City of Emeryville

Greenhouse Gas Emissions Analysis

2004 Community Emissions Inventory
&
2004 Municipal Operations Emissions Inventory

December 2006
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Credits and Acknowledgements

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ICLEI
Local Governments for Sustainability

With generous support from the Stopwaste.org

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1. Introduction

1.1. Introduction and History

In 1999, the Emeryville City Council adopted a resolution authorizing the Mayor to sign the U.S. Mayors Climate Protection Agreement, thereby committing the City to taking action for climate protection. In doing so, the City joined all of the other local governments in Alameda County in committing to becoming a member of ICLEI and participating in the Alameda County Climate Protection Project. The project was launched by ICLEI in partnership with StopWaste.Org and the Alameda County Conference of Mayors.

Through these actions, the City recognized that "climate disruption is a reality and that human activities are largely responsible for increasing concentrations of global warming pollution." Through energy efficiency in its facilities and vehicle fleet, clean alternative energy sources, sustainable purchasing and waste reduction efforts, land use and transportation planning, preparing for sea level rise, and other activities, the City of Emeryville can achieve multiple benefits, including lower energy bills, improved air quality, economic development, reduced emissions, and a better quality of life throughout the community.

This greenhouse gas emissions inventory represents completion of the first step in Emeryville's climate protection process. As advised by ICLEI, it is essential to first quantify recent-year emissions to establish: 1) a baseline, against which to measure future progress, and 2) an understanding of where the highest percentages of emissions are coming from, and, therefore, where the greatest opportunities for emissions reductions are. Presented here are estimates of greenhouse gas emissions in 2004 resulting from the community as a whole, and from the City's government operations.

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. Modern human activity, most notably the burning of fossil fuels for transportation and electricity generation, introduces large amounts of carbon dioxide and other gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface temperature to rise, which is in turn expected to affect global climate patterns.

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. In response to the threat of climate change, communities worldwide are voluntarily reducing greenhouse gas emissions. The Kyoto Protocol, an international effort to coordinate mandated reductions, went into effect in February 2005 with 161 countries participating. The United States is one of three industrialized countries that chose not to sign the Protocol.

In the face of federal inaction, many communities in the United States are taking responsibility for addressing climate change at the local level. The community of Emeryville might be impacted by rising sea levels and resultant changes in the height, salinity and behavior of the San Francisco Bay, as well as other changes to local and regional weather patterns and species migration. Beyond our community, scientists also expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and land slides, summer water shortages as a result of reduced snow pack, and disruption of ecosystems, habitats and agricultural activities.

Although one jurisdiction cannot independently resolve the issue of climate change, local governments can make a positive impact through cumulative local action. This is the impetus of the Alameda County Climate Protection Project. Cities and counties have the ability to reduce greenhouse gas emissions through effective land use and transportation planning, wise waste management, and the efficient use of energy.

1.3. ICLEI Membership and the Five Milestones

By adopting a resolution committing the City to locally advancing climate protection, Emeryville has joined an international movement of local governments. More than 800 local governments, including over 450 in the United States, have joined ICLEI. In addition to Emeryville, all 14 Alameda municipalities and the County are ICLEI members, part of the 120 member California network (approximately 80 members are located in the Bay Area).

The Five Milestone Process provides a framework for local communities to identify and reduce greenhouse gas emissions, organized along five milestones:

(1) Conduct an **inventory** of local greenhouse gas emissions;

(2) Establish a greenhouse gas emissions **reduction target**;

(3) Develop a **climate action plan** for achieving the emissions reduction target;

(4) **Implement** the climate action plan; and,

(5) **Re-inventory** emissions to monitor and report on progress.

This report represents the completion of the first CCP milestone, and provides a foundation for future work to reduce greenhouse gas emissions in Emeryville.

1.4. Sustainability and Climate Change Mitigation Activities in Emeryville

Emeryville has already taken many steps toward increasing energy efficiency, reducing air pollution, and reducing solid waste. Examples include:

- Extensive programs over the last 15 years for brownfield re-development resulting in urban in-fill projects and reducing the need for urban sprawl.
- Establishment of the EPA-award-winning Emery-Go-Round which now shuttles over one million riders per year from the MacArthur BART station to the City.
- Reducing building permit fees for single family home solar installations
- Installing Solar PV panels on the Civic Center roof
- Requiring stormwater treatment using vegetation in all new developments reducing the heat island effect in the city and reducing energy use for cooling and increasing CO2 uptake by plants
- Increasing Street tree planting standards for new developments ensuring the long-term health of more trees in the City
- Implementing environmental purchasing decisions such as switching to recycled content copy paper in many City buildings. This practice benefits the community by incentivizing business practices that conserve resources, reduce emissions, and reduce waste.
- Working with the Emeryville Chamber of Commerce to get 17 businesses in Emeryville to “Go Green” and become certified green businesses over the last three years.
- Working with “SmartLights” of the East Bay Energy Watch program to reduce energy use in the lighting of commercial properties in the City.
- Adopting StopWaste.Org’s Multi-Family Green Building Guidelines, which serve to reduce greenhouse gas emissions by keeping construction and demolition debris out of landfills and

increasing energy efficiency in buildings.

- Converting traffic signal lights to more energy efficient LED lamps.
- Requiring new developments to rate their projects using the green building scoring systems from StopWaste.Org and the United States Green Building Council (USGBC)
- Implementing residential food scrap recycling. Currently approximately 20% percent of households in the single family neighborhoods participate, thereby diverting 9 of tons of food scraps in 2006 from the landfill to a composting facility.
- Requiring landscapes in new developments and city projects to use locally produced compost and mulch partially made of feedstocks from municipal sources.
- Equipping the City Corporation Yard with motion occupancy sensors and energy efficient lighting. These steps save the City money, and reduce the emissions that cause global warming. The Senior Center also received rebate funds for the replacement of the old boiler. Other City facilities are also being considered for lighting retrofits.
- Installing Emeryville's first bike boulevard, adding more bike lanes and building the first phases of the Emeryville Greenway encouraging more people to travel by bike and on foot reducing vehicle emissions.
- Educating the residents of Emeryville at each years Earth Day event in Temescal Creek Park about environmental issues that face the City and the planet.[1]

[1] From Draft Emeryville Climate Action Plan. Provided to ICLEI by Peter Schultze-Allen in August 2008.

2. City of Emeryville 2004 Greenhouse Gas Emissions Inventory

2.1. Methods

ICLEI assists local governments in systematically tracking energy and waste related activities within their jurisdiction, and in calculating the relative quantities of greenhouse gases produced by each activity and sector. The greenhouse gas inventory protocol involves performing two assessments: 1) a community-wide assessment, and 2) a separate inventory of municipal facilities and activities. The municipal inventory is a subset of the community inventory.

Once completed, these inventories provide the basis for policy development, the quantification of emissions reductions associated with proposed measures, the creation of an emissions forecast, and the establishment of an informed emissions reduction target.

2.1.1. CACP Software

To facilitate community efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package in partnership with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO)[2], and Torrie Smith Associates. This software calculates emissions resulting from energy consumption and waste generation. The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. CACP aggregates and reports the three main greenhouse gas emissions (CO_2, CH_4, and N_2O) in terms of equivalent carbon dioxide units, or CO_2e. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane (CH_4) is twenty-one times more powerful than carbon dioxide on a per weight basis in its capacity to trap heat; so the CACP software converts one metric ton of methane emissions to 21 metric tons of carbon dioxide equivalents.[3] The CACP software is also capable of reporting input and output data in several formats, including detailed, aggregate, source-based and time-series reports.

The emissions coefficients and quantification method employed by the CACP software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change (1996 Revised IPCC Guidelines for the Preparation of National Inventories) and the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA form1605).

The CACP software has been and continues to be used by over 400 U.S. cities, towns and counties to reduce their greenhouse gas emissions. However, it is worth noting that, although the software provides Emeryville with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation of reality, rather than an exact value. It should also be understood by policy makers, staff, and the public that the final total may change as new data, emissions coefficient sets, and better estimation methods become available.

2.1.2. Creating the Inventory

The greenhouse gas emissions inventory consists of two distinct components: one for the Emeryville community as a whole defined by its geographic borders, and the second for emissions resulting from the City of Emeryville's municipal operations. The municipal inventory is effectively a subset of the

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

[3] The potency of a given gas in heating the atmosphere is defined as its Global Warming Potential, or GWP. For more information on GWP see: IPCC Fourth Assessment Report, Working Group I, Chapter 2, Section 2.10.

community-scale inventory (the two are not mutually exclusive). This allows the municipal government, which has formally committed to reducing emissions, to track its individual facilities and vehicles and to evaluate the effectiveness of its emissions reduction efforts at a more detailed level. At the same time, the community-scale analysis provides a performance baseline against which we can build policies and demonstrate progress for Emeryville.

Creating this emissions inventory required the collection of information from a variety of sources, including the Pacific Gas and Electric Company (PG&E), Stopwaste.org, the Bay Area Air Quality Management District, the Metropolitan Transportation Commission, CalTrans, the California Integrated Waste Management Board, the California Energy Commission, Association of Bay Area Governments.

2.2. Inventory Results

2.2.1. Community Emissions Inventory

There are numerous items that can be included in a community scale emissions inventory, as demonstrated above. This inventory includes sources from the following sectors:

- Residential
- Commercial / Industrial
- Transportation
- Waste

Emissions by Sector

The community of Emeryville emitted approximately *178,832 metric tons of CO_2e in the year 2004*[4]. As visible in Figure 1 and Table 1 below, the transportation sector was the largest emitter, totaling 48.9% of the community's emissions. The commercial and industrial sectors were significant sources of community greenhouse gases (42.6%) while Emeryville's small residential sector accounted for 5.2% of community emissions. Methane generated by waste sent to landfill comprised 3.2% of total emissions.

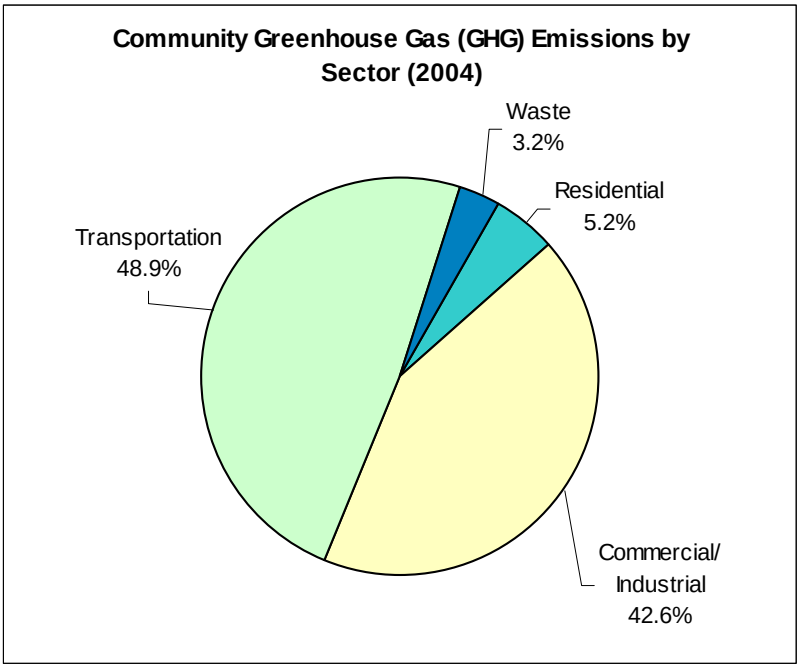


Figure 1 – *Community GHG Emissions by Sector*

[4] There are slight variations in emitted CO_2e totals throughout the report due to different rounding techniques between the CACP software and Microsoft Excel.

Table 1 – *Community GHG Emissions by Sector (metric tons CO_2e)*

2004 Community Emissions by Sector	Residential	Commercial/ Industrial	Transportation	Waste	TOTAL
CO_2e (metric tons)	9,380	76,204	87,447	5,801	**178,832**
Percent of Total CO_2e	5.2%	42.6%	48.9%	3.2%	**100.0%**
Energy Equivalent (MMBtu)	160,562	1,267,105	1,180,261	0	**2,607,928**

Transportation

As with other San Francisco Bay area cities, travel by motorized vehicle (when including State highways) constitutes the greatest percentage of greenhouse gas emissions in Emeryville. In 2004, MTC estimated that 35.1 million vehicle miles traveled (VMT) occurred on Emeryville city roads. As Table 1 and Figure 1 show, this resulted in approximately one-half of the overall community emissions (87,447 metric tons CO_2e).

Since Emeryville's inventory was for 2004, state highway VMT data was not available. The City chose to include state highway VMT from 2005 as a proxy for 2004 data. Using this data, Table 2 breaks down emissions from the transportation sector by type.

Table 2 – *Transportation GHG Emissions by Road Type*

Transportation Road Type Emissions Sources 2004[5]	Local Roads	State Highways	TOTAL
CO_2e (metric tons)	19,445	68,002	**87,447**
Percent of Total CO_2e	22.2%	77.8%	**100%**
Total Vehicle Miles Traveled	35,109,350	122,780,890	**157,890,240**

Please see the appendices for more detail on methods and emissions factors used in calculating emissions from the transportation sector. It is important to note that ICLEI used 2005 Alameda County emissions coefficients to calculate emissions from the transportation sector, as 2004 emissions coefficients are currently unavailable. When the data becomes available, ICLEI will assist the City in updating its emissions inventory.

As a side note, ICLEI (in partnership with staff from the Bay Area Rapid Transit (BART) district) also developed a methodology for allocating the greenhouse gases that BART emits as a major regional transit provider. *The results of this quantification are meant to be illustrative and are not included in Emeryville's CO2 baseline.* ICLEI generated the emissions estimates for BART travel by collecting 2004 electricity consumption data from BART and then allocating that consumption to Alameda County jurisdictions based on ridership (exit counts from the relevant BART stations). Emeryville's share of ridership at the Macarthur station is based on Emery-Go-Round ridership data. As BART's source of electricity through the year 2004 is hydropower, 2004 BART-related emissions are zero. That being said, BART's future fuel mix will not rely solely on hydropower. As such, based on ICLEI's methodology for allocating BART emissions to the jurisdictions that have access to a BART station, Emeryville is projected to be allocated 1,513 tons of eCO2 in 2020 (based on PG&E emissions factors).

The Built Environment (Residential, Commercial, Industrial)

In 2004, 47.8 % of total community-wide emissions came from the built environment, which is comprised of the residential, commercial and industrial sectors. These sectors consumed about 224.9 million kWh of electricity and 6.6 million therms of natural gas. Within this report the commercial and industrial sectors have been combined due to a mandatory aggregating of commercial and industrial data by PG&E.

[5] 2004 State Highway VMT is proxied from 2005 data.

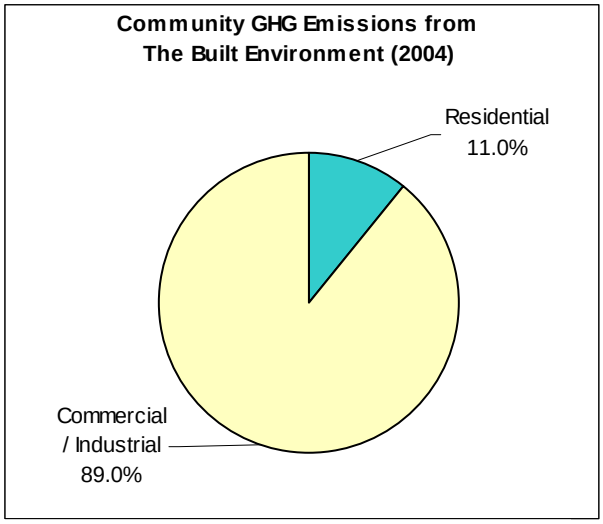


Figure 2 – *Built Environment Emissions*

The City of Emeryville receives its electricity from Pacific Gas & Electric Company (PG&E). The 2005 emissions coefficients for electricity provided by PG&E are included in the notes in Appendix B. Similar to the transportation sector, CCAR-verified 2004 PG&E emissions coefficients for CH_4 and N_2O were unavailable, and ICLEI used 2005 PG&E coefficients as a proxy for 2004.

The types of power sources that make up a utility's electricity generation mix have a significant impact on a city's greenhouse gas emissions. A coal fired power plant, for example, releases 1.3 tons of CO_2e per megawatt-hour of electricity generated versus 0.7 tons for gas turbines and 0 tons for renewable sources such as solar, wind, or hydroelectric power.

Because Emeryville has very strong commercial and industrial sectors, emissions from the built environment are overwhelmingly composed of emissions from these sectors (89.0 %, see Figure 2). Emeryville's growing residential sector contributed 11.0% of all emissions from the built environment. All of the emissions that are being calculated from the built environment are the result of local natural gas consumption and local consumption of electricity that is being generated outside of Emeryville.

Residential

In 2004, Emeryville's approximately 7,770[6] residents consumed 19.3 million kWh of electricity, or about 4,300 kWh per household, and 945,917 therms of natural gas, or about 212 therms per household[7]. This consumption resulted in a release of 9,380 tons of CO_2e, 4,321 tons from electricity and 5,059 from natural gas. Major residential energy uses include refrigeration, lighting and water heating.

Commercial/Industrial

In 2004, Emeryville's commercial/industrial sector buildings consumed 205.6 million kWh of electricity and 5.65 million therms of natural gas. This consumption resulted in a release of 76,204 tons of CO_2e into the atmosphere, 45,967 tons from electricity and 30,236 from natural gas.

Waste

In 2004, Emeryville sent approximately 16,710 tons of solid waste, and 150 tons of alternative daily cover (ADC)[8] to landfill, resulting in a total of 5,801 metric tons of CO_2e. Table 3 breaks down emissions for municipal solid waste by type.

Emissions from the waste sector are an estimate of methane (CH_4) generation that will result from the anaerobic decomposition of the waste sent to landfill from community as a whole in the base year (2004). It is important to note that these emissions are not solely generated in the base year, but occur over the 100+ year timeframe in which the waste generated in 2004 will decompose. This "frontloading" of future emissions allows for simplified accounting and accurate comparison of the emissions impacts of waste

[6] Populations and household estimates are from ABAG's *Projections 2005.*
[7] Ibid.
[8] The California Integrated Waste Management Board defines ADC as "Alternative cover material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging."

disposed in each year. Therefore, if the amount of waste sent to a landfill is significantly reduced in a future year, that year's emissions profile will reflect those reductions[9].

As some types of waste (e.g. paper, plant debris, food scraps, etc.) generate methane within the anaerobic environment of a landfill and others do not (e.g. metal, glass, etc.), it is important to characterize the various components of the waste stream. Alameda County is unique among California counties in that it conducted its own waste characterization study in the year 2000. ICLEI utilized this study to determine the average composition of the waste stream for all Alameda municipalities. The specific characterization of ADC tonnage was provided by the CIWMB via the Disposal Reporting System (DRS).

Most landfills in the Bay Area capture methane emissions either for energy generation or for flaring. The US EPA estimates that 60%-80%[10] of total methane emissions are recovered at the landfills to which Emeryville sends its waste. Following the recommendation of the Alameda County Waste Management Authority, and keeping with general IPCC guidelines to err towards conservative estimation, ICLEI has adopted 60% as the methane recovery factor used in these calculations.

The tonnage of waste that is recycled, composted, or otherwise diverted from landfills is not directly inputted into CACP. The impact of such programs, however, is reflected in the CACP software model as a reduction in the total tonnage of waste going to the landfill (therefore reducing the amount of methane produced at that landfill). The CACP model does not capture the emissions reductions in "upstream" energy use from recycling (or any other emissions reduction practice) in the inventory. However, it should be noted that *recycling and composting programs can have significant additional impact on GHG emissions, as* manufacturing products with recycled materials avoids emissions from the energy that would have been used during extraction, transporting and processing of virgin materials.

Table 3 – *Community Waste Composition and Emissions by Waste Type*[11]

Waste Type	Paper Products	Food Waste	Plant Debris	Wood/ Textiles	All Other Waste	TOTAL
CO_2e (metric tons)	3,916	734	175	939	0	**5,764**
Percent of Total CO_2e	67.9%	12.7%	3.0%	16.3%	0.0%	**100%**
Percent of Tonnage Disposed	30.2%	10.0%	4.2%	25.6%	30.0%	**100%**

2.2.2. Community Emissions Forecast

Under a business-as-usual scenario, the City of Emeryville's emissions will grow over the next decade and a half by approximately 35.1%, from 178,832 to 241,659 metric tons CO_2e[12] . 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, ICLEI conducted an emissions forecast for the year 2020. Figure 3 and Table 4 show the results of the forecast. A variety of different reports and projections were used to create the emissions forecast.

Residential Forecast Methodology

For the residential sector, ICLEI calculated the compounded annual population growth rate[13] between 2005 and 2020, using population projections from Emeryville's General Plan. This growth rate (3.444%)

[9] As the emissions reductions associated with decreasing the amount of waste being landfilled are real and there are usually few external variables that change those emissions levels later, this front-loading is considered to be an accurate practice for counting and reporting emissions that will be generated over time.

[10] AP 42, section 2.4 Municipal Solid Waste, 2.4-6, http://www.epa.gov/ttn/chief/ap42/index.html

[11] Waste characterization study conducted by Stopwaste.org for the year 2000. Figures include only municipal solid waste, and not alternative daily cover.

[12] Growth rates calculated for this forecast assume a base year of 2005, and would be slightly different that estimates from 2004.

[13] Compounded annual growth rate= ((2020 population/2005 population)^(1/15))-1

was used to estimate average annual compound growth in energy demand. From the Emeryville General Plan, ICLEI estimated that the City's population will be 13,300 in 2020[14].

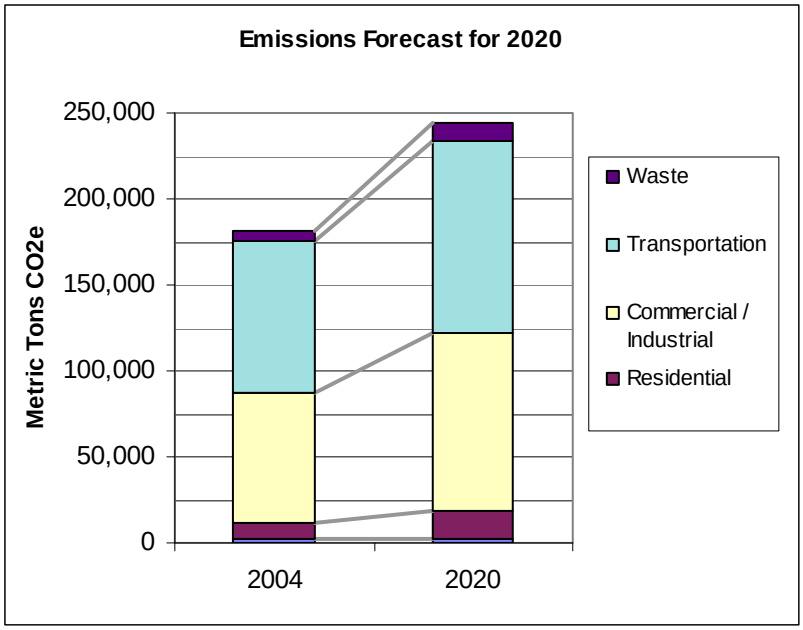
Commercial / Industrial Forecast Methodology

Analysis contained within "California Energy Demand 2008-2018: Staff Revised Forecast[15]," a report by the California Energy Commission (CEC), shows that commercial floor space and the number of jobs have closely tracked the growth in energy use in the commercial sector. Using job growth projections from the Emeryville General Plan, ICLEI calculated that the compounded annual growth in energy use in the commercial sector between 2005 and 2020 will be 1.99%.[16]

Transportation Forecast Methodology

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 Emeryville. 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 their report, "Transportation Energy Forecasts for the 2007 Integrated Energy Policy Report," the CEC projects that on-road VMT will increase at an annual rate of 1.51% per year through 2020[17]. This is the number that was used to estimate emission growth in the transportation sector for the Emeryville forecast.

Figure 3 – *Community Emissions Forecast*



Waste Forecast Methodology

As with the residential sector, the primary determinate for growth in emission in the waste sector is population. Therefore, the compounded annual population growth rate for 2005 to 2020 (3.444%[18], as calculated from the Emeryville General Plan), was used to estimate future emissions in the waste sector.

[14] The General Plan provides population predictions for 2030. To estimate 2020 population, ICLEI used 2000 Census data and assumed an equal growth rate every year between 2000 and 2030.
[15] http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF
[16] The Emeryville General Plan states that 10,000 new jobs will be added by 2030. ICLEI estimated the 2007 number of jobs by assuming a constant growth between 2005 and 2010 from ABAG jobs forecast data and added 10,000 to estimate 2030 jobs (30,668). This was then prorated in the same manner as population projections to estimate 2020 jobs (27,065).
[17] Report available at: http://www.energy.ca.gov/2007publications/CEC-600-2007-009/CEC-600-2007-009-SF.PDF. Compounded Annual growth rate for 2005-2020 is calculated from Table 4 on page 12. In light of recent fuel cost increases, the calculation assumes high fuel cost scenario.
[18] Ibid

Table 4 – *Community Emissions Growth Projections by Sector*

2004 Community Emissions Growth Forecast by Sector	2004	2020	Annual Growth Rate	Percent Change from 2004 to 2020
Residential	9,380	16,124	3.444%	71.9%
Commercial / Industrial	76,204	104,445	1.990%	37.1%
Transportation	87,447	111,118	1.509%	27.1%
Waste	5,801	9,972	3.444%	71.9%
TOTAL	**178,832**	**241,659**	**--**	**35.1%**

As Table 4 shows, emissions from the residential and waste sectors will experience the largest relative increase, growing by 71.9%. Emeryville can dramatically reduce these emissions by ensuring energy and water efficiency standards in new residential developments and promoting recycling and composting across the City. The transportation and commercial/industrial sectors will still compose the large majority of the City's emissions, and Emeryville should focus policy solutions on these sectors.

2.2.3. Government Operations Emissions Inventory

The sources of emissions that are being counted in the Government Inventory are facilities and equipment owned and operated by the City. The Government Operations Inventory includes sources from the following sectors:

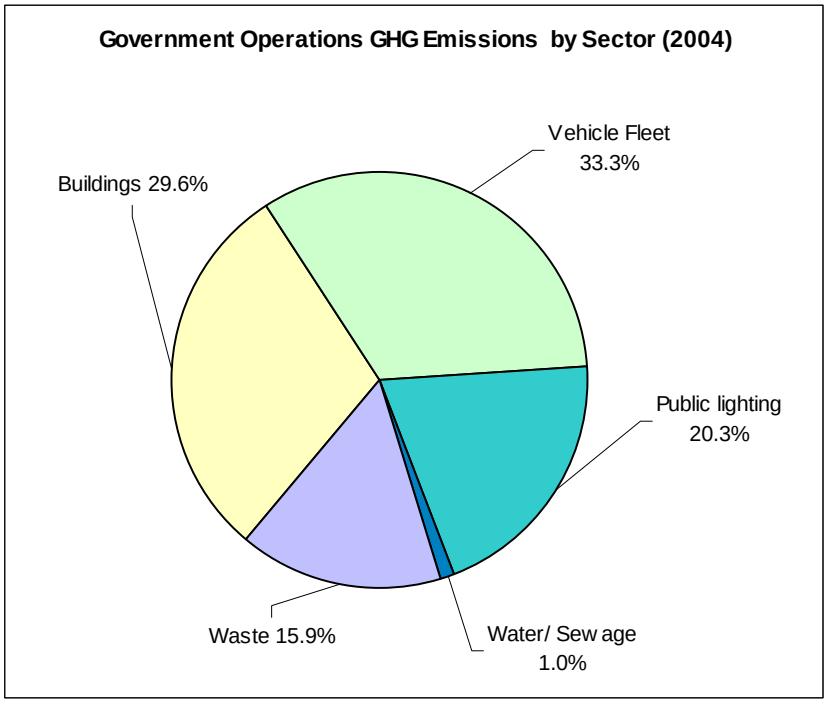
- Facilities
- Vehicle Fleet
- Public lighting
- Water Pumping and Irrigation
- Solid Waste

Emissions by Sector

The government operations in the City of Emeryville emitted approximately *1,335 metric tons of CO_2e in the year 2004*.

As visible in Table 5 and Figure 4, the City's vehicle fleet (including some contracted vehicles) is the largest emitter of greenhouse gases, composing about one-third of the government emissions. Emissions from City facilities compose another significant proportion of the total government emissions (29.6%), with public lighting generating 20.3%, and the remainder coming from waste (15.9%) and electricity for pumping water, sewage and stormwater (1.0%).

Figure 4 – *Government GHG Emissions by Sector*



Energy Related Costs

In addition to generating estimates on emissions per sector, ICLEI has calculated the basic energy costs of various government operations. During 2004, the Emeryville municipal government spent approximately $433,000 on energy (electricity, natural gas, gasoline and diesel) for its buildings, public lighting and vehicles. Powering and heating facilities composed the majority of costs ($169,608), with public lighting energy costing $136,974 and fuel for the City's fleet costing $118,974.

Beyond reducing harmful greenhouse gases, any future reductions in municipal energy use have the potential to reduce these costs, enabling Emeryville to reallocate limited funds toward other municipal services. For example, if Emeryville police replaced some vehicles with bicycles, they could reduce costs associated with fuel and maintenance (maintenance costs not included here) while reducing emissions from the police fleet.

Table 5 – *Government GHG Emissions by Sector*

Government Emissions 2005	Facilities	Vehicle Fleet	Public lighting	Water/ Sewage	Waste	TOTAL
CO_2e (metric tons)	395	444	271	13	212	1,335
Percent of Total CO_2e	29.6%	33.3%	20.3%	1.0%	15.9%	100.0%
Energy Equivalent (MMBtu)	6,633	5,713	4,137	195	-	16,678
Cost ($)	$169,608	$118,974	$136,974	$7,801	-	$433,357

Facilities / Municipal Buildings

In 2004, Emeryville municipal buildings and other facilities consumed about 972,928 kWh of electricity and 33,122 therms of natural gas, which resulted in a release of 395 tons of CO_2e emissions into the atmosphere.

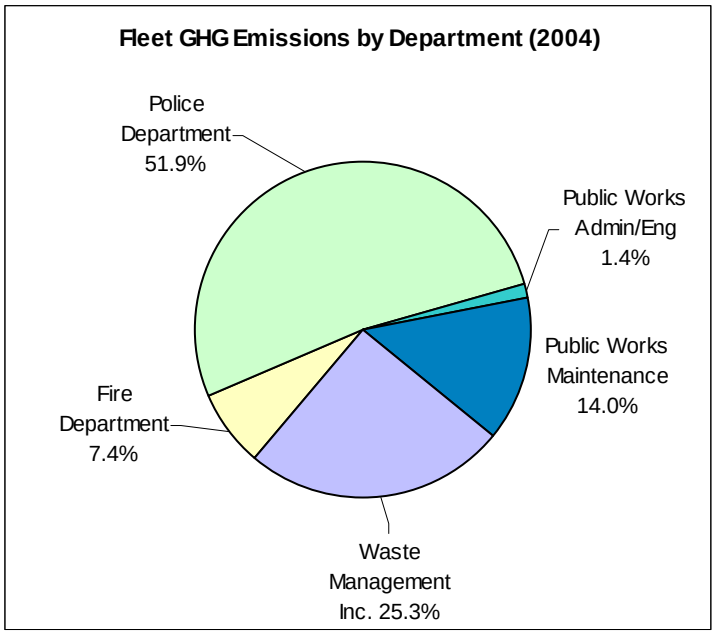
As stated above, and as visible in Figure 4, emissions from municipal facilities constitute approximately 29.6% of total City emissions. Table 6 breaks down emissions by facility. About half of the emissions from City buildings came from the Civic Center and the Police Station. The Senior Center was responsible for 12.4% of City operations emissions, and the Development Center, Corporation Yard, and Fire Stations each composed less than 10% of total emissions. Cumulatively, the City spent approximately $169,608 on electricity and natural gas to power and heat City facilities in 2004.

Table 6– *Emissions from Municipal Facilities*

Facility	CO_2e (metric tons)	Percent CO_2e of All Facilities	Electricity Consumption (kWh)	Natural Gas Consumption (therms)	Energy Equivalent (MMBtu)	Total Cost ($)
Child Care Development Center	35	8.9%	67,429	3,784	609	$13,932
Civic Center (Offices)	127	32.2%	352,000	9,052	2,107	$56,126
Corp Yard	29	7.4%	94,920	1,365	460	$16,341
Fire Station #1	36	9.1%	100,400	2,600	603	$17,761
Fire Station #2	33	8.4%	70,859	3,260	568	$14,037
Police Station	85	21.6%	252,320	5,410	1,402	$39,128
Senior Center	49	12.4%	35,000	7,651	885	$12,283
TOTAL	**394**	**100.0%**	**972,928**	**33,122**	**6,634**	**$169,608**

City and Contractor Vehicle Fleet

Figure 5 – *Emissions from City Fleet Vehicles*



As visible in Figure 4, the fleet of City-owned and contractor vehicles were the largest source of municipal emissions in 2004, producing 33.3% of total emissions. Not including the Fire Department and Public Works Maintenance vehicles, the City owned 31 vehicles in 2004, and Waste Management used 4 vehicles to haul the City's waste.

The vehicle fleet consumed 63,266 gallons of fuel (including gasoline, diesel, ultra low sulfur diesel and natural gas) and emitted about 444 tons of CO_2e. The municipal fleet includes all vehicles owned and operated by the City of Emeryville plus some contractor vehicles performing City functions. As portrayed in Figure 5 and Table 7, the greatest percentage of fleet emissions (51.9%) comes from gasoline and diesel consumption in Police Department vehicles. Waste Management vehicles that use CNG and ultra low sulfur diesel emitted one-quarter of the City's mobile emissions. The Fire Department and the Public Works Department are collectively responsible for the remaining quarter of the total fleet emissions.

Table 7 – *2004 City Vehicle Fleet Emissions and Fuel Consumption*

Department	CO_2e (metric tons)	Percent CO_2e of Total Fleet	Gasoline Consumption (gal)	Other Fuel consumption (gal)	Total Fuel Cost ($)
Fire Department	33	7.4%	1,958	1,454 (diesel)	$6,620
Police Department	230	51.9%	23,684	0	$50,466
Public Works Admin/Eng	6	1.4%	660	0	$1,406
Public Works Maintenance	62	14.0%	6,082	325 (diesel)	$13,641
Waste Management Inc.	112	25.3%	4	17,452 (CNG), 11,648 (ULSD)	$46,841
TOTAL	**443**	**100.0%**	**32,388**	**30,879**	**$118,974**

Public Lighting

The category of public lighting includes all traffic signals and all sidewalk and outdoor parking lighting. In 2004, public lighting consumed about 1.2 million kWh of electricity, which resulted in a release of 271 metric tons of CO_2e emissions into the atmosphere. Table 8 breaks down energy use and emissions from public lighting by type. Over all categories of energy, across all sectors of municipal operation, public lighting generated about 20.3 % of emissions (Figure 4).

Table 8 – *2004 Public Lighting Emissions and Energy Use*

Lighting Type	CO_2e (metric tons)	Electricity Consumption (kWh)	Energy Equivalent (MMBtu)	Cost ($)
Streetlights	255	1,138,978	3887	$125,282.00
Traffic Signals/Controllers	16	73,817	250	$11,692.00
TOTAL	**271**	**1,212,795**	**4,137**	**$136,974**

Water/Sewage

This water infrastructure in Emeryville is comprised mainly of pumps and irrigation equipment. Emissions associated with the electricity needed to power this infrastructure are included in this report. In 2004, water distribution consumed about 57,000 kWh of electricity, which resulted in a release of 13 metric tons of CO_2e emissions into the atmosphere. Table 9 breaks down energy use and emissions from water/sewage by type. Water pumping facilities accounted for approximately 1.0% of total municipal emissions – the smallest contributor to City emissions.

Table 9 – *2004 Water/Irrigation Emissions and Energy Use*

Water/Irrigation Type	CO_2e (metric tons)	Electricity Consumption (kWh)	Energy Equivalent (MMBtu)	Cost ($)
Waterpumps	12	54,505	186	$6,882.00
Irrigation / Sprinkler Systems	1	2,580	9	$919.00
TOTAL	**13**	**57,085**	**195**	**$7,801**

Solid Waste

Solid waste generated by City-owned facilities and infrastructure produced an estimated 15.9% (Figure 4) of the total emissions from government operations. As in the community analysis, these emissions are an estimate of future methane generation over the full, multi-year decomposition period of the waste generated in the year 2004.

In 2004, Emeryville sent approximately 550 tons of solid waste to landfill, resulting in a total of 212 metric tons of CO_2e.

In the absence of a centralized disposal record like the CIWMB Disposal Reporting System, waste generation figures from government operations, as well as the characterization of government waste, were estimated by Waste Management staff. Additionally, the final emissions number generated by the CACP software used the 60% methane recovery factor discussed above.

2.2.4. Government Operations Emissions Forecast

While the community emissions growth forecast is based upon known per capita energy consumption, workforce expansion, and population growth projections, the forecast of growth within municipal operations is based upon the expansion of City services or infrastructure. It was not within the scope of this project to estimate growth of City infrastructure or services, and, therefore, the government operations emissions forecast is not included. ICLEI advises that the City conduct such a forecast to be included in this report at a later date, and to inform the process of selecting an emission reduction target for City operations.

3. Conclusion

In passing a resolution to endorse the U.S. Conference of Mayors Climate Protection Agreement, the City of Emeryville made a formal commitment to reduce its greenhouse gas emissions. This report lays the groundwork for those efforts by estimating baseline emission levels against which future progress can be demonstrated.

This analysis found that the Emeryville community as a whole was responsible for emitting *178,832 metric tons of CO_2e in the base year 2004*, with the transportation sector contributing the most (48.9%) to this total. The City of Emeryville's own municipal operations were responsible for 1,*335 metric tons of CO_2e in the year 2004*, with the greatest percentage of emissions coming from the City vehicle fleet and City facilities.

In addition to establishing the baseline for tracking progress over time, this report serves to identify the major sources of Emeryville emissions, and therefore the greatest opportunities for emission reductions. In this regard, the emissions inventory ought to inform the areas of focus within the Emeryville Climate Action Plan.

Following the ICLEI methodology, we also recommend that the City of Emeryville utilize the inventory to begin to consider potential greenhouse gas reduction targets for the community and for municipal operations.

As Emeryville works to finalize the Climate Action Plan, the City should identify and quantify the emission reduction benefits of projects that have already been implemented since 2004, as well as the emissions reduction benefits of proposed future emissions reduction measures. The benefits of both existing and proposed strategies can be tallied against the baseline established in this report to determine the appropriate set of strategies that will deliver the City to its chosen emissions reduction goal.

4. Appendices

4.1. Appendix A: Forecast Data from ABAG's *Projections 2005*

Forecast Table 1 – ABAG Projections on Job Growth in Emeryville

TOTAL JOBS					
JURISDICTIONAL BOUNDARY	2000	2005	2010	2015	2020
ALAMEDA	27,380	27,960	34,750	37,990	41,080
ALBANY	5,190	4,940	5,560	5,650	5,670
BERKELEY	78,320	76,890	79,080	80,580	81,690
DUBLIN	16,540	19,950	24,770	29,170	32,030
EMERYVILLE	19,860	20,140	21,460	21,750	21,900
FREMONT	104,830	96,530	105,060	119,360	136,770
HAYWARD	76,320	73,670	80,030	84,330	88,790
LIVERMORE	32,820	33,660	40,420	46,170	55,070
NEWARK	21,420	21,180	23,310	23,810	24,230
OAKLAND	199,470	207,100	223,490	235,030	250,260
PIEDMONT	2,120	2,120	2,140	2,160	2,190
PLEASANTON	58,670	58,670	66,050	72,020	73,410
SAN LEANDRO	44,370	42,790	44,840	50,460	54,380
UNION CITY	19,310	19,920	24,000	29,010	34,900
UNINCORPORATED	43,540	41,980	43,880	47,480	50,940

Forecast Table 2 – ABAG Projections on Population Growth in Emeryville

TOTAL POPULATION					
JURISDICTIONAL BOUNDARY	2000	2005	2010	2015	2020
ALAMEDA	72,259	75,400	77,600	79,900	82,300
ALBANY	16,444	16,800	17,200	17,400	17,800
BERKELEY	102,743	105,300	107,200	109,500	111,900
DUBLIN	29,973	40,700	50,000	57,000	63,800
EMERYVILLE	6,882	8,000	8,800	9,300	9,900
FREMONT	203,413	211,100	217,300	226,900	236,900
HAYWARD	140,030	146,300	151,400	156,600	160,300
LIVERMORE	73,345	78,000	84,300	90,200	96,300
NEWARK	42,471	44,400	46,000	47,400	49,000
OAKLAND	399,484	414,100	430,900	447,200	464,000
PIEDMONT	10,952	11,100	11,200	11,200	11,200
PLEASANTON	63,654	68,200	72,600	76,500	80,400
SAN LEANDRO	79,452	82,400	84,300	87,500	90,800
UNION CITY	66,869	71,400	75,100	78,600	82,600
UNINCORPORATED	135,770	143,900	150,600	153,600	157,300

4.2. Appendix B: Emissions Factors Used in the Alameda County Climate Protection Partnership

PG&E Emission Factors:

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity	CO_2	0.489155 lbs/kwh (for 2004 and 2005)	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-this factor includes release of CH_4 and N_2O. Figure provided is a 2005 number being used as proxy for 2004.
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	

Alameda County Transportation Sector Emission Factors:

CH_4 Rates (grams/mile)		N_2O Rates (grams/mile)		VMT Mix		CO_2 Rates- (grams/gallon)		Fuel Efficiency (miles/gallon)	
Gas	Diesel	Gas	Diesel	Gas (Passenger Vehicles)	Diesel (Heavy Trucks)	Gas	Diesel	Gas	Diesel
0.062	0.042	0.070	0.050	92.8%	7.2%	8,599	10,092	19.1	6.4

Provided by the Bay Area Air Quality Management District EMFAC Model

Alameda County Waste Sector Emission Factors:

Waste Type	Methane Emissions (tonne/tonne of waste disposed)	Sequestration (tonne/tonne of waste disposed)
Paper Products	2.138262868	0
Food Waste	1.210337473	0
Plant Debris	.685857901	0
Wood/Textiles	.605168736	0
All Other Waste	0	0

Methane recovery factor of 60% derived from the US EPA AP 42 Emissions Factors report (http://www.epa.gov/ttn/chief/ap42/index.html).

4.3. Appendix C: Waste Calculation Methodology

Emissions Calculation Methods

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:

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

Where:
W_t is the quantify of waste type 't',
R is the methane recovery factor,
A is the CO_2e emissions of methane per metric ton of waste at the disposal site (the methane factor)

While the WARM model often calculates upstream emissions, as well as carbon sequestration in the landfill, these dimensions of the model were omitted for this particular study for two reasons:

1) This inventory functions on a 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'.

4.4. Appendix D: Detailed CACP Report: Government Operations Greenhouse Gas Emissions in 2004 *(attached)*

4.5. Appendix E: Detailed CACP Report: Community Greenhouse Gas Emissions in 2004 *(attached)*