Town of Ross

2010 Greenhouse Gas Emissions Inventory

August 2012

Prepared by the
Marin Climate & Energy Partnership

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Table of Contents

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 February 2009, Ross completed a Greenhouse Gas Inventory report for the baseline year of 2005, and the Ross Town Council approved a greenhouse gas reduction target of 15% below 2005 levels by the year 2020, a target that is comparable to the state goal. In November 2010, the Ross Town 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 Town 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 Ross reduced community greenhouse gas emissions 4.6% between 2005 and 2010, from 16,663 metric tons in 2005 to 15,899 metric tons in 2010 – a reduction of 764 metric tons CO2e. Reductions occurred in all sectors. On a percentage basis, the greatest declines occurred in the waste (-36%), water (-30%) and off-road (-12%) sectors. In absolute terms, the greatest reductions were made in the transportation (265 metric tons), residential (207 metric tons), and waste (194 metric tons) sectors.

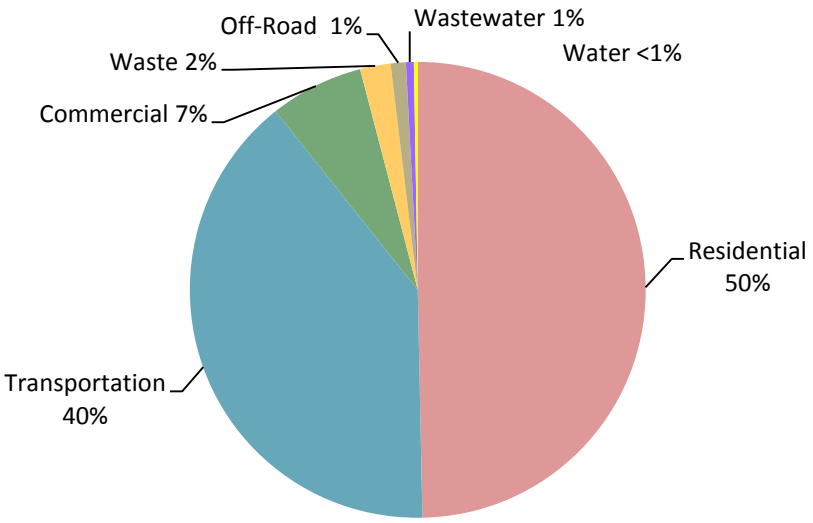
TABLE A: EMISSIONS BY SECTOR, 2005 AND 2010

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	8,105	49%	7,898	50%	-207	-2.6%
Commercial	1,105	7%	1,054	7%	-51	-4.6%
Transportation	6,565	39%	6,300	40%	-265	-4.0%
Off-Road	196	1%	171	1%	-24	-12.4%
Water	62	<1%	44	<1%	-19	-30.0%
Wastewater	92	1%	88	1%	-4	-4.5%
Waste	638	3%	343	2%	-194	-36.2%
Total	**16,663**	**100%**	**15,899**	**100%**	**-764**	**-4.6%**

The great strides that were made in the waste sector were primarily due to a 34% reduction in waste going to the landfill. Declines in electricity usage and a decline in the carbon intensity of electricity provided by PG&E were largely responsible for the decrease in emissions in the residential and commercial sectors, while a decrease in water usage led to declines in the water and wastewater sectors. More detailed analysis of the factors related to decreases in emissions appears in the Community Inventory Detail by Sector section beginning on page 12.

As shown in Figure A, emissions from the residential sector are responsible for the greatest percentage of greenhouse gas emissions (50%), followed by emissions from the transportation sector (40%) and the commercial sector (7%). The waste, wastewater, off-road and water sectors are each responsible for 2% or less of total community emissions.

FIGURE A: EMISSIONS BY SECTOR, 2010

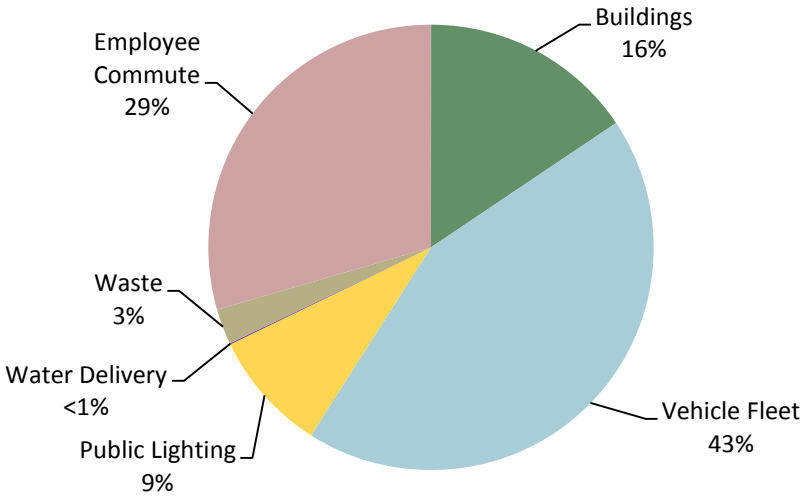


Within government operations, emissions decreased by 19.6 metric tons CO_2e, or by 7.6%. The majority of this decrease appeared in the employee commute sector (-21%), waste sector (-18%) and public lighting sector (-13%). Emissions increased in the vehicle fleet sector by 2.3% and in the buildings and facilities sector by 2.4%.

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	36.2	14%	37.0	16%	+0.8	+2.4%
Vehicle Fleet	100.8	39%	103.2	43%	+2.4	+2.3%
Public Lighting	24.1	9%	20.9	9%	-3.2	-13.2%
Water Delivery	0.2	<1%	0.2	<1%	0.0	0.0%
Waste	7.4	3%	6.1	3%	-1.3	-17.7%
Employee Commute	88.4	34%	70.1	29%	-18.3	-20.7%
Total	**257.2**	**100%**	**237.6**	**100%**	**-19.6**	**-7.6%**

FIGURE B: GOVERNMENT OPERATIONS EMISSIONS BY SECTOR, 2010



These results show that Ross is on its way to accomplishing its greenhouse gas reduction goals. If emissions continue to decrease at the current rate, Ross will achieve a reduction in community emissions of 13% and a reduction in governmental operations emissions of nearly 23% by 2020.

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 Ross 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 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, 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

As no standardized protocol has yet been adopted for community emissions, 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 draft 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 town 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 town limits but are generated outside of the town. For example, electricity from Pacific Gas & Electric Company is consumed within Ross but the greenhouse gasses associated with this consumption are emitted outside of the town 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 Ross' 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. Examples of greenhouse gas emissions that are not included in the community inventory include refrigerants released into the atmosphere from the use of air conditioning in cars and buildings, and the combustion of propane used in outdoor heaters, barbeques, portable stoves, torches, etc.

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 Ross' government operations. Information items for this inventory include one public works vehicle using the refrigerant R-12 and an air conditioning unit in the public safety building using the refrigerant 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
Public Works Vehicle	R-12	0.7
Public Safety Building Air Conditioner	R-22	0.2
Total		0.9

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]

Climate Change Mitigation Activities in Ross

Since approval of the Ross Climate Action Plan in November 2010, the Town has continued to implement greenhouse gas reduction programs in Ross. These include the following:

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

- In partnership with Marin Sanitary Service, implemented curbside food waste collection. The program reduces methane emissions by composting food waste instead of depositing it into the landfill.
- Adopted a construction and demolition (C&D) debris recycling ordinance that requires a minimum of 70% of C&D waste to be recycled rather than deposited into the landfill. The ordinance incrementally increases diversion requirements until targets meet 95% by the end of 2025.
- Adopted a Zero Waste resolution that commits the Town to reaching a 94% diversion rate by 2025.
- 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 Ross ratepayers with the ability to purchase electricity with a higher renewable energy content.
- Converted all municipal electricity accounts to Marin Clean Energy light green electricity. This move is anticipated to reduce the Town's electricity consumption emissions by 27% or more.
- Completed an energy-efficient lighting retrofit of Town Hall, the Public Safety building, and the Public Works building in 2011.

COMMUNITY INVENTORY RESULTS

ROSS PROFILE

Ross is a town of 1.6 square miles, located in the heart of Ross Valley in Marin County. According to the U.S. Census, the population of Ross in 2010 was 2,415 and there were 884 housing units. The California Department of Finance estimates the population of Ross in 2005 was 2,332.[2] Ross enjoys a temperate climate, with cool, wet, and almost frostless winters and dry summers. The town 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 Ross community resulted in approximately 16,663 metric tons of CO_2e. In 2010, those activities resulted in approximately 15,899 metric tons of CO_2e, a reduction of 764 metric tons, or approximately 4.6%. 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 residential sector was the largest emitter of greenhouse gas emissions in both 2005 (49%) and 2010 (50%). Emissions from the transportation sector produced the second highest quantity (39% in 2005 and 40% in 2010), followed by the commercial sector. Emissions were reduced in all sectors, with the greatest reductions occurring in the transportation sector (265 metric tons), residential sector (207 metric tons), and waste sector (194 metric tons).

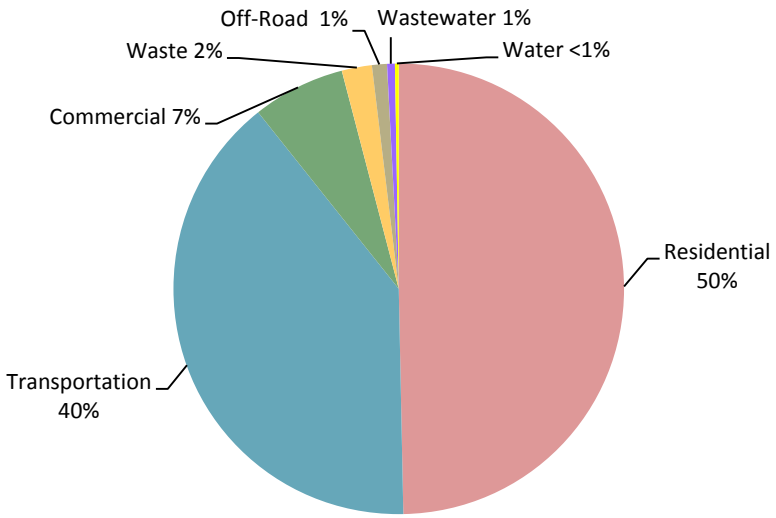
[2] California Department of Finance, "E-4 Population Estimates for Cities, Counties, and the State 2001-2010, with 2000 & 2001 Census Counts," August 2011. To make comparisons to U.S. Census data, this is the average between California Department of Finance estimates for January 1, 2005, and January 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 6/4/12. 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 in Ross 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	8,105	7,898	-207	-2.6%
Commercial	1,105	1,054	-51	-4.6%
Transportation	6,565	6,300	-265	-4.0%
Off-Road	196	171	-24	-12.4%
Water	62	44	-19	-30.0%
Wastewater	92	88	-4	-4.5%
Waste	538	343	-194	-36.2%
Total	**16,663**	**15,899**	**-764**	**-4.6%**

FIGURE 1: EMISSIONS BY SECTOR, 2010



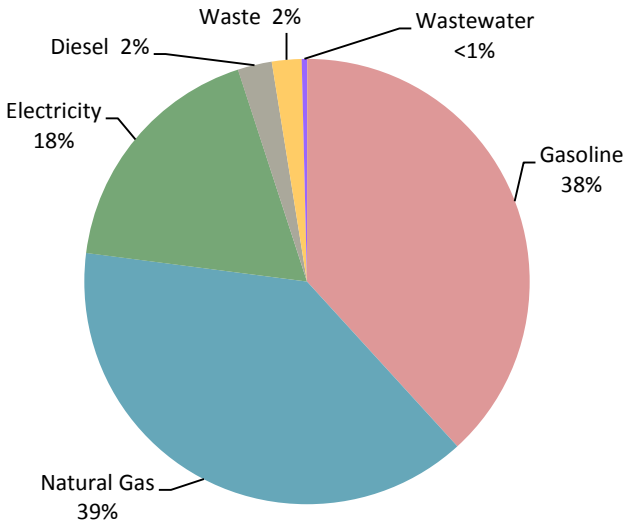
SUMMARY BY SOURCE

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 Ross' 2005 and 2010 greenhouse gas emissions by source. Between 2005 and 2010, emissions from the combustion of natural gas increased by nearly 2%, or 100 metric tons. Emissions from other sources decreased in all categories except wastewater treatment, which experienced a small increase. In 2010, the largest source of emissions was natural gas (39%), followed by gasoline (38%) and electricity (18%).

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	6,327	6,079	-248	-3.9%
Natural Gas	6,072	6,172	+100	+1.6%
Electricity	3,234	2,851	-383	-11.8%
Diesel	434	393	-41	-9.4%
Waste	538	343	-194	-36.2%
Wastewater Treatment	59	61	+2	+3.6%
Total	**16,663**	**15,899**	**-764**	**-4.6%**

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 12,644 metric tons CO_2e in 2010. Scope 2 emissions comprised the second largest amount (2,780 metric tons CO_2e), and Scope 3 emissions totaled 475 metric tons CO_2e. The greatest reduction occurred in Scope 3 emissions, which includes emissions from the waste, water, and wastewater sectors.

TABLE 6: SUMMARY BY SCOPE, 2005 AND 2010

Activity	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_{2e}	% Change
Scope 1	12,833	12,644	-1.5%
Scope 2	3,138	2,780	-11.4%
Scope 3	692	475	-31.4%
Total	**16,663**	**15,899**	**-4.6%**

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 population yields a result of 7.1 metric tons of CO_2e per capita in 2005. Per capita emission decreased nearly 8% between 2005 and 2010, falling to 6.6 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 Ross (which would include lifecycle emissions, emissions resulting from air travel, etc.).

TABLE 7: PER CAPITA EMISSIONS, 2005 AND 2010

	2005	2010	% Change
Population	2,332	2,415	+3.6%
Community GHG Emissions (metric tons CO_2e)	16,663	15,899	-4.6%
Per Capita GHG Emissions (metric tons CO_2e)	7.1	6.6	-7.9%

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 Ross homes produced 8,105 metric tons of greenhouse gas emissions in 2005 and 7,898 metric tons in 2010, a decrease of 2.6%. All residential sector emissions are the result of electricity

consumption and the on-site combustion of natural gas. 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, Ross' entire residential sector consumed 11,403,003 kWh of electricity and 1,044,790 therms of natural gas.

As shown in Table 8, electricity usage in Ross' residential sector decreased by 3.1% between 2005 and 2010, while emissions decreased by 11.8%. 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	11,403,003 kWh	2,551	11,050,214 kWh	2,251	-3.1%	-11.8%
Natural Gas	1,044,790 therms	5,554	1,062,348 therms	5,647	+1.7%	+1.7%
Total	-	8,105	-	7,898	-	-2.6%

Natural gas usage increased 1.7% 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 1.7%.

As shown in Table 9 below, Ross residents generated nearly 10 metric tons of greenhouse gas emissions per household in 2010. This is a decrease of approximately 4% per household since 2005. [5]

TABLE 9: RESIDENTIAL EMISSIONS PER HOUSEHOLD

	2005	2010
Number of Occupied Housing Units	790	798
Residential GHG Emissions (metric tons CO_2e)	8,105	7,898
Residential GHG Emissions per Household (metric tons CO_2e)	10.3	9.9

COMMERCIAL SECTOR

The commercial sector includes emissions from the operations of businesses as well as public agencies. Between 2005 and 2010, emissions in the commercial sector fell by 4.3%. In 2010, buildings and facilities within the

[4] See discussion on page 9.

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

commercial sector produced 1,057 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 6.1% in the commercial sector between 2005 and 2010, while natural gas usage increased 1.3%. Despite the increase in electricity use, emissions decreased for the emission factor reasons explained above. This decrease was offset by an increase in natural gas emissions of 1.3%. The net effect was to decrease total emissions from the commercial sector by 4.6%.

TABLE 10: COMMERCIAL 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	2,341,990 kWh	587	2,485,337 kWh	530	+6.1%	-9.8%
Natural Gas	97,455 therms	518	98,720 therms	525	+1.3%	+1.3%
Total		1,105		1,054		-4.6%

Table 11 shows commercial emissions based on the estimated number of jobs in Ross in 2005 and 2010.[6] Emissions increased by approximately 61% per job.

TABLE 11: COMMERCIAL / INDUSTRIAL EMISSIONS PER JOB

	2005	2010
Number of Jobs	860	510
Commercial / Industrial GHG Emissions (metric tons CO_2e)	1,105	1,054
Commercial /Industrial GHG Emissions per Job (metric tons CO_2e)	1.3	2.1

TRANSPORTATION SECTOR

Emissions in the transportation sector are calculated by estimating all vehicle miles traveled on local roads within the town limits. Air travel and vehicle miles traveled outside of Marin County are not included in the analysis. In 2005, the transportation sector generated 6,565 metric tons of CO_2e. By 2010, emissions from the transportation sector decreased by approximately 4% to 6,300 metric tons CO_2e. As shown in Table 12, vehicle miles traveled on local roads decreased slightly between 2005 and 2010 by 0.7%.

[6] Number of Ross jobs in 2005 is based on ABAG Projections 2009 estimates. Number of Ross jobs in 2010 is from the Association of Bay Area Governments, "Job-Housing Connection Strategy," revised May 16, 2012.

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	13,410,101	6,565	13,318,850	6,300	-0.7%	-4.0%

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 12.4% 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	9,587	86	6,670	60	-30.4%	-29.9%
Lawn and Garden Equipment	11,069	110	11,223	111	+1.4%	+1.3%
Total	20,656	196	17,893	171	-13.4%	-12.4%

WATER SECTOR

Emissions in the water sector are a result of Marin Municipal Water District's (MMWD) use of electricity to pump, treat, convey and distribute water from the water source to the water users in Ross. Emissions from the water sector decreased 30% 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 and the Marin Energy Authority (MEA). MMWD began purchasing electricity procured by the Marin Energy Authority about mid-way through 2010, and MEA electricity represented about 54%

[7] See the Appendix for further information.

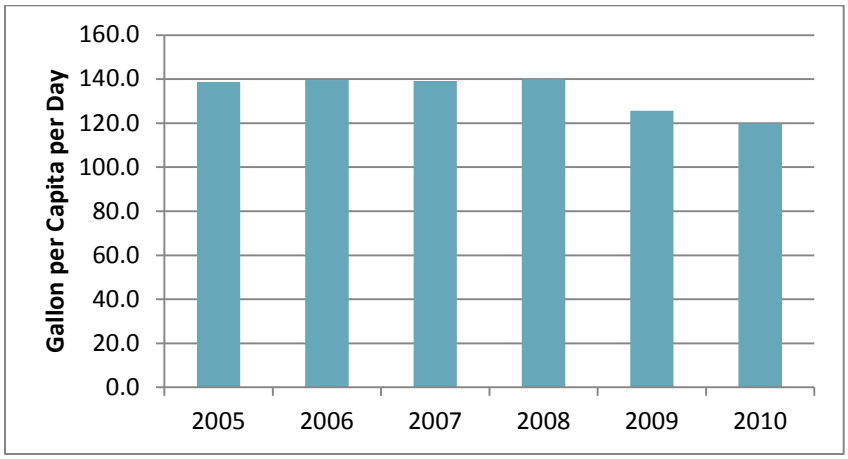
of the District's total electricity usage in that year. MEA's electricity was about 27% less carbon intensive than PG&E electricity in 2010.

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	278,021	62	250,586	44	-9.9%	-30.0%

The Water District's electricity usage decreased by almost 13% between 2005 and 2010 as a result of declining water demand. As shown in Figure 3, water use has declined from 138.7 gallons per person in 2005 to 119.8 gallons per person in 2010, a reduction of almost 14%. 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. MMWD has increased water rates significantly in recent years (9.7% in 2008, 7.3% in 2009, and 9.8% in 2010), and demand has most likely declined in response to these rate increases. The recession of December 2007 to June 2009, and the poor economic conditions that followed the official end of the recession, have also contributed to a reduction in water demand.

FIGURE 3: MMWD PER CAPITA WATER USE, 2005 TO 2010



WASTEWATER SECTOR

Waste water 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 Central Marin Sanitation Agency, chemical processes in aerobic and anaerobic conditions lead to the creation and emission of two greenhouse gases: methane and nitrous oxide. Emissions are also created from use of electricity to collect and process the wastewater.

Emissions from the wastewater sector decreased by 4.5% between 2005 and 2010, due to a reduction in overall water usage in the community and an improvement in the carbon intensity of PG&E electricity.

TABLE 15: WASTEWATER 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
Electricity	151,216	34	135,326	28	-10.5%	-18.6%
Treatment	-	59	-	61	-	+3.6%
Total	-	92	-	88		-4.5%

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.

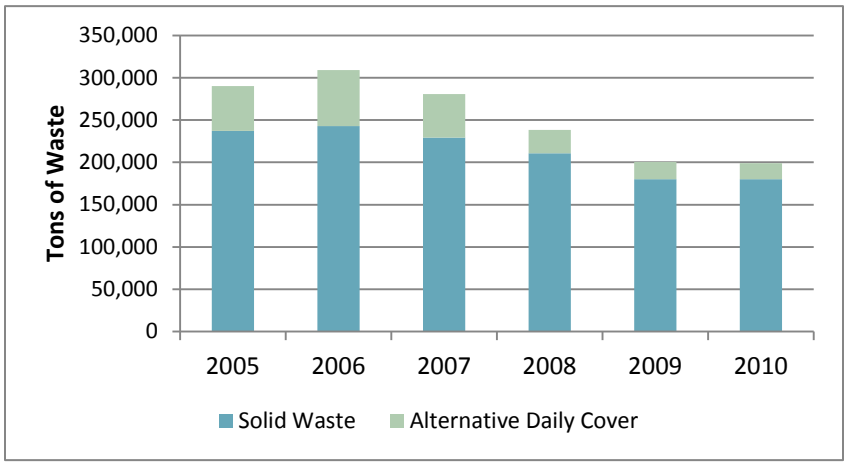
Emissions from waste generated by the Ross community in 2010 were 36% lower than 2005. This was due to a reduction in landfilled waste and in a change in the composition of alternative daily cover. In 2005, a greater proportion of green waste was used as alternative daily cover and then buried in the 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	2,241	453	1,643	332	-26.6%	-26.6%
Alternative Daily Cover	499	85	173	11	-65.3%	-87.2%
Total	3,394	538	1,816	343	-33.7%	-36.2%

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

FIGURE 4: COUNTYWIDE WASTE GENERATION, 2005 TO 2010



GOVERNMENT OPERATIONS INVENTORY

GOVERNMENT PROFILE

The Town of Ross 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 fire department and police department. In 2010, there were 25 total employees. General fund expenditures for fiscal year 2010-2011were $5,694,091.

GOVERNMENT OPERATIONS INVENTORY SUMMARY

In 2005, Ross' government operations produced approximately 257 metric tons of CO_2e. In 2010, those activities resulted in approximately 238 metric tons of CO_2e, a reduction of almost 20 metric tons, or 7.6%. These numbers include all Scope 1 emissions from the on-site combustion of fuels in facilities and vehicles, Scope 2 emissions from the purchase of electricity generated outside Ross' borders, and Scope 3 emissions from waste generated by local government operations and employee commutes. The following summaries break down these totals by sector, sources and scope.

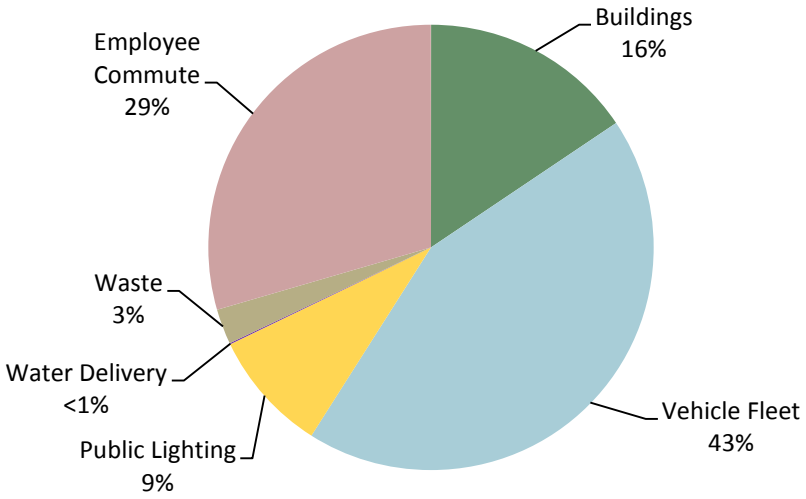
SUMMARY BY SECTOR

As shown in Table 17, the greatest reductions in emissions came from the employee commute sector, which experienced a reduction in emissions of 18.3 metric tons CO2e, or nearly 21%. Emissions were also reduced in the waste sector (-17.7%) and in the streetlights and traffic signals sector (-13.2%). On the other hand, emissions increased in both the buildings and facilities sector (2.4%) and the vehicle fleet sector (2.3%). Figure 5 shows that the vehicle fleet sector was the largest emitter of greenhouse gas emissions in 2010 (43%), followed by the employee commute sector (29%).

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	36.2	37.0	+0.9	+2.4%
Vehicle Fleet	100.8	103.2	+2.3	+2.3%
Streetlights & Traffic Signals	24.1	20.9	-3.2	-13.2%
Water Delivery	0.2	0.2	0.0	0.0%
Waste	7.4	6.1	-1.3	-17.7%
Employee Commute	88.4	70.1	-18.3	-20.7%
Total	**257.2**	**237.6**	**-19.6**	**-7.6%**

FIGURE 5: EMISSIONS BY SECTOR, 2010



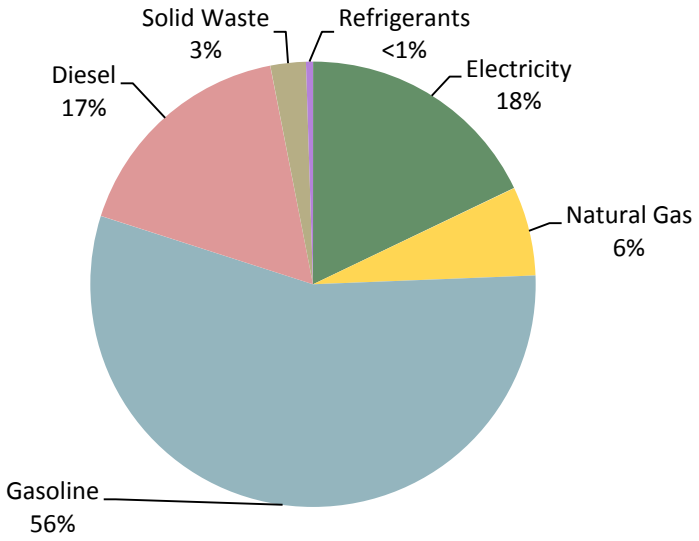
SUMMARY BY SOURCE

Table 18 shows the as summary of the Town's greenhouse gas emissions by source. Emissions from diesel increased the most (+306%), while emissions from gasoline decreased the most (-24.6%). Despite the decrease in gasoline emissions, gasoline was the largest source of greenhouse gas emissions in Ross' governmental operations in 2010 (see Figure 6). 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	45.7	42.6	-3.1	-6.9%
Natural Gas	14.5	15.4	+0.9	+5.9%
Gasoline	175.1	132.0	-43.0	-24.6%
Diesel	13.2	40.3	+27.1	+306%
Solid Waste	7.4	6.1	-1.3	-17.8%
Refrigerants	1.2	1.2	0.0	0.0%
Total	**257.2**	**237.6**	**-19.6**	**-7.6%**

FIGURE 6: 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, and these emissions increased by 2.6% in 2010. The largest decrease occurred in Scope 3 emissions, which include the waste and employee commute sectors.

TABLE 19: SUMMARY BY SCOPE, 2005 AND 2010

Activity	2005 Metric Tons CO_{2e}	2010 Metric Tons CO_{2e}	% Change
Scope 1	115.6	118.8	+2.6%
Scope 2	45.7	42.6	-6.9%
Scope 3	95.9	76.2	-20.5%
Total	**257.2**	**237.6**	**-7.6%**

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. 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, Ross operated three major facilities – the Town Hall, the public safety building, and a public works building. 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 Ross staff.

As shown in Table 20, emissions from the buildings sector increased by 2.4% between 2005 and 2010. Although electricity consumption increased by nearly 10%, emissions did not increase because the carbon intensity of PG&E electricity was lower in 2010. Natural gas consumption and emissions increased by 5.9%.

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	95,619 kWh	21.4	105,009 kWh	21.4	+9.8%	0.0%
Natural Gas	2,736 therms	14.5	2,898 therms	15.4	+5.9%	+5.9%
Gasoline	5 gallons	0.0	5 gallons	0.0	0.0%	0.0%
Refrigerants	--	0.2	--	0.2	--	0.0%
Total	--	36.2	--	37.0	--	+2.4%

Streetlights and Traffic Signals

Ross operates traffic signals/controllers located at Sir Francis Drake Boulevard intersections and 265 streetlights. Emissions associated with the operation of this public lighting are from electricity consumption. Electricity consumption in the public lighting sector decreased by 4.6% between 2005 and 2010, due to a retrofit of bridge street lights from high-wattage incandescent bulbs to compact fluorescent bulbs. Emissions dropped even more, by 13.2%.

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	105,694 kWh	23.6	100,742 kWh	20.5	-4.7%	-13.3%
Traffic Signals	2,143 kWh	0.5	2,165 kWh	0.4	+1.0%	-8.2%
Total	107,837 kWh	24.1	102,907 kWh	20.9	-4.6%	-13.2%

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. In 2010, Ross operated a water pump irrigation systems for parks. The source of Ross' water delivery emissions is from a small amount of electricity consumption. Emissions from the water delivery sector were flat.

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	745 kWh	0.2	1,128 kWh	0.2	+51.4%	0.0%

VEHICLE FLEET

The vehicles and mobile equipment used in Ross' daily operation include public works trucks, police cars, fire engines, and landscaping maintenance equipment. 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, Ross operated a fleet of 15 vehicles, including six police patrol cars, two fire engines, four pick-up trucks, a backhoe, and two vehicles for employee use.

Table 23 shows that total fuel consumption increased by 1.5% between 2005 and 2010. Emissions increased by 2.3%, primarily due to an increase in diesel fuel consumption by the Public Works Department.

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 ($MTCO_2e$)
Police	7,041 gallons	62.9	6,111 gallons	53.8	-13.2%	-14.5%
Fire	1,381 gallons	13.9	2,645 gallons	25.2	+91.5%	+81.3%
Public Works	2,578 gallons	23.0	2,412 gallons	23.2	-6.4%	+0.9%
Refrigerants, all departments	—	1.0	—	1.0	--	0.0%
Total	11,000 gallons	100.8	11,168 gallons	103.2	+1.5%	+2.3%

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 17.6% 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 ($MTCO_2e$)
Town Cans	14.2 tons	2.9	14.6 tons	3.0	+2.8%	+2.8%
Corp Yard	22.6 tons	4.6	15.7 tons	3.2	-30.5%	-30.5%
Total	36.8 tons	7.4	30.3 tons	6.1	-17.6%	-17.6%

Employee Commute

Emissions in the employee commute sector are due to the combustion of fuels used by Town employees commuting to and from work in Ross. Table 25 shows that while vehicle miles traveled decreased by 3% between 2005 and 2010, emissions decreased at a much greater rate of 20.7%. This drop in emissions may be attributed to an improvement in the fuel efficiency of the vehicles that Ross employees drive. 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

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
Employee Commute	164,103 miles	88.4	159,154 miles	70.1	-3.0%	-20.7%

CONCLUSION

Ross has achieved some early successes in reducing greenhouse gas emissions over the past five years. Community emissions decreased by 4.6% between 2005 and 2010, putting the town on track to reduce emissions by 13% below the 2005 baseline year if the community continues to reduce emissions at the current rate. Emissions decreased in all sectors.

One of the brightest spots in the inventory came from the waste sector, which saw a reduction in emissions of 36%. 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, water and off-road categories, these sectors are relatively small, collectively representing about 4% of total community emissions. Emissions reductions in the transportation and residential sectors, 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 Town 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.

As a new customer of the Marin Energy Authority, Ross can expect to experience reductions in electricity emissions as Ross 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 Ross' community emissions. Ross 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.

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 Town can encourage better uses of resources by adopting more stringent green building regulations.

Within government operations, emissions decreased by 7.6%. While reductions occurred in the employee commute, waste and public lighting sectors, emissions rose in the buildings and vehicle fleet sector. The Town's recent decision to use Marin Clean Energy electricity for all facilities should have a significant, positive effect on emissions. The Town can reduce emissions even more by installing energy efficient lighting and equipment and purchasing more fuel-efficient vehicles. Staff should always be aware of the impact their decisions have on the environment.

Ross 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. Ross 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 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	11,403,003	kWh	2,530.09	0.06	0.16	2,550.99
	1	Natural Gas	1,044,790	therms	5,539.48	0.01	0.52	5,553.69
		TOTAL			8,069.57	0.07	0.68	8,104.67
Commercial	2	Electricity	2,037,634	kWh	452.11	0.01	0.03	455.84
	1	Natural Gas	97,455	therms	516.71	0.00	0.05	518.03
	2	Direct Access Electricity	304,356	kWh	130.91	0.00	0.00	131.47
		TOTAL			1,099.73	0.01	0.08	1,105.35

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	11,033,621	kWh	2,227.12	0.05	0.15	2,245.68
	1	Natural Gas	1,062,348	therms	5,632.57	0.01	0.53	5647.02
	2	MEA Electricity	0	kWh	0.00	0.00	0.00	0.00
	2	Direct Access Electricity	16,593	kWh	4.96	0.00	0.00	4.98
		TOTAL			7,864.65	0.06	0.68	7,897.68
Commercial	2	PG&E Electricity	2,239,619	kWh	452.06	0.01	0.03	455.83
	1	Natural Gas	98,720	therms	523.41	0.00	0.05	524.76
	2	MEA Electricity	0	kWh	0.00	0.00	0.00	0.00
	2	Direct Access Electricity	245,718	kWh	73.41	0.00	0.00	73.69
		TOTAL			1,048.89	0.01	0.08	1,054.28

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	53.02 kg/MMBtu	Local Government Operations Protocol, Version 1.1, May 2010, Table G.1 U.S. Default Factors for Calculating Carbon Dioxide Emission from Fossil Fuel Combustion.
	CH_4	0.005 kg/MMBtu	Local Government Operations Protocol, Version 1.1, May 2010, Table G.3 Default Methane and Nitrous Oxide Emission Factors by Fuel type and Sector
	N_20	0.0001 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	0.65868 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. Emission factor is not certified.
	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	53.02 kg/MMBtu	Local Government Operations Protocol, Version 1.1, May 2010, Table G.1 U.S. Default Factors for Calculating Carbon Dioxide Emission from Fossil Fuel Combustion.
	CH_4	0.005 kg/MMBtu	Local Government Operations Protocol, Version 1.1, May 2010, Table G.3 Default Methane and Nitrous Oxide Emission Factors by Fuel type and Sector
	N_20	0.0001 kg/MM**B**tu	

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.

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 activity data from the 2005 Greenhouse Gas Emissions Inventory and 2005 emission factors from the LGO Protocol. Activity data for residential natural gas consumption was revised according to updated data provided by PG&E. 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	13,410,101	VMT	6,260.12	0.93	0.85	6,565.24
		TOTAL		VMT	6,260.12	0.93	0.85	6,565.24

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	13,318,850	VMT	6,002.44	0.92	0.59	6,300.49
		TOTAL	13,318,850	VMT	6,002.44	0.92	0.59	6,300.49

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.

EMFAC Data: 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.

2005 data was recalculated using emission factors and fuel usage estimates provided by the Bay Area Air Quality Management District.

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	8,505	gallons	gasoline	74.67	0.00	0.00	74.67
	1		1,082	gallons	diesel	11.05	0.00	0.00	11.05
	1	Lawn and Garden Equipment	2,224	gallons	gasoline	19.53	0.00	0.00	19.53
	1		8,845	gallons	diesel	90.31	0.00	0.00	90.31
		TOTAL	20,656	gallons		195.56	0.00	0.00	195.56

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	5,577	gallons	gasoline	48.97	0.00	0.00	48.97
	1		1,093	gallons	diesel	11.16	0.00	0.00	11.16
	1	Lawn and Garden Equipment	2,340	gallons	gasoline	20.55	0.00	0.00	20.55
	1		8,883	gallons	diesel	90.70	0.00	0.00	90.70
		TOTAL	17,893	gallons		171.37	0.00	0.00	171.37

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	278,021	kWh	61.69	0.00	0.00	62.20
		TOTAL	278,021	kWh	61.69	0.00	0.00	62.20

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	114,332	kWh	23.08	0.00	0.000	23.27
	3	MEA Electricity	136,254	kWh	20.02	0.00	0.00	20.24
		TOTAL	250,586	kWh	43.09	0.00	0.00	43.52

Data Sources

Marin Municipal Water District (MMWD) electricity usage provided by Jon LaHaye, MMWD Principal Engineer, jlahaye@marinwater.org and Jamie Tuckey, Marin Energy Authority Communications Director, jtuckey@marinenergyauthority.org. Electricity usage was provided for the service area population and allocated to individual cities on a per capita basis.

Additional Notes

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	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Wastewater	3	PG&E Electricity	151,216	kWh	33.55	0.00	0.00	33.83
	3	Treatment	2,332	people	0.00	0.20	0.00	58.62
		TOTAL			33.55	0.02	0.00	92.45

2010 Data Summary

Sector	Scope	Fuel	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Wastewater	3	PG&E Electricity	135,326	kWh	27.32	0.00	0.00	27.54
	3	Treatment	2,415	people	0.00	0.20	0.00	60.73
		TOTAL			27.32	0.20	0.00	88.27

Data Sources

Electricity usage estimates: "Refining Estimates of Water-Related Energy Use in California," California Energy Commissions, December 2006.

Wastewater production estimates: Nancy Gibbs, Marin Municipal Water District Business Systems Analyst, ngibbs@marinwater.org and Dan Carney, Marin Municipal Water District Water Conservation Manager, dcarney@marinwater.org.
Wastewater treatment data provided by Robert Cole, Environmental Services Manager, Central Marin Sanitation Agency, rcole@cmsa.us, 415-459-1455 ext 142.
2005 population estimate 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.

Additional Notes

Data analyzed by Christine O'Rourke, Marin Climate and Energy Partnership Sustainability Coordinator, christine.o@comcast.net
Electricity usage calculated according to BAAQMD recommended methodology. 67% of per capita water use assumed to be indoor water use and processed as wastewater. Electricity used to treat wastewater based on northern California averages.
Treatment process emissions calculated according to ICLEI methodology for process N2O emissions from a centralized wastewater treatment plant and stationary CH4 emissions from an anaerobic digester.

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 Municipal Solid Waste	2,241	tons	0.00	0.00	21.57	452.99
	3	Alternative Daily Cover	499	tons	0.00	0.00	4.02	84.52
		TOTAL	2,740	tons	0.00	0.00	25.60	537.51

2010 Data Summary

Sector	Scope	Subsector	Quantity	Units	Greenhouse Gas Emissions (metric tons)			
					CO_2	N_2O	CH_4	CO_2e
Waste	3	Landfilled Municipal Solid Waste	1,643	tons	0.00	0.00	15.82	332.27
	3	Alternative Daily Cover	173	tons	0.00	0.00	0.52	10.84
		TOTAL	1,816	tons	0.00	0.00	16.34	343.11

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

Waste emissions are calculated using ICLEI's Clean Air and Climate protection 2009 Software, Version 3.0. 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	2,736 therms	14.51	0.00	0.00	0.00	14.54
	Stationary Combustion	5 gallons	0.04	0.00	0.00	0.00	0.04
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	0.20
	TOTAL		14.55	0.00	0.00	0.00	14.78
Scope 2	Purchased Electricity	95,619 kWh	21.22	0.00	0.00	0.00	21.39
	TOTAL	95,619 kWh	21.22	0.00	0.00	0.00	21.39

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	2,898 therms	15.37	0.00	0.00	0.00	15.40
	Stationary Combustion	5 gallons	0.04	0.00	0.00	0.00	0.04
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	0.20
	TOTAL		15.41	0.00	0.00	0.00	15.64
Scope 2	Purchased Electricity	105,009 kWh	21.20	0.00	0.00	0.00	21.37
	TOTAL	105,009 kWh	21.20	0.00	0.00	0.00	21.37

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 Ross 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	107,837 kWh	23.93	0.00	0.00	0.00	24.12
	TOTAL	107,837 kWh	23.93	0.00	0.00	0.00	24.12

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	102,907 kWh	20.77	0.00	0.00	0.00	20.94
	TOTAL	102,907 kWh	20.77	0.00	0.00	0.00	20.94

2005 emissions were recalculated using activity data from the Ross 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	745 kWh	0.17	0.00	0.00	0.00	0.17
	TOTAL	745 kWh	0.17	0.00	0.00	0.00	0.17

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	1,128 kWh	0.23	0.00	0.00	0.00	0.23
	TOTAL	1,128 kWh	0.23	0.00	0.00	0.00	0.23

2005 emissions were recalculated using activity data from the Ross 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	11,000 gallons	98.41	1.30	0.07	0.00	99.77
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	1.04
	TOTAL		98.41	1.30	0.07	0.00	100..81

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	11,168 gallons	101.87	0.00	0.00	0.00	102.20
	Fugitive Emissions	--	0.00	0.00	0.00	0.00	0.96
	TOTAL		101.87	0.00	0.00	0.00	103.16

Vehicle fleet data was provided by Ross staff. 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. Emissions were calculated using default emission factors from the LGOP.

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, emissions were calculated using 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	36.8 tons	0.00	0.00	0.35	0.00	7.44
	TOTAL	36.8 tons	0.00	0.00	0.35	0.00	7.44

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	30.3 tons	0.00	0.00	0.29	0.00	6.12
	TOTAL	30.3 tons	0.00	0.00	0.29	0.00	6.12

2005 solid waste emissions were recalculated using activity data from the Ross 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 Neil Roscoe at Marin Sanitary District. Containers were assumed to be 100% filled at 75 lbs. cubic yard. Waste characterization is as noted above; see Appendix A for more details on waste characterization and emission factors.

Employee Commute Sector Notes

LGO Protocol – Emissions by Scope and Emission Type, 2005

Scope	Emission Type	Vehicle Miles Traveled	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Mobile Combustion	164,103	85.25	0.01	0.01	0.00	88.42
	TOTAL	164,103	85.25	0.01	0.01	0.00	88.42

LGO Protocol – Emissions by Scope and Emission Type, 2010

Scope	Emission Type	Vehicle Miles Traveled	Greenhouse Gas Emissions (metric tons)				
			CO_2	N_2O	CH_4	HFCs	CO_2e
Scope 3	Mobile Combustion	159,154	69.01	0.00	0.00	0.00	70.08
	TOTAL	159,154	69.01	0.00	0.00	0.00	70.08

2005 data obtained from the Ross 2005 Greenhouse Gas Inventory.

For the 2010 inventory, the Town 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. Twenty-one employees responded to the survey, a response rate of 84%. Estimates for total employee commutes were extrapolated from this data.