City of Novato

2010 Greenhouse Gas Emissions Inventory

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Prepared by the
Marin Climate & Energy Partnership

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EXECUTIVE SUMMARY

Climate change, caused by an increase in the concentration of atmospheric greenhouse gases, has been called one of the greatest challenges facing society today. Potential climate change impacts in Northern California include declining water supplies, spread of disease, diminished agricultural productivity, sea level rise, and increased incidence of wildfire, flooding, and landslides. In addition, the volatility of energy markets has roused concern, and is forcing communities to think differently about their resources. Here, in the State of California – with Assembly Bill 32, the Attorney General's efforts to mandate GHG reductions via CEQA, and other legislation—policies, programs and state laws designed to reduce greenhouse gases to 1990 levels by the year 2020 have been created and are being implemented.

In 2009, Novato completed a Greenhouse Gas Inventory report for the baseline year of 2005, and the Novato City Council adopted a greenhouse gas reduction target of 15% below 2005 levels by the year 2020, a target that is comparable to the state goal. In December 2009, the Novato City Council approved a Climate Action Plan that lays out a path to achieve those greenhouse gas reductions in local government operations and throughout the community. This report measures the progress the City has made on reducing greenhouse gas emissions between 2005 and 2010. In some cases, changes have been made to the baseline year calculations in order to ensure an apples-to-apples comparison of emissions between 2005 and 2010. The inventory quantifies greenhouse gas emissions from a wide variety of sources, from the energy used to power, heat and cool buildings, to the fuel used to move vehicles and power off-road equipment, to the decomposition of solid waste and treatment of wastewater. Emissions are arranged by sector to facilitate detailed analysis of emissions sources and comparison of increases and decreases between 2005 and 2010. It is important to note that the inventory provides a snapshot of two years and does not intend to imply there is necessarily a trend line between those years. Total emissions may have gone up or down during the years between 2005 and 2010.

The encouraging news is that Novato reduced community greenhouse gas emissions nearly 3% between 2005 and 2010, from 296,318 metric tons in 2005 to 287,645 metric tons in 2010 – a reduction of 8,673 metric tons CO2e. Reductions occurred in all sectors except the commercial sector. On a percentage basis, the greatest declines occurred in the waste (-33%), off-road vehicles and equipment (-12%) and water and wastewater (-10% each) sectors. In absolute terms, the greatest reductions were made in the transportation (5,160 metric tons), waste (3,754 metric tons), and wastewater (587 metric tons) sectors.

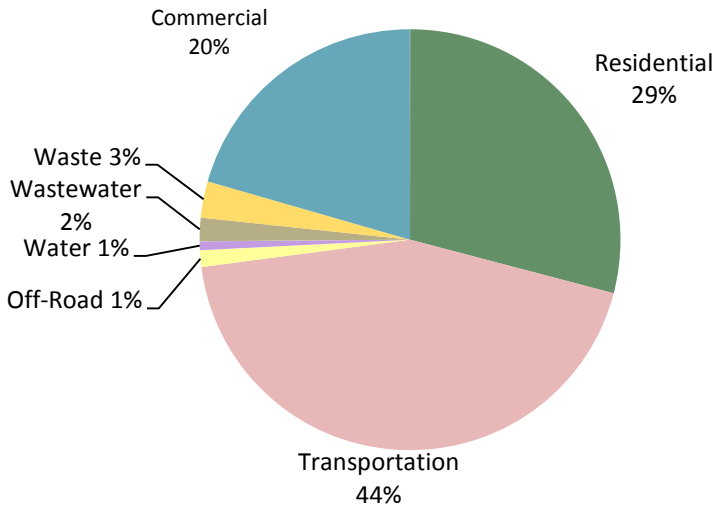
TABLE A: COMMUNITY EMISSIONS BY SECTOR, 2005 AND 2010

Sector	2005 Greenhouse Gas Emissions		2010 Greenhouse Gas Emissions		Change in Metric Tons CO_{2e}	% Change in Metric Tons
	Metric Tons CO_2e	% of Total	Metric Tons CO_2e	% of Total		
Residential	84,137	28%	83,908	29%	-229	-0.3%
Commercial	57,196	19%	58,971	20%	1,775	3.1%
Transportation	131,019	44%	125,859	44%	-5,160	-3.9%
Off-Road	4,179	1%	3,683	1%	-496	-11.9%
Water	2,151	1%	1,930	1%	-221	-10.3%
Wastewater	6,145	2%	5,558	2%	-587	-9.6%
Waste	11,490	4%	7,736	3%	-3,754	-32.7%
Total	**296,318**	**100%**	**287,645**	**100%**	**-8,673**	**-2.9%**

The great strides that were made in the waste sector were primarily due to a 30% reduction in waste going to the landfill. Improvements in fuel efficiency and the carbon intensity of transportation fuels were primarily responsible for the decline in transportation emissions. A 30% decrease in fuel used in construction vehicles and equipment, due to a contraction in the construction industry, was the primary driver behind the reduction in off-road emissions, while a decrease in water usage and an improvement in the carbon intensity of PG&E electricity led to a decline in water and wastewater emissions. More detailed analysis of the factors related to decreases and increases in emissions appears in the Community Inventory Detail by Sector section beginning on page 13.

As shown in Figure A, emissions from the transportation sector are responsible for the greatest percentage of greenhouse gas emissions (44%), followed by emissions from the residential sector (29%) and the commercial sector (20%). The waste, wastewater, off-road and water sectors are each responsible for 3% or less of total community emissions.

FIGURE A: COMMUNITY EMISSIONS BY SECTOR, 2010

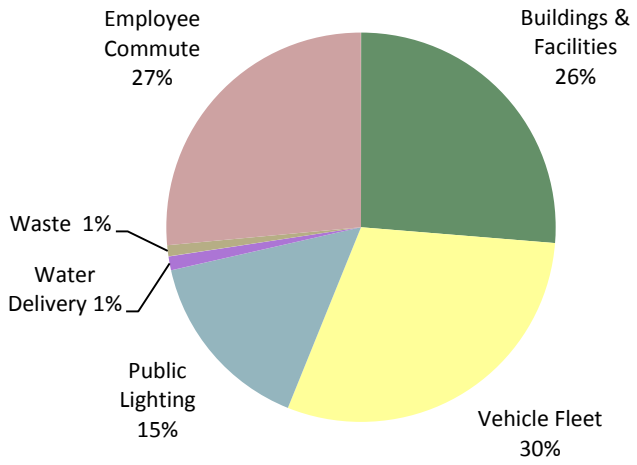


Within government operations, emissions decreased by 357 metric tons CO_2e, or by 13.2%. Emissions decreased in all sectors, with the majority occurring in the waste sector (-39%), vehicle fleet sector (-16%), employee commute sector (-15%), and buildings and facilities sector (-13%). Approximately 66% of the emissions reductions were due to a decrease in gasoline consumption for City vehicles and employee commuting, and about 20% of these reductions may be attributed to a 3% reduction of the City's workforce. Another 28% of the emissions reductions are attributed to a decrease in electricity consumption for City buildings and facilities, coupled with an improvement in the carbon intensity of Pacific Gas & Electric electricity.

TABLE B: GOVERNMENT OPERATIONS EMISSIONS BY SECTOR, 2005 AND 2010

Sector	2005 Greenhouse Gas Emissions		2010 Greenhouse Gas Emissions		Change in Metric Tons CO_{2e}	% Change in Metric Tons CO_2e
	Metric tons CO_2e	% of Total	Metric Tons CO_2e	% of Total		
Buildings & Facilities	714.7	26%	618.6	28%	-96.1	-13%
Vehicle Fleet	831.1	31%	701.2	31%	-129.9	-16%
Public Lighting	366.7	14%	360.2	16%	-6.5	-2%
Water Delivery	30.3	1%	27.3	1%	-3.0	-10%
Waste	35.0	1%	21.5	1%	-13.5	-39%
Employee Commute	730.7	27%	622.7	23%	-108.0	-15%
Total	**2,708.5**	**100%**	**2,351.5**	**100%**	**-357.0**	**-13.2%**

FIGURE B: GOVERNMENT OPERATIONS EMISSIONS BY SECTOR, 2010



These results show that Novato is well on its way to accomplishing its greenhouse gas reduction goals for government operations and has made some progress on reaching its goal for community emissions. If emissions continue to decrease at the current rate, Novato will achieve a reduction in community emissions of 8.5% by 2020, which is substantially short of the City's goal to reduce community emissions by 15%. The City is further challenged by a realization that some of the emissions reduction that occurred between 2005 and 2010 can be attributed to the economic downturn, and emission levels are likely to rebound in some sectors as economic activity picks up.

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 and local government operations in 2010. This inventory provides a comparison to baseline 2005 emissions, and identifies the sectors where significant reductions in greenhouse gas emissions have occurred and where more work needs to be done. In some instances, baseline emissions were recalculated in order to ensure the same methodology was employed for 2005 and 2010. In particular, emissions for the transportation sector were calculated according to updated greenhouse gas plan level guidance from the Bay Area Air Quality Management District which attempts to remove the effects of through traffic on state highways. In addition, some new sectors were added to the inventory; this report includes emissions from water use, off-road vehicles and equipment, and wastewater treatment for the community inventory and fugitive emissions from refrigerants in the government operations inventory.

GENERAL METHODOLOGY

A national standard called the Local Government Operations Protocol (LGO Protocol) has been developed and adopted by the California Air Resources Board (ARB) in conjunction with ICLEI-Local Governments for Sustainability, the California Climate Action Registry and The Climate Registry. This standard provides accounting principles, boundaries, quantification methods and procedures for reporting greenhouse gas emissions from local government operations. The LGO Protocol forms the basis of ICLEI's Clean Air & Climate Protection Software (CACP 2009), which allows local governments to compile data and perform the emissions calculations using standardized methods.

Local government operations emissions have been 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

This inventory utilizes methodologies developed by the Bay Area Air Quality Management District and ICLEI for quantifying community-scale emissions. In general, the inventory follows the standards outlined in the International Local Government GHG Emissions Analysis Protocol and, where appropriate, the LGO Protocol, with additional guidance from the Air District with respect to quantifying emissions from the transportation, off-road, water and wastewater sectors.

Community emissions have been categorized according to seven primary sectors:

- Residential
- Commercial
- Transportation
- Off-Road Vehicles and Equipment
- Water
- Wastewater
- Waste

Calculating Emissions

In general, emissions can be quantified in two ways:

1. **Measurement-based methodologies** refer to the direct measurement of greenhouse gas emissions from a monitoring system. Emissions measured in this way may include those from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This method is the most accurate way of inventorying emissions from a given source, but is generally available for only a few sources of emissions.
2. **Calculation-based methodologies** refer to an estimate of emissions calculated based upon measurable activity data and emission factors. Table 1 provides examples of common emissions calculations. For example, in order to calculate the carbon dioxide emissions from community electricity consumption, the total amount of kilowatt hours of electricity consumed by the community over a one-year period is multiplied by an emission factor specific to that source. This results in the amount of carbon dioxide gas emitted by electricity consumption in that year. All emissions inventoried in this report are calculated in this manner.

Table 1: Factors for Calculating Emissions

Emission Source	Activity Data	Emission Factor	Emissions
Electricity Consumption	Kilowatt hours	CO_2 emitted/kWh	CO_2 emitted
Natural Gas Consumption	Therms	CO_2 emitted/therm	CO_2 emitted
Gasoline/Diesel Consumption	Gallons	$C0_2$ emitted/gallon	CO_2 emitted
Waste Generation	Tons	CH_4 emitted/ton	CH_4 emitted

This inventory calculates individual greenhouse gases – e.g., carbon dioxide, methane and nitrous oxide – and converts each gas emission to a standard metric, known as "carbon dioxide equivalents" or CO_2e, in order to allow an apple-to-apples comparison among the three emissions. Table 2 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 21 times as potent as carbon dioxide; therefore, one metric ton of methane is equivalent to 21 metric tons of carbon dioxide. Greenhouse gas emissions are reported in this inventory as metric tons of carbon dioxide equivalents, or $MTCO_2e$.

TABLE 2: 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	21
Nitrous Oxide	N_2O	Combustion, wastewater treatment	310
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 the city limits.
- **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.

THE SCOPES FRAMEWORK

This inventory reports greenhouse gas emission by sector, as described earlier in this report, and by "scope" as follows:

- **Scope 1:** Direct emissions from the combustion of fuels to produce heat, steam, electricity or to power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; leaked refrigerants; and other sources.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 2 emissions occur as a result of activities that take place within the city limits but are generated outside of the town. For example, electricity from Pacific Gas & Electric Company is consumed within Novato but the greenhouse gasses associated with this consumption are emitted outside of the city where the electricity is generated.
- **Scope 3:** All other emissions sources that hold policy relevance to the local government that can be measured and reported. Typically, these are emissions not covered in Scope 2 that occur as a result of activities within the city. Scope 3 emissions include (but are not limited to) emissions resulting from the decomposition of solid waste, the treatment and distribution of water, and the treatment of wastewater at facilities located outside of the city boundaries. Within the government operations inventory, Scope 3 emissions also include emissions resulting from employee commutes.

Organizational Boundaries

The organizational boundary for the inventory determines which aspects of operations are included in the emissions inventory, and which are not. Under the LGO Protocol, two control approaches are used for reporting emissions: operational control or financial control. A local government has operational control if it has full authority to introduce and implement policies that impact the operation. A local government has financial control if the operation is fully consolidated in financial accounts. If a local government has joint control over an operation, the contractual agreement will have to be examined to see who has authority over operating policies and implementation, and thus the responsibility to report emissions under operational control.

LGO Protocol strongly encourages local governments to utilize operational control as the organizational boundary for a local government operations emission inventory. Operational control is believed to most accurately represent the emissions sources that local governments can most directly influence, and this boundary is consistent with other environmental and air quality reporting program requirements. For this reason, this inventory for local government operations emissions was conducted according to the operational control framework.

Understanding Totals

It is important to realize that the totals listed in the tables and discussed in the report are intended to represent all-inclusive, complete totals for Novato's community emissions. However, these totals are only a summation of inventories 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. 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.

Information Items

Information items are emissions sources that are not included as Scope 1, 2, or 3 emissions in the inventory, but are reported here separately in order to provide a more complete picture of emissions from Novato's government operations. Information items for this inventory include one public works vehicle using the refrigerant R-12 and refrigerators using the refrigerants R-12 and R-22. 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 3: Information Items, 2010

Source	Refrigerant	Metric Tons CO_2e
Vehicle Fleet	R-12	0.46
Refrigerators	R-12, R-22	0.49
Air Conditioning	R-22	7.17
Total		**8.12**

Regional and Local Context

Climate Change Mitigation Activities in California

Since 2005, the State of California has responded to growing concerns over the effects of climate change by adopting a comprehensive approach to addressing emissions in the public and private sectors. This approach was

officially initiated with the passage of the Global Warming Solutions Act of 2006 (AB 32), which requires the state to reduce its greenhouse gas emissions to 1990 levels by 2020. The AB 32 Scoping Plan was developed to identify strategies for meeting the AB 32 goal, and was adopted by the California Air Resources Board (ARB) in December 2008. Among many other strategies, it encourages local governments to reduce emissions in their jurisdictions by 15 percent below current levels by 2020. In addition, it identifies the following strategies that will impact local governance:

- Develop a California cap-and-trade program
- Expand energy efficiency programs
- Establish and seek to achieve reduction targets for transportation-related GHG emissions
- Expand the use of green building practices
- Increase waste diversion, composting, and commercial recycling toward zero-waste
- Continue water efficiency programs and use cleaner energy sources to move and treat water
- Reduce methane emissions at landfills
- Preserve forests that sequester carbon dioxide

Other measures taken by the state include mandating stronger vehicle emissions standards (AB 1493, 2002), establishing a low-carbon fuel standard (EO # S-01-07, 2007), mandating a climate adaptation plan for the state (S-EO # 13-08, 2008), establishing a Green Collar Job Council, and establishing a renewable energy portfolio standard for power generation or purchase in the state. The state also has made a number of legislative and regulatory changes that have significant implications for local governments:

- SB 97 (2007) required the Office of Planning and Research to create greenhouse gas planning guidelines for the California Environmental Quality Act (CEQA). In addition, ARB is tasked with creating energy-use and transportation thresholds in CEQA reviews, which may require local governments to account for greenhouse gas emissions when reviewing project applications.
- AB 811 (2007) authorizes all local governments in California to establish special districts that can be used to finance solar or other renewable energy improvements to homes and businesses in their jurisdiction.
- SB 375 (2008) revises the process of regional transportation planning by metropolitan planning organizations (MPOs), which are governed by elected officials from local jurisdictions. The statute calls on ARB to establish regional transportation-related greenhouse gas targets and requires the large MPOs to develop regional "Sustainable Communities Strategies" of land use, housing and transportation policies that will move the region towards its GHG target. The statute stipulates that transportation investments must be consistent with the Sustainable Communities Strategy and provides CEQA streamlining for local development projects that are consistent with the Strategy.

The Marin Climate & Energy Partnership

Created in 2007, the mission of the Marin Climate & Energy Partnership (MCEP) is to reduce greenhouse gases emission levels to the targets of Marin County and local municipalities, consistent with the standards set by AB32. Ten Marin Cities and towns, the County of Marin, the Transportation Authority of Marin, and the Marin Municipal Water District are members. The Marin Climate and Energy Partnership provided staff support and technical expertise for the development of this inventory. Funding for this project was provided in part by the Marin County Energy Watch (MCEW), a joint project of Pacific Gas and Electric Company (PG&E) and the County of Marin.[1]

[1] MCEW is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.

Climate Change Mitigation Activities in Novato

Since approval of the Novato Climate Change Action Plan in December 2009, the City has continued to implement greenhouse gas reduction programs in Novato. These include the following:

- Converted approximately 35% of the City's 3,900 streetlights to more energy-efficient LED fixtures and installed approximately 300 programmable photo cells that turn streetlights off at midnight and back on at 5:30 .m. if it is still dark outside.
- In partnership with Novato Disposal Sanitary Service, implemented curbside food waste collection. The program reduces methane emissions by composting food waste instead of depositing it into the landfill.
- Participated in the Energy Upgrade California program, which provided substantial rebates to homeowners to perform energy audits and "whole house" energy upgrade retrofits.
- Joined the Marin Energy Authority and provided Novato ratepayers with the ability to purchase electricity with a higher renewable energy content.

COMMUNITY INVENTORY RESULTS

NOVATO PROFILE

Novato is a city of 27.7 square miles, located in the northern reach of Marin County. According to the U.S. Census, the population of Novato in 2010 was 51,904 and there were 21,158 housing units. The California Department of Finance estimates the population of Novato in 2005 was 49,839.[2] Novato enjoys a temperate climate, with cool, wet, and almost frostless winters and dry summers. The city is located in climate zone 2, and experienced an estimated 3,649 heating degree days and 292 cooling degree days in 2005. The year 2010 was relatively cooler, with 4,027 heating degree days and 168 cooling degree days. [3]

COMMUNITY INVENTORY SUMMARY

In 2005, the activities taking place by the Novato community resulted in approximately 296,318 metric tons of CO_2e. In 2010, those activities resulted in approximately 287,645 metric tons of CO_2e, a reduction of 8,673 metric tons, or 2.9%. These numbers represent a roll-up of emissions. While the roll-up is a valuable figure, the breakdown of emissions information by sectors, sources, and scope allows the comparative analysis and insight needed for effective decision-making for target setting, developing GHG reduction measures, and monitoring. The following summaries break down these totals by sector, sources, and scope.

SUMMARY BY SECTOR

As shown in Table 4 and Figure 1, the transportation sector was the largest emitter of greenhouse gas emissions in both 2005 and 2010 (44% of total emissions). Emissions from the residential sector produced the second highest quantity (28% in 2005 and 29% in 2010), followed by the commercial sector (19% in 2005 and 20% in 2010). Emissions were reduced in all sectors except the commercial sector, with the greatest reductions occurring in the transportation sector (5,160 metric tons), waste sector (3,754 metric tons), and wastewater sector (587 metric tons).

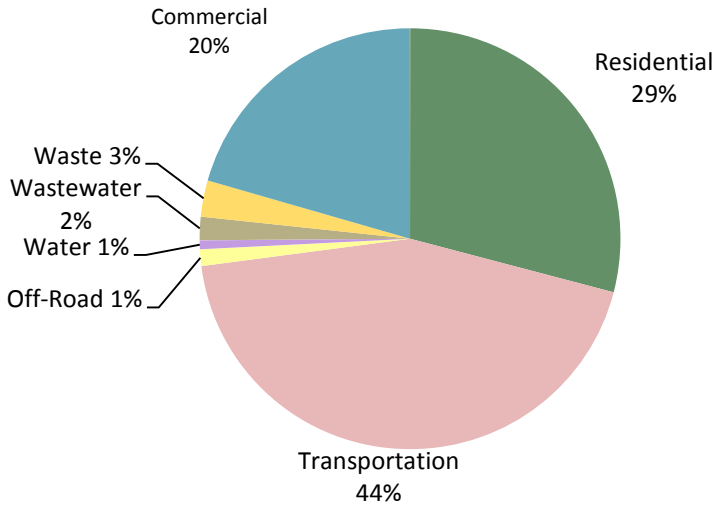
[2] California Department of Finance, "E-4 Population Estimates for Cities, Counties, and the State 2001-2010, with 2000 & 2001 Census Counts," August 2011. To make comparisons to U.S. Census data, this is the average between California Department of Finance estimates for January 1, 2005, and January 1, 2006.

[3] Climate Zone information is supplied by the California Energy Commission, http://www.energy.ca.gov/maps/renewable/Climate_Zones_by_City.pdf, accessed 11/5/12. Heating and cooling degree days data for the North Coast Drainage Division is supplied by NOAA Satellite and Information Service, National Climatic Data Center, U.S. Department of Commerce, http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp, accessed 5/22/12. A heating degree day (HDD) is a measurement designed to reflect demand for energy needed to heat a facility, while a cooling degree day (CDD) is used to reflect the demand on energy needed to cool a building. Degree days are calculated using daily temperature readings and a base temperature (typically 60 or 65 degrees). For example, a typical January day has an average temperature of 47 degrees. For such a day we can approximate the HDD as (65 - 47) = 18.

TABLE 4: SUMMARY BY SECTOR, 2005 AND 2010

Sector	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Residential	84,137	83,908	-229	-0.3%
Commercial/Industrial	57,196	58,971	1,775	3.1%
Transportation	131,019	125,859	-5,160	-3.9%
Off-Road	4,179	3,683	-496	-11.9%
Water	2,151	1,930	-221	-10.3%
Wastewater	6,145	5,558	-587	-9.6%
Waste	11,490	7,736	-3,754	-32.7%
Total	**296,318**	**287,645**	**-8,673**	**-2.9%**

FIGURE 1: EMISSIONS BY SECTOR, 2010



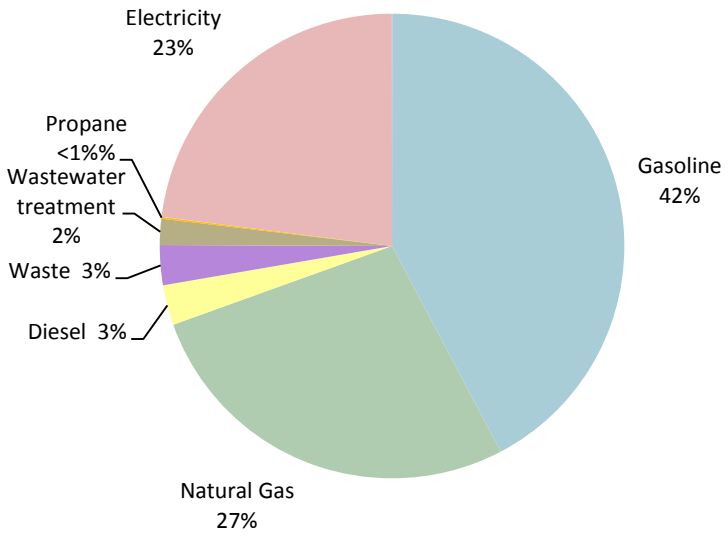
SUMMARY BY SOURCE

When considering how to reduce emissions, it is helpful to look not only at which sectors are generating emissions, but also at the specific raw resources and materials (gasoline, diesel, electricity, natural gas, solid waste, etc.) whose use and generation directly result in the release of greenhouse gases. Table 5 and Figure 2 provide summaries of Novato's 2005 and 2010 greenhouse gas emissions by source. Between 2005 and 2010, emissions from the combustion of natural gas increased by 6%, or 4,430 metric tons. Emissions decreased in all other categories. In 2010, the largest source of emissions was gasoline (42%), followed by natural gas (27%) and electricity (23%).

TABLE 5: SUMMARY BY SOURCE, 2005 AND 2010

Source	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Gasoline	126,695	121,537	-5,158	-4.1%
Natural Gas	73,867	78,297	4,430	6.0%
Electricity	69,231	66,145	-3,086	-4.5%
Diesel	8,504	8,005	-499	-5.9%
Waste	11,490	7,736	-3,754	-32.7%
Wastewater Treatment	6,145	5,558	-587	-9.6%
Propane/LPG	385	367	-18	-4.7%
Total	**296,318**	**287,645**	**-8,673**	**-2.9%**

FIGURE 2: EMISSIONS BY SOURCE, 2010



SUMMARY BY SCOPE

As shown in Table 6, Scope 1 sources produced the largest amount of community greenhouse gas emissions in both 2005 and 2010, with emissions totaling 213,765 metric tons CO_2e in 2010. Scope 2 emissions comprised the second largest amount (66,145 metric tons CO_2e), and Scope 3 emissions totaled 7,736 metric tons CO_2e. The greatest reduction occurred in Scope 3 emissions, which represents emissions from the waste sector.

TABLE 6: SUMMARY BY SCOPE, 2005 AND 2010

Activity	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_{2e}	% Change
Scope 1	215,596	213,765	-0.8%
Scope 2	69,231	66,145	-4.5%
Scope 3	11,490	7,736	-32.7%
Total	**296,318**	**287,645**	**-2.9%**

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, and one must be cognizant that there will be some margin of error when comparing figures.

As detailed in Table 7, dividing the total community-wide GHG emissions by service population (residents and employees) yields a result of 3.9 metric tons of CO_2e per capita in 2005. Per capita emissions decreased 5.3% between 2005 and 2010, falling to 3.7 metric tons per person. 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.).

TABLE 7: PER CAPITA EMISSIONS, 2005 AND 2010

	2005	2010	% Change
Service Population (Residents and Employees)	75,909	77,824	2.5%
Community GHG Emissions (metric tons CO_2e)	296,318	287,645	-2.9%
Service Population Per Capita Emissions (metric tons CO_2e)	3.9	3.7	-5.3%

COMMUNITY INVENTORY DETAIL BY SECTOR

This section explores community activities and emissions by taking a detailed look at each primary sector. As listed above, the sectors included in the community emissions analysis are:

- Residential
- Commercial
- Transportation
- Off-Road Vehicles and Equipment
- Waste
- Water
- Wastewater

RESIDENTIAL SECTOR

Energy consumption associated with Novato homes produced 84,137 metric tons of greenhouse gas emissions in 2005 and 83,908 metric tons in 2010, a decrease of 0.3%. All residential sector emissions are the result of electricity consumption and the on-site combustion of natural gas and propane. Natural gas is typically used in

residences as a fuel for home heating, water heating and cooking, and electricity is generally used for lighting, heating, and to power appliances. In 2005, Novato's entire residential sector consumed 129,386,987 kWh of electricity and 10,310,485 therms of natural gas.

As shown in Table 8, electricity usage in Novato's residential sector increased by 3.2% between 2005 and 2010, while emissions decreased by 6%. This decline in GHG emissions occurred because the carbon intensity of PG&E electricity decreased 9% between 2005 and 2010. This decrease owed, in large part, to an increase in the amount of zero- and low-emitting electricity in their power portfolio and the expanded use of cleaner fossil-fueled electricity, including two new, state-of-the-art natural gas-fired plants that PG&E brought into service in 2010. More than half of PG&E's power came from a combination of non-greenhouse gas emitting and renewable sources in 2010. Several factors affect PG&E's power mix and emissions from year to year, including demand growth, the weather and the availability of hydro power.

TABLE 8: RESIDENTIAL EMISSIONS SOURCES, 2005 AND 2010

Source	2005 Energy Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Energy Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions ($MTCO_2e$)
Electricity	129,386,987 kWh	28,945	133,534,441 kWh	27,198	3.2%	-6.0%
Natural Gas	10,310,485 therms	54,806	10,599,506 therms	56,343	2.8%	2.8%
Propane/LPG	6,208 MMBtu	385	5,919 MMBtu	367	-4.7%	-4.7%
Total	-	84,137	-	83,908	-	-0.3%

Natural gas usage increased 2.8% between 2005 and 2010. This may be due, in part, to the fact that 2010 was a cooler year than 2005.[4] Since the natural gas emissions factor does not fluctuate, the amount of greenhouse gases emitted by the combustion of natural gas also increased 2.8%.

As shown in Table 9 below, Novato residents generated approximately 4.1 metric tons of greenhouse gas emissions per household in 2010. This is a decrease of 2.6% per household since 2005. [5]

TABLE 9: RESIDENTIAL EMISSIONS PER HOUSEHOLD

	2005	2010
Number of Households	19,810	20,279
Residential GHG Emissions (metric tons CO_2e)	84,137	83,908
Residential GHG Emissions per Household (metric tons CO_2e)	4.3	4.1

COMMERCIAL/INDUSTRIAL SECTOR

The commercial and Industrial sector includes emissions from the operations of businesses as well as public agencies. Between 2005 and 2010, emissions in the commercial sector increased by 3.1%. In 2010, buildings and

[4] See discussion on page 9.

[5] Number of Novato households is from ABAG Projections 2009 and 2010 U.S. Census SF1:H3.

facilities within the commercial sector produced 58,971 metric tons of greenhouse gas emissions. All commercial sector emissions included in this inventory are the result of electricity consumption and the on-site combustion of natural gas. Natural gas is typically used in the commercial sector to heat buildings, fire boilers, and generate electricity; electricity is generally used for lighting, heating, and to power appliances and equipment.

As shown in Table 10, electricity usage increased by 11.8% in the commercial sector between 2005 and 2010, and natural gas usage increased 15.2%. Despite the increase in electricity use, emissions decreased for the emission factor reasons explained in the section on residential emissions above. This decrease was offset by an increase in natural gas emissions of 15.2%. The net effect was to increase total emissions from the commercial sector by 3.1%.

TABLE 10: COMMERCIAL/INDUSTRIAL EMISSIONS, 2005 AND 2010

Source	2005 Energy Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Energy Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions ($MTCO_2e$)
Electricity	155,389,128 kWh	38,135	173,738,889 kWh	37,017	11.8%	-2.9%
Natural Gas	3,585,851 therms	19,061	4,130,135 therms	21,954	15.2%	15.2%
Total	--	57,196		58,971	--	3.1%

Table 11 shows commercial emissions based on the estimated number of jobs in Novato in 2005 and 2010.[6] Emissions increased by approximately 4% per job.

TABLE 11: COMMERCIAL / INDUSTRIAL EMISSIONS PER JOB

	2005	2010
Number of Jobs	26,070	25,920
Commercial / Industrial GHG Emissions (metric tons CO_2e)	57,196	58,971
Commercial /Industrial GHG Emissions per Job (metric tons CO_2e)	2.2	2.3

TRANSPORTATION SECTOR

Emissions in the transportation sector are calculated by estimating all vehicle miles traveled on local roads within the city limits and a proportionate share of vehicle miles traveled on state highways that pass through Novato. Air travel and vehicle miles traveled outside of Marin County are not included in the analysis. In 2005, the transportation sector generated 131,019 metric tons of CO_2e. By 2010, emissions from the transportation sector decreased by approximately 4% to 125,859 metric tons CO_2e. As shown in Table 12, vehicle miles traveled on local roads decreased 1.6% between 2005 and 2010, while vehicle miles traveled on state highways are estimated to have increased by 0.4%.

[6] Number of Novato jobs in 2005 and 2010 is based on ABAG Projections 2009 estimates.

TABLE 12: TRANSPORTATION EMISSIONS, 2005 AND 2010

Source	2005 Vehicle Miles Traveled	2005 GHG Emissions ($MTCO_2e$)	2010 Vehicle Miles Traveled	2010 GHG Emissions ($MTCO_2e$)	% Change in Vehicle Miles Traveled	% Change in GHG Emissions ($MTCO_2e$)
Local Roads	169,104,501	82,789	166,469,200	78,748	-1.6%	-4.9%
State Highways	99,148,383	48,230	99,589,503	47,111	0.4%	-2.3%
Total	268,252,884	131,019	266,058,703	125,859	-0.8%	-3.9%

Decreases in transportation sector emissions are largely due to changes in fuel efficiency and the carbon intensity of transportation fuels. The Pavley I vehicle standards are over the long-term increasing fuel efficiency and decreasing emissions per vehicle mile. Fuel efficiency data available for this inventory show an increase in fuel efficiency from an average of 18.1 miles per gallon to an average of 18.5 miles per gallon for vehicles using gasoline between 2005 and 2010. California's Low Carbon Fuel Standard is reducing the carbon intensity of fuel over the long term, and some decreases in carbon intensity were measured between 2005 and 2010.[7]

OFF-ROAD SECTOR

Emissions in the off-road sector are from the combustion of fuels used to power vehicle and equipment in the construction and lawn and garden categories, and include everything from hedge trimmers to cranes. As shown in Table 13, off-road emissions decreased by approximately 12% between 2005 and 2010. This decrease was due to a reduction in gasoline and diesel use in off-road vehicles and equipment, and an improvement in the carbon-intensity of fuels. Emissions from construction equipment and off-road vehicles, in particular, decreased by about 30%, a result of the decline in the construction industry since the peak of the real estate boom in 2006-2007.

TABLE 13: OFF-ROAD EMISSIONS, 2005 AND 2010

Source	2005 Energy Consumption (gallons)	2005 GHG Emissions ($MTCO_2e$)	2010 Energy Consumption (gallons)	2010 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions
Construction Equipment	204,894	1,832	143,350	1,292	-30.0%	-29.5%
Lawn and Garden Equipment	236,561	2,347	241,214	2,391	2.0%	1.9%
Total	441,455	4,179	384,564	3,683	-12.9%	-11.9%

WATER SECTOR

Emissions in the water sector are a result of North Marin Water District's (NMWD) use of electricity to pump, treat, convey and distribute water from the water source to the water users in Novato. Emissions from the water sector decreased about 10% between 2005 and 2010 (see Table 14). This reduction is based on two factors: a decline in the amount of electricity needed to treat and distribute water, and a decline in the carbon intensity of the electricity provided by PG&E.

[7] See the Appendix for further information.

TABLE 14: WATER EMISSIONS, 2005 AND 2010

Source	2005 Energy Consumption (kWh)	2005 GHG Emissions ($MTCO_2e$)	2010 Energy Consumption (kWh)	2010 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions
Water	9,614,068	2,151	9,482,265	1,930	-1.4%	-10.3%

The Water District's electricity usage decreased by approximately 1% between 2005 and 2010 as a result of declining water demand, which is estimated to have dropped about 5% between 2005 and 2010, from 151 to 143 gallons per person per day. Water demand responds to a variety of factors, including economic conditions, precipitation patterns and weather conditions, water conservation fixture and behavioral changes, and water rate structure changes.

WASTEWATER SECTOR

Wastewater coming from homes and businesses is rich in organic matter and has a high concentration of nitrogen and carbon, along with other organic elements. As wastewater is collected, treated and discharged by the Novato Sanitary District, chemical processes in aerobic and anaerobic conditions lead to the creation and emission of two greenhouse gases: methane and nitrous oxide.

Emissions from the wastewater sector are estimated to have decreased by 9.6% between 2005 and 2010, due to a decrease in the amount of wastewater treated at the plant. In 2011, the District brought on line a new wastewater treatment plant, which is expected to reduce future emissions from the wastewater treatment process and plant operations.

TABLE 15: WASTEWATER EMISSIONS, 2005 AND 2010

Source	2005 Flow (MG)	2005 GHG Emissions ($MTCO_2e$)	2010 Flow (MG)	2005 GHG Emissions ($MTCO_2e$)	% Change in Annual Flow	% Change in GHG Emissions
Treatment	2,296	6,145	2,077	5,558	-9.6%	-9.6%

WASTE SECTOR

Emissions from the waste sector are an estimate of methane generation from the decomposition of municipal solid waste and alternative daily cover sent to the landfill in the 2005 and 2010. These emissions are considered Scope 3 because they are not generated in the base year, but will result from the decomposition of 2005 and 2010 waste over the full 100+ year cycle of its decomposition. About 75 percent[8] of landfill methane emissions are captured through landfill gas collection systems, but the remaining 25 percent escape into the atmosphere as a significant contributor to global warming.

[8] U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emissions Factors," AP-42, Fifth Edition, January 1995.

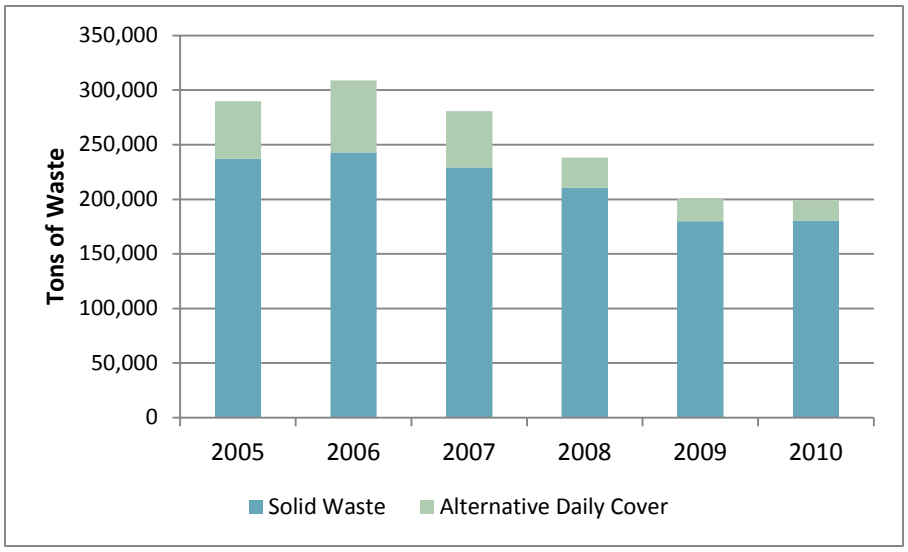
Emissions from waste generated by the Novato community in 2010 were 32.7% lower than 2005. This was due to a reduction in landfilled waste and in a change in the composition of alternative daily cover. In 2005, a greater proportion of green waste was used as alternative daily cover and then buried in the landfill, generating methane as the waste decomposed.

TABLE 16: WASTE EMISSIONS, 2005 AND 2010

Source	2005 Quantity (tons)	2005 GHG Emissions ($MTCO_2e$)	2010 Quantity (tons)	2010 GHG Emissions ($MTCO_2e$)	% Change in Waste Generation	% Change in GHG Emissions
Solid Waste	47,883	9,684	37,046	7,492	-22.6%	-22.6%
Alternative Daily Cover	10,665	1,806	3,896	244	-63.5%	-86.5%
Total	58,548	11,490	40,942	7,736	-30.1%	-32.7%

Figure 4 shows the trend in county-wide waste generation between 2005 and 2010. Waste disposal decreased approximately 31% over that time period. County-wide waste disposal hit a high of nearly 309,000 tons in 2006, steadily declined over the next three years, and leveled off at just over 199,000 tons in 2010.

FIGURE 3: COUNTYWIDE WASTE GENERATION, 2005 TO 2010



GOVERNMENT OPERATIONS INVENTORY

GOVERNMENT PROFILE

The City of Novato is a general law city and operates under the council-city manager form of government. The local government operates administrative, planning, building and public works departments, as well as a police department. In 2010, there were 213 total employees. General fund expenditures for fiscal year 2010-2011 were $28,055,201.

GOVERNMENT OPERATIONS INVENTORY SUMMARY

In 2005, Novato's government operations produced approximately 2,709 metric tons of CO_2e, which represented about 0.9% of total community emissions. In 2010, those activities resulted in approximately 2,352 metric tons of CO_2e, a reduction of 357 metric tons, or 13.2%, and the local government's share of community emissions dropped to 0.8%. These numbers include all Scope 1 emissions from the on-site combustion of fuels in vehicles and buildings, Scope 2 emissions from the purchase of electricity generated outside Novato's borders, and Scope 3 emissions from employee commutes and waste generated by local government operations. The following summaries break down these totals by sector, sources and scope.

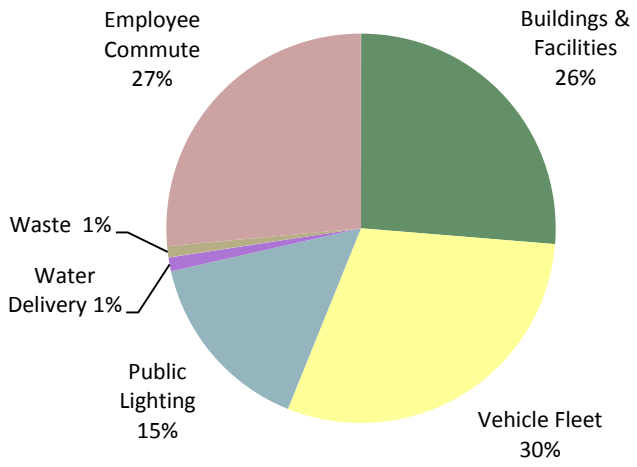
SUMMARY BY SECTOR

As shown in Table 17, emissions from government operations were reduced in all sectors. The greatest reduction occurred in the vehicle fleet sector, which saw emissions drop by 130 metric tons CO2e, or 16%. Other significant reductions occurred in the employee commute sector (108 metric tons) and the buildings and facilities sector (96 metric tons). Figure 4 shows that the vehicle fleet sector was the largest emitter of greenhouse gas emissions in 2010 (30% of total emissions), followed by the employee commute sector (27%) and the buildings and facilities sector (26%).

TABLE 17: SUMMARY BY SECTOR, 2005 AND 2010

Sector	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Buildings & Facilities	714.7	618.6	-96.1	-13%
Vehicle Fleet	831.1	701.2	-129.9	-16%
Public Lighting	366.7	360.2	-6.5	-2%
Water Delivery	30.3	27.3	-3.0	-10%
Waste	35.0	21.5	-13.5	-39%
Employee Commute	730.7	622.7	-108.0	-15%
Total	**2,708.5**	**2,351.5**	**-357.0**	**-13.2%**

FIGURE 4: EMISSIONS BY SECTOR, 2010



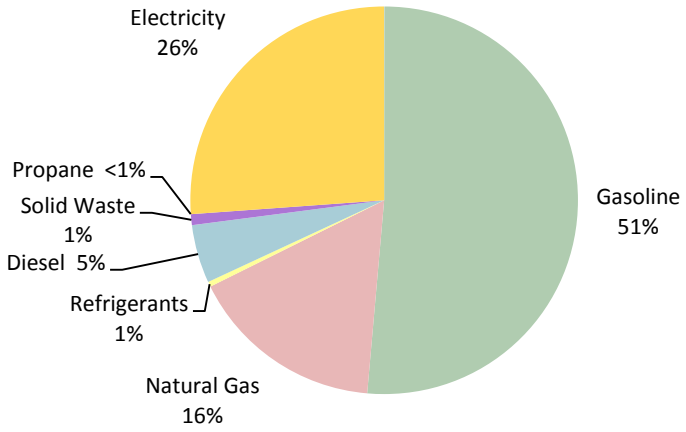
SUMMARY BY SOURCE

Table 18 shows the as summary of the City's greenhouse gas emissions by source. Emissions decreased from all sources except diesel, which experienced an 11% increase. The greatest decreases occurred in emissions from gasoline (244 metric tons) and electricity (108 metric tons). Despite the decrease in gasoline emissions, gasoline was the largest source of greenhouse gas emissions in Novato's governmental operations in 2010 (see Figure 5), contributing more than half of all emissions. Electricity consumption accounts for about one-quarter of all emissions, while natural gas consumption represents 16%. Emissions from refrigerants were not calculated in the 2005 inventory, so the same amount of 2010 greenhouse gas emissions from refrigerants is assumed for 2005.

TABLE 18: SUMMARY BY SOURCE, 2005 AND 2010

Source	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_2e	Change Metric Tons CO_2e	% Change
Electricity	723.1	614.7	-108.4	-15%
Natural Gas	384.8	382.3	-2.5	-1%
Gasoline	1,452.8	1,208.8	-244.0	-17%
Diesel	102.2	113.9	11.7	11%
Solid Waste	35.0	21.5	-13.5	-39%
Refrigerants	10.2	10.2	0.0	0%
Propane/CNG	0.4	0.1	-0.3	-75%
Total	**2,708.5**	**2,351.5**	**-357.0**	**-13.2%**

FIGURE 5: EMISSIONS BY SOURCE, 2010



SUMMARY BY SCOPE

As shown in Table 19, Scope 1 sources produced the largest amount of greenhouse gas emissions from governmental operations in 2005; these emissions decreased by 10% in 2010. The largest decrease occurred in Scope 3 emissions, which include emissions from the waste and employee commute sectors (16%). Scope 2 emissions, which represent emissions from electricity that is used within Novato but generated outside the city, decreased 15%.

TABLE 19: SUMMARY BY SCOPE, 2005 AND 2010

Activity	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_{2e}	% Change
Scope 1	1,219.7	1,092.6	-10%
Scope 2	723.1	614.7	-15%
Scope 3	765.8	644.2	-16%
Total	**2,708.5**	**2,351.5**	**-13.2%**

GOVERNMENT OPERATIONS INVENTORY DETAIL BY SECTOR

This section explores government operations and emissions by taking a detailed look at each primary sector. As listed above, the sectors included in the government operations emissions analysis are:

- Buildings and Other Facilities
- Streetlights and Traffic Signals
- Water Delivery
- Vehicle Fleet
- Waste
- Employee Commute

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 and fuel. 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 2010, Novato operated several major facilities, including the City Hall, 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 was obtained from PG&E and data for refrigerants and fuel used for backup generators were obtained from Novato staff.

As shown in Table 20, emissions from the buildings sector decreased by 13% between 2005 and 2010. Electricity consumption decreased by 23%, while emissions from electricity consumption decreased by 30% because the carbon intensity of PG&E electricity was lower in 2010. Natural gas consumption and emissions decreased by 1%.

Table 20: Buildings and Other Facilities Emissions, 2005 and 2010

Source	2005 Energy Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Energy Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Energy Consumption	% Change in GHG Emissions ($MTCO_2e$)
Electricity	1,457,804 kWh	326	1,116,108 kWh	227	-23%	-30%
Natural Gas	72,386 therms	385	71,915 therms	382	-1%	-1%
Diesel/ Gasoline	105 gallons	1	631 gallons	6	500%	500%
Refrigerants	--	3	--	3	0%	0%
Total	--	**715**	**--**	**619**	**--**	**-13%**

Table 21 shows electricity and natural gas usage by facility. While energy consumption went down in most facilities, there were a few notable exceptions. In particular, natural gas usage increased in the community centers, gymnastic center, and public works buildings. The increases in natural gas consumption are most likely due to a new public works facility that opened in 2007 and expanded programming at community centers and the gymnastics center.

Table 21: Energy Usage at Novato Buildings and Facilities

Building/ Facility	Energy Source	2005 Energy Consumption	2010 Energy Consumption	% Change in Energy Consumption
Police Station	Electricity	496,320 kWh	448,480 kWh	-10%
	Natural Gas	14,408 therms	10,482 therms	-27%
City Hall & RDA	Electricity	255,308 kWh	258,951 kWh	1%
	Natural Gas	16,701 therms	16,343 therms	-2%
Community Centers	Electricity	244,688 kWh	135,646 kWh	-45%
	Natural Gas	6,520 therms	8,277 therms	27%
Gymnastic Center	Electricity	174,240 kWh	6,480 kWh	-96%

	Natural Gas	7,943 therms	11,516 therms	45%
Swimming Pool	Electricity	97,280 kWh	95,000 kWh	-2%
	Natural Gas	19,439 therms	12,238 therms	-37%
Childcare, Museum & Skate Park	Electricity	41,297 kWh	38,505 kWh	-7%
	Natural Gas	652 therms	546 therms	-16%
Public Works Buildings	Electricity	60,600 kWh	27,120 kWh	-55%
	Natural Gas	2,354 therms	5,545 therms	136%
Aggregate Minor Facilities	Electricity	88,071 kWh	105,926 kWh	20%
	Natural Gas	4,369 therms	6,968 therms	59%

Streetlights and Traffic Signals

Novato operates streetlights, traffic signals, ant other outdoor lighting. Emissions associated with the operation of this public lighting are from electricity consumption. Electricity consumption in the public lighting sector increased by 8% between 2005 and 2010, but emissions dropped by 2% due to the lower emission factor of PG&E electricity.

Since 2010, the City has embarked on an ambitous project to convert all of the City's streetlights to more energy-efficient LED fixtures. Utilizing a Department of Energy grant and a zero-percent Pacific Gas and Electric loan for $250,000, the City converted approximately 1,425 of the existing 3,900 streetlights in two phases. Phase I focused on main arterials and collectors, and Phase II focused on residential areas. Included in the project were approximately 300 programmable photo cells that turn streetlights off at midnight and back on at 5:30 a.m. if it is still dark outside. Phase I and II were completed in 2012, and the City plans to convert the remaining streetlights once funding is identified.

The conversions, in combination with the programmable photo cells, are expected to reduce the City's electricity use by about 480,000 kWh per year, or approximately 107 metric tons CO_2e from 2010 levels. The reduction translates into an estimated annual savings of $57,000 that will reduce the City's streetlight energy bill by 50%.

Table 21: Streetlights and Traffic Signal Emissions, 2005 and 2010

Source	2005 Electricity Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Electricity Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Electricity Consumption	% Change in GHG Emissions ($MTCO_2e$)
Streetlights	1,425,158 kWh	319	1,539,063 kWh	313	8%	-2%
Traffic Signals	161,947 kWh	36	154,687 kWh	31	-4%	-14%
Outdoor Lighting	52,097 kWh	12	76,206 kWh	16	46%	33%
Total	**1,639,202 kWh**	**367**	**1,769,956 kWh**	**360**	**8%**	**-2%**

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 by 1%, and emissions dropped by 10%.

TABLE 22: WATER DELIVERY EMISSIONS, 2005 AND 2010

Source	2005 Electricity Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Electricity Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Electricity Consumption	% Change in GHG Emissions ($MTCO_2e$)
Irrigation	17,824 kWh	4	26,839 kWh	5	51%	25%
Water Pumps	117,435 kWh	26	107,330 kWh	22	-9%	-15%
Total	**135,259 kWh**	**30**	**134,169 kWh**	**27**	**-1%**	**-10%**

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 2010, Novato operated a fleet of approximately 130 vehicles.

Table 23 shows that total fuel consumption decreased by 17% between 2005 and 2010 and emissions decreased by 16%. The largest decline occurred in the police department, where fuel usage and emissions dropped by 22%. Fuel usage dropped by 6% in the public works department, but due to a shift to higher diesel use, emissions did not drop as much.

TABLE 23: VEHICLE FLEET EMISSIONS, 2005 AND 2010

Source	2005 Fuel Consumption	2005 GHG Emissions ($MTCO_2e$)	2010 Fuel Consumption	2010 GHG Emissions ($MTCO_2e$)	% Change in Fuel Consumption	% Change in GHG Emissions ($MTCO_2e$)
Public Works	27,345 gallons	247	25,752 gallons	241	-6%	-2%
Police Dept.	59,353 gallons	525	46,265 gallons	408	-22%	-22%
Community Development and Administration	5,883 gallons	52	5,133 gallons	45	-13%	-13%
Refrigerants, all departments	—	7	—	7	--	0%
Total	92,581 gallons	831	77,150 gallons	694	-17%	-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 percent of this methane is routinely captured via landfill gas collection systems; however, a portion escapes into the atmosphere, contributing to the greenhouse effect. Emissions from waste are an estimate of methane generation that will result from the decomposition of all 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 decreased by 39% between 2005 and 2010, and emissions dropped by the same percentage.

TABLE 24: WASTE EMISSIONS, 2005 AND 2010

Source	2005 Landfilled Waste	2005 GHG Emissions ($MTCO_2e$)	2010 Landfilled Waste	2010 GHG Emissions ($MTCO_2e$)	% Change in Landfilled Waste	% Change in GHG Emissions ($MTCO_2e$)
Public Works	104.5 tons	21.1	59.0 tons	11.9	-44%	-44%
City Hall	9.1 tons	1.8	8.0 tons	1.6	-12%	-12%
Administration & Community Development	6.9 tons	1.4	8.3 tons	1.7	20%	20%
Parks, Recreation & Community Services	20.8	4.2	22.9 tons	4.6	10%	10%
Police	20.8	4.2	8.0 tons	1.6	-62%	-62%
Other	11.1 tons	2.2	--	--	-100%	-100%
Total	173.2 tons	35.0	106.2 tons	21.5	-39%	-39%

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 by 15%, due, in part, to a 3% reduction in the workforce. Table 25 shows that emissions per employee decreased 12%, suggesting that Novato employees may be driving more fuel-efficient vehicles. However, it is difficult to draw definitive conclusions from the data, as emissions are determined from employee commute surveys, and changes from year to year may be within the survey's margin of error.

TABLE 25: EMPLOYEE COMMUTE EMISSIONS, 2005 AND 2010

	2005	2010	% Change
Number of Employees	220	213	-3%
Vehicle Miles Traveled	1,452,859	1,408,599	-3%
GHG Emissions ($MTCO_2e$)	731	623	-15%
Emissions per Employee	3.3	2.9	-12%

CONCLUSION

Novato has achieved some early successes in reducing greenhouse gas emissions over the past five years. Community emissions decreased by 2.9% between 2005 and 2010, putting the city on track to reduce emissions by 8.5% below the 2005 baseline year if the community continues to reduce emissions at the current rate. Emissions decreased in all sector except the commercial sector.

One of the brightest spots in the inventory came from the waste sector, which saw a reduction in emissions of 33%. Programs to divert food waste from the landfill, recycle more construction and demolition debris, and achieve zero waste goals in Marin County will continue to reduce emissions in this sector.

While the largest declines (on a percentage basis) occurred in the waste, wastewater, water and off-road categories, these sectors are relatively small, collectively representing about 7% of total community emissions. Emissions reductions in the transportation sector, while small on a percentage basis, had a significant effect on the bottom line. Further reductions in transportation emissions can be expected as state mandates to increase vehicle fuel efficiency and reduce the carbon intensity of transportation fuels take hold. Locally, the City can continue to implement programs and provide infrastructure to increase travel by bicycle, foot, and alternative means of transportation. Electric vehicles also offer much promise to reduce emissions significantly in the community, especially since the electricity provided by local utilities is significantly lower in greenhouse gas emissions than most other electricity producers in the rest of the country.

Novato can also expect to see additional reductions from electricity emissions as PG&E and the Marin Energy Authority add more renewable sources to their energy portfolios. As a new customer of the Marin Energy Authority, Novato can expect to see additional reductions in electricity emissions as Novato residents and businesses enroll in the Marin Clean Energy program sponsored by the Marin Energy Authority. The more customers who sign up for 100% renewable electricity, the more dramatic the impact will be on Novato's community emissions.

Despite the potential for greener electricity, residents and businesses need to do their part to reduce energy demand in homes and commercial buildings. Natural gas consumption increased in 2010, and emissions rose lockstep with consumption. In order to reduce emissions from natural gas consumption, consumers can reduce demand by better insulating and sealing buildings, turning down the thermostat, and installing solar-powered water heaters. The City can encourage better uses of resources by adopting more stringent green building regulations.

Within government operations, emissions decreased 13.2%, nearly meeting the City's goal for 2020. Emissions declined in all sectors, with the majority occurring in the vehicle fleet, employee commute, and buildings and facilities sectors. The City's recent conversion of streetlights to LED fixtures should further reduce emissions, to 17% below 2005 levels, if all else remains constant. Moreover, the new City offices could potentially result in additional reductions in energy use. The City can reduce emissions even more by converting all remaining streetlights to LED fixtures and purchasing more fuel-efficient vehicles. Staff should always be aware of the impact their decisions have on the environment.

Novato has made a good start. If the community's emissions are to continue to decline, then residents, businesses, and other organizations must modify their energy consumption and travel patterns and support more clean energy

from utility providers. Novato can serve as a model to others in curbing the greenhouse gas emissions that will affect the entire world by getting our own house in order.

APPENDIX A: COMMUNITY INVENTORY

RESIDENTIAL AND COMMERCIAL/INDUSTRIAL SECTOR NOTES

2005 DATA SUMMARY

Sector	Scope	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Residential	2	Electricity	129,386,987	kWh	28,708.29	0.65	1.76	28,945.39
	1	Natural Gas	10,310,485	therms	54,666.19	0.10	5.16	54,806.41
	1	Propane/LPG	6,208	MMBtu	381.54	0.01	0.07	385.09
		TOTAL			83,756.02	0.76	6.98	84,136.90
Commercial / Industrial	2	Electricity	139,193,168	kWh	30,884.07	0.69	1.89	31,139.15
	1	Natural Gas	3,585,581	therms	19,012.18	0.04	1.79	19,060.95
	2	Direct Access Electricity	16,195,960	kWh	6,966.41	0.08	0.22	6,996.09
		TOTAL			56,862.67	0.81	3.91	57,196.19

2010 DATA SUMMARY

Sector	Scope	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Residential	2	PG&E Electricity	133,333,931	kWh	26,913.27	0.60	1.75	24,137.59
	1	Natural Gas	10,599,506	therms	56,198.58	0.11	5.30	56,342.73
	2	MEA Electricity	0	kWh	0.00	0.00	0.00	0.00
	2	Direct Access Electricity	200,510	kWh	59.91	0.00	0.00	60.14
	1	Propane/LPG	5,919	MMBtu	363.78	0.01	0.07	367.16
		TOTAL			83,535.54	0.72	7.12	83,907.62
Commercial / Industrial	2	PG&E Electricity	156,561,823	kWh	31,601.79	0.71	2.06	31,865.18
	1	Natural Gas	4,130,135	therms	21,897.98	0.04	2.07	21,954.15
	2	MEA Electricity	0	kWh	0.00	0.00	0.00	0.00
	2	Direct Access Electricity	17,177,066	kWh	5,132.03	0.05	0.23	5,151.67
		TOTAL			58,631.79	0.80	4.35	58,970.99

2005 Emission Factors

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity	CO_2	0.48916 lbs/kwh	Local Government Operations Protocol, Version 1.1, May 2010, Table G.6, Utility Specific Verified Electricity CO2 Emission Factors
	CH_4	0.000030 lbs/kWh	Local Government Operations Protocol, Version 1.1, May 2010, G.7 California Grid Average Electricity Emission Factors
	N_20	0.000011 lbs/kWh	
Default Direct Access Electricity	CO_2	0.94828 lbs/kWh	Local Government Operations Protocol, Version 1.1, May 2010, G.7 California Grid Average Electricity Emission Factors
	CH_4	0.000030 lbs/kWh	
	N_20	0.000011 lbs/kWh	
Natural Gas	CO_2	53.05 kg/MMBtu	PG&E/CCAR. Emission factors are derived from: California Energy Commission, Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999 (November 2002); and Energy Information Administration, Emissions of Greenhouse Gases in the United States 2000 (2001), Table B1, page 140.
	CH_4	0.0059 kg/MMBtu	CCAR. Emission factors are derived from: U.S. EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000" (2002), Table C-2, page C-2. EPA obtained original emission factors from the Intergovernmental Panel on Climate Change, Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (1996), Tables 1-15 through 1-19, pages 1.53-1.57.
	N_20	0.001 kg/MMbtu	

2010 Emission Factors

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity	CO_2	0.445 lbs/kwh	PG&E, http://www.pgecurrents.com/2012/03/26/pge-reports-lowest-greenhouse-gas-emissions/
	CH_4	0.000029 lbs/kWh	Local Government Operations Protocol, Version 1.1, May 2010, G.7 California Grid Average Electricity Emission Factors (2007 factors used)
	N_20	0.000010 lbs/kWh	
Default Direct Access Electricity	CO_2	0.5868 lbs/kWh	eGrid2012 Version 1.0 Year 2009Summary Tables http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf
	CH_4	0.00002894 lbs/kWh	
	N_20	0.00000617 lbs/kWh	
Marin Energy Authority	CO_2	0.323859 lbs/kwh	Marin Energy Authority, Light Green and Deep Green combined.
	CH_4	0.000029 lbs/kWh	Local Government Operations Protocol, Version 1.1, May 2010, G.7 California Grid Average Electricity Emission Factors (2007 factors used)
	N_20	0.000010 lbs/kWh	

Natural Gas	CO_2	53.05 kg/MMBtu	PG&E/CCAR. Emission factors are derived from: California Energy Commission, Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999 (November 2002); and Energy Information Administration, Emissions of Greenhouse Gases in the United States 2000 (2001), Table B1, page 140.
	CH_4	0.0059 kg/MMBtu	CCAR. Emission factors are derived from: U.S. EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000" (2002), Table C-2, page C-2. EPA obtained original emission factors from the Intergovernmental Panel on Climate Change, Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (1996), Tables 1-15 through 1-19, pages 1.53-1.57.
	N_20	0.001 kg/MMbtu	

Data Sources

PG&E Electricity and Natural Gas Data: John Joseph, JGJ3@pge.com, Mathew Sturm, MwSs@pge.com.
Direct Access Electricity: California Energy Commission (CEC): Steven Mac, Smac@energy.state.ca.us
Marin Energy Authority: Justin Kudo, jkudo@marinenergy.com.

Propane/LPG use estimated from number of households using propane/LPG as a home heating source from the 2010 American Community Survey 5 Year Estimate (Table B25040) and average site consumption of propane/LPG from the U.S. Energy Information Administration, Average Consumption by Fuels Used, 2005, Table US9 and Household Site Fuel Consumption in the West Region, Totals and Averages, 2009 (Table CE2.5). Wood and fuel oil use was excluded because average site consumption data was not reported by the U.S. Energy Information Administration for 2009 and no comparison could be made between the two years.

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net.
Estimations of electricity purchased through Direct Access (DA) contracts are derived from county level DA consumption figures, provided by the California Energy Commission.

2005 emissions were recalculated using updated activity data provided by PG&E and 2005 emission factors from the LGO Protocol. Activity data for direct access electricity was revised due to a change in the methodology to allocate direct access among jurisdictions.

Transportation Sector Notes

2005 Data Summary

Sector	Scope	Subsector	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Transportation	1	Local Roads	169,104,501	VMT	78,941.55	11.69	10.73	82,789.18
	1	State Highways	99,148,383	VMT	45,974.40	6.85	6.29	48,230.31
		TOTAL	268,252,884	VMT	124,915.95	18.54	17.01	131,019.49

2005 Emission Factors: Provided by the BAAQMD, using EMFAC 2007

County	CO_2 Rates (grams/mile)		CH_4 Rates (grams/mile)		N_2O Rates (grams/mile)		VMT Mix		CO_2 Rates- (grams/gallon)		Fuel Usage		Fuel Efficiency (miles/gallon)	
	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel
Marin County	476	1,426	0.065	0.030	0.070	0.050	95.5%	4.5%	8,628	9,957	89.2%	10.8%	18.1	7.0
BAAQMD Average	463	1,389	0.063	0.030	0.070	0.050	94.9%	5.1%	8,607	10,091	87.8%	12.2%	18.6	7.3

2010 Data Summary:

Sector	Scope	Subsector	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Transportation	1	Local Roads	166,469,200	VMT	75,023.15	11.52	7.39	78,748.38
	1	State Highways	99,589,503	VMT	44,882.29	6.89	4.42	47,110.89
		TOTAL	266,058,703	VMT	119,905.44	18.41	11.81	125,859.27

2010 Emission Factors: Provided by the BAAQMD, using EMFAC 2007

County	CO_2 Rates (grams/mile)		CH_4 Rates (grams/mile)		N_2O Rates (grams/mile)		VMT Mix		CO_2 Rates- (grams/gallon)		Fuel Usage		Fuel Efficiency (miles/gallon)	
	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel
Marin County	471	1,500	0.045	0.030	0.070	0.050	95.9%	4.1%	8,732	9,673	89.0%	11.0%	18.5	6.4
BAAQMD Average	461	1,469	0.042	0.027	0.070	0.050	95.3%	4.7%	8,695	10,086	88.1%	11.9%	18.9	6.9

Data Sources

State Highway and Local Roads Vehicle Miles Traveled (VMT) Data: 2005 Public Roads Data, Highway Performance Monitoring System (HPMS) division of the California Department of Transportation (Caltrans), http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2005PRD.pdf; 2010 Public Roads Data, HPMS division of Caltrans, http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2010PRD.pdf. State highway VMT determined according to section 1.4.3 of BAAQMD GHG Plan Level Guidance, November 3, 2011.

State highway VMT determined according to section 1.4.3 of Bay Area Air Quality Management District GHG Plan Level Guidance, November 3, 2011.

2005 and 2010 data was calculated using emission factors and fuel usage estimates provided by the Bay Area Air Quality Management District. Data was provided by Amir Fanai, Principal Air Quality Engineer, Bay Area Air Quality Management District, AFanai@baaqmd.gov.

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net.
Local Road and State Highway VMT data provided by MTC is in Daily VMT (DVMT); Annual VMT = DVMT x 365.
Fleet mix data (on-road fleet breakdown by vehicle type, fuel efficiency, and fuel type) was used to extrapolate VMT into actual gallons of gasoline and diesel consumed on Marin roads and state highways.

Off-Road Vehicles and Equipment Sector Notes

2005 Summary

Sector	Scope	Subsector	Quantity	Units	Fuel	Greenhouse Gas Emissions (metric tons)			
						CO_2	N_2O	CH_4	CO_2e
Off-Road	1	Construction and Mining Equipment	181,767	gallons	gasoline	1,595.91	0.00	0.00	1,595.91
	1		23,127	gallons	diesel	236.13	0.00	0.00	236.13
	1	Lawn and Garden Equipment	47,524	gallons	gasoline	417.26	0.00	0.00	417.26
	1		189,037	gallons	diesel	1,930.07	0.00	0.00	1,930.07
		TOTAL	441,455	gallons		4,179.37	0.00	0.00	4,179.37

2010 Data Summary

Sector	Scope	Subsector	Quantity	Units	Fuel	Greenhouse Gas Emissions (metric tons)			
						CO_2	N_2O	CH_4	CO_2e
Off-Road	1	Construction and Mining Equipment	119,853	gallons	gasoline	1,052.31	0.00	0.00	1,052.31
	1		23,497	gallons	diesel	239.90	0.00	0.00	239.90
	1	Lawn and Garden Equipment	50,299	gallons	gasoline	441.63	0.00	0.00	441.63
	1		190,915	gallons	diesel	1,949.24	0.00	0.00	1,949.24
		TOTAL	384,564	gallons		3,683.08	0.00	0.00	3,683.08

Fuel usage data provided by Steve Zelinka, Manager, Emission Inventory Development Section, California Air Resources Board, szelinka@arb.ca.gov. Fuel usage was provided at the county level and allocated to individual cities according to population.

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net.

Water Sector Notes

2005 Data Summary

Sector	Scope	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Water	3	PG&E Electricity	9,614,068	kWh	2,133.16	0.05	0.13	2,150.78
		TOTAL	9,614,068	kWh	2,133.16	0.05	0.13	2,150.78

2010 Data Summary

Sector	Scope	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Water	3	PG&E Electricity	9,482,265	kWh	1,913.98	0.04	0.12	1,929.93
	3	MEA Electricity	0	kWh	0.00	0.00	0.00	0.00
		TOTAL	9,482,265	kWh	1,913.98	0.04	0.12	1,929.93

Data Sources

2005 water consumption data from North Marin Water District (NMWD) 2010 Urban Water Management Plan Table 3-3, page 3-3. 2010 water consumption data from Brad Stompe, NMWD Distribution/Treatment Plant Supervisor, bstompe@nmwd.com, 415-897-4133 x 8610
Treatment Plant x 8830.
Electricity usage estimates: "Refining Estimates of Water-Related Energy Use in California," California Energy Commission, December 2006. Electricity used to convey, treat and distribute water based on northern California averages.

Additional Notes

2005 population estimates from CA Dept. of Finance E-4 Population Estimates for Cities, Counties and State 2001-2010 with 2000 and 2010 Census Counts. 2005 population estimate is mid-point between 1/1/2005 and 1/1/2006 estimates. 2010 population from 2010 U.S. Census.

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net.

Wastewater Sector Notes

2005 Data Summary

Sector	Scope	Source	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Wastewater	1	Treatment Process	2,296.20	million gallons	--	--	--	6,145.09
		TOTAL	2,296.20	MG	--	--	--	6,145.09

2010 Data Summary

Sector	Scope	Source	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Wastewater	1	Treatment Process	2,076.88	million gallons	--	--	--	5,558.14
		TOTAL	2,076.88	MG	--	--	--	5,558.14

Data Sources

Annual flow rates for 2005 and 2010 provided by Sandeep Karkal, Novato Sanitary District, sandeepk@novatosan.com.
Process treatment emissions data provided by Beverly James, Manager-Engineer, Novato Sanitary District, Bevj@novatosan.com.

Novato Sanitary District Treatment Process Emissions, 2005

	MG/year	Emission Factor (lbs CO_2e/MG)	Total Greenhouse Gas Emissions ($MTCO_2e$)
Activated Sludge Oxidation	2,296.2	2,300	2,395.54
Digester Gas Flaring	2,296.2	700	729.08
Sludge Storage Pond Digestion	2,296.2	2,900	3,020.47
Total	2,296.2	10,629	6,145.09

Novato Sanitary District Treatment Process Emissions, 2010

	MG/year	Emission Factor (lbs CO_2e/MG)	Total Greenhouse Gas Emissions ($MTCO_2e$)
Activated Sludge Oxidation	2,076.88	2,300	2,166.73
Digester Gas Flaring	2,076.88	700	659.44
Sludge Storage Pond Digestion	2,076.88	2,900	2,731.97
Total	2,076.88	10,629	5,558.14

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net

Waste Sector Notes

2005 Data Summary

Sector	Scope	Subsector	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Waste	3	Landfilled Solid Waste	47,883	tons	0.00	0.00	461.12	9,683.58
	3	Alternative Daily Cover	10,665	tons	0.00	0.00	86.02	1,806.48
		TOTAL	58,549	tons	0.00	0.00	547.15	11,490.06

2010 Data Summary

Sector	Scope	Subsector	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Waste	3	Landfilled Solid Waste	37,046	tons	0.00	0.00	356.76	7,491.97
	3	Alternative Daily Cover	3,896	tons	0.00	0.00	11.62	244.12
		TOTAL	40,942	tons	0.00	0.00	368.39	7,736.09

Emission Factors

Waste Type	Methane Emissions (metric tons / short ton of waste)	Emission Factor Source
Paper Products	1.940	US EPA
Food Waste	1.098	US EPA
Plant Debris	0.622	US EPA
Wood / Textiles	0.549	US EPA
All Other Waste	0.000	US EPA

Data Sources

Municipal solid waste and ADC tonnage data: CalRecycle Disposal Reporting System http://www.calrecycle.ca.gov/LGCentral/Reports/DRS/Destination/JurDspFa.aspx and Alex Soulard, Waste Management Specialist, ASoulard@marincounty.org, County of Marin Public Works Department - Waste Management.
Landfilled waste characterization: Final Draft Zero Waste Feasibility Study, Marin County Hazardous and Solid Waste Management JPA, R3 Consulting Group, December 2009, http://www.marinrecycles.org/Docs/Final_Draft_Zero_Waste_Feasibility_Study_121609.pdf.
ADC waste characterization: CalRecycle, "Alternative Daily cover (ADC) by Jurisdiction of Origin and Material Type," http://www.calrecycle.ca.gov/LGCentral/Reports/Viewer.aspx?P=ReportName%3dEdrsJurisAndMaterials%26CountyID%3d21%26ReportYear%3d2005 and http://www.calrecycle.ca.gov/LGCentral/Reports/Viewer.aspx?P=ReportName%3dEdrsJurisAndMaterials%26CountyID%3d21%26ReportYear%3d2010.

Landfilled Waste Characterization, 2005 and 2010

Waste Type	% of Total
Paper Products	23.50
Food Waste	22.85
Plant Debris	7.98
Wood / Textiles	9.57
All Other Waste	36.12

Alternative Daily Cover Waste Characterization, 2005

Waste Type	% of Total
Paper Products	0.00
Food Waste	11.63
Plant Debris	88.37
Wood / Textiles	0.00
All Other Waste	0.00

Alternative Daily Cover Waste Characterization, 2010

Waste Type	% of Total
Paper Products	0.00
Food Waste	16.65
Plant Debris	10.90
Wood / Textiles	0.00
All Other Waste	72.46

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net.
The methane emission factors used in ICLEI's CACP Software were derived from the EPA WARM model. For quantification of emissions, only methane generation (or gross emissions) is taken into account. These emissions are estimated to take place over an extensive (up to 100 year) cycle, as anaerobically degradable organic carbon decomposes in a landfill. More information on the WARM Model is available at: http://epa.gov/climatechange/wycd/waste/calculators/Warm_home.html.

2005 solid waste tonnage and emissions were recalculated using municipal solid waste and ADC tonnage data (including sludge ADC) provided by County of Marin Public Works Department Waste Management Division, updated waste characterization from the Final Draft Zero Waste Feasibility Study, Marin County Hazardous and Solid Waste Management JPA, R3 Consulting Group, December 2009, and updated ADC waste characterization from CalRecycle 2005 report , "Alternative Daily Cover (ADC) by Jurisdiction of Origin and Material Type" for Marin County.

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	72,386 therms	383.79	0.00	0.04	0.00	384.78
	Stationary Combustion	105 gallons	0.98	0.00	0.00	0.00	0.99
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	2.77
	TOTAL		384.77	0.00	0.04	0.00	388.53
Scope 2	Purchased Electricity	1,457,804 kWh	323.46	0.01	0.02	0.00	326.13
	TOTAL	1,457,804 kWh	323.46	0.01	0.02	0.00	326.13

LGO PROTOCOL – EMISSIONS BY SCOPE AND EMISSION TYPE, 2010

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Stationary Combustion	71,915 therms	381.29	0.00	0.04	0.00	382.27
	Stationary Combustion	631 gallons	6.44	0.00	0.00	0.00	6.44
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	2.77
	TOTAL		387.74	0.00	0.04	0.00	391.48
Scope 2	Purchased Electricity	1,116,108 kWh	225.28	0.01	0.01	0.00	227.16
	TOTAL	1,116,108 kWh	225.28	0.01	0.01	0.00	227.16

2005 emissions were recalculated using activity data from the 2005 Greenhouse Gas Emissions Inventory and 2005 emission factors from the LGO Protocol. Since refrigerants were not inventoried in 2005, 2010 refrigerant data was used as a proxy.

2010 energy usage was provided by Pacific Gas & Electric Company (PG&E) based on energy usage of PG&E service accounts. Energy usage data included electricity in units of kilowatt hours (kWh) and natural gas in thermal units (therms). 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. See Appendix A for emission factors.

Refrigerant type and capacity for air conditioning units was provided by Novato public works staff. 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_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	1,639,202 kWh	363.70	0.01	0.02	0.00	366.71
	TOTAL	1,639,202 kWh	363.70	0.01	0.02	0.00	366.71

LGO Protocol – Emissions by Scope and Emission Type, 2010

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	1,769,956 kWh	357.26	0.01	0.02	0.00	360.24
	TOTAL	1,769,956 kWh	357.26	0.01	0.02	0.00	360.24

2005 emissions were recalculated using activity data from the Novato 2005 Greenhouse Gas Emissions Inventory and 2005 emission factors from the LGO Protocol.

2010 energy usage was provided by Pacific Gas & Electric Company (PG&E) based on energy usage of PG&E service accounts. Energy usage data included electricity in units of kilowatt hours (kWh). LGO Protocol recommended methods were followed in collection and analysis of this activity data. See Appendix A for emission factors.

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	135,259 kWh	30.01	0.00	0.00	0.00	30.26
	TOTAL	135,259 kWh	30.01	0.00	0.00	0.00	30.26

LGO Protocol – Emissions by Scope and Emission Type, 2010

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 2	Purchased Electricity	134,169 kWh	27.08	0.00	0.00	0.00	27.31
	TOTAL	1,128 kWh	27.08	0.00	0.00	0.00	27.31

2005 emissions were recalculated using activity data from the Novato 2005 Greenhouse Gas Emissions Inventory and 2005 emission factors from the LGO Protocol.

2010 energy usage was provided by Pacific Gas & Electric Company (PG&E) based on energy usage of PG&E service accounts. Energy usage data included electricity in units of kilowatt hours (kWh). LGO Protocol recommended methods were followed in collection and analysis of this activity data. See Appendix A for emission factors.

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	92,581 gallons	814.35	0.03	0.03	0.00	823.65
	Fugitive Emissions	--	0.00	0.00	0.00	0.01	7.48
	TOTAL		814.35	0.03	0.03	0.01	831.13

LGO Protocol – Emissions by Scope and Emission Type, 2010

Scope	Emission Type	Energy Consumption	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 1	Mobile Combustion	77,150 gallons	690.06	0.01	0.01	0.00	693.68
	Fugitive Emissions	--	0.00	0.00	0.00	0.01	7.48
	TOTAL		690.06	0.01	0.01	0.01	701.16

2005 emissions were recalculated using activity data from the Novato 2005 Greenhouse Gas Inventory and 2005 emission factors from the LGO Protocol. Vehicles were re-categorized into three groups in order to include a new group for Administration and Community Development. Fuel use for generators and stormwater pumps was moved into the buildings and facilities sector.

Vehicle fleet data was provided by Mike Brunelle, City of Novato Equipment Manager. 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. See Appendix A for emission factors.

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. As refrigerant emissions were not included in the 2005 Greenhouse Gas Inventory, 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_2O	CH_4	HFCs	CO_2e
Scope 3	Landfilled Waste	173.2 tons	0.00	0.00	1.67	0.00	35.03
	TOTAL	173.2 tons	0.00	0.00	1.67	0.00	35.03

LGO Protocol – Emissions by Scope and Emission Type, 2010

Scope	Emission Type	Weight	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Landfilled Waste	106.2 tons	0.00	0.00	1.02	0.00	21.49
	TOTAL	106.2 tons	0.00	0.00	1.02	0.00	21.49

2005 solid waste emissions were recalculated using activity data from the Novato 2005 Greenhouse Gas Inventory and updated waste characterization from the Final Draft Zero Waste Feasibility Study, Marin County Hazardous and Solid Waste Management JPA, R3 Consulting Group, December 2009, http://www.marinrecycles.org/Docs/Final_Draft_Zero_Waste_Feasibility_Study_121609.pdf

2010 solid waste collection data for quantity of containers, container size, pick-ups per week was provided by Steve McCaffrey, Novato Disposal Service, stevem@unicycler.com. Containers were assumed to be 100% filled at 89 lbs. 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. Landfilled waste characterization: Final Draft Zero Waste Feasibility Study, Marin County Hazardous and Solid Waste Management JPA, R3 Consulting Group, December 2009, http://www.marinrecycles.org/Docs/Final_Draft_Zero_Waste_Feasibility_Study_121609.pdf. See Appendix A for emission factors.

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	1,452,859	779.34	0.06	0.05	0.00	798.01
	TOTAL	220	1,452,859	779.34	0.06	0.05	0.00	798.01

LGO Protocol – Emissions by Scope and Emission Type, 2010

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	213	1,408,599	614.44	0.02	0.03	0.00	622.68
	TOTAL	213	1,408,599	614.44	0.02	0.03	0.00	622.68

2005 emissions were recalculated using activity data from the Novato 2005 Greenhouse Gas Inventory and emission factors from the LGOP. The previous inventory failed to adjust response data to represent 100% of employees.

For the 2010 inventory, the City distributed commute surveys to its employees regarding travel mode, vehicle type and model year, fuel type, time of travel to work, and miles traveled to work. Information provided by respondents was used to determine fuel efficiency at www.fueleconomy.gov and estimate gallons of fuel consumed. Weekly data were converted into annual VMT data assuming 10 vacation days, 10 sick days and 10 holidays for most full-time employees. Ninety-seven employees responded to the survey, a response rate of 46%. Estimates for total employee commutes were extrapolated from this data.