City of Tracy

2010 Government Operations

Greenhouse Gas Emissions Inventory

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Pacific Gas and Electric Company provides comprehensive climate planning assistance to local governments, from providing energy usage data and assistance with greenhouse gas inventories, to training and guidance on climate action plans.

This program is funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.

Legal Notice

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Executive Summary

The City of Tracy Profile

The City of Tracy covers over 21 square miles and is enclosed by Interstate 580, Interstate 205, and Interstate 5. The City of Tracy had an estimated population of 82,922 in 2010. With 502 city employees in the year 2010, there was a ratio of approximately 6 employees per one thousand residents. The City of Tracy's total budget was $162,191,092 for fiscal year 2009-2010 and $161,513,208 for fiscal year 2010-2011.

The City of Tracy is located within Climate Zone 12,[1] according to the Pacific Energy Center. Climate Zone 12 is classified as a Mediterranean climate by the Köppen Classification System, and is characterized by dry summers and mild winters. Climate Zone 12 recorded 3,260 heating degree days and 1,110 cooling degree days in 2010.[2]

The Purpose of Conducting an Inventory

Each day, local governments operate buildings, vehicle fleets, street lights, traffic signals, water systems, and wastewater plants; local government employees consume resources commuting to work and generate solid waste which is sent for disposal. All of these activities directly or indirectly cause the release of carbon dioxide and other greenhouse gases into the atmosphere. This report presents the findings and methodology of a local government operations (LGO) greenhouse gas emissions inventory for the City of Tracy. The inventory measures the greenhouse gas emissions resulting specifically from the City of Tracy's government operations, arranged by sector to facilitate detailed analysis of emissions sources. The inventory addresses where and what quantity of emissions are generated through various local government activities. Through analysis of a local government's emissions profile, the City of Tracy can tailor strategies to achieve the most effective greenhouse gas emission reductions.

Strategies by which local governments can significantly reduce emissions from their operations include increasing energy efficiency in facilities and vehicle fleets, utilizing renewable energy sources, reducing waste, and supporting alternative modes of transportation for employees. The benefits of these actions include lower energy bills, improved air quality, and more efficient government operations, in addition to the mitigation of local and global climate change impacts. Furthermore, local governments may use emissions mitigation strategies to foster economic development by streamlining the environmental review process for development projects. Setting standards for future development ensures projects will remain within the boundaries of local emissions mitigation strategies, and may help to avoid costly environmental review requirements. By striving to save taxpayer money through efficient government operations, City

[1] Pacific Energy Center's Guide to: California Climate Zones, retrieved from http://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zones_01-16.pdf
[2] NNDC Climate Data, retrieved from http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp

of Tracy is working to improve government services in a smart and targeted way that will benefit all of the City's residents.

Climate change is theorized to result from the greenhouse gas emissions of human activities. Some studies have concluded that global average surface temperatures are rising due to intensification of activities that release carbon dioxide and other greenhouse gases into the atmosphere. Potential impacts of climate change include rising sea levels, more severe and frequent storms, increased flooding, greater rates of coastal erosion, loss of critical habitat and ecosystems, more severe heat waves, increased precipitation, extended drought conditions, larger wildfires, shortages in water supply, formation of ground level ozone, and heightened exposure to vector born diseases.

By conducting this inventory, the City of Tracy is acting now to limit future impacts that threaten the lives and property of the City of Tracy's residents and businesses, make government operations more efficient, and improve the level of service it offers to the residents of Tracy.

Inventory Results

In 2009 the City of Tracy finalized the *Baseline Greenhouse Gas Emissions Inventory Report*. Through a collaborative process headed by Town Green, the City of Tracy brought together ICLEI – Local Governments for Sustainability, ICF/Jones & Stokes, Fehr & Peers, Pacific Gas and Electric Company, local business representatives, and regional transportation agencies to develop a baseline 2006 emissions inventory for both the City's community-wide and municipal operations. These emissions calculations serve as a basis from which the City plans to monitor and reduce emissions over time.

This reassessment inventory, conducted throughout 2012 by the City of Tracy and the Great Valley Center, in partnership with Pacific Gas and Electric Company and ICLEI – Local Governments for Sustainability, presents emissions calculations for the year 2010. A comparative analysis of 2006 emissions versus 2010 emissions allows the City of Tracy to monitor progress in achieving emissions reductions, and to modify reduction strategies as needed.

Figure 1 compares total greenhouse gas emissions from municipal operations in 2006 and 2010. With a reduction of 16% over the four-year period, the City of Tracy is on track to achieve near-term emission reduction goals.

Figure 1: Comparison of 2006 and 2010 Emissions from Municipal Operations

Year	Metric Tons CO_2e	
2006	11,449	
		↓ -16%
2010	9,587	
Total Reduction	**-1,862**	

Regional and Local Context

Climate Change Mitigation Activities in California

Since 2005, the State of California has responded to growing concerns over the effects of climate change by adopting a comprehensive approach to addressing emissions in the public and private sectors. This approach was officially initiated with the passage of the Global Warming Solutions Act of 2006 (AB 32), which requires the state to reduce its greenhouse gas emissions to 1990 levels by 2020. The AB 32 Scoping Plan was developed to identify strategies for meeting the AB 32 goal, and was adopted by ARB in December 2008. Among many other strategies, it encourages local governments to reduce emissions in their jurisdictions by 15 percent below current levels by 2020. In addition, it identifies the following strategies that will impact local governance:

- Develop a California cap-and-trade program
- Expand energy efficiency programs
- Establish and seek to achieve reduction targets for transportation-related related greenhouse gas (GHG) emissions
- Expand the use of green building practices
- Increase waste diversion, composting, and commercial recycling toward zero-waste
- Continue water efficiency programs and use cleaner energy sources to move and treat water
- Reduce methane emissions at landfills
- Preserve forests that sequester carbon dioxide

Other measures taken by the state include mandating stronger vehicle emissions standards (AB 1493, 2002), establishing a low-carbon fuel standard (EO # S-01-07, 2007), mandating a climate adaptation plan for the state (S-EO # 13-08, 2008), establishing a Green Collar Job Council, and establishing a renewable energy portfolio standard for power generation or purchase in the state. The state also has made a number of legislative and regulatory changes that have significant implications for local governments:

- SB 97 (2007) required the Office of Planning and Research to create greenhouse gas planning guidelines for the California Environmental Quality Act (CEQA). In addition, ARB is tasked with creating energy-use and transportation thresholds in CEQA reviews, which may require local governments to account for greenhouse gas emissions when reviewing project applications.
- AB 811 (2007) authorizes all local governments in California to establish special districts that can be used to finance solar or other renewable energy improvements to homes and businesses in their jurisdictions.
- SB 375 (2008) revises the process of regional transportation planning by metropolitan planning organizations (MPOs), which are governed by elected officials from local jurisdictions. The statute calls on ARB to establish regional transportation-related GHG targets and requires the large MPOs to develop regional "Sustainable Communities Strategies" of land use, housing and transportation policies that will

move the region towards its GHG target. The statute stipulates that transportation investments must be consistent with the Sustainable Communities Strategy and provides CEQA streamlining for local development projects that are consistent with the Strategy.

Pacific Gas and Electric Company Supported Inventory Project

With the administrative support of Pacific Gas and Electric Company (PG&E) and funding from California utility customers under the auspices of the California Public Utilities Commission, ICLEI - Local Governments for Sustainability ("ICLEI") was contracted to work with the Great Valley Center to assist in the quantification of greenhouse gas emissions in the City of Tracy and the following other participating communities: the Counties of San Joaquin, Stanislaus and Merced and the cities of Atwater, Dos Palos, Gustine, Lodi, Los Banos, and Manteca. ICLEI is a nonprofit association of local governments that provides information, delivers training resources, organizes conferences, facilitates networking and city-to-city exchanges, carries out research and pilot projects, and offers technical services and consultancy related to climate planning. Throughout 2012, ICLEI provided training and technical assistance to participating regional organizations, interns, and local government staff and facilitated the completion of this report.

Sustainable Action in the City of Tracy

The City of Tracy has already begun the process of emissions mitigation, which is also intended to result in higher energy efficiency and, therefore, savings. The City adopted a Sustainability Action Plan in 2011 which identifies a number of Sustainability Targets related to GHG emissions, energy, transportation and land use, solid waste, water, agriculture and open space, biological resources, air quality, public health, economic development.[3] The Sustainability Action Plan sets the City on a path to achieve these targets through a number of Sustainability Measures, designed to avoid overregulation and barriers to economic growth. Implementing these measures provides the City with the opportunity to simultaneously meet state requirements and become more adaptable to changing economic, environmental and social climates.

Target #1 of the Sustainability Action Plan aims to reduce per capita GHG emissions by 15 percent by 2020. This GHG emissions inventory provides the City with an updated quantification of municipal GHG emissions which will allow the City to monitor progress toward meeting its targets. In addition, the inventory project mentioned above provides participating local governments with a number of resources designed to help them quantify emissions. These resources include quantification software and templates designed by ICLEI, as well as access to ICLEI training sessions (for a full list of resources, refer to Appendix I – Project Resources). Acquiring and learning how to operate such tools is a barrier that many local governments face; yet these tools were provided at no cost to the City of Tracy.

As an added benefit, local governments may be able to apply their GHG emissions quantification capabilities to streamline the assessment of the GHG impact of projects as part of the environmental analyses that are required under

[3] City of Tracy Sustainability Action Plan, available at http://www.ci.tracy.ca.us/documents/Sustainability_Action_Plan.pdf

the California Environmental Quality Act (CEQA). Plans must address a number of criteria before jurisdictions are able to streamline these assessments. The San Joaquin Valley Air Pollution Control District (Valley Air District) provides guidance to help local governments account for and reduce project-related emissions.

Introduction

General Methodology

Local Government Operations Protocol

A national standard called the Local Government Operations Protocol (LGO Protocol) has been developed and adopted by the California Air Resources Board (ARB) in conjunction with ICLEI, the California Climate Action Registry, and The Climate Registry. This standard provides accounting principles, boundaries, quantification methods, and procedures for reporting greenhouse gas emissions from local government operations. The LGO Protocol forms the basis of ICLEI's Clean Air & Climate Protection Software (CACP 2009), which allows local governments to compile data and perform the emissions calculations using standardized methods.

Greenhouse Gases and Carbon Dioxide Equivalent

In accordance with LGO Protocol recommendations, CACP 2009 calculates and reports six internationally recognized greenhouse gases: Carbon Dioxide, Methane, Nitrous Oxide, Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexafluoride. Emissions summaries found throughout this report also use CACP 2009's ability to combine emissions from the various greenhouse gases into carbon dioxide equivalent, CO_2e. Since equal quantities of each greenhouse gas have more or less influence on the greenhouse effect, converting all emissions to a standard metric, CO_2e, allows apples-to-apples comparisons amongst quantities of all six emissions types. Greenhouse gas emissions are reported in this inventory as metric tons of CO_2e ($MTCO_2e$).

Table 1 exhibits the greenhouse gases and their global warming potential (GWP), a measure of the amount of warming a greenhouse gas may cause compared to the amount of warming caused by carbon dioxide.

Table 1: Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organic Waste (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbons	Various	Leaked Refrigerants, Fire Suppressants	12–11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500–9,200
Sulfur Hexafluoride	SF_6	Transmission and Distribution of Power	23,900

Calculating Emissions

In general, emissions can be quantified in two ways.

1. Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions from a monitoring system. Emissions measured this way may include those emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This method is the most accurate way of inventorying emissions from a given source, but is generally available for only a few sources of emissions.

2. Calculation-based methodologies refer to an estimate of emissions calculated based upon measurable ***activity data*** and ***emission factors***. Table 2 provides examples of common emissions calculations.

Table 2: Basic Emissions Calculations

Activity Data x	Emissions Factor =	Emissions
Electricity Consumption (kilowatt hours)	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
Waste Generated by Government Operations (tons)	CH_4 emitted/ton of waste	CH_4 emitted

The Scopes Framework

This inventory reports greenhouse gas emissions by sector and additionally by "scope", in line with the LGO Protocol and World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Emissions Protocol Corporate Standard.

Scope 1: Direct emissions from sources within a local government's operations that it owns and/or controls, with the exception of direct CO_2 emissions from biogenic sources. This includes stationary combustion to produce electricity, steam, heat, and power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; leaked refrigerants; and other sources.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3: All other emissions sources that hold policy relevance to the local government that can be measured and reported. This includes all indirect emissions not covered in Scope 2 that occur as a result of activities within the operations of the local government. Scope 3 emission sources include (but are not limited to) tailpipe emissions from employee commutes, employee business travel, and emissions resulting from the decomposition of government-generated solid waste.

ICLEI and the LGO Protocol provide standard methodologies for calculating emissions from the sources shown in the following table. Other sources of emissions, such as those associated with the production of consumed products do not yet have standard calculation methodologies and are thus excluded from this inventory.

Table 3: Inventoried Emissions Sources by Scope

Scope 1	Scope 2	Scope 3
Fuel consumed at facilities	Purchased electricity consumed by facilities	Solid waste generated by government operations
Fuel consumed by vehicle fleet and mobile equipment	Purchased electricity consumed by electric vehicles	Fuel consumed by vehicles during employee commuting
Fuel consumed to generate electricity	Purchased steam	
Leaked refrigerants from facilities and vehicles	Purchased cooling (chilled water)	
Leaked / deployed fire suppressants		
Solid waste in government landfills		
Wastewater decomposition and treatment at a municipal wastewater treatment plant		

Organizational Boundaries

The organizational boundary for the inventory determines which aspects of operations are included in the emissions inventory, and which are not. Under the LGO Protocol, two control approaches are used for reporting emissions: operational control or financial control. A local government has operational control over an operation if it has full authority to introduce and implement policies that impact the operation. A local government has financial control if the operation is fully consolidated in financial accounts. If a local government has joint control over an operation, the contractual agreement will have to be examined to see who has authority over operating policies and implementation, and thus the responsibility to report emissions under operational control.

LGO Protocol strongly encourages local governments to utilize operational control as the organization boundary for a government operations emissions inventory. Operational control is believed to most accurately represent the emissions sources that local governments can most directly influence, and this boundary is consistent with other environmental and air quality reporting program requirements. For this reason, this inventory was conducted according to the operational control framework.

Types of Emissions

As described in the LGO Protocol, emissions from each of the greenhouse gases can come in a number of forms:

Stationary or mobile combustion: These are emissions resulting from on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat, electricity, or to power vehicles and mobile equipment.

Purchased electricity: These are emissions produced by the generation of power from utilities outside of the City of Tracy.

Fugitive emissions: Emissions that result from the unintentional release of greenhouse gases into the atmosphere (e.g., leaked refrigerants, methane from waste decomposition, etc.).

Process emissions: Emissions from physical or chemical processing of a material (e.g., wastewater treatment).

Significance Thresholds

Within any local government's own operations there will be emission sources that fall within Scope 1 and Scope 2 that are minimal in magnitude and difficult to accurately measure. Within the context of local government operations, emissions from leaked refrigerants and backup generators may be common sources of these types of emissions. For these less significant emissions sources, LGO Protocol specifies that up to 5 percent of total emissions can be reported using methodologies that deviate from the recommended methodologies in LGO Protocol. In the context of registering emissions with an independent registry (such as the California Climate Action Registry), emissions that fall under the significance threshold are called ***de minimis***.

In this report, some emissions were calculated using methods that deviate from the methods recommended in the LGO Protocol. However, the LGO Protocol identifies several alternative methods that still meet emission calculation standards. For the following areas, alternative methods were used to calculate emissions:

- Scope 2 CO2, CH4 and N2O emissions from purchased electricity used to power the West High Pool facility
- Scope 1 CO2, CH4 and N2O emissions from stationary combustion of stationary backup generators
- Scope 1 CO2 emissions from mobile combustion of transit fleet
- Scope 1 CO2 emissions from mobile combustion of mobile equipment

In addition, emissions data from the following sources could not be obtained for this report and therefore emissions from these sources are not included in this inventory:

- Scope 1 fugitive emissions from the leakage of refrigerants from stationary heating, air conditioning, and refrigeration units
- Scope 1 fugitive emissions from the leakage of fire suppressants
- Scope 3 emissions from employees during business travel

Information Items

Information items are emissions sources that are not included as Scope 1, 2, or 3 emissions in the inventory, but are reported here separately in order to provide a more complete picture of emissions from the City of Tracy's government operations.

A common emission that is categorized as an information item is carbon dioxide emitted in the combustion of biogenic fuels. Local governments will often burn fuels that are of biogenic origin (wood, landfill gas, organic solid waste, biofuels, etc.) to generate power. Common sources of biogenic emissions are the combustion of landfill gas from landfills or biogas from wastewater treatment plants, as well as the incineration of organic municipal solid waste at incinerators.

Carbon dioxide emissions from the combustion of biogenic fuels are not included in Scope 1 based on established international principles. Methane and nitrous oxide emissions from biogenic fuels are considered Scope 1 stationary combustion emissions and are included in the stationary combustion sections for the appropriate facilities. These principles indicate that biogenic fuels (e.g., wood, biodiesel), if left to decompose in the natural environment, would release CO_2 into the atmosphere, where it would then enter back into the natural carbon cycle. Therefore, when wood or another biogenic fuel is combusted, the resulting CO_2 emissions are akin to natural emissions and should therefore not be considered as human activity-generated emissions. The CH_4 and N_2O emissions, however, would not have occurred naturally and are therefore included as Scope 1 emissions.

Information items quantified for this inventory include:

- Scope 2 emissions from purchased electricity for electric vehicles

The emissions categorized as information items in this inventory are presented below in Table 4.

Table 4: Information Items

INFORMATION ITEMS	
	CO_2e
Wastewater Treatment Plant Maintenance, Electric Vehicle	0.03
Water Treatment Plant, Electric Vehicle	0.01
Total Information Items	**0.04**

Understanding Totals

It is important to realize that the totals and sub-totals listed in the tables and discussed in this report are intended to represent all-inclusive, complete totals for the City of Tracy's operations. However, these totals are only a summation of inventoried emissions using available estimation methods. Each inventoried sector may have additional emissions sources associated with them that were unaccounted for, such as Scope 3 sources that could not be estimated.

Also, local governments provide different services to their citizens, and the scale of the services (and thus the emissions) is highly dependent upon the size and purview of the local government. For these reasons, comparisons between local government totals should not be made without keen analysis of the basis for figures and the services provided.

It is important to understand that in the case where a local government operates a municipal utility that generates electricity for government facilities, the associated emissions should be considered Scope 1 emissions within the Power Generation Facilities sector, and not Scope 2 emissions within each of the other facilities sectors, when calculating a total. This is advised by the LGO Protocol and done to avoid reporting the same emissions twice, also known as double counting.

Comparative Analysis: 2006 & 2010 Emissions

Highlights

The City of Tracy recorded 11,449 $MTCO_2e$ from municipal operations in 2006. The results of this GHG emissions inventory reassessment indicate that the City reduced emissions to 9,587 $MTCO_2e$ in 2010, a net reduction of approximately 16%.

Purpose of Conducting a Reassessment

After a baseline GHG emissions inventory is completed, the same procedures can be applied periodically to monitor changes in emissions over time. When local governments adopt plans to reduce emissions through deliberate actions, periodic reassessment is the best tool for measuring the efficacy of such actions. A re-inventory of all emissions is recommended because while some actions may result in reductions, others may not be as effective. A reassessment of all emissions allows local governments to identify the net effect of all actions.

Factors of Change

Mitigation Measures

In 2011, the City of Tracy adopted a Sustainability Action Plan that contains eighty-four sustainability measures to reduce GHG emissions over time. These measures address sectors such as energy use, transportation and land use, solid waste generation, and water conservation. While each of these sectors is represented in the 2006 and 2010 GHG inventories, emissions reductions in these sectors between 2006 and 2010 are not directly linked to the measures implemented in 2011.

External Factors

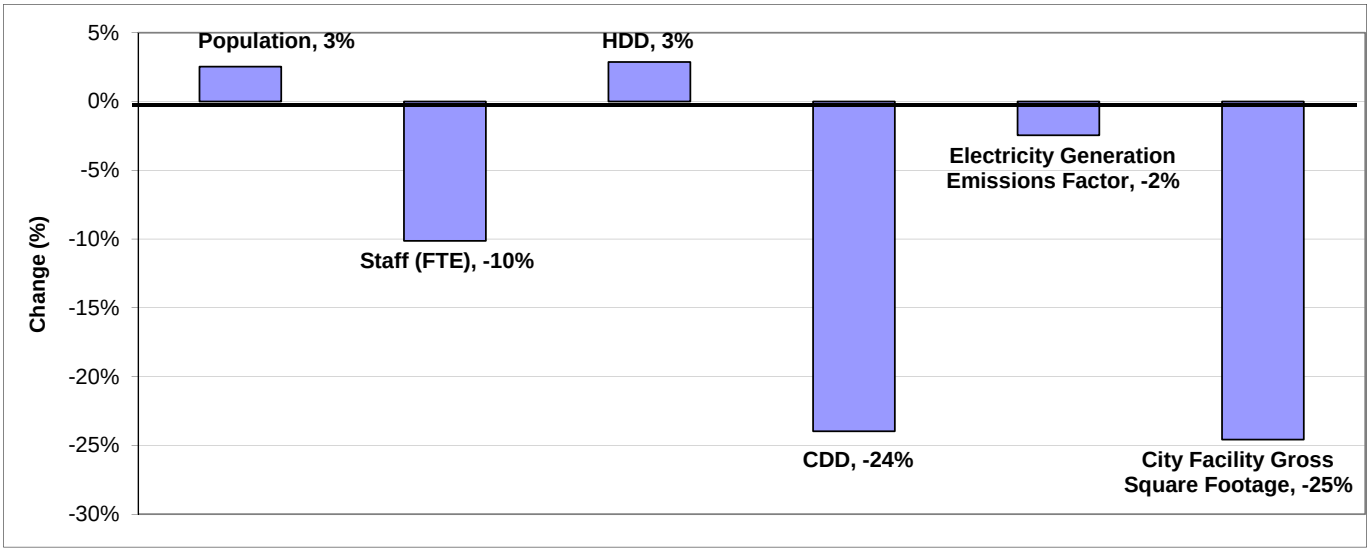
Regardless of whether or not mitigation measures are in place at a local government, many other factors can be responsible for changes in GHG emissions over time. Certain external factors, such as economic decline or technological advancement, naturally result in emissions reductions. Other factors, such as population growth or economic growth, may naturally cause emissions increases. When conducting an emissions reassessment, it is prudent to acknowledge these uncontrollable factors alongside controllable mitigation measures.

Table 5 and Figure 2 document the external changes that occurred in Tracy which impacted emissions in the two inventory years.

Table 5: External Factors Impacting Emissions

External Factors	2006	2010	Change (%)	Units
Population	80,075	82,107	3%	Persons
Staff (Full Time Equivalent)	527	474	-10%	Persons
Weather				
Heating Degree Days	3,169	3,260	3%	HDD
Cooling Degree Days	1,460	1,110	-24%	CDD
Electricity Generation Emissions Factor	456	445	-2%	lbs CO_2 / MWh
City Facility Square Footage	334,000	251,914	-25%	Gross Square Feet

Figure 2: External Factors Impacting Emissions



Summary of changes:

- Population increased by 3%, meaning the demand for services provided by the city may have increased marginally.
- Staffing levels decreased by 10%. This may have resulted in fewer employee commute emissions, less employee-related energy consumption (e.g. computers use, lighting, etc.), and less employee-generated waste.
- Heating Degree Days increased by 3%, meaning the demand for energy to heat municipal facilities relative to outside temperatures increased in 2010.
- Cooling Degree Days decreased by 24%, meaning the demand for energy to cool municipal facilities relative to outside temperatures decreased in 2010.

- The emissions per unit of electricity generated by PG&E declined, meaning the energy was "cleaner" in 2010 and thus resulted in fewer emissions.
- City facility gross square footage decreased by 25%, meaning less energy was required to operate the city's facilities. There was a net decrease of 6 city-owned or leased facilities between 2006 and 2010.

Methodologies

The methods employed to conduct a GHG emissions inventory are important to consider when conducting a reassessment. While the methods employed to conduct this 2010 inventory are disclosed at length in the *Inventory Methodologies* section, it is worth noting some variations between the methodologies for the 2006 and 2010 inventories.

The 2010 inventory relies on the LGO Protocol, as is discussed in the *Introduction* section. By utilizing the LGO Protocol's recommended methods, the 2010 inventory presents as detailed a picture as possible of the City of Tracy's municipal operations and their related GHG emissions. The LGO Protocol and ICLEI recommend to use actual measurements of operations where possible, and to rely on default measures – such as per capita emissions for various operations – only when detailed information cannot be obtained. For the following operations, the 2010 inventory relied on detailed measurements provided by the City, whereas the 2006 inventory relied on other approaches:

- Fuel consumed by vehicles in the vehicle and transit fleet
- Refrigerants recharged into vehicles in the vehicle and transit fleet
- Solid waste generated at government facilities

In addition, emissions from some operations, such as refrigerants used at City facilities, were omitted in the 2010 inventory but included in the 2006 inventory. For more information, refer to the *Significance Thresholds* section.

Because of the variation in methodologies applied between the two inventories, a sector-by-sector analysis of changes to the GHG inventory between 2006 and 2010 would not be an "apples-to-apples" comparison.

Inventory Results

Emissions Total

In 2010, the City of Tracy's greenhouse gas emissions from government operations totaled 9,587 metric tons of CO_2e. This number represents a roll-up of emissions. While the roll-up is a valuable figure, information on the breakdown of emissions from local government operations by scopes, sources, and sectors allows the comparative analysis and insight needed for effective decision-making on target setting, developing GHG reduction measures, or monitoring. The LGO Protocol and ICLEI identify reporting by scopes, sources, and sectors as the strongly preferred form of reporting a greenhouse gas inventory. For more details on the breakdown of the City of Tracy's emissions by scopes, sources, and sectors, refer to subsequent sections within Inventory Results in this report. Please also refer to the Inventory Methodologies section for an overview of the approaches employed to calculate these results, including information about inconsistencies and limitations.

The following figures summarize the results of the LGO greenhouse gas emissions inventory for the City of Tracy, by scope, sector and source. Table 6 delineates the different types of greenhouse gases (CO_2, CH_4, N_2O, etc.), which are assigned a standard metric of carbon dioxide equivalent (CO_2e), and then combined to describe total emissions of the City of Tracy. As illustrated in Figure 3 and Table 7, the sector producing the most greenhouse gas emissions in the City of Tracy was the Wastewater Services sector at 26.9%, followed by the Buildings and Facilities sector at 19.3%. As shown in Figure 4 and Table 8, Electricity and Gasoline were the sources with the greatest percentage of emissions (49.5% and 27.5% respectively).

Table 6: LGO Protocol Report - Overall Emissions by Scope

Total Emissions[4]	CO_2e	CO_2	CH_4	N_2O	HFCs
SCOPE 1	3,326	2,709	4.1	1.3	0.1
SCOPE 2	4,644	4,605	0.3	0.1	-
SCOPE 3	1,617	1,520	2.8	0.1	-
INFORMATION ITEMS	0.0	0.0	0.0	0.0	-

[4] Total emissions are reported as metric tons of each respective greenhouse gas emission type. Values less than 1 have been expanded to include one decimal point. In instances where an emission type is either not present or omitted, the category is marked " – " to signify zero emissions. Omissions and other limitations are outlined in the Significance Thresholds section, and discussed further in the Inventory Methodologies section.

Figure 3: 2010 Government Operations CO_2e Emissions by Sector

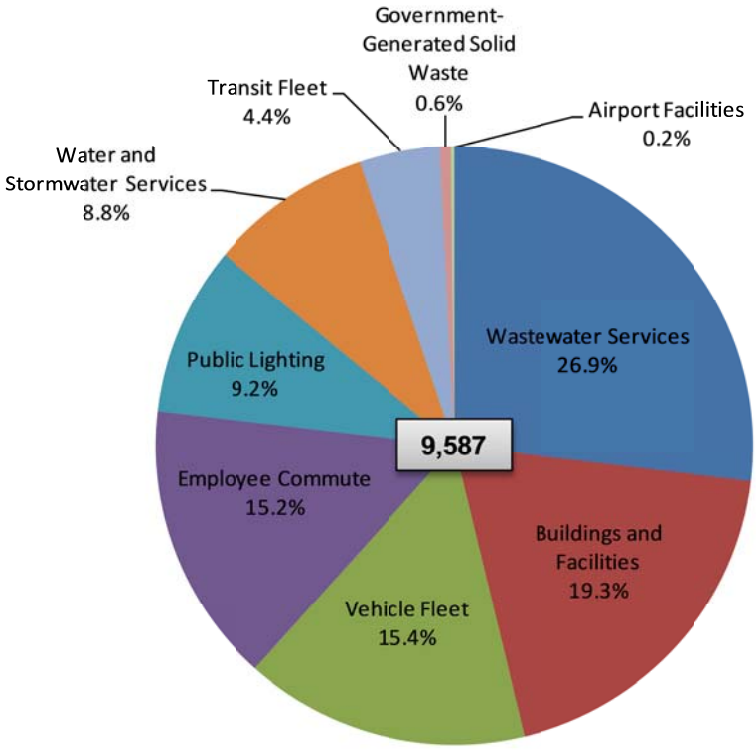


Table 7: 2010 Government Operations CO_2e Emissions by Sector

Sector	metric tons CO_2e	% of Sector Emissions	Cost ($)
Wastewater Services	2,579	26.9%	1,050,532
Buildings and Facilities	1,853	19.3%	1,042,066
Vehicle Fleet	1,474	15.4%	415,066
Employee Commute	1,461	15.2%	-
Public Lighting	882	9.2%	642,526
Water and Stormwater Services	844	8.8%	620,022
Transit Fleet	419	4.4%	-
Government-Generated Solid Waste	57	0.6%	-
Airport Facilities	18	0.2%	14,933
Totals	**9,587**	**100%**	**$ 3,785,145**

Figure 4: 2010 Government Operations CO_2e Emissions by Source

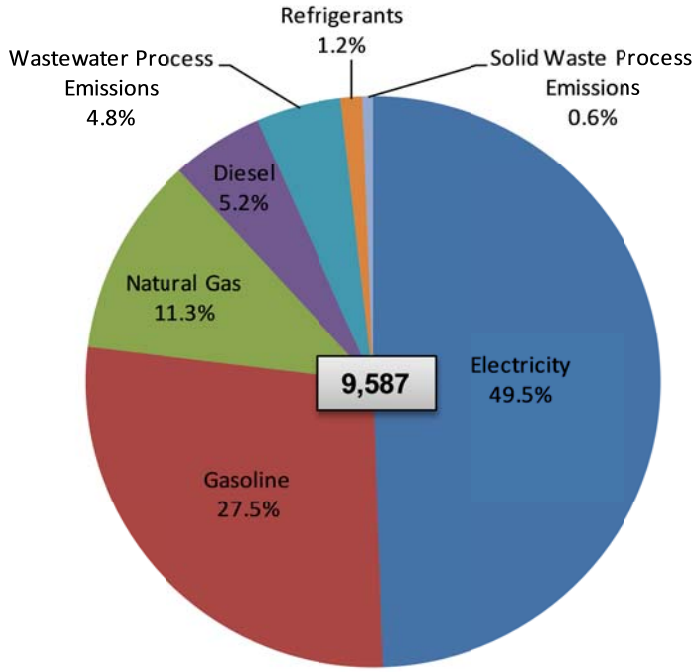


Table 8: 2010 Government Operations CO_2e Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units	Cost ($)
Electricity	4,743	49.5%	23,297,760	kWh	3,231,226
Gasoline	2,633	27.5%	292,593	US gal	359,247
Natural Gas	1,084	11.3%	172,836	therms	133,279
Diesel	494	5.2%	45,634	US gal	61,393
Wastewater Process Emissions	460	4.8%	5	tonnes	-
Refrigerants	117	1.2%	90	kg	-
Solid Waste Process Emissions	57	0.6%	226	tons	-
Totals	**9,587**	**100%**			**$3,785,145**

Buildings and Other Facilities

Facility operations contribute to greenhouse gas emissions in two major ways. First, facilities consume electricity and fuels such as natural gas. This consumption is associated with the majority of greenhouse gas emissions from facilities. Data relating to electricity and natural gas consumption were obtained from PG&E. Data relating to backup generators and fuel consumption were obtained from the Public Works Department. In addition, fire suppression, air conditioning, and refrigeration equipment in buildings can emit hydrofluorocarbons (HFCs) and other greenhouse gases when these systems leak refrigerants or fire suppressants. Refrigerants and fire suppressants are very potent greenhouse gases, and have Global Warming Potential (GWP) of up to many thousand times that of CO_2. For example, HFC-134a, a very common refrigerant, has a GWP of 1300, or 1300 times that of CO_2. Therefore, even small amounts of leaked refrigerants can have a significant effect on greenhouse gas emissions.

The City of Tracy operates facilities ranging from general City offices to parks and museums. For the purpose of reporting emissions, these facilities were grouped by department when possible. Facilities that were unknown or previously uncategorized were included in this section of the inventory and were assigned to a category called "Unspecified Facilities." Airport facilities and wastewater treatment plants are reported separately from the Buildings and Facilities sector due to the unique facilities and operating hours typically involved in such operations.

The Buildings and Facilities sector produced the second-largest amount of emissions by sector. Overall, these facilities produced 1,853 metric tons of CO_2e (19.3% of total emissions). As illustrated in Figure 5 and Table 9, the facility group producing the most greenhouse gas emissions in the City of Tracy was the Park Facilities group at 32.2%. This group includes all park facilities and infrastructure with the exception of park lighting and sprinkler systems which could be separated and reported in subsequent sectors of the inventory. The Park Facilities group does not include administrative facilities which were reported under the City Hall group because the energy consumption for each department could not be disaggregated within shared facilities. The second largest contributor was the Police facility group at 20.5%. This group includes all Police facilities, such as police stations and the shooting range. The third largest contributor was the Public Works Corporation Yard at 18.9%, which does not include administrative offices located within shared facilities. At 7.2%, Fire Department facilities include all fire stations located throughout the City.

As illustrated in Figure 6 and Table 10, the source producing the most greenhouse gas emissions in the Buildings and Facilities sector is purchased electricity at 68.5%, followed by natural gas at 30.3%. Diesel, used to power backup generators across the City, accounted for 1.2% of emissions in this sector. The top five largest individual contributors to emissions from the Buildings and Facilities sector have been ranked in Table 11 below. Table 12 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Buildings and Facilities sector, Scope 2 Indirect accounted for a majority of the CO_2e emissions.

Figure 5: Buildings and Other Facilities Emissions by Department

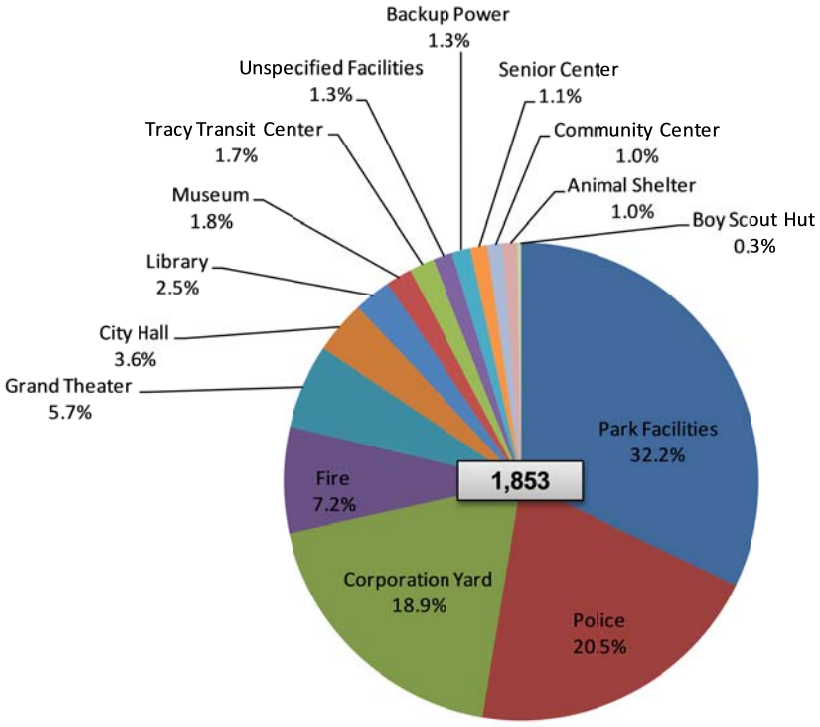


Table 9: Buildings and Other Facilities Emissions by Department

Department	metric tons CO_2e	% of Sector Emissions	Cost ($)
Park Facilities	595.87	32.2%	404,634
Police	378.97	20.5%	232,383
Corporation Yard	350.30	18.9%	87,201
Fire	133.50	7.2%	67,152
Grand Theater	105.18	5.7%	72,574
City Hall	66.28	3.6%	37,798
Library	46.44	2.5%	29,267
Museum	32.66	1.8%	8,891
Tracy Transit Center	31.63	1.7%	20,341
Unspecified Facilities	24.72	1.3%	36,171
Backup Power	23.52	1.3%	7,514
Senior Center	21.27	1.1%	10,184
Community Center	19.25	1.0%	9,401
Animal Shelter	18.78	1.0%	15,846
Boy Scout Hut	4.66	0.3%	2,709
Totals	**1,853**	**100%**	**$1,042,066**

Figure 6: Buildings and Other Facilities Emissions by Source

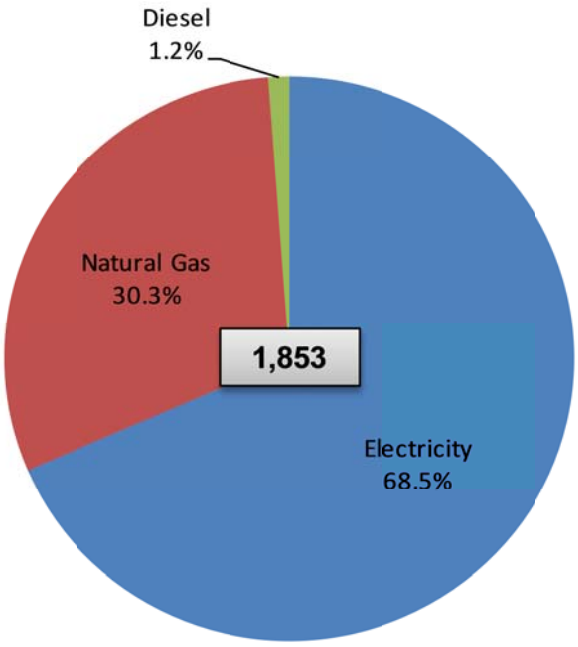


Table 10: Buildings and Other Facilities Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units	Cost ($)
Electricity	1,270	68.5%	6,236,180	kWh	955,068
Natural Gas	561	30.3%	105,631	Therms	81,424
Diesel	22	1.2%	2,144	US gal	5,574
Totals	**1,853**	**100%**			**$ 1,042,066**

Table 11: Top 5 Largest Contributors to Emissions from Buildings Sector

Facility	% of Total Buildings / Facilities Emissions from Electricity	% of Total Buildings / Facilities Emissions from Natural Gas	CO_2e Emissions from Electricity	CO_2e Emissions from Natural Gas	Total CO_2e Emissions
Park Facilities	47%	0%	595	1	**596**
Police	24%	13%	304	75	**379**
Corporation Yard	4%	52%	57	293	**350**
Fire	5%	12%	64	70	**133**
Grand Theater	7%	3%	87	18	**105**
Totals	**87%**	**81%**	**1,107**	**457**	**1,564**

Table 12: LGO Protocol Report - Buildings Sector Emissions by Scope and Emission Type

BUILDINGS & OTHER FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 1		CO_2e	CO_2	CH_4	N_2O
	Stationary Combustion	584	582	0.1	0.0
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	1,270	1,259	0.1	0.0

Streetlights, Traffic Signals, and Other Public Lighting

Like most local governments, the City of Tracy operates a range of public lighting including traffic signals, streetlights, and park lights. The majority of emissions associated with the operation of this infrastructure are due to electricity consumption. Data relating to electricity consumption for public lighting was obtained from PG&E.

While many of the streetlights located within Tracy are owned and operated by the City, some are owned and operated directly by PG&E. Since the City of Tracy does not have operational or financial control over these lights, the emissions resulting from their operation are classified as Scope 3.

The Public Lighting sector produced the fifth-largest amount of emissions of all sectors overall. Overall, these facilities produced 882 metric tons of CO_2e (9.2% of total emissions). As illustrated in Figure 7 and Table 13, the subsector producing the most greenhouse gas emissions in the Public Lighting sector was Streetlights at 82.2%, followed by Scope 3 Streetlights at 11.2% and Traffic Signals/Controllers at 5.8%. Table 14 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Public Lighting sector, Scope 2 Indirect Emissions accounted for a majority of the CO_2e emissions.

Figure 7: Public Lighting Emissions by Subsector

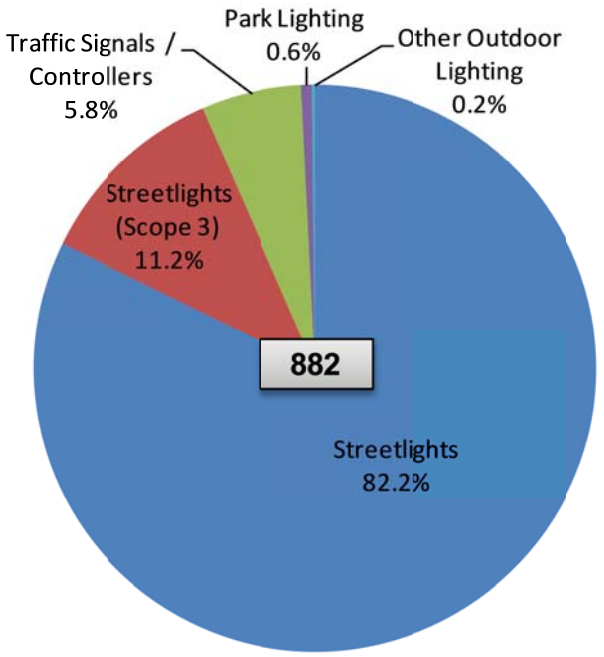


Table 13: Public Lighting Emissions by Subsector

Subsector (Light Type)	metric tons CO_2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Streetlights	725	82.2%	3,561,746	456,389
Streetlights (Scope 3)	99	11.2%	484,508	137,491
Traffic Signals / Controllers	51	5.8%	250,188	41,911
Park Lighting	5.5	0.6%	26,799	4,929
Other Outdoor Lighting	1.5	0.2%	7,443	1,806
Totals	**882**	**100%**	**4,330,684**	**$ 642,526**

Table 14: LGO Protocol Report – Public Lighting Emissions by Scope and Emission Type

STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	783	776	0.1	0.0
SCOPE 3		CO_2e			
	Streetlights (Scope 3)	99			

Water Delivery Facilities

This sector includes emissions from equipment used for the distribution or transport of water, including drinking water, sprinkler systems and irrigation. The City of Tracy operates a range of water transport equipment, including wells, pumps, and a water treatment plant. Electricity consumption was the single source of greenhouse gas emissions from the operation of the City of Tracy's water transport equipment. Data relating to electricity consumption was obtained from PG&E.

The Water Transport sector produced the sixth-largest amount of emissions overall, with 844 metric tons of CO_2e (8.8% of total emissions). As illustrated in Figure 8 and Table 15, the subsector producing the most greenhouse gas emissions in the Water Transport sector was the Water Treatment Plant at 61.4%, followed by Water Pumps at 34.9%. Table 16 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Water Delivery sector, Scope 2 Indirect Emissions accounted for all CO_2e emissions.

Figure 8: Water Delivery Facilities Emissions by Subsector

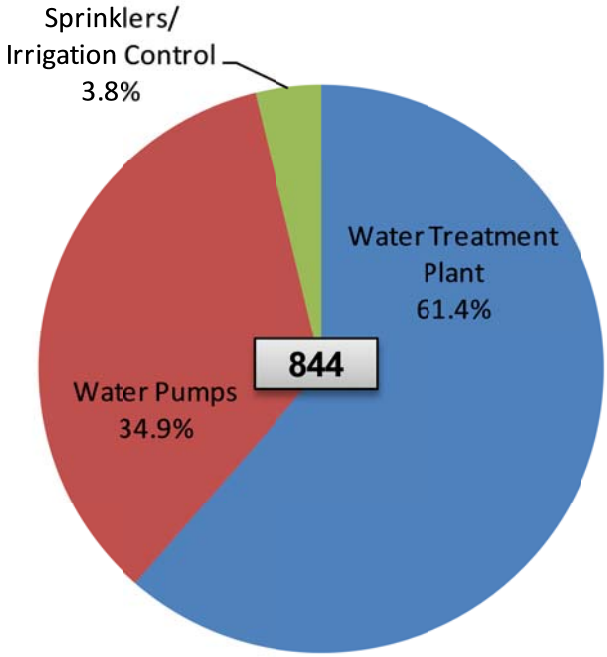


Table 15: Water Delivery Facilities Emissions by Subsector

Subsector (Equipment Type)	metric tons CO_2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Water Treatment Plant	518	61.4%	2,544,854	346,101
Water Pumps	294	34.9%	1,446,117	229,314
Sprinklers/ Irrigation Control	32	3.8%	156,310	44,607
Totals	**844**	**100%**	**4,147,281**	**$ 620,022**

Table 16: LGO Protocol Report - Water Delivery Facilities Emissions by Scope and Emission Type

WATER TRANSPORT FACILITIES					
Scope	Emission Type	Greenhouse Gas Emissions (metric tons)			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	844	837	0.1	0.0

Wastewater Treatment Facilities

Wastewater coming from homes and businesses is rich in organic matter and has a high concentration of carbon and nitrogen (along with other organic elements). As wastewater is collected, treated, and discharged, chemical processes in aerobic and anaerobic conditions lead to the creation and emission of two greenhouse gases: methane and nitrous oxide. Local governments that operate wastewater treatment facilities, including treatment plants, septic systems, collection lagoons, and other facilities, must therefore account for the emission of these gases.

Electricity consumption and the on-site combustion of fuels such as natural gas and diesel are also significant sources of greenhouse gas emissions from the operation of wastewater treatment facilities. Data relating to electricity consumption were obtained from PG&E. Data relating to backup generators and fuel consumption were obtained from the City of Tracy Public Works Department.

The City of Tracy has operated the wastewater treatment plant with secondary treatment since 1976. The treatment plant covers approximately 40 acres and has a design capacity of 10.8 million gallons per day. In 2010, these facilities served approximately 81,000 people.

The Wastewater Treatment sector produced the largest amount of emissions in this inventory. Overall, these facilities produced 2,579 metric tons of CO_2e (26.9% of total emissions). As illustrated in Figure 9 and Table 17, the subsector producing the most greenhouse gas emissions in the Wastewater Treatment sector was Facility Energy Use at 76.7%, followed by Nitrification/Denitrification at 14.9%. The largest source of emissions was Purchased Electricity, which accounted for 67.1% of overall emissions. Table 18 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Wastewater Treatment sector, Scope 2 Indirect Emissions accounted for a majority of the CO_2e emissions.

Figure 9: Wastewater Treatment Facilities Emissions by Subsector

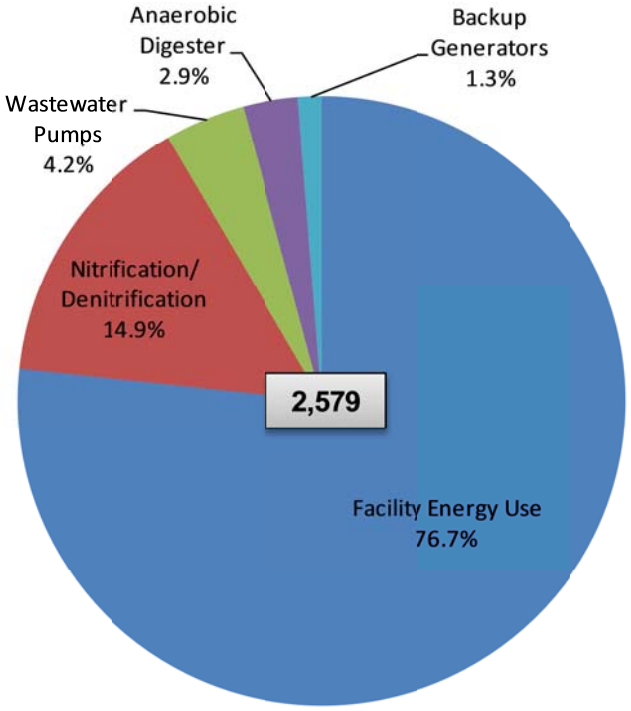


Table 17: Wastewater Treatment Facilities Emissions by Subsector

Subsector	metric tons CO_2e	% of Sector Emissions	Electricity Quantity (kWh)	Electricity Cost ($)	Natural Gas Quantity (therms)	Natural Gas Cost ($)
Facility Energy Use	1,977	76.7%	7,958,818	911,804	67,205	51,855
Nitrification/ Denitrification	384	14.9%	-		-	-
Wastewater Pumps	109	4.2%	536,920	86,873	-	-
Anaerobic Digester	76	2.9%	-		-	-
Backup Generators	32	1.3%	-		-	-
Totals	**2,579**	**100%**	**8,495,738**	**$ 998,677**	**67,205**	**$ 51,855**

Table 18: LGO Protocol Report - Wastewater Treatment Facilities Emissions by Scope and Emission Type

WASTEWATER TREATMENT FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 1		CO_2e	CO_2	CH_4	N_2O
	Stationary Combustion	390	388	0.0	0.0
	Process Emissions	460	-	4	1
	Total Direct Emissions	**849**	**388**	**4**	**1**
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	1,730	1,715	0.1	0.0

Airport Facilities

Airport facilities are reported separately from the Buildings and Facilities sector due to the unique facilities and operating hours typically involved in airport operations. Electricity consumption was the single source of greenhouse gas emissions from the operation of the City of Tracy's Airport Facilities. Data relating to electricity consumption were obtained from PG&E. The Airport Facilities sector produced the ninth-largest amount of emissions in this inventory. Overall, these facilities produced 18 metric tons of CO_2e (0.2% of total emissions). Table 19 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Airport sector, Scope 2 Indirect Emissions accounted for all CO_2e emissions.

Table 19: LGO Protocol Report – Airport Facilities Emissions by Scope and Emission Type

AIRPORT FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	18	18	0.0	0.0

Vehicle Fleet and Mobile Equipment

The vehicles and mobile equipment used in the City of Tracy's daily operations include: heavy and light trucks used for landscape and maintenance tasks; passenger cars driven on a variety of site visits, including building inspections; light trucks transporting goods and equipment from site to site. Most vehicles consume gasoline, some consume diesel, and both result in greenhouse gas emissions. Gasoline and diesel-powered maintenance equipment contribute to greenhouse gas emissions as well; however, exact figures for off-road fuel consumption could not be acquired for individual equipment, so aggregate fuel data were used. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle.

In 2010, the City of Tracy operated a vehicle fleet with approximately 400 vehicles and 100 pieces of mobile equipment. The majority of vehicles in the fleet were used in the Public Works Department across a variety of divisions (e.g. Water, Streets, Park Maintenance, etc.). Other vehicles were used by the Police Department and Fire Department, among others. Vehicles that were counted in this inventory, but which could not be identified by department, were reported under "Miscellaneous Departments" in the results below.

The Vehicle Fleet sector produced the third-largest amount of emissions in this inventory. Overall, this sector produced 1,474 metric tons of CO_2e (15.4% of total emissions). As illustrated in Figure 10 and Table 20, the source producing the most greenhouse gas emissions in the Vehicle Fleet sector was Gasoline at 84.3%, followed by Diesel at 14.9%.

Emissions from vehicle fleet use by department are illustrated in Table 21. Table 22 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Vehicle Fleet sector, Scope 1 Direct Emissions accounted for all CO_2e emissions.

Figure 10: Vehicle Fleet Emissions by Source

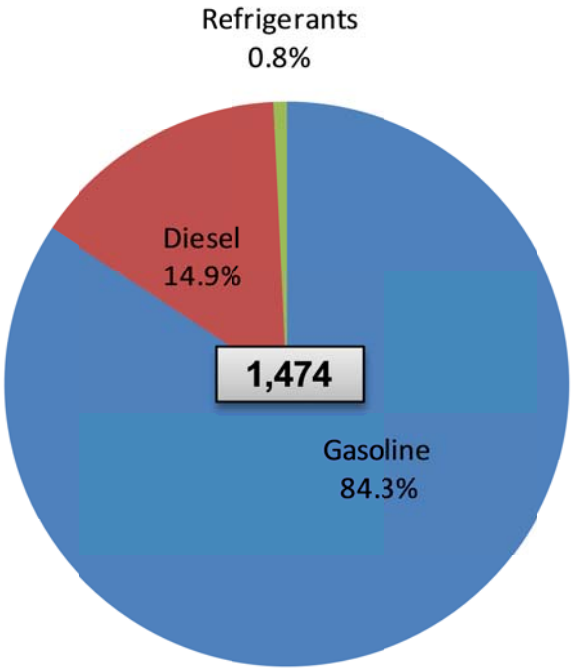


Table 20: Vehicle Fleet Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units	Cost ($)
Gasoline	1,244	84.3%	138,798	US gal	359,247
Diesel	220	14.9%	21,508	US gal	55,819
Refrigerants	11	0.8%	9	kg	-
Totals	**1,474**	**100%**			**$ 415,066**

Table 21: Vehicle Fleet Emissions by Department

Department	metric tons CO_2e	% of Sector Emissions
Police	527	35.8%
Public Works	281	19.1%
Fire	156	10.6%
Parks Maintenance	132	9.0%
Development and Engineering Services	54	3.7%
Roadway Maintenance	53	3.6%
Wastewater Treatment Plant	42	2.9%
Landscape District	39	2.7%
Sidewalk Maintenance	34	2.3%
Electrical Maintenance	20	1.3%
Central Garage	18	1.2%
Animal Shelter	15	1.0%
Parks & Community Services	13	0.9%
Graffiti	12	0.8%
Traffic Maintenance	12	0.8%
Airport	12	0.8%
Refrigerants	11	0.8%
Building Maintenance	11	0.7%
Misc. Departments	7.7	0.5%
Streets Tree Maintenance	6.6	0.4%
Juvenile Services	6.4	0.4%
Sports Complex	4.4	0.3%
Water Treatment	3.8	0.3%
Command Post	1.3	0.1%
Solid Waste & Recycle	1.1	0.1%
Information Systems	0.3	0.0%
Mayor Youth Sports Network	0.0	0.0%
Totals	**1,474**	**100%**

Table 22: LGO Protocol Report - Vehicle Fleet Emissions by Scope and Emission Type

VEHICLE FLEET						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFC 134A
	Mobile Combustion	1,463	1,438	0.1	0.1	
	Fugitive Emissions	11	-	-	-	0.0
	Total Direct Emissions	**1,474**	**1,438**	**0**	**0**	**0**

Transit Fleet

The vehicles and mobile equipment used in the City of Tracy's public transportation operations, including buses and shuttles, burn gasoline, diesel, and natural gas, resulting in greenhouse gas emissions. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle.

The Transit Fleet sector produced the seventh-largest amount of emissions in this inventory. Overall, this sector produced 419 metric tons of CO_2e (4.4% of total emissions). As illustrated in Figure 11 and Table 23, the source producing the most greenhouse gas emissions in the Transit Fleet sector was Natural Gas at 39.6%, followed by Diesel at 35.3%. Table 24 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Transit Fleet sector, Scope 1 Direct Emissions accounted for all CO_2e emissions.

Figure 11: Transit Fleet Emissions by Source

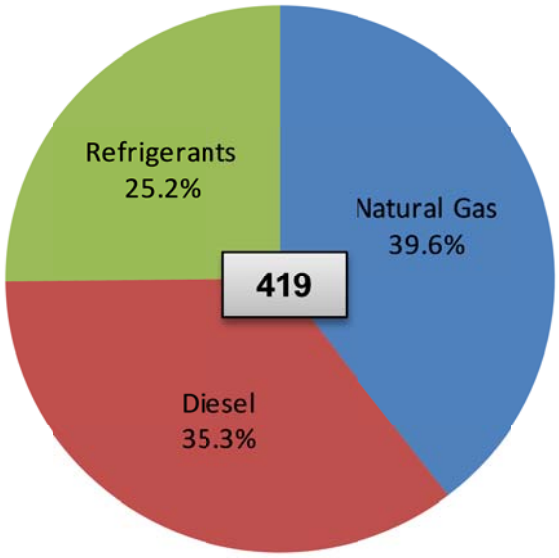


Table 23: Transit Fleet Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units
Natural Gas	166	39.6%	132,092	US gal
Diesel	148	35.3%	34,620	US gal
Refrigerants	105	25.2%	64	kg
Totals	**419**	**100%**		

Table 24: LGO Protocol Report - Transit Fleet Emissions by Scope and Emission Type

TRANSIT FLEET						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFC 134A
	Mobile Combustion	313	300	0.3	0.0	-
	Fugitive Emissions	105	-	-	-	0.1
	Total Direct Emissions	**419**	**300**	**0**	**0**	**0**

Government-Generated Solid Waste

Many local government operations generate solid waste, much of which is eventually sent to a landfill. Typical sources of waste in local government operations include paper and food waste from offices and facilities, construction waste from capital improvement projects, and plant debris from public works departments. Organic materials in government-generated solid waste (including paper, food scraps, plant debris, textiles, wood waste, etc.) generate methane as they decay in the anaerobic environment of a landfill. Emissions from the waste sector are an estimate of methane generation that will result from the anaerobic decomposition of all organic waste sent to landfill in the base year. It is important to note that although these emissions are attributed to the inventory year in which the waste is generated, the emissions themselves will occur over the 100+ year timeframe that the waste will decompose.

The Solid Waste sector produced the eighth-largest amount of emissions in this inventory. Overall, this sector produced 57 metric tons of CO_2e (0.6% of total emissions). Unfortunately, data were not sufficient to determine departmental shares of waste generation. The data were, however, divided into three groups by the City of Tracy Finance Department: City Buildings, Can Service, and City Parks. The City Buildings classification accounts for refuse bins associated with daily operation of City-owned buildings, whereas Cans Service refers to collections from permanent, City-owned cans that line the streets of Tracy. City Parks reports the waste collected at park facilities. According to this division, the group producing the largest share of emissions from solid waste was City Buildings at 66.7%. Can Service at various other City facilities accounted for 32.6% of emissions, while waste from City Parks accounted for less than one percent of emissions. Table 26 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Government-Generated Waste sector, all emissions were reported as Scope 3.

Figure 12: Government Waste Emissions by Subsector

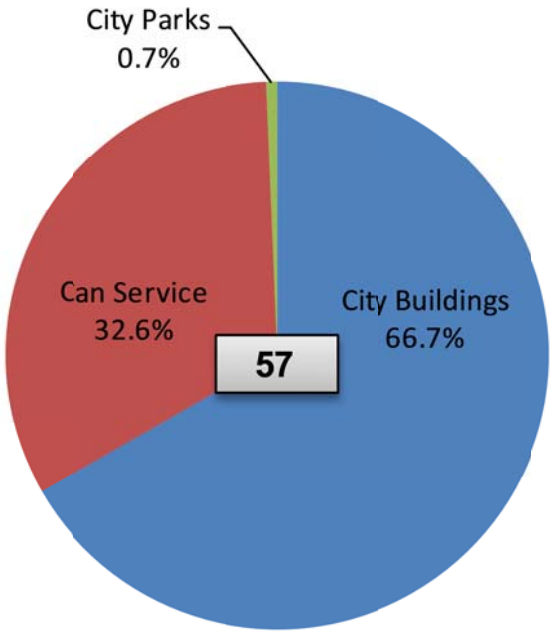


Table 25: Government Waste Emissions by Subsector

Department	metric tons CO_2e	Waste (short tons)
City Buildings	38	151
Can Service	19	74
City Parks	0.4	1
Totals	**57**	**226**

Table 26: LGO Protocol Report - Government Waste Emissions by Scope and Emission Type

SOLID WASTE GENERATION		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Waste All Facilities	57

Employee Commute

Emissions in the Employee Commute sector are due to combustion of fuels in vehicles used by government employees for commuting to work at the City of Tracy. Results from a survey designed by ICLEI and administered by the City of Tracy are shown below. Current full-time City staff members were surveyed and 105 responses were collected, resulting in a sample of approximately 20.7% of employees at 2010 staff levels. The response rate from current employees, 21.2%, was the highest response rate for any recent survey administered at the City of Tracy.

The Employee Commute sector produced the fourth-largest amount of emissions in this inventory. Overall, this sector produced 1,461 metric tons of CO_2e (15.2% of total emissions). Table 27 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Employee Commute sector, all emissions were reported as Scope 3.

Table 27: LGO Protocol Report - Employee Commute Emissions by Scope and Emission Type

EMPLOYEE COMMUTE		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Mobile Combustion	1,461

Inventory Methodologies

ICLEI's Clean Air & Climate Protection Software (CACP 2009) software made it possible to calculate greenhouse gas emissions for the following greenhouse gases: Carbon Dioxide, Methane, Nitrous Oxide, Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexafluoride. Activity data were collected for a number of operations through a number of methods. Activity data were stored in Master Data Workbook (MDWB). The MDWB serves as a tool for organizing and conditioning data, and in some cases, calculating emissions. Data collection methods range from LGO Protocol-recommended, to LGO Protocol-alternative and non-LGO Protocol (but ICLEI-approved) alternatives. The methods used depend on the availability and format of data. Inputting activity data into CACP 2009, along with the correct emission factor, resulted in the calculation of greenhouse gas emissions for the City of Tracy's 2010 government operations.

Buildings and Other Facilities

The Building and Facilities sector of the inventory reports emission from four main sources: electricity, natural gas, backup power generators and refrigerants/fire suppressants. The required data were obtained from the local government departments and regional utility providers. The utility company that services City of Tracy government facilities is Pacific Gas and Electric (PG&E), which provides natural gas and electricity service. The data were acquired per request and approval from the City of Tracy and PG&E. The data were received in the following formats:

- PG&E electricity data – Excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by individual account
- PG&E natural gas data – Excel spreadsheet indicating therms of consumption and cost by individual account

The data were inserted into the corresponding section within the MDWB raw data tabs. The data were then sorted and conditioned in order to use the recommended method for reporting emissions.

Buildings and Other Facilities: Electricity and Natural Gas Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to electricity consumption and natural gas combustion is summing the total number of kWh or therms (Activity Data) and multiplying the Activity Data by a corresponding emission factor. Emission factors are values that are reported by the utility company and are stored within CACP software.

Summed Activity (kWh/therm) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled FA-Utility Raw Data (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled FA-Utility Working Data in the MDWB to be sorted. The data were sorted within the *FA-Utility Working Data* spreadsheet to isolate building facilities kWh and therm usage; premise type, account numbers, addresses, and service descriptions are categories used to sort the data.

Once sorted, the data were copied to the *Building Working Data* spreadsheet, where it was separated into the different building facilities. The kWh and therms were then summed per individual facility. The values per facility and grand total are reported in the *Building Final Data* spreadsheet.

After the *Building Final Data* spreadsheet was populated with all of the facilities and their kWh/therm usage, the information was entered into CACP. According to LGO protocol, inventory of kWh emissions for the Building and Facilities sector is reported as Scope 2-purchased electricity while the inventory of therm emission is reported as Scope 1-stationary combustion. A separate record is entered into CACP per facility's kWh and therm usage to ensure the entry is reported under the correct Scope and with the correct emissions factor.

Buildings and Other Facilities: Refrigerant and Fire Suppressant Emissions

In addition to emissions from electricity and natural gas, leaked refrigerants associated with heating, air conditioning and refrigeration units should be reported in this sector. Leaked fire suppressants should be reported likewise. According to LGO protocol, the recommended method for reporting emissions from leaked refrigerants and fire suppressants is the mass balance method where HFC's that have escaped into the atmosphere are summed and then multiplied by the emissions factor, as in the following formula:

Net leaked HFCs (kg) x Emissions Factor = GHG Emissions

This method requires records for any refrigerant recharges, AC system installations, or AC system disposals, as well as suppressant recharges, purchases or disposals, to be acquired. During the course of this inventory, however, these records were not obtained.

- Facility refrigerants – Data not obtained. *See Reporting Inconsistencies below.*
- Fire suppressants – Data not obtained. *See Reporting Inconsistencies below.*

The raw data should be inserted into the spreadsheet labeled *RF-Raw Data* and then copied to the spreadsheet labeled *RF-FA Working Data* in the MDWB (raw data must be kept without conditioning as a quality-control reference) to be sorted by refrigerant type. Once sorted and conditioned, data can then be entered into the *RF-FA Mass Balance Data* spreadsheet where the total amount of leaked refrigerants and fire suppressants will be reflected.

After the *RF-FA Mass Balance Data* spreadsheet is populated with all of the Refrigerants and their corresponding mass leaked, the information can be entered into CACP. According to LGO protocol, inventory of Refrigerant emissions for

the Building and Facilities sector is reported as Scope 1-fugitive emissions. A separate record is entered into CACP per leaked Refrigerant mass to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each refrigerant).

Buildings and Other Facilities: Backup Power Generators

In addition to emissions from the above activities, emissions from stationary combustion of fuels in backup power generators for facilities should be reported in this sector. According to LGO protocol, the recommended method for reporting emissions from stationary combustion of fuels is summing the total quantity of fuels consumed by type (Activity Data) and multiplying the Activity Data by a default emissions factor (pre-set in CACP) corresponding to the type of fuel:

Summed Activity (quantity of fuel) x Emissions Factor = GHG Emissions

This method requires records for fuel consumption by individual generators to be acquired. In this case, records were obtained from logbooks kept by Public Works. City of Tracy staff maintained a log sheet of operation time for each generator throughout the 2010 calendar year. To obtain data for the volume of fuel consumed, the operation times were multiplied against a given or averaged fuel consumption rate:

Operation Time x Fuel Consumption Rate = Generator fuel consumption

The fuel consumption should then be multiplied by an emissions factor to determine emissions:

Generator fuel consumption x Emissions Factor = GHG Emissions

The raw data should be inserted into the spreadsheet labeled FA-Other Fuel Raw Data and then copied to the spreadsheet labeled RF-FA Working Data in the MDWB (raw data must be kept without conditioning as a quality-control reference) to be sorted by facility and fuel type. Once sorted and conditioned, data can then be entered into the Buildings and Facilities Final Data spreadsheet where the total amount of fuel and cost are reported, corresponding to the facility where the unit is located.

After the *Buildings and Facilities Final Data* spreadsheet is populated, the information can be entered into CACP. According to LGO protocol, inventory of generator fuel emissions for the Building and Facilities sector is reported as Scope 1-stationary combustion. A separate record is entered into CACP to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each refrigerant).

Buildings and Other Facilities: Reporting Inconsistencies and Limitations

During the course of conducting this inventory, some approaches strayed from the LGO protocol's recommended methods; however, alternative approaches were used in an attempt to align with the protocol's alternative methods and to generate the highest quality inventory possible.

The West High School swimming pool complex was operated by both West High School (75%) and the City of Tracy (25%) through a memorandum of understanding (MOU). The complex includes a competition swimming pool (approximately 20 x 50 meters), a 960 square foot restroom facility and a 960 square foot office/storage facility. Since the swimming pool complex shares a single electricity meter with several other West High facilities, it was not possible to identify the actual electricity consumed by these facilities. Instead, proxy data was used to estimate energy consumption, and was based on the energy consumption at another City of Tracy pool and facility on Lowell Avenue.

In determining fuel consumption for backup generators, the necessary fuel consumption rates were unavailable for a majority of the generators. An average fuel consumption rate was calculated for use with those generators without a recorded fuel consumption rate. This allowed a fuel consumption value to be calculated for all backup generators. Additionally, no values for cost were available in the records. However, backup generators account for only 1.2% of all Building and Facility CO_2e emissions, so these approaches are not expected to have notable impacts on cost and emissions information reported for this sector.

Facility refrigerants and fire suppressants were omitted from the inventory due to unavailability of data. Thus, emissions in this sector may be slightly underestimated.

Streetlights, Traffic Signals, and Other Public Lighting

The Lighting sector of the inventory reports emission from one main source: electricity. The required data were obtained from the local government departments and regional utility providers. The utility company that services the City of Tracy's lighting is PG&E, which provides electricity service.

The data were acquired per request and approval from both the City of Tracy and PG&E. The data were received in the following format: PG&E electricity data – Excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by individual account.

The data were inserted into the corresponding section within the MDWB raw data tabs. The data were then sorted and conditioned in order to use the recommended method for reporting emissions.

Public Lighting: Electricity Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to electricity consumption is summing the total number of kWh (Activity Data) and multiplying the Activity Data by a corresponding emission factor. Emission factors are values that are reported by the utility company and are stored within CACP software.

Summed Activity (kWh) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled *FA-Utility Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *FA-Utility Working Data* in the MDWB to be sorted. The data were sorted within the *FA-Utility Working Data* spreadsheet to isolate lighting activity (kWh); premise type, account numbers, addresses, and service descriptions are categories used to sort the data.

Once sorted, the data were copied to the *Public Lighting Working Data* spreadsheet to be separated into the different subsectors (traffic signals, streetlights, park lights, and other outdoor lighting). The kWh data were then summed per individual facility. The values per facility and grand total are reported in the *Public Lighting Final Data* spreadsheet.

After the *Public Lighting Final Data* spreadsheet was populated with all of the subsectors and their kWh usage, the information was entered into CACP. According to LGO protocol, inventory of kWh emissions for the Public Lighting sector is reported as Scope 2-purchased electricity. A separate record is entered into CACP per subsector's kWh usage to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each utility provider).

Water Transport Facilities

The Water Transport sector of the inventory reports emission from two main sources: electricity and natural gas. This sector of the inventory consisted of electricity and limited natural gas consumption for the operation of sprinkler systems, lift stations, and well pumps associated with non-waste water transport. The required data were obtained from the local government departments and regional utility providers. The utility company that services the City of Tracy's water transport infrastructure is PG&E, which provides natural gas and electricity services.

The data were acquired per request and approval from both the City of Tracy and PG&E. The data were received in the following formats:

- PG&E electricity data – Excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by individual account
- PG&E natural gas data – Excel spreadsheet indicating therms of consumption and cost by individual account

The data were inserted into the corresponding section within the MDWB raw data tabs. The data were then sorted and conditioned in order to use the recommended method for reporting emissions.

Water Transport Facilities: Electricity Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to electricity consumption and natural gas combustion is summing the total number of kWh or therms (Activity Data) and multiplying the Activity Data by a corresponding emission factor. Emission factors are values that are reported by the utility company and are stored within CACP software.

Summed Activity (kWh/therms) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled *FA-Utility Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *FA-Utility Working Data* in the MDWB to be sorted. The data were sorted within the *FA-Utility Working Data* spreadsheet to isolate lighting activity (kWh); premise type, account numbers, addresses, and service descriptions are categories used to sort the data.

Once sorted, the data were copied to the *Water Transport Working Data* spreadsheet to be separated into the different subsectors (water delivery pumps, sprinklers/irrigation, storm water, and others). The kWh and therms were then summed per individual facility. The values per facility and grand total are reported in the *Water Transport Final Data* spreadsheet.

After the *Water Transport Final Data* spreadsheet was populated with all of the subsectors and their kWh usage, the information was entered into CACP. According to LGO protocol, inventory of kWh emissions for the Water Transport sector is reported as Scope 2-purchased electricity. A separate record is entered into CACP per subsector's kWh usage to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each utility provider).

Wastewater Treatment Facilities

The Wastewater Treatment Facilities sector of the inventory reports emission from three main sources: electricity, natural gas, and wastewater processes. This sector of the inventory consisted of electricity and limited natural gas consumption for the operation of treatment facilities, wastewater pumps, and wastewater lift stations. In addition, emissions from the City's wastewater treatment facility, including an anaerobic digester, were also reported in this sector of the inventory. The required data were obtained from the City's Wastewater Treatment Division and regional utility providers. The utility company that services the City of Tracy's wastewater treatment infrastructure is PG&E, which provides natural gas and electricity services.

The data were acquired per request and approval from both the City of Tracy and PG&E. The data were received in the following formats:

- PG&E electricity data – Excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by individual account
- PG&E natural gas data – Excel spreadsheet indicating therms of consumption and cost by individual account

The data were inserted into the corresponding section within the MDWB raw data tabs. The data were then sorted and conditioned in order to use the recommended method for reporting emissions.

Wastewater Treatment Facilities: Electricity and Natural Gas Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to electricity consumption and natural gas combustion is summing the total number of kWh or therms (Activity Data) and multiplying the Activity Data by a corresponding emission factor. Emission factors are values that are reported by the utility company and are stored within CACP software.

Summed Activity (kWh/therms) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled *FA-Utility Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *FA-Utility Working Data* in the MDWB to be sorted. The data were sorted within the *FA-Utility Working Data* spreadsheet to isolate the wastewater facility kWh and therm usage as well as wastewater transport kWh; premise type, account numbers, addresses, and service descriptions are categories used to sort the data.

Once sorted, the data were copied to the *WW-Energy Use Working Data* spreadsheet, where they were separated into the different facilities. The kWh and therms were then summed per individual facility. The values per facility and grand total are reflected in the *WW-Energy Use Final Data* spreadsheet.

After the *WW-Energy Use Final Data* spreadsheet was populated with all of the facilities and their kWh/therm usage, the information was entered into CACP. According to LGO protocol, inventory of kWh emissions for the Wastewater Treatment Facilities sector is reported as Scope 2-purchased electricity, the inventory of therm emission is reported as Scope 1-stationary combustion, and the inventory of wastewater treatment is reported as Scope 1-process emissions. A separate record is entered into CACP per facility's kWh and therm usage to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each utility provider).

Wastewater Treatment Facilities: Wastewater Treatment Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to wastewater treatment processes is to obtain site-specific measurements and apply a standard equation (below) based on the type of treatment system in place. The alternative method is to utilize population estimates, which applies a standard per-capita emissions rate. In 2010, the City of Tracy maintained a centralized treatment facility with an anaerobic digester.

As outlined in LGO protocol Equations 10.7 and 10.9 below, quantifying emissions from centralized treatment facilities requires collection of the following data: quantity of nitrogen produced per day, and population served by the treatment facility. The nitrification/denitrification process creates N_2O, which is emitted into the atmosphere. Emissions are calculated using the following formulas, which are built into the MDWB.

Figure 13: LGO Protocol Equation 10.7 - Process N_2O Emissions from WWTP with Nitrification/Denitrification[5]

Annual N_2O emissions (metric tons CO_2e) = ((P_{total} x $F_{ind\text{-}com}$) x EF nit/denit x 10^{-6}) x GWP

Where:

TERM		DESCRIPTION	VALUE
P_{total}	=	total population that is served by the centralized WWTP adjusted for industrial discharge, if applicable [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
EF nit/denit	=	emission factor for a WWTP with nitrification/denitrification [g N_2O/person/year]	7
10^{-6}	=	conversion from g to metric ton [metric ton/g]	10^{-6}
GWP	=	N_2O Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009).

Figure 14: LGO Protocol Equation 10.9 - Process N_2O Emissions from Effluent Discharge (site-specific N load data) [6]

Annual N_2O emissions (metric tons CO_2e) = (N Load x EF effluent x 365.25 x 10^{-3} x 44/28) x GWP

Where:

TERM		DESCRIPTION	VALUE
N Load	=	measured average total nitrogen discharged [kg N/day]	user input
EF effluent	=	emission factor [kg N_2O-N/kg sewage-N produced]	0.005
365.25	=	conversion factor [day/year]	365.25
10^{-3}	=	conversion from kg to metric ton [metric ton/kg]	10^{-3}
44/28	=	molecular weight ratio of N_2O to N_2	1.57
GWP	=	Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009).

As outlined in LGO protocol Equation 10.1 below, quantifying emissions from anaerobic digesters requires collection of the following data: quantity of digester gas produced per day and fraction of digester gas as CH_4. The anaerobic digestion process creates CH_4, which is captured and combusted. Due to minimal destruction inefficiencies, some gases escape the system. Emissions from digester gas are calculated using the following formula, which is built into the MDWB.

Figure 15: LGO Protocol Equation 10.1 - Stationary CH_4 from Incomplete Combustion of Digester Gas (site-specific digester gas data)[7]

Annual CH_4 emissions (metric tons CO_2e) = (Digester Gas x F_{CH_4} x $\varrho(CH_4)$ x (1-DE) x 0.0283 x 365.25 x 10^{-6}) x GWP

Where:

ITEM	DESCRIPTION	VALUE

[5] Source: *Local Government Operations Protocol*, Version 1.1 (May 2010) p. 114
[6] Source: *Local Government Operations Protocol*, Version 1.1 (May 2010) p. 115
[7] Source: *Local Government Operations Protocol*, Version 1.1 (May 2010) p. 109

Digester Gas	=	measured standard cubic feet of digester gas produced per day [ft^3/day]	user input
F CH_4	=	measured fraction of CH_4 in biogas	user input
p(CH_4)	=	density of methane at standard conditions [g/m^3]	662.00
DE	=	CH_4 Destruction Efficiency	.99
0.0283	=	conversion from ft^3 to m^3 [m^3/ft^3]	0.0283
365.25	=	conversion factor [day/year]	365.25
10^{-6}	=	conversion from g to metric ton [metric ton/g]	10^{-6}
GWP	=	Global Warming Potential	21

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-7 (2009).

Airport Facilities

The Airport Facilities sector of the inventory reports emission from two main sources: electricity, and natural gas. The required data were obtained from the local government departments and regional utility providers. The utility company that services the City of Tracy's airport facilities is PG&E, which provides natural gas and electricity services.

The data were acquired per request and approval from both the City of Tracy and PG&E. The data were received in the following formats:

- PG&E electricity data – Excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by individual account
- PG&E natural gas data – Excel spreadsheet indicating therms of consumption and cost by individual account

The data were inserted into the corresponding section within the MDWB raw data tabs. The data were then sorted and conditioned in order to use the recommended method for reporting emissions.

Airport Facilities: Electricity and Natural Gas Related Emissions

According to the LGO protocol, the recommended method for reporting emissions related to electricity consumption and natural gas combustion is summing the total number of kWh or therms (Activity Data) and multiplying the Activity Data by a corresponding emission factor. Emission factors are values that are reported by the utility company and are stored within CACP software.

Summed Activity (kWh/therms) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled *FA-Utility Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *FA-Utility Working Data* in the MDWB to be sorted. The data were sorted within the *FA-Utility Working Data* spreadsheet to isolate airport facilities kWh and therm usage; premise type, account numbers, addresses, and service descriptions are categories used to sort the data.

Once sorted, the data were copied to the *Airport Working Data* spreadsheet, where it was separated into the different building facilities. The kWh and therms were then summed per individual facility. The values per facility and grand total are reflected in the *Airport Final Data* spreadsheet.

After the *Airport Final Data* spreadsheet was populated with all of the facilities and their kWh/therm usage, the information was entered into CACP. According to LGO protocol, inventory of kWh emissions for the Building and Facilities sector is reported as Scope 2-purchased electricity while the inventory of therm emission is reported as Scope 1-stationary combustion. A separate record is entered into CACP per facility's kWh and therm usage to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each utility provider).

Vehicle Fleet and Mobile Equipment

The Vehicle Fleet sector of the inventory reports emission from two main sources: fuel combustion and refrigerants. The recommended method for reporting vehicle related emission varies according to the emission source. For fuels, the recommended method requires individual vehicle fuel data in order to build a detailed fuel consumption record. Incomplete combustion of fuels is also estimated, which requires gathering individual vehicle miles travelled (VMT) and descriptive vehicle information. Finally, refrigerant data must be obtained similar to the methods employed in the Buildings and Facilities sector. Data records were acquired through the Fleet Services division in the following format:

- Detailed fuel consumption records by vehicle/equipment number, including fuel type, quantity and cost
- Detailed vehicle records by vehicle/equipment number, including VMT and/or operating hours for the inventory year, department assignment, model, make, and year
- Aggregate refrigerant purchases per year by refrigerant type

Vehicle Fleet and Mobile Equipment: Fuel and VMT Related Emissions

According to LGO protocol, the emission from vehicle fleet must be reported according to CO_2 emissions, calculated directly from fuel combustion, and according to N_2O/ CH_4 emissions, calculated from VMT.

- Fuel (gallons) x Emissions Factor = CO_2 Emissions
- VMT (miles) x Emissions Factor = N_2O/ CH_4 Emissions

The raw data were inserted into the spreadsheet labeled *TRANSIT-Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *TRANSIT-Working Data* in the MDWB to be sorted by:

- Department
- Vehicle type
- Fuel type

Once sorted and conditioned, data can then be entered into the *TRANSIT-Detailed Fuel Final Data* and *TRANSIT-Detailed VMT Final Data* spreadsheets where the total amount fuel and VMT will be reflected per department and vehicle type.

After the *TRANSIT-Detailed Fuel Final Data* and *TRANSIT-Detailed VMT Final Data* spreadsheets were populated, the information was entered into CACP. According to LGO protocol, inventory of fuel and VMT emissions for the Vehicle Fleet sector is reported as Scope 1-mobile combustion. A separate record is entered into CACP per department to ensure the records are entered as follows:

- Fuel related emissions:
  - Fuel type
  - Vehicle type
  - Model year
  - Fuel CO_2 coefficient - *Default*
  - Transport Average - *Highway Fuel* CO_2 *only*
- VMT related emissions:
  - Fuel type
  - Vehicle type
  - Model year
  - Fuel CO_2 coefficient - *Highway VMT* N_2O, CH_4, *and CAP*
  - Transport Average - *Default* for VMT emissions.

Vehicle Fleet and Mobile Equipment: Refrigerant Related Emissions

This sector of the inventory required refrigerant charge information. For leaked refrigerants, the recommended method requires individual data per vehicle on the amount of refrigerant recharged into the vehicle. In the event that there is not sufficient information to complete the recommended method, alternative methods can be used to calculate the amount of leaked refrigerants. In this inventory, aggregate refrigerant purchases were used as an indicator of the amount of refrigerant recharged into vehicles throughout the year.

According to LGO protocol, the recommended method for reporting emissions from leaked refrigerants is the mass balance method where HFC's that have escaped into the atmosphere are summed and then multiplied by the emissions factor, as in the following formula:

Total purchased HFCs (kg) x Emissions Factor = GHG Emissions

A simplified version of the mass balance method was used in this sector of the inventory, with purchased refrigerants serving as a proxy measure of leaked refrigerants.

The raw data were inserted into the spreadsheet labeled *RF-Raw Data* and then copied to the spreadsheet labeled *RF-TRANSIT Working Data* in the MDWB (raw data must be kept without conditioning as a quality-control reference) to be sorted by refrigerant type. Once sorted and conditioned, the data were then entered into the *RF-TRANSIT Mass Balance Data* spreadsheet.

Once the *RF-TRANSIT Mass Balance Data* spreadsheet was populated, the information was entered into CACP. According to LGO protocol, inventory of refrigerant emissions for the Vehicle Fleet sector is reported as Scope 1-fugitive emissions. A separate record is entered into CACP per leaked refrigerant mass to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each refrigerant).

Certain refrigerant types which are categorized as ozone-depleting chemicals by international protocols, but not the LGO Protocol, have been included in the inventory as Information Items only. The most commonly used of these chemicals are R-12, R-22, and Halons (HCFCs), all of which have substantial emissions factors . Emissions from ozone-depleting chemicals are not included in the inventory as they are being phased out under an internationally accepted agreement called the Montreal Protocol. Thus, R-12 emissions from vehicle refrigerant systems were not accounted for in Scope 1-fugitive emissions.

Vehicle Fleet and Mobile Equipment: Reporting Inconsistencies and Limitations

Scope 1 emissions from mobile equipment may not be completely accurate because of the way fuel use is monitored. City of Tracy staff use "Miscellaneous Cards" to obtain fuel for the various pieces of mobile equipment. There is no way of determining how the fuel is distributed to equipment. For this inventory, a single aggregate number was used to estimate fuel consumption and calculate CO2 emissions by mobile equipment.

Scope 3 emissions from fuel combustion by employees during business travel were omitted from the inventory due to unavailability of data. Quantifying emissions from business travel requires identifying fuel consumption and fuel economy by vehicle. Travel-related reimbursements often include parking, air fare, food and hotel charges, which cannot be reliably separated from mileage reimbursements unless records are itemized.

Transit Fleet

The Transit Fleet sector of the inventory reports emission from two main sources: fuel combustion and refrigerants. The recommended method for reporting transit vehicle related emission varies according to the emission source. For fuels, the recommended method requires individual transit vehicle fuel data in order to build a detailed fuel consumption record. Incomplete combustion of fuels is also estimated, which requires gathering individual transit vehicle miles travelled (VMT) and descriptive transit vehicle information. Finally, refrigerant data must be obtained similar to the methods employed in the Buildings and Facilities sector. Data records were acquired through the Fleet Services division in the following format:

- Detailed fuel consumption records by transit vehicle/equipment number, including fuel type, quantity and cost
- Detailed transit vehicle records by transit vehicle/equipment number, including VMT and/or operating hours for the inventory year, department assignment, model, make, and year
- Aggregate refrigerant purchases per year by refrigerant type

Transit Fleet: Fuel and VMT Related Emissions

According to LGO protocol, the emission from transit fleet must be reported according to CO_2 emissions, calculated directly from fuel combustion, and N_2O/ CH_4 emissions, calculated from VMT.

- Fuel (gallons) x Emissions Factor = CO_2 Emissions
- VMT (miles) x Emissions Factor = N_2O/ CH_4 Emissions

The raw data were inserted into the spreadsheet labeled *TRANSIT-Raw Data* (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled *TRANSIT-Working Data* in the MDWB to be sorted by;

I. Department
II. Transit vehicle type
III. Fuel type

Once sorted and conditioned, data can then be entered into the *TRANSIT-Detailed Fuel Final Data* and *TRANSIT-Detailed VMT Final Data* spreadsheets where the total amount fuel and VMT will be reflected per department and vehicle type.

After the *TRANSIT-Detailed Fuel Final Data* and *TRANSIT-Detailed VMT Final Data* spreadsheets were populated, the information was entered into CACP. According to LGO protocol, inventory of fuel and VMT emissions for the Transit Fleet sector is reported as Scope 1-mobile combustion. A separate record is entered into CACP per department making sure that the records are entered as follows:

- Fuel related emissions:
  - Fuel type
  - Transit vehicle type
  - Model year
  - Fuel CO_2 coefficient - *Default*
  - Transport Average - *Highway Fuel* CO_2 *only*
- VMT related emissions:
  - Fuel type
  - Transit vehicle type
  - Model year
  - Fuel CO_2 coefficient - *Highway VMT* N_2O, CH_4, *and CAP*
  - Transport Average - *Default* for VMT emissions.

Transit Fleet and Mobile Equipment: Refrigerant Related Emissions

This sector of the inventory required refrigerant charge information. For leaked refrigerants, the recommended method requires individual data per transit vehicle on the amount (lbs or kg) of refrigerant recharged into the transit vehicle. In the event that there is not sufficient information to complete the recommended method, alternative methods can be used to calculate the amount of leaked refrigerants. In this inventory, aggregate refrigerant purchases were used as an

indicator of the amount of refrigerant recharged into transit vehicles throughout the year. According to the Fleet Services division, a recycling unit is used to service vehicles; some refrigerant is recycled, and some new refrigerant is added.

According to LGO protocol, the recommended method for reporting emissions from leaked refrigerants is the mass balance method where HFC's that have escaped into the atmosphere are summed and then multiplied by the emissions factor. A simplified version of the mass balance method was used in this sector of the inventory, with purchased refrigerants serving as a proxy measure of leaked refrigerants, as in the following formula:

Total purchased HFCs (kg) x Emissions Factor = GHG Emissions

The raw data were inserted into the spreadsheet labeled *RF-Raw Data* and then copied to the spreadsheet labeled *RF-TRANSIT Working Data* in the MDWB (raw data must be kept without conditioning as a quality-control reference) to be sorted by refrigerant type. Once sorted and conditioned, the data were then entered into the *RF-TRANSIT Mass Balance Data* spreadsheet.

Once the *RF-TRANSIT Mass Balance Data* spreadsheet was populated, the information was entered into CACP. According to LGO protocol, inventory of refrigerant emissions for the Transit Fleet sector is reported as Scope 1-fugitive emissions. A separate record is entered into CACP per leaked refrigerant mass to ensure the entry is reported under the correct Scope and with the correct emissions factor (differs for each refrigerant).

Certain refrigerant types which are categorized as ozone-depleting chemicals by international protocols, but not the LGO Protocol, have been included in the inventory as Information Items only. The most commonly used of these chemicals are R-12, R-22, and Halons (HCFCs), all of which have substantial emissions factors. Emissions from ozone-depleting chemicals are not included in the inventory as they are being phased out under an internationally accepted agreement called the Montreal Protocol. Thus, R-12 emissions from transit vehicle refrigerant systems were not accounted for in Scope 1-fugitive emissions.

Transit Fleet: Reporting Inconsistencies and Limitations

Data for natural gas fuel consumption were obtained for the transit vehicle fleet. However, the units associated with the data seemed inconsistent with typical units for fuel consumption. To avoid relying on potentially unreliable data, an alternative method for determining natural gas consumption was applied. The same values used for Transit Fleet VMT were to be used for calculating natural gas consumption emissions. With CACP, it is possible to modify coefficient conditions such that emissions from VMT and fuel consumption can both be derived from one point of data.

Government-Generated Solid Waste

The Government-Generated Solid Waste sector of the inventory reports emission from one main source: solid waste. This sector of the inventory requires data pertaining to the amount of waste collected from City operations.

Government-Generated Solid Waste: Solid Waste Related Emissions

According to LGO protocol, the recommended method for reporting emissions associated with solid waste is to acquire the volume of waste collected per department within the local government operations. This information was entered into the *WG-Solid Waste by Volume* spreadsheet. The volumes are converted to tons of waste that are ultimately sent to landfill. The totals were then inserted into the *WG-Solid Waste Final Input Data* spreadsheet and used to create a record within CACP. The government-generated waste was entered into CACP as Scope 3 – waste related emissions. The following waste characterization[8] is preset in CACP with different emissions factors for each waste type:

- Paper Products – 39.4%
- Food Waste – 9.8%
- Plant Debris – 7.0%
- Wood and Textiles – 6.7%
- All other waste – 27.1%

Government-Generated Solid Waste: Reporting Inconsistencies and Limitations

Aggregated government-generated solid waste data was obtained for this inventory. The only details associated with the data were designations of general pickup vicinity: Can Service, City Parks, and City Buildings. Departmental data was unavailable.

Employee Commute

The Employee Commute sector of the inventory reports emission from two main sources: fuel combustion and VMT. This sector of the inventory utilized a survey to assess VMT and fuel data. The employees were surveyed on their work commute time, distance, vehicle type, fuel consumption and fuel type. The survey was posted online, and results were automatically recorded in an exportable spreadsheet format.

Employee Commute: Fuel and VMT Related Emissions

Employee commute data were acquired through an online survey of current employees' commute habits. Survey results were automatically recorded to an exportable spreadsheet, and then entered into a separate spreadsheet, formatted to produce summary data compatible with the *EC-Emissions Final Data* spreadsheet of MDWB. Annual fuel consumption,

[8] Default Waste Characterization provided by the CIWMB 1999 Waste Characterization Study -- Public Administration Group: http://www.ciwmb.ca.gov/WasteChar/BizGrpCp.asp. Waste categories in the report were bundled to fit the waste categories of the Clean Air and Climate Protection 2009 software (CACP 2009).

mileage and descriptive vehicle information responses were conditioned to calculate fuel consumption and VMT by vehicle and fuel type. All calculated values were reported in the *EC-Emissions Final Data* spreadsheet.

The results of current employee responses were used as a sample of total employees' commute habits. Annual fuel consumption and VMT were extrapolated to 2010 employee levels using the ratio of responses to 2010 staff-levels (approximately 1:4.8).

The adjusted VMT for each fuel type was entered into CACP as Scope 3 – employee commute. The Total VMT value was entered with the transport average set coefficients set to Default and the fuel set coefficients set to Highway VMT (N_2O, CH_4). The Total Fuel value was entered into CACP as Scope 3 – employee commute. For this data, the transport average set coefficients were set to Highway Fuel CO_2 Only and the fuel set coefficients were set to Default. Ultimately, emissions were reported in aggregate as to avoid mischaracterizing the true profile of employee vehicles in the inventory year, which was unknown at the time of this inventory.

Employee Commute: Reporting Inconsistencies and Limitations

The City of Tracy opted to use the truncated form of the Employee Commute Survey to determine GHG emissions from employee commute. While this survey requires employees to report on commute time, distance, vehicle type, fuel consumption and fuel type it does not include questions to determine behavior choices – as the regular ICLEI survey does. As a result, summary statistics regarding commute choices are not included in this inventory.

The emissions reported in this sector are derived from a sample of approximately 105 current employees, which is a 21% response rate assuming the 2010 staffing level. The calculations rely on commute trends extrapolated from this sample, rather than all employees.

Appendix

I – Project Resources

ICLEI created various tools for the City of Tracy to use to assist with greenhouse gas emissions inventories. These tools are designed to work in conjunction with LGO Protocol, which is the primary reference document for conducting an emissions inventory. The following tools should be saved as resources and supplemental information to this report:

- The "Master Data Workbook", an Excel-based tool that contains most or all of the raw data (including emails), data sources, emissions, notes on inclusions and exclusions, and reporting tools
- The "Data Gathering Instructions", an instructions guide on the types of emissions and data collection methodology for each inventory sector.
- The "Quality Control Checklist for Master Data Workbook", a checklist which provides a list of items to review in the Master Data Workbook to ensure information was entered correctly.
- The "CACP 2009 Data Entry Instructions", an instructions guide on how to enter data collected in the Master Data Workbook into the Clean Air and Climate Protection Software (CACP 2009), ICLEI's greenhouse gas emissions calculator.
- The CACP 2009 "Backup" files, a group of files which contain the calculations of emissions based on inputs from the Master Data Workbook into CACP 2009. The CACP 2009 software is required to open the Backup files.
- The "Checklist for Reviewing the Government Analysis Inputs/Outputs, Details Export" a checklist which provides a list of items to review in this CACP 2009 export file to ensure information was entered correctly.
- CACP 2009 "Government Analysis Inputs/Outputs, Summary with Notes Export", an Excel-based export file which contains a summary report of all calculated emissions, with explanatory notes included.
- CACP 2009 "Government Analysis Inputs/Outputs, Details Export", an Excel-based export file which contains a detailed report of all calculated emissions.
- The "Completing the Inventory Report", an instructions guide from ICLEI on how to report greenhouse gas emissions according to the LGO Protocol.
- The "Charts and Tables Data Conditioning Sheet", an Excel-based tool created by ICLEI and completed by the author to aid in creating the charts and tables within the Master Data Workbook.
- A presentation with slides completed by the author to summarize findings from the greenhouse gas inventory
- Access to an online account for staff to access PG&E energy and greenhouse gas emission data for the jurisdiction: http://greencommunities.pge-smartrate.com/user