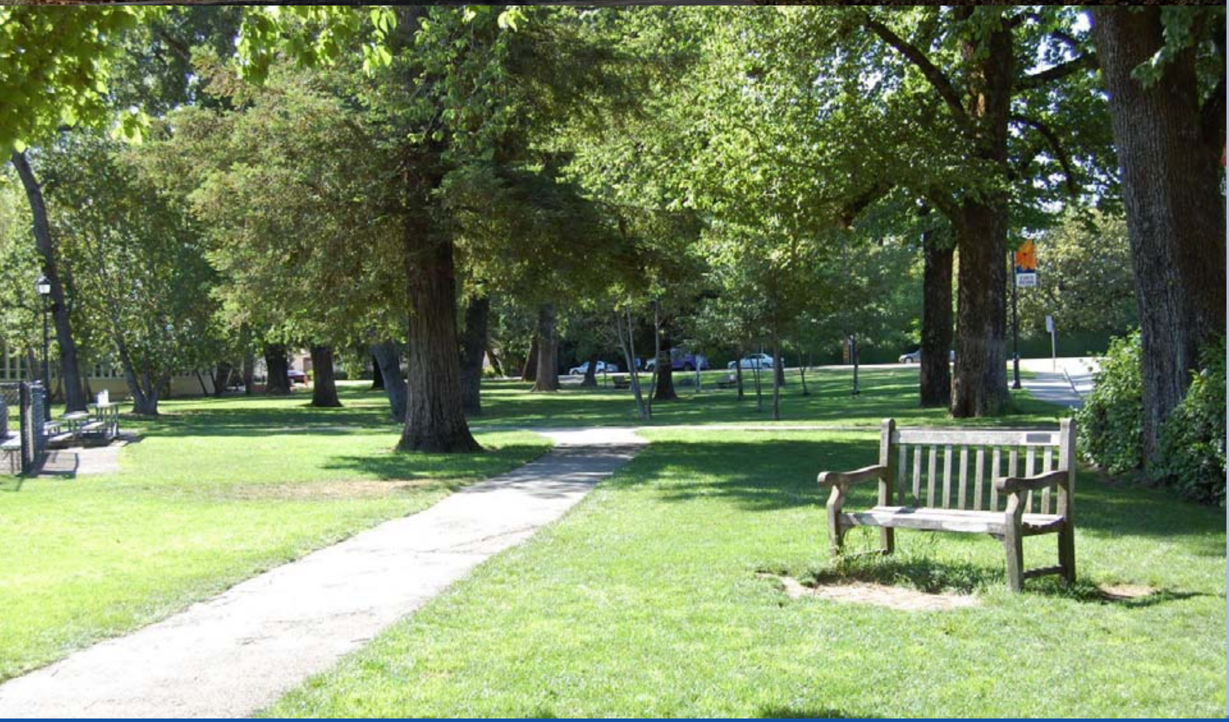
Town of Ross
2005 Greenhouse Gas Emissions Inventory



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ICLEI-Local Governments for Sustainability is a membership association of 1,000 local governments worldwide—500 in the United States—committed to advancing climate protection and sustainability. Through technical expertise, direct support, and the innovation and evolution of tools, ICLEI strives to empower local governments to set and achieve their emissions reduction and sustainability goals.

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Foreward by Mayor William R. Cahill

Last year, Mayor R. Scot Hunter joined over 900 mayors in signing the U.S. Conference of Mayors Climate Protection Agreement. As part of that agreement, the Town of Ross committed itself to completing a comprehensive greenhouse gas inventory for both the town as a whole and for town government operations. I am pleased to now release the results of this important effort.

While there is no substitute for federal action, all levels of government have a role to play in confronting climate change and its potential impacts. Local governments, in particular, can significantly reduce greenhouse gas emissions in their communities through wiser land use planning, building construction, energy use and resource conservation.

This greenhouse gas inventory is a critical first step in reducing our contribution to global carbon dioxide levels. By identifying the sources of greenhouse gases and forecasting future greenhouse gas emissions under a "business-as-usual" scenario, the Town now has the information it needs to set an aggressive emissions reduction target and design strategies that will achieve that target.

Ross has already taken some important steps to curb greenhouse gas emissions. Through our Safe Routes to School initiative, we are constructing pedestrian pathways on Shady Lane and Sir Francis Drake Boulevard that will encourage our residents to walk, rather than drive, to school and our downtown. We also strongly support the use of renewable energy, and we offer reduced fees and easier permitting for residential solar energy systems.

There is still much work to be done, but if we step up to the challenges and opportunities that await us, we will ensure a better future for our children and successive generations. It's up to us!

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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-- policy frameworks committed to the reduction of greenhouse gases have been created and are being implemented. Many of the costs associated with these changes will be borne by local governments. However, local governments are in a unique position to lead an intelligent and timely response to these challenges in a way that will keep them, and their communities, ahead of market and regulatory trends. With decisive action on climate and energy matters, Ross and its community will be strategically positioned to benefit and flourish in this emerging arena.

In joining the Marin Climate and Energy Partnership, and in signing the US Conference of Mayors Climate Protection Agreement,[1] Ross recognizes that climate change is a reality, and that human activities are responsible for increasing the concentration of atmospheric greenhouse gases–the primary drivers of climate change. Ross understands that climate change has the potential to significantly impact Ross' residents and businesses, as well as other communities around the world. Ross also recognizes that local governments play a strong role in reducing greenhouse gas emissions and mitigating the potential impacts of climate change. A range of actions can dramatically reduce these emissions from the local community and government operations including increasing

[1] See Appendix E for more information on the US Mayors Climate Protection Agreement.

energy efficiency in buildings and vehicle fleets, bolstering the use of clean, renewable energy sources, establishing land use and transportation plans that reduce vehicle use, and encouraging waste reduction. The benefits of these measures include lower energy bills, improved air quality, economic development, reduced emissions, and an enhanced quality of life throughout the community. Ross has begun its efforts to address the causes and effects of climate change with the assistance and partnership of the members of Marin Climate and Energy Partnership (MCEP). These partners include the County of Marin, all 11 municipal governments in the County of Marin, the Marin Municipal Water District (MMWD), the Transportation Authority of Marin (TAM), the Marin Energy Management Team (MEMT), and ICLEI-Local Governments for Sustainability.

Ross recently completed this government operations and community-scale greenhouse gas emissions inventory as an important first step in its climate protection initiative. These inventories are essential, as advised by ICLEI, to establish:

- A baseline emissions inventory, against which to measure future progress.
- An understanding of where the highest percentages of emissions are coming from, and, therefore, where the greatest opportunities for emissions reductions lie.

This report contains the estimates of greenhouse gas emissions in 2005 resulting from activities and operations of the Town of Ross and also those taking place within the geographical boundaries of Ross.

Government operations emissions have been categorized according to six primary sectors:

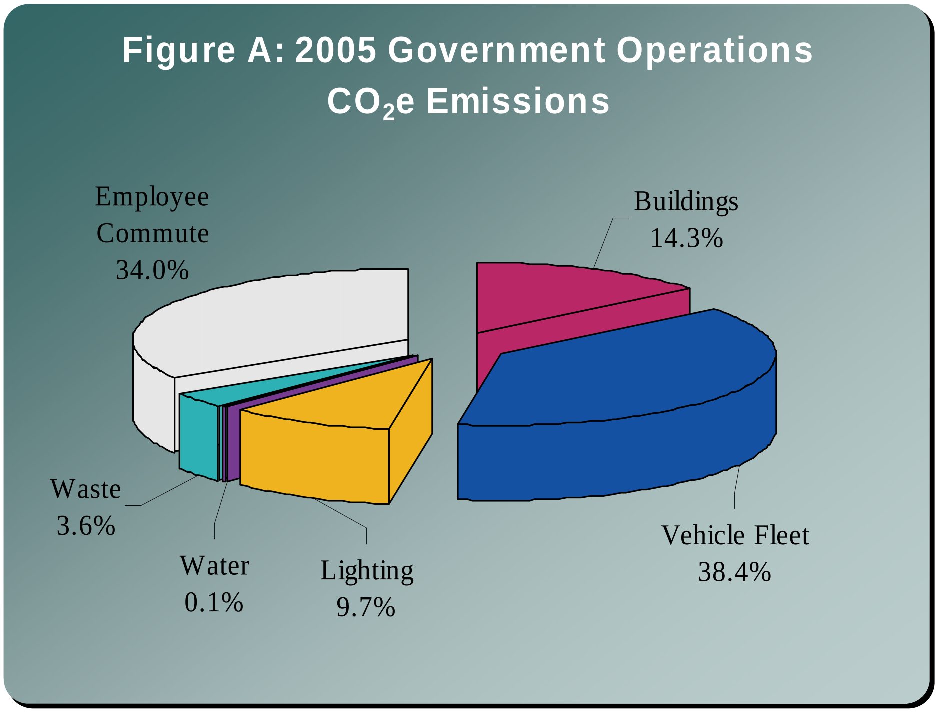
1. Buildings and other facilities
2. Streetlights, traffic signals, and other public lighting
3. Water delivery facilities
4. Vehicle fleet
5. Government-generated solid waste
6. Employee commute

Community emissions have been categorized according to four primary sectors:

1. Residential
2. Commercial / Industrial[2]
3. Transportation
4. Waste

Government Operations Inventory Results

In 2005, Ross government operations emitted approximately 260 metric tons (tons) of CO_2e.[3] As shown in Figure A, the Vehicle Fleet Sector was the largest emitter (38.4 percent) in 2005. Emissions from the Employee Commute Sector produced the second highest quantity of emissions, resulting in 34 percent of total CO_2e; the Buildings Sector produced 14.3 percent of total emissions. The remainder of emissions came from the Lighting Sector (9.7 percent), the Waste Sector (3.6 percent), and the Water Sector (.1 percent). Emissions from government operations produced approximately 1.5% percent of total community emissions.



[2] Emissions from government operations are included as a subset of the Commercial / Industrial sector.
[3] This number includes all Scope 1 emissions from the on-site combustion of fuels in facilities and vehicles, Scope 2 emissions from the purchase of electricity, and Scope 3 emissions from waste generated by local government operations and emissions associated with employee commute patterns.

Table A: 2005 Government Operations Emissions by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (million Btu)	Cost ($)	% of Total Cost
Buildings	37	14.3%	601	$15,763	20.6%
Vehicle Fleet	100	38.4%	1,374	$27,824	36.4%
Lighting	25	9.7%	368	$32,465	42.5%
Water	0.2	0.1%	3	$295	0.4%
Waste	9	3.6%	0	-	0.0%
Employee Commute	88	34.0%	1,140	-	0.0%
TOTAL	**260**	**100.0%**	**3,485**	**$76,346**	**100.0%**

Community Inventory Results

In 2005, the Ross community emitted approximately 17,209 metric tons of CO_2e. As shown in Figure B and Table B below, electricity and natural gas consumption within the Residential Sector, the largest source of emissions, generated approximately 8,239 metric tons of CO_2e, or 47.9 percent of total 2005 emissions. Transportation Sector emissions, the second greatest source of 2005 emissions, are the result of diesel and gasoline combustion in vehicles traveling on local roads and Sir Francis Drake Boulevard; these generated 7,268 metric tons CO_2e, or 42.2 percent of the total. Electricity and natural gas use in Ross' Commercial/Industrial Sector produced 1,102 metric tons CO_2e, or 6.4 percent of total community emissions. The remaining 3.5 percent (600 metric tons) are the estimated future methane emissions that will result from the decomposition of waste that was generated by the Ross community during 2005.

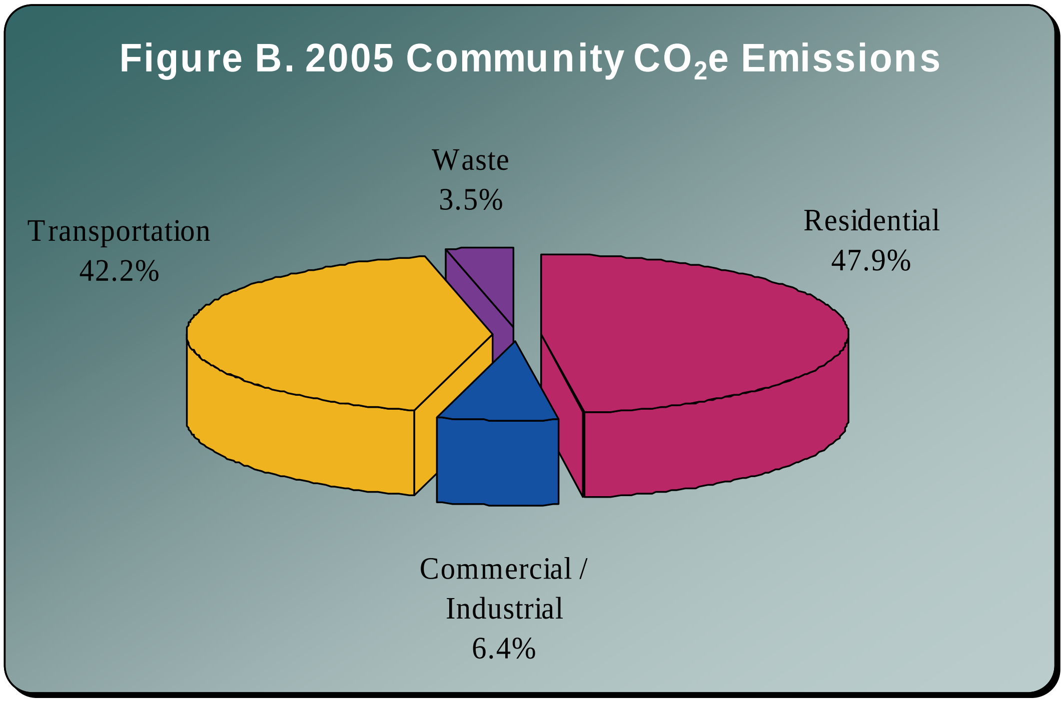


Table B: 2005 Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO2e)	Greenhouse Gas Emissions (% CO2e)	Energy Equivalent (million Btu)
Residential	8,239	47.9%	143,069
Commercial / Industrial	1,102	6.4%	17,804
Transportation	7,268	42.2%	99,389
Waste	600	3.5%	0
TOTAL	**17,209**	**100.0%**	**260,262**

The first step toward reducing greenhouse gas emissions is to identify sources of emissions and establish baseline levels. This information can later inform the selection of a reduction target and possible reduction measures to be included in the climate action plan.

Key Findings

Government Operations

- Ross government operations produced approximately 260 metric tons of CO_2e in 2005.
- The Vehicle Fleet Sector was the greatest source of government operations greenhouse gas emissions in 2005 – producing 100 metric tons of CO_2e, or 38.4 percent of total government operations emissions.
- Government operations comprised just 1.5% of total community emissions.

Community-wide

- Ross' community produced approximately 17,209 metric tons of CO_2e in 2005.
- The Residential Sector was the greatest source of community greenhouse gas emissions in 2005 – producing 8,239 metric tons of CO_2e, or 47.9 % of total community emissions.

Section One: Introduction

1.1 Purpose of Inventory

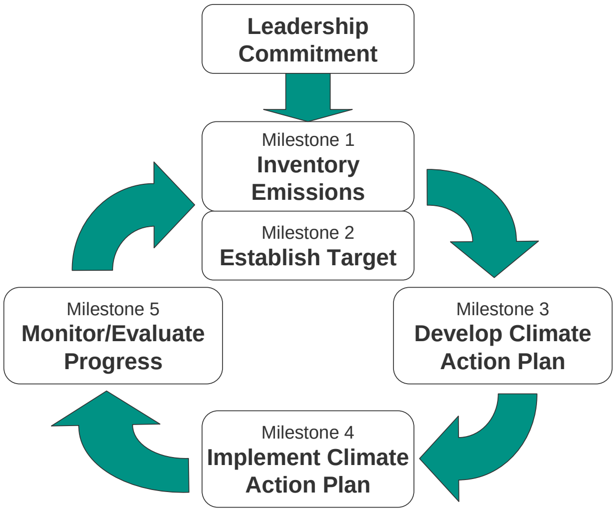
The objective of this greenhouse gas emissions inventory is to identify the sources and quantify the volumes of greenhouse gas emissions resulting from governmental operations as well as activities and operations taking place throughout the community of Ross in 2005. This inventory serves two purposes:

- It creates an emissions baseline against which Ross can set emissions reductions targets and measure future progress.
- It allows an understanding of where the highest percentages of emissions are generated in Ross' internal operations as well as in the community, and, therefore, identifies the greatest opportunities for emissions reductions.

While Ross has already begun to reduce greenhouse gas emissions through its actions (See Section 1.3 for more detail), this inventory represents the first step in a systems approach to reducing Ross' emissions. This system, developed by ICLEI, is called the Five Milestone Process, and is utilized by over 500 local governments in the U.S. to structure their climate protection efforts. The process is as follows:

Milestone 1: Conduct a baseline emissions inventory and forecast
Milestone 2: Adopt an emissions reduction target for the forecast year
Milestone 3: Develop a local climate action plan
Milestone 4: Implement the climate action plan
Milestone 5: Monitor progress and report results

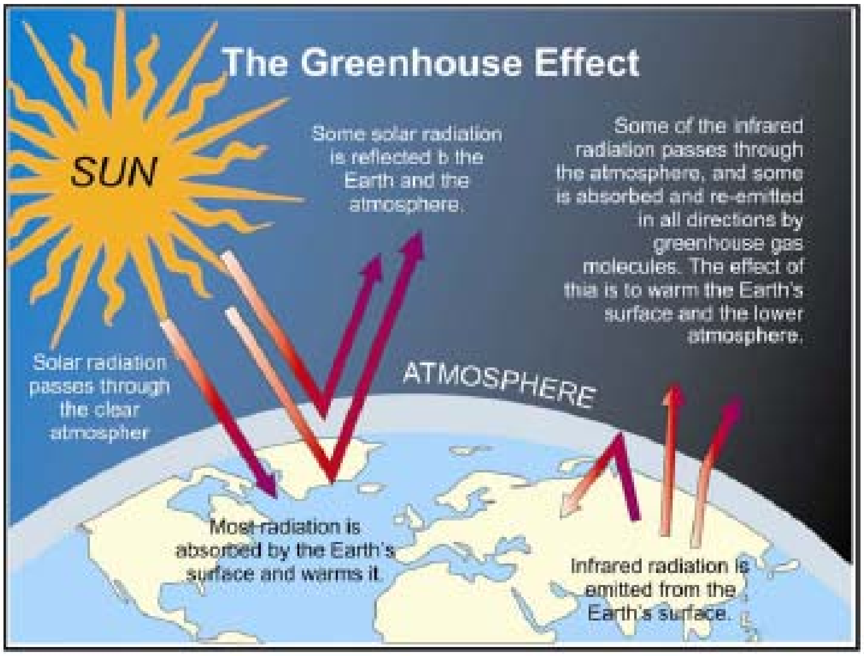
Figure 1.1: The ICLEI Five Milestone Process



1.2 Climate Change Background

A balance of naturally occurring gases dispersed in the atmosphere determines the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence suggests that human activities are increasing the concentration of greenhouse gases in the atmosphere, causing a rise in global average surface temperature and consequent climate change. Modern human activity--most notably the burning of fossil fuels for transportation, electricity and heat generation--introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere.

Figure 1.2: The Greenhouse Effect



Collectively, these gases intensify the natural greenhouse effect, causing global average surface temperatures to rise, which affects local and global climate patterns. These changes in climate are forecasted to manifest themselves in a number of ways that might impact Ross as well as other changes to local and regional weather patterns and species migration.

Beyond the local community, scientists also expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and land slides, summer water shortages as a result of reduced snow pack, and disruption of ecosystems, habitats, and agricultural activities. In response to the threat of climate change, communities worldwide are voluntarily reducing greenhouse gas emissions. Many communities in the United States are taking responsibility for addressing climate change at the local level. Since many of the major sources of greenhouse gas emissions—fuel consumption in personal vehicles, energy consumption in buildings, organic waste decomposition in landfills—are directly or indirectly controlled through local policies, local governments have a primary role to play in reducing greenhouse gas emissions within their jurisdictional boundaries. Through the use of proactive measures around sustainable land use patterns, transportation demand management, energy efficiency, renewable energy, green building, and waste diversion, local governments can dramatically reduce emissions in their communities. In addition, as the effects of climate change become more common and severe, local government adaptation policies will be fundamental in preserving the welfare of local residents and businesses.

1.3 Climate Change Mitigation Activities in Ross

1.3.1 Ross Profile

Ross is a town of 1.6 square miles, located in Marin County in the San Francisco Bay Area. According to the Association of Bay Area Governments (ABAG), in 2005 the Ross population was 2,350, and there were approximately 770 households located in Ross. Included as an indicator of commercial activity, the number of jobs within Ross in 2005 was 870. Ross is located in climate zone 3 and, in 2005, experienced an estimated 3,649 Heating Degree Days and 292 Cooling Degree Days.[4]

Table 1.1: Ross Profile Chart 2005

Size	Population	Annual Budget	Employees	Climate Zone	Heating and Cooling Degree Days
1.6 sq. miles	2,350	$4,739,917	24	3	HDD: 3,649 CDD: 292

In 2005, Ross provided the following core services, which have been identified as having an impact on greenhouse gas emission levels:

Table 1.2: Ross Services

Service / Facility		Service / Facility	
Water Treatment		Solid Waste Collection	X
Water Distribution		Solid Waste Disposal (landfill)	
Wastewater Treatment		Hospitals	
Wastewater Collection		Airport	
Electric Utility		Seaport / Shipping Terminal	
Fire Protection	X	Marina	
Police	X	Stadiums/Sports Venues	
Mass Transit (buses)		Convention Center	
Mass Transit (light rail)		Street Lighting and Traffic Signals	X
Mass Transit (ferries)		Natural Gas Utility	
Schools (primary/secondary)		Other	
Schools (colleges and universities)			

[4] Climate Zone information is supplied by the U.S. Department of Energy, http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/dbimages/full/973.jpg , accessed 1/29/09. 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 1/29/09.

These services and others, and the facilities and equipment that are instrumental in the delivery of these services, are the focus of this greenhouse gas emissions inventory. There are a number of opportunities for reducing emissions from government operations, many of which have added benefits of reducing government operating costs and improving workplace efficiency.

1.3.2 Greenhouse Gas Emission Reduction Actions

In its recently updated General Plan 2007-2025, the Town adopted a number of sustainable building and community policies to reduce resource consumption and improve energy efficiency, including:

1. Requiring large houses to limit the energy usage to that of a more moderately-sized house as established in design guidelines.
2. Encouraging affordable workforce housing and a development pattern that encourages people to walk.
3. Using green materials and resources.
4. Conserving water, especially in landscaping.
5. Encouraging transportation alternatives to the private automobile.
6. Increasing the use of renewable energy sources, including solar energy.
7. Recycling building materials.
8. Reducing building footprints.

In 2007, Ross joined the County of Marin and the other ten Marin municipalities to form the Marin Climate and Energy Partnership (MCEP) whose goal is to reduce greenhouse gas emissions and create sustainable communities. MCEP received a Bay Area Air Quality Management District Climate Protection grant in 2008 to develop programs to reduce energy use in residential buildings and in municipal buildings, vehicle fleets, and operations.

In May of 2008, the Ross Mayor signed the U.S. Mayors Climate Protection Agreement, which commits the Town to strive to meet Kyoto Protocol emissions reduction targets and support state and federal greenhouse gas emission reduction legislation. Under the agreement, the Town agreed to target a reduction in greenhouse gas emissions 7% below 1990 levels by 2012. The Town plans to achieve this by adopting land-use policies that create a walkable community, promoting alternative transportation options and energy use, increasing energy efficiency and recycling efforts, and encouraging sustainable building practices.

The Town has already implemented several programs to reduce the community's greenhouse gas emissions. Under the Safe Routes to School program, the Town is building safe pathways along Shady Lane and Sir Francis

Drake Boulevard that will encourage children to walk to school and residents to walk to downtown rather than drive. The Town has also adopted various incentives to encourage solar energy installation. Zoning laws were amended to allow solar energy panels within side and rear setbacks on existing rooftops and to exempt panels from lot coverage calculations; these changes enable more homeowners to apply for solar energy system permits without the time and cost of requesting a variance. The Town also waives all building permit fees for solar energy systems, reduces variance fees for solar energy systems by one half, and offers a rebate of up to $1,000 on building permit fees for projects that include solar energy components.

1.4 The Marin Climate and Energy Partnership

The Marin Climate and Energy Partnership is a collaborative effort of the County of Marin, the 11 municipal governments of Marin, the Marin Municipal Water District (MMWD) and the Transportation Authority of Marin (TAM). Planning for the establishment of the Marin Climate and Energy Partnership was initiated in early 2007 under the auspices of Joint Venture Marin and ICLEI-Local Governments for Sustainability. In March of 2007, leaders from Joint Venture Marin, Marin Municipal Water District, and the County of Marin submitted a request for planning funds from the Marin Community Foundation, for the purpose of convening cities and public agency partners. This work was being developed alongside ICLEI's multi-year engagement of Marin local governments on climate and energy matters, and the two efforts came together to convene the Partnership. In October of 2007, representatives of all 11 Marin cities, the County, and MMWD agreed to jointly:

Develop the mission, work plan, and structure of the Marin Climate & Energy Partnership

Apply for a $75,000 grant from the Bay Area Air Quality Management District (BAAQMD) for the purpose of hiring a Climate Action Director

Provide support in the amount of $2,000 from each member jurisdiction

Work together with other member jurisdictions to identify the resources needed to sustain the Climate Action Director position in FY 2009-10 and FY 2010-11

The Climate Action Director was hired in October of 2008, and has begun working with the MCEP jurisdictions to identify near-term opportunities for reducing greenhouse gas emissions. Marin Climate and Energy Partnership jurisdictions have also been working closely with ICLEI to complete this greenhouse gas emissions inventory, and to begin considering options for comprehensive climate action planning efforts to be undertaken in 2009.

Section Two: Methodology

2.1 Analysis Parameters

The inventories in this report follow two standards, one for government operations emissions and one for community emissions. As local governments all over the world continue to rapidly join the climate protection movement, the need for common conventions and a standardized approach to quantifying greenhouse gas (GHG) emissions is more pressing than ever. The community emissions inventory follows the standard outlined in the draft International Local Government GHG Emissions Analysis Protocol (IEAP). ICLEI has been developing this guidance since the inception of its Cities for Climate Protection Campaign in 1993, and has recently formalized version 1 of the IEAP as a means to set a common framework for all local government worldwide. ICLEI is also working with the California Air Resources Board (CARB) and the California Climate Action Registry (CCAR) to leverage the IEAP in establishing a community GHG protocol specifically for California local governments. The pending community protocol will serve as a corollary to the recently adopted Local Government Operations Protocol (LGOP). The LGOP, which was adopted in 2008 by the California Air Resources Board (CARB), serves as the national standard for quantifying and reporting greenhouse emissions from local government operations.

2.1.1 Background

International Local Government GHG Emissions Analysis Protocol (IEAP)

ICLEI has developed the International Local Government GHG Protocol (IEAP) to provide a set of guidelines to assist local governments in quantifying the greenhouse gas emissions from both their internal operations and from the whole communities within their geopolitical boundaries. By developing common conventions and a standardized approach, ICLEI seeks to make it easier for local governments to achieve tangible reductions in greenhouse gas emissions.

The IEAP states that "an emissions inventory should comprise two parallel analyses for a chosen analysis year, one for local government operations and one for emissions from all sectors in the community, determined by the geopolitical boundary of the jurisdiction." This report details the findings from Ross' community inventory only.

Local Government Operations Protocol (LGOP)

In 2008, ICLEI, CARB, and the California Climate Action Registry (CCAR) released the LGOP to serve as a national appendix to the IEAP. The purpose of the LGOP is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory. It leads participants through the process of accurately reporting emissions, including providing calculation methodologies and reporting guidance. The LGOP guidance is divided into three main parts: identifying emissions to be included in the inventory, quantifying emissions using best available estimation methods, and reporting emissions.

The overarching goal of the LGOP is to allow local governments to develop emissions inventories using standards that are consistent, comparable, transparent, and recognized nationally, ultimately enabling the measurement of emissions over time. The LGOP was created only to standardize how emissions inventories are conducted and reported; it represents a currently accepted standard for inventorying emissions and does not contain any legislative or program-specific requirements. Mandates by the State of California or any other legislative body, while possibly using the LGOP as a standard, do not currently exist, and local governments are not currently required to inventory their emissions. Program-specific requirements, such as ICLEI's Milestones or CCAR's reporting protocol, are addressed in the LGOP but should not be confused with the LGOP itself.

Also, while the LGOP standardizes inventories from government operations, it does not seek to be a wholly accurate inventory of all emissions sources, as certain sources are currently excluded or otherwise impossible to accurately estimate. This and all emissions inventories therefore represent a best estimate of emissions, using best available data and calculation methodologies outlined in the LGOP; it does not provide a complete picture of all emissions resulting from Ross' operations, and emissions estimates are subject to change as better data and calculation methodologies become available in the future.

2.1.2 Baseline Years

A primary aspect of the emissions inventory process is the requirement to select a "performance datum" with which to compare current emissions, or a base year. Local governments should examine the range of data they have over time and select a year that has the most accurate and complete data for all key emission sources. It is also preferable to establish a base year several years in the past to be able to account for the emissions benefits of recent actions. .A local government's emissions inventory should comprise all greenhouse gas emissions occurring during a selected *calendar* year.

This inventory utilizes 2005 as the baseline year, as this year is increasingly becoming the standard for such inventories. The 1990 baseline year for the State of California is usually too difficult for most local governments to meet and would not produce the most accurate inventory.

After setting a base year and conducting an emissions inventory for that year, local governments should make it a practice to complete a comprehensive emissions inventory on a regular basis to compare to the baseline year. ICLEI recommends conducting and emissions inventory at least every five years.

2.1.3 Boundaries of GHG Inventory Analysis

Community: Geopolitical Boundary

Setting an organizational boundary for greenhouse gas emissions accounting and reporting is an important step in the inventory process. As stated above, the community inventory assesses emissions resulting from activities taking place within the geopolitical boundary of the jurisdiction. The IEAP defines geopolitical boundary as that "consisting of the physical area or region over which the local government has jurisdictional authority." Activities that occur within the community boundary can be controlled or influenced by jurisdictional policies, educational programs and establishing a precedent. Although some local governments may have only limited influence over the level of emissions from some activities, it is important that every effort be made to compile a complete analysis of all activities that result in the emission of greenhouse gases.

Within the geopolitical boundaries of a jurisdiction, emissions are organized according to where they fall relative to those boundaries. There are two primary metrics of internal categorization: 1) scopes, and 2) sectors.

Government: Organizational Boundaries

Under the LGOP, two control approaches are used for reporting emissions: operational control or financial control. A local government has operational control over a facility if it has full authority to introduce and implement its operating policies at the facility. 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.[5] Local governments must choose which approach is the most applicable and apply this approach consistently throughout the inventory.

While both control approaches are acceptable, there may be some instances in which the choice may determine whether a source falls inside or outside of a local government's boundary. *It should be noted that the LGOP strongly encourages local governments to utilize operational control.* Operational control is believed to most accurately represent emissions' sources that local governments can most directly influence and is consistent with other environmental and air quality reporting program requirements.

2.1.4 Greenhouse Gases and Types of Emissions

According to both the IEAP and the LGOP, local governments should assess emissions of all six internationally recognized greenhouse gases regulated under the Kyoto Protocol (see Table 2.1 below). Local governments are encouraged to quantify greenhouse gases beyond these six, however neither the IEAP, nor LGOP provides guidance on quantifying or reporting emissions from other gases. As quantifying emissions beyond the three primary GHGs (CO_2, CH_4, and N_2O) can be quite difficult, ICLEI has also created a means for local governments to produce an inventory that is otherwise in accordance with the methodology of the IEAP and LGOP, and is focused on primary

[5] Please see Local Government Operations Protocol for more detail on defining your organizational boundary: http://www.icleiusa.org/programs/climate/ghg-protocol

policy options associated with climate protection. This alternate approach is what is referred to as the Quick Action Report. This is the standard followed in this particular inventory.

Table 2.1: Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organics (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbons	Various	Leaked Refrigerants, Fire Suppressants	43-11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500-9,000
Sulfur Hexafluoride	SF_6	Transmission and Distribution of Power	23,900

2.1.5 Units Used in Reporting Emissions

In this narrative report, emissions from all gases released by an emissions source (e.g. stationary combustion of natural gas in facilities) are combined and reported in metric tons of carbon dioxide equivalent (CO_2e). This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide. See Table 2.1 above for the GWPs of the gases discussed in this section.

2.1.6 Reporting Emissions: The Scopes Framework

For both community and government operations, emissions sources are also categorized according to where they fall relative to the geopolitical boundary of the community, or the operational boundaries of the government. Emissions sources are categorized as direct or indirect emissions--Scope 1, Scope 2, or Scope 3-- in accordance with the World Resources Institute and the World Business Council for Sustainable Development's *Greenhouse Gas Protocol Corporate Standard.* The standard is to report emissions by scope as a primary reporting framework.[6]

Community Scope Definitions

The Scopes framework identifies three emissions scopes for community emissions:

Scope 1: All direct emissions from sources located within the geopolitical boundary of the local government.

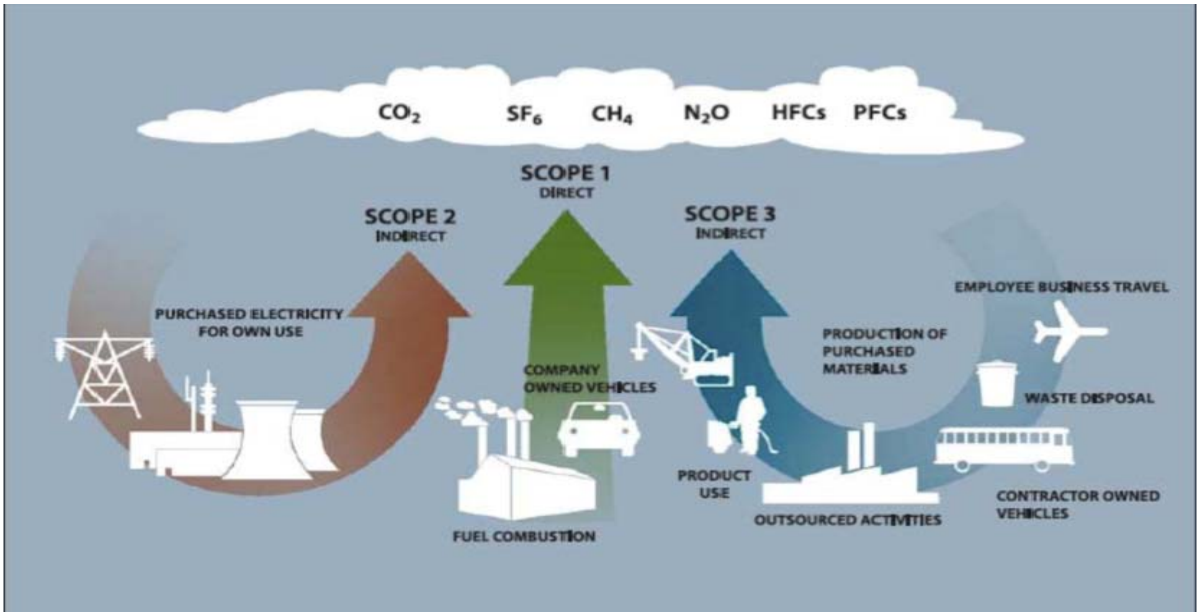
Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the geopolitical boundary of the local government, but that occur at sources located outside of the government's jurisdiction.

[6] Another common reporting framework is emissions by sector: See Section 2.1.7-Emisisons Sectors for details

Scope 3: All other indirect or embodied emissions not covered in Scope 2, that occur as a result of activity within the geopolitical boundary.

Scope 1 and Scope 2 sources are the most essential components of a community greenhouse gas analysis. This is because these sources are typically the most significant in scale, and are most easily impacted by local policy making. The IEAP also includes, in its *Global Reporting Standard,* the reporting of Scope 3 emissions associated with the decomposition of solid waste and sewage waste-water produced within the geopolitical boundaries of the local government.

Figure 2.1 – Emissions Scopes



Source: WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition), Chapter 4.

Government Scope Definitions

Similar to the community framework, the government scopes are divided into three main categories:

Scope 1*:* Direct emissions from sources within a local government's organizational boundaries that the local government owns or controls.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity.

Scope 3: All other indirect emissions not covered in Scope 2, such as emissions from up-stream and downstream activities that occur as a result of activities within the operational boundaries of the local government, emissions resulting from the extraction of and production of purchased materials and fuels, contracted services, and waste disposal.

As with the community inventory, Scope 1 and Scope 2 sources are the most essential components of a local greenhouse gas analysis. This is because these sources are usually significant in scale and are directly under the control of local governments. According to the LGOP all Scope 1 and Scope 2 categories must be included when conducting an emissions inventory.

Scope 3 emissions comprise all other sources of emissions. Scope 3 emissions can be more challenging to estimate. Local governments may only have indirect control over these emissions, or there may be unique circumstances surrounding the emissions. For example, solid waste generated from government operations is included as Scope 3 in the LGOP because of the unique circumstances in which emissions are generated—emissions from waste are generated over time as the waste decomposes and not directly in the base year. The LGOP encourages local governments to conduct as complete an analysis as is practicable, but distinguishes Scope 3 emissions sources so that local governments can prioritize their efforts and appropriately categorize emissions sources according to where the emissions occur, the relative magnitude of the emissions, and which entity is responsible for the emissions. In this inventory, the Scope 3 emission sources include tailpipe emissions from employee commute and government-generated waste. The LGOP does not provide methods for estimating Scope 3 emissions, and ICLEI has estimated these emissions using methods derived from various accepted standards.

Scopes and Double Counting

One of the most important reasons for using the scopes framework for reporting greenhouse gas emissions at the local level is to prevent double counting for major categories such as electricity use and waste disposal. If, for example, all of the cities in a county decided to aggregate their emission inventories to create a county-level government operations inventory without disaggregating scopes, the emissions from electricity and waste sectors would be double counted if there were any power plants or active landfills located in the county. These inventories use rollup numbers (emissions added across scopes), but are very clear to identify the types of emissions included in the rollup numbers. ICLEI strongly encourages local governments to do the same whenever they report a rollup number as they can be very misleading and easily misquoted by policymakers or others when referring to the inventory.

2.1.7 Emissions Sectors

In addition to categorizing emissions by scope, ICLEI recommends that local governments examine their emissions in the context of the sector that is responsible for those emissions. Many local governments will find a sector-based analysis more directly relevant to policy making and project management, as it assists in formulating sector-specific reduction measures and climate action plan components.

Community Sectors

The IEAP outlines the following sectors, in accordance with the Intergovernmental Panel on Climate Change (IPCC):

Stationary Combustion: Including utility delivered fuel consumption at stationary sites (Scope 1), utility delivered electricity / heat consumption at stationary sites (Scope 2), decentralized fuel consumption at stationary sites (e.g. propane, kerosene, stationary diesel from small vendors) (scope 1), utility consumed fuel for electricity / heat generation (scope 1), etc.

Mobile Combustion: Including tailpipe emissions from vehicles traveling on roads within the geopolitical boundary of the local government (Scope 1), tailpipe emissions from off-road vehicles operating within the geographical boundaries (Scope 1), rail traffic occurring within geographical boundaries (Scope1), marine transportation occurring between two jurisdictions (Scope 3), etc.

Fugitive and Other Energy Emissions: Including leaked natural gas from distribution infrastructure located within geopolitical boundaries (Scope 1), leaked refrigerants from residential and commercial / industrial facilities (Scope1), etc.

Industrial Processes and Product Use: Including non-energy related emissions generated in the production of cement (Scope 1), in the refining of fuels (Scope 1), in the processing of coal (Scope 1), etc.

Agriculture, Forestry and Other Land Use: Including emissions from the use of nitrogenous fertilizers (Scope 1), methane emissions from livestock farms (Scope 1), negative net biogenic carbon flux (Scope 3), etc.

Waste: Including fugitive methane emissions at landfills (Scope 1), fugitive methane and nitrous oxide emissions at waste water treatment facilities (Scope 1), estimated future emissions associated with base year waste disposal (Scope 3), etc.

In most cases, analysis and the facilitation of decision making will be enhanced by further subdividing these sectors in a manner consistent with the way that the local government is accustomed to considering their community and policy setting roles. It is not mandatory that a local government conduct an analysis of all sectors listed by the IPCC. This emissions inventory contains the following sectors:

Stationary Combustion

Residential Sector

Commercial / Industrial Sector

Mobile Combustion

Transportation Sector

Waste

Waste Generation

Government Sectors

The LGOP breaks emissions down into the following general sectors:

Facilities,

Streetlights and traffic signals,

Water delivery facilities,

Vehicle fleet,

Power generation facilities,

Solid waste facilities,

Wastewater treatment facilities,

Port facilities,

Airport facilities,

Other process and fugitive emissions from special operations, and

Information items (to be quantified yet not included as Scope 1 , 2, or 3 emissions).

This particular inventory includes the following sectors:

Facilities,

Streetlights and traffic signals,

Water delivery facilities, and

Vehicle fleet.

Additionally, this report includes the following two Scope 3 sectors in the government operations inventory:

Government Generated Waste

Employee Commute

2.1.8 Significance Thresholds for Reporting Emissions

Within any community or local government's operations there will be emission sources that fall within Scope 1 and Scope 2 that are minimal in magnitude and difficult to accurately measure. At the local government level, rarely used backup generators and fugitive emissions from a fleet maintenance facility are two examples. For these small, difficult to quantify emission sources, the LGOP specifies that up to five percent of total emissions can be reported using estimation methods not outlined in the LGOP.

2.2 Quantifying Emissions

2.2.1 Quantification Methods

Emissions can be quantified in two ways:

Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This methodology is not generally available for most types of emissions and will only apply to a few local governments that have these monitoring systems.

The majority of the emissions recorded in this inventory have been calculated using **calculation-based methodologies** to calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Activity Data

Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for detailed listing of the activity data used in composing this inventory.

Emission Factors

Emission factors are used to convert energy usage or other activity data into associated emissions quantities. They are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh). Please see Appendices B and C for a listing of emissions factors used in this report. Table 2.2 demonstrates an example of common emission calculations that use this formula.

Table 2.2: Basic Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kWh)	CO2 emitted/kWh	CO2 emitted
Natural Gas Consumption (therms)	CO2 emitted/therm	CO2 emitted
Gasoline/Diesel Consumption (gallons)	CO2 emitted /gallon	CO2 emitted
Vehicle Miles Traveled	CH4, N2O emitted/mile	CH4, N20 emitted

2.2.2 CACP Software

To facilitate local government efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software in partnership with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO)[7], and Torrie Smith and Associates. This software calculates emissions by combining emission factors with a range of activity data, such as energy consumption and waste generation.[8] This is the primary tool used to calculate emissions for this report.

The CACP software is used by more than 500 U.S. cities and towns to quantify their greenhouse gas emissions. However, it is important to note that precisely calculating emissions from energy use, fuel consumed, and waste disposed is difficult. As with many emissions analyses and models, CACP depends on numerous assumptions, and is limited by the quality of available data. With this in mind, it is useful to consider specific numbers generated by CACP as an approximation of reality, rather than an exact value.

[7] Now the National Association of Clean Air Agencies (NACAA)
[8] Please see Appendices B and C for a list of emission factors.

Section Three:
2005 Government Operations Inventory

3.1 Government Operations Inventory Summary

In 2005, Ross' government operations produced approximately 260 metric tons of CO_2e— 1.5% percent of total community emissions. This number includes 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.

As mentioned in Section 2.1, the LGOP requires reporting by emissions scope, and this analysis is included in Section 3.1. In order to provide a useful policy discussion, this chapter also provides a breakdown of all emissions by sector and source, rolling up and comparing emissions only as appropriate to avoid double counting.[9]

3.1.1 Summary by Scope

As shown in Table 3.1, Scope 1 emissions constituted the largest amount of greenhouse gas emissions from jurisdiction's operations in 2005, totaling 113 metric tons of CO_2e. Scope 3 emissions constituted the second largest amount (98 metric tons of CO_2e), and Scope 2 emissions totaled 48 metric tons of CO_2e.[10]

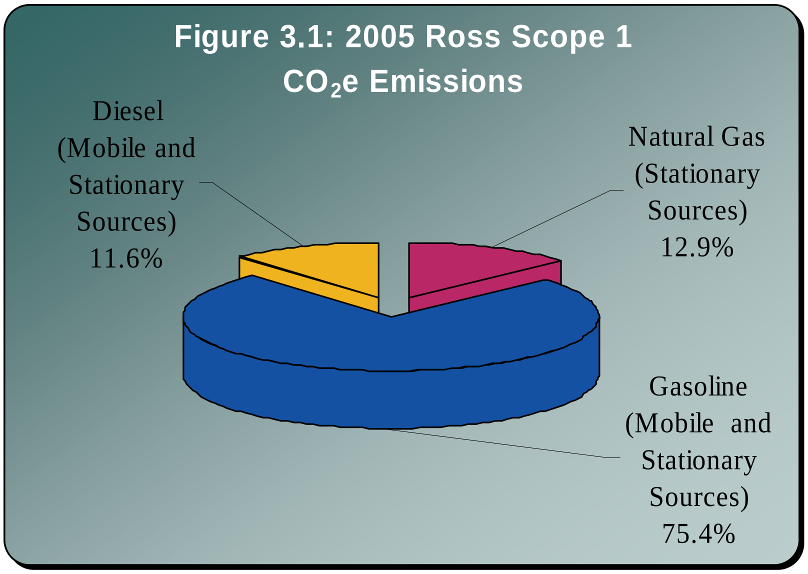
Table 3.1: 2005 Ross Government Emissions by Scope

Activity	CO_2e emitted	Scope Total
Scope 1		**113**
Natural Gas (Stationary Sources)	15	
Gasoline (Mobile and Stationary Sources)	85	
Diesel (Mobile and Stationary Sources)	13	
Scope 2		**48**
Purchased Electricity	48	
Scope 3		**98**
Employee Commute	88	
Government Generated Solid Waste	9	

[10] These emissions have not been totaled as this may result in double counting and a percentage is not significantly relevant to forming emissions reduction policy. The summaries by sector and source have percentage breakdowns, as do individual sources of emissions.

Scope 1 Emissions

In 2005, Ross' government operations produced 113 metric tons CO_2e of Scope 1 greenhouse gas emissions. As seen in Figure 3.1, the largest percent (75.4 percent) of Scope 1 emissions resulted from the combustion of gasoline in Town vehicles and equipment.. The second largest source of Scope 1 emissions was from stationary combustion of natural gas in Ross facilities, constituting 12.9 percent of Scope 1 emissions.



Scope 2 Emissions

In 2005, Ross' government operations generated 48 metric tons of CO_2e in the form of Scope 2 emissions from purchased electricity. All Scope 2 emissions in this inventory result from electricity consumption. Scope 2 government operations emissions are generated outside of Ross' operational boundaries, but are the result of Ross' government operations, and therefore are counted as an integral part of the inventory.

Scope 3 Emissions

In 2005, Ross' government operations generated 98 metric tons of CO_2e in the form of Scope 3 emissions. Two types of Scope 3 emissions are included in this report: those from Town of Ross employees' commutes, and those from waste generated at government-operated facilities. While reporting of Scope 3 emissions is optional, doing so enables Ross to develop innovative policy approaches for reducing greenhouse gases.

In 2005, 88 metric tons of CO_2e resulted from the consumption of fossil fuels by Ross employees in their personal vehicles while commuting to and from work. The anaerobic decay of solid organic waste (paper, plant debris, etc.) generated through Ross' operations in 2005 generated 9 metric tons of CO_2e.

3.1.2 Summary by Sector

By better understanding the relative scale of emissions from each of the sectors, Ross can more effectively focus emissions reductions strategies to achieve the greatest emissions reductions. For this reason, an analysis of emissions by sector is included here, based on the total of 260 metric tons of CO_2e. The sectors included in this total are the following:

Facilities	Vehicle fleet
Public lighting	Waste generation
Water delivery	Employee commute

As shown in Figure 3.2 and Table 3.2, the Vehicle Fleet Sector was the largest emitter (38.4 percent) in 2005. Emissions from the Employee Commute Sector produced the second highest quantity of emissions, resulting in 34 percent of total CO_2e. The Town's Buildings Sector produced 14.3 percent of total emissions with the remainder coming from the Lighting Sector (9.7 percent), the Waste Sector (.3.6 percent), and the Water Sector (.1 percent).

Figure 3.2: 2005 Government Operations CO_2e Emissions Summary by Sector

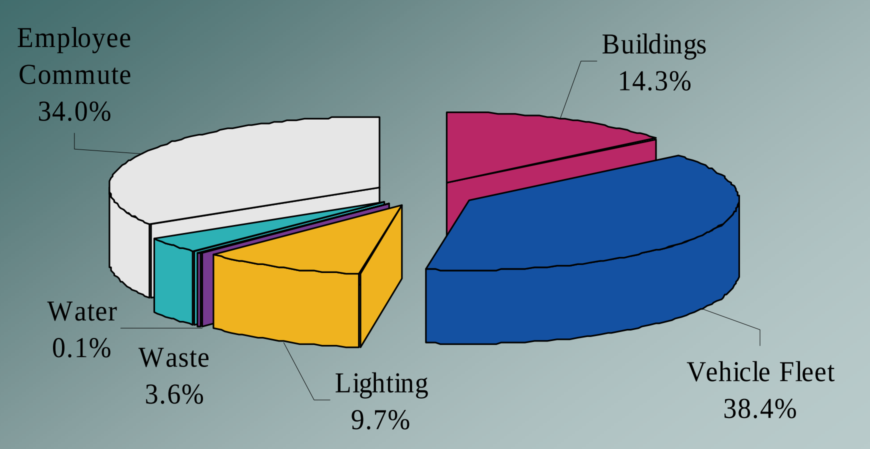


Table 3.2: 2005 Government Operations Emissions by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Buildings	37	14.3%
Vehicle Fleet	100	38.4%
Lighting	25	9.7%
Irrigation & Water Pump	0	0.1%
Waste	9	3.6%
Employee Commute	88	34.0%
TOTAL	**260**	**100.0%**

3.1.3 Summary by Source

When considering how to reduce emissions, it is also 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 directly result in the release of greenhouse gases. Such analysis can help target resource management in a way that will successfully reduce greenhouse gas emissions. Below is a summary of Ross' government operations 2005 greenhouse gas emissions by fuel type or material, based upon the total government operations emissions of 249 metric tons, excluding waste.

As shown in Figure 3.3, the greatest percentage of government emissions (69.7 percent) came from Gasoline. The next highest percentage of emissions came from Electricity (19.2 percent) and Natural Gas (5.9 percent).

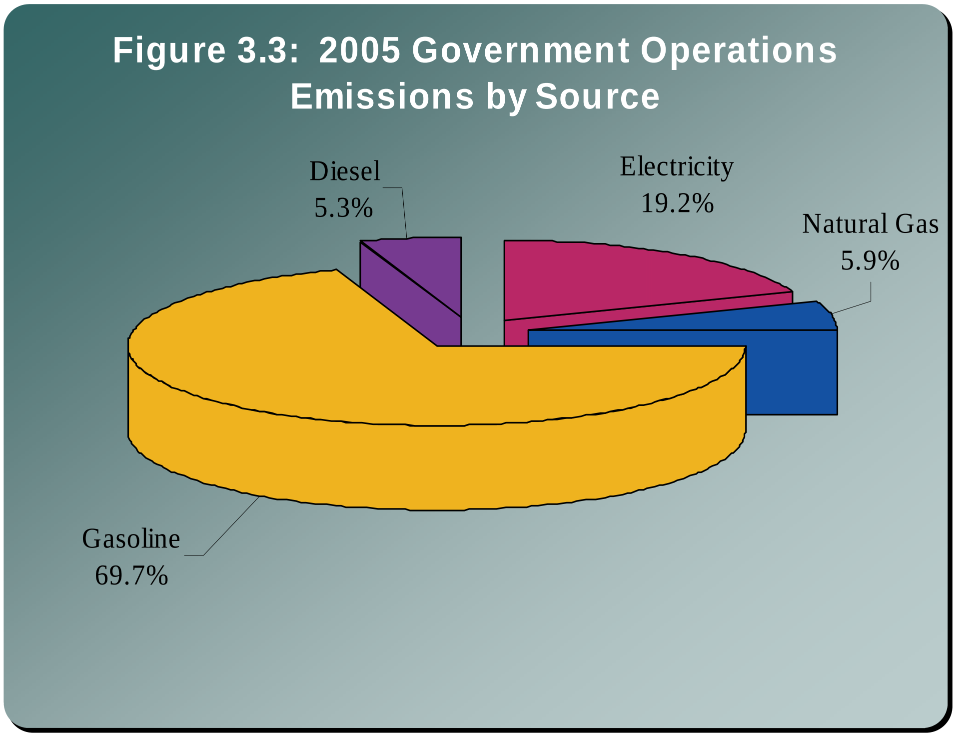


Table 3.3: 2005 Government Operations Emissions by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Electricity	48	19.2%
Natural Gas	15	5.9%
Gasoline	174	69.7%
Diesel	13	5.3%
TOTAL	**249**	**100.0%**

3.1.4 Summary of Energy-Related Costs

In addition to tracking energy consumption and generating emissions estimates, this report looks at the basic energy costs of various government operations. During 2005, Ross' internal operations spent approximately $76,278 on energy (electricity, natural gas, gasoline and diesel) for its buildings, water delivery systems, streetlights and vehicles. Sixty-four percent of these energy expenses ($48,510) are the result of electricity and natural gas purchases from PG&E. Ross spent approximately $27,755 on gasoline and diesel for the municipal fleet (36 percent of total costs).[11] Beyond reducing harmful greenhouse gases, any future reductions in energy use will have the potential to reduce these costs, enabling Ross to reallocate limited funds toward other municipal services or create a revolving energy loan fund to support future climate protection activities.

Table 3.4: 2005 Government Operations Costs by Sector

Sector	Cost ($)
Buildings	$15,763
Vehicle Fleet	$27,824
Lighting	$32,465
Water	$295
Waste	n/a
Employee Commute	n/a
TOTAL	**$76,346**

3.2 Government Operations Inventory Detail by Sector

This section discusses the activities and types of emissions coming from government operations by taking a detailed look at each primary sector. Again, the sectors included in this analysis are:

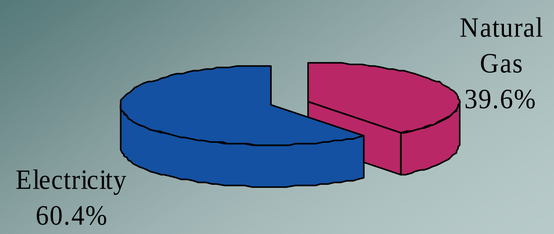
Facilities	Vehicle fleet
Public lighting	Waste generation
Water delivery	Employee commute

[11] Expense records for gasoline and diesel purchases were not obtained for this report. Instead, expenses were estimated using average annual fuel prices provided by the Metropolitan Transportation Commission (MTC) and the California Energy Commission.

3.2.1 Buildings and Other Facilities

Buildings and other facilities operated by local governments produce a significant amount of greenhouse gas emissions. In 2005, Ross operated the Town Hall, the Public Safety building housing police and fire operations, and a public works building. Electricity consumption and the on-site combustion of fuels such as natural gas were the most significant sources of 2005 greenhouse gas emissions from Ross facilities.

Figure 3.4: CO_2e Emissions from Government Buildings by Source



In 2005, the operation of Ross facilities produced approximately 37 metric tons of CO_2e from all of these sources. Ross spent approximately $15,763 in 2005 on the fuels and electricity that were the cause of these emissions. As discussed in Section 3.1, emissions from facilities represent 14.3 percent of "total" emissions from Ross operations in 2005. Of total facility emissions, 60.4 percent came from the consumption of electricity and 39.6 percent came from the combustion of natural gas (see Figure 3.4). [12]

3.2.2 Streetlights, Traffic Signals, and Other Public Lighting

Ross operates a range of public lighting, including streetlights and the traffic signal at Sir Francis Drake Boulevard and Lagunitas Road. Electricity consumed in the operation of this infrastructure is a significant source of greenhouse gas emissions.

In 2005, public lighting in Ross consumed a total of 107,837 kWh, producing approximately 25 metric tons CO_2e. This represents 9.7 percent of total emissions from Ross in 2005. The Town is currently analyzing an upgrade of outdated incandescent and mercury vapor streetlight lamps with more energy-efficient technologies such as high pressure sodium vapor and LED lamps in order to reduce the amount of greenhouse gas emissions

[12] For a detailed description of the methodology and emission factors used in calculating the above numbers please see Appendix C.

being generated by Ross operations and potentially save tax-payer dollars. Please refer to Table 3.5 to compare electricity consumption across the various public lighting categories.

Table 3.5: Energy Use and CO_2e Emissions from Public Lighting

Source	Greenhouse Gas Emissions (metric tons CO_2e)	% CO2e	Electricity Use (kWh)	Cost ($)	Energy Equivalent (million Btu)
Traffic Signals/Controllers	1	2.0%	2,143	$376.00	7
Streetlights	25	98.0%	105,694	$32,089.00	361
TOTAL	**25**	**100.0%**	**107,837**	**$32,465.00**	**368**

3.2.3 Water Delivery Facilities

This section addresses any facilities used for the management and distribution of water. Typical systems included in the Water Delivery Facilities section are: potable water delivery pumps, sprinkler and irrigation controls, and storm water management. Ross operates a water pump and an irrigation system. Electricity consumption is the most significant source of greenhouse gas emissions from the operation of Ross water delivery facilities.

In 2005, Ross emitted approximately .2 metric tons of CO_2e from these sources, which represents .1 percent of total emissions from Ross in 2005. Ross spent approximately $295 in 2005 on the electricity that were the cause of these emissions.

3.2.4 Vehicle Fleet

The majority of jurisdictions use vehicles as an integral part of their daily operations—from maintenance trucks used for parks and recreation to police cruisers and fire trucks. Combustion of fuels produce significant quantities of emissions within most local governments.

In 2005, Ross operated a fleet of approximately15 vehicles, as well as a small assortment of combustion equipment used primarily for landscaping and park maintenance. Ross' vehicle fleet performed a number of essential services, including park, right-of-way, and street maintenance, and police and fire protection services. In 2005, the Town operated five police cars, three fire engines, four pick-up trucks, one backhoe, and two vehicles for town employee use.

The operation of Ross' fleet in 2005 consumed approximately 1,294 gallons of diesel and 9,706 gallons of gasoline, producing a total of 100 metric tons CO_2e, or 38.4 percent of total government emissions. On a gallon basis, Ross' fleet consumed 88.2 percent gasoline and 11.8 percent diesel. As shown in Figure 3.5, 86.7 percent of Ross' fleet emissions came from gasoline and 13.3 percent from diesel, diesel being slightly more carbon intensive than gasoline. Please see Figure 3.6 for a depiction of emissions per Ross department.

Figure 3.5: Vehicle Fleet CO_2e Emissions by Fuel Type

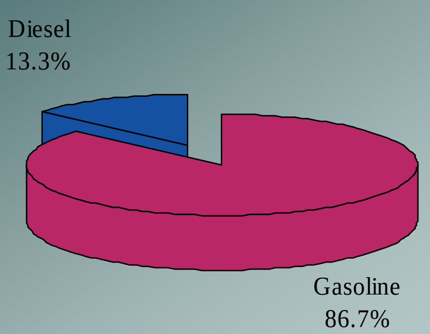
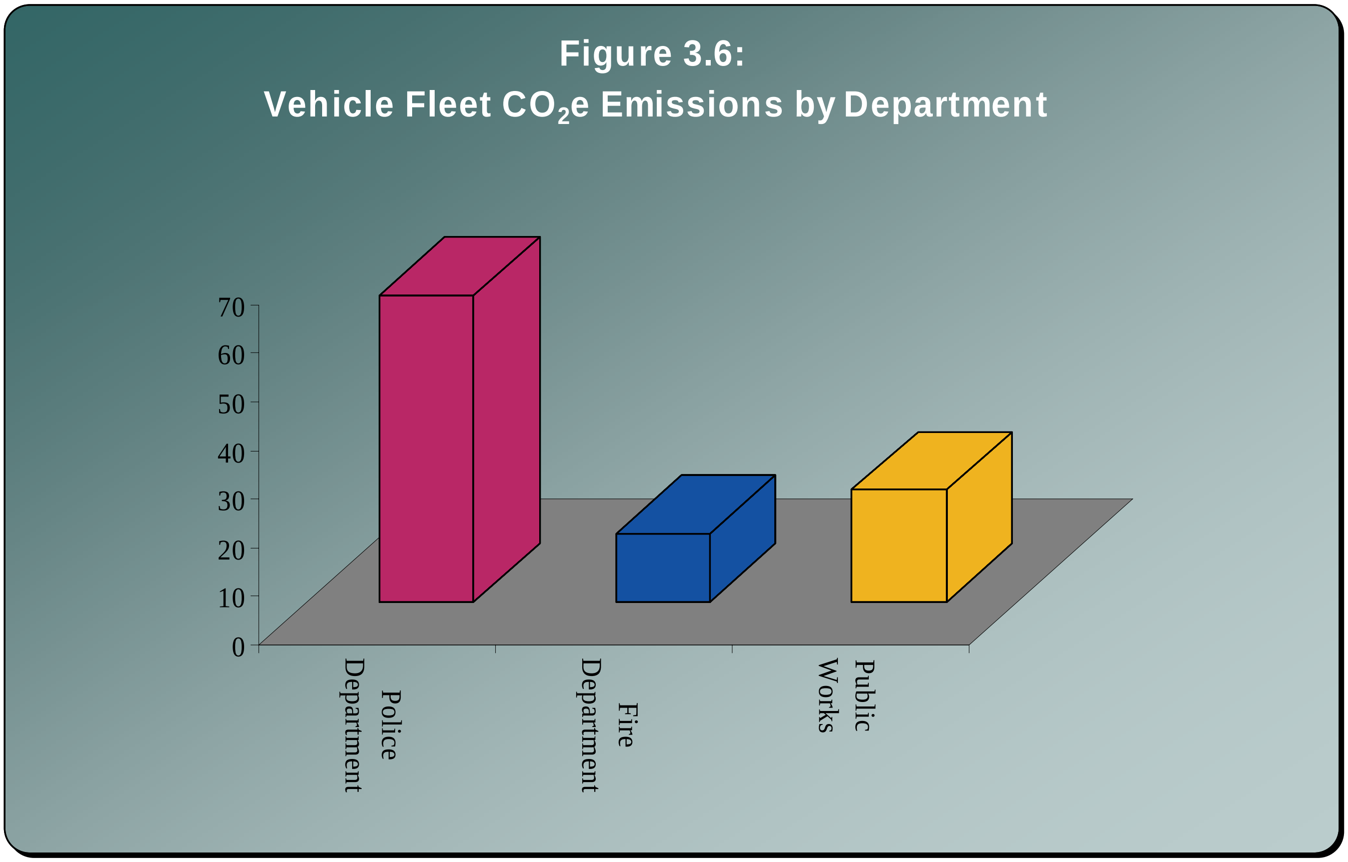


Table 3.6: Vehicle Fleet CO_2e Emissions by Department

Function	GHG Emissions (metric tons)	% CO_2e of Fleet Emissions	Gasoline Consumption (gal)	Diesel Consumption (gal)	Cost ($)	Energy Equivalent (million Btu)
Police Department	63	63.0%	7,041	0	$17,743	884
Fire Department	14	13.9%	122	1,259	$3,581	169
Public Works	23	23.1%	2,543	35	$6,499	320
TOTAL	**100**	**100.0%**	**9,706**	**1,294**	**$27,824**	**1,374**



Emissions from mobile combustion are the result of two separate processes. First, when fossil fuels (gasoline, diesel, natural gas) combust, they release carbon dioxide as a product of the combustion process, and these emissions are reported as Scope 1.[13] In addition, no combustion process results in a completely combusted fuel, and

[13] CO_2 emissions from the combustion of biofuels are not reported as Scope 1 emissions but are reported in Section 7 as information items.

two of the byproducts of incomplete combustion are methane (CH_4) and nitrous oxide (N_2O). These emissions are also considered Scope 1 emissions and are included in the final CO_2e number for mobile combustion.[14]

Scope 3 Emissions Sources

The LGOP designates a number of important sources of greenhouse gas emissions as Scope 3 emissions, encouraging local governments to inventory these emissions in order to provide a more complete picture of emissions resulting from government operations. Of the many possible Scope 3 emissions that could be quantified, ICLEI encouraged local governments (including Ross) participating in the Marin Climate and Energy Partnership inventories to quantify emissions resulting from vehicles driven by employees while commuting, and solid waste generated during government operations.

Since the LGOP describes Scope 3 emissions as optional, it does not provide guidance on recommended methods for quantifying these types of emissions. ICLEI therefore devised data collection and calculation methods based upon previous experience and LGOP-recommended methods for similar sectors.

3.2.5 Solid Waste Generation

Despite recent success with improving diversion rates throughout California, our communities and government operations have not yet reached "zero waste." Among the solid waste routinely generated by government buildings and operations, organic materials (including paper, food scraps, plant debris, textiles, construction waste, etc.) within the landfilled waste stream generate methane (CH_4) as they decay in the anaerobic environment of a landfill. An estimated 75 percent of this methane is routinely captured via landfill gas collection systems,[15] however, a portion escapes into the atmosphere, contributing to the greenhouse effect. As such, quantifying the amount of waste generated by government operations, and calculating the resulting greenhouse gas emissions is an important component of a comprehensive emission inventory.

[14] CH_4 and N_2O emissions from the incomplete combustion of biofuels are reported as Scope 1 emissions in this section. See Section 7 for more details for this reporting.

[15] Most commonly, captured methane gas is flared into the atmosphere, a process which converts the methane gas to levels of CO_2 commensurate with aerobic decomposition, effectively negating the anthropogenic impact on atmospheric greenhouse gas concentration. Increasingly, landfill methane is being used to power gas-fired turbines as a carbon-neutral means of generating electricity.

It is estimated that the waste disposed by government facilities in 2005 will cumulatively produce 9 metric tons $C0_2e$. Please see Table 3.7 for a breakdown of emissions per facility.

Table 3.7: Solid Waste CO_2e Emissions by Facility

Source	Greenhouse Gas Emissions (metric tons CO_2e)	% CO_2e of Waste Generation	Landfilled Waste (Tons)
Town Cans	4	38.6%	14
Corp Yard	6	61.4%	23
TOTAL	**9**	**100.0%**	**37**

Fugitive methane emissions resulting from the anaerobic decomposition of municipal solid waste are a unique class of indirect emissions, and therefore are classified as Scope 3 under the LGOP. These emissions are considered indirect because they do not result at the point of waste generation (as with fuel combustion), but in a landfill located outside of Ross' jurisdictional boundaries all together. These emissions are further differentiated from Scope 2 indirect emissions (such as electricity), because they are not generated in the base year (as with electricity generation) but over a lengthy decomposition period of about 100 years. Ross is in a unique position to reduce emissions from government generated waste by decreasing material consumption and increasing recycling and composting in government facilities.

3.2.6 Employee Commute

By the standard designated in the LGOP, the tailpipe emissions from passenger vehicles operated by municipal employees traveling to and from work are considered indirect emissions and are reported under Scope 3 (CO_2, N_20, and CH_4). The LGOP encourages reporting these emissions, as the scale of emissions from employees commuting is often relatively large when compared to the rest of government operations, and local governments do have the ability to influence their employees' commute decisions through alternative commute policies.

Given the scale of emissions from employee commutes, local governments can see significant emissions reductions by encouraging and creating incentives for alternatives to driving alone to work. Local governments all over the country have developed effective programs for reducing emissions from the commute patterns of their employees, and therefore, employee commute emissions were included in this report as an area where Ross can make significant progress towards greenhouse gas emissions reductions.

In 2005, employees commuting in vehicles to and from their jobs at Ross emitted approximately 88 metric tons CO_2e, or 34 percent of total government emissions.

Section Four:
2005 Community Inventory

4.1 Community Inventory Summary

In 2005, activities and operations taking place within Ross' geopolitical boundary resulted in approximately 17,209 metric tons of CO_2e. This number includes all Scope 1 emissions from the on-site combustion of fuels in the residential and commercial / industrial sectors, and from the combustion of gasoline and diesel in vehicles traveling on local roads and on sir Francis Drake Boulevard within the Ross town limits. This number also includes all Scope 2 emissions associated with community electricity consumption, and Scope 3 emissions from waste generated by the Ross community.[16]

4.1.1 Summary by Scope

As shown in Table 4.1, Scope 1 sources produced the largest amount of community greenhouse gas emissions in 2005, totaling 13,360 metric tons of CO_2e. Scope 2 emissions constituted the second largest amount (3,249 metric tons of CO_2e), and Scope 3 emissions totaled 600 metric tons of CO_2e.[17]

Table 4.1: 2005 Ross Community Emissions by Scope

Activity	CO_2e emitted	Scope Total
Scope 1		**13,360**
Natural Gas (Stationary Sources)	6,092	
Transportation Gasoline	6,400	
Transportation Diesel	868	
Scope 2		**3,249**
Purchased Electricity (All Stationary Sources)	3,249	
Scope 3		**600**
Waste Generation	600	

Scope 1 Emissions

In 2005, Ross' community produced 13,360 metric tons CO_2e of Scope 1 greenhouse gas emissions. As seen in Figure 4.1, transportation within the Ross jurisdictional boundaries resulted in 54.4 percent of Scope 1 emissions. The stationary combustion of natural gas (e.g., home heating, cooking, and water heating) resulted in 45.6 percent of Scope 1 emissions.

[16] For a detailed description of scopes, please see Section 2: Methodology

[17] These emissions have not been totaled as this may result in double counting and a percentage is not significantly relevant to forming emissions reduction policy. The summaries by sector and source have percentage breakdowns, as do individual sources of emissions.

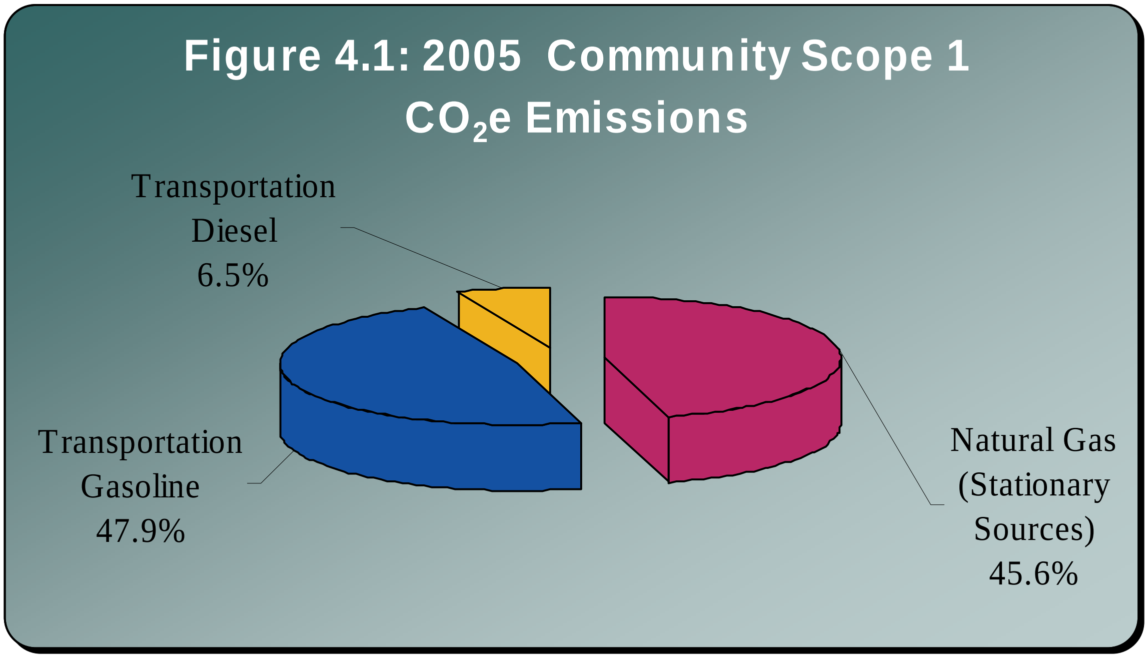


Figure 4.1: 2005 Community Scope 1 CO_2e Emissions

Scope 2 Emissions

In 2005, Ross' community generated 3,249 metric tons of CO_2e in the form of Scope 2 emissions from purchased electricity. All Scope 2 emissions in this inventory result from electricity consumed within Ross but produced out side of Ross.

Scope 3 Emissions

In 2005, Ross' community generated 600 metric tons of CO_2e in the form of Scope 3 emissions. All Scope 3 sources included in this report are an estimate of methane emissions that will result from the anaerobic decomposition of solid waste, generated by the Ross community during 2005.

4.1.2 Summary by Sector

By better understanding the relative scale of emissions from each primary sector, Ross can more effectively focus emissions reductions strategies to achieve the greatest emission reductions. For this reason, an analysis of emissions by sector is included in this report, based on the total of 17,209 metric tons of CO_2e. The four sectors included in this inventory are the following:

Residential

Commercial / Industrial

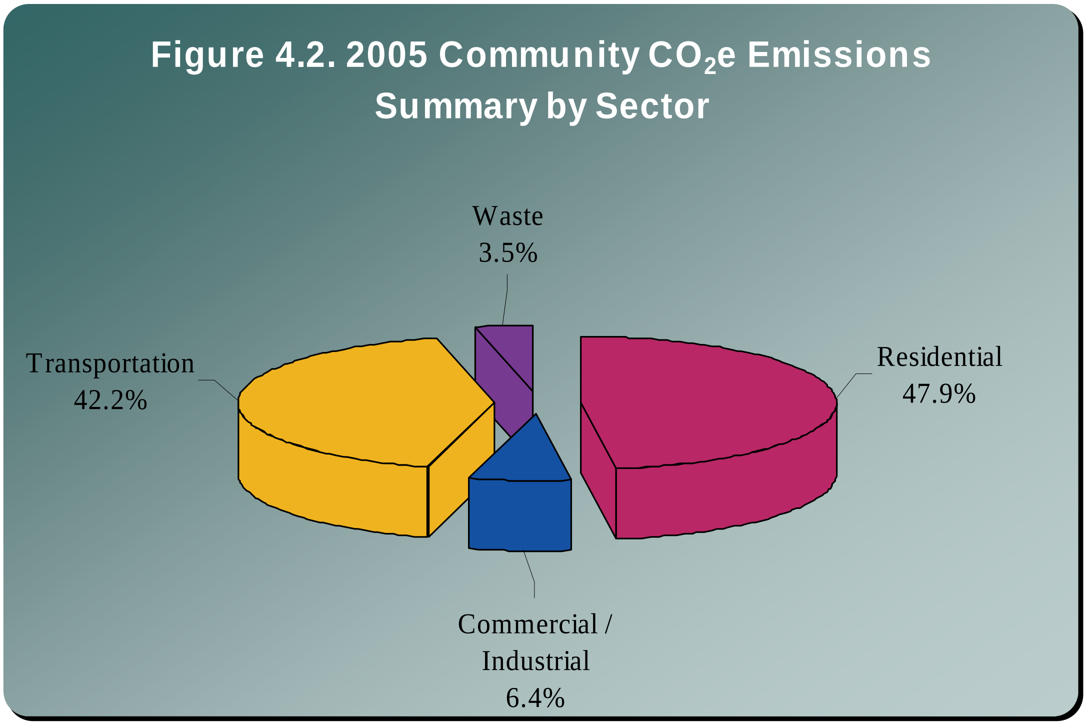
Transportation

Waste Generation

As shown in Figure 4.2, the Residential Sector was the largest emitter (47.9 percent) in 2005. Emissions from the Transportation Sector produced the second highest quantity, resulting in 42.2 percent of total emissions, or 7.268 metric tons of CO_2e. The remainder of emissions came from the Commercial/Industrial Sector (6.4 percent) and the Waste Sector (3.5 percent). Please see detailed sector emissions analyses below for more detail.

Table 4.2: 2005 Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (million Btu)
Residential	8,239	47.9%	143,069
Commercial / Industrial	1,102	6.4%	17,804
Transportation	7,268	42.2%	99,389
Waste	600	3.5%	0
TOTAL	**17,209**	**100.0%**	**260,262**



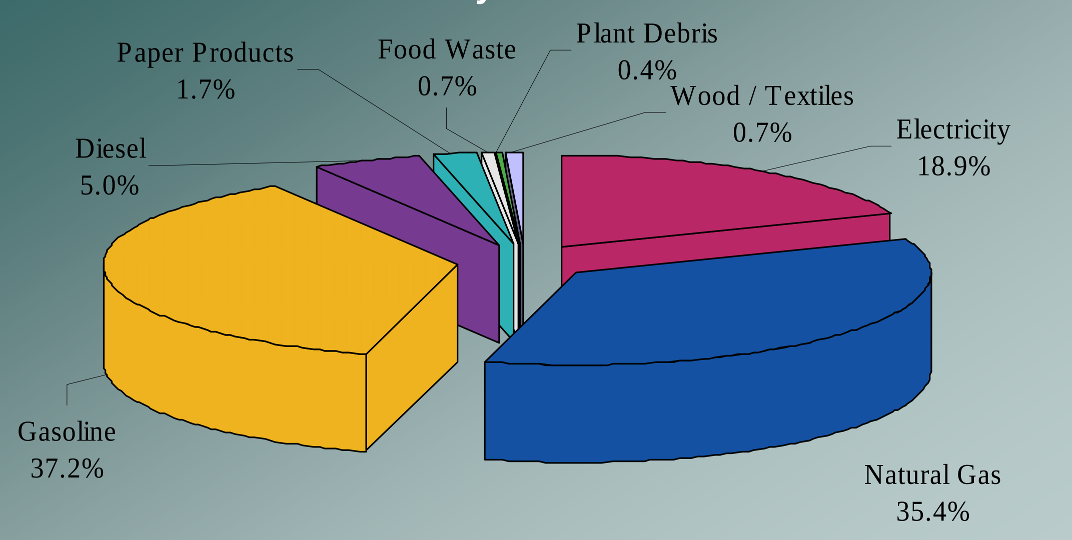
4.1.3 Summary by Source

When considering how to reduce emissions, it is also 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. Such analysis can help target resource management in a way that will successfully reduce greenhouse gas emissions. Below (Figure 4.3 and Table 4.3) is a summary of Ross' 2005 greenhouse gas emissions by fuel type or material, based upon the total community emissions of metric tons.

Table 4.3: 2005 Community Emissions by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Electricity	3,249	18.9%
Natural Gas	6,092	35.4%
Gasoline	6,400	37.2%
Diesel	868	5.0%
Paper Products	295	1.7%
Food Waste	116	0.7%
Plant Debris	65	0.4%
Wood / Textiles	124	0.7%
TOTAL	**17,209**	**100.0%**

Figure 4.3 2005 Community Emissions by Source



4.1.4 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 of this margin of error when comparing figures.

As detailed in Table 4.4, dividing the total community-wide GHG emissions by population yields a result of 7.3 metric tons of CO_2e per capita. 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 4.4: 2005 Per Capita Emissions

Estimated 2005 Population*	2,350
Community GHG Emissions (metric tons CO_2e)	17,209
Per Capita GHG Emissions (metric tons (CO_2e)	7.3

4.2 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 / Industrial

Transportation

Waste Generation

4.2.1 Residential Sector

Energy consumption associated with Ross homes produced 8,239 metric tons of greenhouse gas emissions in 2005 (47.9 percent of total community emissions.) All Residential Sector emissions are the result of electricity consumption and the on-site combustion of natural gas. It is important to note that emissions from lawn equipment, wood-fired stoves, transportation and waste generation are **not** included in these totals. As shown in Table 4.5 below, Ross residents generated approximately 10.7 metric tons of greenhouse gas emissions per household.[18] Per household emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one's emissions with neighboring cities and against regional and national averages.

Table 4.5: 2005 Residential Emissions per Household

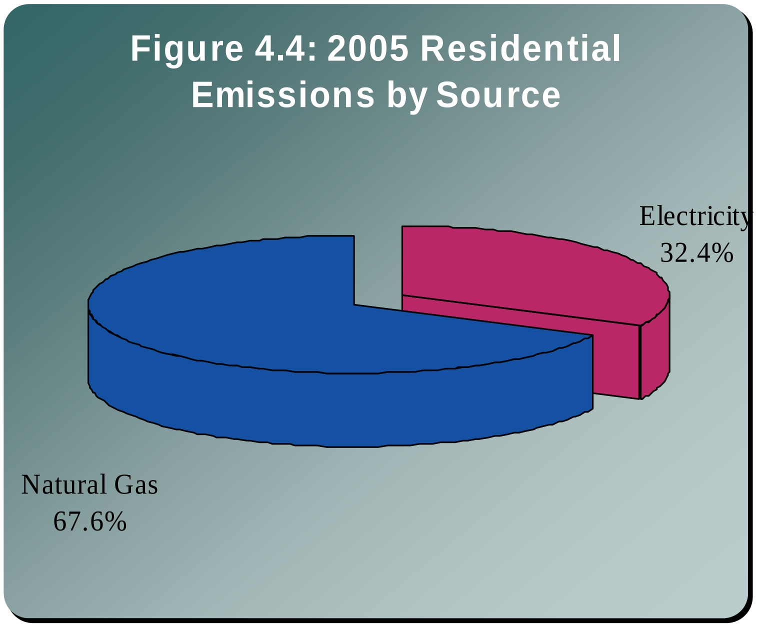
Number of Occupied Households	770
Total Residential GHG Emissions (metric tons CO2e)	8,239
Residential GHG Emissions per Household (metric tons CO2e)	10.7

In 2005, Ross' entire Residential Sector consumed 11,403,003 kWh of electricity and 1,041,509 therms of natural gas. As shown in Figure 4.4, 67.6 percent of total Residential emissions were the result of natural gas use, and 32.4 percent were the result of electricity consumption. 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. There are a number of ways that Ross can help reduce emissions from the Residential Sector, such as implementing measures to improve energy efficiency, increase the use of renewable energy, and bolster energy conservation in Ross homes.

[18] Number of Ross households in 2005 is based on estimates conducted by the Association of Bay Area Governments (ABAG).

Table 4.6: Residential Emission Sources 2005

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Consumption	Unit	Energy Equivalent (million Btu)
Electricity	2,668	32.4%	11,403,003	kWh	38,918
Natural Gas	5,570	67.6%	1,041,509	therms	104,151
TOTAL	**8,239**	**100.0%**			**143,069**



4.2.2 Commercial / Industrial Sector

The Commercial / Industrial sector includes emissions from the operations of businesses as well as public agencies. For example, the majority of buildings and facilities included in the government operations inventory are also included as a subset of the Commercial / Industrial sector, as per classification made by PG&E.[19] In 2005, buildings and facilities within the Commercial / Industrial sector produced

[19] There are a few cases where government facilities will be classified as residential.

1,102 metric tons of greenhouse gas emissions (6.4 percent of total community emissions). All Commercial / Industrial Sector emissions included in this inventory are the result of electricity consumption and the on-site

Table 4.7: Commercial / Industrial Emission Sources 2005

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Consumption	Unit	Energy Equivalent (million Btu)
Electricity	581	52.7%	2,361,007	kWh	8,058
Natural Gas	521	47.3%	97,455	therms	9,746
TOTAL	**1,102**	**100.0%**			**17,804**

combustion of natural gas. It is important to note that emissions from off-road equipment, transportation, waste generation, stationary combustion other than natural gas, and other industrial processes are **not** included in these totals.

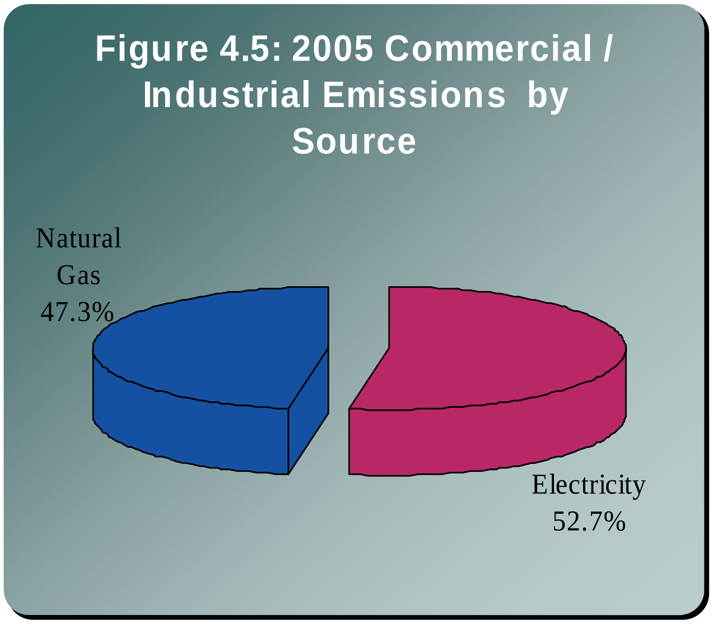
Table 4.8 lists Commercial / Industrial emissions based on the estimated number of jobs in Ross in 2005.[20]

Table 4.8: 2005 Commercial / Industrial Emissions per Job

Number of Jobs	870
Total Commercial / Industrial GHG Emissions (metric tons CO_2e)	1,102
Commercial / Industrial GHG Emissions per Job (metric tons CO_2e)	1.3

As shown in Figure 4.5, 52.7 percent of total Commercial / Industrial emissions were the result of electricity consumption, and 47.3 percent were the result of natural gas use electricity consumption. Natural gas is typically used in the Commercial / Industrial sector to heat buildings, fire boilers, and generate electricity; and electricity is generally used for lighting, heating, and to power appliances and equipment. There are a number of ways that Ross can help reduce emissions from the Commercial / Industrial Sector, such as providing incentives for businesses to improve energy efficiency and the use of renewable energy, and by instating policies that demand certain levels of energy performance within the commercial / industrial sector.

[20] Number of Ross jobs in 2005 based on estimates conducted by ABAG.



4.2.3 Transportation Sector

Between 2002 and 2004, emissions from the Transportation Sector produced an average of nearly 40% percent of California statewide emissions.[21] Here in Marin County, the Transportation Sector accounted for an estimated 62% of countywide emissions. As with many other local governments, travel by motorized vehicle within Ross' geographical boundary constitutes a large percentage (42.2 percent) of community wide greenhouse gas emissions – 7,268 metric tons CO_2e.

As shown in Table 4.9, 88.1 percent of Transportation Sector emissions were due to gasoline consumption with the remaining 11.9 percent coming from diesel use. Transportation Sector emissions can be reduced dramatically by making it easier for residents to use alternative modes of transportation, including walking, bicycling, and riding public transportation. The State of California is also aiming to address transportation emissions by increasing the

[21] AB 32 Scoping Plan

fuel efficiency standards of vehicles, and by increasing the amount of renewable fuels (e.g. biodiesel and ethanol) within mainstream fuel sources.

Emissions that resulted from the air travel of Ross residents were not included in the Transportation Sector analysis. With more time and the availability of suitable proxy data the greenhouse gas emissions from air travel could be estimated. Please see Appendix B for more detail on methods and emissions factors used in calculating emissions from the Transportation Sector.

Table 4.9: Transportation Fuel Emissions Sources 2005

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (million Btu)
Gasoline	6,400	88.1%	88,870
Diesel	868	11.9%	10,519
TOTAL	**7,268**	**100.0%**	**99,389**

4.2.4 Community Generated Solid Waste

As noted above in Figure 4.2, the Waste Sector constituted 3.5 percent of total emissions for the Ross community in 2005. Emissions from the Waste Sector are an estimate of methane generation from the decomposition of municipal solid waste (MSW) and alternative daily cover (ADC) sent to landfill in the base year (2005). These emissions are considered Scope 3 because they are not generated in the base year, but will result from the decomposition of 2005 waste over the full 100+ year cycle of its decomposition. As stated in the Government Inventory section, about 75 percent[22] 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. Please see Table 4.10 below for a summary of emissions per waste type.[23]

[22] US EPA AP 42.
[23] Waste characterization figures were provided by the 2004 *California Waste Characterization Study*, http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097

Table 4.10: Waste Emissions Sources 2005

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Paper Products	295	49.2%
Food Waste	116	19.4%
Plant Debris	65	10.8%
Wood / Textiles	124	20.6%
TOTAL	**600**	**100.0%**

4.3 Community Emissions Forecast

To illustrate the potential emissions growth based on projected trends in energy use, driving habits, job growth, and population growth from the baseline year going forward, this report includes an emissions forecast for the year 2020. Under a business-as-usual scenario, Ross' emissions will grow by approximately 13.7 percent by the year 2020, from 17,209 to 19,566 metric tons CO_2e. Figure 4.6 and Table 4.11 show the results of the forecast. A variety of different reports and projections were used to create the emissions forecast, as profiled below.

Figure 4.6: Community Emissions Forecast for 2020

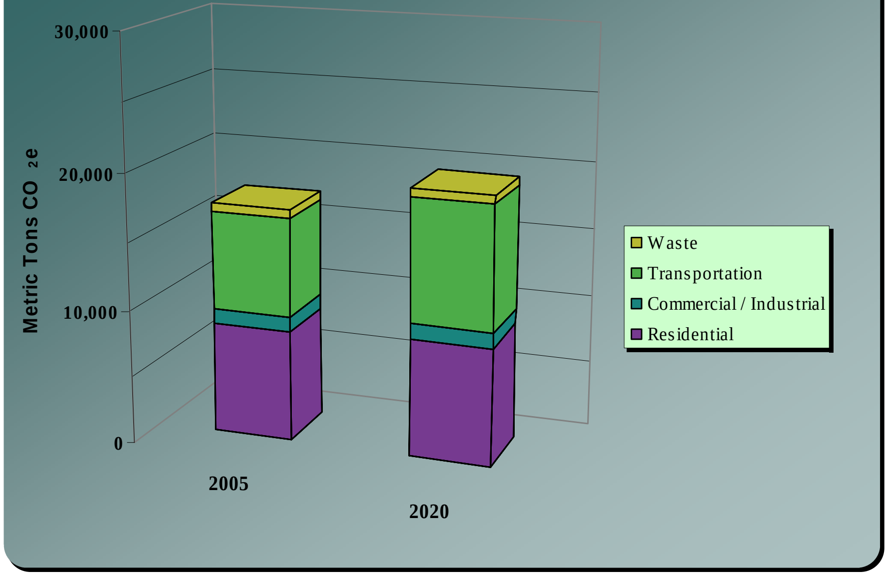


Table 4.11: 2005 Community Emissions Growth Forecast by Sector

Sector	2005 (metric tons CO_{2e})	2020 (metric tons CO_2e)	Annual Growth Rate	Percent Change from 2005 to 2020
Residential	8,239	8,694	0.36%	5.5%
Commercial / Industrial	1,102	1,140	0.23%	3.4%
Transportation	7,268	9,098	1.51%	25.2%
Waste	600	633	0.36%	5.5%
TOTAL	**17,209**	**19,566**	**--**	**13.7%**

4.3.1 Residential

For the Residential Sector, a population projection for Ross, which was conducted by the Association of Bay Area Governments (ABAG), was used to estimate average annual compound growth in energy demand (.36 percent). ABAG estimates that the Ross population was 2,350 in 2005, and will be 2,480 in 2020.

4.3.2 Commercial / Industrial

Analysis contained within *California Energy Demand 2008-2018: Staff Revised Forecast*[24], a report by the California Energy Commission (CEC), shows that commercial floor space and the number of jobs have closely tracked the growth in energy use in the Commercial Sector. Using job growth projections for Ross also provided by ABAG, it was calculated that the average annual growth in energy use in the Commercial / Industrial Sector between 2005 and 2020 will be .23 percent.[25]

4.3.3 Transportation

For the Transportation Sector, projected growth in energy demand was obtained from the CEC 2008 energy demand forecast referenced above. The recently passed federal Corporate Average Fuel Economy standards and the state of California's pending tailpipe emission standards could significantly reduce the demand for transportation fuel in Ross. An analysis of potential fuel savings from these measures at a scale that would be useful for the purpose of this report has not been conducted, nor would such an analysis produce a true business-as-usual estimation. Regardless of future changes in the composition of vehicles on the road as a result of state or federal rulemaking, emissions from the Transportation Sector will continue to be largely determined by growth in vehicle-miles-traveled

[24] http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF
[25] See Appendix B for more detail.

(VMT). In their report, *Forecast of the Transportation Energy Demand, 2003-2023*[26], the CEC projects that on-road VMT will increase at an annual rate of 1.65 percent per year through 2023. This is the number that was used to estimate emission growth in the Transportation Sector for the Ross forecast.

4.3.4 Waste Generation

As with the Residential Sector, population is the primary determinate for growth in emissions pertaining to waste generation. Therefore, the average annual population growth rate from 2005 to 2020 (.36 percent, as calculated from above population projections) was used to estimate future emissions from waste disposal.

[26] http://www.energy.ca.gov/reports/2003-10-01_100-03-016.PDF

Conclusion

Climate change, caused by an increase in the concentration of atmospheric greenhouse gases, is 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. Local governments are in a unique position to lead an intelligent and timely response to these challenges in a way that will keep them, and their communities, ahead of market and regulatory trends.

This greenhouse gas emissions inventory completes an important first step in Ross' climate protection and energy management efforts. By identifying the largest sources of emissions, and by estimating overall baseline emission levels against which future progress can be demonstrated, this report establishes a foundation for informed institutional action.

The completion of this report is only the beginning of a larger process. ICLEI recommends that Ross capitalize on the resources invested in this report, by setting an emission reduction target and by creating a comprehensive plan for emissions reduction and energy management. Additionally, to streamline Ross' ability to monitor its progress toward achieving its climate protection goals over time, ICLEI recommends that Ross institutionalize the inventory process. By creating data compilation and analysis systems in line with the International Local Government GHG Emissions Analysis Protocol (IEAP) and the Local Government Operations Protocol (LGOP), Ross will be able to inventory greenhouse gas emissions every two to three years in an efficient and protocol-compliant manner. ICLEI is proud to be of continued service to Ross in establishing such systems, and in advancing tangible improvements towards local sustainability – ensuring, for years to come, that Ross builds and retains a competitive economic position while protecting the environment and its people.

Appendices

Appendix A: IEAP Community Scopes Framework

Macro Sector (IPCC)		Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions
Energy	Stationary Combustion	Utility-delivered fuel consumption Decentralized fuel consumption Utility-consumed fuel for electricity / heat generation	n/a	Upstream/downstream emissions (e.g., mining/transport of coal)
	Electricity / Heat Consumption	n/a	Utility-delivered electricity / heat /steam consumption	Upstream/downstream emissions
			Decentralized electricity / heat /steam consumption	(e.g., mining/transport of coal)
	Mobile Combustion	Tailpipe emissions from on-road vehicles Tailpipe emissions from rail, sea, airborne and non-road vehicles, operating within the community	Electricity consumption associated with vehicle movement within the community (e.g., light rail)	Tailpipe emissions from vehicles used by community residents Upstream/downstream emissions (e.g. mining/transport of oil) Tailpipe emissions from rail, sea, and airborne vehicles departing from or arriving into the community
	Other Energy	Fugitive emissions not already accounted for	n/a	Upstream/downstream emissions
Industrial Processes and Product Use		Decentralized process emissions	n/a	Upstream/downstream emissions
Agriculture, Forestry and Other Land Use		Livestock methane, managed soils	n/a	Upstream/downstream emissions from fertilizer/pesticide manufacture
		Net biogenic carbon flux	n/a	n/a
Waste	Solid Waste Disposal	Direct emissions from landfill, incineration and compost facilities located inside the community	n/a	Landfill, incineration and compost emissions occurring in present-year from waste produced to date inside the community Future emissions associated with waste disposed Upstream/downstream emissions (e.g. transport to the landfill)
	Wastewater Treatment and Discharge	Direct emissions from wastewater facilities located inside the community	n/a	Wastewater emissions occurring in present year from wastewater produced to date inside the community Future emissions associated with wastewater treated Upstream/downstream emissions

Appendix B: Community Inventory Methodology Summary

Residential, Commercial, Industrial Sector Notes

Data Inputs / Outputs Summary:

Sector	Fuel	Quantity	Units	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Residential	Electricity	11,403,003	kWh	38,918	2,549.22	0.37	0.28	2,668.30
	Natural Gas	1,041,509	therms	104,151	5,525.21	0.10	0.61	5,570.40
	TOTAL			**143,069**	**8,074.43**	**0.47**	**0.90**	**8,238.69**
Commercial / Industrial	Electricity	2,037,634	kWh	6,954	455.53	0.07	0.05	476.81
	Natural Gas	97,455	therms	9,746	517.00	0.01	0.06	521.23
	Direct Access Electricity	323,373	kWh	1,104	100.71	0.01	0.01	104.09
	TOTAL			**17,804**	**1,073.24**	**0.09**	**0.12**	**1,102.12**

Emission Factors:

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity*	CO_2	0.489155 lbs/kwh	The certified CO_2 emission factor for delivered electricity is publicly available at http://www.climateregistry.org/CarrotDocs/19/2005/2005_PUP_Report_V2_Rev1_PGE_rev2_Dec_1.xls
	CO_2e	0.492859 lbs/kwh	PG&E
Default Direct Access Electricity*	CO_2	343.3 short tons/GWh	ICLEI/Tellus Institute (2005 Region 13 - Western Systems Coordinating Council/CNV Average Grid Electricity Coefficients)
	CH_4	0.035 short tons/GWh	
	N_20	0.027 short tons/GWh	
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: Jasmin Ansar, JxA2@pge.com, Xantha Bruso, XxB1@pge.com.

Direct Access Electricity Estimates: California Energy Commission (CEC): Andrea Gough, agough@energy.state.ca.us

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

Estimations of electricity purchased through Direct Access (DA) contracts are derived from county level DA consumption figures, provided by the California Energy Commission. The ratio of DA to utility supplied electricity is applied to governments that The amount of DA in a given community varies. 13.7 percent of "non-residential" electricity consumption in Marin County was DA in 2005 according to the CEC.

Transportation Sector Notes

Data Inputs / Outputs Summary:

Sector	Sub Sector	Quantity	Units	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Transportation	Local Roads	13,410,100	vehicle-miles traveled	99,389	6,963.11	0.93	0.85	7,268.23
	TOTAL	**13,410,100**	**vehicle-miles traveled**	**99,389**	**6,963.11**	**0.93**	**0.85**	**7,268.23**

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

Data Sources:

Local Roads Vehicle Miles Traveled (VMT) 2005 Data: Harold Brazil, Air Quality Associate, Metropolitan Transportation Commission (MTC) hbrazil@mtc.ca.gov, (510) 817-5747. Data analyzed by Micah Lang, Program Officer, ICLEI.

State Highways Vehicle Miles Traveled (VMT) 2005 Data: CalTrans, analyzed by Micah Lang, ICLEI Program Officer and Theresa Crebbs, ICLEI. Data source file: 2005 Public Roads Data, HPMS division of CalTrans http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2005PRD.pdf

EMFAC Data: Amir Fanai, Principal Air Quality Engineer, Bay Area Air Quality Management District, AFanai@baaqmd.gov

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

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.

Waste Sector Notes

Data Inputs / Outputs Summary:

Sector	Sub Sector	Quantity	Units	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Waste	Landfilled Municipal Solid Waste	2,895	tons	0.00	0.00	0.00	24.79	520.59
	Alternative Daily Cover	546	tons	0.00	0.00	0.00	3.76	78.94
	TOTAL	**3,441**	**tons**	**0.00**	**0.00**	**0.00**	**28.55**	**599.53**

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: Alex Soulard, Waste Management Specialist, ASoulard@co.marin.ca.us, The County of Marin Public Works Department - Waste Management

Waste characterization: CIWMB 2004 Statewide Waste Characterization Study. This state average waste characterization accounts for residential, commercial and self-haul waste. http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097

ICLEI CACP software categories correlate with the CIWMB's waste categories according to the following guidelines:

CACP	CIWMB	% of Total
Paper Products	All paper types	21.0
Food Waste	Food	14.6
Plant Debris	Leaves and Grass, Prunings and Trimmings, Branches and Stumps, Agricultural Crop Residues, and Manures	6.9
Wood/Textiles	Textiles, Remainder/Composite Organics, Lumber, and Bulky Items	19.8
All Other Waste	The other category includes all inorganic material types reported: Glass, Metal, Electronics, Plastics, Non-organic C&D, and Special/Hazardous Waste.	37.7

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

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

Appendix C: Government Inventory Methodology Summary

Facilities, Public Lighting, and Water Delivery Sector Notes

Data Inputs / Outputs Summary

Sector	Facility or Record	Fuel	Quantity	Units	Cost	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Facilities	Civic Center	Natural Gas	2,738	therms	3,810	274	14.53	0.00	0.00	14.64
		Electricity	95,619	kWh	11,940	326	21.38	0.00	0.00	22.37
	Generator	Gasoline	5	gallon	13	1	0.04	0.00	0.00	0.04
	TOTAL				$15,763	**601**	**35.94**	**0.00**	**0.00**	**37.06**

Sector	Facility or Record	Fuel	Quantity	Units	Cost	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Public Lighting	Traffic Signals	Electricity	2,143	kWh	376	7	0.48	0.00	0.00	0.50
	Streetlights	Electricity	105,694	kWh	32,089	361	23.63	0.00	0.00	24.73
	TOTAL	**Electricity**	**107,837**	**kWh**	**$32,465**	**368**	**24.11**	**0.00**	**0.00**	**25.23**

Sector	Facility or Record	Fuel	Quantity	Units	Cost	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Water	Irrigation	Electricity	745	kWh	295	3	0.17	0.00	0.00	0.17
	TOTAL	**Electricity**	**745**	**kWh**	**$295**	**3**	**0.17**	**0.00**	**0.00**	**0.17**

Emission Factors:

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity*	CO_2	0.489155 lbs/kwh	The certified CO_2 emission factor for delivered electricity is publicly available at http://www.climateregistry.org/CarrotDocs/19/2005/2005_PUP_Report_V2_Rev1_PGE_rev2_Dec_1.xls
	CO_2e	0.492859 lbs/kwh	PG&E
Natural Gas	CO_2	53.05 kg/MMBtu	CCAR: Emission factors are derived from the 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: Lynne Galal, L1G7@pge.com

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org.

Vehicle Fleet Sector Notes

Data Inputs / Outputs Summary:

Sector	Department or Vehicle Group	VMT	Fuel / Input	Quantity	Units	Cost	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Vehicle Fleet	Public Works	31,898	Gasoline	2,543	gallons	6,408.36	316	22.17	0.43	0.02	22.97
		0	Diesel	35	gallons	91.00	4	0.36			
	SUB TOTAL	31,898		2,578	gallons	6,499.36	320	22.53	0.43	0.02	22.97
	Fire	1,588	Gasoline	122	gallons	307.44	15	1.07	0.04	0.00	13.89
		5,035	Diesel	1,259	gallons	3,273.40	154	12.78			
	SUB TOTAL	6,623		1,381	gallons	3,580.84	169	13.85	0.04	0.00	13.89
	Police	112,154	Gasoline	7,041	gallons	17,743.32	884	62.03	0.84	0.04	62.91
		0	Diesel	0	gallons	0.00	0	0.00			
	SUB TOTAL	112,154		7,041	gallons	17,743.32	884	62.03	0.84	0.04	62.91
	TOTAL	**150,675**		**11,000**	**gallons**	**$27,823.52**	**1,374**	**98.41**	**1.30**	**0.07**	**99.77**

Emission Factors:

Emission Source	GHG	Emission Factor	Emission Factor Source
Gasoline	CO_2	**8.81 kg / gallon**	Local Government Operations Protocol (LGOP) Table G.9 / US EPA *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005* (2007), Annex 2.1, Tables A-31, A-34, A-36, A-39, except those marked + (from EPA Climate Leaders, Mobile Combustion Guidance, 2008).
	CH_4	x g / mi. *	Local Government Operations Protocol (LGOP) Table G.10 / US EPA Climate Leaders, Mobile Combustion Guidance, (2007) based on U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and* Sinks: 1990-2005 (2007).
	N_20	x g / mi.*	Local Government Operations Protocol (LGOP) Table G.10 / US EPA Climate Leaders, Mobile Combustion Guidance, (2007) based on U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and* Sinks: 1990-2005 (2007).
Diesel	CO_2	**10.15 kg CO_2 / gallon**	Local Government Operations Protocol (LGOP) Table G.9 / US EPA *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005* (2007), Annex 2.1, Tables A-31, A-34, A-36, A-39, except those marked + (from EPA Climate Leaders, Mobile Combustion Guidance, 2008).

	CH_4	x g / mi.*	Local Government Operations Protocol (LGOP) Table G.10 / US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005* (2007), Annex 3.2, Table A-98.
	N_20	x g / mi.*	Local Government Operations Protocol (LGOP) Table G.10 / US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005* (2007), Annex 3.2, Table A-98.

* CH_4 and N_2O (incomplete combustion) emission factors from mobile combustion are assigned per vehicle type, model year, and fuel type, and therefore vary per vehicle. See LGOP Table G.10.

Emission factors were derived from the Local Government Operations Protocol (LGOP) for CO_2, CH_4, and N_2O.

Data Sources:

Fuel Consumption: Robert Maccario, Public Works Superintendent; Tom Vallee, Fire Chief; Jim Reis, Police Chief; Christine O'Rourke, Project Planner.

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

Waste Sector Notes

Data Inputs / Outputs Summary:

Sector	Facility / Waste Group	Quantity	Units	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Waste	Town Cans	14.2	tons	0.00	0.00	0.00	0.17	3.60
	Corp Yard	22.6	tons	0.00	0.00	0.00	0.27	5.73
	TOTAL	**36.8**	**tons**	**0.00**	**0.00**	**0.00**	**0.44**	**9.33**

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:

Waste Generation: Ray Holmes, Controller, Marin Sanitary Services, (415) 458-5521, Ray.Holmes@marinsanitary.com.

Waste Characterization: California Integrated Waste Management Board (CIWMB), derived specifically for the "Public Administration" sector, using the Business Waste Characterization portion of the CIWMB 1999 Statewide Waste Characterization Study: http://www.ciwmb.ca.gov/WasteChar/BizGrpCp.asp

ICLEI CACP software categories correlate with the CIWMB's waste characterization categories according to the following guidelines:

CACP	CIWMB	Percent of Total
Paper Products	All paper types	39.4
Food Waste	Food	9.8
Plant Debris	Leaves and Grass, Prunings and Trimmings, Branches and Stumps, Remainder/Composite Organic	17.0
Wood/Textiles	Textiles (Under "Other Organic"), Lumber (Under "Construction and Demolition"), Remainder/Composite Construction and Demolition	6.7
All Other Waste	The other category includes all inorganic material types reported: Glass, Metal, Electronics, Plastics, Non-organic C&D, and Special/Hazardous Waste.	27.1

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

75% methane recovery factor is derived from the Local Government Operations Protocol, Chapter 9.

Tons of waste disposed were primarily estimated (with the generous support of Marin Sanitary Service) using trash pick-up schedules, combined with the volumetric size of each container (dumpster, etc) at each site, and estimates the average fill and diversion rate. 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.) Trash pick-up schedules from proxy year (2008) were used as proxy for unavailable 2005 base year data.. It is assumed that there have not been any drastic alterations in the level of garbage service provided to Ross facilities between 2005 and proxy year (2008).

CO_2e emissions from waste and ADC disposal were calculated using the *methane commitment method* in the CACP software, which uses a version of the EPA WARM model. This model has the following general formula:

CO2e = Wt * (1-R)A

Where:

Wt is the quantify of waste type 't',

R is the methane recovery factor,

A is the CO2e emissions of methane per metric ton of waste at the disposal site (the methane factor)

While the WARM model often calculates upstream emissions, as well as carbon sequestration in the landfill, these dimensions of the model were omitted for this particular study for two reasons: 1) this inventory functions on an end-use analysis, rather than a life-cycle analysis, which would calculate upstream emissions), and 2) this inventory solely identifies emissions sources, and no potential sequestration 'sinks'.

It is important to note that 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

Employee Commute Sector Notes

Data Inputs / Outputs Summary:

Sector	Vehicle Type	Fuel Type	Quantity	Units	Energy Output (MMBtu)	CO2 Output (metric tons)	N2O Output (metric tons)	CH4 Output (metric tons)	Combined Output (metric tons CO2e)
Employee Commute	Auto – Subcompact / Compact	Gasoline	38,220	vehicle miles traveled					
	Auto – Mid-Size	Gasoline	50,917	vehicle miles traveled					
	Auto – Full-Size	Gasoline	22,446	vehicle miles traveled					
	Passenger Vehicle	Gasoline	0	vehicle miles traveled					
	Light Truck/SUV/Pickup	Gasoline	52,520	vehicle miles traveled					
	Vanpool Van	Gasoline	0	vehicle miles traveled					
	Heavy Truck	Gasoline	0	vehicle miles traveled					
	Motorcycles	Gasoline	0	vehicle miles traveled					
	SUB TOTAL	Gasoline	164,103	vehicle miles traveled	1,140	85.25	0.01	0.01	88.42
	Auto – Subcompact / Compact	Diesel	0	vehicle miles traveled					
	Auto – Mid-Size	Diesel	0	vehicle miles traveled					
	Auto – Full-Size	Diesel	0	vehicle miles traveled					
	Passenger Vehicle	Diesel	0	vehicle miles traveled					
	Light Truck/SUV/Pickup	Diesel	0	vehicle miles traveled					
	Vanpool Van	Diesel	0	vehicle miles traveled					
	Heavy Truck	Diesel	0	vehicle miles traveled					
	Motorcycles	Diesel	0	vehicle miles traveled					
	SUB TOTAL	Diesel	0	vehicle miles traveled	0	0.00	0.00	0.00	0.00
	TOTAL		**164,103**	**vehicle miles traveled**	**1,140**	**85.25**	**0.01**	**0.01**	**88.42**

Emission Factors:

Emission factors derived from the CACP Software

Data Sources:

Ross staff, via the employee commute survey

Additional Notes:

Data entered by Christine O'Rourke, Project Planner, christine.o@comcast.net, with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org

To calculate emissions, Ross utilized an employee commute survey created by ICLEI. The survey collected the following information:

The number of days and number of miles employees drive to work (one-way) in an average week,

Vehicle type, as well as the type of fuel consumed,

Some other general transit mode information.

Where surveys were not completed, commute miles were estimated based upon the employee's place of residence. Weekly data were then converted into annual VMT data by multiplying each employee entry by 52 weeks and subtracting vacation days (employee specific), twelve holidays (where appropriate), and ten sick days. VMT data were then entered into the CACP software, which converts VMT to fuel use based on default fuel efficiency by vehicle type.

Appendix D: Example Employee Commute Survey

This information is being gathered as part of the Town's participation in the ICLEI Cities for Climate Protection program, and as part of a collaborative effort among Marin local governments to reduce greenhouse gas emissions called the Marin Climate and Energy Partnership. The goal is to reduce energy consumption, save money and reduce greenhouse gas and local air pollution. All information will be kept anonymous and confidential. Thank you in advance for your participation!

For the year *2005* please make your best estimate for the following questions:

1) How did you travel to work? (ex. Drive, bus, bicycle, walk, carpool . . .) (Check or highlight one.)
    - Drive alone ___
    - Carpool ___
    - Bike ___
    - Take Public Transit ___
    - Bike ___
    - Walk ___

2) If you carpooled, how many other Ross employees traveled with you on average? ___

3) If you drive, what type of vehicle did you drive most often? (Check or highlight one.)
    - Auto – full size ___
    - Auto – mid size ___
    - Auto – compact ___
    - Heavy truck ___
    - Light truck/ SUV ___
    - Motorcycles ___
    - Van ___

4) What type of fuel does your vehicle use? (Check or highlight one.)
    - Gasoline ___
    - Diesel ___
    - Ultra-low sulfur diesel ___
    - Bio-diesel ___
    - Hybrid ___
    - ethanol ___
    - electric ___
    - LPG ___
    - CNG ___
    - Other ___

5) On average, how many days per week did you work during *2005*?

6) On an average day, how many miles did you travel to work round trip each day during *2005?*

7) If an incentive were available, would you be willing to use mass transportation? (Circle or highlight one.)

Yes No

8) Select a mass transportation mode that you would most likely use (Circle or highlight one):

Car Pool
Van Pool
Take the Bus
Bicycle
Walk
Commuter train, if available.
Other

Please email this form to christine.o@comcast.net, or print and return directly to Linda Lopez. If you have any questions please don't hesitate to contact me at:

Christine O'Rourke
Project Planner
415-613-2907
christine.o@comcast.net

Appendix E: The U.S. Mayors Climate Protection Agreement

The U.S. Mayors Climate Protection Agreement

(As endorsed by the 73rd Annual U.S. Conference of Mayors meeting, Chicago, 2005)

A. We urge the federal government and state governments to enact policies and programs to meet or beat the target of reducing global warming pollution levels to 7 percent below 1990 levels by 2012, including efforts to: reduce the United States' dependence on fossil fuels and accelerate the development of clean, economical energy resources and fuel-efficient technologies such as conservation, methane recovery for energy generation, waste to energy, wind and solar energy, fuel cells, efficient motor vehicles, and biofuels;

B. We urge the U.S. Congress to pass bipartisan greenhouse gas reduction legislation that 1) includes clear timetables and emissions limits and 2) a flexible, market-based system of tradable allowances among emitting industries; and

C. We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as:

1. Inventory global warming emissions in City operations and in the community, set reduction targets and create an action plan.
2. Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities;
3. Promote transportation options such as bicycle trails, commute trip reduction programs, incentives for car pooling and public transit;
4. Increase the use of clean, alternative energy by, for example, investing in "green tags", advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste to energy technology;
5. Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;
6. Purchase only Energy Star equipment and appliances for City use;
7. Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system;
8. Increase the average fuel efficiency of municipal fleet vehicles; reduce the number of vehicles; launch an employee education program including anti-idling messages; convert diesel vehicles to bio-diesel;
9. Evaluate opportunities to increase pump efficiency in water and wastewater systems; recover wastewater treatment methane for energy production;
10. Increase recycling rates in City operations and in the community;
11. Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO_2; and
12. Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution.