

CITY OF NOVATO

2016 GREENHOUSE GAS EMISSIONS INVENTORY

COMMUNITY | MUNICIPAL OPERATIONS

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Prepared by the
Marin Climate & Energy Partnership



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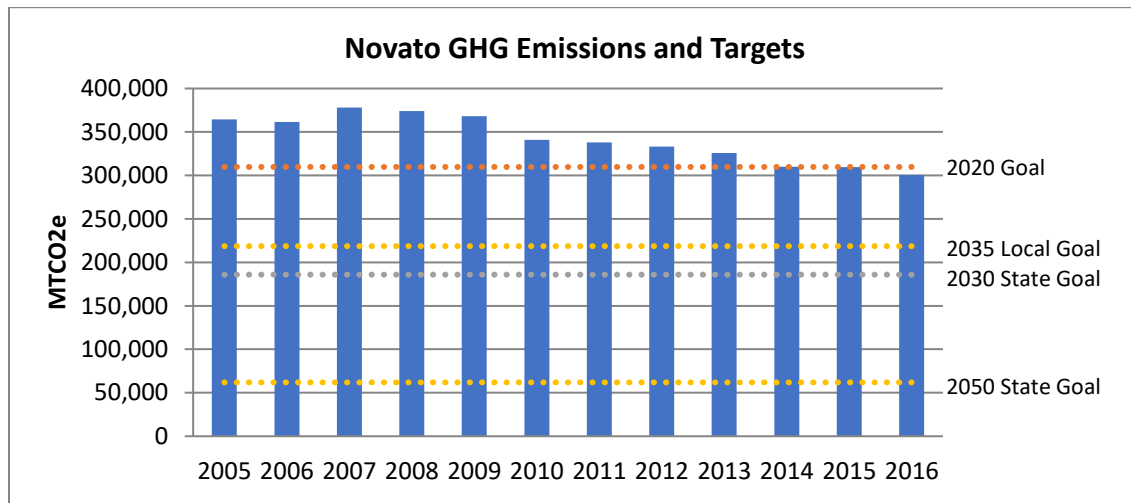
EXECUTIVE SUMMARY

THE TAKEAWAY

COMMUNITY EMISSIONS DOWN 18%
AND MUNICIPAL OPERATIONS
EMISSIONS DOWN 37% SINCE 2005

Novato 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 15% below baseline (2005) emissions by 2020 and 40% below baseline emissions by 2035. In addition to the community inventories, MCEP periodically prepares inventories for municipal 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 Novato community has reduced emissions 18% since 2005 and has reached the 2020 reduction target four years early. Emissions dropped from about 364,440 metric tons carbon dioxide equivalents (MTCO_{2e}) in 2005 to 300,530 MTCO_{2e} in 2016. The community emissions trend and targets are shown below. Novato needs to reduce emissions another 115,000 MTCO_{2e} to meet the State target for 2030 and another 239,000 MTCO_{2e} to meet the State target for 2050, which is 80% below 1990 levels.



This report also reviews emissions from municipal operations, which is a subset of community emissions. Emissions from government operations decreased 37% since 2005, or 1,055 metric tons CO_{2e}. While municipal emissions are less than 1% of overall community emissions, local government plays a large role in setting an example for the rest of the community. Emissions from municipal operations are detailed beginning on page 10.

Recognizing the need for collaborative approaches to reducing greenhouse gases, City and county leaders launched Marin Climate and Energy Partnership (MCEP) in 2007. The City of Novato 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 Marin County Energy Watch Partnership which administers public goods charges collected by PG&E. Marin community inventories are available 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 Novato community, as well as municipal operations in 2016. 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 municipal 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.

Municipal operations emissions are categorized according to the following sectors:

- Buildings and Other Facilities
- Streetlights, Traffic Signals, and Other Public Lighting
- Water Delivery Facilities
- Vehicle Fleet
- Solid Waste
- Employee Commute

Community emissions are categorized according to seven sectors:

- Residential
- Commercial
- 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 generated from natural gas and therefore has a higher emissions factor. Electricity that is produced 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 CO₂e, 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 MTCO₂e.

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 ₂ O	Combustion, wastewater treatment	265
Hydroflourocarbons	Various	Leaked refrigerants, fire suppressants	12 to 11,700

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 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 Novato community resulted in approximately 364,442 metric tons of CO₂e. In 2016, those activities resulted in approximately 300,531 metric tons of CO₂e, a reduction of 18%. This means that the City has met the State and local goal to reduce emissions 15% below the 2005 baseline by 2020.

The community inventory tracks emissions in seven sectors:

- The **Residential** sector represents emissions generated from the use of electricity, natural gas, and propane in Novato homes.
- The **Commercial** 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 Novato, 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 and Commercial 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 Novato city limits. Energy used to convey water from the city limits to water users is embedded in energy use included in the Commercial sector.
- The **Wastewater** sector represents 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 is included in the Commercial sector.

Table 2 shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Transportation sector (-27,113 MTCO₂e), followed by the Residential sector (-22,312 MTCO₂e). The likely reasons for the largest emissions decreases are described in the remainder of this report.

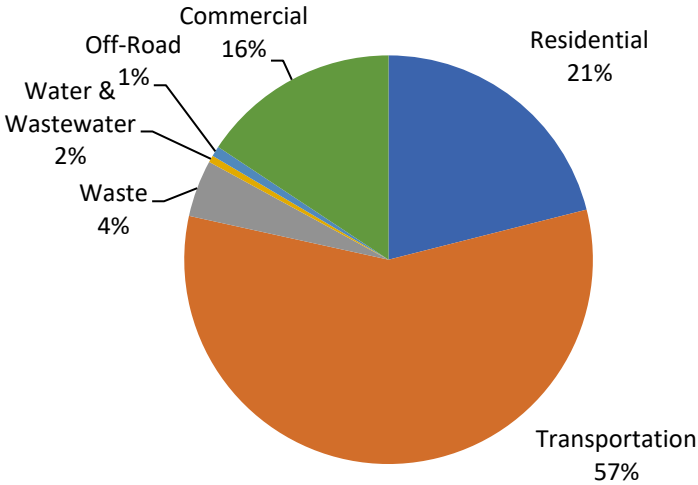
TABLE 2: SUMMARY BY SECTOR, 2005 THROUGH 2016

Year	Residential	Commercial	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005
2005	85,598	57,054	199,570	15,734	2,292	3,061	1,133	364,442	0%
2006	86,439	55,672	197,067	15,849	2,299	3,022	1,142	361,489	-1%
2007	95,703	68,381	193,850	14,712	2,308	1,981	1,165	378,100	4%
2008	96,411	68,943	190,107	12,638	2,314	2,407	1,173	373,993	3%
2009	94,563	68,546	188,125	10,853	2,321	2,588	1,178	368,175	1%

2010	85,673	58,944	181,012	10,673	2,327	996	1,184	340,811	-6%
2011	85,832	56,997	180,469	10,407	2,356	658	1,190	337,910	-7%
2012	80,568	57,966	179,474	10,802	2,377	671	1,202	333,060	-9%
2013	79,379	56,514	174,708	11,024	2,408	726	1,217	325,974	-11%
2014	64,879	52,148	177,457	11,140	2,441	806	1,232	310,104	-15%
2015	65,691	51,458	176,860	11,590	2,448	503	1,239	309,788	-15%
2016	63,286	47,171	172,456	13,523	2,449	397	1,249	300,531	-18%
Change from 2005	-22,312	-9,883	-27,113	-2,211	157	-2,663	116	-63,911	
% Change from 2005	-26%	-16%	-14%	-14%	7%	-87%	10%	-18%	

Figure 1 below shows the relative contribution of emissions from these sectors in 2016.

FIGURE 1: EMISSIONS BY SECTOR, 2016

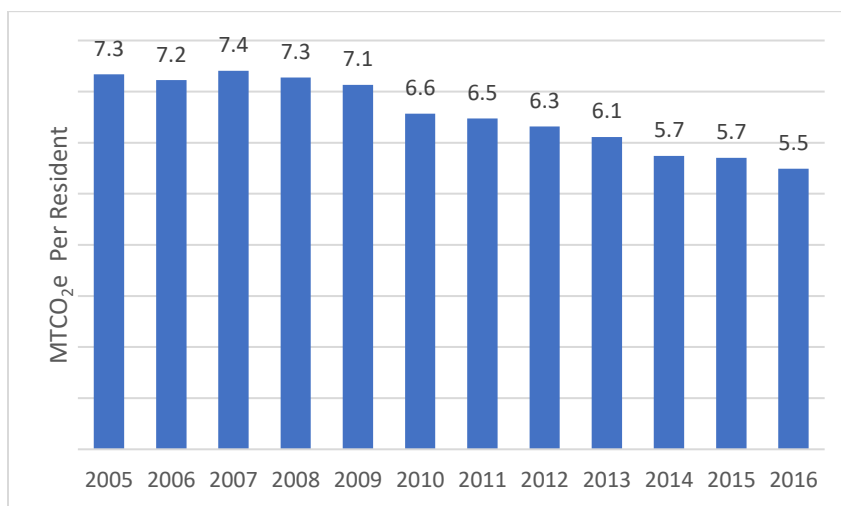


PER CAPITA EMISSIONS

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 7.3 metric tons of CO₂e per capita in 2005. Per capita emissions decreased 25% between 2005 and 2016, falling to 5.5 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 Novato, which would include lifecycle emissions, emissions resulting from air travel, etc.

FIGURE 2: EMISSIONS PER CAPITA



MAJOR SOURCES OF EMISSIONS

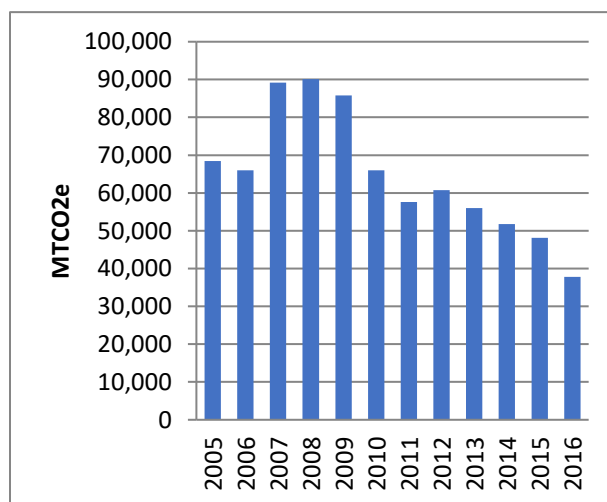
The following sections provide a year-by-year analysis of the changes in GHG emissions from the City’s largest sources: electricity, natural gas, transportation, waste, and water use. Whenever possible, each section discusses the change in emissions from previous years and the likely influence of state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

ELECTRICITY USE

Electricity use in homes and businesses in Novato decreased about 7% between 2005 and 2016. The Residential sector, which uses 45% of all electricity in Novato, reduced electricity use 8% since 2005. Electricity use decreased 6% in the Commercial 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 use in Marin County in 2016.

Electricity-related greenhouse gas emissions in the Residential and Commercial 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 Novato customers in 2012, 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 Novato. In 2016, about 0.5% of MCE electricity purchased by Novato customers was 100% renewable Deep Green electricity.

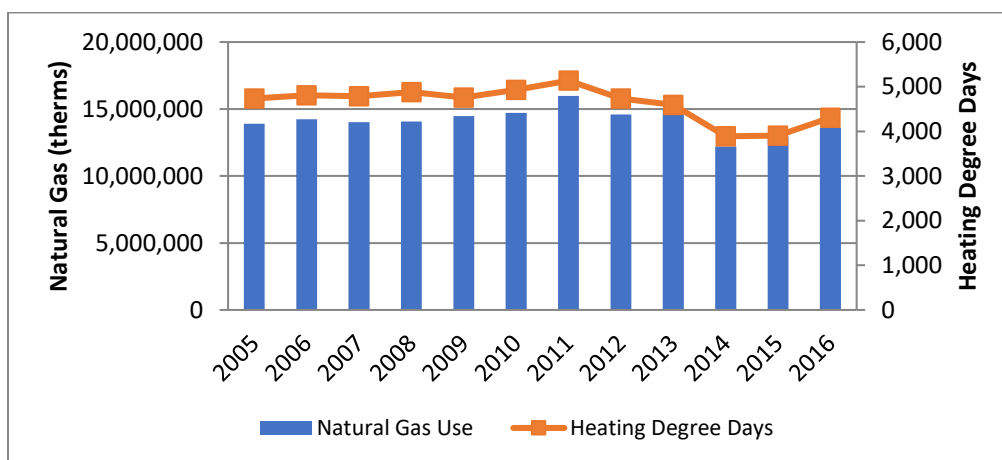
FIGURE 3: ELECTRICITY EMISSIONS



NATURAL GAS USE

Natural gas is used in residential and commercial 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 Novato to fluctuate from year to year, from a high of 16.0 million therms in 2011 to a low of 12.2 million therms in 2014. Emissions from natural gas consumption increased 5% between 2015 and 2016, most likely due to colder temperatures. **Figure 4** below compares natural gas usage in Novato 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 2% 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 57% of Novato's emissions in 2016. Vehicle miles traveled have decreased approximately 2% since 2005. Transportation emissions have decreased 14% due primarily 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.

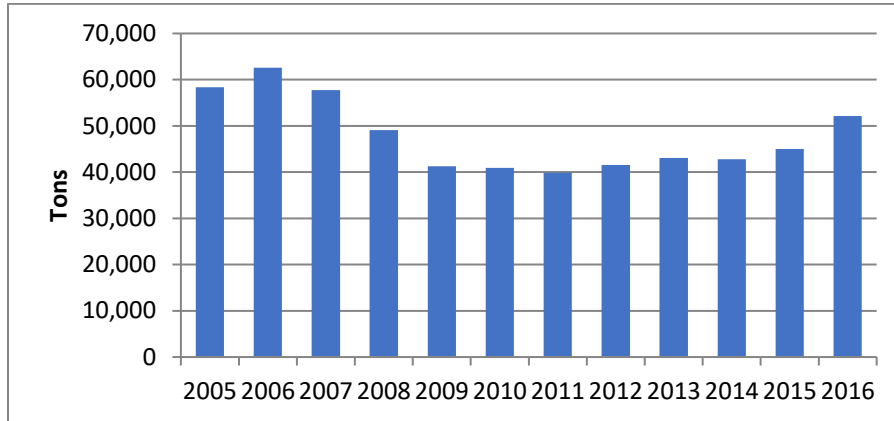
While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the City has undertaken many efforts to reduce transportation emissions by encouraging workforce housing and making it easier for residents to use alternative modes of transportation, including bicycling, walking, and public transportation. The City has also promoted electric vehicle adoption by installing chargers and providing free electricity at eight municipal EV charging stations with a combined total of 16 charging ports.

WASTE DISPOSAL

Waste generated by the community hit a low in 2011 but has since increased as shown in **Figure 5** below (based on countywide disposal data). Landfilled waste increased 16% between 2015 and 2016 but is still 11% 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.

FIGURE 5: DISPOSED WASTE

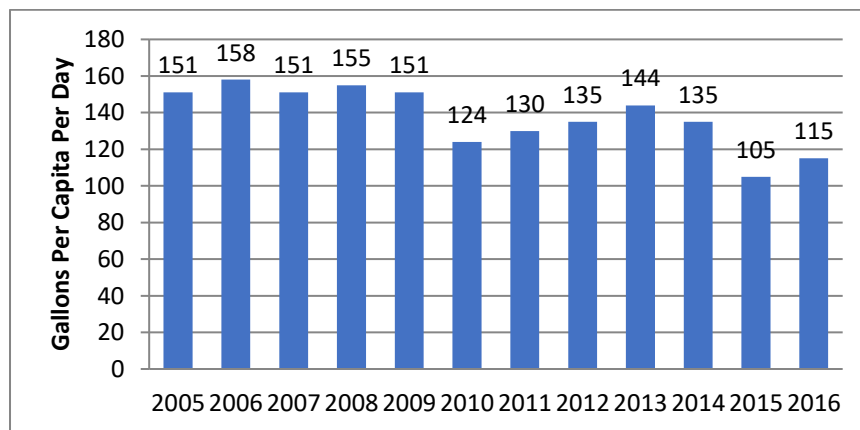


Source: CalRecycle

WATER USE

Per capita water use declined 24% 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 87% between 2005 and 2016. The additional reduction is due to the lower carbon intensity of electricity. The Sonoma County Water Agency, which supplies approximately 80% of Novato's water, uses renewable and carbon-free sources for its electricity needs.

FIGURE 6: PER CAPITA WATER USE



Source: North Marin Water District

The North Marin Municipal Water District (NMWD) 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, water-efficient landscapes, graywater systems, and rain barrels. NMWD provides free home and landscape water-use evaluations.

MUNICIPAL OPERATIONS INVENTORY

MUNICIPALITY PROFILE

The City of Novato is a general law city and operates under the council-city manager form of government. The municipality operates administrative, planning, building, public works, parks, recreation and community services departments, as well as a police department. In 2015, there were 201 total employees. General fund expenditures for fiscal year 2015-2016 were \$31,623,068.

MUNICIPAL OPERATIONS INVENTORY SUMMARY

In 2005, Novato’s municipal operations produced approximately 2,815 metric tons CO_{2e}, which represented about 0.8% of total community emissions. In 2016, those activities resulted in approximately 1,760 metric tons CO_{2e}, a reduction of 1,055 metric tons, or 37%, and the municipality’s share of community emissions dropped to 0.6%. The following summaries break down these totals by sector and sources.

SUMMARY BY SECTOR

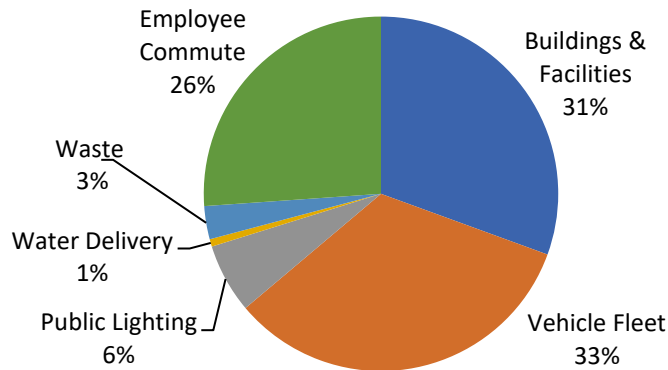
As shown in **Table 3**, emissions from municipal operations reduced in all sectors, in comparison to 2005 emissions. The greatest reduction occurred in the employee commute sector, where emissions dropped 271 metric tons CO_{2e}, or 37%. Other significant reductions occurred in the public lighting sector (255 metric tons), vehicle fleet sector (251 metric tons), and buildings and facilities sector (176 metric tons).

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	714	538	-176	-25%
Vehicle Fleet	837	586	-251	-30%
Public Lighting	366	111	-255	-70%
Water Delivery	30	12	-18	-60%
Waste	136	53	-83	-61%
Employee Commute	731	460	-271	-37%
Total	2,815	1,760	-1,055	-37%

Figure 7 below illustrates that the vehicle fleet sector was the largest emitter of greenhouse gas emissions in 2016 (33% of total emissions), followed by the buildings and facilities sector (31%).

Figure 7: Emissions by sector, 2016



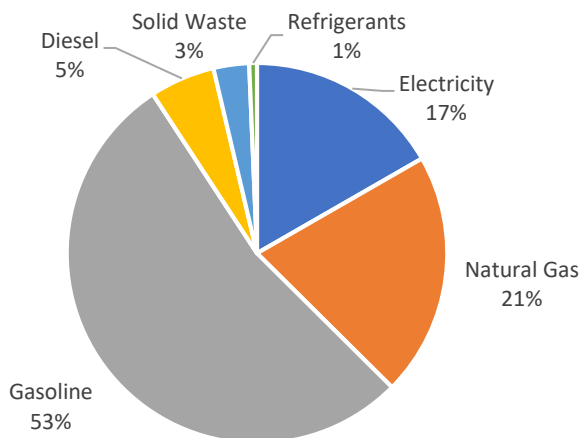
SUMMARY BY SOURCE

Table 4 shows a summary of the City’s greenhouse gas emissions by source. Emissions decreased from all sources except refrigerants, which increased 13%. The greatest decreases occurred in emissions from gasoline (515 metric tons) and electricity (429 metric tons). Despite the decrease in gasoline emissions, gasoline was the largest source of greenhouse gas emissions in Novato’s governmental operations in 2016 (see **Figure 8**), contributing more than half of all emissions. Natural gas consumption accounts for about one-fifth of all emissions, while electricity consumption represents 17% of 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	722	294	-429	-59%
Natural Gas	385	365	-20	-5%
Gasoline	1,453	938	-515	-35%
Diesel	102	97	-5	-5%
Propane	7	1	-6	-87%
Solid Waste	136	53	-83	-61%
Refrigerants	10	12	1	13%
Total	2,815	1,760	-1,055	-37%

FIGURE 8: EMISSIONS BY SOURCE, 2016



MUNICIPAL OPERATIONS INVENTORY DETAIL BY SECTOR

This section explores municipal 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 fossil 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 CO₂. For example, HFC-134a, a very common refrigerant, has a GWP of 1300, or 1300 times that of CO₂. Therefore, even small amounts of leaked refrigerants can have a significant effect on greenhouse gas emissions.

In 2016, Novato operated several major facilities, including City Hall, the administration building, the police station, public works buildings, sports and recreation facilities, and community centers. Data relating to electricity and natural gas consumption for buildings and facilities were obtained from PG&E and MCE and data for refrigerants and fuel used for backup generators were obtained from Novato staff.

As shown in **Table 5**, emissions from the buildings sector decreased 25% between 2005 and 2016. Electricity consumption decreased 10%, while emissions from electricity consumption decreased 48% because of the lower carbon intensity of electricity. Natural gas consumption and emissions decreased 5%.

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

Source	2005 Energy Consumption	2005 GHG Emissions (MTCO ₂ e)	2016 Energy Consumption	2016 GHG Emissions (MTCO ₂ e)	% Change in Energy Consumption	% Change in GHG Emissions (MTCO ₂ e)
Electricity	1,457,804 kWh	325	1,307,744 kWh	170	-10%	-48%
Natural Gas	72,386 therms	385	68,575 therms	365	-5%	-5%
Diesel/Gasoline	105 gallons	1	0 gallons	0	-100%	-100%
Refrigerants	--	3	--	3	0%	0%
Total	--	714	--	538	--	-25%

Table 6 shows electricity and natural gas usage by facility. While energy consumption went down in most facilities, there were a few notable exceptions. Electricity consumption increased in the City Administration building and natural gas usage increased in the City Administration building, community centers, and public works buildings. The increases in energy consumption are most likely due to a new City administration building that opened in 2014, a new public works facility that opened in 2007, and expanded programming at the community centers.

TABLE 6: ENERGY USAGE AT NOVATO BUILDINGS AND FACILITIES

Building/ Facility	Energy Source	2005 Energy Consumption	2016 Energy Consumption	% Change in Energy Consumption
Police Station	Electricity	496,320 kWh	449,995 kWh	-9%
	Natural Gas	14,408 therms	13,480 therms	-6%
City Administration	Electricity	255,308 kWh	459,933 kWh	80%
	Natural Gas	16,701 therms	18,841 therms	13%
Community Centers	Electricity	244,688 kWh	43,664 kWh	-82%
	Natural Gas	6,520 therms	8,388 therms	29%
Gymnastic Center	Electricity	174,240 kWh	54,214 kWh	-69%
	Natural Gas	7,943 therms	7,407 therms	-7%
Swimming Pool	Electricity	97,280 kWh	89,668 kWh	-8%
	Natural Gas	19,439 therms	10,250 therms	-47%
Childcare, Museum & Skate Park	Electricity	41,297 kWh	36,303 kWh	-14%
	Natural Gas	652 therms	533 therms	-18%
Public Works Buildings	Electricity	60,600 kWh	52,065 kWh	-14%
	Natural Gas	2,354 therms	4,287 therms	82%
Aggregate Minor Facilities	Electricity	88,071 kWh	121,902 kWh	-10%
	Natural Gas	4,369 therms	5,389 therms	23%

STREETLIGHTS AND TRAFFIC SIGNALS

Novato 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 48% between 2005 and 2016 due to conversion of inefficient lighting to LED fixtures and bulbs. Novato had converted all of its streetlights by the end of 2016, reducing electricity used for streetlights by more than half. Emissions decreased 70%; the additional reduction is due to the lower carbon intensity of MCE electricity in 2016.

TABLE 7: STREETLIGHTS AND TRAFFIC SIGNAL EMISSIONS, 2005 AND 2016

Source	2005 Electricity Consumption	2005 GHG Emissions (MTCO ₂ e)	2016 Electricity Consumption	2016 GHG Emissions (MTCO ₂ e)	% Change in Electricity Consumption	% Change in GHG Emissions (MTCO ₂ e)
Streetlights	1,425,158 kWh	319	690,772 kWh	90	-52%	-72%
Traffic Signals	161,947 kWh	36	127,913 kWh	17	-21%	-54%
Outdoor Lighting	52,097 kWh	12	37,737 kWh	5	-28%	-58%
Total	1,639,202 kWh	366	856,422 kWh	111	-48%	-70%

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 Novato’s water delivery emissions is from electricity consumption. Overall, electricity usage declined 32% and emissions dropped 60%.

TABLE 8: WATER DELIVERY EMISSIONS, 2005 AND 2016

Source	2005 Electricity Consumption	2005 GHG Emissions (MTCO ₂ e)	2016 Electricity Consumption	2016 GHG Emissions (MTCO ₂ e)	% Change in Electricity Consumption	% Change in GHG Emissions (MTCO ₂ e)
Irrigation	17,824 kWh	4	27,703 kWh	4	55%	-9%
Water Pumps	117,435 kWh	26	64,313 kWh	8	-45%	-68%
Total	135,259 kWh	30	92,016 kWh	12	-32%	-60%

VEHICLE FLEET

The vehicles and mobile equipment used in Novato’s daily operations include public works trucks and equipment, police cars and motorcycles, and vehicles for use by administration and community development 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. In 2016, Novato operated a fleet of approximately 150 vehicles.

Table 9 shows that total fuel consumption and emissions decreased 30% between 2005 and 2016. The largest decline occurred in the Police department, where fuel usage dropped 23,266 gallons, a 39% reduction from 2005.

TABLE 9: VEHICLE FLEET EMISSIONS, 2005 AND 2016

Source	2005 Fuel Consumption	2005 GHG Emissions (MTCO ₂ e)	2016 Fuel Consumption	2016 GHG Emissions (MTCO ₂ e)	% Change in Fuel Consumption	% Change in GHG Emissions (MTCO ₂ e)
Public Works	27,345 gallons	253	26,406 gallons	241	-3%	-5%
Police Dept.	59,353 gallons	525	36,087 gallons	317	-39%	-40%

Community Development and Administration	5,883 gallons	52	1,851 gallons	16	-69%	-69%
Parks & Recreation	--	--	288 gallons	3	--	--
Refrigerants, all departments	--	7	--	9	--	17%
Total	92,581 gallons	837	64,632 gallons	586	-30%	-30%

WASTE

Waste generated by municipal 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 municipal operations decreased 61% between 2005 and 2016.

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})
Public Works	297.5 tons	83	51.6 tons	15	-83%	-82%
City Hall	23.9 tons	7	25.4 tons	7	6%	8%
Administration & Community Development	19.5 tons	5	23.4 tons	7	20%	22%
Parks, Recreation & Community Services	87.8 tons	25	64.4 tons	18	-27%	-25%
Police	58.5 tons	16	22.4 tons	6	-62%	-61%
Total	487.2 tons	136	187.1 tons	53	-62%	-61%

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 Novato. Emissions dropped 31%, primarily due to an improvement in the fuel-efficiency of the vehicles Novato employees are driving to work. However, it is difficult to draw definitive conclusions from the data, as emissions are determined from employee commute surveys. Thirty-seven 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	220	201	-9%
Vehicle Miles Traveled	1,452,859	1,372,198	-6%
GHG Emissions (MTCO_{2e})	731	460	-37%
Emissions per Employee	3.3	2.3	-31%

APPENDIX A: COMMUNITY INVENTORY

Community GHG Emissions Summary Table

Jurisdiction: City of Novato

Population: 54,749 in 2016 (CA Department of Finance)

Number of Households: 20,589 in 2016 (CA Department of Finance)

Inventory year: 2016

Date Prepared: September 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 ₂ e)
1.0	Built Environment						
1.1	Use of fuel in residential and commercial stationary combustion equipment	Both	•				72,664
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	37,793
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	129,984
2.2	On-road passenger vehicles associated with community land uses	Activity	•				
2.3	On-road freight and service vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	33,861
2.4	On-road freight and service vehicles associated with community land uses	Activity	•				
2.5	On-road transit vehicles associated with community land uses	Activity		•		Unable to obtain source data, therefore obtained activity-based data instead	8,611

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			NE		
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		•			2,449
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			NO		
3.2	Generation and disposal of solid waste by the community	Activity	•				13,523
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	•				397
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 facility is 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	•				1,249
4.6	Use of septic systems by 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.) used 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 ₂ O)	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 ₂ O 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 ₂ O)	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 ₂ O)	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 ₂ O)	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 ₂ O 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 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 ₂ O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing the 2017 Regional Transportation Plan).	CH ₄ and N ₂ O 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 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 ₂ O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing the 2017 Regional Transportation Plan).	CH ₄ and N ₂ O 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 ₂ O)	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 ₂ O 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 estimated from District-wide gallons per capita per day data provided by North Marin Water District (NMWD). Assumed 20% of water from NMWD and 80% from Sonoma County Water Agency (SCWA). Estimated electricity use for NMWD water from CEC report, "Refining Estimates of Water-Related Energy Use in California."	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 ₂ O)	Water consumption estimated from District-wide gallons per capita per day data provided by North Marin Water District (NMWD). Assumed 20% of water from NMWD and 80% from Sonoma County Water Agency (SCWA). Estimated electricity use for NMWD water from CEC report, "Refining Estimates of Water-Related Energy Use in California."	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 estimated percent of methane in digester gas (65%) provided by Novato Sanitary District.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.1.(alt).
	Stationary Emissions from Combustion of Digester Gas (N ₂ O)	Known amount of digester gas produced per day and estimated percent of methane in digester gas (65%) provided by Novato 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 with Nitrification or Denitrification	Estimated population served by wastewater treatment plant provided by Novato Sanitary District.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.7.
	Fugitive Emissions from Effluent Discharge (N ₂ O)	Estimated population served by wastewater treatment plant provided by Novato Sanitary District. Assumed significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12(alt).

APPENDIX B: MUNICIPAL 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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 1	Stationary Combustion	72,386 therms	383.79	0.00	0.04	0.00	385.00
	Stationary Combustion	105 gallons	1.07	0.00	0.00	0.00	1.07
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	2.77
	TOTAL		384.77	0.00	0.04	0.00	388.84
Scope 2	Purchased Electricity	1,457,804 kWh	323.46	0.01	0.02	0.00	325.47
	TOTAL	1,457,804 kWh	323.46	0.01	0.02	0.00	325.47

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 1	Stationary Combustion	68,575 therms	363.58	0.00	0.03	0.00	364.73
	Stationary Combustion	0 gallons	0.00	0.00	0.00	0.00	0.00
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	2.82
	TOTAL		387.74	0.00	0.04	0.00	367.55
Scope 2	Purchased Electricity	1,307,744 kWh	169.06	0.00	0.02	0.00	170.24
	TOTAL	1,307,744 kWh	169.06	0.00	0.02	0.00	170.24

Energy usage was provided by Pacific Gas & Electric Company (PG&E) based on PG&E service accounts. Backup generators for buildings and facilities were recorded by amount of fuel consumed and fuel type. LGO Protocol recommended methods were followed in collection and analysis of this activity data. For electricity, utilized verified utility-specific (PG&E and MCE) CO₂ emissions factor and eGrid subregion default N₂O and CH₄ emission factors for WECC California. For natural gas, utilized default CO₂, CH₄ & N₂O emission factors by fuel type (U.S. Community Protocol, v. 1.1, May 2010, Tables B.1 and B.3).

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

STREETLIGHTS AND TRAFFIC SIGNALS SECTOR NOTES

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2005

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 2	Purchased Electricity	1,639,202 kWh	363.71	0.01	0.02	0.00	365.97
	TOTAL	1,639,202 kWh	363.71	0.01	0.02	0.00	365.97

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 2	Purchased Electricity	856,422 kWh	110.71	0.00	0.01	0.00	111.48
	TOTAL	856,422 kWh	110.71	0.00	0.01	0.00	111.48

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. Utilized verified utility-specific (PG&E and MCE) CO₂ emissions factor and eGrid subregion default N₂O and CH₄ emission factors for WECC California.

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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 2	Purchased Electricity	135,259 kWh	30.01	0.00	0.00	0.00	30.20
	TOTAL	135,259 kWh	30.01	0.00	0.00	0.00	30.20

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 2	Purchased Electricity	92,016 kWh	11.90	0.00	0.00	0.00	11.98
	TOTAL	92,016 kWh	11.90	0.00	0.00	0.00	11.98

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. See Utilized verified utility-specific (PG&E and MCE) CO₂ emissions factor and eGrid subregion default N₂O and CH₄ emission factors for WECC California.

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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 1	Mobile Combustion	82,799 gallons gasoline	726.98	0.03	0.02	0.00	735.80
	Mobile Combustion	8,557 gallons diesel	87.37	0.00	0.00	0.00	87.43
	Mobile Combustion	1,225 gallons propane	6.49	0.00	0.00	0.00	6.52
	Fugitive Emissions	--	0.00	0.00	0.00	0.01	7.48
	TOTAL		820.84	0.03	0.02	0.01	837.23

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 1	Mobile Combustion	57,617 gallons gasoline	505.88	0.01	0.01	0.00	506.10
	Mobile Combustion	6,854 gallons diesel	69.98	0.00	0.00	0.00	69.98
	Mobile Combustion	161 gallons propane	0.85	0.00	0.00	0.00	0.86
	Fugitive Emissions	--	0.00	0.00	0.00	0.01	8.75
	TOTAL		576.77	0.01	0.01	0.01	585.75

Vehicle fleet data was provided by City of Novato. LGO Protocol methods were followed in collection and analysis of vehicle fuel consumption and vehicle miles traveled (VMT). In some cases, VMT was estimated according to fuel consumption and estimated vehicle fuel efficiency. Utilized default CO₂ emission factors for transport fuel from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.11. Utilized default N₂O and CH₄ emission factors for highway vehicles by model year from the from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.12.

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 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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 3	Landfilled Waste	487.2 tons	0.00	0.00	4.86	0.00	136.11
	TOTAL	487.2 tons	0.00	0.00	4.86	0.00	136.11

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2016

Scope	Emission Type	Weight	Greenhouse Gas Emissions (metric tons)				
			CO ₂	N ₂ O	CH ₄	HFCs	CO ₂ e
Scope 3	Landfilled Waste	187.1 tons	0.00	0.00	1.90	0.00	53.22
	TOTAL	187.1 tons	0.00	0.00	1.90	0.00	53.22

Solid waste collection data for quantity of containers, container size, pick-ups per week was provided by Novato Disposal Service. Containers were assumed to be 100% filled at 250 lbs. per cubic yard. 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 CH₄.

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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 3	Mobile Combustion	220	1,452,859	712.06	0.06	0.05	0.00	730.73
	TOTAL	220	1,452,859	712.06	0.06	0.05	0.00	730.73

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 ₂ O	CH ₄	HFCs	CO ₂ e
Scope 3	Mobile Combustion	201	1,372,198	459.22	0.01	0.02	0.00	459.52
	TOTAL	201	1,372,198	459.22	0.01	0.02	0.00	459.52

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. Seventy-four employees responded to the survey, a response rate of 37%. Estimates for total employee commutes were extrapolated from this data. 2015 data was used as a proxy for the 2016 inventory. Utilized default CO₂ emission factors for transport fuel from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.11. Utilized default N₂O and CH₄ emission factors for highway vehicles by model year from the from the Local Government Operations Protocol, v. 1.1, May 2010, Table G.12.

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 Novato's municipal operations. Information items for this inventory include one public works vehicle, refrigerators 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.

TABLE 2: INFORMATION ITEMS, 2016

Source	Refrigerant	Metric Tons CO ₂ e
Vehicle Fleet	R-12	0.92
Refrigerators	R-12, R-22	0.49
Air Conditioning	R-22	6.97
Total		8.37