emissions.