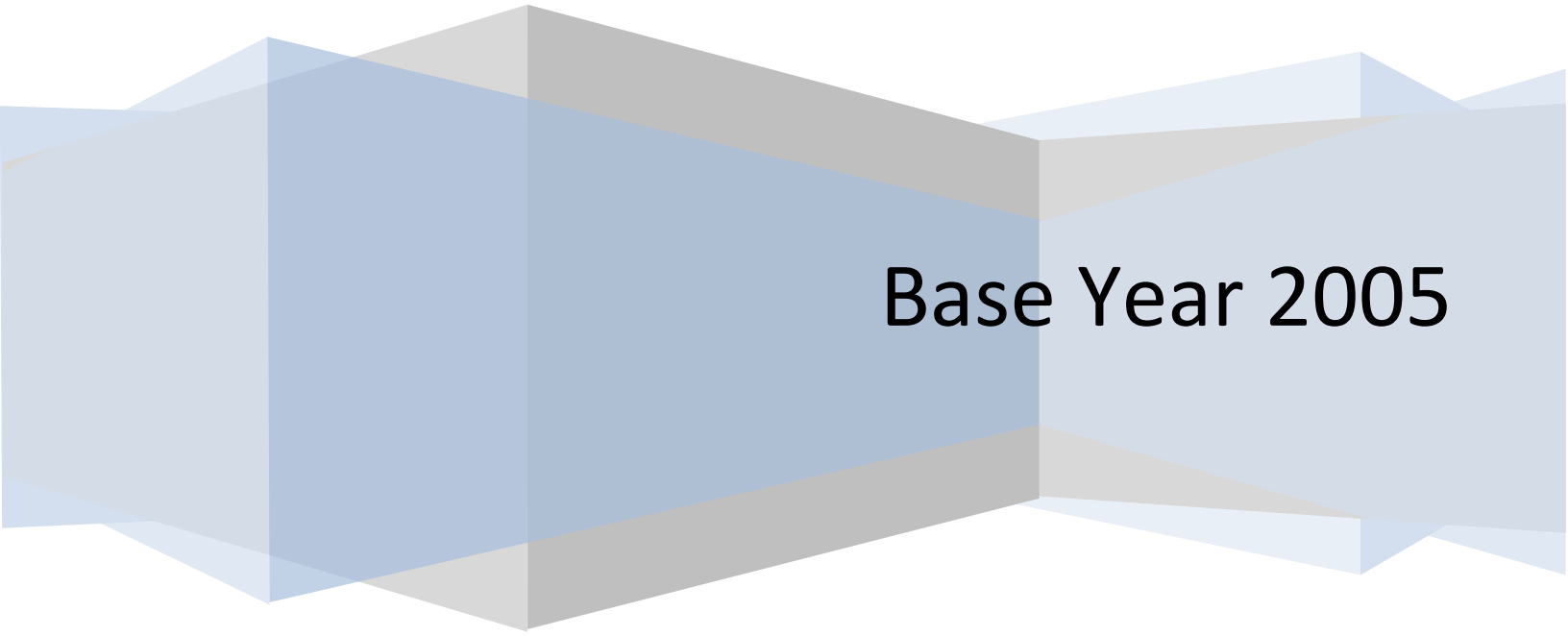
City of Novato

2005 Greenhouse Gas Emissions Inventory

Municipal & Community Scale Analysis



Base Year 2005

CREDITS AND ACKNOWLEDGEMENTS

CITY OF NOVATO

Mike Brunelle, Equipment Technician Supervisor, Public Works

Jennifer Goldfinger, Assistant to the City Manager

Kathy Robinson, Management Analyst I, Administrative Services

Dan Weakly, Deputy Director, Administrative Services

COUNTY OF MARIN

Dawn Weisz, Principal Planner

Omar Pena, Assistant Planner

Mike Frost, Deputy Director of Public Works

Alex Soulard, Waste Management Specialist

Tim Rosenfeld, Director Marin Energy Management Team

PG&E

Lynne Galal, Senior Project Manager

Corie Cheeseman, Program Manager

NOVATO DISPOSAL

Steve McCaffery, Director

METROPOLITAN TRANSPORTATION COMMISSION (MTC)

Benjamin Espinoza, Transportation Planner

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)

Ana Sandoval, Senior Policy Advisor

ICLEI-LOCAL GOVERNMENTS FOR SUSTAINABILITY USA

Alison Culpen, Program Associate

Michael Currey, Webmaster

Alden Feldon, California Manager

Don Knapp, Communications Officer

Wesley Look, Program Officer

Kim Lundgren, US Services Director

Annie Strickler, Communications Director

Jonathan Strunin, Program Officer

Melissa Stults, Senior Program Officer

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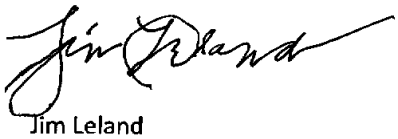
Letter from Mayor of the City of Novato

This inventory report documents the City of Novato's greenhouse gases for 2005. Having this information is a critical step to reducing our contribution to the State of California's carbon dioxide emissions. By identifying the largest sources of Greenhouse Gases, determining which actions have the greatest impacts on reductions, and showing the impact of actions to date, we can develop policies and strategies that move forward with the City's commitment to help meet the environmental challenges facing local government.

The City Council and City staff are committed to facing the climate change challenge head-on and we all look forward to the Council Sustainability Committee's recommendations on actions to reduce GHG emissions in the Novato Climate Action Plan. The Committee will first continue its interaction with a wide range of community representatives to develop GHG emission reduction targets and then develop the Novato Climate Action Plan.

The City Council recognizes that while Climate Change is a significant global problem that requires commitment and resources, it is also a local opportunity that can lead to a stronger community with a more resilient economy.



Jim Leland
Mayor, City of Novato

EXECUTIVE SUMMARY

Climate change, caused by an increase in the concentration of atmospheric greenhouse gases (GHG), 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, the City of Novato 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] the City of Novato 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

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

climate change. The City of Novato understands that climate change has the potential to significantly impact Novato's residents and businesses, as well as other communities around the world. The City of Novato 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 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. The City of Novato 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.

The City of Novato 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 City of Novato, and those taking place within the geographical boundaries of Novato.

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

1. Buildings (and other facilities)
2. Vehicle Fleet
3. Streetlights, traffic signals, and other public lighting
4. Water / Sewage
5. Government-generated solid waste
6. Employee commute

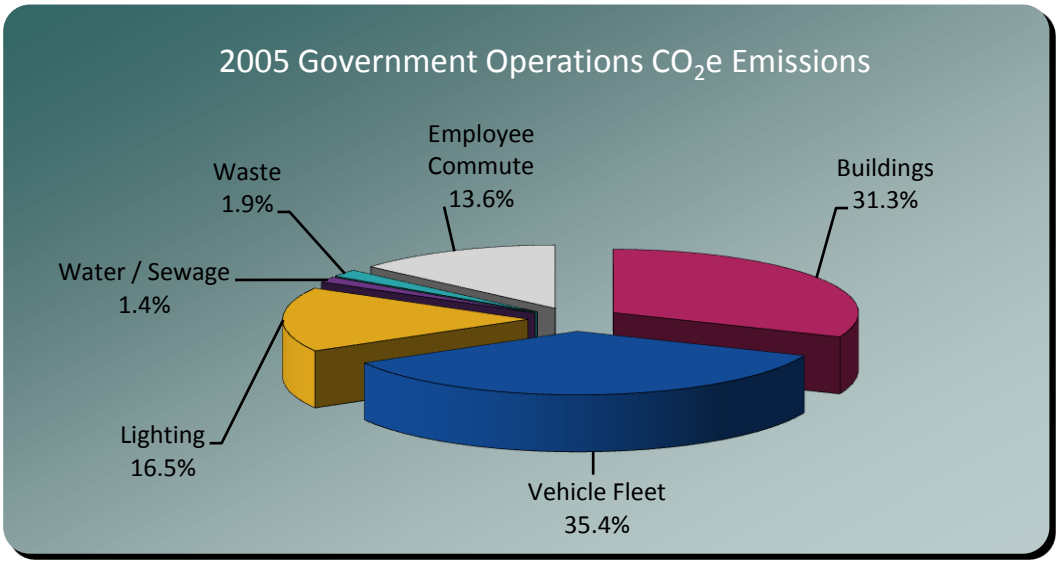
Community emissions have been categorized according to four primary sectors:

1. Residential
2. Commercial / Industrial
3. Transportation
4. Waste Generation

GOVERNMENT OPERATIONS INVENTORY RESULTS

In 2005, the City's operations emitted approximately **2,329 metric tons (tons) of CO_2e.**[2] As shown in the following, **Figure 1** and **Table A**, VEHICLE FLEET was the largest emitter (35.4 percent) in 2005. Emissions from BUILDINGS produced the second highest quantity of emissions, resulting in 31.3 percent of total CO_2e, followed by LIGHTING at 16.5 percent and EMPLOYEE COMMUTE at 13.6 percent of total emissions. The remainder of emissions came from WASTE (1.9 percent), and WATER/SEWAGE (1.4 percent). Emissions from government operations produced approximately 0.50 percent of total community emissions.

Figure 1: 2005 Government Operations CO_2e Emissions



[2] 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 Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (MMBtu)		Cost ($)	% of Total Cost
Water / Sewage	32	1.4%	462	$	22,907.00	3.3%
Waste	44	1.9%	-	$	-	0.0%
Employee Commute	316	13.6%	4,084	$	-	0.0%
Lighting	384	16.5%	5,595	$	183,304.00	26.2%
Buildings	728	31.3%	12,214	$	283,513.00	40.6%
Vehicle Fleet	826	35.4%	-	$	208,611.21	29.9%
TOTAL	**2,329**	**100.0%**	**22,355**	**$**	**698,335.21**	**100.0%**

COMMUNITY INVENTORY RESULTS

In 2005, the City of Novato community emitted approximately **465,892 metric tons of CO_2e**. As shown in the following **Figure 2** and **Table B**, the TRANSPORTATION SECTOR was by far the largest source of emissions, generating approximately **313,130 metric tons of CO_2e**, or 62.7 percent of total 2005 emissions. Transportation sector emissions are the result of diesel and gasoline combustion in vehicles traveling on both local roads, and state highways that pass through the jurisdictional boundaries of Novato. Electricity and natural gas consumption within the RESIDENTIAL SECTOR, the second greatest source of 2005 emissions, generated **85,418 metric tons CO_2e**, or 18.3 percent of the total. Similarly, electricity and natural gas use in Novato's COMMERCIAL /INDUSTRIAL SECTOR produced **56,952 metric tons CO_2e**, or 12.2 percent of total community emissions. The remaining 2.2 percent (**10,361 metric tons CO_2e**) are the estimated future methane emissions that will result from the decomposition of WASTE that was generated by the Novato community during 2005.

Figure 2: 2005 Community CO_2e Emissions

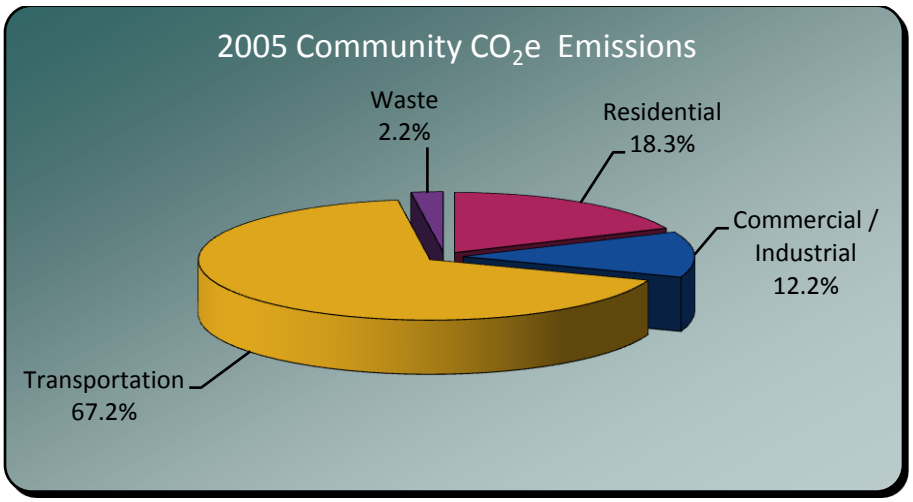


Table B: 2005 Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (%CO_2e)	Energy Equivalent (MMBtu)
Waste	10,361	2.2%	-
Commercial / Industrial	56,952	12.2%	888,810
Residential	85,418	18.3%	1,253,315
Transportation	313,160	67.2%	4,282,278
TOTAL	**465,892**	**100.0%**	**6,643,693**

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

KEY FINDINGS

GOVERNMENT OPERATIONS

- The City of Novato's government operations produced approximately **2, 329 metric tons of CO_2e in 2005**, 0.5 percent of total community emissions.
- The VEHICLE FLEET was the greatest source of government greenhouse gas emissions in 2005 – producing **728 metric tons of CO_2e**, or 35.4 percent of total government emissions.

COMMUNITY-WIDE

- Novato's community produced approximately **465,892 metric tons of CO_2e** in 2005.
- The TRANSPORTATION SECTOR was the greatest source of community greenhouse gas emissions in 2005 – producing **313,160 metric tons of CO_2e**, or 67.2% of total community emissions.

Section One:

Introduction

1. 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 Novato in 2005. This inventory serves two purposes:

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

While the City of Novato 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 Novato's 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

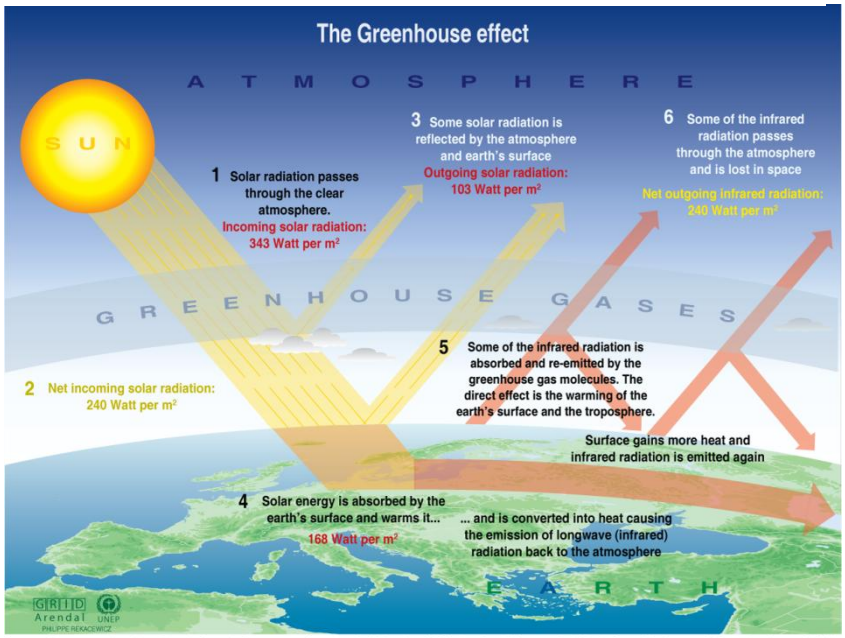
Figure 3: The ICLEI Five Milestone Process

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 (see **Figure 4**)[3]. 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.

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 Novato, such as rising sea levels and changes in the salinity and behavior of the San Francisco and San Pablo Bay, as well as other changes to local and regional weather patterns and species migration.

Figure 4: The Greenhouse Effect



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Beyond the local community, scientists also expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and landslides, 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

[3] Image courtesy of http://maps.grida.no/go/graphic/greenhouse-effect, Catographer / Designer Philippe Rekacewicz UNEP/GRID-Arendal

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 THE CITY OF NOVATO

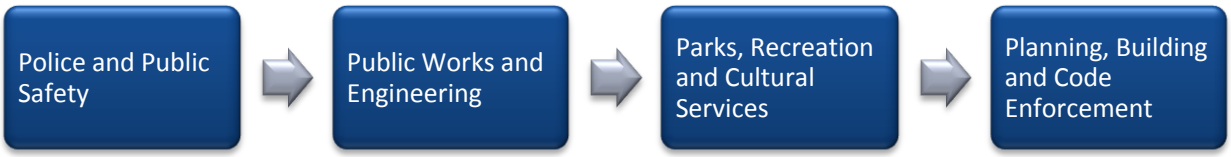
1.3.1 THE CITY OF NOVATO PROFILE

The City of Novato is a city of 28 square miles, located in Marin County, 29 miles Northeast of San Francisco. According to the Association of Bay Area Governments (ABAG), in 2005 the City's population was 50,900, and there were approximately 20,040 households located in the City of Novato. Included as an indicator of commercial activity, the number of jobs within the City of Novato in 2005 was 25,960. The City of Novato is located in the Climate Zone 3 and, in 2005, experienced an estimated 3,694 Heating and 292 Cooling Degree Days.[4]

Table C: City of Novato BY 08/09 Profile Chart

Size	Population	Annual Budget	Employees	Climate Zone	Heating / Cooling Degree days
28 Square Miles	52,737	$ 33,937,216	228	3	3694/292

The City of Novato offers the following core services:



In 2005, Novato provided the following core services, which have been identified as having an impact on greenhouse gas emission levels: POLICE SERVICES, STREET LIGHTING and TRAFFIC SIGNALS. These services and others, and the facilities and equipment that are instrumental in the delivery of these services, are the focus of

[4] http://www1.ncdc.noaa.gov/pub/orders/CDODiv9325901710089.txt

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

SUSTAINABILITY AND CLIMATE CHANGE MITIGATION ACTIVITIES IN THE CITY OF NOVATO

The City has been actively involved in the following sustainability and climate change activities: Green Building, Waste Reduction and Recycling, Climate-Friendly Purchasing, Water Reduction, Renewable Energy, Energy Efficiency and Conservation, and Efficient Transportation.

As early as 2001 the City began its effort in sustainability and climate change with "Waste Reduction and Recycling" when the City partnered with the Novato Sanitary District to implement a free household and electrical waste collection program. In 2002, the City Council approved a Construction and Demolition Waste Recovery Ordinance which required projects to recycle or reuse at least 50% of scrap material from the project.

In April 2007, the City Council adopted a resolution for Zero Waste Goal which states that the City will adopt Zero Waste as a long term goal, with the milestone of 80% landfill diversion by 2012 and Zero Waste by 2025, with a further directive to review the 80% milestone in 2010.

In 2004, the City began working on "Green Building" with the establishment of Green Building Standards. In September 2005, the City Council adopted a Residential Green Building Ordinance, which states the following:

> *New residential construction to meet a minimum of 50 Green Building Points with a minimum of 10 points in each category (Resources, Energy, Indoor Air Quality/Health) in the design and construction.*
>
> *Major renovations to meet a minimum of 30 Green Building Points with a minimum of five points in each category (Resources, Energy, Indoor Air Quality/Health) in the design and construction.*

The City Council adopted a Multi-Family Green Building Ordinance in May of 2007, which states:

> *All covered projects shall meet a minimum of 60 Green Building points with a minimum of points in specific categories: Community (6), Energy (11), Indoor Air Quality/Health (5), Resources (6), Water (3) in the design and construction of the covered project.*

The final action to complete the City's Green Building efforts is to have the Commercial and Civic Green Building Ordinance adopted by early 2009.

In 2007, the Administrative Services department began development of a citywide Green Purchasing Policy based on a model policy developed by Stopwaste.org. The policy was approved and implemented in April 2008.

Additional on-going efforts in "Renewable Energy" were the application for Clean Renewable Energy Bonds (CREBs) and subsequent approval of $2.5M for city facilities, and the City's participation on the Community Choice Aggregation (CCA) Task Force.

In the area of "Energy and Conservation", the Public Works Department continues its program of installing new LED traffic lights as the yellow lights burn-out. To date, all red and green lights have been replaced. In "Efficient Transportation" the City has purchased some hybrids and currently provides a Commuter Van for carpooling eight employees who reside in Sonoma County.

A Council sub-committee on sustainability was formed in March 2008, which is currently developing a local climate action plan for the City.

1.4 THE MARIN CLIMATE AND ENERGY PARTNERSHIP

The Marin Climate and Energy Partnership (MCEP) 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 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 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 and 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 September 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.

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Section Two:

Methodology

2. 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 rapidly continue to 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 an easily implemented set of guidelines to assist local governments in quantifying the greenhouse gas emissions from both their internal operations and from the whole community 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 Emissions Report details the findings from Novato’s Government Operations and the community inventory.

LOCAL GOVERNMENT OPERATIONS PROTOCOL (LGOP)

In 2008, ICLEI, CARB, and the California Climate Action Registry (CCAR) jointly released the Local Government Operations Protocol (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 the best available data and calculation methodologies outlined in the LGOP; it does not provide a complete picture of all emissions resulting from Novato's operations, and emissions estimates are subject to change as more accurate 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 that year is increasingly becoming the standard for such inventories. The 1990 baseline year that the State of California uses 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 "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 determine 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 D** below).

Table D: Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO_2e)[6]
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

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, Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O), can be quite difficult, ICLEI has also created a means for local governments to produce a simplified inventory that is otherwise in accordance with the methodology of the IEAP and LGOP, and is focused on primary 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 inventory.

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

[6] GPW for 100 year time horizon (GPW is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming).

2.1.5 UNITS USED IN REPORTING EMISSIONS

The IEAP and the LGOP require reporting of individual gas emissions, and this report is included in Appendix A: Emissions Inventory Details. 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 previous **Table D** 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.[7]

COMMUNITY SCOPE DEFINITIONS

The Scopes framework identifies three emissions scopes for community emissions:

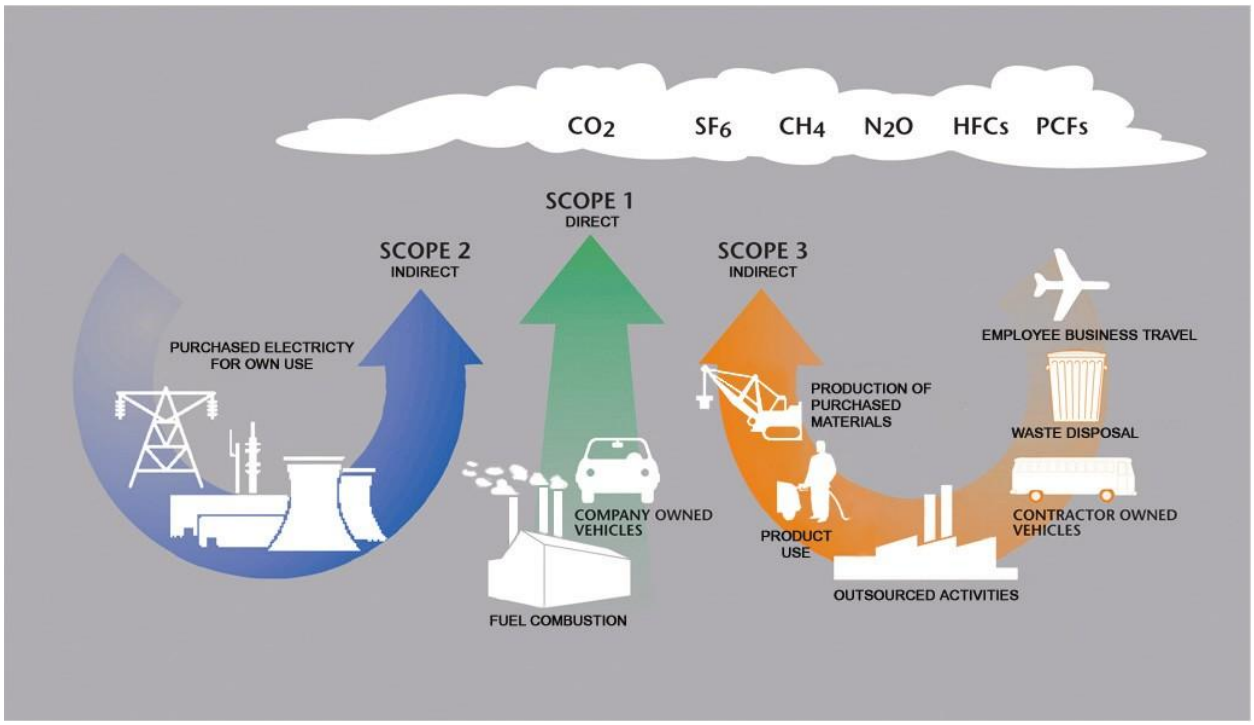
SCOPE 1: All direct emissions from sources located within the geopolitical boundary of the local government.

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.

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

[7] Another common reporting framework is emissions by sector: See Section 2.1.6-Emisisons Sectors for details

Figure 5: Emissions Scopes



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

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.

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 practical, 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 (Scope 1), marine transportation occurring between two jurisdictions (Scope 3), etc.

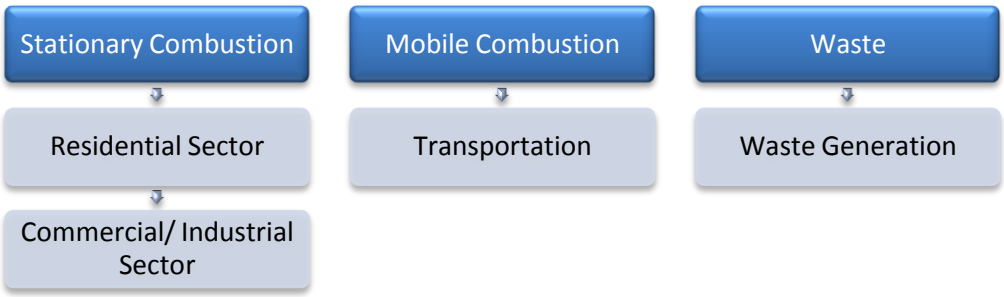
Fugitive and Other Energy Emissions: Including, leaked natural gas from distribution infrastructure located within geopolitical boundaries (Scope 1), leaked refrigerants from residential and commercial / industrial facilities (Scope 1), etc.

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:



GOVERNMENT SECTORS

The LGOP breaks emissions down into the following general sectors:

The City of Novato inventory includes the following sectors:

- Buildings (and other facilities)
- Vehicle Fleet
- Streetlights and Traffic Signals

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

Activity data refers 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 Appendix B & C for a listing of emissions factors used in this report. **Table E** demonstrates an example of common emission calculations that use this formula.

Table E: Basic Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kWh)	CO_2 emitted/kWh	CO_2 emitted
Natural Gas Consumption (therms)	CO_2 emitted/therm	CO_2 emitted
Gasoline/Diesel Consumption (gallons)	CO_2 emitted /gallon	CO_2 emitted
Vehicle Miles Traveled	CO_2, N_2O emitted/mile	CH_4, N_20 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)[8], 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.[9] 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.

[8] Now the National Association of Clean Air Agencies (NACAA)

[9] Please see Appendix B and Appendix C for a list of emission factors.

Section Three:

2005 Government Operations Inventory

3. 2005 GOVERNMENT OPERATIONS INVENTORY

3.1 GOVERNMENT OPERATIONS INVENTORY SUMMARY

In 2005, the City of Novato's government operations produced approximately **2,329 metric tons of CO_2e** — 0.50 percent of total community emissions. This amount includes all Scope 1 emissions from the on-site combustion of fuels in facilities and vehicles, leakage of refrigerants any other process/fugitive emissions, Scope 2 emissions from the purchase of electricity generated outside Novato's borders, and Scope 3 emissions from waste generated by local government operations and employee commute patterns. It *does not* include any other excluded emissions—while not included in this rollup number, these emissions are discussed below in this report.[10]

As mentioned in Section 2.1, the LGOP requires reporting by emissions scope, and this analysis is included in Section 2.1.1. 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.[11]

3.1.1 SUMMARY BY SCOPE

[10] In this report, this number will be used to represent "total" emissions.

[11] When combining scopes it is possible to produce erroneous results if one is not careful. For example, if a government generates the electricity that it consumes, there is a danger of counting emissions twice--as associated with both power generation (Scope 1) and electricity consumption (Scope 2).

As shown in **Table F**, SCOPE 1 emissions constituted the largest amount of greenhouse gas emissions from City of Novato's operations in 2005, totaling **1213 metric tons of CO_2e**. SCOPE 2 emissions constituted the second largest amount (**756 metric tons of CO_2e**), and SCOPE 3 emissions totaled **360 metric tons of CO_2e**.[12]

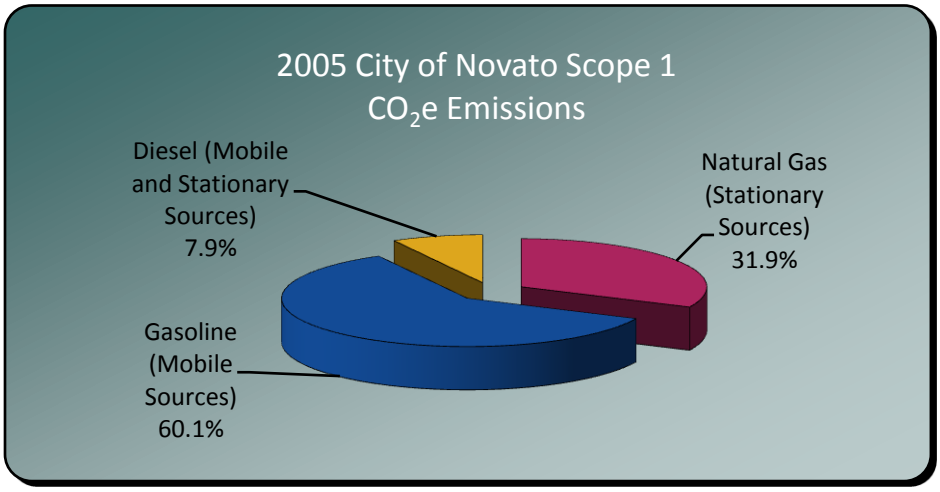
Table F: 2005 Novato Government Emissions by Scope

Activity	CO_2e emitted	Scope Total
Diesel (Mobile & Stationary Sources)	96	
Natural Gas(Stationary Sources)	387	
Gasoline (Mobile Sources)	729	
Scope 1		**1213**
Purchased Electricity	756	
Scope 2		**756**
Government Generated Solid Waste	44	
Employee Commute	316	
Scope 3		**360**

SCOPE 1 EMISSIONS

In 2005, the City of Novato's government operations produced **1213 metric tons CO_2e** of Scope 1 greenhouse gas emissions. As seen in **Figure 6**, the largest percent (60.1 percent) of Scope 1 emissions resulted from combustion of gasoline in city vehicles and equipment. The second largest source of Scope 1 emissions was from the stationary combustion of natural gas in Novato facilities, constituting 31.9 percent of Scope 1 emissions. The remaining 7.9 percent resulted from the combustion of diesel in city vehicles and equipment.

Figure 6: 2005 city of Novato Scope 1 CO_2e Emissions



[12] 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 2 EMISSIONS

In 2005, the City of Novato's government operations generated **756 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 Novato's operational boundaries, but are the result of Novato's government operations, and therefore are counted as an integral part of the inventory.

SCOPE 3 EMISSIONS

In 2005, the City of Novato's government operations generated **360 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 Novato's employee commute patterns, and those from waste generated at government-operated facilities. While reporting of Scope 3 emissions is optional, doing so enables Novato to develop innovative policy approaches for reducing greenhouse gases.

In 2005, **316 metric tons of CO_2e** resulted from the consumption of fossil fuels by City of Novato employees in their personal vehicles while commuting to and from work. The anaerobic decay of solid organic waste (paper, plant debris, etc.) generated through Novato's operations in 2005 generated **44 metric tons of CO_2e**.

3.1.2 SUMMARY BY SECTOR

By better understanding the relative scale of emissions from each of the sectors, the City of Novato 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 **2,329 metric tons of CO_2e**. The sectors included in this total are the following:

1. Buildings (and other facilities)
2. Vehicle Fleet
3. Streetlights, traffic signals, and other public lighting
4. Water / Sewage
5. Government-generated solid waste
6. Employee commute

As shown in **Figure 7** and **Table G**, VEHICLE FLEET was the largest emitter (**35.4 percent**) in 2005. Emissions from BUILDINGS produced the second highest quantity of emissions, resulting in **31.3 percent** of total CO_2e. The City of Novato's LIGHTING produced **16.5 percent** and EMPLOYEE COMMUTE, produced **13.6 percent** of total emissions with the remainder coming from Waste (**1.9 percent**), and Water / Sewage (**1.4 percent**).

Figure 7: 2005 Government Operations CO2e Emissions Summary by Sector

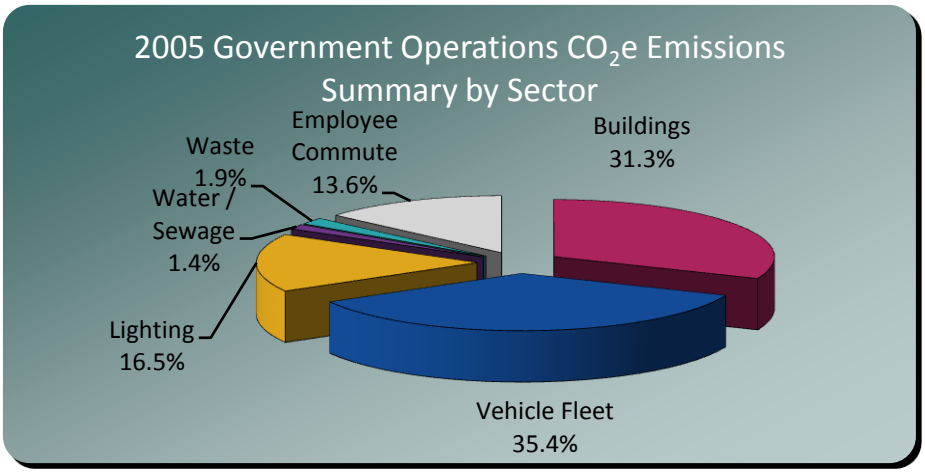


Table G: 2005 Government Operations Emissions by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Water / Sewage	32	1.4%
Waste	44	1.9%
Employee Commute	316	13.6%
Lighting	384	16.5%
Buildings	728	31.3%
Vehicle Fleet	826	35.4%
TOTAL	**2,329**	**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 the City of Novato's government operations 2005 greenhouse gas emissions by fuel type or material, based upon the total government operations emissions of **2,329 metric tons**.

As shown in **Figure 8** and **Table H**, the greatest percentage of government emissions (**38.4 percent**) came from ELECTRICITY. The next highest percentage of emissions came from GASOLINE (**37.0 percent**) and NATURAL GAS (**19.7 percent**).

Figure 8: 2005 Government Operations Emissions by Source

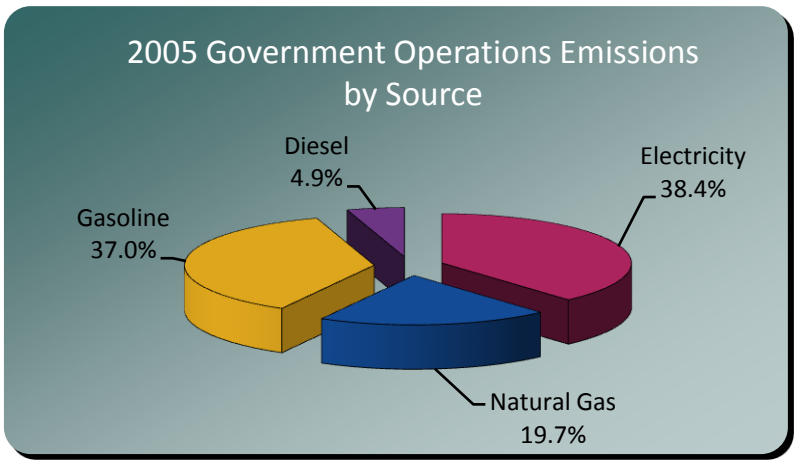


Table H: 2005 Government Operations by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Diesel	96	4.9%
Natural Gas	387	19.7%
Gasoline	729	37.0%
Electricity	756	38.4%
TOTAL	**1,969**	**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 (**see Table I**). During 2005, the City of Novato's internal operations spent approximately **$698,335** on ENERGY (electricity, natural gas, gasoline and diesel) for its BUILDINGS, STREETLIGHTS and VEHICLES. The majority, 70.13 percent, of these energy expenses (**$489,724**) are the result of ELECTRICITY and NATURAL GAS purchases from PG&E. The City of Novato spent approximately **$208,611** on gasoline and diesel for its MUNICIPAL FLEET (29.87 percent of total costs). Beyond reducing harmful greenhouse gases, any future reductions in energy use will have the potential to reduce these costs, enabling the City of Novato to reallocate limited funds toward other municipal services or create a revolving energy loan fund to support future climate protection activities.

Table I: 2005 Government Operations Costs by Sector

Sector	Cost ($)
Buildings	$ 283,513
Vehicle Fleet	$ 208,611
Lighting	$ 183,304
Water / Sewage	$ 22,907
Waste	N/A[13]
Employee Commute	
TOTAL	**$ 698,335**

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:

1. Buildings (and other facilities)
2. Vehicle Fleet
3. Streetlights, traffic signals, and other public lighting
4. Water / Sewage
5. Government-generated solid waste
6. Employee commute

3.2.1 BUILDINGS AND OTHER FACILITIES

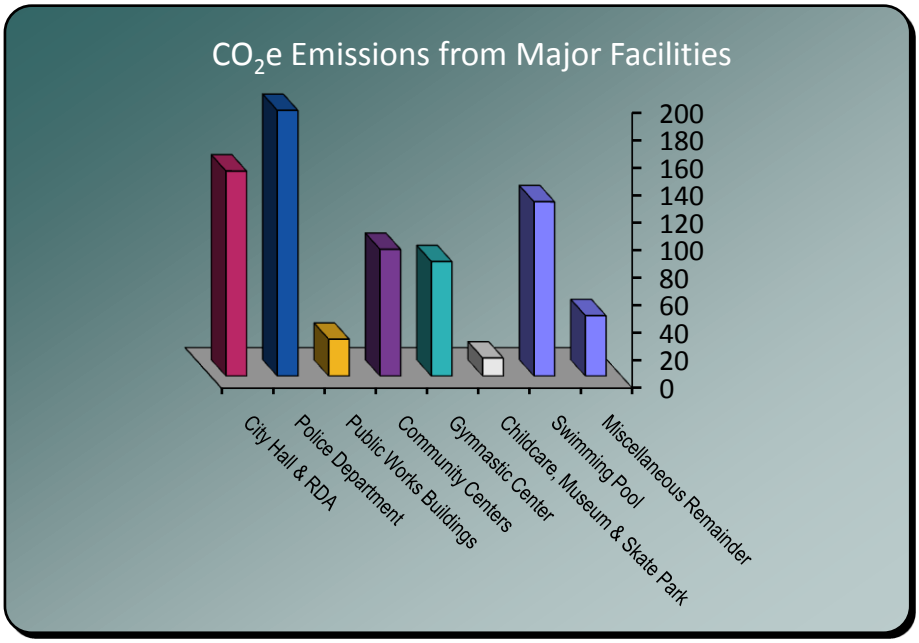
Buildings and other facilities operated by local governments produce a significant amount of greenhouse gas emissions. In 2005, the City of Novato operated several major facilities. For the purposes of this analysis the major facilities have been grouped into the following eight major categories:

1. City Hall & RDA
2. Police Department
3. Public Works Buildings
4. Community Centers
5. Gymnastic Center
6. Childcare Facilities, Museum, & Skate Park
7. Swimming Pool
8. Miscellaneous

[13] Expense records were not obtained for this report.

In 2005, the operation of the City of Novato facilities produced approximately **728 metric tons of CO_2e** from all of these sources. The City of Novato spent approximately **$281,758** in 2005 on the fuels and electricity that were the cause of these emissions. **Figure 9** depicts 2005 emissions per facility, and **Table J** shows estimated costs associated with the activities that generated these emissions. As discussed in Section 3.1.2, emissions from facilities represent **31.3 percent** of "total" emissions from the City's operations in year 2005. Of total facility emissions, **46.8 percent** came from the consumption of electricity and **53.2 percent** came from the combustion of natural gas. [14]

Figure 9: CO_2e Emissions from Major Facilities



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

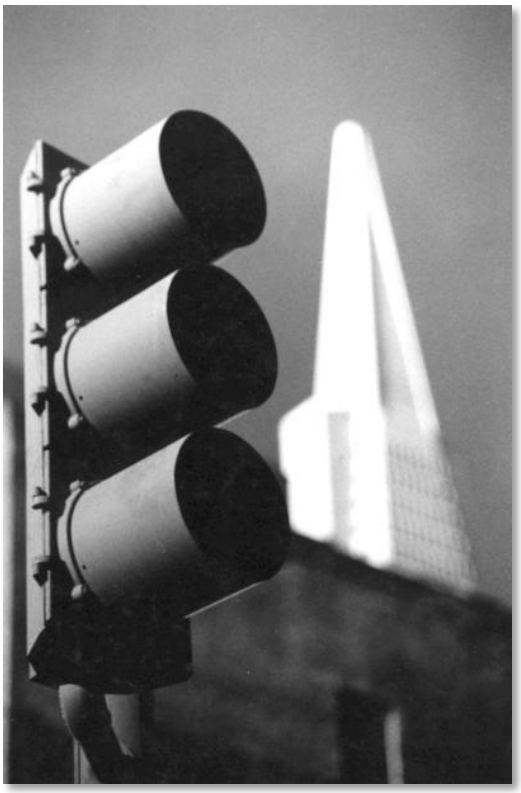
Table J: Energy Use and CO_2e Emissions from Major Facilities

Facility	Greenhouse Gas Emissions (metric tons CO_2e)	% CO_2e of All Facilities	Electricity Use (kWh)	Natural Gas Use (therms)		Cost ($)	Energy Equivalent (MMBtu)
Childcare, Museum & Skate Park	13	1.8%	41,297	652	$	7,534	206
Public Works Buildings	27	3.7%	60,600	2,354	$	10,833	442
Aggregate Minor Facilities[15]	44	6.0%	88,071	4,369	$	17,030	738
Gymnastic Center	83	11.4%	174,240	7,943	$	34,957	1,389
Community Centers	92	12.7%	244,688	6,520	$	43,632	1,487
Swimming Pool	127	17.4%	97,280	19,439	$	36,027	2,276
City Hall & RDA	149	20.5%	255,308	16,701	$	56,455	2,541
Police Department	193	26.5%	496,320	14,408	$	77,045	3,135
TOTAL	**728**	**100.0%**	**1,457,804**	**72,386**	**$**	**281,758**	**12,214**

Electricity consumption and the on-site combustion of fuels such as natural gas were the most significant sources of 2005 greenhouse gas emissions from the City of Novato facilities.

3.2.2 STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING

The City of Novato operates a range of public lighting, from traffic signals and street lighting to park lights. Electricity consumed in the operation of this infrastructure is a significant source of greenhouse gas emissions.



In 2005, public lighting in Novato consumed a total of **1,639,202 kWh**, producing approximately **384 metric tons CO_2e**. This represents 16.47 percent of total emissions from the City of Novato government operations in 2005. There are a number of ways that the City of Novato can improve the efficiency of public lighting, reducing the amount of greenhouse gas emissions being generated by Novato operations and saving tax-payer dollars. Please refer to **Table K** to compare electricity consumption across the various public lighting categories.

[15] Includes 853 Reichert Ave, aggregate minor facilities, and pedestal as labeled by Novato Disposal data, see Appendix 2, Facilities Lighting.

Table K: Energy Use and CO_2e Emissions from Public Lighting

Source	Greenhouse Gas Emissions (metric tons CO_2e)	% CO_2e	Electricity Use (kWh)		Cost ($)	Energy Equivalent (MMBtu)
Outdoor Lighting	12	3.2%	52,097	$	6,980.00	178
Traffic Signals/Controllers	38	9.9%	161,947	$	24,623.00	553
Streetlights	333	86.9%	1,425,158	$	151,701.00	4,864
TOTAL	**384**	**100.0%**	**1,639,202**	**$**	**183,304.00**	**5,595**

3.2.3 WATER AND SEWAGE USE

This section addresses any facilities used for the managment and distribution of water, excluding public water delivery services and those pertaining to wastewater and sewage treatment facilities as the City of Novato does not provide these services. Typical systems included in this section are: potable water delivery pumps, sprinkler and irrigation controls and storm water management. The systems identified for this report and used by the City were water delivery pumps, and sprinkler and irrigation controls.

In 2005 the City of Novato emitted approximately **32 metric tons of CO_2e** from all of these sources, which represents 1.37 percent of total government emissions from Novato in 2005. The City spent approximately $22,907 in 2005 on the fuels, electricity and refrigerants that were the cause of these emissions. **Table L** shows emissions, consumption, and costs associated with water and wastewater delivery.

Table L: Energy Use and CO_2e Emissions from Water Delivery Facilities

Source	Greenhouse Gas Emissions (metric tons CO_2e)	% CO_2e	Electricity Use (kWh)	Cost ($)	Energy Equivalent (MMBtu)
Irrigation / Sprinkler Systems	4	13.2%	17,824	$ 4,797	61
Water Pumps	27	86.8%	117,435	$18,110	401
TOTAL	**32**	**100.0%**	**135,259**	**$22,907**	**462**

3.2.4 VEHICLE FLEET

Most jurisdictions use vehicles as an integral part of their daily operations—from maintenance trucks used for parks and recreation to police cruisers. Combustion of fuels produce significant quantities of emissions within most local governments, and the City of Novato will be able to reduce its emissions by enacting policies such as purchasing alternative fuel vehicles, replacing oversized vehicles with more appropriately-sized ones, or removing vehicles from the fleet.

In 2005, the City of Novato operated a fleet of approximately 146 vehicles, as well as a small assortment of combustion equipment used primarily for landscaping and park maintenance. Novato's vehicle fleet performed a number of essential services, from citywide maintenance; services to the Hamilton Community Facilities District for the levee, two pump stations, and roadside landscaping on the main thoroughfares in the former Hamilton Air Field and Rafael Village areas; as well as another set of services provided for emergency response, operations and cleanup. In 2005, the majority of vehicles in the fleet (58 percent) were used by the Public Works Department, while the remaining 42 percent were used by the Police Department.

The operation of the City's fleet, in 2005, consumed approximately **8,599** gallons of DIESEL FUEL and **82,862** gallons of GASOLINE, producing a total of **826 metric tons CO_2e**, or 35.5 percent of total government emissions, as shown in **Table M.** On a gallon-per-gallon basis, the City of Novato's fleet consumed 63.8 percent gasoline and 36.2 percent diesel. As shown in **Figure 10**, 88.3 percent of the City's fleet emissions came from gasoline and 11.7 percent from diesel, diesel being slightly more carbon intensive than gasoline. Please see **Figure 11** for a depiction of emissions per City Department.

Table M: 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 (MMBtu)
Public Works	299	36.2%	23,446	8,599	$ 74,408	7,455
Police Department	527	63.8%	59,416	-	$ 134,450	3,989
TOTAL	**826**	**100.0%**	**82,862**	**8,599**	**$ 208,858**	**11,444**

Figure 10: Vehicle Fleet CO_2e Emissions by Fuel Type

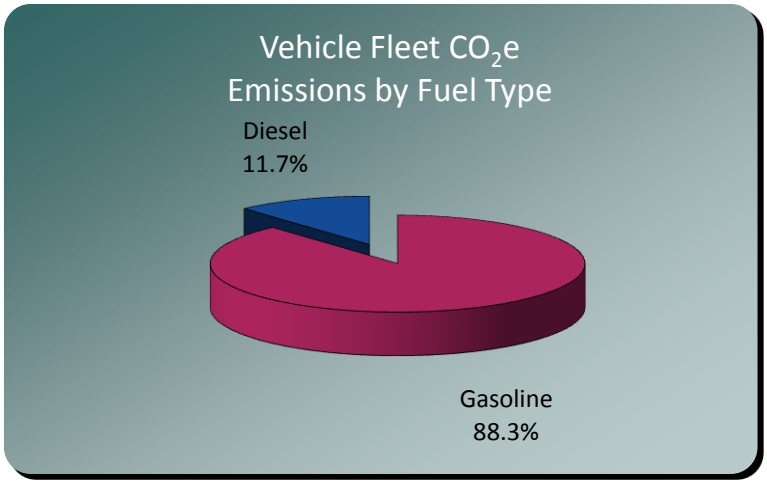
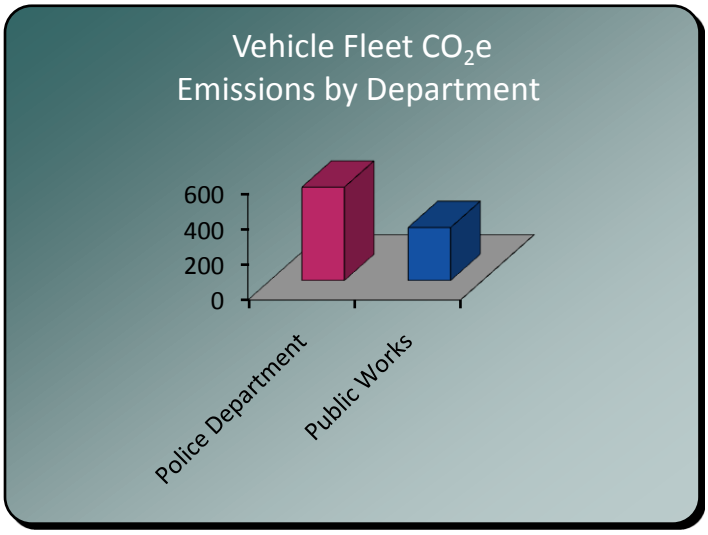


Figure 11: Vehicle Fleet CO_2e Emissions by Department



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.[16] In addition, no combustion process results in a completely combusted fuel,

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

and 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.[17]

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 Novato) 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 land-filled 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,[18] however, a portion escapes into the atmosphere, contributing to the greenhouse effect. As such, quantifying the amount of waste generated by

[17] 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.

[18] 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.

government operations, and calculating the resulting greenhouse gas emissions is an important component of a comprehensive emission inventory.

The following address locations, which were provided by Novato Disposal, as shown in **Table N** estimated that the waste disposed by government facilities in 2005 will cumulatively produce **173.20 metric tons of methane gas**, or **44.93 metric tons CO_2e**.

Table N: Solid Waste CO_2e Emissions by Address Location

Source	Greenhouse Gas Emissions (metric tons CO_2e)	% CO_2e of Waste Generation	Land filled Waste (Tons)
1174 Leafwood Heights	0.33	0.8%	1.30
1530 S. Novato Boulevard	0.33	0.8%	1.30
Hamilton Field - O Hanger Road	1.75	4.0%	6.90
City Hall Offices - 75 Rowland Way	1.75	4.0%	6.90
Gymnastics Center - 950 7th Street	1.75	4.0%	6.90
Hamilton Pool - Bldg 203 El Bonito	2.16	4.9%	8.50
City Hall Offices - 901 Sherman Avenue	2.31	5.3%	9.10
MTSC - 1560 Hill Road	3.53	8.0%	13.90
Police Department - 909 Machin Street	5.28	12.0%	20.80
Public Works - 550 Davidson Street	24.75	56.4%	97.60
TOTAL	**43.93**	**100.0%**	**173.20**

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 often in a landfill located outside of Novato's jurisdictional boundaries. 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. Novato 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 (CO_2, N_20, and CH_4) from passenger vehicles operated by municipal employees traveling to and from work are considered indirect emissions and are reported under Scope 3. 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 the City of Novato can make significant progress towards greenhouse gas emissions reductions.

In 2005, employees commuting in vehicles to and from their jobs at the City of Novato emitted approximately **316 metric tons CO_2e**, or 13.6 percent of total government emissions.

In 2005, there were approximately 220 Full Time Employees. However, the Employee survey was conducted in Fiscal Year 2008-2009. During this budget year, the City had 228 Full Time Employees. The City had a total of 95 who responded to the survey, giving a 43% response rate, which was factored in when computing the total emissions.

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Section Four:

2005 Community Inventory

4. COMMUNITY INVENTORY

4.1 COMMUNITY INVENTORY SUMMARY

In 2005, activities and operations taking place within the City of Novato's geopolitical boundary resulted in approximately **465,892 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 state highways within the City of Novato. This number also includes all Scope 2 emissions associated with community electricity consumption, and Scope 3 emissions from waste generated by the City of Novato community.[19]

4.1.1 SUMMARY BY SCOPE

As shown in **Table O**, SCOPE 1 sources produced the largest amount of community greenhouse gas emissions in 2005, totaling **387,483 metric tons of CO_2e**. SCOPE 2 emissions constituted the second largest amount (**68,047 metric tons of CO_2e**), and SCOPE 3 emissions totaled **10,361 metric tons of CO_2e**.[20]

Table O: 2005 Novato Community Emissions by Scope

Activity	CO_2e emitted	Scope Total
Transportation Diesel	37,403	
Natural Gas (Stationary Sources)	74,323	
Transportation Gasoline	275,757	
Scope 1		**387,483**
Purchased Electricity (All Stationary Sources)	68,047	
Scope 2		**68,047**
Waste Generation	10,361	
Scope 3		**10,361**

SCOPE 1 EMISSIONS

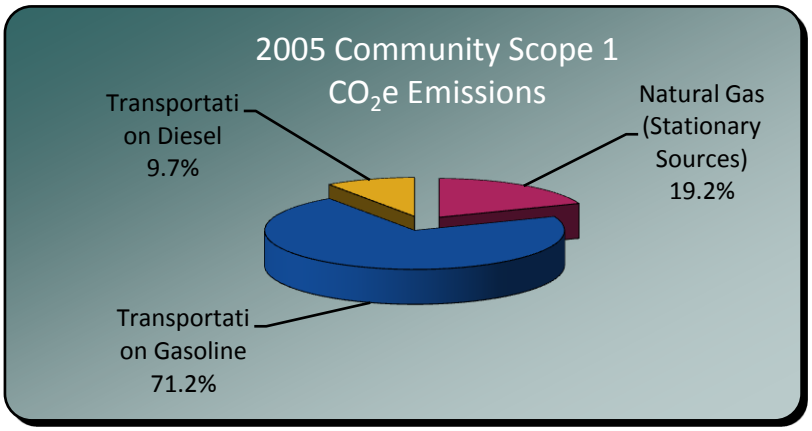
In 2005, the City of Novato's community produced **387,483 metric tons CO_2e** of Scope 1 greenhouse gas emissions. As seen in **Figure 12**, the largest percent of Scope 1 emissions resulted from mobile combustion of

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

[20] 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.

fuels, with 71.2 percent from gasoline and 9.7 percent from diesel. The second largest source of Scope 1 emissions was stationary combustion, constituting 19.2 percent of Scope 1 emissions.

Figure 12: 2005 Community Scope 1 CO_2e Emissions



SCOPE 2 EMISSIONS

In 2005, the City of Novato's community generated **68,047 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 the City of Novato but produced outside Novato.

SCOPE 3 EMISSIONS

In 2005, the City of Novato's community generated **10,361 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 City of Novato community during 2005.

4.1.2 SUMMARY BY SECTOR

By better understanding the relative scale of emissions from each primary sector, the City of Novato 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 **465,892 metric tons of CO_2e**. The four sectors included in this inventory are the following:

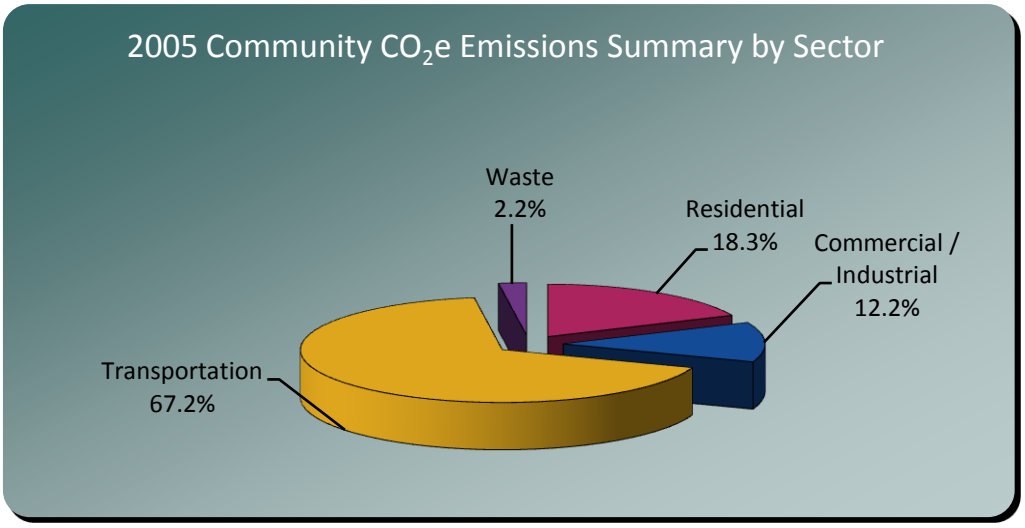
1. Residential
2. Commercial / Industrial
3. Transportation
4. Waste Generation

As visible in **Table P** and **Figure 13**, the TRANSPORTATION SECTOR was the largest emitter (67.2 percent) in 2005 a total of **313,160 metric tons of CO_2e**. Emissions from the RESIDENTIAL SECTOR produced the second highest quantity, resulting in 18.3 percent of total emissions, or **85,418 metric tons of CO_2e**. The remainder of emissions came from COMMERCIAL/INDUSTRIAL SECTOR (12.2 percent) and WASTE SECTOR (2.2 percent).

Table P: 2005 Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (MMBtu)
Waste	10,361	2.2%	-
Commercial / Industrial	56,952	12.2%	888,810
Residential	85,418	18.3%	1,472,605
Transportation	313,160	67.2%	4,282,278
TOTAL	**465,892**	**100.0%**	**6,643,693**

Figure 13: 2005 Community CO_2e Emissions Summary by Sector



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 14** and **Table Q**) is a summary of the City of Novato's 2005 Community greenhouse gas emissions by fuel type or material, based upon the total community emissions of **465,892 metric tons**.

Figure 14: 2005 Community Emissions by Source

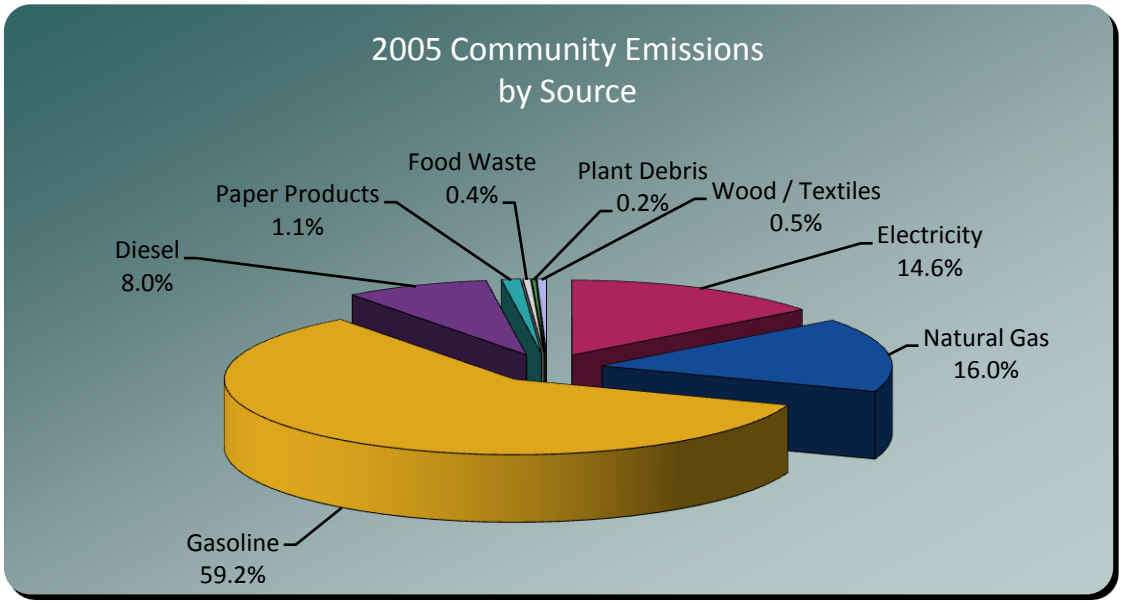


Table Q: 2005 Community Emissions by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Plant Debris	1,038	0.2%
Food Waste	1,937	0.4%
Wood / Textiles	2,463	0.5%
Paper Products	4,923	1.1%
Diesel	37,403	8.0%
Electricity	68,047	14.6%
Natural Gas	74,323	16.0%
Gasoline	275,757	59.2%
TOTAL	**465,892**	**100.0%**

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 R**, dividing the total community-wide GHG emissions by population yields a result of **9 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 the City of Novato (which would include lifecycle emissions, emissions resulting from air travel, etc.).

Table R: 2005 Per Capita Emissions

Estimated 2005 Population*	50,900
Community GHG Emissions (metric tons CO_2e)	465,892
Per Capita GHG Emissions (metric tons (CO_2e)	9

**All calculations for this report used ABAG estimations for consistency*

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:

1. Residential
2. Commercial / Industrial
3. Transportation
4. Waste Generation

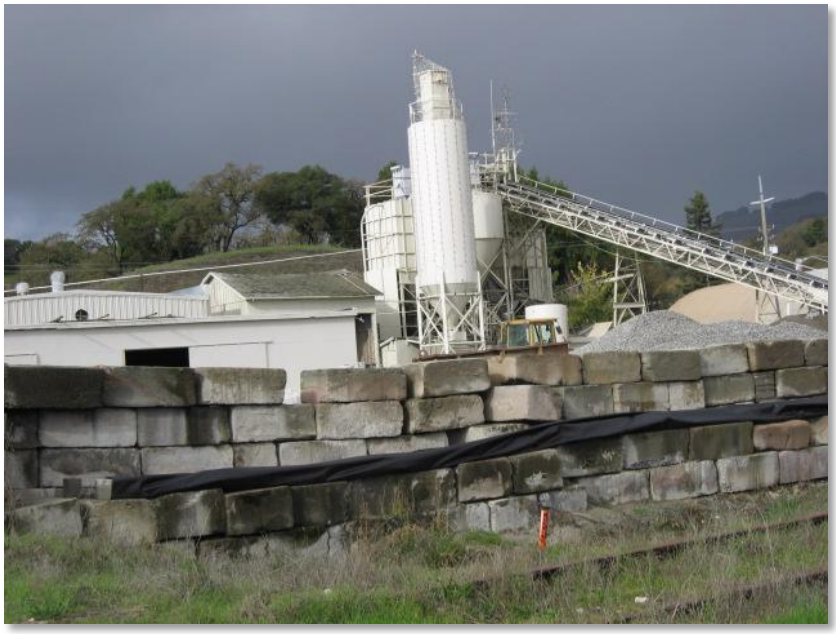
4.2.1 RESIDENTIAL SECTOR

Energy consumption associated with the City of Novato homes produced **85,418 metric tons** of greenhouse gas emissions in 2005 (18.3 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 S** below, the City of Novato residents generated approximately **4 metric tons of CO_2e per** emissions per household.[21] 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 S: 2005 Residential Emissions per Household

Number of Occupied Households	20,040
Total Residential GHG Emissions (metric tons CO_2e)	85,418
Residential GHG Emissions per Household (metric tons CO_2e)	4

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

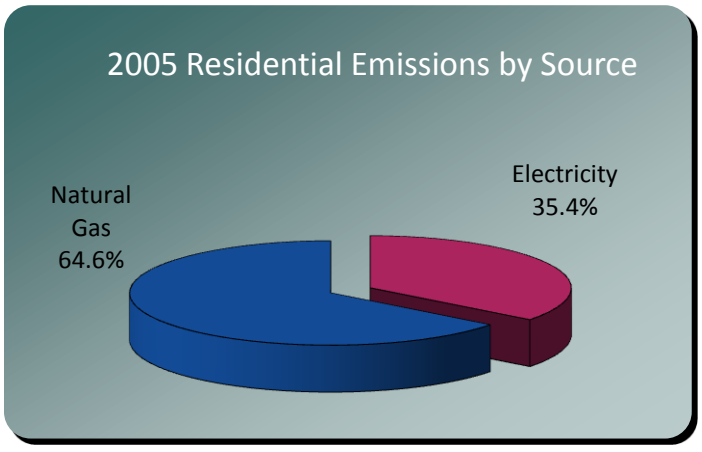


In 2005, the City of Novato's entire Residential Sector consumed 129,375,145 kWh of electricity and 10,310,521 therms of natural gas. As shown in **Table T** and **Figure 15**, 64.6 percent of total Residential emissions were the result of electricity consumption, and 35.4 percent were the result of natural gas use. Electricity is generally used for lighting, heating, cooking, and to power appliances. Natural gas is typically used in residences as a fuel for heating, water heating, and cooking. There are a number of ways that the City of Novato 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 the City of Novato homes.

Table T: Residential Emission Sources 2005

Source	GHG Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Consumption	Unit	Energy Equivalent (MMBtu)
Electricity	30,274	35.4%	129,375,145	kWh	441,553
Natural Gas	55,145	64.6%	10,310,521	therms	1,031,052
TOTAL	**85,418**	**100.0%**	**139,685,666**		**1,472,605**

Figure 15: 2005 Residential Emissions by Source



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, per the classification made by PG&E.[22] In 2005, buildings and facilities within the Commercial / Industrial sector produced **56,952 metric tons of greenhouse gas emissions** (12.22 percent of total community emissions). All Commercial / Industrial Sector emissions included in this inventory are the result of electricity consumption and the on-site 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 U lists Commercial / Industrial emissions based on the estimated number of jobs in the City of Novato in 2005.[23] The City of Novato businesses generated **2 metric tons of GHG emissions per job** in 2005.

Table U: 2005 Commercial / Industrial Emissions per Job

Number of Jobs	25,960
Total Commercial / Industrial GHG Emissions (metric tons CO_2e)	56,952
Commercial / Industrial GHG Emissions per Job (metric tons CO_2e)	2

As shown in **Table V** and **Figure 16**, 33.7 percent of total Commercial / Industrial emissions were the result of natural gas use, and 66.3 percent were the result of 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 the City of Novato 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.

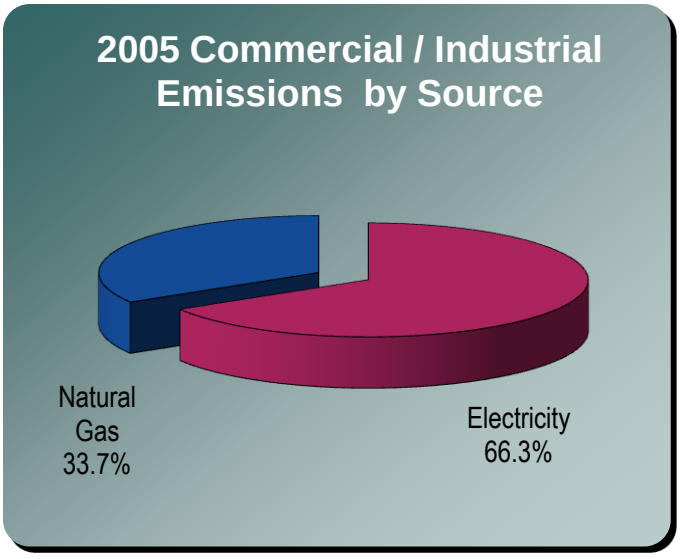
Table V: Commercial / Industrial Emissions Sources 2005

Source	GHG Emissions (metric tons CO_2e)	GHG Emissions (% CO_2e)	Energy Consumption	Unit	Energy Equivalent (MMBtu)
Electricity	37,774	66.3%	139,193,168	kWh	559,281
Natural Gas	19,179	33.7%	3,585,854	therms	378,236
TOTAL	**56,952**	**100.0%**			**937,517**

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

[23] Number of City of Novato jobs in 2005 based on estimates conducted by ABAG.

Figure 16: 2005 Commercial / Industrial Emissions by Source



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.[24] 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 the City of Novato's geographical boundary constitutes the greatest percentage (67.22 percent) of community wide greenhouse gas emissions **– 313,160 metric tons CO_2e**.

As shown in **Table W**, 29.3 percent of Transportation Sector emissions came from travel on local city roads, and 70.7 percent came from travel on state highways passing through the jurisdictional boundary of the City of Novato. Of the total emissions in the Transportation Sector, an estimated 88.1 percent were due to gasoline consumption with the remaining 11.9 percent coming from diesel use (see **Figure 17**.) 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

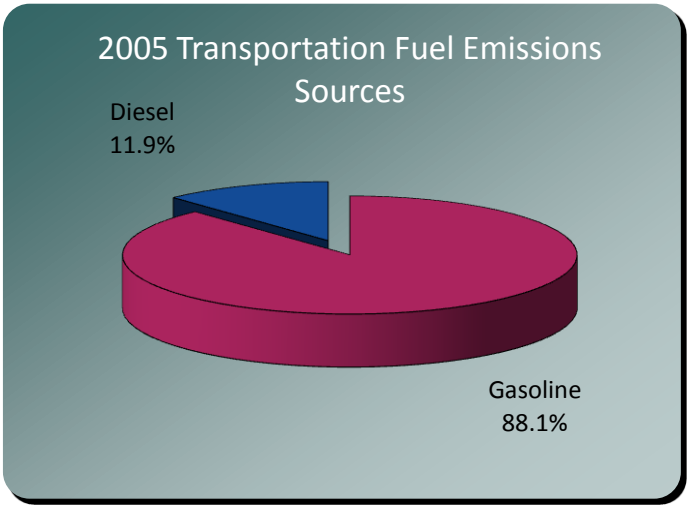
[24] AB 32 Scoping Plan

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

Table W: 2005 Transportation Emission by Road Type

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)	Energy Equivalent (MMBtu)
Local Roads	91,654	29.3%	1,321,996
State Highways	221,506	70.7%	3,194,950
TOTAL	**313,160**	**100.0%**	**4,516,946**

Figure 17: 2005 Transportation Fuel Emissions Sources



Emissions that resulted from the air travel of Novato 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.

4.2.4 COMMUNITY GENERATED SOLID WASTE

As noted previously in **Figure 13**, the Waste Sector constituted 2.2 percent of total emissions for the City of Novato 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 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[25]. Please **see Table X** for a summary of emissions per waste type.[26]

Table X: Waste Emission Sources 2005

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Greenhouse Gas Emissions (% CO_2e)
Plant Debris	1,038	10.0%
Food Waste	1,937	18.7%
Wood / Textiles	2,463	23.8%
Paper Products	4,923	47.5%
TOTAL	**10,361**	**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, the City of Novato's emissions will grow by approximately 24.2 percent by the year 2020, from **465, 892 to 578,611 metric tons CO_2e**. **Table Y** and **Figure 18** show the results of the forecast. A variety of different reports and projections were used to create the emissions forecast, as profiled below.

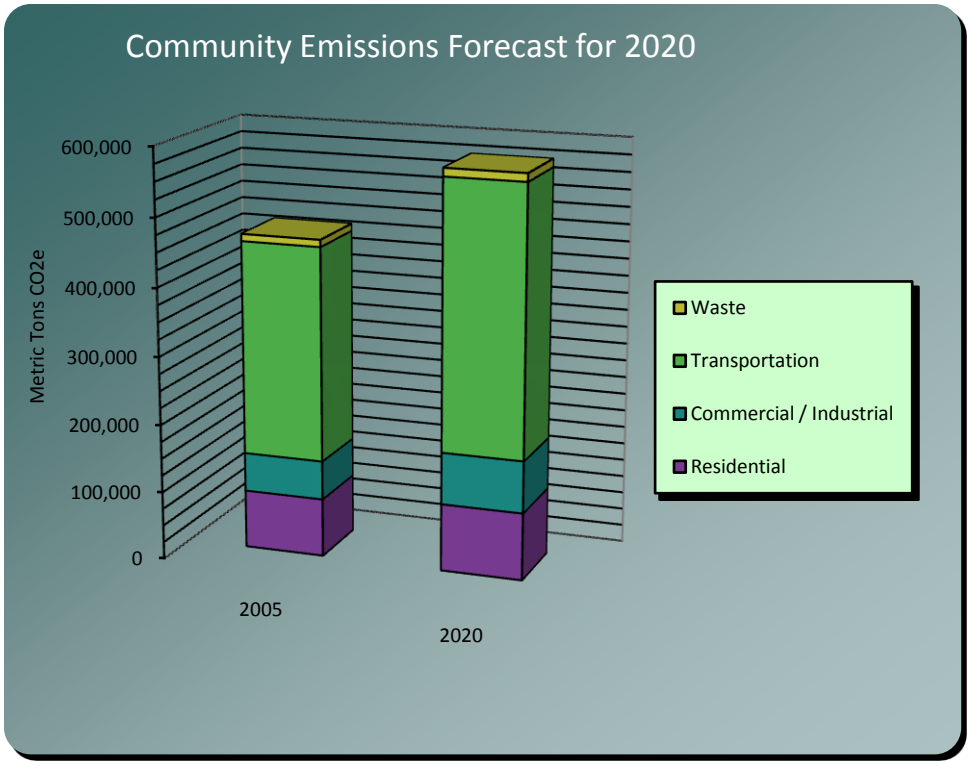
Table Y: 2005 Community Emission Growth Forecast by Sector

Sector	2005 (metric tons $CO_2e_)$	2020 (metric tons CO_2e)	Annual Growth Rate	Percent Change from 2005 to 2020
Waste	**10,361**	11,969	0.97%	15.5%
Commercial / Industrial	**56,952**	75,951	1.94%	33.4%
Residential	**85,418**	98,676	0.97%	15.5%
Transportation	**313,160**	392,015	1.51%	25.2%
TOTAL	**465,892**	**578,611**	--	**24.2%**

[25] US EPA AP 42.

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

Figure 18: Community Emissions Forecast for 2020



4.3.1 RESIDENTIAL

For the Residential Sector, a population projection for the City of Novato, which was conducted by the Association of Bay Area Governments (ABAG), was used to estimate average annual compound growth in energy demand (1.51 percent). ABAG estimates that the City of Novato population was 50,900 in base year 2005, and will be 58,800 in target year 2020.

4.3.2 COMMERCIAL / INDUSTRIAL

Analysis contained within *California Energy Demand 2008-2018: Staff Revised Forecast*[27], a report by the California Energy Commission (CEC), show 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 the City of Novato also provided

[27] http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF

by ABAG, it was calculated that the average annual growth in energy use in the Commercial / Industrial Sector between base year 2005 and target year 2020 will be 1.94 percent.[28]

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 the City of Novato. 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 (VMT). In its report, *Forecast of the Transportation Energy Demand, 2003-2023*[29], 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 City of Novato forecast.

4.3.4 WASTE GENERATION

As with the Residential Sector, population is the primary determinate for growth in emission pertaining to waste generation (Information Item). Therefore, the average annual population growth rate from base year 2005 to target year (0.97 percent, as calculated from above population projections) was used to estimate future emissions from waste disposal.

[28] See Appendix B for more detail.

[29] 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 the City of Novato's 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 the City of Novato 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 the City of Novato's ability to monitor its progress toward achieving its climate protection goals over time, ICLEI recommends that the City of Novato 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), the City of Novato will be able to inventory greenhouse gas emissions every two to three years in an efficient and protocol-compliant manner.

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)	CO_2e Output (metric tons)	N_2O Output (metric tons)	CH_4 Output (metric tons)	Combined Output (metric tons CO_2e)
Residential	Electricity	129,375,145	kWh	465,751	28,923	4.00	3.20	30,274
	Natural Gas	10,310,521	Therms	1,087,554	54,697	1.03	6.08	55,145
TOTAL		**139,685,666**		**1,553,304**	**83,620**	**5.03**	**9.28**	**85,418**
Commercial	Electricity	139,193,168	kWh	501,095	31,118	4.46	3.44	32,571
	Natural Gas	3,422,593	Therms	361,015	18,157	0.34	2.02	18,305
Industrial	Electricity	16,162,716	kWh	58,186	5,034	0.52	0.40	5,203
	Natural Gas	163,261	Therms	17,221	866	0.02	0.10	873
TOTAL		**158,941,738**		**937,517**	**55,174**	**5.33**	**5.96**	**56,952**

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 Kathy Robinson, Management Analyst I, City of Novato, krobinson@ci.novato.ca.us; 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. 12.07 percent of "non-residential" electricity consumption in Contra Costa County was DA in 2005 according to the CEC.

TRANSPORTATION SECTOR NOTES

DATA INPUTS / OUTPUTS SUMMARY:

Sector	Fuel	Quantity	Units	Energy Output (MMBtu)	CO_2e Output (metric tons)	N_2O Output (metric tons)	CH_4 Output (metric tons)	Combined Output (metric tons CO_2e)
State Highway	Gasoline	390,294,547	VMT[30]	2,856,820	186,048	27.32	25.37	195,050
	Diesel	18,390,843	VMT	338,130	26,160	0.92	0.55	26,456
Local Roads	Gasoline	161,494,798	VMT	1,182,086	76,982	11.30	10.50	80,707
	Diesel	4,609,703	VMT	139,910	10,824	0.38	0.23	10,947
TOTAL		**574,789,891**		**4,516,946**	**300,014**	**39.93**	**36.65**	**313,160**

[30] VMT – Vehicle Miles Traveled

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	0.07	0.03	0.07	0.05	95.5%	4.5%	8,63	9,96	89.2%	10.8%	18.1	7.0
BAAQMD Average	463	1,389	0.06	0.03	0.07	0.05	94.9%	5.1%	8,61	10,09	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 Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; 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 Richmond roads and state highways.

WASTE SECTOR NOTES

DATA INPUTS / OUTPUTS SUMMARY:

Sector	Fuel	Quantity	Units	Energy Output (MMBtu)	CO_2e Output (metric tons)	N_2O Output (metric tons)	CH_4 Output (metric tons)	Combined Output (metric tons CO_2e)
Waste	Plant Debris	40	(tons)	0	0	0	37	768
	Wood/Textiles	60	(tons)	0	0	0	48	1,017
	Paper Products	21	(tons)	0	0	0	234	4,923
	Food Waste	15	(tons)	0	0	0	92	1,937
	Plant Debris	7	(tons)	0	0	0	25	519
	Wood/Textiles	22	(tons)	0	0	0	69	1,446
TOTAL		**164**					**505**	**10,610**

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 Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; 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	Cost	Units	Energy Output MMBtu	CO_2e Output metric tons	N_2O Output metric tons	CH_4 Output metric tons	Combined Output metric tons CO_2e
Building & Facilities	503 S Palm Drive	Natural Gas	2,438	$ 3,145	therms	257.16	12.93	0.00	0.00	13.04
		Electricity	22,848	$ 3,461	kWh	82.25	5.11	0.00	0.00	5.35
		Sub-total	**25,286**	**$ 6,606**		**339.41**	**18.04**	**0.00**	**0.00**	**18.39**
	815 De Long Avenue	Natural Gas	652	$ 874	therms	68.77	3.46	0.00	0.00	3.49
		Electricity	8,078	$ 1,179	kWh	29.08	1.81	0.00	0.00	1.89
		Sub-total	**8,730**	**$ 2,053**		**97.85**	**5.26**	**0.00**	**0.00**	**5.38**
	853 Reichert Avenue	Natural Gas	1,146	$ 1,598	therms	120.88	6.08	0.00	0.00	6.13
		Electricity	17,188	$ 2,446	kWh	61.88	3.84	0.00	0.00	4.02
		Sub-total	**18,334**	**$ 4,044**		**182.76**	**9.92**	**0.00**	**0.00**	**10.15**
	Aggregate Minor Facilities	Natural Gas	3,223	$ 4,271	therms	339.96	17.10	0.00	0.00	17.24
		Electricity	20,450	$ 3,439	kWh	73.62	4.57	0.00	0.00	4.79
		Sub-total	**23,673**	**$ 7,710**		**413.58**	**21.67**	**0.00**	**0.00**	**22.02**
	City Hall Offices	Natural Gas	2,380	$ 3,587	therms	251.04	12.63	0.00	0.00	12.73
		Electricity	62,668	$ 8,509	kWh	225.60	14.01	0.00	0.00	14.66
		Sub-total	**65,048**	**$ 12,096**		**476.65**	**26.64**	**0.00**	**0.00**	**27.39**
	Corporation Yard	Natural Gas	2,354	$ 3,032	therms	248.30	12.49	0.00	0.00	12.59
		Electricity	60,600	$ 7,801	kWh	218.16	13.55	0.00	0.00	14.18
		Sub-total	**62,954**	**$ 10,833**		**466.46**	**26.04**	**0.00**	**0.00**	**26.77**
	Gymnastics Center	Natural Gas	7,943	$ 10,009	therms	837.83	42.14	0.00	0.00	42.48
		Electricity	174,240	$ 24,948	kWh	627.26	38.95	0.01	0.00	40.77
		Sub-total	**182,183**	**$ 34,957**		**1,465.09**	**81.09**	**0.01**	**0.01**	**83.25**
	Margaret Todd Senior Center	Natural Gas	4,082	$ 5,013	therms	430.57	21.66	0.00	0.00	21.83
		Electricity	221,840	$ 32,013	kWh	798.62	49.59	0.01	0.01	51.91
		Sub-total	**225,922**	**$ 37,026**		**1,229.19**	**71.25**	**0.01**	**0.01**	**73.74**
	Lou Sutton Childcare Center	Electricity	12,712	$ 2,161	(kWh)	45.76	2.84	0.00	0.00	2.97
		Sub-total	**12,712**	**$ 2,161**		**45.76**	**2.84**	**0.00**	**0.00**	**2.97**
	Museum	Electricity	9,627	$ 1,565	kWh	350.21	2.15	0.00	0.00	2.25
		Sub-total	**9,627**	**$ 1,565**		**34.66**	**2.15**	**0.00**	**0.00**	**2.25**
	Novato Public Finance	Natural Gas	14,321	$ 16,477	therms	1,510.58	75.97	0.00	0.01	76.59
		Electricity	192,640	$ 27,882	kWh	693.50	43.07	0.01	0.00	45.08
		Sub-total	**206,961**	**$ 44,359**		**2,204.08**	**119.04**	**0.01**	**0.01**	**121.67**
	Pedestal	Electricity	50,433	$ 5,276	kWh	350.21	11.27	0.00	0.00	11.80
		Sub-total	**50,433**	**$ 5,276**		**181.56**	**11.27**	**0.00**	**0.00**	**11.80**
	Police Station	Natural Gas	14,408	$ 17,280	therms	1,519.76	76.43	0.00	0.01	77.06
		Electricity	496,320	$ 59,765	kWh	1,786.75	110.96	0.02	0.01	116.14
		Sub-total	**510,728**	**$ 77,045**		**3,306.51**	**187.39**	**0.02**	**0.02**	**193.20**
	Skate Park	Electricity	10,880	$ 1,755	kWh	350.21	2.43	0.00	0.00	2.55
		Sub-total	**10,880**	**$ 1,755**		**39.17**	**2.43**	**0.00**	**0.00**	**2.55**
	Hamilton Swimming Pool	Natural Gas	19,439	$ 19,662	therms	2,050.43	103.12	0.00	0.01	103.97
		Electricity	97,280	$ 16,365	kWh	350.21	21.75	0.00	0.00	22.76
		Sub-total	**116,719**	**$ 36,027**		**2,400.63**	**124.87**	**0.01**	**0.01**	**126.73**
TOTAL			**1,530,190**	**$ 283,513**		**12,883.37**	**709.91**	**0.05**	**0.08**	**728.27**

Sector	Facility or Record	Fuel	Quantity	Cost	Units	Energy Output MMBtu	CO_2e Output metric tons	N_2O Output metric tons	CH_4 Output metric tons	Combined Output metric tons CO_2e
Lighting	Outdoor Lighting	Electricity	52,097	$ 6,980	(kWh)	187.55	11.65	0.00	0.00	12.19
	Traffic Signals	Electricity	161,947	$ 24,623	(kWh)	583.01	36.20	0.01	0.00	37.90
	Streetlights	Electricity	1,425,158	$ 151,701	(kWh)	5,130.57	318.60	0.05	0.04	333.49
TOTAL			**1,639,202.00**	**$ 183,304**		**5,901.13**	**366.46**	**0.05**	**0.04**	**383.57**
Water	Sprinklers Irrigation	Electricity	17,824	$ 4,797	(kWh)	64.17	3.98	0.00	0.00	4.17
	Water Delivery Pumps	Electricity	117,435	$ 18,110	(kWh)	422.77	26.25	0.00	0.00	27.48
TOTAL			**135,259.00**	**$ 22,907**		**486.93**	**30.24**	**0.00**	**0.00**	**31.65**

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 Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; 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	Fuel / Input	Quantity	Cost	Units	Energy Output MMBtu	CO_2e Output metric tons	N_2O Output metric tons	CH_4 Output metric tons	Combined Output metric tons CO_2e
Vehicle Fleet	Public Works	*VMT*	*295,395*							
		Gasoline	23,446	$ 23,446	gallons	2,945	293	N/A	323	299
		Diesel	8,557	$ 8,557	gallons	8,557				
	SUB TOTAL		**32,003**	**$ 74,294**		11,502				
	Police	*VMT*	*502,979*							
		Gasoline	59,353	$134,316	gallons	7,455	523	N/A	254	526
		Diesel	-		gallons	-				
	SUB TOTAL		**59,353**	**$ 134,316**		7,455				
TOTAL			**91,356**	**$208,610**		**18,957**	**826**	**N/A**	**577**	**8277**

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 CO2 / 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.

DATA SOURCES:

Fuel Consumption: Mike Brunelle, Public Works, mbrunelle@ci.novato.ca.us.

ADDITIONAL NOTES:

Data entered by Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org.

WASTE SECTOR NOTES

DATA INPUTS / OUTPUTS SUMMARY:

Sector	Address Location	Fuel	Waste	Units	CH_4 Output metric tons	Combined Output metric tons CO_2e
Waste	1174 Leafwood Heights	Paper Products	0.51	(tons)	0.011828	0.25
		Food Waste	0.13	(tons)	0.001665	0.03
		Plant Debris	0.22	(tons)	0.001637	0.03
		Wood/Textiles	0.09	(tons)	0.000569	0.01
		All Other Waste	0.35	(tons)	0.000000	0.00
			1.30		**0.015700**	**0.33**
	1530 S Novato Blvd	Paper Products	0.51	(tons)	0.011828	0.25
		Food Waste	0.13	(tons)	0.001665	0.03
		Plant Debris	0.22	(tons)	0.001637	0.03
		Wood/Textiles	0.09	(tons)	0.000569	0.01
		All Other Waste	0.35	(tons)	0.000000	0.00
			1.30		**0.015700**	**0.33**
	O Hanger Road	Paper Products	2.72	(tons)	0.062780	1.32
		Food Waste	0.68	(tons)	0.008839	0.19
		Plant Debris	1.17	(tons)	0.008689	0.18
		Wood/Textiles	0.46	(tons)	0.003021	0.06
		All Other Waste	1.87	(tons)	0.000000	0.00
			6.90		**0.083329**	**1.75**
	550 Davidson Street	Paper Products	38.45	(tons)	0.888022	18.65
		Food Waste	9.56	(tons)	0.125026	2.63
		Plant Debris	16.59	(tons)	0.122899	2.58
		Wood/Textiles	6.54	(tons)	0.042738	0.90
		All Other Waste	26.45	(tons)	0.000000	0.00
			97.60		**1.178685**	**24.75**
	909 Machin Street	Paper Products	8.20	(tons)	0.189251	3.97
		Food Waste	2.04	(tons)	0.026645	0.56
		Plant Debris	3.54	(tons)	0.026192	0.55
		Wood/Textiles	1.39	(tons)	0.009108	0.19
		All Other Waste	5.64	(tons)	0.000000	0.00
			20.80		**0.251195**	**5.28**
	75 Rowland Way	Paper Products	2.72	(tons)	0.062780	1.32
		Food Waste	0.68	(tons)	0.008839	0.19
		Plant Debris	1.17	(tons)	0.008689	0.18
		Wood/Textiles	0.46	(tons)	0.003021	0.06
		All Other Waste	1.87	(tons)	0.000000	0.00
			6.90		**0.083329**	**1.75**
	1560 Hill Road	Paper Products	5.48	(tons)	0.126470	2.66
		Food Waste	1.36	(tons)	0.017806	0.37
		Plant Debris	2.36	(tons)	0.017503	0.37
		Wood/Textiles	0.93	(tons)	0.006087	0.13
		All Other Waste	3.77	(tons)	0.000000	0.00
			13.90		**0.167866**	**3.53**
	950 7th Street	Paper Products	2.72	(tons)	0.062780	1.32
		Food Waste	0.68	(tons)	0.008839	0.19
		Plant Debris	1.17	(tons)	0.008689	0.18
		Wood/Textiles	0.46	(tons)	0.003021	0.06
		All Other Waste	1.87	(tons)	0.000000	0.00
			6.90		**0.083329**	**1.75**
	901 Sherman Avenue	Paper Products	3.59	(tons)	0.082797	1.74
		Food Waste	0.89	(tons)	0.011657	0.24
		Plant Debris	1.55	(tons)	0.011459	0.24
		Wood/Textiles	0.61	(tons)	0.003985	0.08
		All Other Waste	2.47	(tons)	0.000000	0.00
			9.10		**0.109898**	**2.31**
	Bldg 203 El Bonito	Paper Products	3.35	(tons)	0.077338	1.62
		Food Waste	0.83	(tons)	0.010888	0.23
		Plant Debris	1.45	(tons)	0.010703	0.22
		Wood/Textiles	0.57	(tons)	0.003722	0.08
		All Other Waste	2.30	(tons)	0.000000	0.00
			8.50		**0.102652**	**2.16**
TOTAL			**173.20**		**2.091683**	**43.93**

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: contact name, waste hauler company, email, phone number.

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 Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; 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 Novato Disposal) 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 Novato facilities between 2005 and proxy year (2008). There are a few cases where actual tonnage data were available—most commonly with roll-off service provided by Novato Disposal, where the actual quantity of waste is weighed before dumping.

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:

$CO_2e = Wt * (1-R)A$

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

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:

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	Combined Output (metric tons CO_2e)
Employee Commute	Auto – Subcompact / Compact	Gasoline	138,486	VMT	80.87
	Auto – Mid-Size	Gasoline	147,688	VMT	86.25
	Auto – Full-Size	Gasoline	17,910	VMT	10.46
	Passenger Vehicle	Gasoline	None reported	VMT	-
	Light Truck/SUV/Pickup	Gasoline	156,724	VMT	91.52
	Vanpool Van	Gasoline	29,462	VMT	17.21
	Heavy Truck	Gasoline	17,854	VMT	10.43
	Motorcycles	Gasoline	24,836	VMT	14.50
	SUB TOTAL	**Gasoline**	**532,960**	VMT	**311.24**
	Auto – Subcompact / Compact	Diesel	None reported	VMT	-
	Auto – Mid-Size	Diesel	None reported	VMT	-
	Auto – Full-Size	Diesel	None reported	VMT	-
	Passenger Vehicle	Diesel	None reported	VMT	-
	Light Truck/SUV/Pickup	Diesel	8,560	VMT	5.06
	Vanpool Van	Diesel	None reported	VMT	-
	Heavy Truck	Diesel	None reported	VMT	-
	Motorcycles	Diesel	None reported	VMT	-
	SUB TOTAL	**Diesel**	**8,560**	VMT	**5.06**
TOTAL			**541,520**	**VMT**	**316.30**

EMISSION FACTORS:

Emission factors derived from the CACP Software.

DATA SOURCES:

City of Novato Employees, via the Employee Commute Survey.

ADDITIONAL NOTES:

Data entered by Kathy Robinson, Management Analyst, City of Novato, krobinson@ci.novato.ca.us; with help from Wesley Look, Program Officer, ICLEI, wesley.look@iclei.org.

To calculate emissions, City of Novato 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.

These weekly data were then converted into annual VMT data by multiplying each week by 52 (the approximate number of weeks in a year). It was assumed that employees took an average of 10 sick days, 10 vacation days and 10 holiday days within the year. VMT data were then entered into the CACP software, which converts VMT to fuel use based on default fuel efficiency by vehicle type.

This particular survey received a response rate of 43percent of total employees. In order to estimate total emissions from employee commute patterns, the emissions from the sample were extrapolated to 100 percent. Current staff responded to the survey, and therefore, current commute patterns are being used to estimate (proxy) 2005 patterns.

APPENDIX D: EXAMPLE EMPLOYEE COMMUTE SURVEY

For the year 2007, please make your best estimate for the following questions:

1. How did you travel to work? (Check only one)
   - ☐ Drive alone
   - ☐ Carpool
   - ☐ Bike
   - ☐ Take Public Transit
   - ☐ Walk

2. If you carpooled, how many other City of Novato Employees traveled with you on average? (Check only one)
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6
   - ☐ 7
   - ☐ 8 or more

3. For 2007, if you drove, what type of vehicle did you drive most often? (Check only one)
   - ☐ Auto - Full-size
   - ☐ Auto - Mid-size
   - ☐ Auto – Compact
   - ☐ Heavy Truck
   - ☐ Light Truck/SUV
   - ☐ Motorcycle
   - ☐ Van
   - ☐ Other

4. For 2007, what type of fuel did your commuter vehicle use? (Check only 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 2007?
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6
   - ☐ 7

6. On average, how many miles did you travel to work round trip each day during 2007? _____ miles

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

1. How did you travel to work? (Check only one)
   - ☐ Drive alone
   - ☐ Carpool
   - ☐ Bike
   - ☐ Take Public Transit
   - ☐ Walk

2. If you carpooled, how many other City of Novato Employees traveled with you on average? (Check only one)
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6
   - ☐ 7
   - ☐ 8 or more

3. For 2005, if you drove, what type of vehicle did you drive most often? (Check only one)
   - ☐ Auto - Full-size
   - ☐ Auto - Mid-size
   - ☐ Auto – Compact
   - ☐ Heavy Truck
   - ☐ Light Truck/SUV
   - ☐ Motorcycle
   - ☐ Van
   - ☐ Other

4. For 2005, what type of fuel did your commuter vehicle use? (Check only 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?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ Not employed in 2005

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

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ Not employed in 2005

Whether or not you worked for the City of Novato in 2005, please answer these final questions.

1. If an incentive were available, would you be willing to use mass transportation?

- ☐ Yes
- ☐ No

2. Select a mass transportation mode that you would most likely use:

- ☐ Carpool
- ☐ van pool
- ☐ Take the bus
- ☐ Other
- ☐ Walk
- ☐ Commuter train
- ☐ Bicycle
- ☐ Other (please specify)

3. Have you completed a home energy audit in the location that you currently reside in?

- ☐ Yes
- ☐ No

4. Would you consider having a free home energy audit done for your current home?

- ☐ Yes
- ☐ No

5. If a commuter train were available in Marin and Sonoma counties, how often, per week, would you take the train to your job in Novato?

- ☐ Not at all
- ☐ Seldom
- ☐ 1-2
- ☐ 3
- ☐ 4
- ☐ Everyday

6. Where do you live? City: _____ County: _____

APPENDIX E: 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 CO2; and
12. Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution.

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