City of Manteca

2005 Government Operations

Greenhouse Gas Emissions Inventory

Narrative Report

Supported by Pacific Gas and Electric Company
In Collaboration with Great Valley Center and
ICLEI-Local Governments for Sustainability USA

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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.

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Table of Contents

List of Tables and Figures

Executive Summary

City of Manteca Profile

The City of Manteca covers over 20 square miles and ranges from Interstate 5 to Highway 99, 60 miles east of San Francisco in the San Joaquin Valley. The City of Manteca had an estimated population of 60,598 on Jan. 1, 2005 and 61,926 on Jan. 1, 2006. With 340 city employees in the year 2005, there was a ratio of approximately 5.5 employees per one thousand residents. The City of Manteca's General Fund budget was approximately $27 million in 2005.

City of Manteca is located within Climate Zone 12,[1] according to the U.S. Department of Energy. Climate Zone 12 is classified as a Mediterranean climate, by the Köppen Classification System, and is characterized by cool, wet winters and warmer, dry summers. The City of Manteca experiences a climate similar to the Stockton area, which recorded 2,841 heating degree days[2] and 1,328 cooling degree days in 2005.[3]

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 City of Manteca. The inventory measures the greenhouse gas emissions resulting specifically from City of Manteca'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 Manteca 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. By

[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] Heating and Cooling Degree Days are a measurement designed to reflect demand for energy needed to heat or cool a facility, and are calculated as the difference between the average daily temperature for a region and a baseline temperature (usually 65° or 80° F). HDD value is the summation of degrees of the average temperature per day below 65° F for the year. CDD is the summation of degrees of the average temperature per day above 80° F for the year.

[3] NNDC Climate Data, retrieved from http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp

striving to save taxpayer money through efficient government operations, City of Manteca is working to improve government services in a smart and targeted way that will benefit all of the City's residents.

City of Manteca recognizes that climate change resulting from the greenhouse gas emissions of human activities is a reality. 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, City of Manteca is acting now to limit future impacts that threaten the lives and property of Manteca's residents and businesses, make government operations more efficient, and improve the level of service it offers to the residents of Manteca.

Inventory Results

The following figures summarize the results of the LGO greenhouse gas emissions inventory for the City of Manteca. Table 1 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 the City's total emissions. As illustrated in Figure 1 and Table 2, the sector producing the most greenhouse gas emissions in the City of Manteca is the Vehicle Fleet sector at 32.2%, followed by the Wastewater Facilities sector at 23.7%. As shown in Figure 2 and Table 3, Electricity and Gasoline are the sources with the greatest percentage of emissions (45.9% and 26.6% respectively).

Table 1: LGO Protocol Report - Overall Emissions by Scope

Total Emissions[4] (Metric Tons)					
	CO_2e	CO_2	CH_4	N_2O	HFC-134
SCOPE 1	2,929	2,491	5	1.0	0.0
SCOPE 2	3,361	3,333	0.2	0.1	-
SCOPE 3	1,032	956	2.4	0.1	-

For more detail on the concepts of scopes, sources, and sectors, and to review more granular data produced through the inventory study, please refer to the full report on the following pages.

[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 1: 2005 Government Operations CO_2e Emissions by Sector

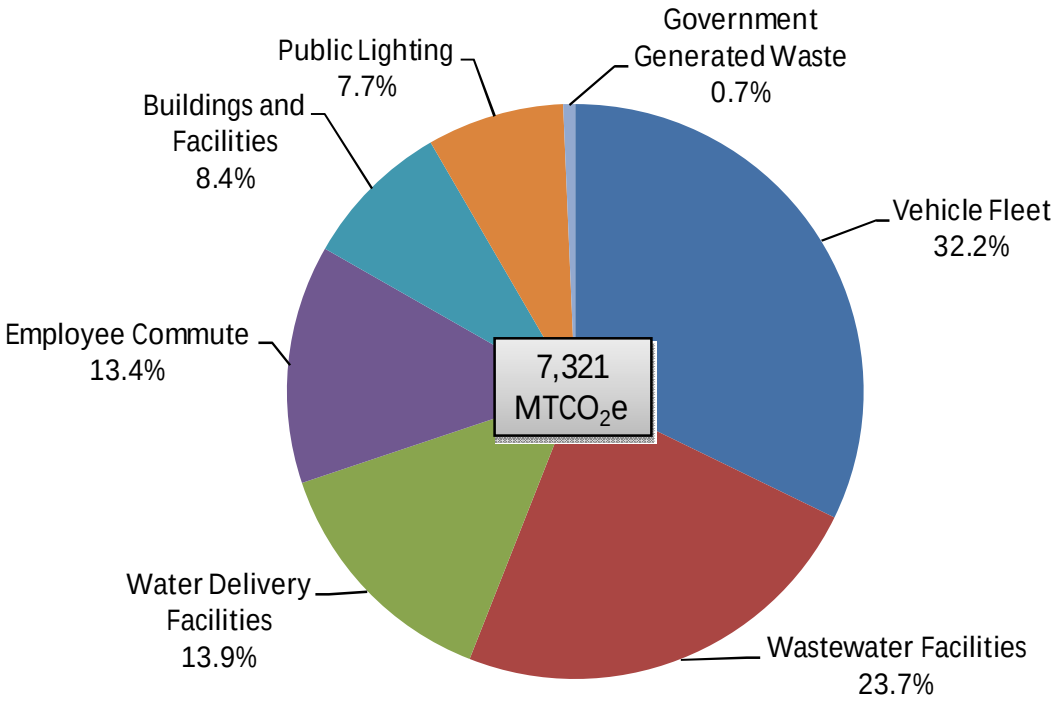


Table 2: 2005 Government Operations CO_2e Emissions by Sector

Sector	metric tons CO_2e	% of Sector Emissions	Cost ($)
Vehicle Fleet	2,358	32.2%	591,944
Wastewater Facilities	1,738	23.7%	637,410
Water Delivery Facilities	1,017	13.9%	561,141
Employee Commute	983	13.4%	-
Buildings and Facilities	613	8.4%	325,926
Public Lighting	564	7.7%	276,290
Government Generated Waste	49	0.7%	8,412
Totals	**7,321**	**100%**	**$2,401,123**

Figure 2: 2005 Government Operations CO_2e Emissions by Source

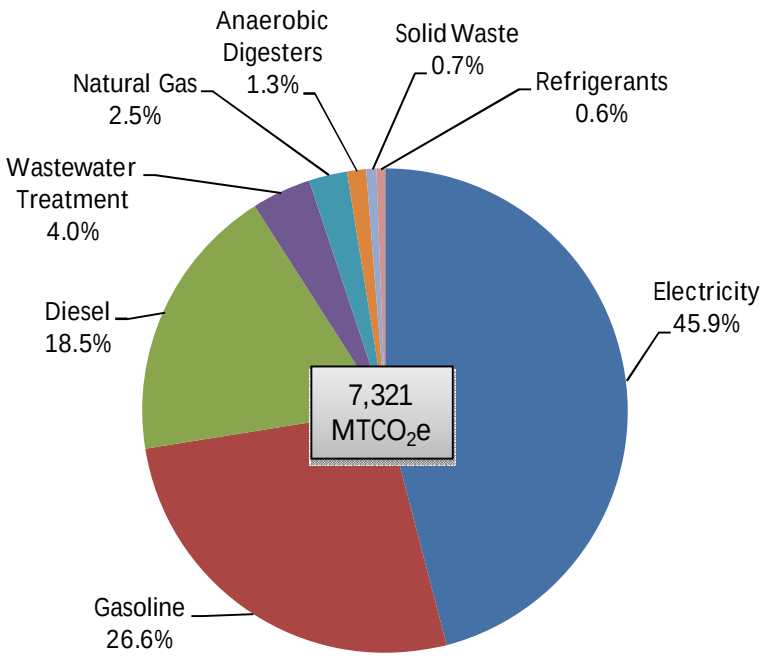


Table 3: 2005 Government Operations CO_2e Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units	Cost ($)
Electricity	3,361	45.9%	15,023,038	kWh	1,756,361
Gasoline	1,947	26.6%	217,484	US Gallons	293,813
Diesel	1,353	18.5%	132,433	US Gallons	298,131
Wastewater Treatment	289	4.0%	1	Metric Tons N2O	-
Natural Gas	186	2.5%	35,004	Therms	44,406
Anaerobic Digesters	95	1.3%	5	Metric Tons CH4	-
Solid Waste	49	0.7%	210	Short Tons	8,412
Refrigerants	41	0.6%	41	kg	-
Totals	**7,321**	**100%**			**$ 2,401,123**

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 jurisdiction.
- 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 City of Manteca 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 Tracy. 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.

Climate Change Mitigation Activities in City of Manteca

The City of Manteca has already begun the process of emissions mitigation within City operations, which is also intended to result in higher energy efficiency and, therefore, savings. The City is currently developing a Climate Action Plan as part of the Smart Valley Places program. Prior to that, in 2010, the City adopted an updated Housing Element within the General Plan. This update triggered requirements for the City to update the Land Use, Conservation, and Safety Elements to address flood risk management, flood hazards, ground water recharge and storm water management. The City intends to expand on these requirements to include policies and programs that promote Smart Growth Principles.

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 all six internationally recognized greenhouse gases regulated under the Kyoto Protocol (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 4 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 4: 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 5 provides examples of common emissions calculations.

Table 5: 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 6: 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 jurisdiction.

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, the following emissions fell under the significance threshold and were reported using best available methods:

- Scope 1 fugitive emissions from the leakage of refrigerants from vehicles

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 1 CO_2, CH_4 and N_2O emissions from mobile fuel combustion in vehicle fleet and 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 3 CO_2, CH_4 and N_2O emissions from combustion of fuel by employees for business-travel

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 City of Manteca'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.

Inventory Results

Emissions Total

In 2005, City of Manteca's greenhouse gas emissions from government operations totaled 7,321 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 Manteca'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.

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. 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.

City of Manteca operates several facilities, ranging from general City offices to parks and community resource centers. For the purpose of reporting emissions, these facilities were grouped by department when possible. Data relating to natural gas and electricity consumption were obtained from PG&E. Data relating to backup generators and fuel consumption were obtained from aggregated fuel reports provided by the City.

The Buildings and Facilities sector produced the fifth-largest amount of emissions by sector. Overall, these facilities produced 613 metric tons of CO_2e (8.4% of total emissions). As illustrated in Figure 3 and Table 7, the facility group producing the most greenhouse gas emissions in the City of Manteca was the City Hall Campus at 29.1%. The second largest contributor was the Public Works facility group at 15.6%. As illustrated in Figure 4 and Table 8, the source producing the most greenhouse gas emissions in the Buildings and Facilities sector was electricity at 74.1%, followed by natural gas at 25.9%. The top five largest individual contributors to emissions from the Buildings and Facilities sector

have been ranked in Table 9 below. Table 10 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Buildings and Facilities sector, Scope 2 Indirect Emissions accounted for a majority of the CO_2e emissions.

Figure 3: Buildings and Other Facilities Emissions by Operation

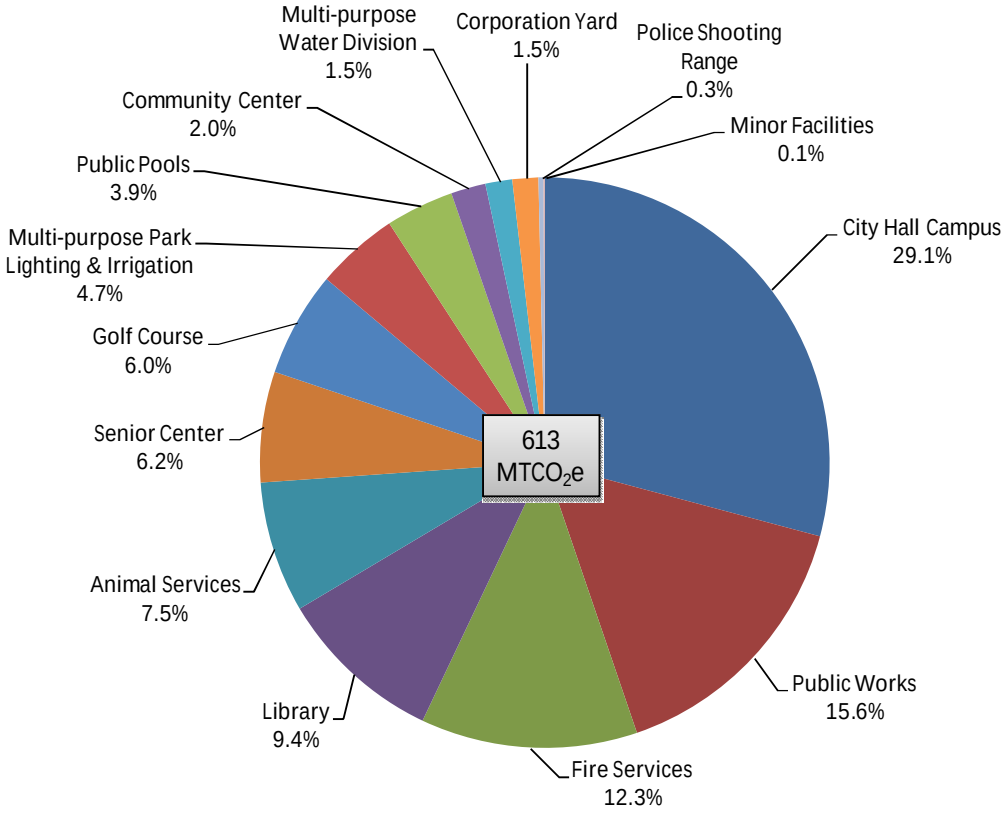


Table 7: Buildings and Other Facilities Emissions by Operation

Operation	metric tons CO_2e	% of Sector Emissions	Cost ($)
City Hall Campus	178	29.1%	101,862
Public Works	96	15.6%	55,060
Fire Services	75	12.3%	35,817
Library	58	9.4%	30,251
Animal Services	46	7.5%	17,034
Senior Center	38	6.2%	18,470
Golf Course	37	6.0%	23,044
Multi-purpose Park Lighting & Irrigation	29	4.7%	20,789
Public Pools	24	3.9%	9,594
Community Center	12	2.0%	3,011
Multi-purpose Water Division	9	1.5%	4,042
Corporation Yard	9	1.5%	5,249
Police Shooting Range	2	0.3%	1,314
Minor Facilities	0.4	0.1%	389
Totals	**613**	**100%**	**$ 325,926**

Figure 4: Buildings and Other Facilities Emissions by Source

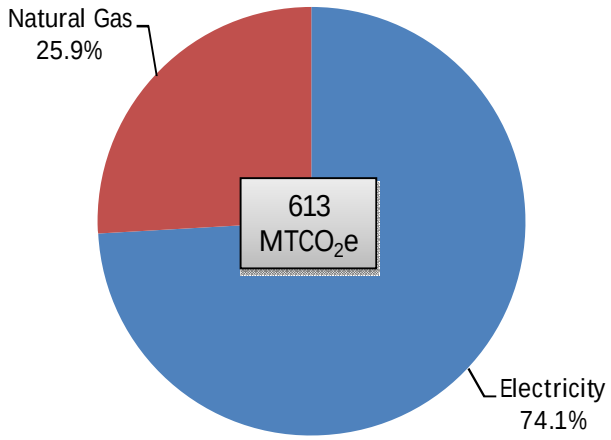


Table 8: Buildings and Other Facilities Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Quantity	Units	Cost ($)
Electricity	454	74.1%	2,028,656	kWh	288,421
Natural Gas	159	25.9%	29,854	Therms	37,505
Totals	**613**	**100%**			**$ 325,926**

Table 9: 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
City Hall Campus	36%	4%	162	16	**178**
Public Works	19%	2%	88	8	**96**
Fire Services	9%	8%	40	36	**75**
Library	9%	4%	41	17	**58**
Animal Services	3%	7%	14	32	**46**
Totals	**76%**	**24%**	**344**	**109**	**453**

Table 10: 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	159	158	0.0	0.0
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	454	450	0.0	0.0

Streetlights, Traffic Signals, and Other Public Lighting

Like most local governments, the City of Manteca operates a range of public lighting including streetlights, park lighting and traffic signals. The majority of emissions associated with the operation of this infrastructure are due to electricity consumption. Data relating to electricity consumption for public lighting were obtained from PG&E. This sector of the inventory does not include those park lights which could not be disaggregated from multipurpose park lighting and irrigation, which is quantified in the buildings and facilities sector.

The Public Lighting sector produced the sixth-largest amount of emissions of all sectors. Overall, these facilities produced 564 metric tons of CO_2e (7.7% of total emissions). As illustrated in Figure 5 and Table 11, the subsector producing the most greenhouse gas emissions in the Public Lighting sector is Streetlights at 89.7%, followed by Traffic Signals/Controllers at 5.9%. Table 12 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Public Lighting sector, Scope 2 Indirect Emissions accounted for all CO_2e emissions.

Figure 5: Public Lighting Emissions by Subsector

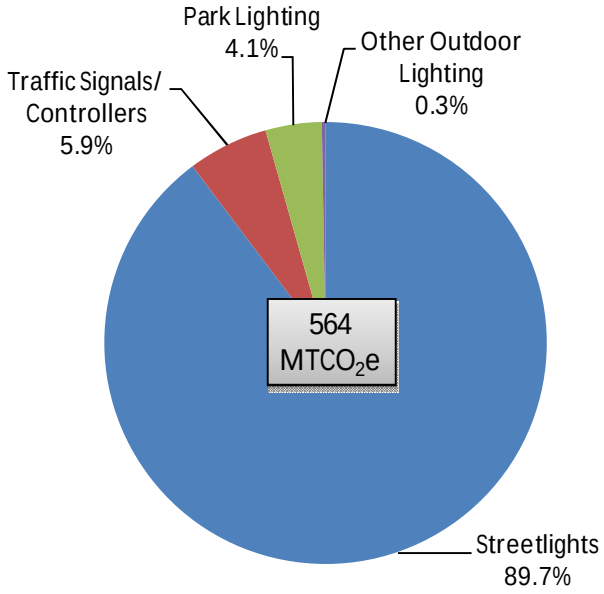


Table 11: Public Lighting Emissions by Subsector

Subsector (Light Type)	metric tons CO_2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Streetlights	506	89.7%	2,260,504	238,648
Traffic Signals / Controllers	33	5.9%	148,093	23,131
Park Lighting	23	4.1%	103,258	13,293
Other Outdoor Lighting	2	0.3%	7,060	1,218
Totals	**564**	**100%**	**2,518,915**	**$ 276,290**

Table 12: LGO Protocol Report – Public Lighting Emissions by Scope and Emission Type

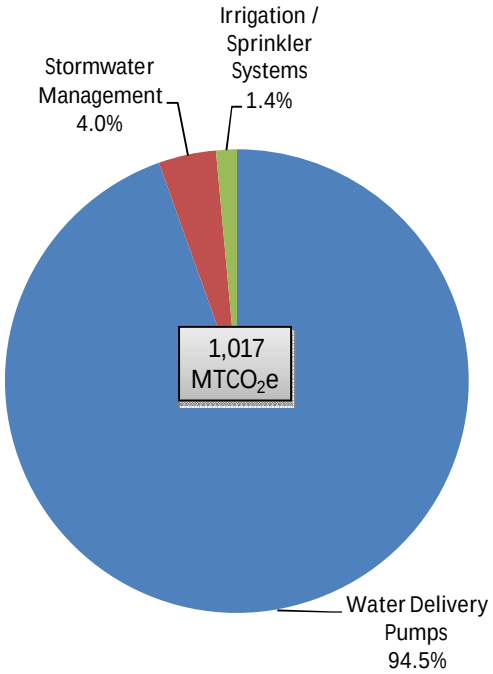
STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	564	559	0.0	0.0

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 Manteca operates a range of water transport equipment, including 16 potable water wells that pump groundwater to residences and businesses at a maximum capacity of 25,010 gallons per minute[5]. The City also operates stormwater management and sprinkler/irrigation systems. Electricity consumption is a significant source of greenhouse gas emissions from the operation of the City of Manteca's water transport equipment. Data relating to electricity consumption were obtained from PG&E.

The Water Delivery sector produced the third-largest amount of emissions overall, with 1,017 metric tons of CO_2e (13.9% of total emissions). As illustrated in Figure 6 and Table 13, the subsector producing the most greenhouse gas emissions in the Water Transport sector is Water Delivery Pumps at 94.5%, followed by Storm Water Management at 4.0% and Irrigation/Sprinkler Systems at 1.4%. Table 14 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 6: Water Delivery Facilities Emissions by Subsector



[5] According to the 2008 Municipal Service Review, available at http://www.co.san-joaquin.ca.us/lafco/municipal_service_reviews_adopte.htm

Table 13: Water Delivery Facilities Emissions by Subsector

Subsector (Equipment Type)	metric tons CO_2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Water Delivery Pumps	962	94.5%	4,298,442	516,426
Stormwater Management	41	4.0%	183,865	31,707
Irrigation / Sprinkler Systems	14	1.4%	64,616	12,893
Totals	**1,017**	**100%**	**4,546,923**	**$ 561,026**

Table 14: 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	1,017	1,009	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 significant sources of greenhouse gas emissions from the operation of wastewater treatment facilities. Data relating to electricity consumption was obtained from PG&E.

The City of Manteca has operated the wastewater treatment plant on Airport Way since 1959, with its inception as a main facility with an oxidation pond.[6] It has undergone 3 major improvement projects, the most recent in 2001, bringing the facility to its current capacity of 9.87 million gallons per day. In 2005, these facilities served approximately 86,000 people, including the residents and businesses located in Manteca, Lathrop, and Raymus Village, which is outside of city limits.

The Wastewater Treatment sector produced the second-largest amount of emissions in this inventory. Overall, these facilities produced 1,738 metric tons of CO_2e (23.7% of total emissions). As illustrated in Figure 7 and Table 15, the subsector producing the most greenhouse gas emissions in the Wastewater Treatment sector is the Wastewater Treatment Facility at 76.3%, followed by Process Emissions at 17.6%. Table 16 reports emissions by scope and

[6] 2008 Municipal Service Review, available at http://www.co.san-joaquin.ca.us/lafco/municipal_service_reviews_adopte.htm

emission type, as recommended by the LGO Protocol. In the Wastewater Treatment sector, Scope 2 Indirect Emissions accounted for a majority of CO_2e emissions.

Figure 7: Wastewater Treatment Facilities Emissions by Subsector

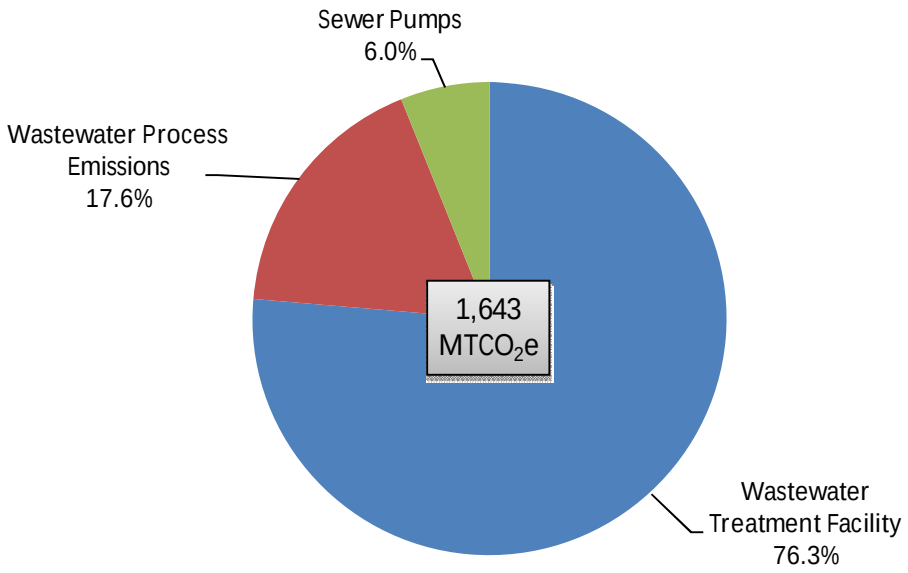


Table 15: Wastewater Treatment Facilities Emissions by Subsector

Subsector	metric tons CO_2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)	Natural Gas Use (kWh)	Cost ($)
Wastewater Treatment Facility	1,254	72.2%	5,607,166	588,203	-	-
Wastewater Process Emissions	289	22.1%	-	-	-	-
Sewer Pumps	99	5.7%	321,378	42,421	5,150	6,786
Totals	**1,643**	**100%**	**5,928,544**	**$ 630,624**	**5,150**	**$ 6,786**

Table 16: 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	27	27	0.0	0.0
	Process Emissions	289	-	-	0.9
	Total Direct Emissions	**317**	**27**	**0**	**1**
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	1,326	1,315	0.1	0.0

Vehicle Fleet and Mobile Equipment

The vehicles and mobile equipment used in the City of Manteca's daily operations include: heavy duty trucks responding to emergency fire calls and for city waste collection; heavy and light trucks used for landscape and maintenance tasks; passenger cars, light trucks, and sport utility vehicles (SUVs) driven on a variety of site visits, including building inspections; among others. Most vehicles consume gasoline, some consume diesel, and each results in greenhouse gas emissions. Gasoline and diesel-powered maintenance equipment contributes 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 was used. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle.

In 2005, City of Manteca operated a vehicle fleet with approximately 285 vehicles and 60 pieces of equipment. The largest concentration of vehicles in the fleet is dedicated to the Police Department with 29.8%, followed by the Parks and Solid Waste Departments each with approximately 14.2% of the fleet. Other vehicles were used by the Fire Department and Administration.

The Vehicle Fleet sector produced the largest amount of emissions in this inventory. Overall, this sector produced 2358 metric tons of CO_2e (32.2% of total emissions). As illustrated in Figure 8 and Table 17, the source producing the most greenhouse gas emissions in the Vehicle Fleet sector was Diesel at 53.0%, followed by Gasoline at 45.3%. Table 18 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 8: Vehicle Fleet Emissions by Source

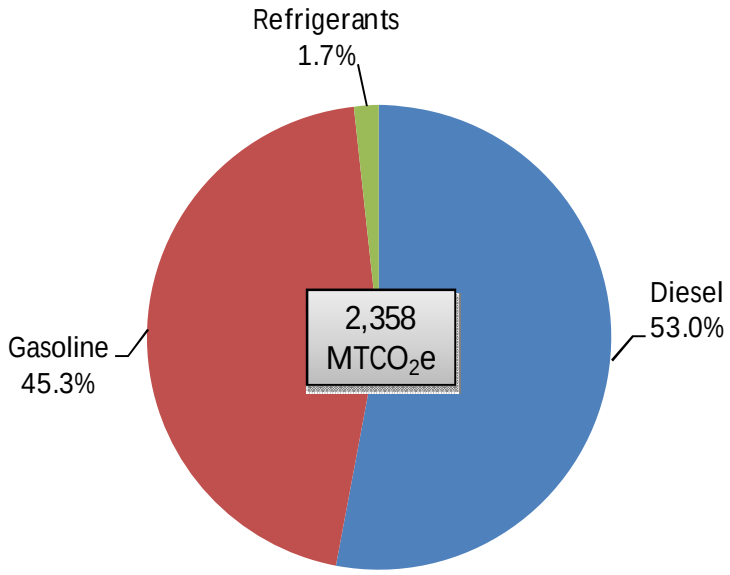


Table 17: Vehicle Fleet Emissions by Source

Source	metric tons CO_2e	% of Sector Emissions	Consumption Quantity	Consumption Units	Cost ($)
Diesel	1,249	53.0%	122,235	Gallons	298,131
Gasoline	1,068	45.3%	120,461	Gallons	293,813
Refrigerants	41	1.8%	41	kg	-
Totals	**2,358**	**100%**			**$ 591,944**

Table 18: 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	2,317	2,306	0.0	0.0	-
	Fugitive Emissions	41	-	-	-	0.0
	Total Direct Emissions	**2,358**	**2,306**	**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 public works, and plant debris from parks 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 City of Manteca manages its own Solid Waste Fleet that collects waste from government facilities, private businesses, and residents within the city limits. The collected waste is then deposited in a county facility located outside of city limits.

The Solid Waste sector produced the smallest amount of emissions in this inventory. Overall, this sector produced 49 metric tons of CO_2e (0.7% of total emissions). As illustrated in Figure 9 and Table 19, the department contributing the most solid waste was the Wastewater Treatment group at 32.6%. Parks facilities contributed to 19.2% of waste, followed by the Solid Waste division, Fire Services and City Hall, each contributing 12.1% of total waste. Table 20 reports emissions by scope and emission type, as recommended by the LGO Protocol. In the Solid Waste sector, all emissions were reported as Scope 3.

Figure 9: Government Waste Emissions by Department

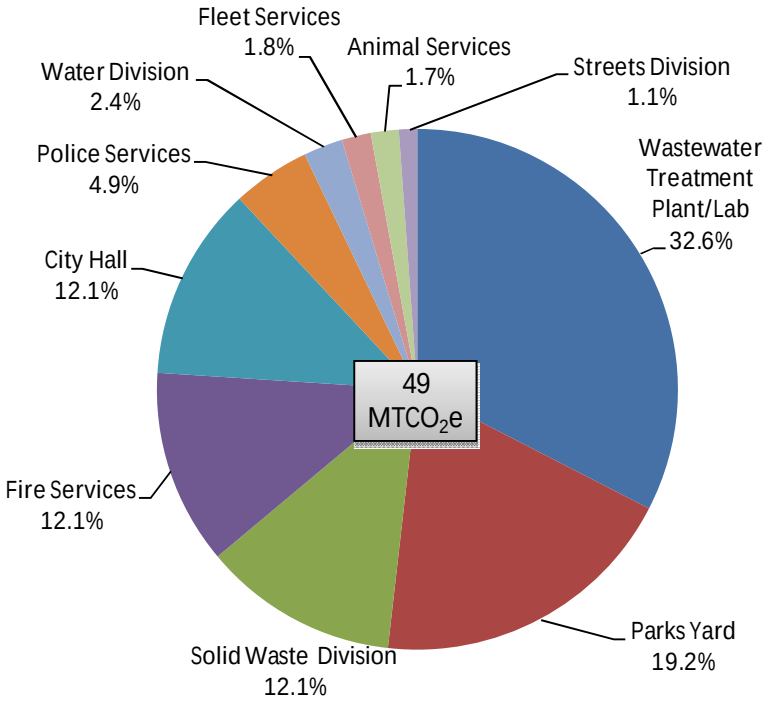


Table 19: Government Waste Emissions by Department

Department	metric tons CO_2e	% of Sector Emissions	Solid Waste (short tons)	Cost ($)
Wastewater Treatment Plant/Lab	16	32.6%	62	2,496
Parks Yard	9.3	19.2%	56	2,220
Solid Waste Division	5.9	12.1%	23	928
Fire Services	5.9	12.1%	23	928
City Hall	5.9	12.1%	23	924
Police Services	2.4	4.9%	9	372
Water Division	1.2	2.4%	5	184
Fleet Services	0.9	1.8%	4	140
Animal Services	0.8	1.7%	3	132
Streets Division	0.6	1.1%	2	88
Totals	**49**	**100%**	**210**	**$ 8,412**

Table 20: 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	49
INDICATORS		
	Short tons of solid waste	210

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 Manteca. Results from a survey designed by ICLEI and administered by the City of Manteca are shown below. Current full-time City staff members were surveyed and 94 responses were collected, resulting in a sample of approximately 28% of employees at 2005 staff levels. The survey was used to collect the data needed to calculate emissions and also capture other information that will help the City of Manteca set effective policy addressing this sector.

The Employee Commute sector produced the fourth-largest amount of emissions in this inventory. Overall, this sector produced 983 metric tons of CO_2e (13.4% of total emissions). Table 21 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. Tables 22 through 27 present summary information from preference-based questions included in the survey. This information is intended to inform the City of Manteca about potential transportation options to increase convenience and productivity while reducing the City's impact on the environment.

Table 21: 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	983

Table 22: Employee Commute - Reasons for Not Carpooling Data

Reason	Percentage
Other people do not match my schedule or route	47%
Work late or irregular hours	47%
Need to make stops on the way to work or home	43%
Dislike being dependent on others	39%
May not be able to get home quickly in an emergency	37%
Like the privacy when I'm in my own car	27%
Difficult to find others to carpool/vanpool	14%
Makes my trip too long	10%
Other	9%
Need my car on the job	6%
Never considered carpooling or vanpooling	3%
I don't know enough about carpooling or vanpooling	2%

Table 23: Employee Commute - Reasons for Not Taking Transit

Reason	Percentage
Transit service doesn't match my route or schedule	68%
Need to make stops on the way to work or home	34%
It takes too long	33%
May not be able to get home quickly during an emergency	33%
I work late or irregular hours	31%
Like the privacy when I'm in my own car	18%
Other	14%
It is not safe or easy to walk to work from the transit stop	11%
It is too far to walk to work from the transit stop	6%
Need my car on the job	6%
Never considered using public transit	6%
I don't know enough about taking transit	3%
It costs too much	2%
Not enough parking at the transit stop from which I'd depart	0%

Table 24: Employee Commute - Reasons for Not Walking/Biking

Reason	Percentage
I live too far away	60%
Weather	37%
May not be able to get home quickly in an emergency	29%
There isn't a safe or easy route for walking or biking	25%
Need to make stops on the way to work or home	23%
It's not easy to look good and feel comfortable for work after walking or biking	20%
Workplace does not have adequate facilities for showering/changing	15%
Other	12%
Never considered walking or biking to work	6%
No place at work to store bikes safely	2%
I don't know enough about walking or biking to work	0%

Table 25: Employee Commute - Travel Mode Data

Mode	Percentage
Drive Alone	86%
Split Modes	7%
Carpooling/Vanpooling	3%
Walking	2%
Public Transportation	0%
Bicycling	0%
Telecommute/Other	0%

Table 26: Employee Commute - Miles from Work Data

Miles	Percentage
0-5	40%
6-10	9%
11-15	13%
15-20	9%
21-25	10%
26-30	8%
31-35	2%
36-40	2%
41-45	1%
46-50	2%
51-75	3%
76-100	1%
Over 100	0%

Table 27: Employee Commute - Time to Work Data

Time (Minutes)	Percentage
Less than 5	19%
6 to 15	30%
16 to 25	23%
26 to 35	10%
36 to 45	11%
Over 45	7%

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 was collected for a number of operations through a number of methods. Activity data was stored in Master Data Workbook (MDWB), which 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 Manteca's 2005 government operations.

Buildings and Other Facilities

The Building and Facilities sector of the inventory reports emission from two main sources: electricity and natural gas. The required data was obtained from the local government departments and regional utility providers. The utility company that services the City of Manteca's government facilities is:

- Pacific Gas and Electric (PG&E) – natural gas and electricity service

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

- PG&E electricity data was provided in an excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by service address
- PG&E natural gas data was provided in an excel spreadsheet indicating therms of consumption and cost by service address

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 Emission

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 (differs for each utility provider).

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 Global Warming Potential (GWP) factor.

- Net leaked HFCs (kg) x GWP 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, records regarding facility refrigerants not be obtained, and fire suppressants were omitted due to limited activity.

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

The raw data collected 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 GWP 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 the 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. During the course of this inventory, however, these records could not be separated from aggregated fuels reported in the Vehicle Fleet sector.

- Generator fuel consumption – Data included in Vehicle Fleet sector. See Reporting Inconsistencies below.

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 GWP factor (differs for each refrigerant).

Buildings and Other Facilities: Reporting Inconsistencies and Limitations

Electricity and natural gas data was conditioned according to the LGO protocol with some minor inconsistencies. While sorting the data to clearly identify the electricity and natural gas used per facility, there were some facilities that had unclear descriptions as to their sector or function. Therefore, some assumptions were made:

A "Multi-purpose: Park Lighting and Irrigation" category was created to place services at 1282 Laurel Park Circle and 710 E Woodward Road, as it was not possible to determine whether these accounts referred to park lighting,

sprinkler/irrigation systems, or both. Thus, emissions in the Buildings and Facilities sector may be slightly over-counted, while emissions from the Public Lighting and Water Delivery sectors may be slightly under-counted.

Information pertaining to the leaked refrigerants was not included in this inventory due to lack of available records in the Building Maintenance and Finance Departments at the time of this inventory. It is recommended that these records be made accessible for future inventories.

Fire suppressants were intentionally omitted from the inventory. According to the City's contracted service-technicians, the City's extinguishers are inspected routinely. In the event that a leak is detected, the unit is repaired immediately. The contractor uses a recapture system that prevents leakage of suppressant into the atmosphere.

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 Manteca's lighting is:

- PG&E – electricity service

This data were acquired per request and approval from both the City of Manteca 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 recommend method for reporting emissions.

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).

Lighting: Reporting Inconsistencies and Limitations

A "Multi-purpose: Park Lighting and Irrigation" category was created in the Buildings and Facilities sector to contain account data from 1282 Laurel Park Circle and 710 E Woodward Road, as it was not possible to determine whether these accounts referred to park lighting, sprinkler/irrigation systems, or both.

Water Transport Facilities

The Water Transport sector of the inventory reports emission from one source: electricity. This sector of the inventory consisted of electricity 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 City of Manteca's water transport infrastructure is:

- PG&E – electricity service

This data were acquired per request and approval from both the City of Manteca 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 recommend 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 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) 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 each activity; 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 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).

Water Transport Facilities: Reporting Inconsistencies and Limitations

In the Water Delivery Pump subsector, there is a record for an Emergency Water Pump with only a cost for natural gas usage reported (no therms). The record remains in the MDWB Water Transport Working Data spreadsheet in the same format as provided by PG&E.

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 data from the treatment facility, wastewater pumps, and wastewater lift stations. In addition, emissions from refrigerants and emissions from wastewater treatment method are also reported in this sector of the inventory. The required data were obtained from the local government departments and regional utility providers:

- PG&E – natural gas and electricity service
- City of Manteca Wastewater Treatment Plant – facility operations

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

- PG&E electricity data was provided in an excel spreadsheet indicating kilowatt-hour (kWh) consumption and cost by service address
- Wastewater treatment data entered into MDWB worksheets by WWTP superintendent

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/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 WW-Energy Use Working Data spreadsheet, where it was separated into the different facilities. The kWh and therms were then summed per individual facility. The values per facility and grand total are reported 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 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).

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 Manteca 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 10: LGO Protocol Equation 10.7 - Process N_2O Emissions from WWTP with Nitrification/Denitrification[7]

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 11: LGO Protocol Equation 10.9 - Process N_2O Emissions from Effluent Discharge (site-specific N load data) [8]

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.

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

Figure 12: LGO Protocol Equation 10.1 - Stationary CH_4 from Incomplete Combustion of Digester Gas (site-specific digester gas data)[9]

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

Where:

TERM		DESCRIPTION	VALUE
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).

Wastewater Treatment Facilities: Reporting Inconsistencies and Limitations

Data provided for wastewater processes was a sample of 2009 data and is used as proxy for 2005 data. The City acquired new software in 2009, making data collection and storage more efficient and accurate from that point on, which should also aid in data collection for future inventories.

Vehicle Fleet and Mobile Equipment

The Vehicle Fleet sector of the inventory reports emission from two main sources: fuel combustion and vehicle miles traveled. This sector of the inventory required fuel and vehicle miles traveled (VMT) data to be acquired. The recommended method for reporting vehicle related emission varies according to the emission source. For fuel, the recommended method requires individual vehicle fuel data in order to build a detailed fuel consumption record. For VMT, the recommended method involves gathering individual vehicle miles to create a detailed record. Vehicle maintenance records and fuel purchases were provided by the Police, Public Works and Parks Departments and were in the following format:

- PDF - the Ward Equipment Report contained data including department codes, vehicle/equipment codes, vehicle type, location, and odometer readings as of December 12, 2007
- Excel spreadsheet - the Vehicle List and Mileage file contained data on vehicles including department ID numbers, vehicle type and odometer readings at maintenance intervals. Average Monthly Fuel Usage FY 2006 contained data for gallons and cost of fuels

The PDF file was converted into an Excel spreadsheet to enable conditioning of data.

[9] Source: Local Government Operations Protocol, Version 1.1 (May 2010) p. 109

Vehicle Fleet and Mobile Equipment: Fuel and VMT Related Emissions

According to the LGO protocol, emissions from vehicle 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 VF-Raw Data (raw data must be kept without conditioning as a quality-control reference) and then copied to the spreadsheet labeled VF-Working Data in the MDWB to be sorted by department, vehicle type, and fuel type. Once sorted and conditioned, the fuel consumption data were then entered into the VF-Aggregate Fuel Final Data spreadsheet where the total amount of fuel was reflected per fuel type. The VMT data were entered into the VF-VMT Final Data spreadsheet where the total amount of VMT was reflected per department, vehicle type, vehicle year, and fuel type.

After the MDWB 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. Separate records are entered into CACP to ensure the data 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

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 (lbs or kg) 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.

The raw data were inserted into the spreadsheet labeled RF-Raw Data and then copied to the spreadsheet labeled RF-VF 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-VF Mass Balance Data spreadsheet.

Once the RF-VF 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 to ensure the entry is reported under the correct Scope and with the correct GWP factor (differs for each refrigerant).

Vehicle Fleet and Mobile Equipment: Reporting Inconsistencies and Limitations

Obtaining accurate data for this sector was a challenge. Vehicle records from past years were collected and maintained by an employee who recently retired. The City now operates a new system in the Vehicle Maintenance division which tracks records, including fuel consumption and VMT, which will be of great use in future inventories.

Fuel consumption data were in aggregate form by fuel type. The LGO Protocol recommends utilizing detailed fuel data by department, vehicle type, model year and fuel type to most accurately calculate emissions. However, the use of aggregate fuel by type is an LGO protocol-approved alternative approach.

Fuel consumption data for the entire calendar year 2005 could not be obtained; however, fuel consumption records for fiscal year 2005-2006 were available and were used as proxy data in lieu of 2005 data. Fuel stored and used at the Golf Course during this same time period was added to the aggregate fuel data based on fuel cost for the golf course. The fuel type was assumed to be gasoline based on the known profile of the vehicle fleet at the time. The cost was divided by the cost per gallon reported in the Monthly Average Fuel Report, which resulted in estimated fuel quantities per fuel type. Diesel used to power back-up generators throughout the city is also included in the aggregate fuel data.

VMT data for each vehicle were estimated based on odometer readings and vehicle model years reported in the Ward Equipment Report. The LGO Protocol recommends utilizing detailed VMT recorded over the course of the inventory year. An annual average VMT estimate was calculated for each vehicle based on the vehicle's total mileage divided by the life of the vehicle (in years). These figures were used in lieu of actual VMT measures for the inventory year.

VMT data were obtained from the Ward Equipment Report, which was finalized in December of 2007. This was the earliest available document referencing the City's entire vehicle and equipment fleet. To further verify the accuracy of this proxy data, the total vehicle and equipment counts were compared between 2005 and 2007, based on a separate file provided by the City. The comparison yielded a slight increase in the vehicle fleet over time; thus, emissions reported in this sector may be slightly overestimated.

Vehicle fleet refrigerant data were obtained by the Vehicle Maintenance department supervisor as an aggregate quantity of refrigerant used for FY 2007-08, which was used as proxy data in lieu of 2005 data.

Transit Fleet

There was no transit fleet in operation by City of Manteca in 2005. However, there is currently a transit system that the city operates that should be included in future inventories.

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 required data pertaining to the amount of waste collected from city operations. The records were acquired through the City of Manteca Solid Waste Division.

Government-Generated Solid Waste: Solid Waste Related Emissions

According to the 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 were converted to tons of waste that are ultimately sent to landfill. The totals were then pasted into the WG-Solid Waste Final Input Data spreadsheet and used to create a record within CACP. The government-generated waste outputs were entered into CACP as Scope 3 – waste related emissions. The following waste characterization[10] 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

Data for this sector were easily conditioned. It was decided that trash receptacles in city parks and on downtown streets would not be calculated in this inventory because the government is not directly responsible for generating waste placed into those receptacles.

Employee Commute

The Employee Commute sector of the inventory reports emission from two main sources: fuel combustion and VMT. The recommended method for reporting vehicle related emission varies according to the emission source. For fuels, the

[10] 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).

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 VMT and descriptive vehicle information. 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, fuel type, and several reasons for not using alternative transportation like bus transit or bicycling.

Employee Commute: Fuel and VMT Related Emissions

Employee commute data were acquired through an online survey of current employees' commute habits. A survey designed by ICLEI was administered by City staff. Survey results were automatically recorded to an exportable spreadsheet, and then entered into the EC-Raw Data spreadsheet of MDWB. Annual fuel consumption by fuel type was automatically calculated within MDWB. Mileage and descriptive vehicle information responses were conditioned to calculate 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 2005 employee levels using the ratio of responses to 2005 staff-levels (approximately 1 : 3.7).

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 for each fuel type 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.