CITY OF SAN RAFAEL

COMMUNITY AND GOVERNMENT OPERATIONS GREENHOUSE GAS INVENTORY FOR 2016

April 2019

Prepared by the
Marin Climate & Energy Partnership

MARIN CLIMATE & ENERGY PARTNERSHIP

Table of Contents

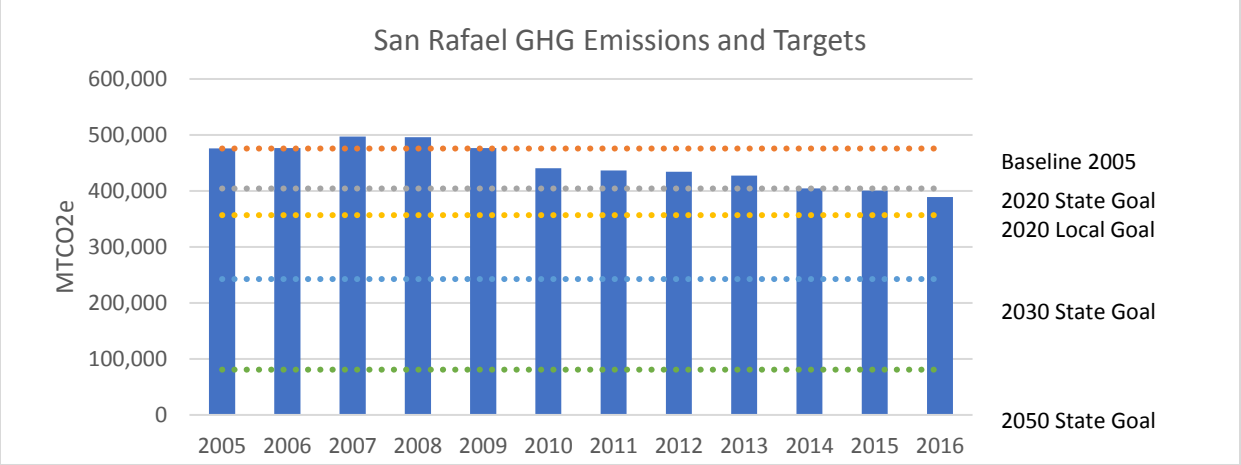
EXECUTIVE SUMMARY

THE TAKEAWAY:

COMMUNITY EMISSIONS DOWN 18% AND GOVERNMENT OPERATIONS EMISSIONS DOWN 16% SINCE 2005

San Rafael publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the City to more closely monitor its progress in meeting its local goal to reduce community emissions 25% below baseline (2005) emissions by 2020 and to meet the statewide goal to reduce emissions 40% below baseline emissions by 2030. In addition to the community inventories, MCEP periodically prepares inventories for government operations emissions.

This report reviews emissions generated from the community from 2005 through 2016, the most recent year data is available. The inventory shows that the San Rafael community has reduced emissions 18% since 2005, meeting the State target for 2020. Emissions dropped from abo ut 473,378 metric tons carbon dioxide equivalents ($MTCO_2e$) in 2005 to 388,950 $MTCO_2e$ in 2016. The community emissions trend and targets are shown below. San Rafael needs to reduce emissions another 147,530 $MTCO_2e$ to meet the State target for 2030 and another 308,450 $MTCO_2e$ to meet the State target for 2050, which is 80% below 1990 levels.



This report also reviews emissions from government operations, a subset of community emissions. Emissions from government operations decreased 16% between 2005 and 2016, or about 700 metric tons CO_2e. While government emissions are less than 1% of overall community emissions, the local government plays a large role in setting an example for the rest of the community. Emissions from government operations are detailed beginning on page 10.

Recognizing the need for a collaborative approach to greenhouse gas reductions, City and county leaders launched the Marin Climate and Energy Partnership (MCEP) in 2007. The City of San Rafael is a member of MCEP and works with representatives from the County of Marin and the other Marin cities and towns to address and streamline the implementation of a variety of greenhouse gas reduction measures. Funding for this inventory was provided by the Marin County Energy Watch Partnership, which administers public goods charges collected by PG&E. Community inventories are available on the MCEP website at marinclimate.org and are used to update the Marin Sustainability Tracker.

INTRODUCTION

PURPOSE OF INVENTORY

The objective of this greenhouse gas emissions inventory is to identify the sources and quantify the amounts of greenhouse gas emissions generated by the activities of the San Rafael community in 2016 and local government operations in 2015. This inventory provides a comparison to baseline 2005 emissions and identifies the sectors where significant reductions in greenhouse gas emissions have occurred. In some instances, previous year emissions were updated with new data and/or recalculated to ensure the same methodology was employed for all inventory years.

GENERAL METHODOLOGY

This inventory uses national standards for the accounting and reporting of greenhouse gas emissions. The Local Government Operations Protocol, version 1.1 (May 2010) was used for the quantification and reporting of greenhouse gas emissions from local government operations, and the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, version 1.1 (July 2013) was used for the quantification and reporting of community emissions. Quantification methodologies, emission factors, and activity and source data are detailed in the appendices.

Local government operations emissions are categorized according to the following sectors:

- Buildings and Other Facilities
- Public Lighting
- Water Delivery Facilities
- Vehicle Fleet
- Solid Waste
- Employee Commute

Community emissions are categorized according to seven sectors:

- Residential Energy
- Non-Residential Energy
- Transportation
- Off-Road Vehicles and Equipment
- Waste
- Water
- Wastewater

CALCULATING EMISSIONS

Emissions are quantified by multiplying the measurable activity data – e.g., kilowatt hours of electricity, therms of natural gas, and gallons of diesel or gasoline – by emissions factors specific to the energy source. Most emissions factors are the same from year to year. Emission factors for electricity, however, change from year to year due to

the specific sources that are used to produce electricity. For example, electricity that is produced from coal generates more greenhouse gases than electricity that is generated from natural gas and therefore has a higher emissions factor. Electricity that is produced solely from renewable energy sources such as solar and wind has an emissions factor of zero.

This inventory calculates individual greenhouse gases – e.g., carbon dioxide, methane and nitrous oxide – and converts each greenhouse gas emission to a standard metric, known as "carbon dioxide equivalents" or CO_2e, to provide an apple-to-apples comparison among the various emissions. Table 1 shows the greenhouse gases identified in this inventory and their global warming potential (GWP), a measure of the amount of warming each gas causes when compared to a similar amount of carbon dioxide. Methane, for example, is 28 times as potent as carbon dioxide; therefore, one metric ton of methane is equivalent to 28 metric tons of carbon dioxide. Greenhouse gas emissions are reported in this inventory as metric tons of carbon dioxide equivalents, or $MTCO_2e$.

TABLE 1: GREENHOUSE GASES

Gas	Chemical Formula	Emission Source	Global Warming Potential
Carbon Dioxide	CO_2	Combustion of natural gas, gasoline, diesel, and other fuels	1
Methane	CH_4	Combustion, anaerobic decomposition of organic waste in landfills and wastewater	28
Nitrous Oxide	N_2O	Combustion, wastewater treatment	265
Hydroflourocarbons	Various	Leaked refrigerants, fire suppressants	4 to 12,400

Source: IPCC Fifth Assessment Report (2014)

TYPES OF EMISSIONS

Emissions from each of the greenhouse gases can come in a number of forms:

- **Stationary or mobile combustion** resulting from the on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat or electricity, or to power vehicles and equipment.
- **Purchased electricity** resulting from the generation of power from utilities outside the jurisdictional boundary.
- **Fugitive emissions** resulting from the unintentional release of greenhouse gases into the atmosphere, such as leaked refrigerants and methane from waste decomposition.
- **Process emissions** from physical or chemical processing of a material, such as wastewater treatment.

UNDERSTANDING TOTALS

The totals listed in the tables and discussed in the report are a summation of emissions using available estimation methods. Each inventoried sector may have additional emissions sources associated with them that were unaccounted for due to a lack of data or robust quantification methods. For example, greenhouse gas emissions associated with air travel and the production of goods outside the community's boundary are not included in the inventory. Additionally, the community inventory does not include refrigerants released into the atmosphere from the use of air conditioning in cars and buildings.

COMMUNITY INVENTORY

COMMUNITY INVENTORY SUMMARY

In 2005, the activities taking place by the San Rafael community resulted in approximately 473,378 metric tons of CO_2e. In 2016, those activities resulted in approximately 388,950 metric tons of CO_2e, a reduction of 18% from 2005 levels. This means that the City has met the State goal to reduce emissions 15% below the 2005 baseline by 2020 and is on track to meet the local goal to reduce emissions 25% by that same year.

The community inventory tracks emissions in seven sectors:

- The **Residential Energy** sector represents emissions generated from the use of electricity, natural gas, and propane in San Rafael homes.
- The **Non-Residential Energy** sector represents emissions generated from the use of electricity and natural gas in commercial, industrial and governmental buildings and facilities.
- The **Transportation** sector includes tailpipe emissions from passenger vehicle trips originating and ending in San Rafael, as well as a share of tailpipe emissions generated by medium and heavy-duty vehicles and buses travelling on Marin County roads. Electricity used to power electric vehicles is embedded in electricity consumption reported in the Residential Energy and Non-Residential Energy sectors.
- The **Waste** sector represents fugitive methane emissions that are generated over time as organic material decomposes in the landfill. Although most methane is captured or flared off at the landfill, approximately 25% escapes into the atmosphere.
- The **Off-Road** sector represents emissions from the combustion of gasoline and diesel fuel from the operation of off-road vehicles and equipment used for construction and landscape maintenance.
- The **Water** sector represents emissions from energy used to pump, treat and convey potable water from the water source to the San Rafael water users.
- The **Wastewater** sector represents stationary, process and fugitive greenhouse gases that are created during the treatment of wastewater generated by the community. Emissions created from energy used to convey and treat wastewater are included in the Non-Residential Energy sector.

Figure 1 shows the relative contribution of emissions from these sectors in 2016. **Table 2** shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Transportation sector (-30,220 $MTCO_2e$), followed by the Residential Energy sector (-24,519 $MTCO_2e$) and the Non-Residential Energy sector (-24,270 $MTCO_2e$). The likely reasons for the largest emissions decreases are described in the remainder of this report.

FIGURE 1: EMISSIONS BY SECTOR, 2016

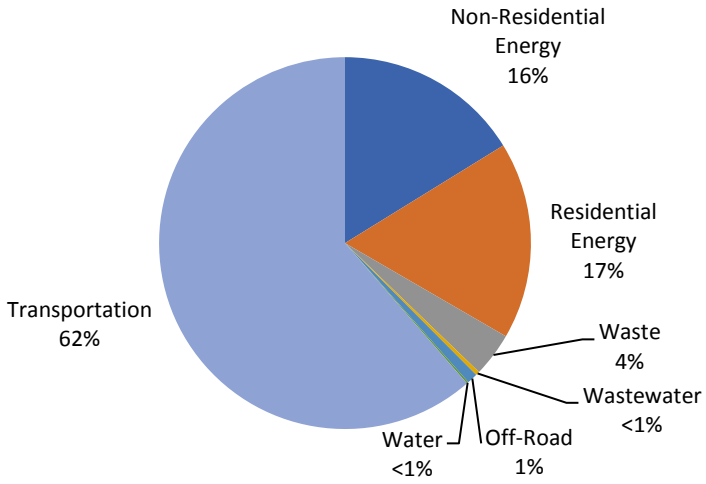


TABLE 2: EMISSIONS SUMMARY BY SECTOR ($MTCO_2E$), 2005 THROUGH 2016

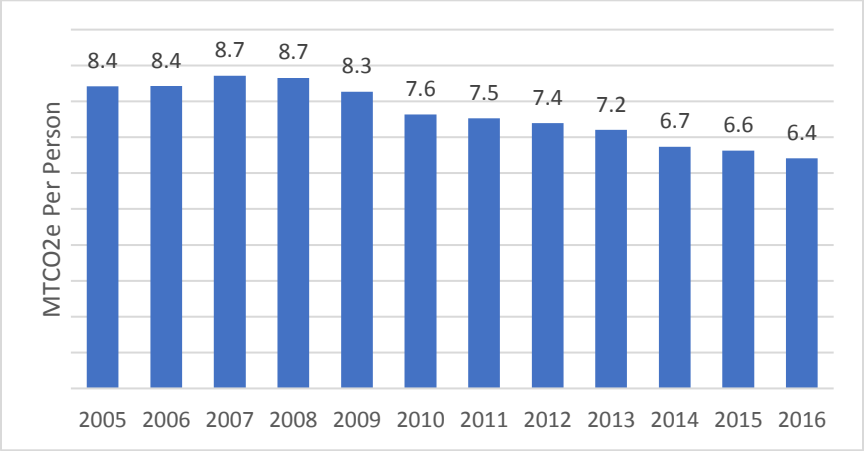
Year	Residential Energy	Non-Residential Energy	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005
2005	91,303	87,336	269,163	17,827	4,710	2,181	856	473,378	0%
2006	92,563	84,676	271,915	17,848	4,560	1,946	858	474,367	0%
2007	100,441	99,888	269,712	16,348	4,410	2,386	866	494,051	4%
2008	100,443	100,513	270,622	14,011	4,259	2,271	872	492,991	4%
2009	97,995	90,724	264,703	12,022	4,109	2,144	877	472,574	0%
2010	89,364	79,733	253,328	11,868	3,959	1,258	888	440,397	-7%
2011	88,755	78,271	252,303	11,574	3,934	747	894	436,479	-8%
2012	85,060	78,264	252,731	12,037	3,894	980	909	433,875	-8%
2013	81,245	77,320	250,309	12,266	3,843	1,138	922	427,044	-10%
2014	68,173	69,921	247,955	12,375	3,792	1,039	944	404,198	-15%
2015	68,487	68,785	244,795	12,878	3,694	789	924	400,351	-15%
2016	66,784	63,067	238,943	14,933	3,613	633	978	388,950	-18%
Change from 2005	-24,519	-24,270	-30,220	-2,894	-1,097	-1,548	121	-84,428	
% Change from 2005	-27%	-28%	-11%	-16%	-23%	-71%	14%	-18%	

PER CAPITA EMISSIONS

Per capita emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one community's emissions with neighboring cities and against regional and national averages. That said, due to differences in emission inventory methods, it can be difficult to produce directly comparable per capita emissions numbers. Per capita emission rates may be compared among Marin jurisdictions, although some jurisdictions may have higher rates due to the presence of commercial and industrial uses.

Dividing the total community-wide GHG emissions by residents yields a result of 8.4 metric tons CO_2e per capita in 2005. Per capita emissions decreased 24% between 2005 and 2016, falling to 6.4 metric tons per person. Figure 2 shows the trend in per capita emissions over time. It is important to understand that this number is not the same as the carbon footprint of the average individual living in San Rafael, which would include lifecycle emissions, emissions resulting from air travel, etc.

FIGURE 2: EMISSIONS PER CAPITA



MAJOR SOURCES OF EMISSIONS

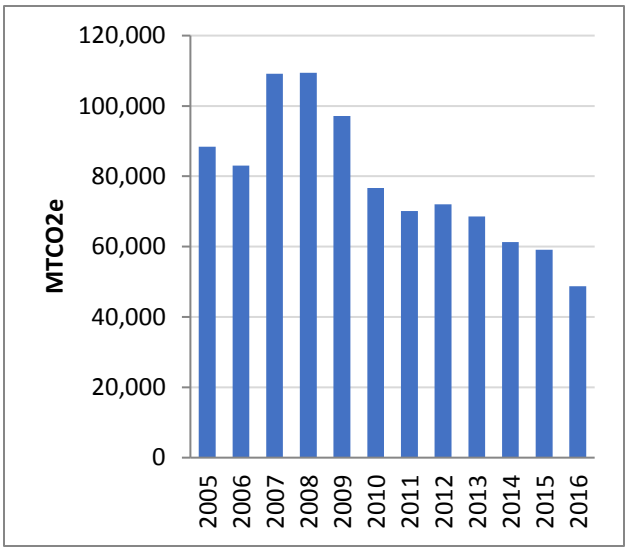
The following sections provide a year-by-year analysis of the changes in GHG emissions from the City's largest sources: electricity, natural gas, transportation, waste, and water use. Whenever possible, each section discusses the change in emissions from previous years and the likely influence of state and local programs or policies and external factors on reducing emissions.

ELECTRICITY USE

Electricity use in homes and businesses in San Rafael decreased about 9% between 2005 and 2016. The Residential Energy sector, which uses 35% of all electricity in San Rafael, reduced electricity use 11% since 2005. Electricity use decreased 8% in the Non-Residential Energy sector over the same period. Electricity reductions have most likely occurred due to improved energy efficiency, conservation, and solar installation. Distributed solar generation from local roofs, carports and ground-mounted systems provided about 4% of the electricity used in Marin County in 2016.

Electricity-related greenhouse gas emissions in the Residential Energy and Non-Residential Energy sectors decreased 45% since 2005, as shown in Figure 3. This is primarily due to the lower carbon intensity of electricity. PG&E has been steadily increasing the amount of renewable energy in its electricity mix, which was 40% less carbon intensive in 2016 than it was in 2005. MCE Clean Energy (MCE), which began providing electricity to San Rafael customers in 2010, has historically provided electricity that is less carbon intensive than PG&E electricity. In 2016, MCE Light Green electricity was 3% less carbon intensive than PG&E. MCE carries about 69% of the electricity load in San Rafael. In 2016, about 1.6% of MCE electricity purchased by San Rafael customers was 100% renewable Deep Green electricity.

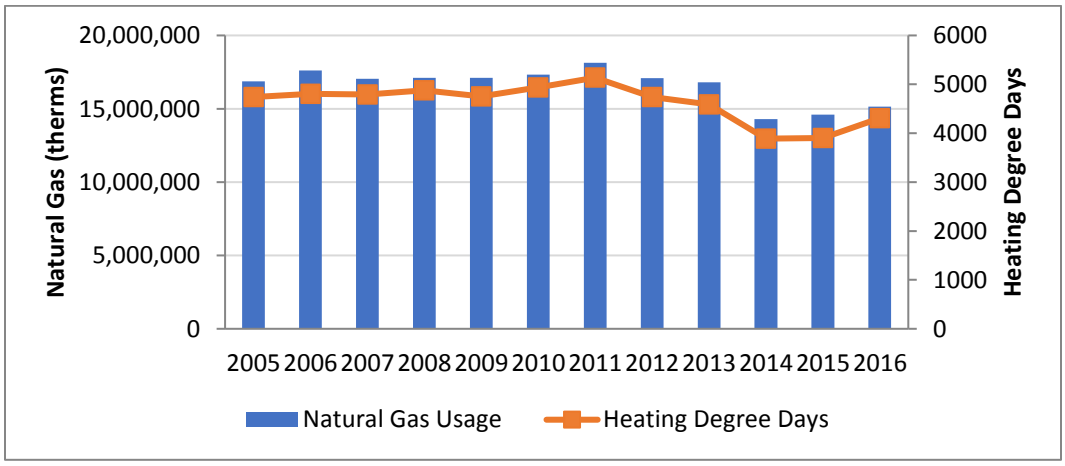
FIGURE 3: ELECTRICITY EMISSIONS



Natural Gas Use

Natural gas is used in residential, commercial and industrial buildings to provide space and water heating and power appliances. Use of natural gas is highly variable depending on the weather conditions in a given year. This variability has led natural gas use consumption in San Rafael to fluctuate from year to year, from a high of 18.1 million therms in 2011 to a low of 14.3 million therms in 2014. Emissions from natural gas consumption increased 4% between 2015 and 2016, most likely due to colder temperatures. The chart below compares natural gas usage in San Rafael to regional heating degree days, a measure of how much energy is required to warm the interior of a building relative to the outside temperature. Warmer days result in fewer heating degree days. As shown below, natural gas consumption is highly correlated to heating degree days. Overall, natural gas use has declined 10% since 2005.

FIGURE 4: NATURAL GAS USE



Source (heating degree days): U.S. Department of Commerce, National Climatic Data Center

Reduction in energy use may also be attributed to energy efficiency programs and rebates, local green building ordinances, and State building codes. California's goal is to require all new residential buildings to be net zero electricity use by 2020 and all new residential and commercial buildings to be zero net energy by 2030.

TRANSPORTATION

Transportation activities accounted for approximately 62% of San Rafael's emissions in 2016. Although vehicle miles traveled have increased approximately 3% since 2005, transportation emissions have decreased 11% due to more fuel-efficient and alternatively fueled cars. Marin County continues to be a leader in zero emission vehicles (ZEVs) – second only to Santa Clara County – with an estimated 4,000 ZEVs in Marin in 2016, or about 2% of registered vehicles. ZEVs include battery electric cars, plug-in hybrid electric cars, hydrogen fuel cell cars, and zero-emission motorcycles.

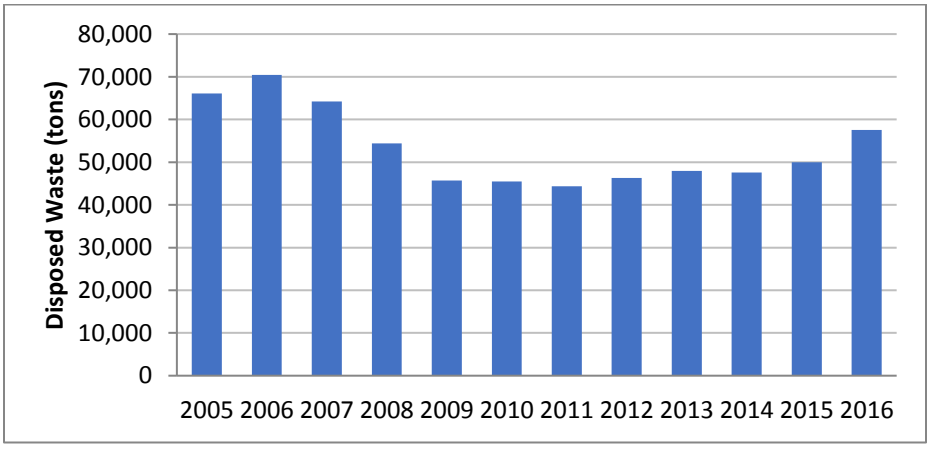
While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the City has undertaken many efforts to reduce transportation emissions. The City encourages workforce housing and has made improvements to the transportation network to make it easier for residents to bicycle, walk, and take public transportation. The City has also promoted electric vehicle adoption by installing chargers and providing free electricity at municipal EV charging stations.

WASTE DISPOSAL

Waste generated by the community hit a low in 2011 but has since increased as shown in the chart below (based on countywide disposal data). Landfilled waste increased 15% between 2015 and 2016 but is still 13% below the 2005 baseline.

The decrease in emissions from waste disposal is most likely a result of community and County goals to move toward Zero Waste. Ongoing waste diversion programs include a residential food waste composting program and mandatory food waste recycling subscription for larger commercial producers. The more recent increases are most likely due to the growth in the economy and increase in online sales and packaging.

FIGURE 5: DISPOSED WASTE

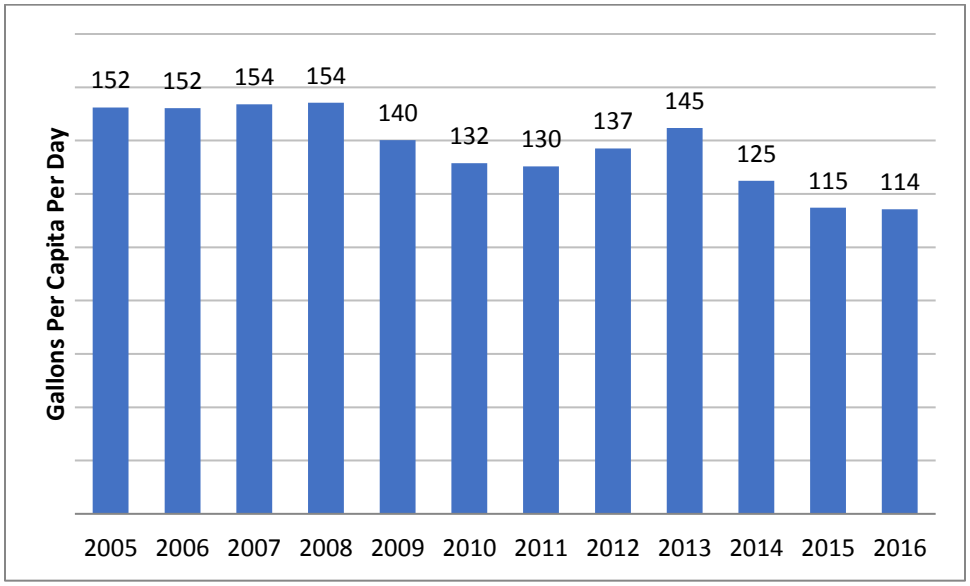


Source: CalRecycle

WATER USE

Per capita water use declined 25% since 2005. Emissions, which are based on an estimate of energy used to pump, treat, and convey water from the water source to the City limits, dropped 74% between 2005 and 2016. The additional reduction is due to the lower carbon intensity of electricity. The Sonoma County Water Agency, which supplies approximately 25% of the Marin Municipal Water District's (MMWD) water, uses renewable and carbon-free sources for its electricity needs. MMWD began purchasing MCE Deep Green electricity in mid-2017, which will result in additional reductions in the 2017 inventory year.

FIGURE 6: PER CAPITA WATER USE



Source: Marin Municipal Water District

MMWD provides rebates and programs to reduce water use. Rebates are available to replace fixtures with high-efficiency toilets and clothes washers, and to purchase pool covers, hot water recirculating systems, organic mulch, laundry-to-landscape system components, and rain barrels. MMWD provides free home and landscape water-use evaluations. The California Department for Water Resources offers a turf replacement rebate of up to $2,000 for single-family homes.

GOVERNMENT OPERATIONS INVENTORY

GOVERNMENT PROFILE

The City of San Rafael is a general law city and operates under the council-city manager form of government. The local government operates administrative, planning, building, public works, community services, fire and police departments. In 2015, there were 413 total employees. General fund expenditures for fiscal year 2015-2016 were approximately $68,655,000.

GOVERNMENT OPERATIONS INVENTORY SUMMARY

In 2005, San Rafael's government operations produced approximately 4,442 metric tons CO_2e. In 2016, those activities resulted in approximately 3,742 metric tons CO_2e, a reduction of 701 metric tons, or 16%, and the local government's share of community emissions was just under 1.0%. The following summaries break down these totals by sector and sources.

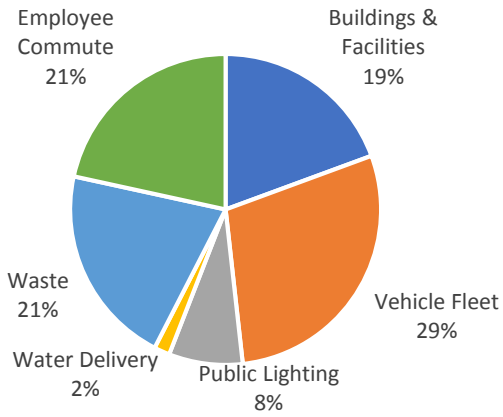
SUMMARY BY SECTOR

As shown in Table 3, emissions from government operations were reduced in all sectors except the vehicle fleet and waste sectors. The greatest reduction occurred in the employee commute sector, where emissions dropped 530 metric tons CO2e, or 40%. Other significant reductions occurred in the public lighting sector (258 metric tons). Figure 7 shows that the vehicle fleet sector was the largest emitter of greenhouse gas emissions in 2016 (29% of total emissions), followed by the employee commute sector (21%) and the buildings and facilities sector (19%).

TABLE 3: SUMMARY BY SECTOR, 2005 AND 2016

Sector	2005 Metric Tons CO_{2e}	2016 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Buildings & Facilities	799	725	-73	-9%
Vehicle Fleet	933	1,079	147	16%
Public Lighting	545	287	-258	-47%
Water Delivery	118	61	-57	-48%
Waste	711	781	70	10%
Employee Commute	1,337	807	-530	-40%
Total	**4,442**	**3,742**	**-701**	**-16%**

FIGURE 7: EMISSIONS BY SECTOR, 2016



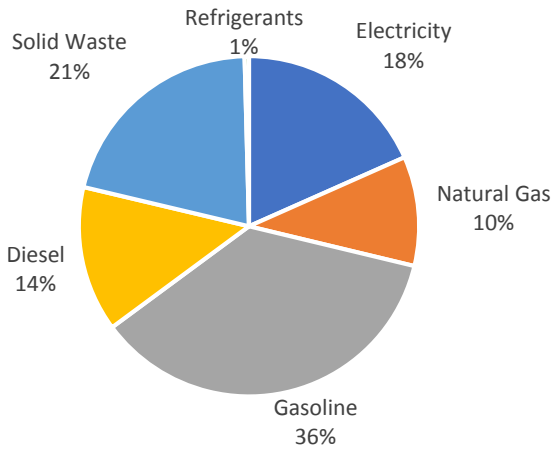
SUMMARY BY SOURCE

Table 4 shows a summary of the City's greenhouse gas emissions by source. The greatest decreases occurred in emissions from gasoline (634 metric tons), which includes gasoline used in both the municipal fleet and City employees' commute, and electricity (475 metric tons). Emissions from the combustion of natural gas and diesel increased 31% and 91%, respectively. Despite the decrease in gasoline emissions, gasoline was the largest source of greenhouse gas emissions in San Rafael's governmental operations in 2016 (see Figure 8), contributing more than one-third of all emissions.

TABLE 4: SUMMARY BY SOURCE, 2005 AND 2016

Source	2005 Metric Tons CO_{2e}	2016 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Electricity	1,161	687	-475	-41%
Natural Gas	298	389	91	31%
Gasoline	1,986	1,352	-634	-32%
Diesel	271	518	247	91%
Solid Waste	711	781	70	10%
Refrigerants	16	16	0	0%
Total	**4,442**	**3,742**	**-701**	**-16%**

FIGURE 8: EMISSIONS BY SOURCE, 2016



GOVERNMENT OPERATIONS INVENTORY DETAIL BY SECTOR

This section explores government operations and emissions by taking a detailed look at each primary sector.

BUILDINGS AND OTHER FACILITIES

Facilities operations contribute to greenhouse gas emissions in two major ways. First, facilities consume electricity and fuels such as natural gas. This consumption is associated with the majority of greenhouse gas emissions from facilities. In addition, air conditioning and refrigeration equipment in buildings can emit hydrofluorocarbons (HFCs) and other greenhouse gases when these systems leak refrigerants. Refrigerants are very potent greenhouse gases and have Global Warming Potential (GWP) of up to many thousand times that of CO_2. For example, HFC-134a, a very common refrigerant, has a GWP of 1300, or 1300 times that of CO_2. Therefore, even small amounts of leaked refrigerants can have a significant effect on greenhouse gas emissions.

In 2016, San Rafael operated several major facilities, including City Hall, the library and police station, fire stations, public works buildings, childcare facilities, and community centers. As shown in Table 5, emissions from the buildings sector decreased 9% between 2005 and 2016. Electricity consumption increased 15%, and natural gas consumption increased 31%. Total emissions from buildings and facilities decreased, however, because the carbon intensity of electricity was 42% lower in 2016.

TABLE 5: BUILDINGS AND OTHER FACILITIES EMISSIONS, 2005 AND 2016

Source	2005 Energy Consumption	2005 GHG Emissions ($MTCO_2e$)	2016 Energy Consumption	2015 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions ($MTCO_2e$)
Electricity	2,231,608 kWh	498	2,564,438 kWh	334	15%	-33%
Natural Gas	56,042 therms	298	73,188 therms	389	31%	31%
Refrigerants	--	2	--	2	0%	0%
Total	--	**799**	**--**	**725**	**--**	**-9%**

Table 6 shows electricity and natural gas usage by facility.

TABLE 6: ENERGY USAGE AT SAN RAFAEL BUILDINGS AND FACILITIES, 2005 AND 2016

Building/ Facility	Energy Source	2005 Energy Consumption	2016 Energy Consumption	% Change in Energy Consumption
City Hall	Electricity	637,920 kWh	590,255 kWh	-7%
	Natural Gas	5,651 therms	16,908 therms	199%
Community Centers	Electricity	329,020 kWh	476,126 kWh	42%
	Natural Gas	27,758 therms	34,606 therms	25%
Childcare Facilities	Electricity	111,985 kWh	210,681kWh	88%
	Natural Gas	4,304 therms	3,335 therms	-23%
Public Works	Electricity	324,010 kWh	385,250 kWh	19%
	Natural Gas	5,541 therms	6,158 therms	11%
Fire Department	Electricity	248,214 kWh	255,165 kWh	3%
	Natural Gas	9,431 therms	9,491 therms	1%
Library	Electricity	117,350 kWh	172,871 kWh	47%
Parking Garages & Lots	Electricity	211,118 kWh	350,004 kWh	66%
Other Facilities	Electricity	251,991 kWh	133,086 kWh	-47%
	Natural Gas	3,357 therms	2,690 therms	-20%

PUBLIC LIGHTING

San Rafael operates streetlights, traffic signals, and other outdoor lighting. Emissions associated with the operation of this public lighting are from electricity consumption. Electricity consumption in the public lighting sector decreased 10% between 2005 and 2016 due to conversion of inefficient lighting to LED fixtures and bulbs. Emissions decreased 47%; the additional reduction is due to the lower carbon intensity of MCE electricity in 2016.

TABLE 7: PUBLIC LIGHTING EMISSIONS, 2005 AND 2016

Source	2005 Electricity Consumption	2005 GHG Emissions ($MTCO_2e$)	2016 Electricity Consumption	2016 GHG Emissions ($MTCO_2e$)	% Change in Electricity Consumption	% Change in GHG Emissions ($MTCO_2e$)
Streetlights	2,066,450 kWh	461	1,901,838 kWh	248	-8%	-46%
Traffic Signals	249,861 kWh	56	176,831 kWh	23	-29%	-59%
Outdoor Lighting	126,245 kWh	28	128,751 kWh	17	4%	-41%
Total	**2,442,556 kWh**	**545**	**2,207,420 kWh**	**287**	**-10%**	**-47%**

WATER DELIVERY

This sector includes any facilities used for the management and distribution of water. Typical systems included in this sector are potable water delivery pumps, sprinkler and irrigation controls, and stormwater management. The systems identified for this report and used by the City were water delivery pumps and sprinkler and irrigation systems. The source of San Rafael's water delivery emissions is from electricity consumption. Overall, electricity usage declined 11% and emissions dropped 48%.

TABLE 8: WATER DELIVERY EMISSIONS, 2005 AND 2016

Source	2005 Electricity Consumption	2005 GHG Emissions ($MTCO_2e$)	2016 Electricity Consumption	2016 GHG Emissions ($MTCO_2e$)	% Change in Electricity Consumption	% Change in GHG Emissions ($MTCO_2e$)
Irrigation	7,410 kWh	2	8,157 kWh	1	10%	-36%
Water Pumps	520,185 kWh	116	462,193 kWh	60	-11%	-48%
Total	**527,595 kWh**	**118**	**470,350 kWh**	**61**	**-11%**	**-48%**

VEHICLE FLEET

The vehicles and mobile equipment used in San Rafael's daily operations include public works trucks and equipment, police cars and motorcycles, fire trucks, and vehicles for use by administration and other department staff. These vehicles and equipment burn gasoline and diesel, which result in greenhouse gas emissions. In addition, vehicles with air conditioning use refrigerants that leak from the vehicle.

Table 9 shows that gasoline consumption decreased 19% since 2005 while diesel consumption increased 35%. The net effect was to decrease total fuel consumption 4% and emissions 3%.

TABLE 9: VEHICLE FLEET EMISSIONS, 2005 AND 2016

Source	2005 Fuel Consumption	2005 GHG Emissions ($MTCO_2e$)	2016 Fuel Consumption	2016 GHG Emissions ($MTCO_2e$)	% Change in Fuel Consumption	% Change in GHG Emissions ($MTCO_2e$)
Gasoline	72,682 gallons	649	69,683 gallons	615	-4%	-5%
Diesel	26,489 gallons	271	44,142 gallons	451	67%	67%
Refrigerants	--	13	--	13	--	0%
Total	**99,171 gallons**	**933**	**113,825 gallons**	**903**	**15%**	**16%**

WASTE

Waste generated by government buildings and operations include organic material such as paper, food scraps, plant debris, textiles, and construction waste. This organic material generates methane as it decays in the anaerobic environment of a landfill. An estimated 75% of this methane is routinely captured via landfill gas collection systems; however, a portion escapes into the atmosphere. Emissions from waste are an estimate of methane generation that will result from the decomposition of organic waste sent to the landfill in the inventoried year, even though those emissions will occur over the 100+ year timeframe that the waste will decompose.

Waste generated by governmental operations increased 8% between 2005 and 2016 and emissions increased 10%. This was most likely due to an increase in dumping in the public right of way, including parks, streets and open space. In addition, higher rates of contamination have resulted in the contents of some recycling bins to be landfilled.

TABLE 10: WASTE EMISSIONS, 2005 AND 2016

Source	2005 Landfilled Waste	2005 GHG Emissions ($MTCO_2e$)	2016 Landfilled Waste	2016 GHG Emissions ($MTCO_2e$)	% Change in Landfilled Waste	% Change in GHG Emissions ($MTCO_2e$)
Street Cans	1,438 tons	402	1,296 tons	368	-10%	-8%
Parks	548 tons	153	520 tons	148	-5%	-3%
Community Facilities	239 tons	67	281 tons	80	18%	20%
Other Facilities	135 tons	38	270 tons	77	99%	103%
Waste Hauled by the City	184 tons	51	378 tons	108	105%	109%
Total	**2,544 tons**	**711**	**2,746 tons**	**781**	**8%**	**10%**

EMPLOYEE COMMUTE

Emissions in the employee commute sector are due to the combustion of fuels used by City employees commuting to and from work in San Rafael. Emissions dropped 38%, primarily due to an improvement in the fuel-efficiency of the vehicles San Rafael employees are driving to work. However, it is difficult to draw definitive conclusions from the data, as emissions are determined from employee commute surveys. Twenty-six percent of City employees responded to the survey in 2015. Estimates for total employee commutes were extrapolated from this data.

TABLE 11: EMPLOYEE COMMUTE EMISSIONS, 2005 AND 2015

	2005	2015	% Change
Number of Employees	425	413	-3%
Vehicle Miles Traveled	2,572,471	2,329,163	-9%
Emissions per Employee	3.1	2.0	-38%
GHG Emissions ($MTCO_2e$)	1,337	807	-40%

APPENDIX A: COMMUNITY INVENTORY

Community GHG Emissions Summary Table

Jurisdiction: City of San Rafael
Population: 60,661 in 2016 (CA Department of Finance)
Number of Households: 23,051 (CA Department of Finance)

Inventory Year: 2016
Date Prepared: October 10, 2018
Reporting Framework: Communitywide Activities

ID	Emissions Type	Source or Activity	Included, Required Activities	Included, Optional Activities	Excluded (IE, NA, NO or NE)	Notes	Emissions ($MTCO_2e$)
1.0	Built Environment						
1.1	Use of fuel in residential and commercial stationary combustion equipment	Both	●				81,067
1.2	Industrial stationary sources	Source			NE		
1.3	Power generation in the community	Source			NO		
1.4	Use of electricity in the community	Activity	●			Includes transmission and distribution losses	48,784
1.5	District heating/cooling facilities in the community	Source			NE		
1.6	Use of district heating/cooling facilities in the community	Activity			NE		
1.7	Industrial process emissions in the community	Source			NO		
1.8	Refrigerant leakage in the community	Source			NE		
2.0	Transportation and Other Mobile Sources						
2.1	On-road passenger vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	
2.2	On-road passenger vehicles associated with community land uses	Activity	●				174,006
2.3	On-road freight and service vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	
2.4	On-road freight and service vehicles associated with community land uses	Activity	●				55,442
2.5	On-road transit vehicles associated with community land uses	Activity		●		Unable to obtain source data, therefore obtained activity-based data instead	9,495
2.6	Transit rail vehicles operating with the community boundary	Source			NO		

2.7	Use of transit rail travel by the community	Activity			NE		
2.8	Inter-city passenger rail vehicles operating within the community boundary	Source			NO		
2.9	Freight rail vehicles operating within the community boundary	Source			NO		
2.10	Marine vessels operating within the community boundary	Source			NE		
2.11	Use of ferries by the community	Activity			NE		
2.12	Off-road surface vehicles and other mobile equipment operating within the community boundary	Source		●			3,583
2.13	Use of air travel by the community	Activity			NE		
3.0	Solid Waste						
3.1	Operation of solid waste disposal facilities in the community	Source			NE		
3.2	Generation and disposal of solid waste by the community	Activity	●				14,933
4.0	Water and Wastewater						
4.1	Operation of water delivery facilities in the community	Source			IE	Energy use is included in 1.1 and 1.4.	
4.2	Use of energy associated with use of potable water by the community	Activity	●				633
4.3	Use of energy associated with generation of wastewater by the community	Activity	●			Energy use is included in 1.1 and 1.4.	
4.4	Process emissions from operation of wastewater treatment facilities located in the community	Source			NE	Wastewater treatment facilities are located in the community but only process emissions associated with generation of wastewater by the community are reported in 4.5.	
4.5	Process emissions associated with generation of wastewater by the community	Activity	●				978
4.6	Use of septic systems in the community	Source			NE		
5.0	Agriculture						
5.1	Domesticated animal production	Source			NE		
5.2	Manure decomposition and treatment	Source			NE		
6.0	Upstream Impacts of Communitywide Activities						
6.1	Upstream impacts of fuels used in stationary applications by the community	Activity			NE		
6.2	Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community	Activity			IE	Transmission and distribution losses included in 1.4.	
6.3	Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary	Activity			IE	Included in 4.2 and 4.3.	
6.4	Upstream impacts of select materials (concrete, food, paper, carpets, etc.) sued by the whole community.	Activity			NE		

Legend

IE – Included Elsewhere: Emissions for this activity are estimated and presented in another category of the inventory. The category where these emissions are included should be noted in the explanation.

NE – Not Estimated: Emissions occur but have not been estimate or reported (e.g., data unavailable, effort required not justifiable).

NA – Not Applicable: The activity occurs but does not cause emissions; explanation should be provided.

NO – Not Occurring: The source or activity does not occur or exist within the community.

Community Emissions Data Sources and Calculation Methodologies

Sector/ID	Emissions Source	Source and/or Activity Data	Emission Factor and Methodology
1.0 Built Environment			
1.1 Stationary Combustion	Stationary Combustion (CO_2, CH_4 & N_2O)	Known fuel use (meter readings by PG&E) and estimated fuel use (American Community Survey 5-Year Estimates, and U.S. Energy Information Administration Household Site Fuel Consumption data).	Default CO_2, CH_4 & N_2O emission factors by fuel type (U.S. Community Protocol v. 1.1 Tables B.1 and B.3). U.S. Community Protocol v. 1.1, Appendix C, Method BE.1.1 and BE.1.2.
1.4 Electricity Use	Electricity Use (CO_2, CH_4 & N_2O)	Known electricity use (meter readings by PG&E and MCE) and estimated direct access electricity consumption.	Verified utility-specific emission factors (PG&E and MCE) and eGrid subregion default emission factors. U.S. Community Protocol v. 1.1, Appendix C, Method BE.2.1.
	Electric Power Transmission and Distribution Losses (CO_2, CH_4 & N_2O)	Estimated electricity grid loss for Western region from eGrid.	U.S. Community Protocol v. 1.1, Appendix C, Method BE.4.1.
2.0 Transportation and Other Mobile Sources			
2.2 On-Road Passenger Vehicle Operation	On-Road Mobile Combustion (CO_2)	Estimated passenger vehicle miles traveled associated with origin and destination land uses (Metropolitan Transportation Commission, http://capvmt.us-west-2.elasticbeanstalk.com/data).	CO_2 for on-road passenger vehicles quantified in the EMFAC2017 model. Passenger vehicle emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.1.A.
	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated vehicle miles traveled associated with origin and destination land uses (Metropolitan Transportation Commission, http://capvmt.us-west-2.elasticbeanstalk.com/data).	CH_4 and N_2O for on-road passenger vehicles quantified in the EMFAC2017 model and adjusted for IPCC AR5 100-year values. Passenger vehicle emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.1.A.
2.4 On-Road Freight and Service Truck Freight Operation	On-Road Mobile Combustion (CO_2)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2040 and the 2017 Regional Transportation Plan).	CO_2 for on-road commercial vehicles quantified in the EMFAC2017 model. Emissions allocated utilizing LEHD data according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.2.A.
	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2040 and the 2017 Regional Transportation Plan).	CH_4 and N_2O for on-road commercial vehicles quantified in the EMFAC2017 model and adjusted for IPCC AR5 100-year values. Emissions allocated utilizing LEHD data according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.2.A.
2.5 On-Road Transit Operation	On-Road Mobile Combustion (CO_2)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2040 and the 2017 Regional Transportation Plan).	CO_2 for on-road commercial vehicles quantified in the EMFAC2017 model. Emissions allocated according to jurisdiction's share of countywide population. Recommended U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.A could not be used due to lack of data.

	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing the 2017 Regional Transportation Plan).	CH_4 and N_2O for on-road passenger vehicles quantified in the EMFAC2017 model and adjusted for IPCC AR5 100-year values. Emissions allocated according to jurisdiction's share of countywide population. Recommended U.S. Community Protocol v. 1.1 Method TR.4.B, Appendix D, could not be used due to lack of data.
2.12 Off-Road Vehicles and Equipment	Off-Road Mobile Combustion (CO_2)	Estimated fuel use from OFFROAD 2007 for Lawn and Garden and from OFFROAD2017 for Construction equipment. All categories are allocated by share of countywide households.	CO_2 emissions calculated according U.S. Community Protocol v. 1.1, Appendix D, Method TR.8. Emission factors provided in Table TR.1.6.
	Off-Road Mobile Combustion (CH_4 & N_2O)	Estimated fuel use from OFFROAD 2007 for Lawn and Garden and from OFFROAD2017 for Construction equipment. All categories are allocated by share of countywide households.	CH_4 and N_2O emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.8. Emission factors provided in the Local Government Operations Protocol Table G.11 and G.14.
3.0 Solid Waste			
3.2 Solid Waste Generation and Disposal	Fugitive Emissions from Landfilled Waste (CH_4)	Estimated landfilled tons based on reporting to CalRecycle by Marin County Solid and Hazardous Waste JPA and allocated to jurisdiction based on share of countywide population. Waste characterization based on the Statewide Waste Characterization Study (2008 and 2014) and Alternative Daily Cover by Jurisdiction of Origin and Material Type as reported to CalRecycle.	Emission factors calculated utilizing U.S. Community Protocol for Accounting and Report of Greenhouse Gas Emissions, Version 1.1, July 2013, Appendix E, Method SW.4.
4.0 Water and Wastewater			
4.2 Water Supply & Conveyance, Treatment and Distribution	Electricity Use (CO_2)	Water consumption data provided by Marin Municipal Water District (MMWD). Assumed 75% of water from MMWD resources and 25% from Sonoma County Water Agency (SCWA). Electricity consumption data provided by MMWD.	Verified utility-specific emission factors (PG&E, MCE and SCWA). Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.14.
	Electricity Use (CH_4 & N_2O)	Water consumption data provided by Marin Municipal Water District (MMWD). Assumed 75% of water from MMWD resources and 25% from Sonoma County Water Agency (SCWA). Electricity consumption data provided by MMWD.	eGrid subregion default emission factors. Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.14.
4.5 Treatment of Wastewater	Stationary Emissions from Combustion of Digester Gas (CH_4)	Known amount of digester gas produced per day and known percent of methane in digester gas provided by Central Marin Sanitation Agency. Known amount of digester gas produced	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.1.a.

		per day (2016) and known percent of methane in digester gas (2017) provided by Las Gallinas Valley Sanitary District.	
	Stationary Emissions from Combustion of Digester Gas (N_2O)	Known amount of digester gas produced per day and known percent of methane in digester gas provided by Central Marin Sanitation Agency. Known amount of digester gas produced per day (2016) and known percent of methane in digester gas (2017) provided by Las Gallinas Valley Sanitary District.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.2.a.
	Process Emissions from Wastewater Treatment Plant without Nitrification or Denitrification	Estimated population served by wastewater treatment plant provided by Central Marin Sanitation Agency.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.8.
	Process Emissions from Wastewater Treatment Plant with Nitrification or Denitrification	Estimated population served by wastewater treatment plant provided by Las Gallinas Valley Sanitary District (2010 data).	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.7.
	Fugitive Emissions from Effluent Discharge (N_2O)	Estimated population served by wastewater treatment plant provided by Central Marin Sanitation Agency. Assumed significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12(alt).
	Fugitive Emissions from Effluent Discharge (N_2O)	Estimated population served by wastewater treatment plant provided by Las Gallinas Valley Sanitary District. Assumed no significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12.

APPENDIX B: GOVERNMENT OPERATIONS INVENTORY

BUILDINGS AND OTHER FACILITIES SECTOR NOTES

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2005

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Stationary Combustion	56,042 therms	297.13	0.00	0.03	0.00	298.07
	Fugitive Emissions	Refrigerants	0.00	0.00	0.00	0.00	2.38
	TOTAL		297.13	0.00	0.03	0.00	300.45
Scope 2	Purchased Electricity	2,231,608 kWh	495.15	0.01	0.03	0.00	498.23
	TOTAL		495.15	0.01	0.03	0.00	498.23

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Stationary Combustion	73,188 therms	388.04	0.00	0.04	0.00	389.26
	Fugitive Emissions	Refrigerants	0.00	0.00	0.00	0.00	2.38
	TOTAL		388.04	0.00	0.04	0.00	389.26
Scope 2	Purchased Electricity	2,564,438 kWh	331.52	0.00	0.04	0.00	333.83
	TOTAL		331.52	0.00	0.04	0.00	333.83

Energy usage was provided by Pacific Gas & Electric Company (PG&E) based on PG&E service accounts. LGO Protocol recommended methods were followed in collection and analysis of this activity data. For electricity, verified utility-specific (PG&E and MCE) CO_2 emissions factor and eGrid subregion default N_2O and CH_4 emission factors for WECC California were used. For natural gas, default CO_2, CH_4 & N_2O emission factors by fuel type were used (U.S. Community Protocol, v. 1.1, May 2010, Tables B.1 and B.3).

Refrigerant type and capacity for air conditioning units were provided by San Rafael public works staff. 2010 refrigerant data was used as a proxy for 2005 and 2016. LGO Protocol alternate methods were followed in collection and analysis of refrigerant activity data.

Public Lighting Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	2,442,556 kWh	541.95	0.01	0.04	0.00	545.33

LGO Protocol – Emissions by Scope and Emission Type, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	2,207,420 kWh	285.36	0.00	0.03	0.00	287.35

Energy usage was provided by Pacific Gas & Electric Company (PG&E) based on energy usage of PG&E service accounts. LGO Protocol recommended methods were followed in collection and analysis of this activity data. Verified utility-specific (PG&E and MCE) CO_2 emissions factor and eGrid subregion default N_2O and CH_4 emission factors for WECC California were used to calculate emissions.

Water Delivery Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	527,595 kWh	117.06	0.00	0.01	0.00	117.79

LGO Protocol – Emissions by Scope and Emission Type, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	470,350 kWh	60.80	0.00	0.01	0.00	61.23

Energy usage was provided by Pacific Gas & Electric Company (PG&E) based on energy usage of PG&E service accounts. LGO Protocol recommended methods were followed in collection and analysis of this activity data. Verified utility-specific (PG&E and MCE) CO_2 emissions factor and eGrid subregion default N_2O and CH_4 emission factors for WECC California were used to calculate emissions.

Vehicle Fleet Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Mobile Combustion	72,682 gallons gasoline	638.15	0.04	0.03	0.00	648.84
	Mobile Combustion	26,489 gallons diesel	270.45	0.00	0.00	0.00	270.68
	Fugitive Emissions	Refrigerants	0.00	0.00	0.00	0.01	13.15
	TOTAL		908.60	0.04	0.03	0.01	932.67

LGO Protocol – Emissions by Scope and Emission Type, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Mobile Combustion	69,683 gallons gasoline	611.82	0.01	0.02	0.00	615.26
	Mobile Combustion	44,142 gallons diesel	450.69	0.00	0.00	0.00	450.87
	Fugitive Emissions	Refrigerants	0.00	0.00	0.00	0.01	13.15
	TOTAL		1,062.51	0.01	0.02	0.01	1,079.28

On and off-road vehicle fleet and equipment fuel data were provided by City of San Rafael. VMT data for 2010 was used as a proxy for 2016. LGO Protocol methods were followed in collection and analysis of vehicle fuel consumption and vehicle miles traveled (VMT). Default CO_2 emission factors for transport fuel from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.11 were used. Default N_2O and CH_4 emission factors for highway vehicles by model year from the from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.12. 2005 emissions were used and were adjusted to reflect IPCC AR5 values for N_2O and CH_4.

Refrigerant capacities for vehicles were estimated using sources provided by ICLEI. LGO Protocol alternate methods were followed in collection and analysis of refrigerant activity data. 2010 activity data and emissions were used as a proxy for 2005 and 2015 data.

Waste Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Weight	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Landfilled Waste	2,543.6 tons	0.00	0.00	25.38	0.00	710.68

LGO Protocol – Emissions by Scope and Emission Type, 2016

Scope	Emission Type	Weight	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Landfilled Waste	2,745.7 tons	0.00	0.00	27.90	0.00	781.06

Solid waste collection data for quantity of containers, container size, pick-ups per week was provided by Marin Sanitary Service. Containers were assumed to be 100% filled at 250 lbs. per cubic yard. 2005 data was revised to reflect a higher weight per cubic yard estimate as recommended by Marin Sanitary Service. All trash bins were assumed to have a 0% diversion rate and all recycling bins were estimated to have an 85% diversion rate as some of the waste erroneously included in recycling containers is not recyclable.

Waste characterization estimated based on the Statewide Waste Characterization Study (2008 and 2014). Emission factors calculated utilizing U.S. Community Protocol for Accounting and Report of Greenhouse Gas Emissions, Version 1.1, July 2013, Appendix E, Method SW.4. 2005 emissions were adjusted to reflect IPCC AR5 values for CH_4.

Employee Commute Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Number of Employees	Vehicle Miles Traveled	Greenhouse Gas Emissions (metric tons)				
				CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Mobile Combustion	220	2,572,471	1,306.95	0.11	0.08	0.00	1,337.23

LGO Protocol – Emissions by Scope and Emission Type, 2016

Scope	Emission Type	Number of Employees	Vehicle Miles Traveled	Greenhouse Gas Emissions (metric tons)				
				CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Mobile Combustion	413	2,329,163	357.60	0.02	0.04	0.00	807.42

In 2015, the City distributed commute surveys to its employees regarding travel mode, vehicle type and model year, fuel type, fuel efficiency, and miles traveled to work. Information provided by respondents was used to estimate gallons of fuel consumed and, if necessary, to determine fuel efficiency at www.fueleconomy.gov. Weekly data were converted into annual VMT data assuming 10% reduction for vacation days, sick days and holidays for full-time and part-time employees. 106 employees responded to the survey, a response rate of 26%. Estimates for total employee commutes were extrapolated from this data. Utilized default CO_2 emission factors for transport fuel from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.11. Utilized default N_2O and CH_4 emission factors for highway vehicles by model year from the from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.12. 2005 emissions were adjusted to reflect IPCC AR5 values for N_2O and CH_4.

Information Items

Information items are emissions sources that are not included in the inventory but are reported here to provide a more complete picture of emissions from San Rafael's government operations. Information items for this inventory include one parks department vehicle, refrigerators, freezers, and air conditioning units using R-12 and R-22 refrigerants. These refrigerants are not included in the inventory because they are ozone-depleting substances and are being phased out by 2020 under the terms of the Montreal Protocol. 2010 data was used as a proxy for refrigerant data for years 2015.

Information Items

Source	Refrigerant	Metric Tons CO_2e
Vehicle Fleet	R-12	0.76
Refrigerators	R-12, R-22	0.54
Air Conditioning	R-22	13.86
Total		**15.16**