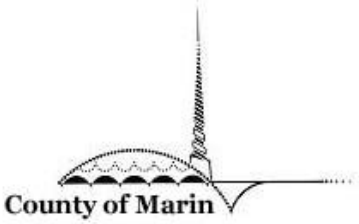
County of Marin
Cities for Climate Protection Campaign

Greenhouse Gas Emissions Analysis Report
June 2003

Alex Hinds, Director
Dawn Weisz, Sustainability Planner
Sam Ruark, Sustainability Planning Assistant
Gwen Johnson, Sustainability Planning Aide
Carey Knecht, Sustainability Planning Intern



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

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Background

Mounting scientific and economic information suggests that global climate change is a result of escalating greenhouse gas emissions and that immediate action to reduce these emissions should be taken to reduce its negative environmental, social and economic impacts.

The Intergovernmental Panel on Climate Change (IPCC), an international scientific body assembled by the United Nations Environment Program and the World Meteorological Organization, determined that "the balance of evidence suggests a discernible human influence on global climate."

In 1997, twenty-five hundred United States economists, including eight Nobel laureates, published a statement stating that economic research supports the following conclusions:

- Global climate change carries with it significant environmental, economic, social, and geopolitical risks.
- Preventive steps are economically justified.
- There are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs.
- For the United States in particular. . . there are policy options that would slow climate change without harming American living standards.
- These measures may in fact improve U.S. productivity in the longer run.

Global climate change will seriously affect local communities. Cities and counties in urban and suburban areas may experience damage to infrastructure, property, and natural resources as well as public health problems from prolonged heat waves, migrating disease patterns and an increase in asthma cases due to air pollution. As a coastal community, Marin will feel the impacts of rising sea levels profoundly.

Addressing climate change at a local level can have a significant impact, and, in the absence of federal action, is quite critical. Many local government policies – such as building codes, the arrangement of roads and neighborhoods, the provision of public transit, and waste management practices – seriously affect the amount of greenhouse gases released by a community. Each of these decisions affects the emissions not only now, but in the decades that the building or landfill is in existence. Therefore, and because of the potentially serious local impacts, city and county governments should act as quickly as possible to reduce greenhouse gas emissions.

Addressing climate change locally has numerous additional benefits. Actions that reduce greenhouse gases (GHGs) save money by reducing electricity and fuel use, savings that accrue to its citizens, businesses and institutions. Decreased energy costs, coupled with the growth of new technologies and services, such as renewable energy and energy efficiency, will be a boon to Marin's local economy.

County of Marin: Cities for Climate Protection Campaign Partner

In May of 1999, the Marin County Board of Supervisors unanimously approved a set of environmental sustainability recommendations. The Board of Supervisors 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 that began in 2000.

During Earth Week 2002, the Board 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 attempts 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. 20% GHG reduction by 2020.
3) **Develop a local action plan**: this plan is a description of policies, programs, and measures that Marin will implement in order to meet its 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 County has now finished its first analysis of greenhouse gas emissions levels and is currently working on developing an emissions reduction target.

Milestone 1: Results of Emissions Analysis

An inventory of 1990 greenhouse gas emissions shows levels to be approximately at 2,860 megatons of eCO2 (or 2.8 million tons). Overall, Marin has experienced an 8% increase in greenhouse gas emissions from 1990 to 2000. Unincorporated areas of Marin account for approximately 21% of greenhouse gas emissions in the County.

Year	**1990**	**2000**
Countywide (tons)		
Unincorporated	617,562	639,741
Incorporated	2,237,162	2,473,825
Total	2,634,003	3,113,565
Percentage growth	**+ 15%**	
Internal (tons)		
Total	16,945	18,451
Percentage growth	**+ 8%**	

Milestone 2: Establishing an Emissions target

Adopting a target and a timetable for its achievement is essential to foster not only political will but also to create a framework that guides planning and implementation of greenhouse gas-reducing measures. Two targets will be set, one for internal County government and one that is Countywide. Internal County government emissions will be significantly easier to effect because government operations that generate the majority of CO2 emissions, such as vehicle fleets,

building energy use and waste generation, can be directly influenced by internal policies and procedures. Countywide targets will be pursued by means of the Countywide Plan, energy and water conservation programs, and improvements in the efficiencies and alternatives to our current modes of transportation; because of the nature of these measures, the lead times to reduce CO2 can be considerably longer. The targets should be realistic and feasible, yet progressive. Initial investigation into targets for Marin suggests that what is appropriate given current growth patterns, availability of necessary technology to reduce emissions, and other pertinent trends is: 15% – 20% for County government, and 15% Countywide.

The targets should take into consideration the following:

1) Measures that have already been implemented to reduce emissions.

Internal: The County has taken many steps to reduce energy and water use and waste generation, where possible. Actions such as purchasing hybrids, retrofitting facilities for energy efficiency, lighting retrofits, providing commuter alternatives for employees and switching incandescent traffic signals to light emitting diodes (LEDs) have all helped the County reduce internal operation emissions by at least 4% over baseline levels.

Countywide: Recycling programs, energy rebate programs, the Green Business Program, renewable energy purchases and alternative fuel vehicles have all contributed to reducing overall greenhouse gas emissions.

2) Measures that will reduce emissions, as mandated by federal and state legislation.

Internal and Countywide: Legislation such as Senate Bill 58 and Assembly Bill 1493 will result in reduces emissions without action on the part of Marin County. SB 58 establishes a renewable portfolio standard (RPS) for California, which would require the utilities to increase their renewable power procurement by at least 1% each year, with the goal that 20% of the electricity sold to California customers come from renewable resources by 2015. AB 1493, the first of its kind in the nation, is a bill directing the California Air Resources Board (CARB) to adopt Corporate Average Fuel Economy (CAFE) standards for cars and light-duty trucks beginning with the model year 2009.

3) Additional County-level measures that can be feasibly and economically implemented.

Internal & Countywide: Potential measures that the County can engage in that will lead to meaningful decreases in CO2 emissions include investing in renewable energy, increasing the number of alternative fuels and alternative fuel vehicles, and additional energy and water conservation measures.

4) The Ecological Imperative.

When developing a short-term target, it is important to keep the longer-term effects of global climate change in mind. The "Ecological Imperative" refers to the broader view of how much greenhouse gas emissions need to be reduced in order to mitigate a global climate change crisis. One study suggests that by the end of the century a 60% reduction in global emissions is required to stabilize at current CO2 levels. Other studies suggest that the actual number is closer to 75-85% reduction just to maintain current levels of 370 parts per million (ppm). IPCC has demonstrated that if we reduce emissions by some large percentage during the next 100 years, it will still take 100-300 years to stabilize at the new level (somewhere between current levels of 370 ppm to 550 ppm). Temperatures would continue

to rise for another 300 years or more. Sea level will still be rising for the next 3000 years - even if we stabilize our emissions[1].

Target Breakdown

Below are tables that categorically separate the components of the greenhouse gas reductions target. For measures where there is not yet a method for assessing the CO2-reducing potential, they are listed at "to be determined" (TBD).

Internal County Government

TARGET YEAR	TARGET BREAKDOWN	Percentages
BY 2020	**What has already been achieved**	**Estimated CO2 Reduction To date**
1.A	Lighting/energy retrofits	2.4%
1.B	LED traffic signals	0.6%
1.C	Solar Installation (100 KW)	0.5%
1.D	Alternative fuel vehicles	0.1%
1.E	Recycling Programs	2%
1.F	Purchasing preferences for recycling	TBD
1.G	Employee Commuter Incentives	4%
	SUBTOTAL	**9.6%**
BY 2020	**What Can be Achieved through Mandates**	**Potential CO2 Reduction**
2.A	CAFE standards	1.5% – 3%
2.B	RPS	1.5% – 3%
	SUBTOTAL	**3% – 6%**
BY 2020	**Policy-Driven**	**Potential CO2 Reduction**
3.A	Green power purchases	5%
3.B	Add'l renewable energy investments	7%
3.C	Add'l alternative fuels	3%
	SUBTOTAL	**15%**
BY 2020	**Suggested Target**	**15-20%**

BY 2100	**The Ecological Imperative**	60%

[1] IPCC. Climate Change 2001: Synthesis Report. Third Assessment Report.

Unincorporated County

TARGET YEAR	TARGET BREAKDOWN	Percentages
BY 2020	**What has already been achieved**	**Estimated CO2 Reduction To date**
1.A	Green Business Program	TBD
1.B	Rebate Program	.5%
1.C	Energy Efficiency Ordinance	TBD
1.D	Alternative fuel vehicles	TBD
1.E	Recycling Programs	4%
1.F	Construction & Demolition Ordinance	TBD
1.G	Green Building Program	TBD
1.H	Solar Installations	.5%
	SUBTOTAL	**5%**
BY 2020	**What Can be Achieved through Mandates**	**Potential CO2 Reduction**
2.A	CAFÉ standards	1 – 3%
2.B	RPS	3% – 5%
	SUBTOTAL	**4.5% - 8%**
BY 2020	**Policy-Driven**	**Potential CO2 Reduction**
3.A	Green power purchases	TBD
3.B	Add'l renewable energy investments	5%
3.C	Add'l alternative fuels	5%
3.D	Countywide Plan policies/programs	5%
	SUBTOTAL	**15%**
BY 2020	**Suggested Target**	**15%**

BY 2100	**The Ecological Imperative**	**60%**

Examples of other targets:

In California:
- San Jose: 20%
- Los Angeles: 20%
- Chula Vista: 20%
- Oakland: 15%
- Berkeley: 15%

In other states:
- Fort Collins, CO: 30%
- Miami-Dade County, FL: 20%
- Portland, OR: 20%
- Austin, TX: 10-20%
- Overland Park, KS: stabilize

Process

This report summarizes the first milestone in the Cities for Climate Protection Campaign (CCP). The intent is to determine the current levels of GHG throughout the county. Although the Marin County government has jurisdiction over only unincorporated county areas, data limitations made it impossible to exclude incorporated areas; the data represents the entire county. This calculation method has the benefit of encouraging the County to provide positive leadership to other municipalities. However, when setting emission reduction targets, it should be realized that the County has influence over only a limited portion of the total countywide emissions.

The greenhouse gases analyzed in this study include carbon dioxide, methane, nitrous oxide, and various hydrofluorocarbons[2]. The levels of the emissions are reported in equivalent carbon dioxide (eCO_2) units. Converting all emissions to carbon dioxide units allows for comparison between greenhouse gases of varying strengths; for instance, methane is twenty-one times more powerful than carbon dioxide in its capacity to trap heat, therefore 1 ton of methane is equal to 21 tons of carbon dioxide.

The County gathered information on greenhouse gas emissions in three years – 1990, 1995, and 2000 – to understand trends in the County's greenhouse gas emissions. These trend lines, along with indicators, will be used to forecast greenhouse gas emissions in 2020, in the absence of ameliorative measures.

Greenhouse gas emissions were calculated for the following categories:

- Energy use: residential, commercial, industrial
- Transportation
- Waste
- Agriculture

The calculations were computed using CCP software, which translates data on a community's energy use and solid waste into the corresponding levels of greenhouse gas emissions. The process of the computation is explained below. Data sources are listed in Appendix B.

Indicators

Indicators are basic statistics on a particular jurisdiction such as population, number of households and number of commercial employees. Where specialized data does not exist, indicators are used to forecast greenhouse gas emissions because indicators can be expected to reasonably approximate a population's emissions patterns over time.

Coefficients

Coefficients are standardized values that reflect the quantity of eCO2 emissions associated with the use of a particular unit of fuel or the decomposition of a unit of waste. Coefficients for electricity generation are based on California's fuel mix; other California-specific coefficients include livestock sources of methane.

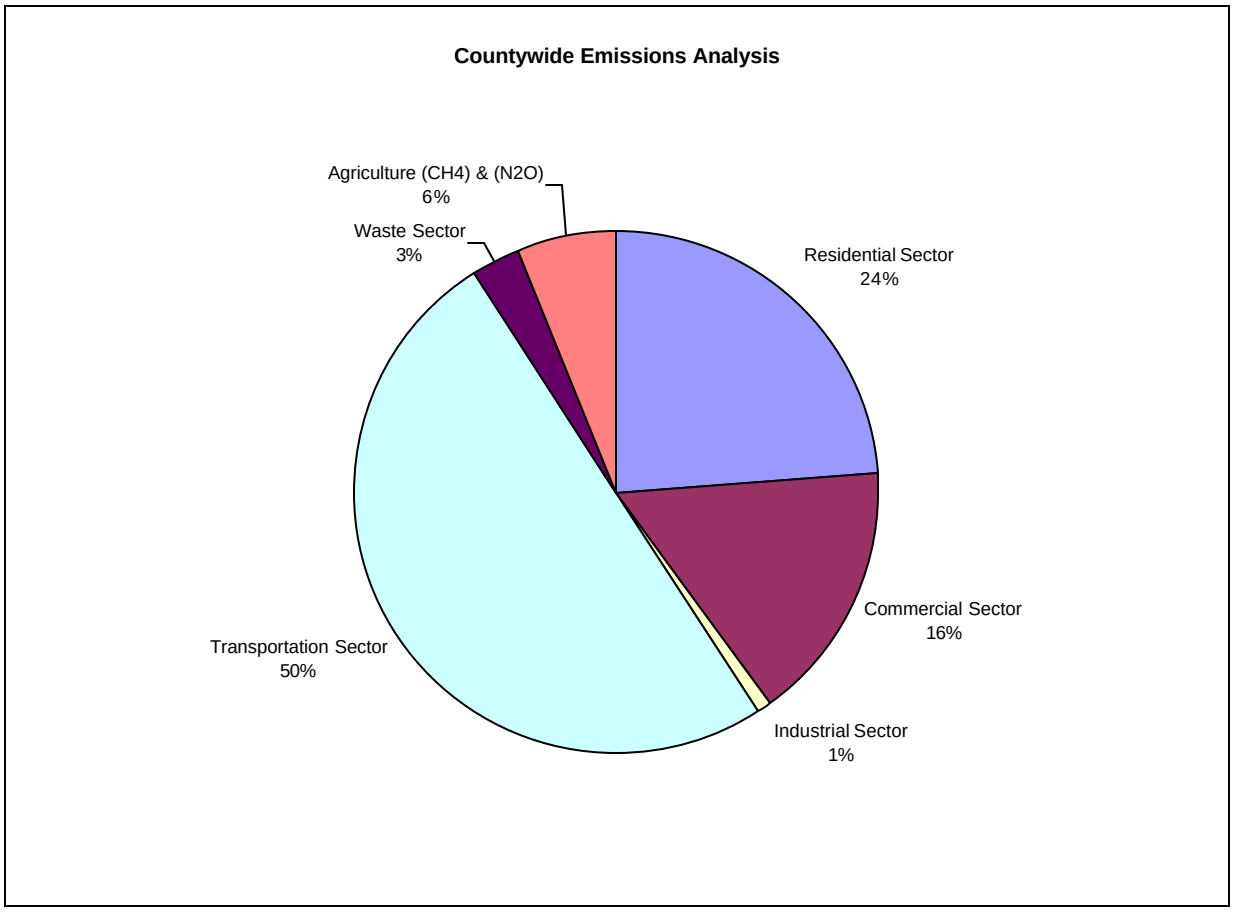
[2] These are HFC-23, HFC-125, HFC-134a, HFC-152a, CF_4, C_2F_6, and SF_6.

Total Energy Use

Countywide emissions for all sectors are summarized in the following table:

SECTOR	1990	2000
Transportation Sector	1,542,175	1,649,116
Residential Sector	724,835	797,499
Commercial Sector	469,933	562,434
Agriculture	197,376	183,462
Industrial Sector	36,609	15,145
Waste Sector	-116,204	-94,091
Totals	2,854,742	3,113,565

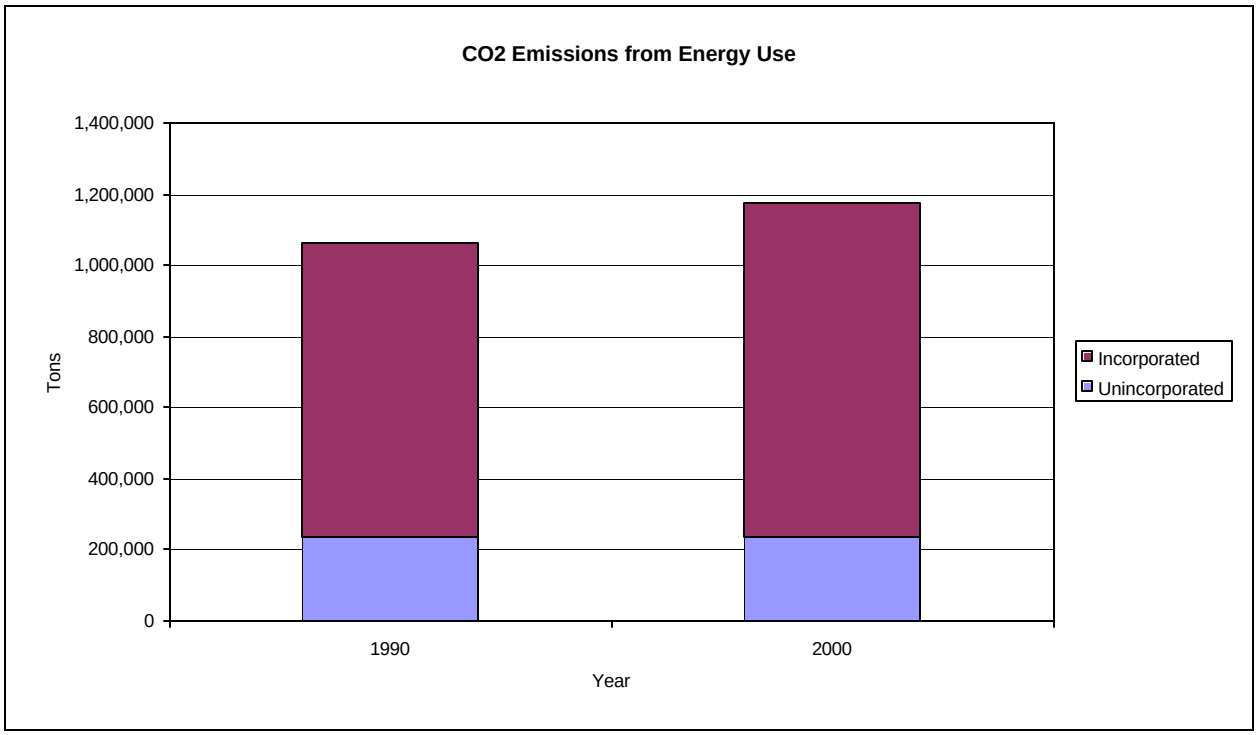
By percentage, the transportation sector is the largest contributor to GHG emissions, followed by residential and commercial energy use.



Building Energy Use

Stationary energy use by buildings in all sectors (residential, commercial and industrial) accounts for 44% of the total GHG emissions in Marin. In California, these emissions are largely the result of combusting natural gas for electricity and heat in the residential and business sector.

The County has experienced an overall increase in energy use from 1990 through 2000 of 10%, from 1.23 Megatons of eCO2 to 1.38 Megatons of eCO2. In 2000, unincorporated Marin is responsible for approximately 17% of emissions from stationary energy sources.



Inputs

The greenhouse gas emissions resulting from energy use were calculated from the amounts of electricity and natural gas used by residents and businesses in the County.

- Inputs for all sectors: electricity (kilowatt-hours) and natural gas (therms).
- Residential energy use indicators: population, number of households.
- Commercial energy use indicators: area of commercial floor space, number of employees, and number of commercial establishments.
- Industrial energy use indicators: area of industrial floor space, number of employees, and number of industrial establishments.

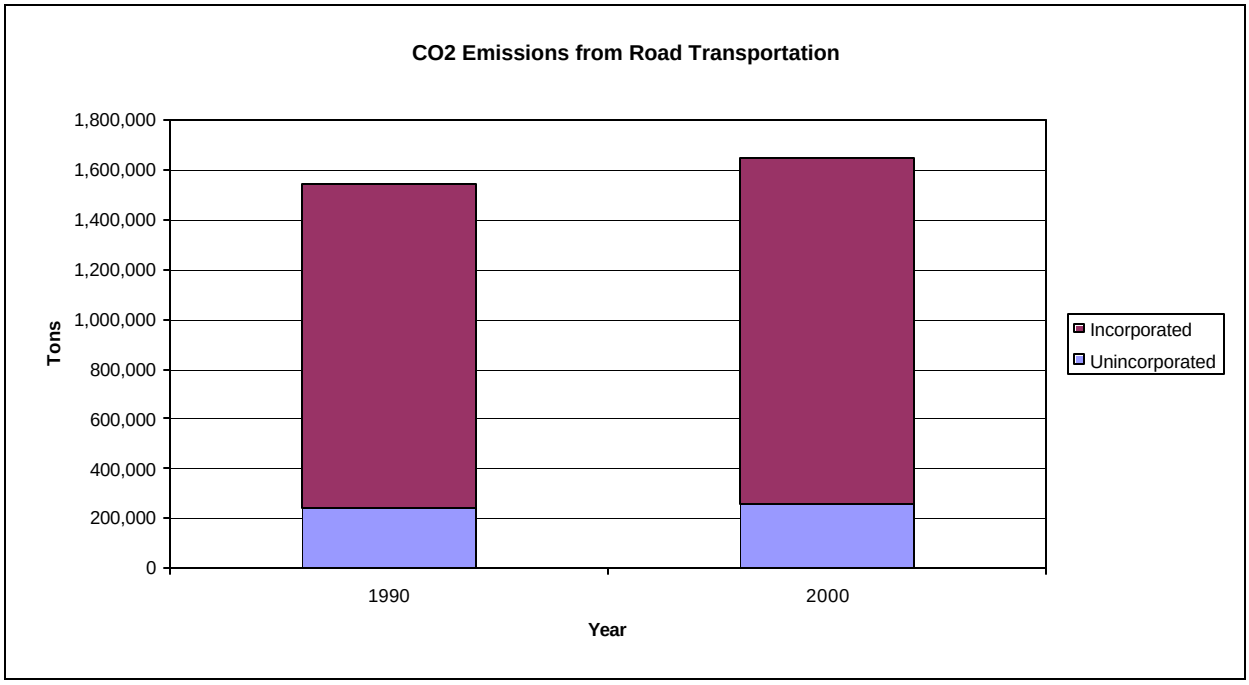
Qualifications

To obtain values for unincorporated Marin, total energy use was divided by the number of households in Marin, which provided an energy use per household figure. This number was then multiplied by the number of households in unincorporated Marin.

This information does not include self-generated energy, such as individual diesel generators, heating oil, and propane.

Transportation

Transportation is responsible for 53% of total greenhouse gas emissions. There was an overall increase in transportation emissions of 6% from 1990 to 2000. As of 2000, transportation within the unincorporated areas of Marin accounts for approximately 15% of total Countywide emissions, based on CalTrans vehicle studies.



Inputs

Transportation sources of greenhouse gases were separated into two fuel types: gasoline and diesel. Emissions were calculated using annual vehicle miles traveled (VMT) by personal vehicles, commercial trucks, buses, and "other" vehicles, the fuel efficiency of each type of vehicle, and therefore, the number of gallons of fuel used to power each vehicle type.

Other inputs include annual vehicle miles traveled (VMT) in Marin, statewide breakdown of VMT by vehicle and fuel type, and statewide fuel economy for each vehicle and fuel type.

Qualifications

Overall vehicle miles traveled are Marin specific values. To divide these miles by vehicle and fuel type requires use of state averages, which can introduce some error. In addition, these state averages only included gasoline and diesel fuel types; it was assumed that alternative fuel vehicles, such as those powered by biodiesel or compressed natural gas, do not comprise a significant portion of Marin's traffic.

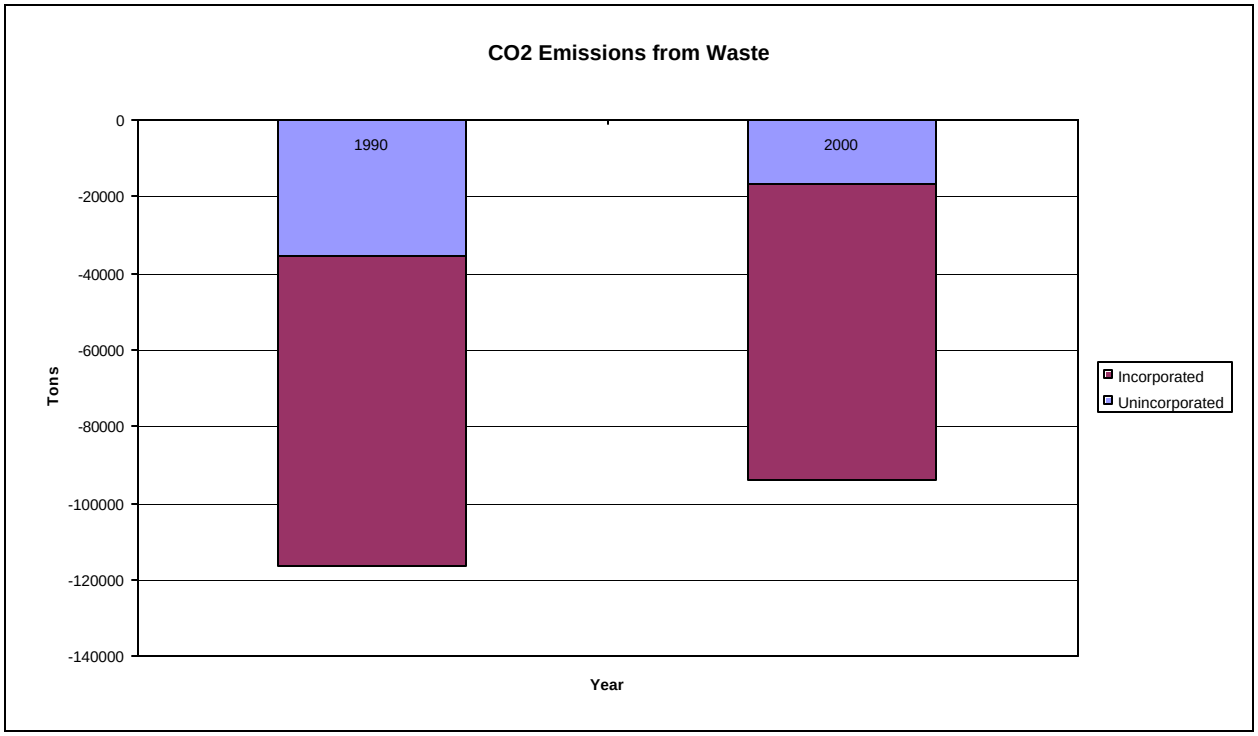
Fuel efficiency values are state averages and may not accurately represent the average fuel efficiencies of Marin vehicles. Informal observations suggest that while there is a disproportionately high number of sport-utility vehicles (SUVs) driven in Marin than in California as a whole, which have problematically low fuel economies, there may also be fewer pickup trucks as there is less industry, no off-road trails, and the area is built-out.

Waste

In 2000, waste was – 4% of Marin's GHG emissions, which means it serves as a sink (net loss) of eCO2.

The methodology for quantifying GHG releases from the landfill was developed by the EPA. The intent was to measure not the amount of greenhouse gases emitted in a given year from waste piled in landfills, but the amount eventually to be emitted as a result of the waste sent to landfill in a given year. Although this is a sight deviation from the other sections which measure the greenhouse gases actually released, it is a more accurate representation of the atmospheric pollution occurring due to a year's actions, and it allows the data to reflect actions such as waste reduction and recycling.

Under natural conditions, food, paper and other organic matter would decay and release CO2. In a landfill, there are two conditions. First, the anaerobic conditions lead to decomposition, which produces methane, a GHG more potent than CO2. Some of this gas perpetually remains under the liner of the landfill. Most methane is recovered and then flared, which converts the methane back into CO2 as it combusts. Depending on the balance between the characteristics of the waste stream, the methane that is trapped, the flaring and the release of methane from the landfill, waste deposition can act as a sink for GHG.



Inputs

Tons of waste sent to landfill include the following categories: paper; food; plant; wood, furniture, and textiles; and other. Data from residential and commercial sectors were combined. Methane emission coefficients were included due to the landfill's collection and burning of methane, which converts methane to CO2.

Qualifications

Actual data on the methane emission coefficient was unavailable and estimated to be 90% based on conversations with landfill personnel. The national average is 75%; therefore it is

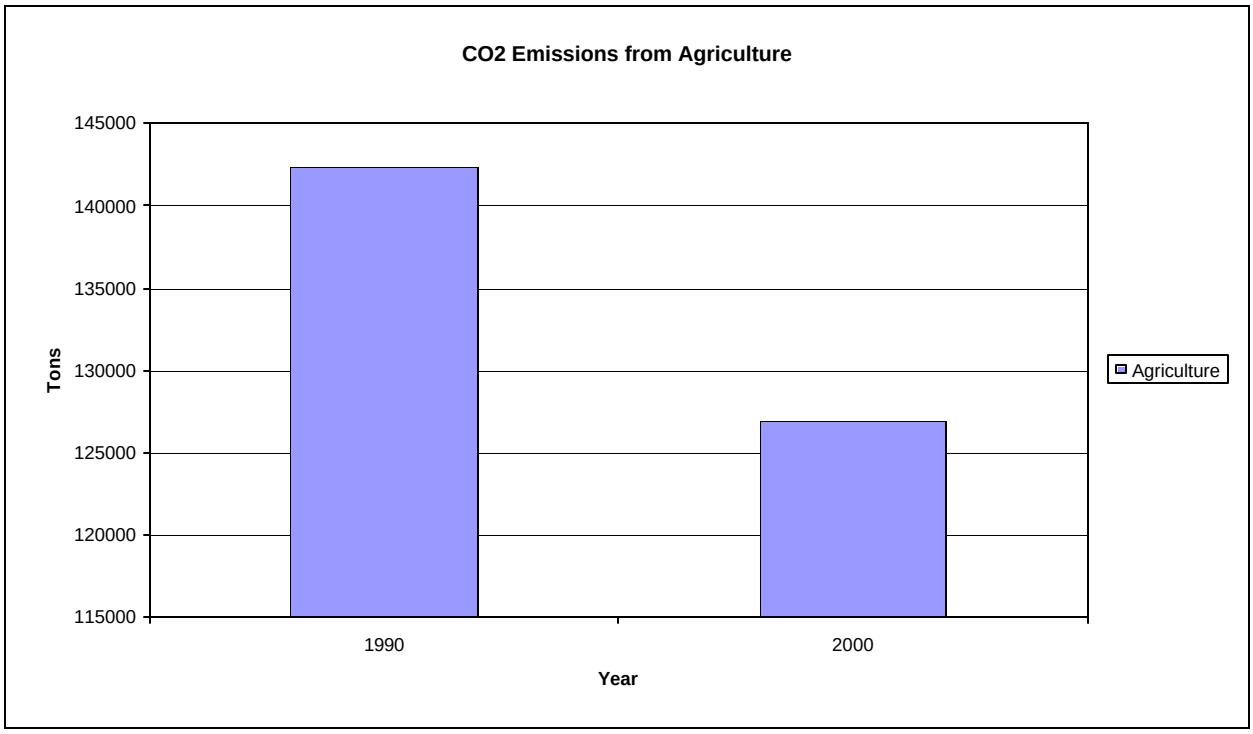
assumed that local landfills have higher than average efficiencies of methane collection due to stricter California waste regulations.

Information on waste was not available for this report; it was estimated by projecting upwards from 1995. This estimation method assumes a constant rate of change in waste amounts and would not record a sudden population jump or sudden increase in recycling (although we doubt that this occurred). The Solid Waste Characterization Database (www.ciwmb.ca.gov) shows the estimated composition of waste typically disposed by single family and multifamily residences within California. Total tonnage for each jurisdiction is computed using regional per capita disposal rates obtained in the 1999 Statewide Waste Characterization Study. This is average data and may not reflect actual composition for Marin's specific jurisdiction.

Agriculture

Agricultural practices are responsible for greenhouse gas emissions through the methane produced by livestock and through soil and cropping practices such as fertilizer applications and crop residue burning. This report focuses on livestock-related emissions. Farm animals contribute to methane emissions both through the production and release of methane during digestion and through the release of methane as their manure decompose. Nitrogen compounds, such as N_2O, are also released through manure decomposition, though this is a much smaller source of livestock-related greenhouse gases. Methane and N_2O released by livestock are considered human-caused greenhouse gases for two reasons: people control the animal population to provide human food and other services, and the high concentrations in which the animals are kept causes their manure to produce more gases as it decays than it would under unmanaged conditions.

An 8% decrease in emissions from agricultural sources occurred from 1990 to 2000. This is probably due to a shrinking number of ranchers in the area. Agricultural emissions account for approximately 6% of the County's total emissions in 2000. In terms of agriculture's contribution to unincorporated Marin's emissions, most agriculture occurs within these boundaries; therefore methane constitutes approximately 27% of total emissions in unincorporated Marin.



Inputs

Direct emissions from livestock: number of livestock by livestock type, typical methane released per livestock head per year.

Emissions from manure decomposition (methane): number of livestock by livestock type, typical animal mass, weight of solids released per animal mass, portion of farms using different manure management systems (e.g., deep pit, pasture, and anaerobic lagoon), conversion rate of solids to methane for each manure management system.

Emissions from manure decomposition (N_2O): number of livestock by livestock type, typical animal mass, Kjeldahl nitrogen released daily in manure (per animal mass), portion of farms using different manure management systems (e.g., deep pit, pasture, and anaerobic lagoon),

conversion constant representing the amount of nitrogen in managed manure that volatizes to non-greenhouse gases, conversion rate of remaining nitrogen to N_2O for each manure management system.

Qualifications

The assumption is made that all agriculture emissions are found in the unincorporated areas of Marin. Only the livestock contributions to greenhouse gases were calculated. Other agriculture-related emissions from soil and crop management, such as fertilizer applications or crop reside burning, were not calculated due to lack of data. Their contribution is expected to be much lower than that of livestock. Those crops whose residues are commonly burned, such as rice, are grown in very small quantities, if at all, in Marin County. Livestock-based products account for the vast majority of Marin County agriculture both in value and acreage, due primarily to the nature of West Marin's rugged topography, soil limitations, and scarcity of water.

Values used for the agriculture emissions for 1990 and 2000 were calculated using information on livestock populations 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. Because animal populations likely changed between 1987 and 1990, for example, this approximation probably introduced a small amount of error. Because census data populations did not perfectly match the populations for which counts were needed, assumptions (e.g., 1 bull for every 100 cows) had to be made. These assumptions used in calculating the animal populations may have also introduced a small source of error; they are detailed in Appendix B.

It was also assumed that the manure management method currently employed was also used in 1987, 1992, and 1997. If manure management methods have changed, some error may be present.

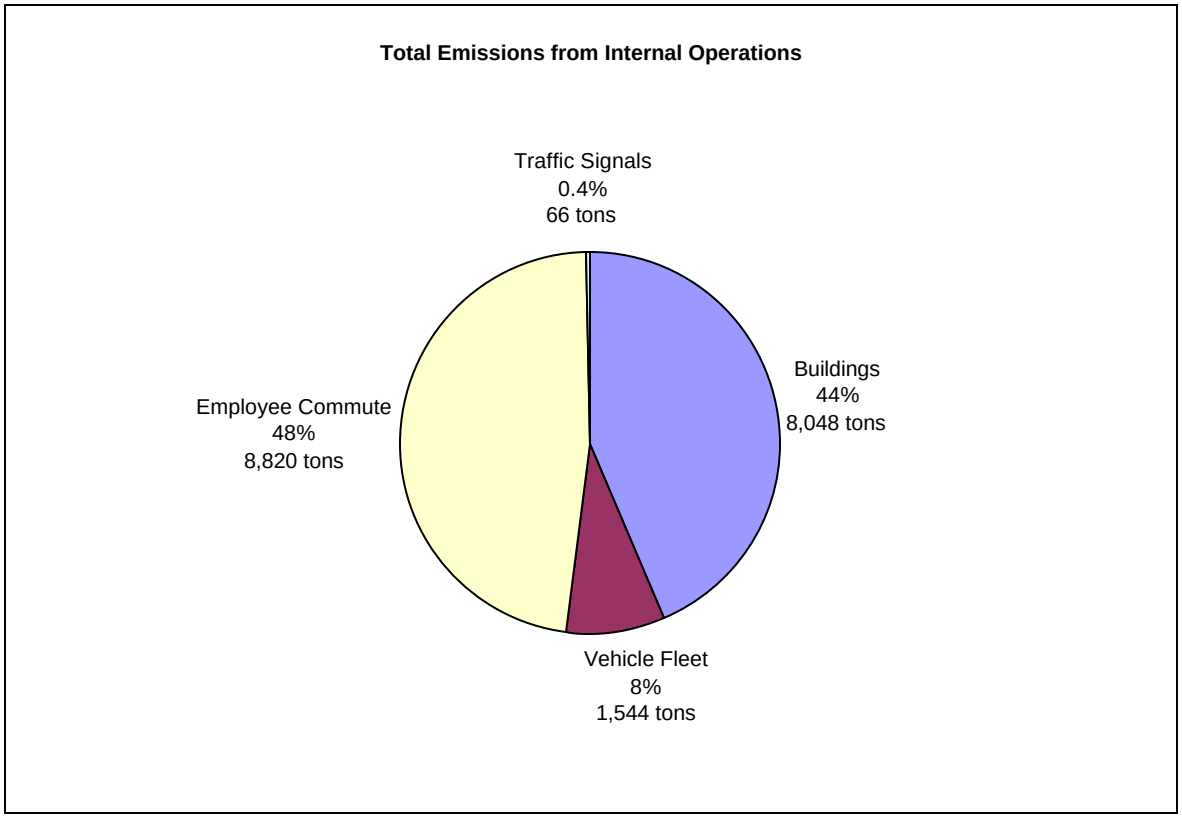
Internal County Greenhouse Gas Analysis

Overview

An inventory was taken of greenhouse gas emissions that result from the County's daily operations. Energy usage was analyzed in the following categories: employee commuting, County facilities, County fleet, traffic signals and waste.

As the graph shows, employee commuting and buildings account for the majority of GHG emissions, followed by County-maintained vehicles, while traffic signals and waste is minor.

Internal emissions are estimated to be 18,450 tons of equivalent CO2 (eCO2) for 2000. The following graph illustrates the tons of eCO2 emitted in 2000.



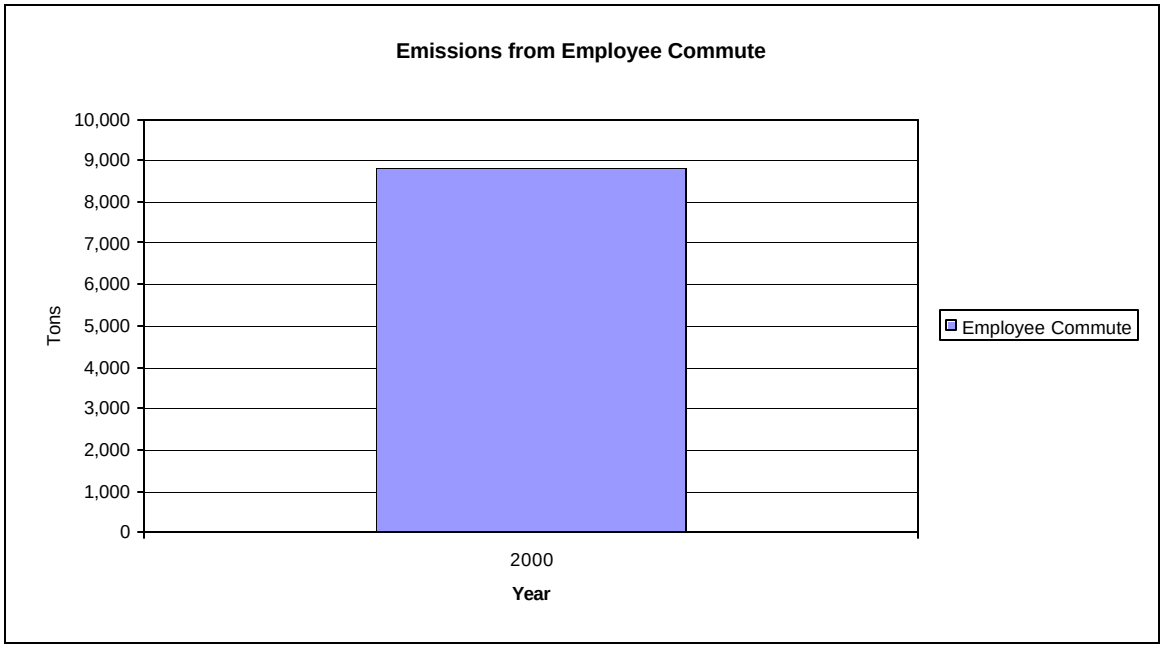
Qualifications

The data for all 1990 categories are approximations based on indicators involving county growth; sufficient data was not available for a complete analysis. The use of 1990 in the following report is only meant as a means of obtaining a broader picture of changes in emissions at the County.

Employee Commute

Employee commuting accounts for 48% of total internal emissions. A survey conducted by the Department of Public Works of 450 out of 2,554 employees shows that a daily average of 84% of our employees drove alone. The survey also states that approximately 49% of County employees live in Marin County and 31% live in Sonoma County, collectively totaling 80%. The remaining 20% live in Contra Costa, Solano, Alameda, San Francisco, and Napa Counties, as well as several other counties outside of the Bay Area, such as Butte and Santa Cruz Counties.

Notably, the County has experienced an almost 10% decrease in employee commute emissions (approximately 1,000 tons), which can be attributed to the success of the County's Employee Commute Alternatives Program, which provides incentives for using public transit, riding bicycles and carpooling.

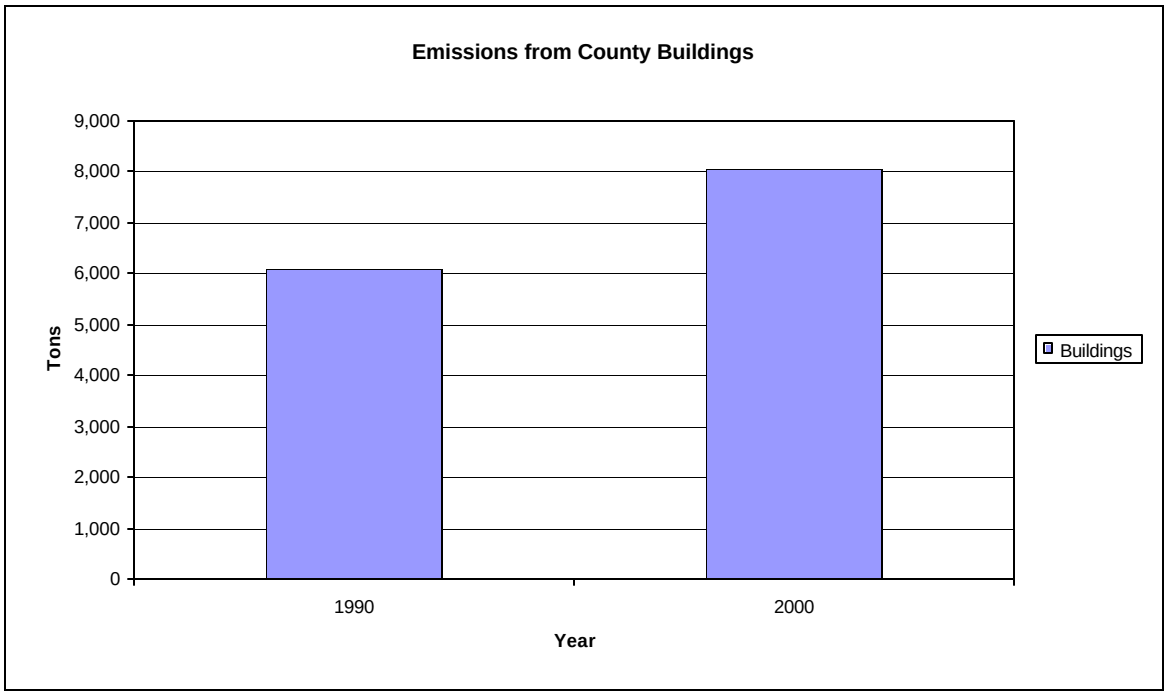


Qualifications

Transportation data was gathered from surveys conducted by Department of Public Works Transportation Services Division. The survey was able to obtain a relatively high response rate of 17%, though the survey was done during inclement weather, which might skew commuting patterns slightly more towards travel in single-occupancy vehicles.

Buildings

Building energy consumption accounts for 44% of internal emissions. While overall energy use has grown between 1990 and 2000, the Marin Civic Center building, which accounts for over half (54%) of all County facilities' electricity use, performed lighting, heating and cooling retrofits that decrease the annual consumption in that building alone by 26% below 1990 levels. This is equivalent to a 490-ton reduction in CO2 emissions. However, the increase in square footage of County facility space has lead to an overall increase in energy consumption, as shown in the graph below.

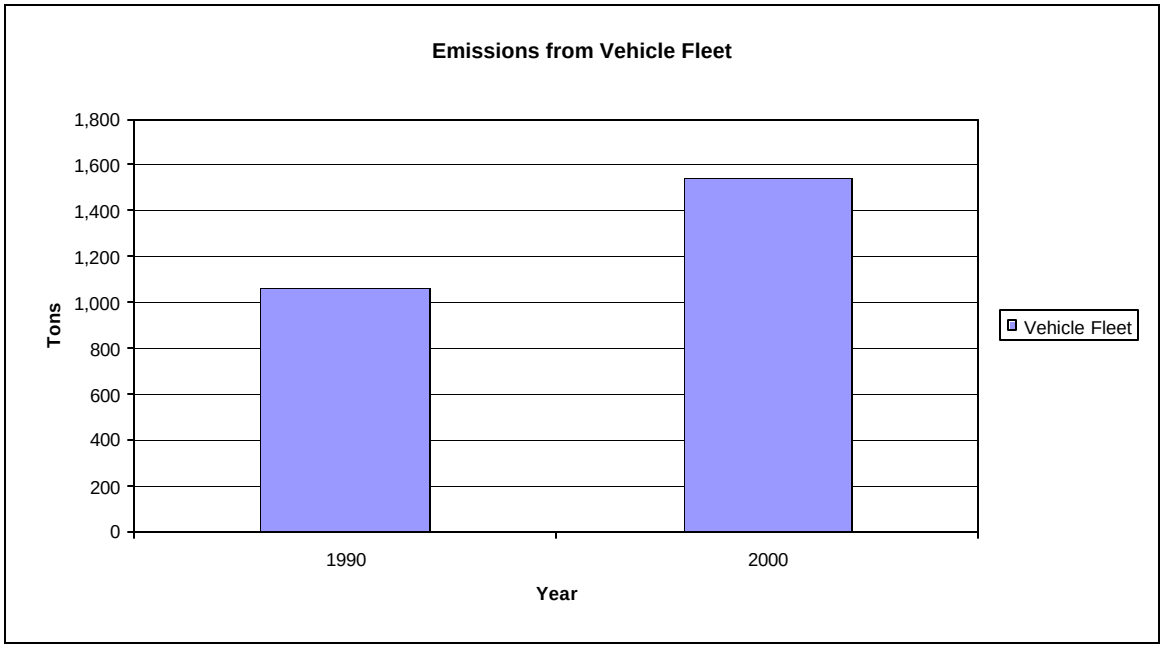


Qualifications

Data for specific County buildings was not available for any facilities in 1990. The approximate levels of electricity and gas usage for 1990 were recorded in a report by Rich Wallace, in the Marin County Maintenance Division.

Vehicle Fleet

The County's vehicle fleet contributes 8% to internal emissions. There was an approximate 36% increase in carbon emissions from County vehicles from 1990 to 2000. While fuel efficiency generally improved over the past decade, the number of vehicles in the County fleet increased from 394 to 491.

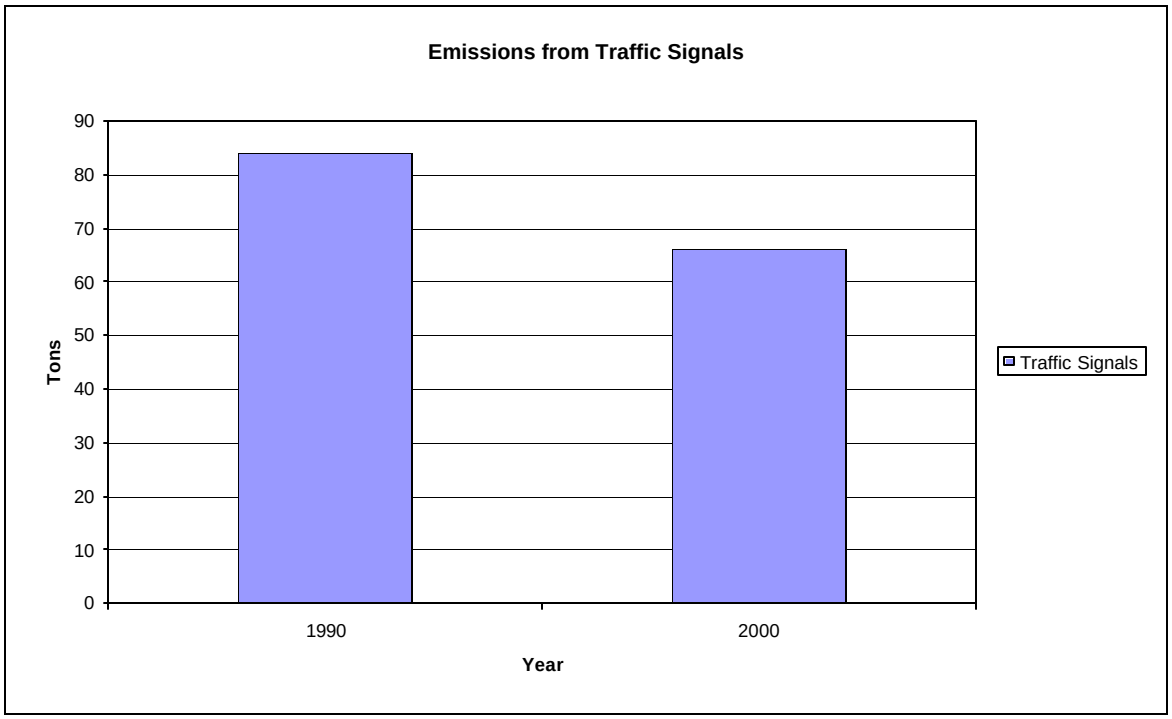


Qualifications

For 1990, data was obtained from the 1990 – 1991 Proposed Budget Books, which aggregates gasoline and diesel costs and usage and does not breakdown data by vehicle category.

Traffic Signals

Carbon emissions resulting from traffic signals is 0.5% of total emissions with a 27% decrease in energy consumption from 1990 to 2000. Significant energy savings having been achieved through retrofits of red incandescent bulbs to light-emitting diodes (LEDs). Since 2000, the majority of remaining incandescent bulbs, both green and yellow, have been switched to LEDs.

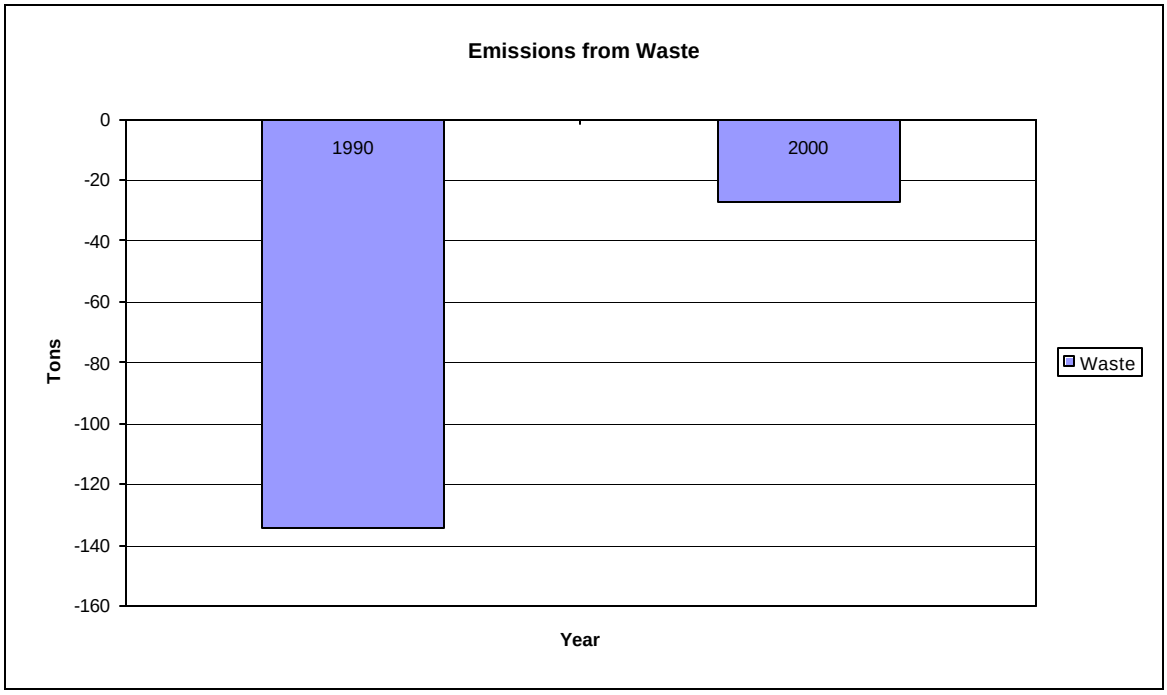


Qualifications

In order to obtain the estimate for 1990, the assumption was made that energy consumption by traffic signals is relatively the same from 1990 to 1998, as there were no significant improvements or changes to the lamps until LEDs were introduced. Data for 1990 is approximated as 1998 traffic signals data; two additional traffic signals were installed between 1990 and 1998, which are reflected in the calculations.

Waste

Analysis of the County's waste stream shows that, overall, it is a slight greenhouse gas (GHG) sink, at – 0.1%, which means that it is absorbing more GHGs than it is emitting. The difference in emissions from 1990 and 2000 is approximately 80%. This is a result of recycling programs, which did not exist in 1990. Recycling programs divert the majority of the County's waste from the landfill.



Qualifications

The data characterizing the County's waste stream (i.e. percentage of waste coming from paper, plants, wood and other) were obtained from the California Integrated Waste Management's Solid Waste Characterization Study, under the category of public administration. A characterization of waste streams for public administrations does not exist for 1990, so data from the closest year (1995) was used.

Appendix A

RESOLUTION NO. 2002 – 46

A RESOLUTION OF THE MARIN COUNTY BOARD OF SUPERVISORS to participate in the Cities for Climate Protection Campaign to reduce both greenhouse gas and air pollution emissions throughout the community.

WHEREAS, a scientific consensus has developed that Carbon Dioxide and other greenhouse gases released into the atmosphere have a profound effect on the Earth's climate; and

WHEREAS, scientific evidence including the Third Assessment Report from the International Panel on Climate Change and the U.S. Global Change Research Program's First National Assessment indicate that global warming has begun, with the 1990's the hottest decade in recorded history and January 2002 the hottest on record; and

WHEREAS, rising sea levels due to melting glaciers and expansion due to temperature rise is a primary effect of global warming; and

WHEREAS, rising sea level inundate wetlands and other low-lying lands, erode beaches, intensify flooding, and increase the salinity of rivers, bays, and groundwater tables; and

WHEREAS, scientists predict that North America will experience the El Nino effect in 2002-2003 which may exasperate floods, hurricanes, and record-high temperatures; and

WHEREAS, local governments absorb human and financial costs of the damage caused by such effects; and

WHEREAS, energy consumption, specifically the burning of fossil fuels, accounts for more than 80% of U.S. greenhouse gas emissions; and

WHEREAS, local governments greatly influence the community's energy usage by exercising key powers over land use, transportation, construction, waste management, and energy supply and management; and

WHEREAS, more than 160 countries pledged under the United Nations Framework Convention on Climate Change to reduce their green-house gas emissions; and

WHEREAS, the Cities for Climate Protection Campaign, sponsored by the International Council for Local Environmental Initiatives (ICLEI), has invited the County of Marin, California, to become a partner in the Campaign;

NOW, THEREFORE, BE IT RESOLVED by the Marin County Board of Supervisors that the County of Marin commits to participate in the Cities for Climate Protection Campaign and, as a participant, pledges to:

1. Take a leadership role in promoting public awareness about the causes and impacts of climate change.

2. Undertake the Cities for Climate Protection program's 4 milestones to reduce both greenhouse gas and air pollution emissions throughout the community, specifically:

- conduct a greenhouse gas emissions inventory and forecast to determine the source and quantity of greenhouse gas emissions in the jurisdiction;
- establish a greenhouse gas emissions reduction target;
- develop an action plan with both existing and future actions which when implemented will meet the local greenhouse gas reduction target; and
- implement the action plan and monitor progress.

PASSED AND ADOPTED at a regular meeting of the Board of Supervisors of the County of Marin, State of California, on the 23rd day of April, 2002, by the following vote to-wit:

AYES: Supervisors:

NOES: Supervisors:

ABSENT: Supervisors:

_____
CYNTHIA MURRAY, PRESIDENT
MARIN COUNTY BOARD OF SUPERVISORS

Attest:

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Mark J. Riesenfeld, AICP
Clerk of the Board

Appendix B – Countywide Analysis Data Sources and Specifics

Energy Use

Information on electricity and natural gas consumption for Marin County was provided by the California Energy Commission (CEC) divided into certain industry categories (residential, commercial, TCU, industrial, farm, and unclassified).

Indicator values for residential energy use (population and number of households) for 1990 and 2000 were determined from the U.S. Census.

Of the commercial and industrial energy use indicators, the number of employees and establishments for each category were taken from the County Business Patterns, provided by the U.S. Census. The numbers are recorded annually, in mid-March of each year. Employment data was divided by the Standard Industry Classification (SIC) prior to its replacement in 1998 by the North American Industry Classification System (NAICS). These codes were used to align employment statistics as closely as possible with the energy consumption categories provided by the CEC. Slight inaccuracies may originate in converting from SIC categories to NAICS or in matching employment categories to energy consumption categories. Farm employment was found from the California Employment Development Department, Labor Market Information Division, Industry Employment and Labor Force, Annual Average, "Total Farm" line (series 000120).

Transportation

To calculate the greenhouse gases resulting from transportation required accessing the annual vehicle miles traveled by category of vehicle and the average fuel efficiency for each category. Annual vehicle miles traveled (AVMT) for Marin County were found in the California Department of Transportation (Caltrans), Division of Transportation System Information, Office of Travel Forecasting & Analysis, Highway Inventory & Performance Branch database (HPMS Database) at http://www.dot.ca.gov/hq/tsip. This includes a breakdown of VMT by municipality.

The percentage of the statewide AVMT traveled by different vehicle types (car, small truck, etc.) and fuel types (gasoline and diesel) is found in California Department of Transportation (Caltrans) California Motor Vehicle Stock, Travel, and Fuel Forecast (MVSTAFF) reports from November 1991 (1990 data) and November 2001 (2000 data). This document also reports statewide fleet fuel economy for each vehicle type and fuel type. The use of statewide numbers to apportion the County's AVMT into vehicle and fuel types may introduce errors to the analysis.

Waste

In the waste sector, greenhouse gases reflect the gases that will eventually be released by the decomposition of the waste sent to landfill in a given year. The California Integrated Waste Management Board (CIWMB) Solid Waste Characterization Database provided the data. Since this varies significantly by the waste composition, the gas amounts are calculated from the tons of waste in four categories: paper; food; plant; wood, furniture, and textiles; and other. The waste composition data categories of the CIWMB were divided as accurately as possible into these five categories.

Waste tonnage data was provided for the residential and commercial sectors. These sectors were totaled to find the total waste for a year. In the residential sector, CIWMB data was available for 1990 and 1999. Residential tonnages for 2000 were estimated by

assuming a constant rate of change between 1990 and 1999 and assuming this rate continued to 2000. Commercial tonnages were available for 1990 and 1999; data for 2000 was extrapolated using the rate of change between 1995 and 1999.

According to the CIWMB website, business waste tonnage and composition is estimated by the business makeup of the county and typical business waste compositions for particular SIC codes, estimated by sorting garbage samples of individual businesses in southern California. Residential tonnages and waste composition is computed using regional per capita disposal rates obtained in the 1999 Statewide Waste Characterization Study. More information on the CIWMB's approximation methods is available at http://www.ciwmb.ca.gov.

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_2O produced during manure decomposition. The calculations follow the process prescribed by the United States Environmental Protection Agency (U.S. EPA) Emission 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.

Where livestock population data was not sufficiently detailed, it was supplemented through conversation with Stephanie Larson, Livestock Range Advisor, Marin County Agriculture Extension Office, University of California, Davis. This issue was especially important for cattle populations. For example, the census provides the population counts for mature cows and the total cattle population, but not for the subpopulations of bulls and calves. Thus, a method for estimating these subpopulations was required.

To estimate bull populations, it was assumed that for every 100 cows, beef farms kept 4 bulls and cattle farms kept 1 bull. To estimate calf populations, every adult cow was assumed to have one calf. Of these, 20% become "replacement calves." For every 100 cattle, there are thus 20 replacement calves 0-12 months of age and 20 replacements 12-24 months of age (the 12-24 month replacements should actually be 20% of last year's population, but the census does not occur annually). The other 80% of the calves are typically sold when they're six months old. Thus, in addition to the 20 calves (per 100 adults) that are replacement calves 0-12 months old, there are 80 calves kept for one-half of the year, or approximately 40 additional calves 0-12 months old (per 100 adults). Thus, the population of replacement calves 0-12 months old was 60% of the adult cow population, while the population of replacement calves 12-24 months old was 20% of the adult cow population.

The appropriateness of this population estimation method was confirmed by observing that it yielded total cattle populations very close to the actual county total as counted by the census. For the three years considered, percentage error ranged from was 1.3%, 0.4%, and 8.9%. (Because calves are born in different seasons, it is reasonable to assume that at any given time, half of that year's calves will be present for counting.) When calculating emissions, however, this estimation method may slightly overestimate emissions because a calf kept until 6 months of age will produce less than half of the emissions of a calf kept from birth to age 1, because emissions increase with size. However, a more appropriate scalar for calf emissions could not be found.

In calculating the releases of nitrogen and methane as manure decomposes, for dairy cattle, the EPA calculation method only offers nitrogen and methane conversion values for "heifers," (female cattle that have not calved over 500 pounds). It gives no value for calves under 500 pounds. Nor did the subpopulation categories already calculated (determined by age) line up with these new categories (determined by weight). Therefore, it was assumed that all calves 12-24 months represented a heifer, while all calves 0-12 months of age (a figure that includes those 80 calves kept for one-half the year) represented one-half of a heifer. Other assumptions and more detailed information on data sources and methods can be found by contacting the Marin County Advanced Planning Department.

To calculate the amount of nitrogen and methane released from manure decomposition, assumptions had to be made about the proportion of farms using particular manure management techniques. Percentages of farms employing particular manure management practices, such as deep pit, pasture, and anaerobic lagoon, were estimated by Stephanie Larson, UC Davis, for cattle and sheep, by Michael Murphy, UC Davis, for horses, and by individual animal raisers for turkeys. Where not specified, values (e.g. typical animal mass, methane conversion rates) are national or state averages supplied by the U.S. EPA EIIP handbook. It was assumed that the manure management method currently employed was also used in 1987, 1992, and 1997. If manure management methods have changed, some error may be present. For beef farms, it was assumed that 100% of the manure was deposited on the range. For dairy farms, it was assumed that 70% of the manure was managed in anaerobic lagoons, 15% was managed in drylots, and 15% was deposited on the range.

To calculate the amount of manure released directly by livestock, the population of that animal was multiplied by the pounds of methane typically released annually by that animal.

To calculate the amount of methane released from manure decomposition, the number of livestock was multiplied by the typical animal mass, the typical weight of solids produced per animal mass and the amount of methane produced per unit of solids. The latter value was calculated using a weighted average of the different manure management methods used in the County and these methods' methane conversion rates.

To calculate the amount of N_2O released from manure decomposition, the number of each type of livestock was multiplied by the typical animal mass for that type, the Kjeldahl N/year/animal mass, the percentage of manure managed (as opposed to being deposited on the range or paddock), and a conversion factor of 80% which represents the amount of elemental nitrogen that is not volatized to NH_3 or NOx and thus remains to potentially become N_2O. This calculation determines the amount of elemental nitrogen annually present in Marin County's managed manure. To calculate the amount of elemental nitrogen becomes N_2O, the kg/year of unvolatized N was multiplied by a conversion factor for each type of manure management system weighted by the percentage of manure managed in that system. Because fewer manure management conversion factors were provided, these calculations were less precise than those for methane, reducing the calculation's accuracy slightly.

Appendix C – Internal Operations Analysis Data Sources

Employee Commute
Information taken from the Employee Transportation Survey conducted under the FY 2002-03 Transportation Services Work Program.

Buildings
Data obtained from PG&E as well as the County's energy accounting software, Utility Manager 3.1. Buildings included in this analysis:
Airport
Juvenille Hall
10 & 20 N San Pedro
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.
Libraries: Novato (Ignacio, Novato Blvd); Corte Madera

Vehicle Fleet
Data obtained from Department of Public Works' fleet accounting software, Cascade.

Traffic Signals
Data obtained from PG&E as well as the County's energy accounting software, Utility Manager 3.1.

Waste
Data obtained from Michael Frost, Waste Specialist with the Department of Public Works.