

# Marin County Re-Inventory of Greenhouse Gas Emissions

September 2007

*"It is the policy of the State that all State agencies consider and implement measures to reduce greenhouse gas emissions. This policy shall be incorporated into all state agencies' decision-making activities." –AB 32, Section 42875.1.*



Marin County Community Development Agency  
3501 Civic Center Drive, San Rafael, CA 94903

# Table of Contents

## Introduction

<i>Executive Summary</i>	2
<i>Review: County of Marin and Climate Protection</i>	4
<i>Scientific Background</i>	5

## Inventory Results

<b><i>Countywide Emissions</i></b>	<b>6</b>
Residential Building Energy Use	7
Commercial and Industrial	7
Transportation	7
Agriculture	8
Waste	8
<b><i>Internal Government Emissions</i></b>	<b>9</b>
Total Energy Use	9
Employee Commute	9
Vehicle Fleet	9
Building Energy Use	10
Streetlighting and Traffic Signals	10
Waste	10
Meeting Targets	11

## Next Steps 12

## Appendices

<b><i>A. Countywide Analysis and Data Notes</i></b>	<b>i</b>
<b><i>B. Government Operations Analysis and Data Notes</i></b>	<b>iii</b>
<b><i>C. Updates and Technical Revisions</i></b>	<b>v</b>



3501 Civic Center Drive  
San Rafael, CA 94903

**County of Marin  
Community Development Agency  
Sustainability Team**

Alex Hinds, Director  
Dawn Weisz, Senior Planner  
Omar Peña, Sustainability Aide  
Dru Krupinsky, Sustainability Intern  
Amelia Schmale, Sustainability Intern

[www.marinsustainability.org](http://www.marinsustainability.org)

# Executive Summary

## Marin County Climate Protection

In recognition of the growing consensus regarding both the threat of global climate change and the need for local municipalities to take action, the County of Marin Board of Supervisors voted to join the ICLEI- Local Governments for Sustainability Cities for Climate Protection (CCP) program in 2002. The program guides local governments through five milestones to inventory the production of greenhouse gas emissions, set reduction targets, create a local action plan, put the plan into implementation, and monitor results.

The first inventory of Marin County greenhouse gas emissions levels was published in June of 2003. Targets for reduction were set in August of the same year. After analyzing internal and countywide emissions, a target was set to voluntarily reduce greenhouse gas emissions 15% - 20% below 1990 levels by 2020 for internal government and 15% countywide. The County also developed a local action plan that was accepted by the Board of Supervisors in October 2006. Implementation of the action plan will commence pending resource availability.

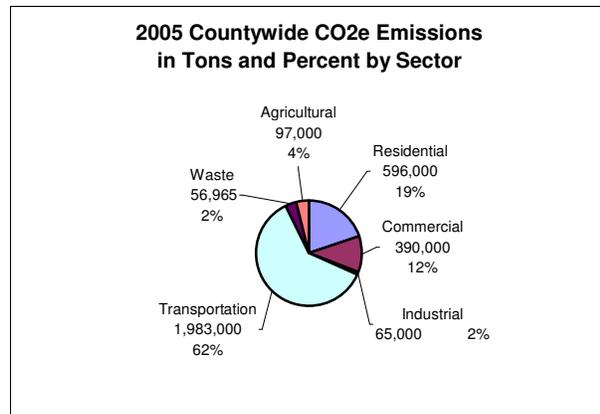
This report represents the fifth CCP milestone, to monitor progress and report results. However, it is not the end of the process. As the local action plan has just recently been adopted, effects of implementation will continue to emerge. The County will continue to monitor emission levels and other indicators in order to analyze the effectiveness of various reduction measures.

The inventory quantifies emissions of the three main greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrogen oxides (NO<sub>x</sub>). The unit of measure being used for greenhouse gas emissions throughout this report (as well as in the inventory itself) is tons of CO<sub>2</sub> equivalents (abbreviated CO<sub>2</sub>e).

## Re-Inventory Results: 2005

### Countywide:

Total Countywide greenhouse gas emissions of CO<sub>2</sub>e increased approximately 6% between 1990 and 2005 - from 3,005,674 to 3,188,522 tons CO<sub>2</sub>e. There was a larger increase between 1995 and the year 2000, but emissions decreased between 2000 and 2005 by over 60 thousand tons, or about 2%.



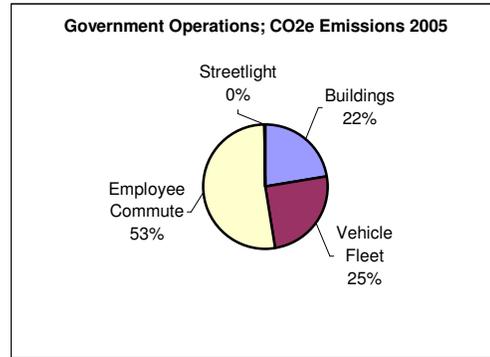
## **Countywide CO<sub>2</sub> Emissions**

Source	1990	1995	2000	2005
<b>TOTAL Tons CO<sub>2</sub>e</b>	<b>3,005,674</b>	<b>2,916,005</b>	<b>3,252,049</b>	<b>3,188,522</b>
<b>% Change from 1990</b>	<b>0%</b>	<b>-3%</b>	<b>8%</b>	<b>6%</b>

Internal Government:

Between 1990 and 2005, overall emissions from County government operation increased approximately 43%, or 7,267 tons. This increase is mostly due to an increase in vehicle miles traveled directly related to an increase in the number of FTE employees.

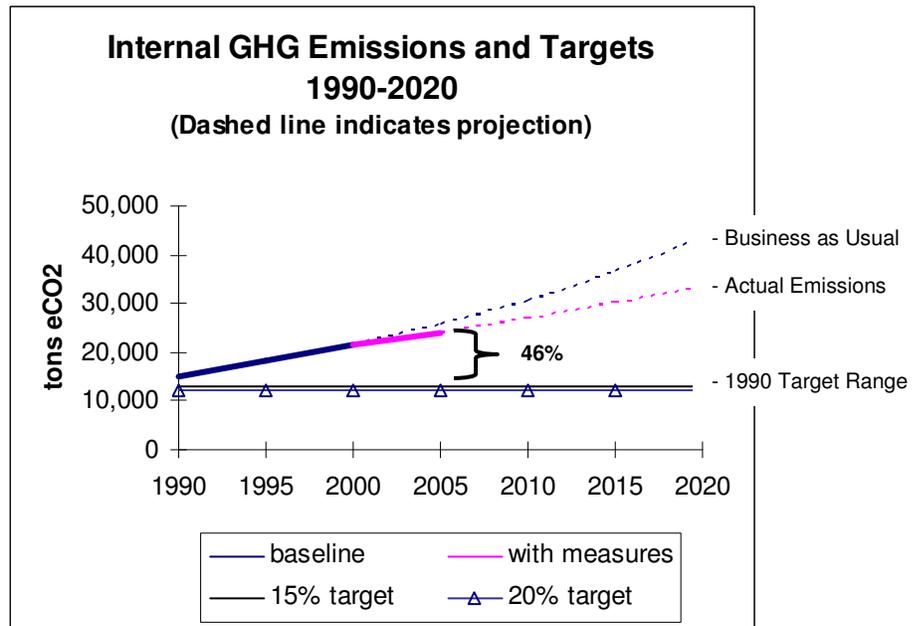
Based on this trend data current projections indicate that the rate of reduction achieved to date is not at a sufficient rate to meet the target of 15-20% below 1990 levels by 2020. However, between 2000 and 2005 the increase slowed dramatically and resulted in emissions levels measuring 8% lower than anticipated.



**Internal Government CO2 Emissions**

Sector	1990	2000	2005
<b>TOTAL (Tons CO2e)</b>	<b>16,857</b>	<b>21,685</b>	<b>24,124</b>
<b>% Change from 1990</b>	<b>0</b>	<b>29%</b>	<b>43 %</b>

Because many of the reduction measures and programs undertaken by the County have long-term implementation, it is likely that ongoing measures will continue to reduce GHG emissions, especially those from the County building sector. However, due to emissions increases since 1990, the County would need to reduce current emissions by 46% in order to meet the target of 15% below 1990 levels by year 2020.



## Review: County of Marin and Climate Protection

Marin County has long understood the importance of environmental stewardship and preservation. In May of 1999, the Marin County Board of Supervisors continued this legacy by unanimously approving a set of environmental sustainability recommendations. The Board committed the County to undertake actions such as public environmental education, improving County operations, and using sustainability as the foundation for the Countywide Plan Update.

During Earth Week 2002, the Board of Supervisors signed a resolution to join the Cities for Climate Protection Campaign (CCP). This campaign is administered under the International Council for Local Environmental Initiatives (ICLEI) and works to reduce international greenhouse emissions through actions by local governments.

CCP calls on municipalities to proceed through **five milestones** to reduce their contribution to climate change:

- 1) **Analyze greenhouse gas emission levels:** determine current greenhouse gas (GHG) emissions and forecast the growth in emissions that will occur without preventative action.
- 2) **Set a reduction target:** the target is the specific reduction that Marin aims to achieve by a designated year; e.g. 15-20% GHG reduction by 2020 for internal government and 15% countywide.
- 3) **Develop a local action plan:** this plan is a description of policies, programs, and measures that will be implemented in order to meet the target.
- 4) **Implement the local action plan:** follow through on the proposed actions.
- 5) **Monitor progress and report results:** determine the success of the plan.

The first inventory of greenhouse gas emissions levels was published in June of 2003 and reduction targets were set in August of the same year. As a result of analyzing emissions from internal government operations, as well as from the County as a whole, a target was set to voluntarily reduce greenhouse gas emissions 15% - 20% below 1990 levels by 2020 for internal government and 15% countywide. The County also developed a local action plan that was accepted by the Board of Supervisors in October 2006. Implementation of the action plan will commence pending staffing availability.

This report represents the fifth milestone, to monitor progress and report results, but it is not the end of the process. As the local action plan has only recently been adopted, effects of implementation will continue to emerge. The County will continue to monitor emission levels and other indicators in order to analyze the effectiveness of various reduction measures.

# Scientific Background on Climate Change

There is widespread agreement among climate scientists worldwide that human activity is increasing the concentration of greenhouse gases in the earth's atmosphere and accelerating global warming. While some greenhouse gases occur naturally, others are discharged into the atmosphere by certain human activities such as the burning of fossil fuels (for heating, electricity, and transportation), deforestation activities and some agricultural practices.

The potential consequences of global warming – some of which are already occurring – include:

- Increased frequency of extreme weather events
- Damage to natural habitats and ecosystems
- Dislocation of agricultural and commercial activities
- Glacial melting and thawing of Arctic tundra
- A rise in sea levels
- Desertification
- Increased possibility of large and/or abrupt regional or global climate changes

Local projections include:

- Increased flooding, erosion and sedimentation
- Increased risk of drought and a shrinking snow pack
- Increased risk of wildfires
- Risk of saltwater contamination in low-lying aquifers

Nine of the ten warmest years in the last four decades have occurred since 1990 and today's temperatures are rising three times faster than in the early 1900s.<sup>1</sup> During the 20th Century, global average surface temperatures increased about one degree centigrade. Over the next 100 years, temperatures are likely to increase another 2-10 degrees centigrade.

Atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) have skyrocketed over the past 150 years due to increased industrialization and per capita energy consumption. Global temperatures and changes in CO<sub>2</sub> concentrations have paralleled almost exactly in the same time period.

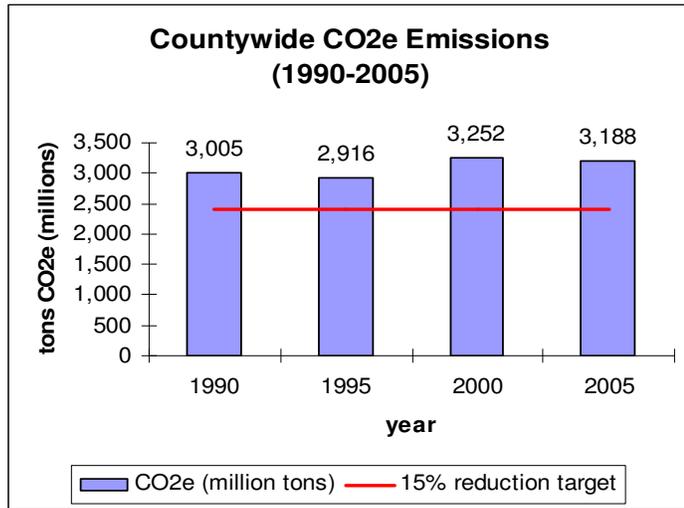
The United States represents just four percent of the world's population; yet, we produce 25 percent of anthropogenic greenhouse gas emissions. In California about half of our CO<sub>2</sub> emissions come from the transportation sector.

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<sup>1</sup> World Meteorological Organization – (<http://www.wmo.ch/web/Press/Press670.html>)

# Inventory Results: Marin Countywide GHG Emissions

Total Countywide greenhouse gas emissions increased approximately 9% between 1990 and 2005 - from 2,827,000 to 3,080,000 tons CO<sub>2</sub>e. There was a large increase between 1995 and the year 2000, but total countywide emissions decreased by about 3% between 2000 and 2005, some 100 thousand tons.

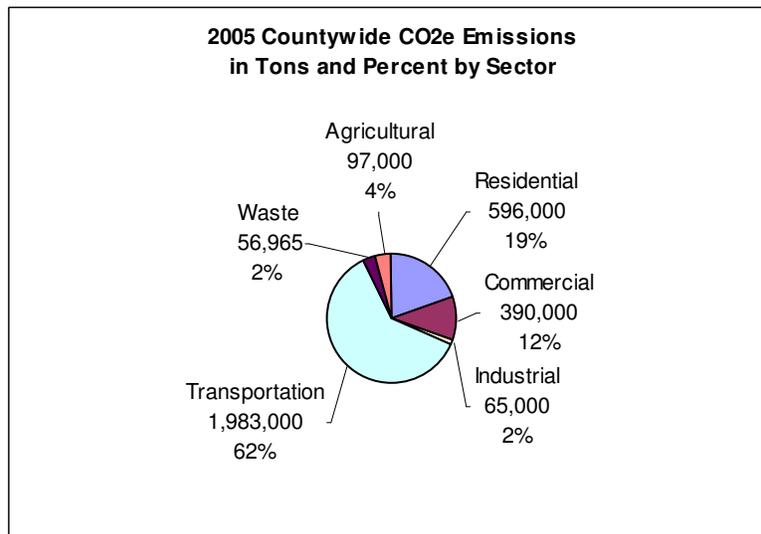


Countywide GHG emissions for all sectors are summarized in the table and pie chart below. All units are expressed in tons of CO<sub>2</sub>e.

## Countywide CO<sub>2</sub> Emissions

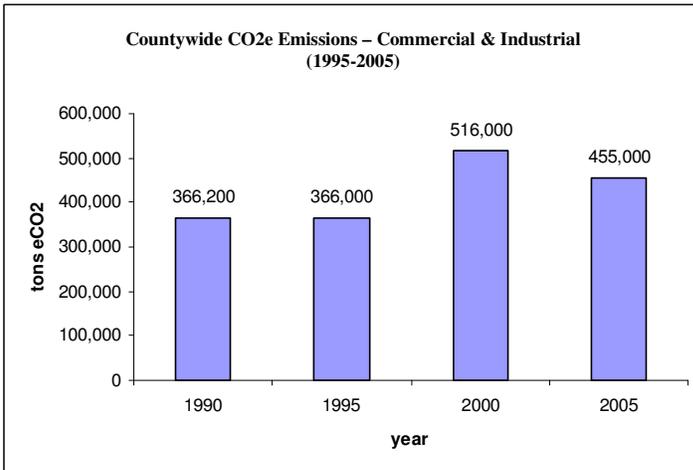
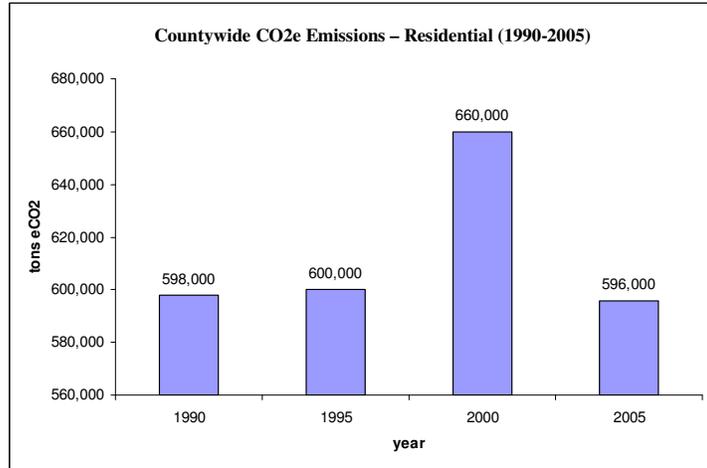
Source	1990	1995	2000	2005
Residential (% of Annual Total)	598,000 (20%)	600,000 (21%)	660,000 (20%)	596,000 (19%)
Commercial and Industrial	366,200 (12%)	366,000 (13%)	516,000 (16%)	455,000 (14%)
Transportation	1,849,400 (62%)	1,756,000 (60%)	1,933,000 (59%)	1,983,000 (62%)
Waste	74,054 (2%)	90,935 (3%)	36,757 (1%)	56,965 (2%)
Agriculture	118,000 (4%)	112,000 (4%)	107,000 (3%)	97,000 (3%)
<b>TOTAL Tons CO<sub>2</sub>e</b>	<b>3,005,674</b>	<b>2,916,005</b>	<b>3,252,049</b>	<b>3,188,522</b>
<b>% Change from 1990</b>	<b>0%</b>	<b>-3%</b>	<b>8%</b>	<b>6%</b>

Addition may not be exact due to rounding.



### Residential Building Energy Use

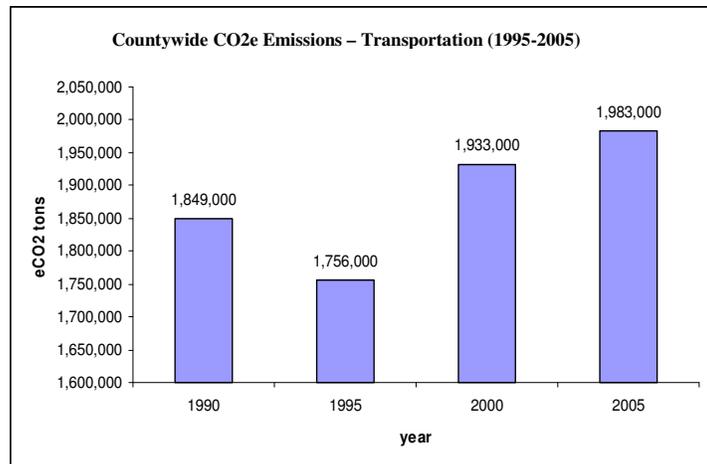
– Emissions from the residential sector saw a decrease between 2000 and 2005 and are slightly below 1990 levels. While electricity consumption continues to steadily rise, a decrease in natural gas use helped drive CO<sub>2</sub>e emissions in this sector down by approximately 10% since 2000.



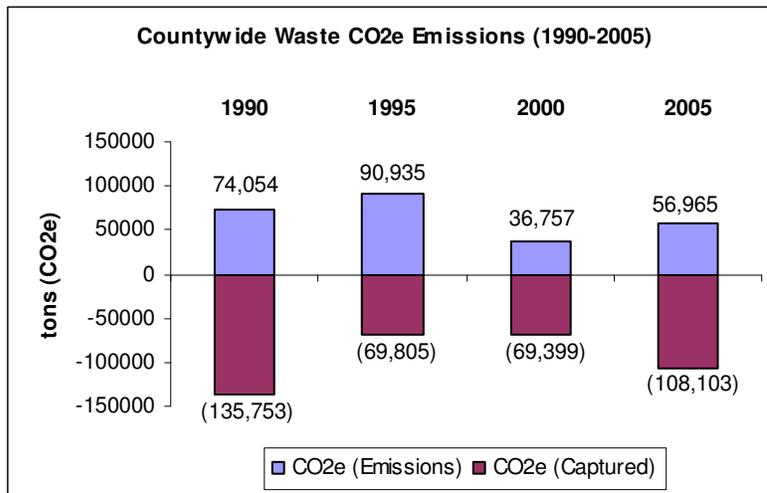
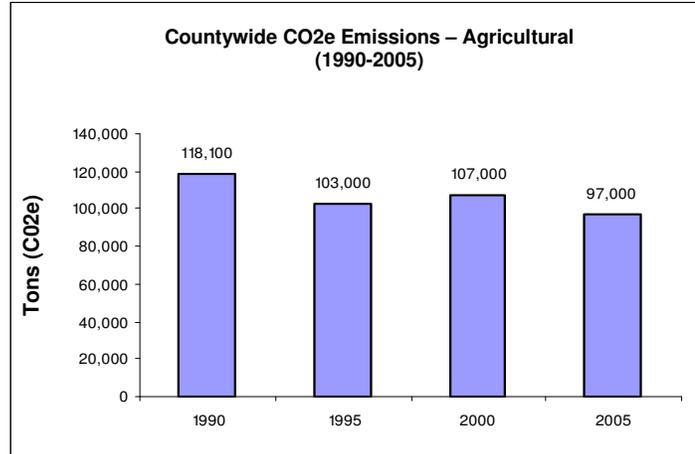
### Commercial and Industrial Energy Use

– Emissions produced by the commercial and industrial sectors increased quite dramatically until the year 2000 (almost 41%) but a 12% decrease between 2000 and 2005 helped bring the overall rate of increase since 1990 to 24%.

**Transportation** – Between 2000 and 2005, GHG emissions from transportation increased by 2.6%. This increase brings total growth in this sector to 7.2% from 1990 levels and is consistent with the trend of continuing increases. The software used to calculate greenhouse gas emissions in this report applies coefficients to measure the effect of newer, more efficient cars replacing older vehicles that consume more fuel per mile.



**Agricultural Emissions** – GHG emissions in this sector have decreased by almost 18% since 1990. There was a slight increase between 1995 and 2000, but emissions declined again between 2000 and 2005 to a total of 97,000 tons CO<sub>2</sub>e. This may be the result of some methane-recovery at Marin’s largest dairy farm as well as a general decrease in the amount of cattle in the County.



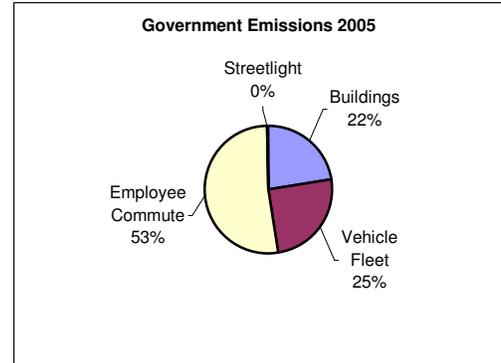
**Waste** – The waste sector can be a significant contributor of the greenhouse gas methane. However, due to methane recovery at the landfill, some GHG emissions are avoided as the methane that would be released by the decomposition of organic materials is captured and converted to CO<sub>2</sub>, which has a lower GHG impact.

Since disposed tons of waste in the County increased by nearly 84,000 tons between 2000 to 2005, there was an increase of 20,208 tons of CO<sub>2</sub>e. The modeling data used in this report is not capable of including a full life-cycle analysis of waste generation. If included, factors such as the energy used to create and transport the products that enter the waste stream would cause a significant increase in the total GHG impact. In addition, local practices such as using green waste (which is counted as ‘diverted’) as daily cover in the landfill, is not factored into the analysis and could also have an impact on total GHG calculations.

# Inventory Results: Internal Government GHG Emissions

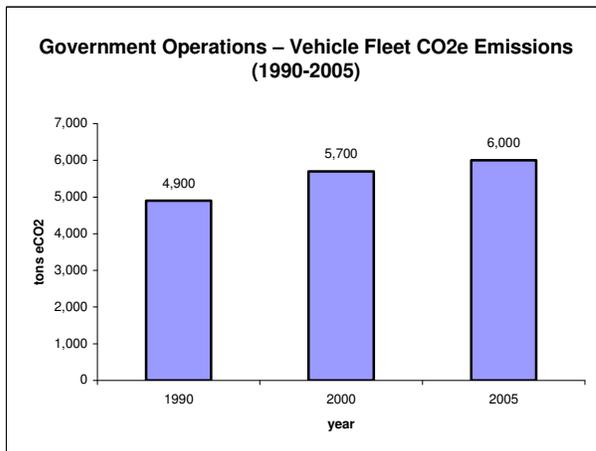
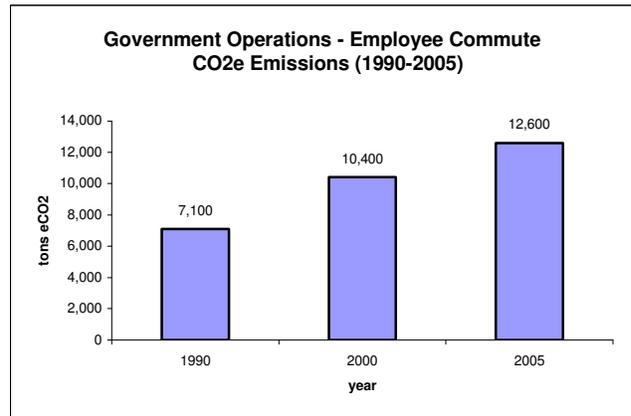
## Internal Government CO2 Emissions

Sector	1990	2000	2005
Buildings (% of Annual Total)	3,100 (18%)	5,500 (25%)	5,400 (22%)
Vehicle Fleet	4,900 (29%)	5,700 (26%)	6,000 (25%)
Employee Commute	7,100 (42%)	10,400 (48%)	12,600 (52%)
Streetlights	52 (0.3%)	43 (0.2%)	42 (0.2%)
Waste	28.8 (0.2%)	18.9 (0.1%)	15.5 (0.1%)
<b>TOTAL (Tons CO2e)</b>	<b>16,857</b>	<b>21,685</b>	<b>24,124</b>
<b>% Change from 1990</b>	<b>0</b>	<b>29%</b>	<b>43%</b>



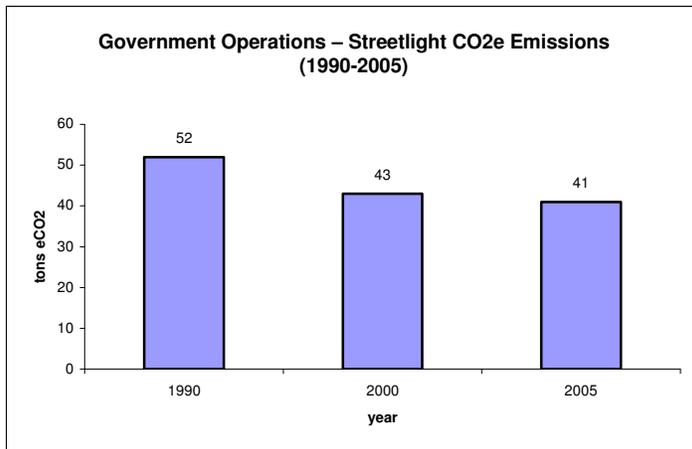
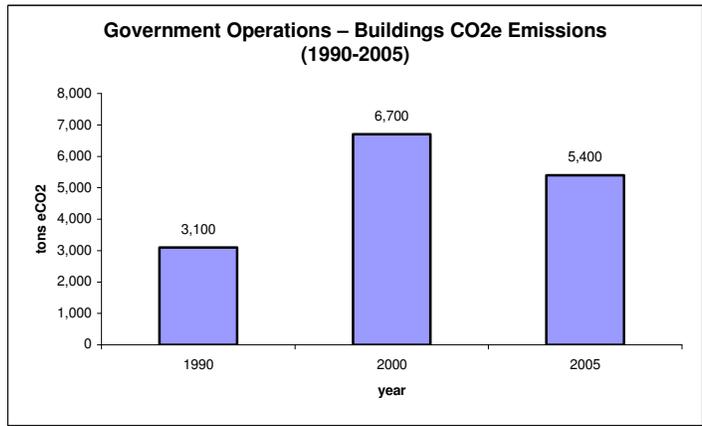
**Total Energy Use** – Between 1990 and 2005, overall emissions from County government operation have increased approximately 43, or 7,267 tons. This increase is mostly due to an increase in vehicle miles traveled in employee commuting and by the county fleet. Street lighting is the smallest contributor to GHG emissions.

**Employee Commute** – Based on the analysis of a 2002 transportation study, it was determined that 7,344 miles were generated for every full-time equivalent (FTE) employee. Growth in this sector is due to an increase in the number of FTE employees.

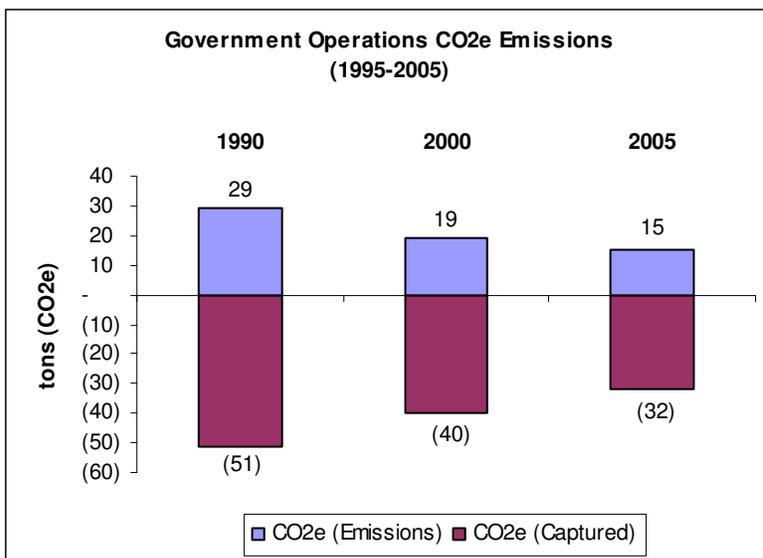


**Vehicle Fleet** – As in the community at large, transportation continues to be the most prevalent source of GHG emissions for County operations. The trend is starting to reverse however, as the rate of growth in Vehicle Fleet emissions has slowed from 1.6% per year (between 1990 -2000) to approximately 1% per year (2000-2005). As more hybrids are added to the County vehicle fleet and older vehicle are retired, this rate is likely to decrease further.

**Building Energy Use** – There was a modest decline in CO<sub>2</sub>e emissions from County buildings. Most of the reductions can be attributed to more efficient buildings and some installed solar power. With more photovoltaic systems expected to be online soon, along with ongoing efforts from the department of Public Works and the Community Development Agency, this area is likely to see continued emissions reductions.

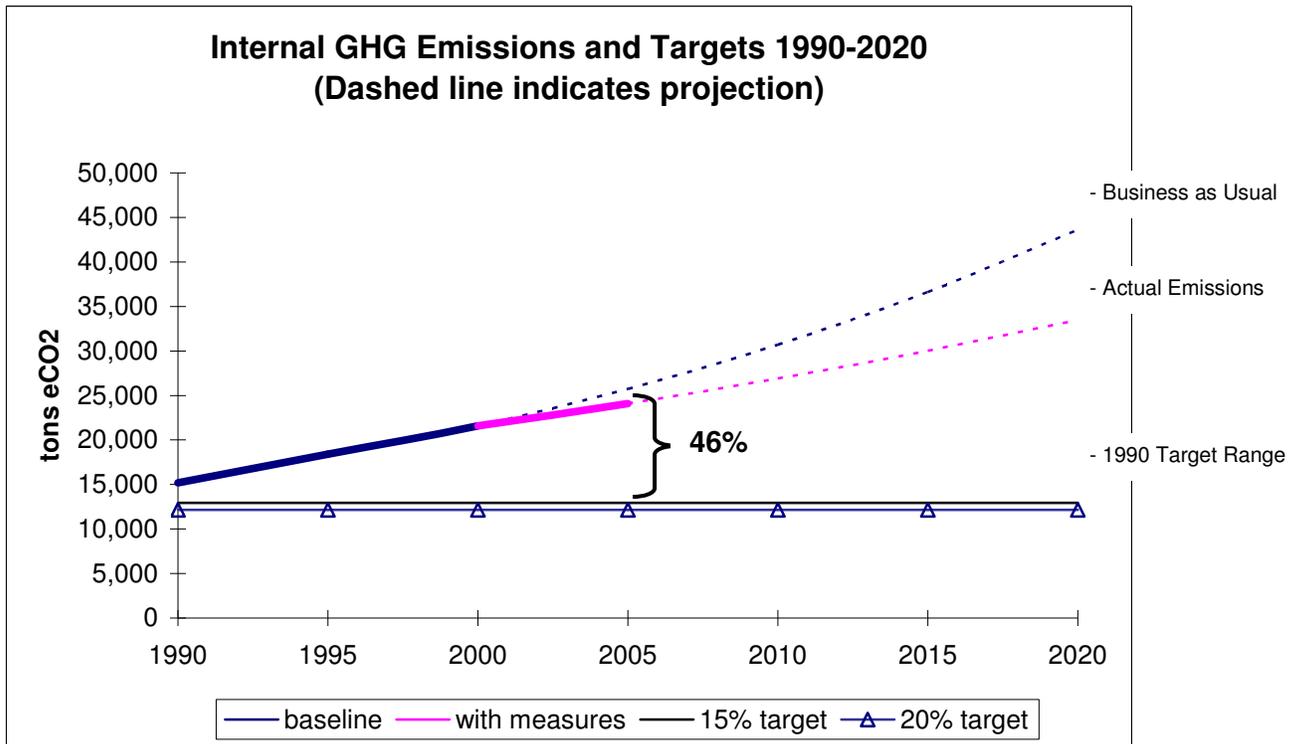


**Streetlighting and Traffic Signals** - Emissions in this sector decreased approximately 0.5% per year between 2000 and 2005. This rate of decrease is not quite as robust as that achieved between 1990 and 2000, which can be traced to one-time efforts such as replacing traditional lights with more efficient Light Emitting Diodes (LEDs).



**Waste** – The Civic Center’s accomplishment of decreasing its volume of disposed waste by 34 tons between 1990 and 2005 has resulted in a 13 ton decrease in GHG emissions during this timeframe. This decrease is primarily due to an increase in waste diversion through recycling practices.

# Meeting Targets



While government operations emissions grew by approximately 11% between 2000 and 2005, GHG emissions were 8% lower than they would have been under a business as usual scenario. As illustrated in the chart above, current projections indicate that the reductions achieved to date are at an insufficient rate to meet the target of 15-20% below 1990 levels by 2020. Because many of the reduction measures and programs undertaken by the County are just moving into implementation, it is likely that GHG emission reductions, both internally and countywide, will continue to be seen, especially in the building sector. However, due to emissions increases since 1990, the County would need to reduce current emissions by 46% in order to meet the target of 15% below 1990 levels by year 2020.

The portion of the total internal government GHG emissions represented by employee commute emissions increased from 47% to 52% in 2005. As building energy efficiency measures and Vehicle Fleet upgrades continue to be successful, it will become increasingly important to address the employee commute sector.

## Next Steps

To continue its commitment to climate protection, the following next steps are possible:

### **Implement the Climate Action Plan**

The Marin County Climate Action Plan was adopted by the Board of Supervisors in October, 2006 and is awaiting implementation. The implementation plan is based on many policies and programs in the draft Countywide Plan. The implementation of the Climate Action Plan will help drive the County towards its climate action goals.

### **Implement the Countywide Plan**

The draft Countywide Plan (CWP) due for adoption in October, 2007 takes climate change and climate protection into account and identifies the minimization of greenhouse gas emissions as a County goal (Goal AIR-4). The Plan names policies for the reduction of heat trapping gases and identifies opportunities for energy efficiency and conservation in buildings, transportation, waste, and agriculture. The CWP calls on the County to integrate climate change concerns into the planning process and to work with regional governments to collaborate on climate action. Lastly, the plan encourages the implementation of and further research into carbon sequestration techniques including the conservation and restoration of carbon sinks such as soils and trees.

### **Continue to Pursue the Feasibility of Community Choice Aggregation**

The County has been working with all the cities in Marin to explore the feasibility of forming a Community Choice Aggregation (CCA) entity. If formed, a CCA would allow local government to act as the power purchaser for the community and increase the amount of renewable (solar, wind, small hydroelectric) energy in the local power supply. The draft CCA business plan for Marin estimates that a reduction in greenhouse gas emissions of between 174,000 and 308,000 tons per year is possible by 2017, as the renewable resources procured and developed by the CCA would displace production from natural gas fueled power plants.

### **Consider Participation in the California Climate Action Registry**

Marin County will consider participating in a registry of greenhouse gas emissions. The California Climate Action Registry, established by state government statute as a non-profit voluntary GHG registry, allows companies and organizations to register GHG emissions baselines against which any future GHG emission reduction requirements may be applied.

The Registry encourages voluntary actions to increase energy efficiency and decrease GHG emissions. Participants record their GHG emissions inventory; the State of California will, in turn, offer its best efforts to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international GHG regulatory scheme. Registry participants include businesses, non-profit organizations, municipalities, state agencies, and other entities.

### **Assist Marin Cities in Climate Protection Process**

The County of Marin will continue to assist local cities in the climate protection process. Cities are able to contact county staff in the Community Development Agency for technical assistance including greenhouse gas inventorying.

### **Re-inventory County Emissions and Monitor Progress**

The County will continue to monitor internal and countywide emission levels and other indicators in order to analyze the effectiveness of various reduction measures.

# Appendix A – Countywide Analysis and Data Notes

## **Units**

The inventory covers the three main greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrogen oxides (NO<sub>x</sub>). The unit of measure being used for greenhouse gas emissions throughout this report (as well as in the inventory itself) is tons of CO<sub>2</sub> equivalents (abbreviated CO<sub>2</sub>e). Using an equivalence factor allows common comparisons to be made between a variety of greenhouse gases and relate them to the most prevalent one (carbon dioxide), even though each greenhouse gas has a different potential for global warming due to differing characteristics in the atmosphere. Using the common metric — CO<sub>2</sub>e — provides the ability to compare the greenhouse gas impacts of widely different activities.<sup>2</sup>

## **Energy Use**

Data was obtained directly from PG&E through the Marin Energy Watch Partnership. The residential sector is very reliable. The Industrial and Commercial sectors were combined due to a discontinuity with the previous distinction between the two categories in the 2003 GHG Inventory. As there is very little industrial activity in the County, combining these two sectors does not have a significant impact on the results. Although emissions from the three sectors (Residential, Commercial, and Industrial) are not calculated differently by the GHG software, they are tracked separately to aid analysis.

## **Transportation**

Countywide Vehicle Miles Traveled (VMT) was the primary input used to calculate GHG emissions in this sector. These data were obtained from the California Department of Transportation; Division of Transportation System Information, Motor Vehicle Stock, Travel, and Fuel (MVSTAFF) Forecast 2005.

The GHG modeling software uses coefficients to measure the effect of newer, more efficient cars gradually replacing older vehicles that consume more fuel per mile. In the period between 1990 and 1995, the overall increase in vehicle miles were moderate so total GHG emissions in this sector actually show a decrease. However, during the next period (1995 to 2000) the increase in vehicle miles traveled outpaced the savings accrued from new cars entering the vehicle fleet and the net effect was an increase in GHG emissions.

## **Waste**

In this sector, the primary input is tons of waste disposed. Data generally was obtained through the California Integrated Waste Management Board (CIWMB). The preliminary disposed tonnage figure for 2005 is currently 231,146 tons.

## **Agriculture**

Agriculture-related greenhouse gas emissions were computed by summing the methane directly emitted by animals, the methane produced during manure decomposition, and the N<sub>2</sub>O produced during manure decomposition. The calculations follow the process prescribed by the United States Environmental Protection Agency (U.S. EPA) Emission

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<sup>2</sup> Adapted from The City of Denver Greenhouse Gas Emissions Inventory Summary, <http://www.greenprintdenver.org/about/reports.php>

Inventory Improvement Program (EIIP) handbook, volume 8, October 1999, Chapters 6 and 7. Equations, conversion factors, and national averages used for typical animal mass and other similar values were found in this report. Livestock populations were taken from the Census of Agriculture produced by the National Agriculture Statistics Service (NASS) and the U.S. Department of Agriculture in 1987, 1992, and 1997. These years' data were applied to the emissions totals for 1990, 1995, and 2000, respectively. The next Census of Agriculture was not yet available at the time of this report. As an interim approach, the 2005 GHG inventory uses an extrapolation based on the rate of change in methane and N<sub>2</sub>O output as determined by the 2003 GHG report.

# Appendix B – Government Operations Analysis and Data Notes

## General Notes

As County data is collected at ten year intervals, no internal operations data was collected specifically for 1995. All figures used in charts and tables were interpolated using the rate of change between 1990 and 2000.

## Buildings

Data for this sector is considered extremely reliable. All facilities covered by the 2003 GHG inventory are also represented here. The Government Ops building group is one of only two groups to achieve a reduction in GHG emissions between 2000 and 2005. The efforts of Marin Energy Watch (formerly Marin Energy Management Team) and the department of Public Works to monitor and reduce energy use in facilities operated by the County have been very successful. Inputs for this sector were entered in units of kilowatt-hours and therms per year. Data obtained from PG&E as well as the County's energy accounting software, Utility Manager 3.1. Buildings included in this analysis:

- Marin County Civic Center
- Marin County Airport
- Juvenile Hall
- Health Center
- IST, Bel Marin Keys
- Garage/radio shop/maintenance
- Nicasio Valley Corp Yard
- Marin County Jail
- Marin Parks and Recreation buildings
- Marin Open Space
- 65 & 161 Mitchell Street, San Rafael
- 120 Redwood Drive, San Rafael
- Flood Control # 1,3,4,7
- Storage Tower Near Water Cargo
- Reservoir Hill Radio
- Civic Center Fountain
- White Hills Pump
- Housing Authority Facility
- Marin City Fire Station, 850 Drake Ave.
- 10 & 20 N San Pedro, San Rafael

## Vehicle Fleet

This sector underwent extensive data revision since the previous GHG inventory and data reliability for this sector is now considered to be good. A new computerized tracking system enables the County to accurately track the gallons of fuel used in government vehicles. For previous GHG inventories, an estimate was generated using vehicle body types, average fuel efficiency, and approximate miles traveled. The new, more reliable data appeared to show a large increase in fuel use since 2000. After examining previous methodology, it was decided that previous data underestimated actual fuel use. New figures were extrapolated using the rate of increase in fuel consumption between 2003 and 2006.

## Employee Commute

New data was unavailable for this sector. Instead, an average based on past levels of emissions per employee was used to estimate current levels for the number of employees in 2005. As mentioned in the main body of text, this average was based on examination of a 2002 study prepared by the Department of Public Works. Potentially significant uncertainty exists in this sector due to the unique nature of the 2002 study data (based on individuals who may or may not still work for the County) as well as unknown changes between 2002 and the time of this inventory.

**Streetlights**

Data for this sector is considered extremely reliable. This sector represents the smallest percentage of total government emissions. The installation of LED bulbs, and other measures, has reduced CO2e emissions by slightly more than 20% since 1990.

**Waste**

Data, while extremely reliable, only represents waste generated at the Civic Center and does not cover the entirety of waste production due to County government activities. If other facilities are going to be added to this sector, it is recommended that tracking begin as soon as possible in order to facilitate collection of the 1990 data. All data, expressed in tons, was supplied by the Department of Public Works.

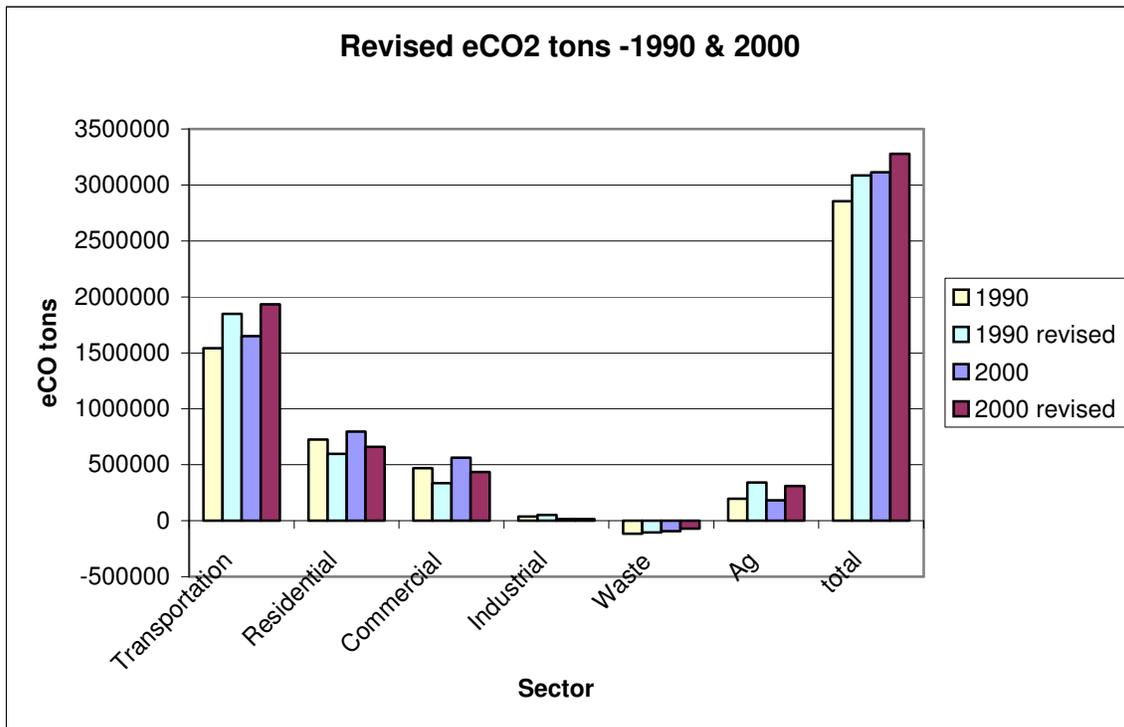
## Appendix C – Updates and Technical Revisions

The results of this inventory were obtained by inputting energy, transportation, and waste data into the modeling software provided by ICLEI- Local Governments for Sustainability to Cities for Climate Protection (CCP) participants.<sup>3</sup>

Information for years 1990 and 2000 included in this report may differ from the greenhouse gas (GHG) emissions data released in the 2003 GHG report. This is primarily due to two factors:

- Changes in the GHG modeling software
- Revision of primary input data

Major changes in the GHG modeling software center around the coefficients used to translate building energy use, vehicle travel, and industrial activities into equivalent tons of Carbon Dioxide (tons CO<sub>2</sub>e). The new formulas are designed to better reflect our region's electricity generation portfolio as well as the effect of new cars and fuel types on the transportation sector. Additionally, after review, some primary input data were revised. In most cases, these revisions were adjustments to earlier assumptions where no/limited data was available.



<sup>3</sup> STAPPA/ALAPCO and ICLEI Clean Air and Climate Protection Software Version 1.1 June 2005.