City of Alameda

2010 Community-Wide Greenhouse Gas Emissions Inventory

Produced by StopWaste.Org

With Assistance from ICLEI - Local Governments for Sustainability USA

Acknowledgements

City of Alameda

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Executive Summary

In 2006, California passed the Global Warming Solutions Act (AB 32), which charged the California Air Resources Board (CARB) with implementing a comprehensive statewide program to reduce greenhouse gas(GHG) emissions. AB 32 established the following GHG emissions reduction targets for the state of California:

- 2000 levels by 2010
- 1990 levels by 2020

In response to the legislative initiative, CARB encouraged local agencies to develop detailed community plans to document tasks, actions, and goals to combat and reduce GHG emissions. The City of Alameda (Alameda) recognized that GHG emissions from human activity was catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community.

Alameda Council established a City of Alameda Climate Protection Task Force, appointed by the Council to assist in the development of a Local Action Plan for Climate Protection. Members of this committee including members of the Economic Development Commission, Planning Board, Public Utilities Board, Transportation Commission, Alameda County Industries, and four Alameda residents. In 2008, Alameda prepared a baseline GHG emissions inventory (base year 2005), which provided data to support the creation and adoption of the "Local Action Plan for Climate Protection (LAPCP)". The LAPCP commits the City to reducing GHG emissions and introduces four categories of initiatives designed to help them meet reduction goals. The categories are 1) transportation and land use; 2) energy; 3) waste and recycling; and 4) community outreach and education. Potential measures arising from these initiatives include transit-oriented development, energy efficiency programs, and "Zero Waste" ordinances in addition to others[1]. Furthermore, Alameda has multiple opportunities to reduce community GHG emissions. Some of the associated benefits of such actions include reducing energy, waste, and transportation costs for residents and businesses, creating green jobs, improving health of residents, and making the City a more attractive place to live and locate a business.

The LAPCP has been in effect for five years and staff has made progress in many areas. To gauge results and determine if Alameda will meet the 2020 goals, staff initiated a project to measure 2010 emissions. This report provides estimates of GHG emissions resulting from activities in Alameda in 2010, to support further development of Climate Action Planning.

Comparison to 2005 Baseline Inventory

In 2010, community emissions for Alameda were estimated to be 368,813 $MTCO_2e$. It is important to note that these emissions cannot be directly compared with the 303,096 $MTCO_2e$ reported in Alameda's 2005 community inventory,

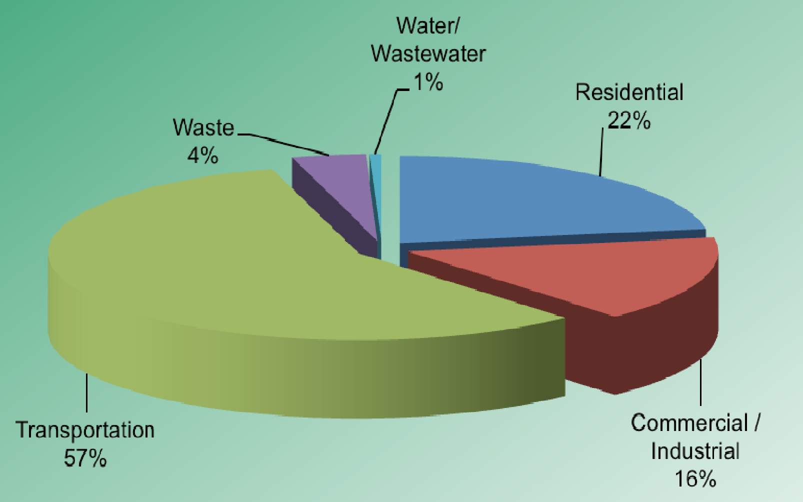
[1] LAPCP can be downloaded at www.cityofalamedaca.gov/Go-Green/

because not all calculations methodologies nor emissions sources were consistent between the two inventories. In order to obtain a better understanding of the relationship between the two inventories, updates were made to the baseline inventory. Please refer to "2005 to 2010 Comparison" starting on pg. 30 for a detailed profile of updated emissions.

When comparable data between 2005 and 2010 are examined, community emissions decreased by 8 percent, from 357,092 $MTCO_2e$ to 329,504 $MTCO_2e$. The decrease in comparable emissions numbers is attributable in part to the following factors:

- Lower electricity emissions factors in 2010 due to a cleaner energy mix used by Alameda Municipal Power, the City's Electrical Utility
- Decreased vehicle miles traveled (VMT) by passenger vehicles, heavy trucks, and buses
- Increased transport fleet fuel efficiency at the level of Alameda County
- Decreased tonnage of landfilled waste

Figure A: Community GHG Emissions by Sector



Key Findings

As can be seen in Figure A, the largest contributor to community emissions is the Transportation sector with 57% of total emissions. The next largest contributor is the Residential sector with 22% of total emissions. Actions to reduce emissions in both of these sectors will be a key part of a climate action plan. The Commercial/Industrial, Waste, and Water/Wastewater sectors were responsible for the remainder of emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within City of Alameda, information that is key to guiding local reduction efforts.

Next Steps

The results of this assessment will be presented to City stakeholders, including the Public Utilities Board, the City Council, and community organization, Community Action for a Sustainable Alameda. Further work will be completed to identify initiatives necessary to achieve greenhouse emission goals.

Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of GHGs and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which together introduce large amounts of carbon dioxide and other GHGs into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

Many communities in the United States have taken responsibility for addressing climate change at the local level. Current and expected impacts to Alameda related to climate change are discussed below. Beyond Alameda, climate scientists expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and landslides, summer water shortages resulting from reduced snow pack, and the disruption of ecosystems, habitats, and agricultural activities.

Reducing fossil fuel use in the community can have many benefits in addition to reducing GHG emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent at local businesses in support of the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling may improve residents' health.

Regional and Local Impacts

Alameda and the rest of the state have already experienced warming; recent warming in the region has been among the most rapid in the nation. This warming is believed to be driving declines in spring Sierra snowpack. Additional projected impacts include the following[2]:

- Projections of future climate change indicate continued strong warming in the region, with much larger increases under higher emissions scenarios as compared to lower emissions scenarios.
- Projected summertime temperature increases are greater than the annual average increases in parts of the region and are likely to be exacerbated by expanding urban heat island effects.
- Further water cycle changes are projected, which, combined with increasing temperatures, signal a serious water supply challenge in the decades and centuries ahead.
- Increased frequency and altered timing of flooding will increase risks to people, ecosystems, and infrastructure.

[2] From the United States Global Change Research Program's Southwest Fact Sheet, part of the landmark 2009 federal report, Global Climate Change Impacts in the United States.

- Cities and agriculture face increasing risks from a changing climate.

Evidence of Human-Caused Climate Change

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states that "warming of the climate system is unequivocal."[3] Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations."

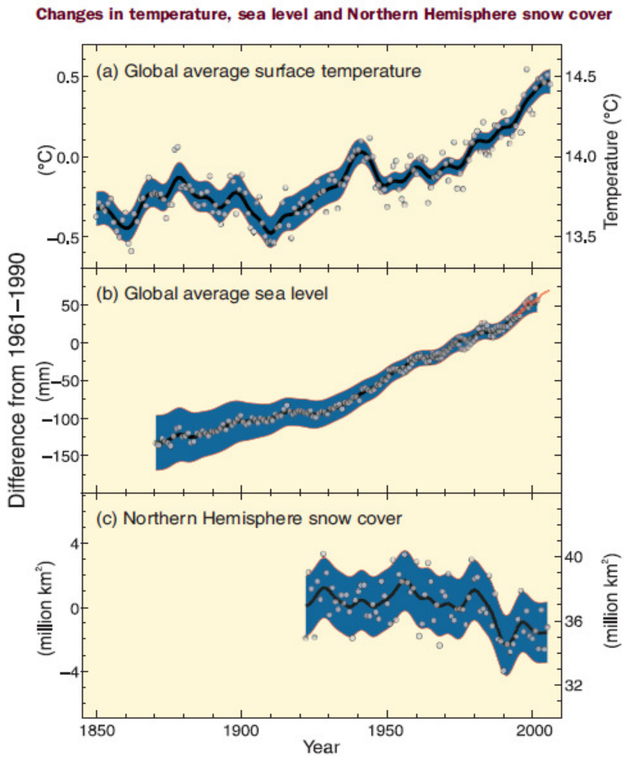


Figure 1: Observed changes in global temperature, sea level and snow cover.

Analysis released in January 2011 by NASA's Goddard Institute for Space Studies shows that global average surface temperatures in 2010 "tied" 2005 as the warmest on record (the difference is smaller than the uncertainty in comparing the temperatures of recent years).[4] The next hottest years, also with very close average temperatures, are 1998, 2002, 2003, 2006, 2007, and 2009. The period from January 2000 to December 2009 is the warmest decade on record, followed by the 1990's, then the 1980's respectively. The steady uptick in average temperatures is significant and expected to continue if action is not taken to greatly reduce GHG emissions.

California Policy

California passed the Global Warming Solutions Act (AB 32) in 2006, which charged the California Air Resources Board (CARB) with implementing a comprehensive statewide program to reduce GHG emissions. AB 32 established the following GHG emissions reduction targets for the state of California:

- 2000 levels by 2010
- 1990 levels by 2020

[3] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

[4] Goddard Institute for Space Studies, "Research Finds 2010 Tied for Warmest Year on Record," 2011, 18 Jan. 2011, <http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>.

Additionally, the passage of SB 375 enhances California's ability to reach its AB 32 goals by promoting good planning with the goal of more sustainable communities. SB 375 requires CARB to develop regional GHG emission reduction targets for passenger vehicles. CARB is to establish targets for 2020 and 2035 for each region covered by one of the State's 18 metropolitan planning organizations (MPOs). Another policy driver for climate action planning in California is SB 97, which established that GHG emissions and their impacts are appropriate subjects for analysis under the California Environmental Quality Act (CEQA). This law directed the State's Office of Planning and Research (OPR) to develop CEQA guidelines on the mitigation of GHG emissions for agencies such that they may follow appropriate standards on calculating GHG emissions from projects, determine potential significance, and implement mitigation measures, if necessary and feasible. Finally, Executive Order S-3-05, issued by Governor Schwarzenegger, reinforces these goals and also establishes a schedule for the reporting of both the measured impacts of climate change upon California's natural environment and the emissions reduction efforts undertaken by a myriad of state, regional, and local groups. Executive Order S-3-05 establishes an additional target of 80% below 1990 levels by 2050. Alameda's GHG emissions inventory is intended to enable the City to develop effective GHG reduction policies and programs to meet these targets and track emissions reduction progress.

ICLEI Local Governments for Sustainability Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of GHG emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing GHG emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI – Local Governments for Sustainability (herewith known as "ICLEI") is an association for local governments that enables them to share knowledge and successful strategies toward increasing local sustainability.[5]

ICLEI provides a framework and methodology for local governments to identify and reduce GHG emissions, organized along Five Milestones:

[5] ICLEI was formerly known as the International Council for Local Environmental Initiatives, but the name has been changed to ICLEI – Local Governments for Sustainability. http://www.iclei.org & http://www.icleiusa.org

1. Conduct an inventory and forecast of local GHG emissions;
2. Establish a GHG emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents an update to ICLEI's Climate Mitigation Milestone One and provides a foundation for future work to reduce GHG emissions in Alameda.

Sustainability & Climate Change Mitigation Activities in Alameda

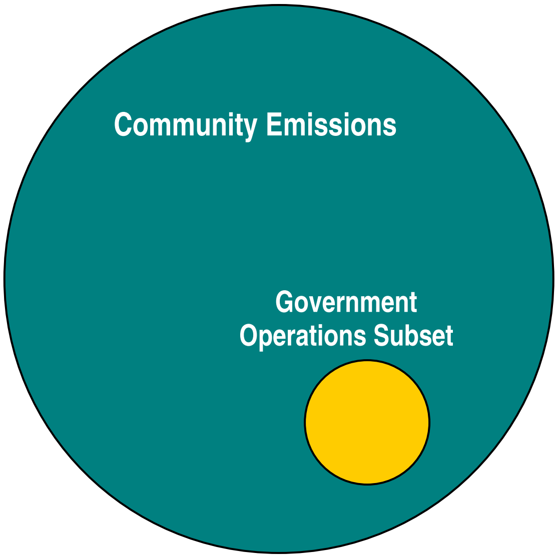
The City of Alameda has formally adopted a goal of reducing GHG emissions by 25% below 2005 levels by 2020. In addition to several initiatives in the Local Climate Action Plan discussed above, the City of Alameda has a wide set of programs and initiatives in place that make Alameda a leader in the area of sustainable practices. Noticeably among these, Alameda Municipal Power (the City's electricity utility) has one of the cleanest energy mixes in the nation[6].

[6] http://www.alamedamp.com/

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible GHG emission reductions requires identifying baseline levels and sources of emissions in the community. As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. Standard processes of accounting for emissions have been developed by ICLEI to which this inventory adheres. Alameda staff used the International Local Government GHG Emissions Analysis Protocol (IEAP) to inventory the City's community emissions based on emissions from calendar years 2005 and 2010. In addition, methods from the Local Government Operations Protocol were used as appropriate for specific sectors.



Alameda had previously completed an inventory of emissions from government operations, published in 2008, based on 2005 emissions. The government operations inventory is a subset of the community inventory; for example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

Community Emissions Protocol

The IEAP, developed by ICLEI, provides guidelines for local governments in quantifying GHG emissions from the community within their geopolitical boundaries. Staff used this protocol to inventory Alameda's community emissions for 2005 and 2010. ICLEI began development of the IEAP with the inception of its Cities for Climate Protection Campaign in 1993, and through this work has established a common GHG emissions inventory protocol for all local governments worldwide.[7] ICLEI USA is currently developing a Community Protocol supplement for the US, which is similar in many respects to the Local Government Operations Protocol (LGO Protocol) described below. StopWaste.Org followed the guidance of the Draft Community Protocol supplement where possible.

[7] International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP). ICLEI. http://www.iclei.org/index.php?id=ghgprotocol

Local Government Operations Protocol

In 2008, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released the LGO Protocol to serve as a national appendix to the IEAP.[8] The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government operations GHG emissions inventory. The LGO Protocols also informs some methods used for community inventories.

Quantifying Greenhouse Gas Emissions

Establishing a Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Alameda's community GHG emissions inventory utilizes 2005 as its base year. 2005 is a commonly accepted baseline year in California – it is the reference year in both SB 375 and Executive Order S-3-05. Also, 2005 is one of the earliest years for which relatively comprehensive data is available and is the base year used in Alameda's government operations inventory.

Establishing Boundaries

Setting an organizational boundary for GHG emissions accounting and reporting is an important step in the inventory process. Alameda's community inventory assesses emissions resulting from activities taking place within the City's geopolitical boundary. The IEAP defines "geopolitical boundary" as "consisting of the physical area or region over which the local government has jurisdictional authority." Activities that occur within this boundary can be, for the most part, controlled or influenced by Alameda's policies and educational programs. Although the City may have limited influence over the level of emissions from some activities, it is important that every effort be made to compile a complete analysis of all activities that result in GHG emissions.

Emission Types

The IEAP and LGOP recommend assessing emissions from the six internationally recognized GHGs regulated under the Kyoto Protocol as listed in Table 1. Emissions of Hydrofluorocarbons and Perfluorocarbons are not included in this inventory because of the difficulty of obtaining data on these emissions at a community scale. GHG emissions are commonly aggregated and reported in terms of equivalent carbon dioxide units, or CO_2e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a GHG may cause, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different GHGs in comparable terms. For example, methane is twenty-one

[8] Local Government Operations Protocol (LGOP). http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

times more powerful than carbon dioxide in its warming effect, so one metric ton of methane emission is equal to 21 metric tons of carbon dioxide equivalents. See Table 1 for the GWPs of the commonly occurring GHGs.

Table 1: Greenhouse Gases

Greenhouse Gas	Chemical Formula	Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	Various	43-11,700
Perfluorocarbons	Various	6,500-9,000
Sulfur Hexafluoride	SF_6	23,900

Quantification Methods

StopWaste.Org worked with local and regional contacts to gather data and calculate emissions of GHGs in Alameda. GHG emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of GHG emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

Most emissions sources in this inventory are quantified using calculation based methodologies. Activity data refer to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please refer to the appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. pounds CO_2/kWh of electricity). Table 2 demonstrates examples of common emission calculations that use this formula. Please see appendices for details on the emissions factors used in this inventory.

Table 2: Basic GHG Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kWh)	CO_2 emitted/kWh	CO_2 emitted
Natural Gas Consumption (therms)	CO_2 emitted/therm	CO_2 emitted
Gasoline/Diesel Consumption (gallons)	CO_2 emitted /gallon	CO_2 emitted
Vehicle Miles Traveled	CH_4, N_2O emitted/mile	CH_4, N20 emitted

CACP 2009 Software

To facilitate community efforts to measure GHG emissions as a first step towards reducing them, ICLEI developed the Clean Air and Climate Protection 2009 (CACP 2009) software package in partnership with the National Association of Clean Air Agencies (NACAA) and the U.S. Environmental Protection Agency (EPA). CACP 2009 is designed for compatibility with the LGO Protocol and determines emissions by combining activity data (energy consumption, waste generation, etc.) with verified emission factors.

The CACP software has been and continues to be used by over 600 U.S. local governments to measure their GHG emissions. However, it is worth noting that, although the software provides governments with a sophisticated and useful tool, calculating emissions from activity data 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.

Evaluating Greenhouse Gas Emissions

There are several important concepts involved in the analysis of emissions arising from many different sources and chemical/mechanical processes throughout the community. Those not touched on already are explored below.

Emissions by Scope

For both community and government operations, emissions sources are categorized relative to the geopolitical boundary of the community or the operational boundaries of the government. Emissions sources are categorized as Scope 1, Scope 2, or Scope 3, as described below. The Scopes framework is used to prevent double counting of emissions for major categories such as electricity use and waste disposal.

The Scopes framework identifies three emissions Scopes for community emissions:

- **Scope 1:** All direct emissions from sources located within the geopolitical boundary of the local government.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the geopolitical

boundary of the local government, but that rely upon emissions-producing processes located outside of the government's jurisdiction.

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

Scope 1 and Scope 2 sources are the most essential components of a community GHG analysis as these sources are typically the most significant in scale, and are most easily affected by local policy making. In addition to the categories in the Scopes framework, emission sources may also fall into a fourth category called Information Items.

Emissions by Sector

In addition to categorizing emissions by Scope, this inventory examines emissions by sector. Many local governments find a sector-based analysis more relevant to policymaking and project management, as it assists in formulating sector-specific reduction measures and climate action plan components. Table 3 shows the sectors are included in this inventory:

Table 3: Community and Local Government Sectors

Community	Municipal
Residential	Buildings
Commercial / Industrial	Streetlights
Transportation	Water Transport
Waste	Vehicle Fleet
Water/Wastewater	Waste
	Employee Commute

Community Emissions Inventory Results

Emissions by Scope

The emissions sources by Scope and sector included in this inventory are listed in Table 4.

Table 4: Scopes and Sectors Included in Alameda Community Inventory

Sector	Scope 1	Scope 2	Scope 3
Residential	Natural Gas	Electricity	
Commercial / Industrial	Natural Gas & Fugitive Emissions	Electricity	
Transportation	Gasoline & Diesel		Electricity from BART
Waste	Emissions from Doolittle Landfill		Future Emissions from 2010 Waste
Water/Wastewater			Up- and Downstream Emissions from EBMUD

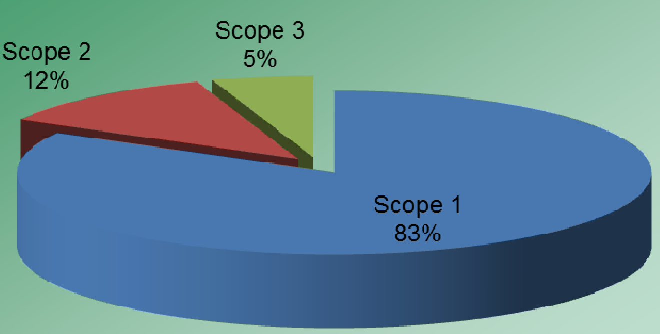
Total roll-up community emissions for Alameda, consisting of all sources indicated in Table 4, were approximately 3,868,813 metric tons[9] of CO_2e in the year 2010. Because the sources that go into a roll-up number vary from community to community, this number should not be used for comparative purposes without a careful analysis of the basis for the number. Table 5 and Figure 2 present the emissions calculations by Scope and sector.

Table 5: Community GHG Emissions per Sector per Scope (metric tons CO_2e)

Sector	Scope 1	Scope 2	Scope 3	TOTAL
Residential	66,554	16,145	0	82,699
Commercial / Industrial	31,547	27,304	0	58,851
Transportation	206,465	0	4,274	210,739
Waste	1,719	0	12,650	14,368
Water/Wastewater	0	0	2,156	2,156
TOTAL	306,285	43,449	19,079	**368,813**
Percentage of Total CO2e	83%	12%	5%	**100%**

[9] All emissions estimated using ICLEI's CACP 2009 Software.

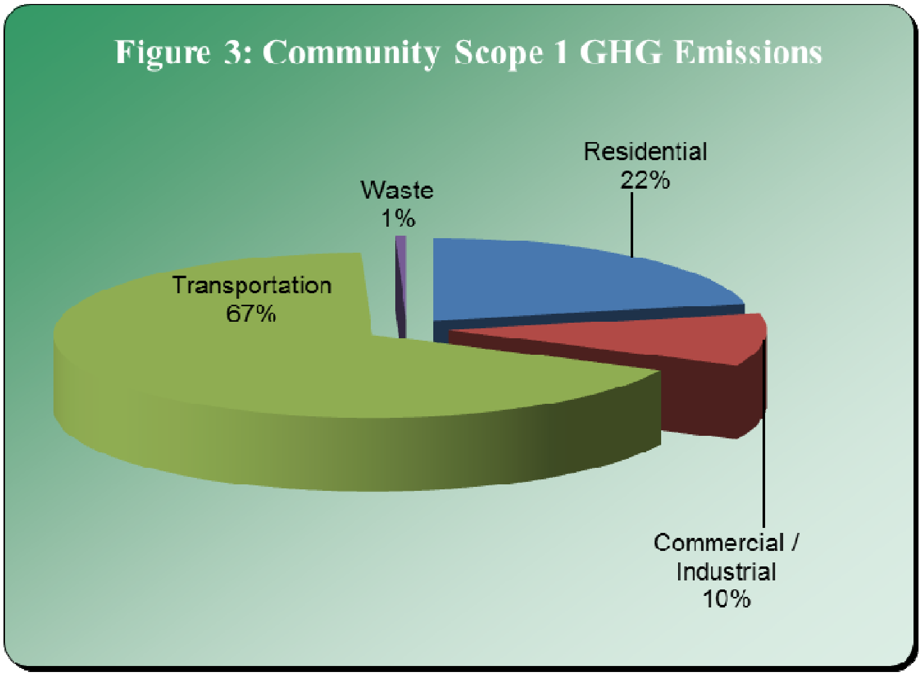
Figure 2: Community GHG Emissions by Scope



The following sections describe each of the individual scopes in more detail. As shown in Table 6 and Figure 3 below, the largest percentage of Scope 1 emissions came from the Transportation Sector (67%). The Transportation Sector emissions are the result of vehicle miles travelled within as well as outside of Alameda that can be attributed to Alameda residents and Alameda business attractors. Please refer to Appendix D for further information on Transportation sector calculation methodologies. The remainder of Scope 1 emissions resulted from natural gas consumption in Alameda homes (Residential Sector, 22%), natural gas consumption in Alameda businesses and fugitive emissions from industry (Commercial/Industrial Sector, 10%), and fugitive methane emissions from the Doolittle Landfill (1%).

Table 6: Community Scope 1 GHG Emissions (metric tons CO_2e)

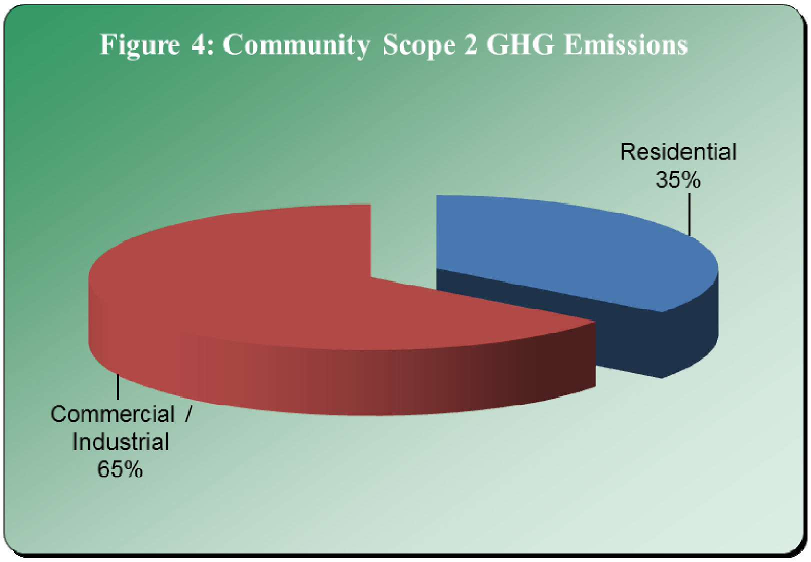
Scope 1 Emissions By Sector	Residential	Commercial / Industrial	Transportation	Waste	TOTAL
CO2e (metric tons)	66,554	31,547	206,465	1,719	306,285
% of Total CO2e	22%	10%	67%	1%	100%



As shown in Table 7 and Figure 4, 65% of 2010 Scope 2 emissions were generated by the Commercial / Industrial Sector and 35% of Alameda's Scope 2 emissions were generated by the Residential sector within City of Alameda boundaries. As noted above in the general description of Scope 2 parameters, the actual emissions from these activities were generated outside of Alameda City boundaries—in this case, at the source of electricity generation. Emissions from these purchases are included in Table 7.

Table 7: Community Scope 2 GHG Emissions (metric tons CO_2e)

Scope 2 Emissions By Sector	Residential	Commercial / Industrial	TOTAL
CO2e (metric tons)	16,145	27,304	43,449
% of Total CO2e	35%	65%	100%



The remaining portion of emissions included in the City of Alameda 2010 community inventory fall under the category of Scope 3. Scope 3 emissions are further subdivided into three categories. The first category is includes an estimate of future emissions over the lifecycle decomposition of waste sent to landfill in the base year (2010). The second category includes estimates of up- and down-stream emissions related water use and wastewater produced in Alameda. These emissions are estimated based on energy usage and process emissions related to water services that take place before water reaches Alameda, such as conveyance from source and treatment, and water services that take place after wastewater leaves Alameda, such as wastewater treatment. The last category includes estimates of emissions from electricity used by BART serving residents of Alameda. Though no BART station is located in Alameda, residents use BART services. Emissions estimates are based on Alameda's proportion of the population of Alameda County and BART's energy use within Alameda County.[10] All three categories are Scope 3 emissions because they originate outside the boundaries of Alameda.

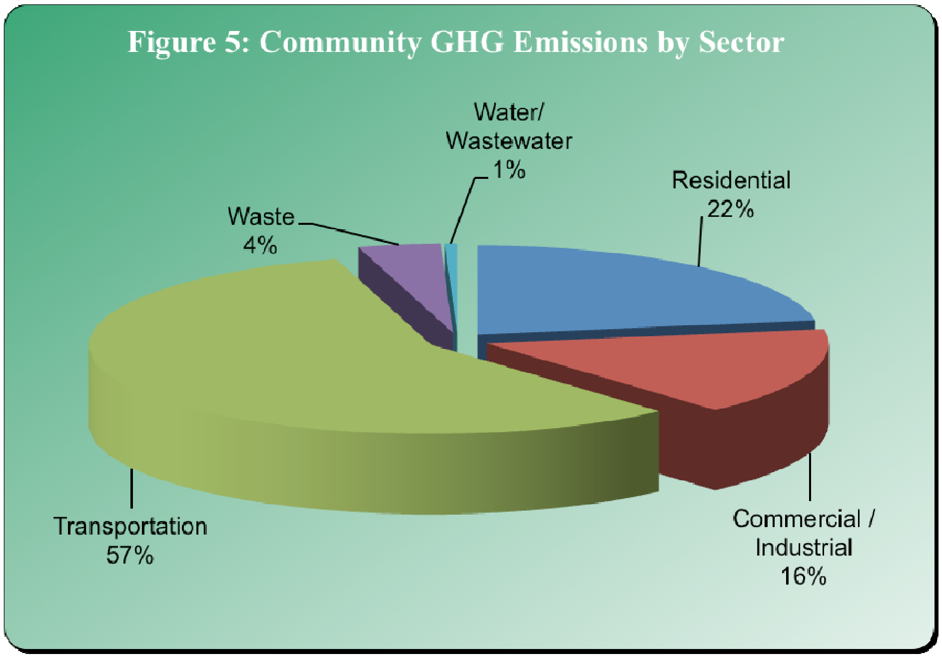
Emissions by Sector

In addition to considering emissions via Scopes, the inventory also focuses specifically on each sector, with scopes aggregated by sector. As visible in Table 8 and Figure 5 below, fuel usage within the Transportation Sector was by far the largest source of community emissions (57%). Electricity and natural gas consumption within the Residential sector accounted for 22% of total community emissions, and electricity and natural gas consumption within the Commercial/Industrial Sector produced 16% of the City's overall emissions. The remaining 5% of emissions came from the Waste (4%) and Water/Wastewater (1%) sectors. Table 8 provides further detail on each sector.

[10] Please refer to detailed breakdown by sector and Appendices for more information on emissions from landfilled waste, water and wastewater services, and BART.

Table 8: Community GHG Emissions by Sector (metric tons CO_2e)

2010 Community Emissions by Sector	Residential	Commercial / Industrial	Transportation	Waste	Water / Wastewater	TOTAL
CO2e (metric tons)	82,699	58,851	210,739	14,368	2,156	368,813
% of Total CO2e	22%	16%	57%	4%	1%	100%



Residential

As shown in Table 8, Alameda's Residential Sector generated an estimated 82,699 metric tons of CO_2e in 2010. This estimate was calculated using 2010 electricity and natural gas consumption data provided by AMP and PG&E. It only includes residential building consumption. Data on residential equipment usage, such as lawnmowers or on-site electricity generation, is not included in this sector. GHG emissions associated with residential transportation and residential waste generation are included separately in the Transportation and Waste Sector emissions totals.

Table 9 provides information on residential emissions on a per household basis. On average, each Alameda household generated, through electricity and natural gas usage, three metric tons of CO2e in 2010. Per household emissions can be a useful metric for measuring progress in reducing GHGs and for comparing emissions with those of neighboring cities as well as against regional and national averages.

Table 9:Alameda 2010 GHG Emissions per Household

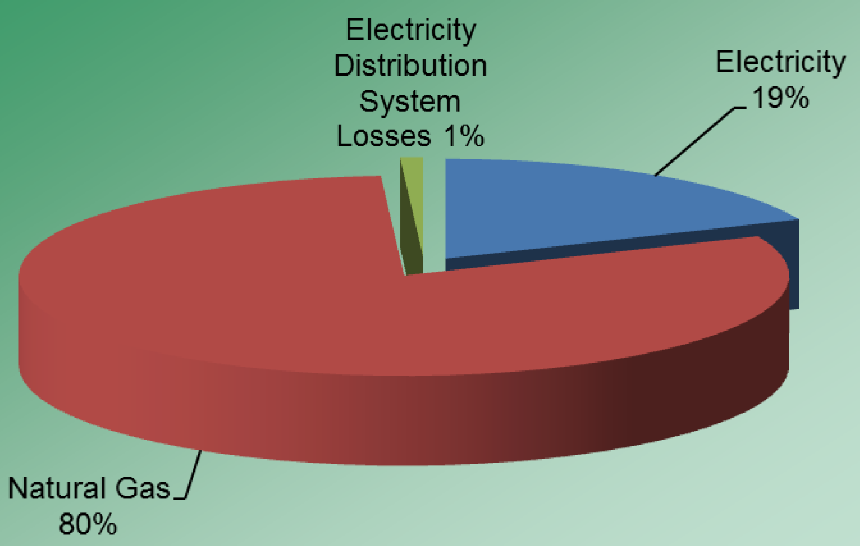
Number of Occupied Housing Units	29,177
Total Residential GHG Emissions (metric tons	82,699
Residential GHG Emissions/Household (metric tons CO2e)	3

Table 10 and Figure 6 illustrate the breakdown of residential GHG emissions by fuel type. Over eighty percent of residential GHG emissions were generated from the use of natural gas. Natural gas is typically used in residences as a fuel for home heating, water heating and cooking. Approximately twenty percent of residential GHG emissions were associated with electricity provided by AMP. Electricity emissions calculated include those related to electricity use in residences and associated distribution losses. Natural gas is supplied by PG&E.

Table 10: Residential Emissions by Source

Residential Emission Sources 2010	Electricity	Natural Gas	Distribution System Losses	TOTAL
MTCO2e	15,349	66,554	797	82,699
% of Total CO2e	19%	80%	1%	100%

Figure 6: Residential Emissions by Source



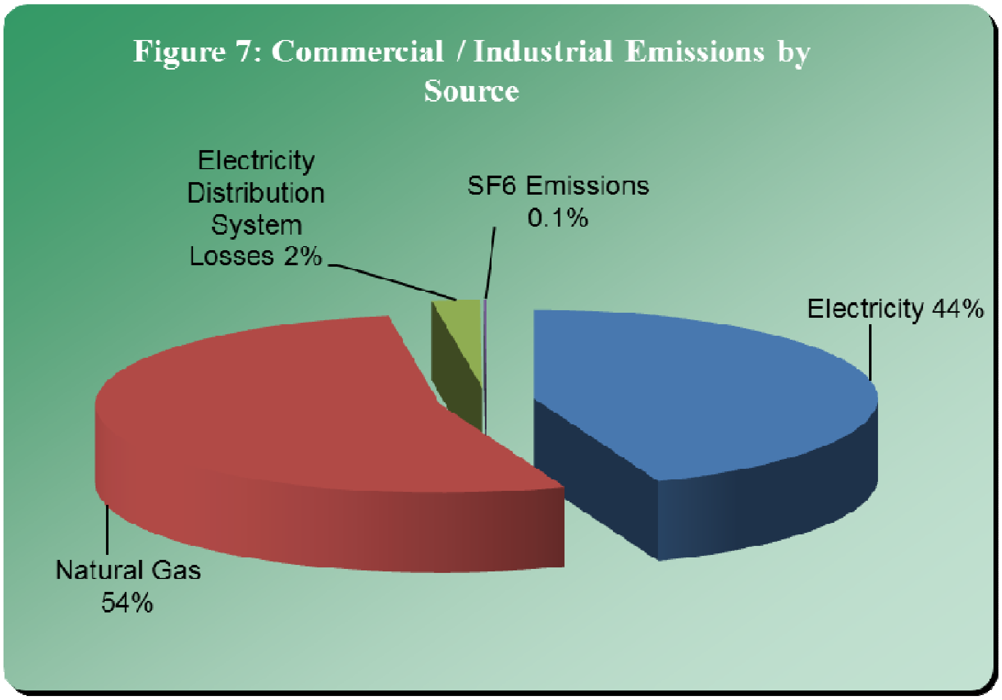
Commercial / Industrial

As mentioned previously, Alameda's businesses and industries generated seventeen percent of community-wide GHG emissions in 2010, or 63,486 metric tons of CO_2e.

As illustrated in Table 11 and Figure 7, 0.1% (or 54 metric tons of CO_2e) of the Commercial/Industrial GHG emissions identified in this study were fugitive emissions, generated by insulation on AMP's electricity distribution lines. While this insulation exists on transmission lines serving residential as well as commercial/industrial sites, these emissions are reported here in the Commercial/Industrial sector because they are related to the industrial process of electricity distribution. 53.5% of emissions were generated from the combustion of natural gas, most likely used in large industrial processes, such as the operation of boilers. Commercial/Industrial electricity accounts for 46.4% of the Commercial/Industrial GHG emissions sources. Electricity emissions include commercial/industrial usage and distribution system losses.

Table 11: Commercial / Industrial Emissions by Source

Commercial / Industrial Emission Sources 2010	Electricity	Natural Gas	Electricity Distribution System Losses	SF6 Emissions	TOTAL
CO2e (metric tons)	25,956	31,493	1,347	54	58,851
% of Total CO2e	44%	54%	2%	0.1%	100%



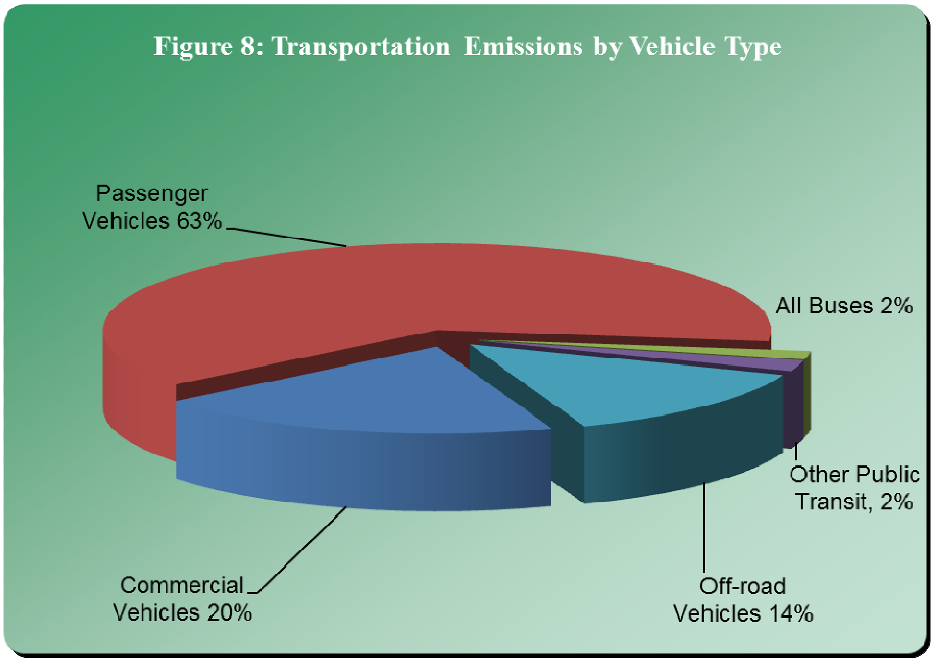
Transportation

As shown previously in Figure 4 and Table 8, Alameda's Transportation Sector accounted for 210,739 metric tons CO_2e, or fifty-seven percent, of the City's 2010 GHG emissions. The Transportation Sector analysis includes emissions from all vehicle trips "demanded" by Alameda City's residents and commercial/industrial activities, as well as off-road vehicles and transit vehicles.

Figure 7 and Table 14, show that nearly eighty-five percent of Alameda's 2010 transportation-related GHG emissions were generated by vehicle miles travelled by commercial vehicles, passenger vehicles, and buses. As mentioned earlier in this report, emissions are calculated from vehicle miles travelled within as well as outside of Alameda that can be attributed to Alameda residents and Alameda business attractors. Thirteen percent of emissions was generated by off-road vehicles operated within the City of Alameda[11], and two percent was generated by BART and ferries serving the population of Alameda and others visiting Alameda.[12]

Table 12: Transportation Emissions by Vehicle Type

Transportation Vehicle Type Emissions Sources 2010	Commercial Vehicles: Heavy Trucks	Passenger Vehicles: Cars, Light and	All Buses	Other Public Transit: BART, Ferries	Off-road Vehicles	TOTAL
CO2e (metric tons)	41,687	132,458	3,357	4,274	28,962	210,739
% of Total CO2e	20%	63%	2%	2%	14%	100%



Emissions from the air travel by Alameda's residents were not included in the Transportation Sector analysis. With the availability of additional data and standardized calculation methodologies, the GHG emissions from air travel could be estimated. Because there are no airports located within the geographic boundaries of Alameda it is reasonable to exclude air travel from this inventory.

Waste

As noted above in Figure 4 and Table 8, the Waste Sector constituted four percent of total 2010 emissions for the community of Alameda. Emissions from the Waste Sector are an estimate of methane generation from the anaerobic decomposition of organic wastes (such as paper, food scraps, plant debris, wood, etc.) that are deposited in a landfill. Because Alameda is home to the Doolittle Landfill, waste emissions are calculated from two separate sources (and using different analytical models). Table 15 and Figure 9 detail waste emissions by Scope.

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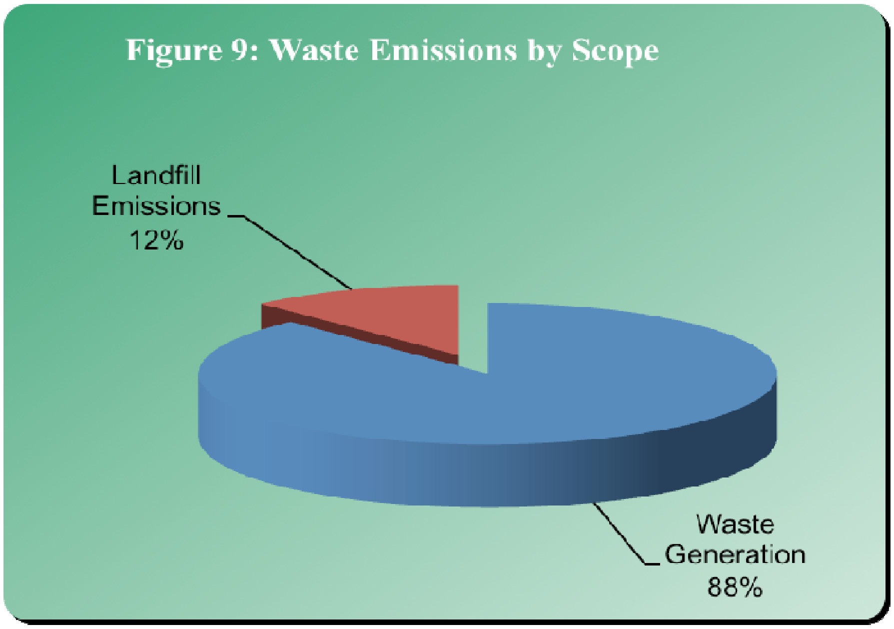
[11] Off-road vehicles include the following categories from the California Air Resource Board's Off-Road Model: Construction and Mining Equipment, Entertainment Equipment, Industrial Equipment, Lawn and Garden Equipment, Light Commercial Equipment, Portable Equipment, Pleasure Craft, Recreation Equipment, and Transport Refrigeration Units.

[12] See Appendix D for further information on Transportation Sector methods, emissions factors, etc.

Table 13: Waste GHG Emissions by Scope

Waste Emissions Categories 2010	Waste Generation	Landfill Emissions	TOTAL
MTCO2e	12,650	1,719	14,368
% of Total CO2e	88%	12%	100%



Landfill Emissions (Scope 1): Total emissions from the Doolittle Landfill in 2010. These emissions are the result of all decomposing organic waste-in-place since the landfill's opening.[13] Specifically, the emissions that are included in the inventory report are an estimate of fugitive emissions (emissions not captured by methane recovery facilities) coming off the landfill in the year 2010. Doolittle Landfill is a non-operational, capped site with a complete landfill gas capture system; therefore emissions are low compared with other landfill-type emissions.

Waste Generation (Scope 3): These emissions are the estimated future emissions of waste that was sent to any landfill by Alameda residents or businesses in the base year 2010. These emissions are considered Scope 3 because they are not generated in the base year, but will result from the decomposition of the 2010 waste over the full 100+ year cycle of its decomposition.

Landfill waste emission estimates used StopWaste.Org's annual landfill gas recovery rate data. A sixty percent methane recovery factor[14] was used to determine the percentage of all generated emissions that was likely escaping into the atmosphere (fugitive emissions).[15]

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[13] It can take over 100 years for a given quantity of waste to fully decompose in a landfill, releasing methane and other gases as it breaks down. As such, base year landfill emissions are the result of many years of waste disposal.
[14] StopWaste.Org's agency-determined rate for Alameda County landfill gas recovery.
[15] See Appendix E for more information on methods and emissions factors used in the Waste Sector analysis.

Waste generation emissions figures are the product of a modeling exercise that estimates the future emissions that will result over the full decomposition of the organic waste sent to any landfill in the base year 2010. The model used in this estimation is based on the U.S. EPA Waste Reduction Model (WARM). In order to arrive at the relative quantities of various types of waste included in the general disposal, figures obtained from 2010 CalRecycle Annual Report Summary for Alameda, City-specific waste characterization figures were utilized from the 2008 Alameda County Waste Characterization Study Final Report.[16] The 48 categories that StopWaste.Org utilized in the waste characterization report were bundled to match the following five categories in CACP software: Paper Products, Food Waste, Plant Debris, Wood/Textile, and All Other Waste.

The Scope 3 waste emissions method is relevant to policy development addressing waste diversion, while the Scope 1 method is most relevant to landfill gas management practices; so both pieces of information are policy-relevant. Because no waste is disposed in Doolittle Landfill, there is no danger of double counting emissions. Transportation emissions generated from the collection, transfer and disposal of solid waste are also included in Transportation Sector GHG emissions.

Water/Wastewater

As noted above in Figure 3 and Table 8, the Water and Wastewater Sectors constituted approximately one percent of total 2010 emissions for the community of Alameda, or 2,156 MT CO2e. The California Energy Commission (CEC) found in 2007 that water-related energy usage accounts for nearly 20% of the state's total energy requirement. While energy used in water service centers or distribution systems within the boundaries of each jurisdiction will be included by default within the Commercial/Industrial sector, there is substantial energy used upstream, in supplying, conveying, and treating water; and downstream, in treating and discharging wastewater, that is not captured within the data available at a geographical level. Additionally, reporting emissions related to water/wastewater services independently of other sources provides the granularity needed to analyze water-related energy uses specifically. The LGOP and the Draft Community Protocol therefore recommends accounting for emissions related to each of several segments of the water services cycle, which are often provided by different agencies.[17]

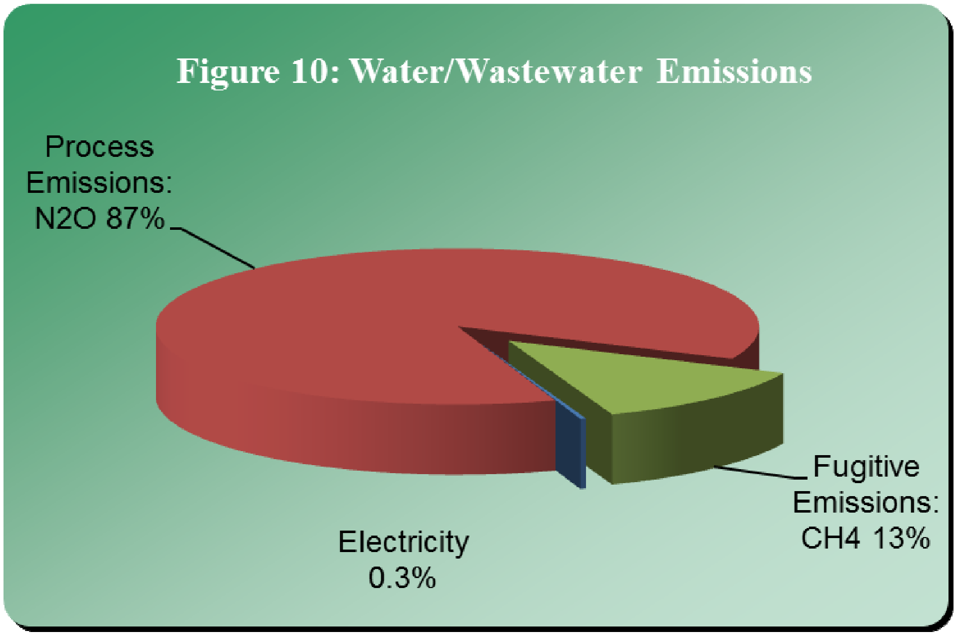
In the case of Alameda, emissions related to water/wastewater services are proportionately low due to the efficiency of EBMUD's water supply system and wastewater treatment operations. Table 14 and Figure 10 below show the breakdown of emissions sources accounted for within the Water/Wastewater sector.

[16] www.stopwaste.org/docs/acwcs-2008r.pdf

[17] See Appendix F for more information on methods used in the Water/Wastewater Sector analysis.

Table 14: Scope 3 Water and Wastewater GHG

Water/Wastewater Emissions 2010	Electricity	Process Emissions: N2O	Fugitive Emissions: CH4	TOTAL
CO2e (metric tons)	7	1,877	272	2,156
Percentage of Total CO2e	0.3%	87%	13%	100%



Per Capita Emissions

Per capita emissions can be a useful metric for measuring progress in reducing GHGs and for comparing one community's emissions with neighboring cities and against regional and national averages. That said, due to differences in emission inventory methods, it can be difficult to get a directly comparable per capita emissions number.

As detailed in Table 15, dividing the roll-up number for community GHG emissions by population yields a result of five metric tons of CO_2e per capita. It is important to understand that this number is not the same as the carbon footprint of the average individual living in Alameda (which would include emissions from production of goods purchased from outside the community, emissions resulting from air travel, etc.).

Table 15: Alameda 2010 GHG Emissions per Capita

Estimated 2010 Population	73,812
Community GHG Emissions (metric tons CO_2e)	368,813
GHG Emissions / Resident (metric tons CO_2e)	5

2005 to 2010 Comparison

To facilitate the comparative analysis process, the baseline inventory has been updated where possible to be comparable to the 2010 inventory. Updates to the 2005 inventory are as follow:

1) Electricity and Natural Gas emissions have been updated for both the Residential and Commercial/Industrial sectors. To update electricity emissions, 2005 electricity emissions factors were calculated to correct data errors and to be consistent with 2010 methodologies. The basic format for updating emissions factors was to use 2010 emissions factors by electricity source (e.g. geothermal, hydro, landfill gas, non-specified) and apply those factors to total kWh used by source in 2005. It is important to note that these updated emissions factors have not been verified and should not be used to calculated real emissions reductions. However, assuming electricity source operations remained fairly consistent between 2005 and 2010, the updated factors give a good approximation of electricity emissions in 2005.[18] Natural gas emissions were recalculated using emissions coefficients consistent with 2010 coefficients. The original emissions appear to have been calculated using a much higher coefficient, potentially in error. The 2010 and updated 2005 emissions were calculated using an emissions factor specifically calculated for natural gas.[19]

2) Transportation sector emissions have been recalculated by applying the 2010 methodology to the 2005 data provided by the Metropolitan Transportation Commission (MTC). When the 2005 inventory was being prepared, MTC used a traffic model to determine total vehicle miles travelled within a jurisdiction that has since been outdated. The current model determines vehicle miles travelled within as well as outside of Alameda that can be attributed to Alameda residents and Alameda business attractors. MTC was able to provide 2005 as well as 2010 data output from the new model[20].

3) Waste emissions were recalculated to be comparable to 2010 numbers. 2005 waste emissions were originally reported as zero, because the methodology used at the time applied an emissions credit to landfilled waste for CO2 sequestered which canceled out fugitive methane emissions. Current methodology recommends reporting fugitive emissions only to prevent encouraging landfilling[21].

Tables A and B below provide a sector-to-sector comparison of emissions across the two inventory years, detailing those sectors and sources that can be directly compared, and those that cannot.

[18] See Appendix B for more information on 2005 electricity emissions factors recalculation.
[19] Source: CACP software database
[20] See Appendix D for further information on Transportation Sector methodology.
[21] See Appendix E for further information on Waste Sector Methodology.

When comparable data between 2005 and 2010 are examined, community emissions decreased by 8 percent, as seen below in Table A. Total comparable emissions in 2005 were 357,091 MT CO2e; total comparable emissions in 2010 were 329,504 MT CO2e. The decrease in comparable emissions numbers is attributable in part to the following factors:

- Lower electricity emissions factors in 2010 due to a cleaner energy mix used by AMP
- Decreased vehicle miles traveled (VMT) by passenger vehicles, heavy trucks, and buses
- More fuel-efficient vehicle fleet at the level of Alameda County
- Decreased tonnage of landfilled waste.

Table A: Directly Comparable Numbers, 2005 and 2010[22]

Sector	Original 2005 Activity Data	Updated 2005 Activity Data	2010 Activity Data	Original 2005 MTCO2e	Updated 2005 MTCO2e	2010 MTCO2e	Percent Change MTCO2e
Residential							
Electricity	137,906,700 kWh	137,906,700 kWh	141,336,935 kWh	13,832	21,956	15,349	-30%
Natural Gas	12,180,175 Therms	12,180,175 Therms	12,520,503 Therms	75,252	64,775	66,554	3%
Total	-	-	-	**89,084**	**86,731**	**81,903**	**-6%**
Commercial/Industrial							
Electricity	223,590,100 kWh	223,590,100 kWh	239,017,888 kWh	22,426	35,598	25,956	-27%
Natural Gas	4,886,714 Therms	4,886,714 Therms	5,924,692 Therms	30,191	25,976	31,493	21%
Total	-	-	-	**52,617**	**61,574**	**57,449**	**-7%**
Transportation							
Commercial Vehicles	not available	27,143,247 VMT	32,040,354 VMT	not available	35,888	41,687	16%
Passenger Vehicles		367,643,598 VMT	347,818,456 VMT		153,497	132,458	-14%
Buses		2,330,839 VMT	1,993,931 VMT		4,120	3,357	-19%
Total	not available	397,117,684 VMT	381,852,741 VMT	**161,395**	**193,505**	**177,502**	**-8%**
Waste							
Total Landfilled Waste	59,024 tons; 7,052 tons additional ADC	49,962 tons	37,310 tons	**0**	**15,281**	**12,650**	**-17%**
TOTAL Comparable Emissions				**303,096**	**357,091**	**329,504**	**-8%**

[22] All original 2005 activity and emissions data were found in "City of Alameda Baseline Greenhouse Gas Emissions Inventory Report, January 2007".

Table B: Non-Directly Comparable Numbers

Sector	2010 Activity Data	2010 MTCO2e	Notes
Residential			
Electrical Distribution System Losses	7,337,379 kWh	797	Data for this sector was not collected for the 2005 inventory. This information will be useful for comparison to future inventories, and upcoming policies.
Commercial/Industrial			
Electrical Distribution System Losses	12,408,398 kWh	1,347	Data on Electrical Distribution System Losses was not collected for the 2005 inventory. This information will be useful for comparison to future inventories, and upcoming policies.
Electrical Distribution System SF6 Emissions	-	54	
Total		**1,401**	
Transportation			
Off-Road Vehicles		28,962	Data from Off-Road and Transit sources was not collected for the 2005 inventory. This information will be useful for comparison to future inventories, and upcoming policies.
BART		2,861	
Ferries		1,413	
Total	**(see appendices)**	**33,235**	
Waste			
Landfill Emissions	**(see appendices)**	1,719	Data from Doolittle Landfill was not collected for the 2005 inventory. This information will be useful for comparison to future inventories, and water use policies.
Water and Wastewater Services			
Up- and Downstream Emissions from Water/Wastewater Services	**(see appendices)**	2,156	Data for the Water/Wastewater sector was not collected for the 2005 inventory. This information will be useful for comparison to future inventories, and water use policies.
TOTAL Non- Comparable Emissions	**(see appendices)**	**39,308**	

Conclusion

This analysis found that the Alameda community as a whole was responsible for emitting 3,868,831 metric tons of CO_2e in 2010, with emissions from the Transportation sector contributing the most to this total.

Based on the ICLEI methodology and recommendations, Alameda should begin to document emissions reduction measures that have been implemented since the 2005 baseline inventory and should quantify the emissions benefits of these measures to demonstrate progress made to date.

As Alameda moves forward with considering emission reduction strategies and works to update its local climate action plan, the City should identify and quantify the emission reduction benefits of climate and sustainability strategies that could be implemented in the future, including energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction and other strategies. Through these efforts and others the City of Alameda can achieve additional benefits beyond reducing emissions, including saving money and improving Alameda's economic vitality and its quality of life. City staff will continue to update this inventory as additional data become available.

Appendices

Appendix A - General Notes

1. Raw data for all sectors is located in Alameda's "Community Master Data Workbook."
2. Readers should refer to the following ICLEI for additional information relating to methodologies.
   http://www.iclei.org/fileadmin/user_upload/documents/Global/Progams/CCP/Standards/IEAP_October2010_color.pdf
   http://www.icleiusa.org/tools/ghg-protocol/community-protocol/us-community-protocol-for-accounting-and-reporting-of-greenhouse-gas-emissions

Appendix B - Residential Sector Notes

2010 Data Inputs:

Residential	Electricity Consumption	kWh	141,336,935
	Natural Gas Consumption	Therms	12,520,503

Data Sources: Data was obtained from Alameda Municipal Power (AMP) and Pacific Gas & Electric (PG&E). All sales on the residential rate were included in this sector.

Calculating Emissions Factors:

AMP purchases from many different sources, therefore AMP-specific emissions factors were calculated. The final emissions factor used to prepare this inventory was .109 MT CO_2e/MWh. The updated 2005 emissions factor used to prepare the comparison section was .157 MT CO2e/MWh.

Emissions factors were calculated for each generation source in CO_2e/kWh. These factors were then applied to AMP sales (recorded in kWh)[23] for each source to determine total CO_2e emissions attributable to City of Alameda in 2010. Finally, total CO_2e was divided by total AMP sales (kWh) to come up with a consolidated emissions factor for all of Alameda's electricity usage in 2010. This factor was entered into CACP and applied to all electricity records entered thereafter. Note that the 2005 inventory used specific emissions factors for each CO_2, N_2O, and CH_4, instead of one factor in CO_2e.

Data Sources for emissions factor:

- Alan Hanger, Assistant Utility Analyst of AMP's Power Resources team, provided total kWh purchased from each source in 2010 in the document "2010 ICLEA Generation Resources." AMP's sources in 2010 were the

[23] "Sales" denotes electricity that was consumed by residents and activities within the City of Alameda. AMP purchases surplus energy each month that ends up being sold. This electricity was not used to calculated emissions factors

Northern California Power Agency, Morgan Stanley, Western Hydro, High Winds Project, and several small landfill gas-burning operations.

- NCPA sources include Combustion Turbines, Geothermal, and Hydro plants. Total emissions for each NCPA plant were found in the document "CRIS: Climate Registry Information System: Entity Emissions Detailed Report: Northern California Power Agency", provided by Meredith Owens, Senior Management Analyst, AMP, owens@alamedamp.com. Total NCPA generation at each plant in 2010 is from "AMP 2010 Emissions Factors 02 Aug 2011", a report developed by AMP staff and provided by Kelly Birdwell, Utility Energy Analyst, AMP, Birdwell@alamedamp.com. Source for total generation is listed as "Jan Bonatto data base query" in the above-cited report. Note: the NCPA report includes emissions from direct combustion, process emissions, fugitive emissions, mobile combustion, and purchased electricity.

- Electricity purchased from Morgan Stanley is defined as "unspecified source" and could be from a variety of generation activities. The best emissions factors for this source are California Grid Average emissions factors, calculated by the CEC[24]. The latest CEC factors are from 2007; therefore, 2010 emissions factor was determined by taking an average of emissions factors from 2003-2007. This is the same methodology that was used in 2005.

- No emissions factors were calculated for High Winds or Western Hydro; no emissions data was available from any known source. These sources were omitted from the 2005 emissions factor as well.

- The emissions factor for landfill gas plants was determined based on default values of N_2O, CH_4, and CO_2 per MMBTU biogas[25]. Alan Hanger reported MMBTU per MWh specific to these plants.[26]

Alameda Municipal Power does not own any electricity generation facilities, but transmits and distributes purchased electricity within Alameda. Following the LGOP, the author calculated emissions in CO_2e from fugitive SF_6 and electricity lost in transmission and distribution.

- SF_6 emissions from T&D lines are reported annually to the California Air Resources Board under mandatory reporting. Reported emissions in CO_2e for 2010 were sourced from the CARB website[27].

- AMP reported losses in distribution.

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[24] Source: CACP software
[25] 52.07 kg CO2/MMBTU; .001 kg N2O/MMBTU; .003 kg CH4/MMBTU. Source: CACP software.
[26] 10.5 MMBTU/MWh
[27] http://www.arb.ca.gov/cc/reporting/ghg-rep/reported_data/ghg-reports.htm

Updating 2005 Emissions Factors:

The emissions factor used in the original 2005 inventory was .091 MT CO2e/MWh. AMP expected to see emissions factors going down overall from 2005-2010, because of a cleaner energy mix. After analyzing the 2005 emissions factors calculations, it appears that there was an error in calculating the 2005 factors for natural gas combustion turbines: the heat factor used was 3.413 MMBTU/MWh, while reported heat factors for combustion turbines are between 9 and 15 MMBtu/MWh. Additionally, emissions from ancillary engines and vehicle fleets were calculated based on AMP ownership of NCPA facilities, instead of the energy used. Finally, landfill gas emissions were assumed to be zero. For these reasons, a 2005 emissions factor for AMP was roughly recalculated using 2010 emissions factors by source and 2005 usage by source. The updated 2005 emissions factor used in the comparison section is .157 MT CO2e/MWh. CACP was used to recalculate comparable emissions using the electricity usage data for 2005 and the updated factor

Appendix C - Commercial / Industrial Sector Notes

2010 Data Inputs:

Commercial/Industrial	Electricity Consumption	kWh	239,017,888
	Natural Gas Consumption	Therms	5,924,692

Data Sources: Data was obtained from Alameda Municipal Power. All non-residential sales were included in this sector.

Notes:

AMP purchases from many different sources, therefore AMP-specific emissions factors were calculated. Final emissions factor used to prepare this inventory was 0.115 MT CO2e/MWh. Please see Residential Sector notes for emissions factor calculation steps.

Appendix D - Transportation Sector Notes

2010 Data Inputs:

Transportation	Heavy Trucks VMT[2]	Annual VMT	32,040,354
	Passenger cars, light and medium trucks VMT [3]	Annual VMT	347,818,456
	Buses VMT [3]	Annual VMT	1,993,931
	BART direct emissions	MT CO2e	2,860
	Ferries fuel use	Gallons diesel	137,108
	Off-road direct emissions	MT CO2e	28,132

Data Sources and Notes:

On-Road Data

The San Francisco Metropolitan Transportation Commission did a run of its Travel One activity-based travel model specifically for this inventory for each city in Alameda County, for both passenger and heavy truck travel. This activity-based model is designed to better reflect vehicle travel that falls within a city's sphere of influence, and to account separately for travel that begins or ends at a city destinations, and through traffic that makes no stops in the city. This treatment is considered more fair to cities that contain major through travel arteries, but whose ability to influence this traffic through land use planning is limited. A full discussion of the philosophy underlying the Travel One model may be found in a paper by MTC analyst David Ory, an MTC analyst: "Using Activity-based Travel Models to Inform Climate Action Plans: A Proposed Approach."

For *passenger travel*, the model provided daily VMT figures for six different categories of drivers based on residence and workplace, and three different categories of trip: wholly within, partially within, and wholly outside the jurisdictional boundary. All of the mileage "wholly within" and half of the mileage "partially within" Alameda was summed and multiplied by 365 to provide annual total passenger vehicle VMT attributed to Alameda.

MTC also provided a county-wide CO_2 emissions rate of 407.33 grams/mile in the year 2010, derived from EMFAC 2011. This was used to determine total CO_2e emissions from passenger vehicles. Passenger vehicles include cars, light and medium trucks, motorcycles, and motorhomes.

To determined emissions of N_2O and CH_4, StopWaste.Org used The Air Resources Board's EMFAC model to determine the percentage of VMT from each fuel type and passenger vehicle type. The model parameters used were "EMFAC 2011/2010 Estimated Annual Emissions/EMFAC 2011 Vehicle Categories/Alameda County".[28] The percentages were entered into the CACP "Transport Assistant" which calculated methane and nitrous oxide emissions by vehicle and fuel type VMT. The 0.55% from motorcycles was not entered in Transport Assistant (so the Transport Assistant percentages summed to 99.45%) because CACP does not have emissions factors for motorcycle VMT. Total CO_2 from motorcycles is accounted for in direct emissions from passenger vehicles as explained above, which accounts for the majority of emissions attributable to motorcycles.

Passenger Vehicle Percentages for Transport Assistant

56.95%	Passenger Car Gas
0.247%	Passenger Car Diesel
40.64%	Light Truck Gas
1.33%	Light Truck Diesel
0.55%	Motorcycle Gas
0.13%	Heavy Truck Gas (Motorhome)
0.16%	Heavy Truck Diesel (Motorhome)

MTC's Travel One model includes VMT from all vehicle categories except buses. To calculate VMT from buses, StopWaste.Org ran an EMFAC analysis for all bus VMT in Alameda County. After determining total percentage of buses in the Alameda County vehicle fleet not including commercial trucks, total bus VMT was estimated using MTC data on passenger vehicles as a base. The resulting VMT figure was entered into CACP under the record "All Buses VMT". Bus fleet was broken down into diesel and gasoline fuel as above with passenger vehicles using EMFAC's breakdown.

For the *commercial vehicles* (all heavy trucks), the Travel One model was run at the county level to determine countywide VMT. Then, US Census employment data was used to estimate the number of jobs in each city in industries that generate high numbers of truck trips. Alameda was estimated to have 2.53 percent of all such jobs in Alameda County, and was thus assigned 2.53 percent of truck VMT.

[28] http://www.arb.ca.gov/jpub/webapp//EMFAC2011WebApp/emsSelectionPage_1.jsp

Drawing on work done by the City of Berkeley, StopWaste.Org assigned 30.4% of VMT to gas-powered trucks and 69.6% to diesel-powered trucks. This breakdown is assumed to be more applicable to the local cities than EMFAC's breakdown.

Off-Road Data- The Off-Road 2007 modeling software can be accessed at http://www.arb.ca.gov/msei/offroad/offroad.htm and is offered by the ARB. This model allows the user to determine on a county-wide basis, the amount of off-road vehicles and equipment that are used, how much fuel they consume, and how much pollution they create. This model was run by StopWaste.Org and then allocated based upon population for each jurisdiction. The following assumptions can be used to recreate the model:

Download and launch software
Enter the following in Tabs,

Episode- 2010, Mon-Sun, Annual
Reporting- TOG, Report by County, Exhaust
Area- County, Alameda
Equipment- All
Fuel and HP- All Fuel Types, All Horsepower
Data Files- Population

File Save
Run Current Scenario File
Export to Excel file type

These data were recorded in CACP as Scope 1, in-boundary emissions.

Fixed Route Transit- Commuter Rail- BART- Contact was made with BART, and ridership as well as direct emissions data was obtained for 2010. The StopWaste.Org team generated an allocation methodology based upon full (100%) of emissions allocation proportion for each jurisdiction that had a station in bounds, or a partial (25%-50%) emissions allocation proportion for those cities that didn't have a station in bounds. In this way, the entire county of Alameda shares the burden of BART emissions, as closely as possible to the proportion of service that the service provides. These emissions were considered Scope 3 emissions for all jurisdictions because the data were not granular enough to provide a better alternative.

Non- Fixed Route Transit- Bus Agencies- Where possible, all bus agencies serving jurisdictions in Alameda County were contacted in order to retrieve agency specific data. Efforts were successful with many agencies including WHEELS and Santa Clara Valley Transit Authority. Several attempts to contact AC Transit and East Bay Paratransit were unsuccessful. When data were gathered, the protocol called for fuel consumption and VMT data, a method which is similar to fleet methodology. These data were assigned as Information Items because comprehensive Scope 1 bus data were gathered under the passenger vehicle and heavy truck methodology.

Fixed Route Transit- Passenger Rail- Per the Community Inventory protocols, passenger rail data were gathered and assigned where applicable. Typical data gathered included total amount of fuel consumed, and revenue miles. Using

GIS or specific information from each agency allowed StopWaste.Org to assign an allocation of fuel to each jurisdiction that the line traveled through. These emissions were recorded as Scope 1 since the combustion occurred in-boundary.

To estimate emissions from Amtrak passenger rail, annual minutes of train operation between and at each station in Alameda County on the Capitol Corridor and San Joaquin lines were calculated based on published schedule data. This was then converted to gallons of diesel using an average fuel consumption of 23.45 gallons/hour provided by James Allison of Capitol Corridor. Fuel consumed while idling at a station was allocated to the city containing that station.

Next, StopWaste.Org used Google Maps' Distance Measurement Tool to estimate the length of track within each city boundary per segment and calculate the percentage within each city. Each city was then allocated the corresponding percentage of emissions from that segment. Finally, the emissions from travel and idle operations on each of the two lines were summed to yield a final total of diesel gallons, which was entered directly into CACP.

Other- Ferries- In some jurisdictions, notably Oakland and Alameda, the communities are heavily served by commuter ferry transport. In this case, specific data was gathered from WETA (ferry authority). Data collected is similar in style to passenger rail and includes total fuel consumed, and revenue miles travelled. Since the lines are fixed and travel only between SF, Alameda and Oakland, it was assumed that the trip attractor was SF, and therefore half of the total emissions were allocated to SF. Oakland and Alameda split the other half of the emissions equally. These emissions were recorded as Scope 3, since they are not technically combusted in either jurisdiction.

2005 Transportation Sector Comparison-

MTC:

The San Francisco Metropolitan Transportation Commission ran its Travel One activity-based travel model for each city in Alameda County for both 2005 and 2010, for both passenger and heavy truck travel. As stated above, this activity-based model is designed to better reflect vehicle travel that falls within a city's sphere of influence, and to account separately for travel that begins or ends at city destinations, and through traffic that makes no stops in the city. MTC's previous travel model is no longer used and no data exists for this model past 2009. MTC's planned future data analysis, and as such data availability for future GHG inventories, is expected to center on the Travel One model. For this reason, StopWaste.Org chose to update 2005 transportation numbers in order to provide comparable emissions estimates across inventory years, rather than any other option available.

- Passenger Travel: The Travel One model provided daily VMT figures for six different categories of drivers based on residence and workplace, and three different categories of trip: wholly within, partially within, and wholly outside the jurisdictional boundary. All of the mileage "wholly within" Albany and half of the mileage "partially within" Albany was summed and multiplied by 365 to provide annual total passenger vehicle VMT attributed to Albany.

- Heavy Trucks: The Travel One model was run at the County level to determine countywide VMT for heavy trucks. Then, US Census employment data was used to estimate the number of jobs in each city in industries that generate high numbers of truck trips. Each jurisdiction was assigned a percentage of truck VMT based on its percentage of all such jobs in Alameda County. Drawing on work done by the City of Berkeley, StopWaste.Org assigned 30.4% of VMT to gas-powered trucks and 69.6% to diesel-powered trucks.

EMFAC:

To obtain EMFAC data for 2005 analysis, StopWaste ran the Air Resources Board's 2011 EMFAC model with the following parameters: EMFAC 2011/2005 Estimated Annual Emissions/ EMFAC 2007 Vehicle Categories/Alameda County. This data was then used to determine the County-specific percentage of VMT from each type of passenger vehicle. The percentages were entered into the CACP "Transport Assistant," which calculated absolute VMT.

- Buses: MTC's Travel One model includes VMT from all vehicle categories except buses. To calculate VMT from buses, StopWaste.Org ran an EMFAC analysis for percentage of VMT in Alameda County attributable to buses. This figure was then applied to MTC passenger vehicle data to determine additional VMT travelled by bus, and entered in to CACP using a fuel-type breakdown generated by the EMFAC model mentioned above.

Other Transportation Data:

Because StopWaste was not able to obtain 2004 off-road vehicle emissions or transit agency data, these emissions data were not included in the 2004 Transportation Sector analysis.

Appendix E - Waste Sector Notes

2010 Data Inputs:

Waste	Total Landfill Waste (See Waste Table)	Short Tons	37,710

Data Sources and Notes:

CalRecycle Data- State CalRecycle reports were obtained from StopWaste.Org for the year 2010 which included the total amount of landfilled waste per jurisdiction for the reference year. Alternative Daily Cover (ADC) tonnages were left out of total tons used to calculate emissions. As ADC is mostly non-organic in composition, emissions are assumed to be negligible. Waste characterization percentages were generated from the 2008 Alameda County Waste Characterization Study Final Report.[29]. This characterization was based upon the site-specific data reported in Appendix 5 per each jurisdiction. The 48 categories that StopWaste.Org utilized in the waste characterization report were bundled to match the following five categories in CACP software: Paper Products, Food Waste, Plant Debris, Wood/Textile, and All Other Waste.

Waste generation emissions figures for each category are the product of a modeling exercise that estimates the future emissions that will result over the full decomposition of the organic waste sent to any landfill in the base year 2010. The model used to run this estimation is based on the U.S. EPA Waste Reduction Model (WARM). Landfill waste emission estimates were made using a 60 percent methane recovery factor[30] to determine the percentage of all generated emissions that was likely escaping into the atmosphere (fugitive emissions).

2005 Update-

Waste emissions were recalculated to be comparable to 2010 numbers. 2005 waste emissions were originally reported as zero, because the methodology used at the time applied an emissions credit to landfilled waste for CO2 sequestered which canceled out fugitive methane emissions. Current methodology recommends reporting fugitive emissions only, or risk encouraging landfilling. When recalculating 2005 emissions from waste, total tons disposed was found from CalRecycle. Total tonnage reported to CalRecycle was 49,962. This is a much smaller number than recorded in the original baseline inventory. StopWaste determined to use the same source of data for both inventory years.

29 www.stopwaste.org/docs/acwcs-2008r.pdf
30 StopWaste.Org's agency-determined rate for Bay Area landfill gas recovery.

Appendix F – Water and Wastewater Sector Notes

2010 Data Inputs:

Water/Wastewater	Electricity Use	kWh	32,681
	Process N_2O	MT N_2O	6.05
	Fugitive CH_4	MT CH_4	12.97

Data Sources and Notes:

As stated above, reporting emissions related to water/wastewater services independently of other sources provides the granularity needed to analyze water-related energy uses specifically. The LGOP and the Draft Community Protocol therefore recommend accounting for emissions related to each of several segments of the water services cycle, which are often provided by different agencies.

Below is a brief description of the segments:
Supply and Conveyance: energy used in extraction of water and pumping to different regions, from the source.
Treatment: Energy used to treat raw water to a potable state.
Distribution: Energy used to pump water from conveyance terminus to retail customers, usually at a local level.
Wastewater Collection: energy used in pumping drain water from the retail customer to a treatment plant.
Wastewater treatment: energy used in treating wastewater to cleanliness standards for discharge
Water Disposal: Energy used to discharge treated water to natural body of water or other discharge site.
Often but not always, several of these segments are provided for by the same water agency; e.g. potable water services will be under the purveyance of one agency, and wastewater services will fall under another.

City of Alameda's water and wastewater services are provided by the East Bay Municipal Utility District (EBMUD). EBMUD handles supply and conveyance, treatment, and distribution of potable water for Alameda, Albany, Berkeley, Emeryville, Oakland, Piedmont, San Leandro, and Unincorporated Alameda County. In addition, EBMUD provides wastewater collection, treatment, and discharge services for Alameda, Albany, Berkeley, Emeryville, Oakland, and Piedmont. Information provided was total gallons served to each city, total wastewater gallons treated, and energy intensities for each segment. The energy intensity factor consists of total energy used to process a unit of water, and is different for each segment because energy demands differ by segment. Wastewater was apportioned to city by fraction of total population served by EBMUD. All information provided by Charles Bohling, EBMUD.

Emissions factors were the same as PG&E, though it is possible that some of the conveyance energy would have been outside of PG&E territory. Also, there is an inherent measure of double counting, as some of the conveyance and treatment could be happening within the boundaries of the jurisdiction, and thus would already be counted in the Commercial/Industrial sector.

Note: there is potentially significant energy use related to recycled water that has not been accounted for; EBMUD and the DSRSD both have additional operations to treat and distribute recycled water to several large customers in Alameda County. These operations should be included in future inventories, especially if recycled water use increases.

<u>Wastewater Plant data</u>

Wastewater plants were located by contacting each service provider. The wastewater treatment plants provided total energy (electricity and natural gas) used, and source data for calculating total process and fugitive emissions. Calculated emissions are attributed to specific cities based on population or usage metrics as described above, and reported as Scope 3 emissions. If the plant is within the boundaries of the jurisdiction in question, all emissions are reported as Scope 1 and total emissions attributable to the population of the jurisdiction are reported as information items to avoid double counting. Each item was labeled and entered separately in CACP and PG&E emissions factors were applied. In the case of Albany, only Scope 3 emissions as described here are applicable. Charles Bohlig at EBMUD supplied total energy used in the plant, as well as total process and fugitive emissions source data. Population numbers were sourced from the United States Census Bureau.