MEMO

To: Mark Kielty, Planning & Building Director
CITY OF TULARE

From: Tammy Seale

Cc: Lew Nelson, Public Works Director

Date: September 3, 2010

Re: Tulare's City Government Operations Greenhouse Gas Emissions Inventory

1. INTRODUCTION

PURPOSE

The purpose of this greenhouse gas (GHG) emissions inventory (Inventory) is to identify the major sources of GHG emissions from City government operations and provide a baseline against which future progress can be measured.[1] This Inventory supplements the community-wide inventory dated August 27, 2010. Government operations occur within the City of Tulare; therefore these government operations emissions are a subset of the community-wide inventory, meaning that all City government operations are included in the commercial/industrial, transportation, waste, or "other" categories of the community-wide inventory.[2] However, similar to the way in which businesses and factories perform their own facility-scale GHG inventories, this Inventory analyzes City emissions in more detail in order to help the City assess and identify emissions-reducing strategies for the Climate Action Plan (CAP) that responds to local emission trends and positions the City for long-term success.

Specifically, this Inventory does the following:

- Calculates GHGs from City government operations in calendar year 2006.
- Details the contribution of City government operations to overall community-wide emissions in order to identify inefficiencies and create an example for other organizations to identify their operational emissions.

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[1] In this report, the term "city" refers to the area inside the jurisdictional boundary of the City of Tulare, whereas "City government" or "City" refers to those activities which are under the operational control of City agencies. "Planning Area" refers to the area within the City's Planning Area or Urban Area Boundary that falls outside city limits.

[2] "Community-wide" or "community" refers to all activities within the city (as defined above), including those from businesses, industrial processes, residents, vehicles, and City government operations.

- Forecasts how emissions from City government operations will increase if no behavioral changes are made.

- Provides City decision-makers with adequate information to direct development of the Climate Action Plan (CAP) and establish an appropriate emissions reduction target.

This Inventory captures the major sources of greenhouse gases (GHGs) caused by City government activities within the city per best practice and International Council for Local Environmental Initiatives (ICLEI) California Air Resources Board protocol.[3] The Inventory does not include refrigerants from City government operations, facilities, and vehicles, due to a lack of data. It is estimated that the sources not included in the Inventory comprise less than 5.0% of total City emissions. As GHG inventories become more common, it is likely that methodology and accessibility to data will improve.

The emissions identified in this report are primarily GHGs that the City has directly caused and has the ability to reduce through implementation of conservation actions, a Climate Action Plan, or corresponding efforts. The Appendix provides additional summaries of government operation emissions by sector.

II. SCOPE OF THE INVENTORY IN RELATIONSHIP TO THE CLIMATE ACTION PLAN

The Inventory focuses specifically on baseline emissions from City government operations and business-as-usual forecasts for these emissions.

City government actions that have taken place since the baseline year of 2006 and that will directly reduce GHG emissions (such as upgrades to the City's wastewater treatment plant) will be accounted for in the Climate Action Plan. Crediting City government actions in the Climate Action Plan will highlight the City's leadership and efforts to date, more clearly depicting the value of the City's voluntary actions. This approach will emphasize the important role of the City in reaching targets that will be established in the CAP.

KEY TERMS AND TIMELINES

The following terms are used throughout the Inventory. These are concepts fundamental to understanding the contents of the Inventory.

- **Baseline year:** Emissions are quantified for the baseline year of 2006, due to the availability of reliable data. The 2006 baseline is also before the initiation of the majority of City actions that are anticipated to have reduced GHG emissions. This baseline year allows the City to track and observe the impact of its actions taken to date on GHG emissions and better inform future strategies.

- **Carbon dioxide equivalent (CO_2e):** The universal unit for comparing emissions of different GHGs expressed in terms of the global warming potential of one unit of carbon dioxide.

[3] California Air Resources Board 2010.

- **Greenhouse gas (GHG) emissions:** Gases that trap heat in the earth's atmosphere are called greenhouse gases, or GHGs. GHGs include carbon dioxide, methane, nitrous oxide, and fluorinated gases. While many of these gases occur naturally in the atmosphere, modern human activity has led to a steep increase in the amount of GHGs released into the atmosphere over the last 100 years. Collectively, these gases intensify the natural greenhouse effect, thus causing global average surface temperatures to rise, which in turn affects global climate patterns. GHGs are often quantified in terms of CO_2 equivalent, or CO_2e, a unit of measurement that equalizes the potency of GHGs.[4]

- **Sector:** Emissions are grouped by the type of activity that generated the emissions, such as transportation, residential energy use, commercial energy use, and more.

- **City Limits vs. Planning Area:** Throughout this memo, emissions within the city's existing geopolitical boundary are designated as emissions in "city limits," whereas all emissions within the Planning Area (including the existing geopolitical boundary) are designated as "city limits & Planning Area." Unless specifically noted, any references to the Planning Area refer to land that falls outside city limits but is within the Planning Area. This approach is necessary to distinguish between methodologies for calculating emissions within city limits and outside of city limits.

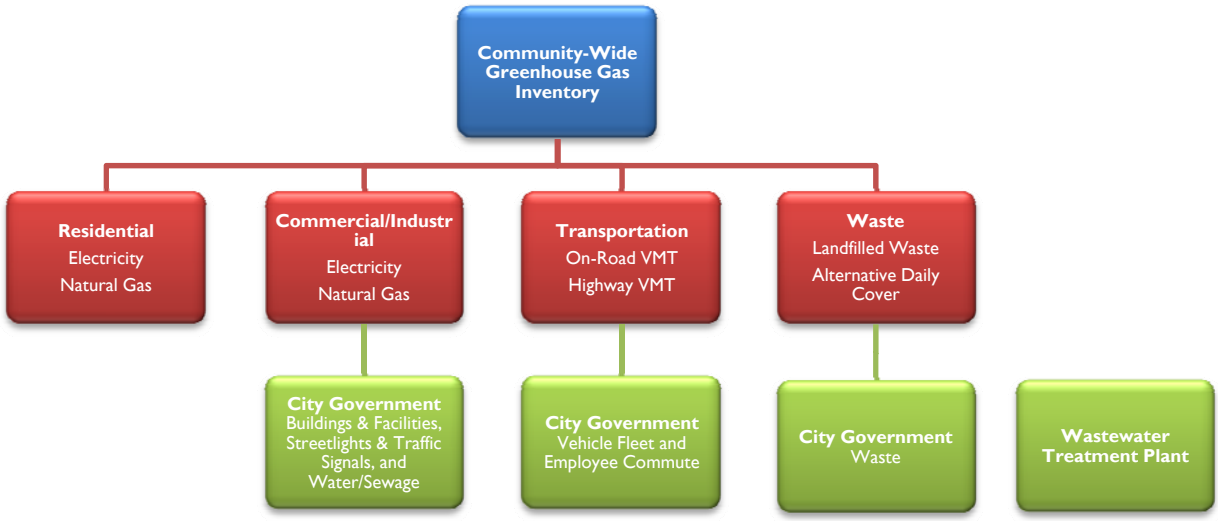
III. CITY GOVERNMENT OPERATIONS GHG INVENTORY RESULTS

Consistent with protocol established by the California Air Resources Board, this Inventory supplements the assessment of activities throughout the community providing a more detailed analysis of City government operations including streetlights, building energy use, fleet vehicles, and more.[5] The City government operations inventory was conducted consistent with the Local Government Operations Protocol developed by the California Air Resources Board (ARB), ICLEI, The Climate Registry, and the California Climate Action Registry (CCAR). City government emissions result from solid waste, energy consumption from water facilities, buildings, streetlights and other facilities, fuel consumption by the vehicle fleet, employee commutes, and the wastewater treatment plant. It is important to note that the City government operations inventory is a subset of the community-wide inventory, meaning that City government operations are generally included in the commercial/industrial, transportation, waste, or "other" categories of the community-wide inventory. However, point-source emissions such as the City's wastewater treatment plant that are accounted for in this Inventory are *excluded* from the community-wide Inventory. It is also acknowledged that some of the emissions generated by City employee commutes may have occurred outside of the City's jurisdiction. Because these emissions are the result of City actions, they are included in the City government operations inventory per standard practice and Protocol guidance. Therefore, the City's government operations inventory should not be added to the community analysis; rather it should be looked at as a slice of the complete picture as illustrated in Figure 1.

[4] Refer to the IPCC website for more information (http://www.ipcc.ch/).

5 Refer to Seale 2010.

Figure 1: Relationship Between the Community-Wide GHG Inventory and City Government Operations GHG Inventory



City government operations and facilities produced approximately 155,538 metric tons of GHG emissions in 2006. As displayed in Figure 2, this amount represents approximately 18.3% of total emissions in city limits and the Planning Area. However, note that this percentage is purely for illustrative purposes of scale and results only when total City emissions and community-wide emissions are aggregated. Process-based emissions from the wastewater treatment plant are not included in the community-wide Inventory and therefore do not actually represent a percentage of community-wide emissions.[6] When emissions from the wastewater treatment plant are excluded from the comparison, City government emissions contribute approximately 4.6% of community-wide emissions.

[6] Process-based wastewater treatment plant emissions are not included in the community-wide Inventory; therefore, assessing City government operation emissions as a percentage of community-wide emissions is inaccurate when wastewater treatment plant emissions are accounted for. Such a comparison is provided to depict the relative magnitude of emissions from the wastewater treatment plant in proportion to the total amount of emissions generated by the community at large.

Figure 2: City Government Portion of Community-Wide GHG Emissions in City Limits

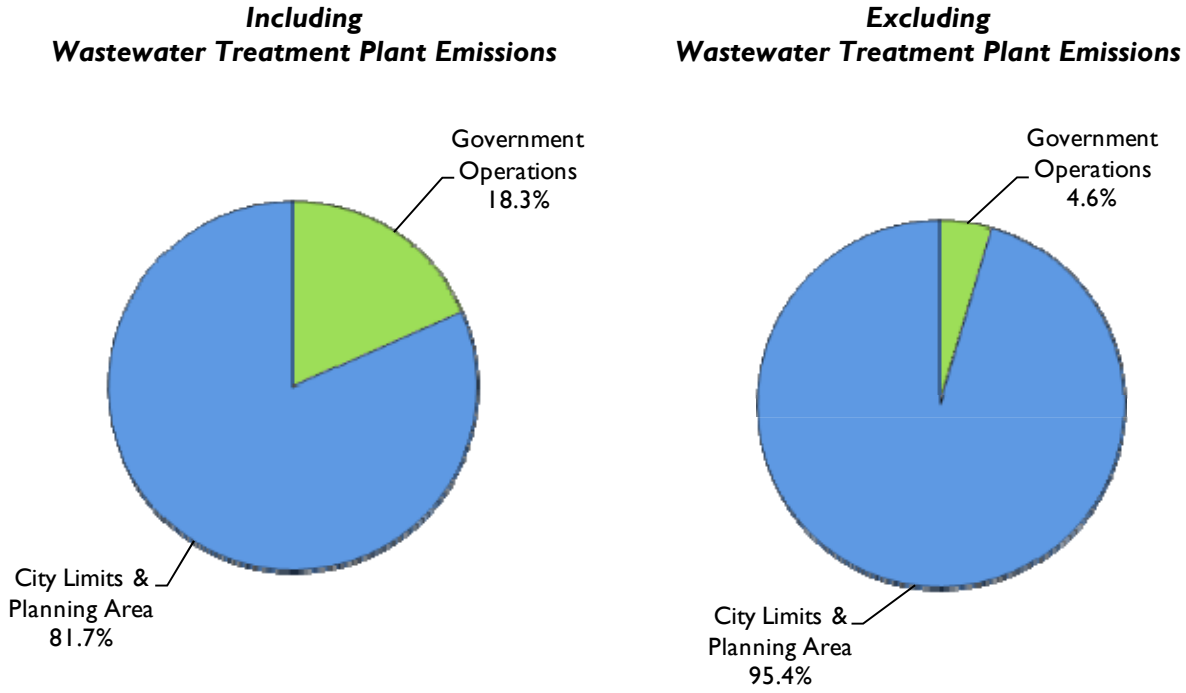


Figure 3: City Government Operations Emissions by Sector, Including Wastewater Treatment Plant Emissions

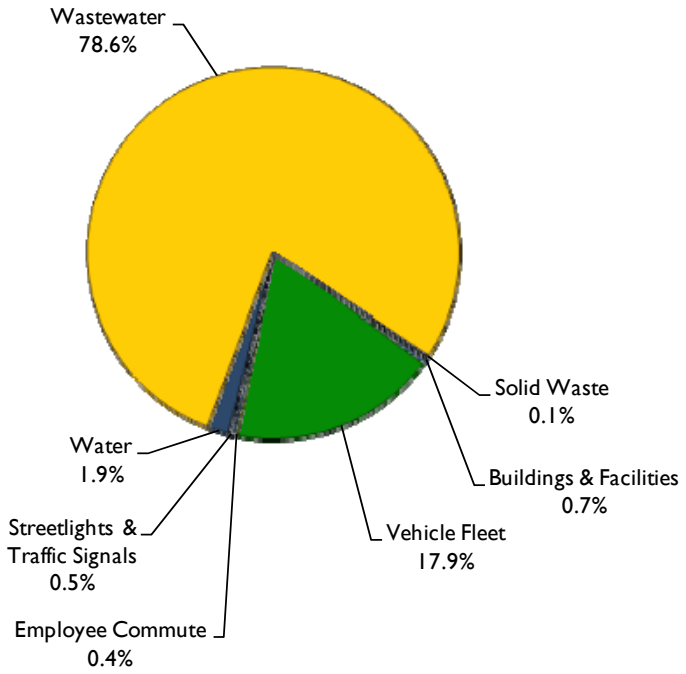
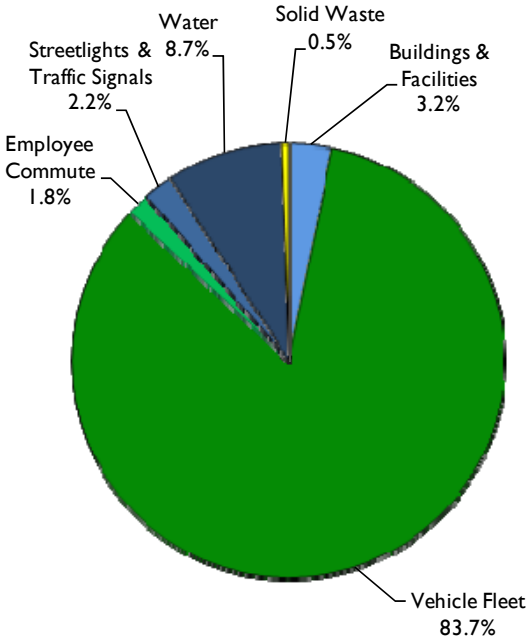


Figure 4: City Government Operations Emissions by Sector, Excluding Wastewater Treatment Plant Emissions



As shown in Figure 3 and Table 1**,** the City's wastewater treatment plant was the largest contributor to the City's emissions (78.6%), producing 122,308 metric tons of carbon dioxide equivalent. The second largest contributor was fuel consumption from the vehicle fleet (17.9%). Every other sector contributed individually less than 10.0% to City emissions, including (in order of contribution) water-related energy consumption (1.9%), buildings and facilities (0.7%), streetlights and traffic signals (7.5%), fuel consumption from employee commutes (0.4%), and solid waste (0.1%). Figure 4 excludes emissions from the wastewater treatment plant to depict the relative proportion of all other sectors to the City's emissions.

Table 1: City Government Emissions by Sector

2006 Municipal Emissions by Sector	Buildings & Facilities	Vehicle Fleet	Employee Commute	Street-lights & Traffic Signals	Water	Waste-water	Solid Waste	TOTAL
CO_2e (metric tons)	1,073	27,798	594	719	2,885	122,308	162	155,539
Percentage of Total CO_2e	0.7%	17.9%	0.4%	0.5%	1.9%	78.6%	0.1%	100.0%

It can also be helpful to view overall City government emissions by source. As shown in Table 2, the majority of emissions are the result of wastewater treatment plant processes (75.0%), gasoline consumed by the vehicle fleet and in employee commutes (16.1%), and electricity consumption in City-owned buildings, streetlights, and water facilities (6.3%). Compressed natural gas, diesel, natural gas, solid waste decomposition, and flex fuel contributed in decreasing amounts to the remaining 2.6% of the overall City GHG emissions.

Table 2: City Government Emissions by Source

City Emissions 2006 by Source	CO_2e (metric tons)	CO_2e (percentage of total)
Electricity[1]	9,796	6.3%
Natural Gas	519	0.3%
Gasoline	25,075	16.1%
Diesel	996	0.6%
CNG	2,309	1.5%
Ethanol[2]	12	0.0%
Wastewater Treatment Processes	116,669	75.0%
Solid Waste	162	0.1%
TOTAL	155,538	100.0%

Notes:
1. Note: Electricity includes electricity consumed at the wastewater treatment plant.
2. Ethanol emissions represent only that portion of flex fuel combustion in the employee commute that is attributed to ethanol (i.e., assumes that flex fuel consumption in the employee commute is E85 blend, and hence excludes 15% of flex fuel consumption that is assumed to be gasoline fuel consumption; see details on the employee commute below for additional information). Ethanol contributes approximately 0.001% of total City emissions.

Table 3 provides information on activity data and data sources and for all sources of City emissions. A summary of the methodology used to obtain and calculate emissions for each sector follows. Refer to the Appendix for additional descriptions of detailed emissions outputs, emissions coefficients, assumptions, and data sources that were used to calculate emissions from City government operations.

Table 3: City Government Operations Data Sources

Sector	Information	Unit of Measurement	Activity Data Source	Emissions Coefficients Source
Buildings & Facilities	Electricity consumption	kWh	Southern California Edison	Local Government Operations Protocol
	Natural gas consumption	Therms	SoCal Gas Co.	Local Government Operations Protocol
Vehicle Fleet	Diesel consumption & diesel vehicle fleet	Gallons	City of Tulare	Local Government Operations Protocol & EMFAC 2007
	Gasoline consumption & gasoline vehicle fleet	Gallons	City of Tulare	Local Government Operations Protocol & EMFAC 2007
	Compressed natural gas consumption & corresponding vehicle fleet	Gallons	City of Tulare	Local Government Operations Protocol

Sector	Information	Unit of Measurement	Activity Data Source	Emissions Coefficients Source
Employee Commute	Sample of employee commuting patterns	Annual VMT	Commuter survey (June 2010)	Local Government Operations Protocol & EMFAC2007
Streetlights & Traffic Signals	Electricity consumption	kWh	Southern California Edison	Local Government Operations Protocol
Water Delivery	Electricity consumption	kWh	Southern California Edison	Local Government Operations Protocol
Waste	Rates of waste generation, pick-up, number, and size of waste bins at all City facilities	Short tons	Tulare County RMA Solid Waste Division and City of Tulare	California Air Resources Board Landfill Emissions Tool
Wastewater Treatment Plant	Electricity consumption for buildings, facilities, lifts and pumps and process-based emissions	kWh used, and methane and nitrous oxide process emissions	Southern California Edison and City of Tulare	ICLEI's Wastewater Treatment Plant Emissions excel-based calculator, and Local Government Operations Protocol

WASTEWATER TREATMENT PLANT

In 2006, the City's wastewater treatment plant contributed a combined total of 122,308 metric tons of CO_2e that resulted from electricity consumption and process-based emissions at the plant. Electricity consumption from water and wastewater facilities operated by the City emitted approximately 4.61% of emissions at the wastewater treatment plant, or 5,640 metric tons of CO_2e. This category includes energy use at the wastewater treatment facilities and water yard, as well as the numerous lift stations and pumps that are necessary to convey water to serve all city residents. Point-source emissions that arise from the wastewater treatment system due to temporary aerobic conditions or incomplete combustion of captured biogas from anaerobic digesters resulted in an additional 116,674 metric tons of CO_2e, contributing approximately 95.40% of emissions from this category (see Table 2 in the Appendix).

Energy consumption data was provided by the City's Southern California Edison Account Manager online portal and converted into emissions using coefficients from the Local Government Operations Protocol v.1.1.[7] Wastewater treatment plant characteristics were provided by Lew Nelson, Public Works Director for the City of Tulare. Process-based emissions from the treatment of wastewater were calculated using ICLEI's Wastewater Treatment Plant Emissions Excel-based calculator and the Local Government Operations Protocol v.1.1.[8]

VEHICLE FLEET

Fuel consumption from the City's fleet comprised 17.9%of total City emissions (27,798 metric tons of CO_2e). This sector includes gasoline, diesel, and compressed natural gas consumption from all departments in the City operating vehicles (refer to Table 3 and Figures 1 and 2 in the Appendix).

[7] California Air Resources Board 2010.

[8] California Air Resources Board 2010.

Aggregate fuel consumption by fuel type was provided by the City, in addition to a list of vehicle types. Per Protocol guidance, national emissions coefficients provided by the Local Government Operations Protocol v1.0 for gasoline, diesel, and compressed natural gas vehicles were utilized.[9] Since fuel consumption by vehicle type was not available, average emissions coefficients for relevant vehicle classes were assumed. In order to comply with Protocol guidance, average fuel efficiencies for each relevant vehicle category were calculated using averages for Tulare County from the California Air Resources Board's vehicle emissions model EMFAC2007.[10]

WATER

This sector contributed 1.9% of City emissions (2,885 metric tons of CO_2e). This category includes energy use for the City's miscellaneous pumps and irrigation facilities that are necessary to convey water to serve all city residents and maintain City facilities. It excludes pumps and related facilities at the City's wastewater treatment plant. Energy consumption data was provided by the City's Southern California Edison Account Manager online portal and converted into emissions using coefficients from the Local Government Operations Protocol v.1.1.[11]

BUILDING SECTOR

This sector contributed 0.7% of City emissions (1,073 metric tons of CO_2e). The building sector includes GHG emissions from energy consumption in facilities owned and operated by the City. The facilities included in this analysis include the Civic Building, the Corporation Yard, the Parks Department, the Police modular, parks, public activity centers, and numerous other facilities (see Table 4 and Figure 3 in the Appendix). Energy consumed at the wastewater treatment plant and for streetlights and traffic signals and facilities associated with the treatment and conveyance of water is analyzed separately.

Electricity consumption data was provided by the City's Southern California Edison Account Manager online portal. Natural gas consumption was provided by Southern California Gas Company (SoCal Gas Co).[12] Natural gas and electricity coefficients are provided by the Local Government Operations Protocol v.1.1.[13]

STREETLIGHTS AND TRAFFIC SIGNALS

Streetlights and traffic signals comprised 0.5% of City emissions (719 metric tons of CO_2e). Information regarding the electricity consumed by City streetlights and traffic signals in calendar year 2006 was provided by the City's Southern California Edison Account Manager online portal and converted into emissions using coefficients from the Local Government Operations Protocol v.1.1.[14] This Inventory

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[9] 2010.

[10] California Air Resources Board 2008.

[11] California Air Resources Board 2010.

[12] Colby Morrow 22 July 2010.

[13] California Air Resources Board 2010.

[14] California Air Resources Board 2010.

accounts for all traffic signals included in the 48 traffic signal service accounts and 27 streetlight service accounts for which the Southern California Edison Account Manager provided records.

EMPLOYEE COMMUTE

This sector includes GHG emissions from City employees traveling to and from work in 2006, which contributed 0.4% to total City emissions (594 metric tons of CO_2e) The estimate is based on a June 2010 online survey conducted by the City (a blank version is included as Figure 4 in the Appendix). Respondents also completed and submitted hard copies of the survey, which were then electronically entered into the survey database. Approximately 103 employees responded to the survey with usable information, meaning that all essential questions were answered, for an approximate 31.5% response rate, the results of which were applied to the City employment total for 2006 (578 employees in 2006).

The survey found that 92.3% of City employees travel to and from work alone by car (see Table 5 in the Appendix). Employees were asked how many days of the week they travel by each commute mode, including driving alone (which includes motorcycles), carpooling, vanpooling, public transit, bicycling, walking, telecommuting, and other. These figures for commute mode were combined with each respondent's travel distance to work, car model (if any), and fuel type (if any). The results yield vehicle miles traveled (VMT) annually per vehicle type and fuel type (see Table 6 in the Appendix). These VMT numbers were then adjusted for the total employee population in 2006.

Consistent with Protocol guidance, national emissions coefficients provided by the Local Government Operations Protocol v1.0 for gasoline, diesel, and ethanol vehicles were utilized.[15] Average emissions coefficients for relevant vehicle classes were assumed. In order to comply with Protocol guidance, average fuel efficiencies for each relevant vehicle category were calculated using averages for Tulare County from the California Air Resources Board's vehicle emissions model EMFAC2007.[16] Flex fuel vehicles were assumed to represent consumption of E85 fuel blend (of the 6 survey responses designating use of flex fuel, only 2 respondents indicated fuel type E85) and assumed to have similar fuel efficiencies as gasoline vehicles. The rate of consumption of flex fuel was assumed to be 85% ethanol and 15% gasoline, per the definition of E85 fuel provided by the Protocol; therefore, 85% of flex fuel mileage was assumed to release biogenic emissions from ethanol combustion and 15% of flex fuel mileage was assumed to release fossil emissions from gasoline consumption.[17] Compressed natural gas (CNG) vehicle mileage was excluded as de minimus (CNG commutes contributed less than 1% of total miles). Additional data would be needed to quantify emissions from CNG commute trips (including cubic feet of natural gas consumed).

WASTE

Waste from City operations generated 162 metric tons of CO_2e. Municipal waste is not tracked by the City of Tulare, the Consolidated Waste Management Authority (CWMA), or Tulare County Solid

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[15] 2010.

[16] California Air Resources Board 2007.

[17] For additional information on calculating emissions from alternative fuel vehicles, refer to sections 7.1.2 and 7.1.3 of California Air Resources Board 2010.

Waste. Therefore, waste tonnages were calculated based on assumptions provided by Lew Nelson, including the number and size of waste bins at City facilities and frequency of pickup, adjusted to account for the number of municipal facilities operating in 2006.[18] To calculate emissions, the Inventory assumes a proportional ratio of waste generation to emissions and calculates the proportion of community-wide waste emissions that can be attributed to the City by applying the ratio of waste to emissions for each landfill to waste generated by the City. The emissions for this sector capture life-cycle emissions that result from the decomposition of waste. Emissions were calculated using the California Air Resources Board (ARB) Landfill Emissions Tool from all waste in place, assuming the characteristics of the top three landfills receiving waste from the CWMA and an average methane capture rate of 75%, as recommended by the Local Government Operations Protocol (ARB protocol).[19] This tool applies the IPCC's First Order Decay Model independently for each landfill based on historical data trends. Details on the methodology used to determine emissions from community-wide waste in the city are described earlier in this Inventory.

IV. INVENTORY FORECAST

To illustrate municipal emissions growth for the forecast years 2020 and 2030, existing trends, planned expansions, and levels of service were taken into account to create a municipal business-as-usual forecast. Municipal forecasts and reductions will be captured under the umbrella of community-wide reductions. Note that any improvements the City has completed since 2006 that would reduce emissions are excluded from the business-as-usual forecast. Most changes in municipal emissions trends will ultimately contribute to the achievement of community-wide targets and will be credited as community-wide progress toward reduction goals, yet forecasting City emissions over time helps the City to better understand the impact of municipal efforts to reduce GHG emissions.[20] All City actions taken since the baseline year of 2006 that would impact emissions will be accounted for in the Climate Action Plan to better highlight the impact of City initiatives taken to date, including upgrades to the wastewater treatment plant and expansion of the City's flex fuel fleet.

Numerous factors informed municipal forecasts. City staff provided data on planned facility expansion. In general, the size of municipal facilities was correlated with energy consumption and waste generation to determine rates of change. The size of City staff was expected to expand proportional to service population growth, which was translated into increased emissions from the employee commute. Emissions from the wastewater treatment plant are expected to grow based on the wastewater service capacity established in the General Plan Update Draft Environmental Impact Report.[21] Emissions from water delivery were expected to increase proportionally with wastewater treatment plant capacity. Emissions from the vehicle fleet in 2010 are based on proxy data for 2009 provided by the City and are assumed to remain constant through 2020 and 2030. Emissions from streetlights and traffic signals are not expected to change significantly, as existing facilities and equipment are sized to meet future needs.

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[18] June 15, 2010.

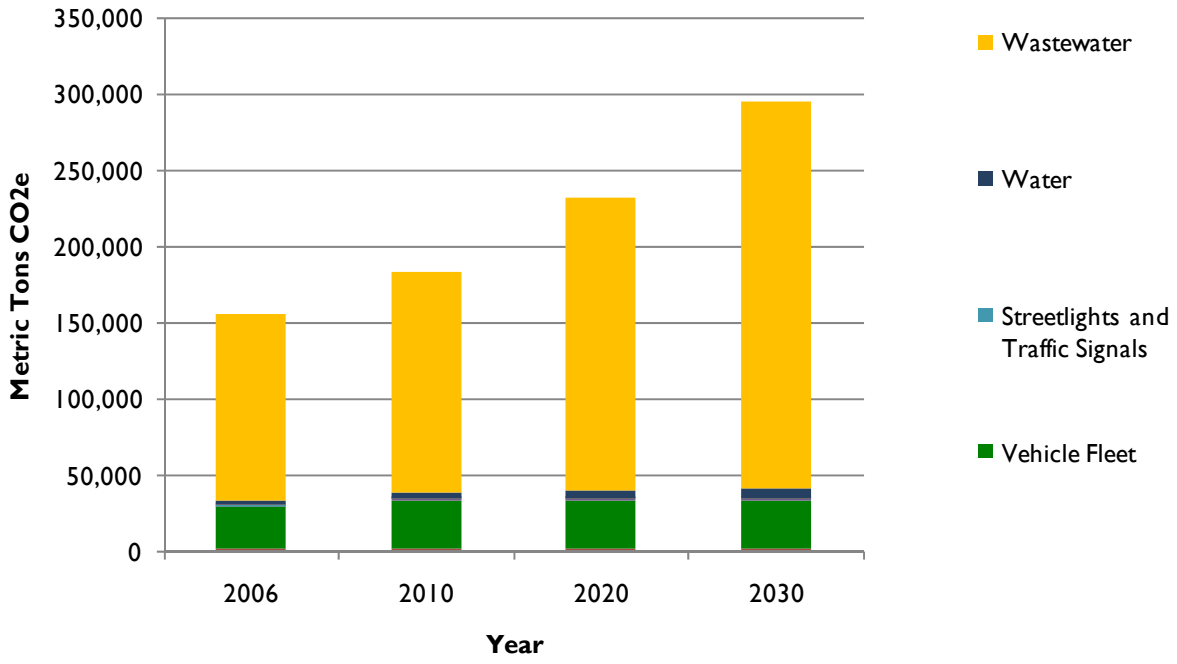
[19] California Air Resources Board 2010.

[20] Appropriate sector for crediting reductions that result from wastewater treatment plant improvements since the baseline year is to be determined during completion of the Climate Action Plan.

[21] City of Tulare 2007.

As shown in Table 4, forecasts show emissions from City government operations increasing by approximately 90.2% by 2030. The majority of forecast increases in emissions result from business-as-usual growth at the wastewater treatment plant to meet service capacity established by the Draft General Plan. Figure 5 depicts the business-as-usual forecast for all sectors; Figure 6 depicts the business-as-usual forecast without emissions from the wastewater treatment. Excluding emissions from the wastewater treatment plant, emissions are expected to only increase by 23.1% by 2030. The business-as-usual forecast assumes the impact of reduced emissions coefficients for electricity and mobile fuel combustion.[22]

Figure 5: City Government Operations Emissions Forecast, with Wastewater Treatment Plant Emissions



[22] Anticipated reduction in emissions coefficients for electricity and mobile fuel combustion that will result from statewide actions is accounted for consistency with community-wide forecasts and to facilitate the calculation of municipal reduction measures. See details on the Renewable Portfolio Standard and Pavley 1 and 2 in the community-wide forecast of the memo dated August 27, 2010, for additional information.

Figure 6: City Government Operations Emissions Forecast, Excluding Wastewater Treatment Plant Emissions

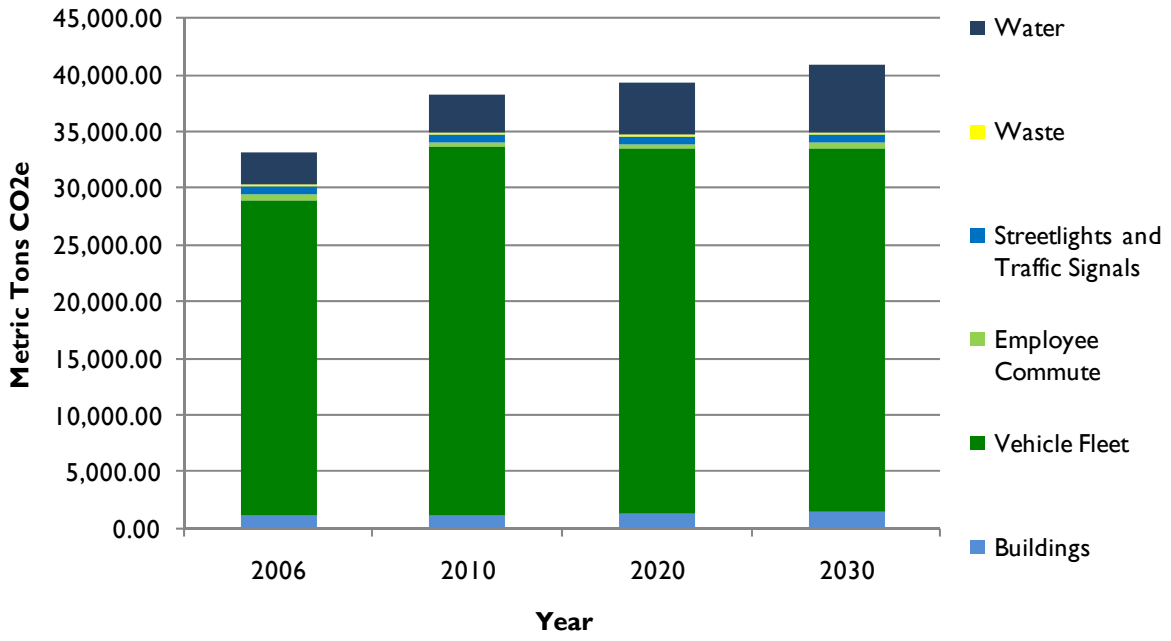


Table 4: City Government Operations Emissions by Sector, Metric Tons CO_2e

Sector	2006	2010	2020	2030	Total % Increase by Sector
Buildings	1,072.75	1,120.78	1,250.39	1,394.98	30.0%
Vehicle Fleet	27,797.82	32,624.99	32,250.83	32,126.12	15.6%
Employee Commute	594.48	255.70	283.45	462.27	-22.2%
Streetlights and Traffic Signals	719.22	719.22	719.22	719.22	0.0%
Waste	162.48	169.75	189.38	211.28	30.0%
Water	2,884.70	3,410.99	4,557.25	6,001.06	108.0%
Wastewater Treatment Plant (WWTP)	122,307.98	144,693.60	193,449.15	254,860.65	108.4%
Total	155,539.43	182,995.04	232,699.68	295,775.57	90.2%
Percentage Increase from Baseline for all Sectors	---	17.7%	49.6%	90.2%	---
Percentage Increase from Baseline for all Sectors Excluding WWTP	---	15.3%	18.1%	23.1%	---

V. CONCLUSION AND NEXT STEPS

The Inventory is an important milestone for the City in assessing and mitigating its impact on climate change from government operations. The Inventory yields data that will shape the development of the Climate Action Plan. Data calculated in the Inventory forms the foundation of the Climate Action Plan and provides a justifiable basis for the City's analysis of its impact on climate change; it is the necessary starting point from which far-reaching municipal initiatives taken since 2006 can be calculated and their impact quantified.

VI. CITATIONS

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Nelson, Lew. 2010c. City of Tulare Public Works. Personal e-mail communication, August 2.

Seale, Tammy. 2010. Tulare's Memorandum to Mark Kielty and Lew Nelson.

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APPENDIX: DETAILED EMISSIONS BY SECTOR FROM GOVERNMENT OPERATIONS

CITY OF TULARE: CITY GOVERNMENT OPERATIONS GREENHOUSE GAS EMISSIONS INVENTORY

Table 1: Municipal Emissions by Sector

2006 Municipal Emissions by Sector	Buildings & Facilities	Vehicle Fleet	Employee Commute	Streetlights & Traffic Signals	Water	Waste-water	Solid Waste	TOTAL
CO_2e (metric tons)	1,073	27,798	594	719	2,885	122,308	162	155,539
Percentage of Total CO_2e	**0.7%**	**17.9%**	**0.4%**	**0.5%**	**1.9%**	**78.6%**	**0.1%**	**100.0%**

Table 2: Wastewater Total Emissions by Source

Total Emissions by Source (Metric Tons CO_2e)				
	CO_2	CH_4	N_2O	% of WWTP Emissions
Lift Stations	93.06	0.09	0.40	0.076%
Miscellaneous Pumps	56.32	0.06	0.25	0.046%
Stormwater Pumps	36.45	0.04	0.16	0.030%
WWTP – Energy	5,423.80	5.51	23.60	4.458%
WWTP – Processes	0.00	116,668.25	0.00	95.389%
Subtotal	5,609.63	116,673.94	24.41	100.000%
Total				**122,307.98**

Table 3: Vehicle Fleet Fuel Consumption

	Gallons	% of Total	CO2e (metric tons)	% of Total CO2e (metric tons)
Gasoline	89,345	14.88%	24,499	88.13%
Diesel	96,748	16.12%	990	3.56%
CNG/LNG	414,200	69.00%	2,309	8.31%
Total	**600,293**	**100.00%**	**27,798**	**100.00%**

Citations:

- California Air Resources Board 2010.
- California Air Resources Board 2007.
- City of Tulare 2010.
- Nelson 2010a.

Notes on methodology:

- Total fuel consumption by fuel type provided by Lew Nelson (2010a). Fuel consumption by department or vehicle for 2006 was unavailable. It was necessary to deviate from the recommended Protocol guidance to calculate emissions for methane (CH_4) and nitrous oxide (N_2O). Average fuel efficiency was assumed in lieu of mileage to complete calculations, using county-wide data supplied by EMFAC2007 (California Air Resources Board 2007). Assumes that all fuel consumption reported by the City is attributed to fleet vehicles, as opposed to equipment. No data available with which to make assumptions about consumption quantity by equipment type.

- Emissions coefficients are national averages provided in the Local Government Operations Protocol v1.1 (California Air Resources Board 2010). Note that EMFAC2007 provides county-wide averages which are relevant at an aggregated, community-wide scale, but inaccurate for a facility-scale inventory (e.g., for certain vehicle populations in the City fleet that are not prevalent at the county scale such as heavy-duty vehicles, no emissions coefficients are provided in EMFAC2007). Relying on nationwide defaults ensures relevant emissions factors that accurately correspond to vehicles in the City's fleet.

  - Carbon dioxide (CO_2) emissions taken from Protocol Table G.11 for gasoline, diesel, and LNG. Note that while the City produces compressed natural gas (CNG) for consumption in vehicles from liquefied natural gas (LNG), emissions coefficients in LNG are available in units of kg/gallon, consistent with units of fuel consumption provided by the City (per the Protocol's recommended approach for CO_2). Therefore, emissions coefficients for LNG fuel in units of kg/gallon are assumed, rather than emissions coefficients for CNG fuel (only available in units of kg/standard cubic foot).

- CH_4 and N_2O: Applies factors of emissions in grams/mile to total gallons consumed. Mileage by vehicle and fuel type was not available; therefore, assumes average fuel efficiencies to apply emissions coefficients and utilizes the Protocol's approach to calculate CH_4 and N_2O. For gasoline, assumes average emissions for all model years through 2006 of passenger cars and light trucks from Protocol Table G.12. For diesel vehicles, assumes the average of all model years for diesel light-duty trucks and diesel heavy-duty vehicles. For LNG consumption, assumes the average of light-duty vehicles, heavy-duty vehicles, and buses. Note that the Protocol only provides LNG emissions coefficients for the heavy-duty category, which are equivalent to emissions factors of CNG. Therefore, it was assumed that CNG emissions coefficients for other categories would apply to the consumption of LNG fuel.

- Fuel efficiencies were determined using county-wide averages provided by EMFAC2007 (California Air Resources Board 2007). For gasoline fuel efficiencies, assumes the average of light-duty autos, light-duty trucks (up to–5,750 lbs) (20.6591 MPG on average). For diesel emissions, assumes the average of emissions for light-duty trucks (3,751–5,750 lbs), medium-duty trucks, light heavy-duty trucks (8,501–10,000 lbs), and medium heavy-duty trucks (10,001–14,000 lbs) (20.8505 MPG on average). Assumes the average fuel economy for CNG vehicles is comparable to traditional gasoline fuel vehicles, as represented by the average of light-duty autos, light-duty trucks, light heavy-duty trucks (up to 14,000 lbs), and urban buses (18.466 MPG on average).

Figure 1: Vehicle Fleet Fuel Consumption by Fuel Type (Gallons)

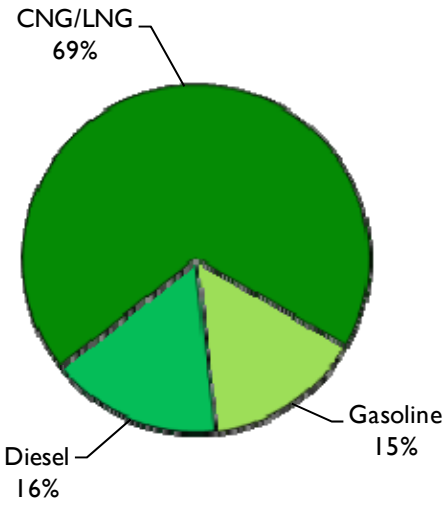

Figure 2: Emissions from Vehicle Fleet by Fuel Type

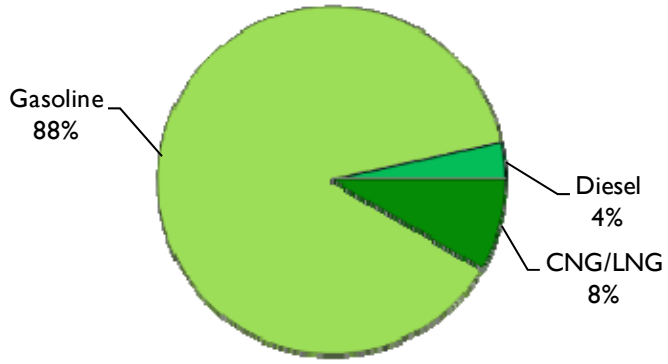

Table 4: Buildings & Facilities Electricity & Natural Gas Emissions

2006 Municipal Emissions by Sector	Electricity	Natural Gas	Total
CO_2e (metric tons)	553	520	1,073
Percentage of Total CO_2e	51.6%	48.4%	100.0%
Energy Use (kWh or Therms)	1,891,058	97,776	1,988,834

Citations:

- California Air Resources Board 2010.
- Nelson 2010a.
- Morrow 2010.

Notes on Methodology:

- Electricity data for buildings and facilities, streetlights, and water delivery was obtained from Southern California Edison billing statements for the baseline year; system access was facilitated by Lew Nelson. Confirmation of facilities and accounts provided by Lew Nelson.
- Natural gas consumption provided by Colby L. Morrow, Air Quality Manager, Customer Programs Environmental Affairs, Southern California Gas Company and San Diego Gas and Electric Company.

- Energy consumption was converted to CO2e using coefficients provided by California Air Resources Board (2010). For CO_2 emissions from electricity, assumes Southern California Edison's verified electricity emission factor for 2006 (Protocol Table G.6). For CH_4 and N_2O emissions from electricity, assumes the California Grid Average for 2006 (Protocol Table G.7). For CO_2 emissions of natural gas, assumes the weighted US average (Protocol Table G.1). For CH_4 and N_2O emissions from natural gas, assumes rates for commercial natural gas consumption (Protocol Table G.3).

Figure 3: Buildings & Facilities Electricity & Natural Gas Emissions

Table 5: Commute Survey Responses

	Days Traveled by Commute Mode (per Week)	Percentage of Total
Drive Alone	893	92.3%
Carpool with Employees	14	1.4%
Carpool with Others	20	2.1%
Vanpool	0	
Public transit	10	1.0%
Bicycle	7	0.7%
Walk	0	0.0%
Telecommute	0	0.0%
Other	24	2.5%
Total	**968**	**100.0%**

Table 6: Adjusted Vehicle Miles Traveled (VMT) from Employee Commute Survey Responses

		2005		2010	
		Annual VMT	Emissions ($MTCO_2e$)	Annual VMT	Emissions ($MTCO_2e$)
Passenger cars	Gas	704,052.74	348.93	222,756.42	110.40
	Flex Fuel	13,492.18	4.59	7,983.54	2.71
	Diesel	–	–	–	–
	Total	717,544.92	353.52	230,739.96	113.11
Light-duty trucks Category 1 (e.g., Toyota RAV4, Chevrolet Tracker, Chevrolet S10 Pickup (4 cylinder), Chrysler PT Cruiser, or similar)	Gas	40,829.28	22.16	24,159.34	13.11
	Flex Fuel	–	–	–	–
	Diesel	–	–	–	–
	Total	**40,829.28**	**22.16**	**24,159.34**	**13.11**
Minivans and light-duty truck/SUV/pickup, Category 2 (e.g., minivans, Ford Explorer, GMC Sonoma Pickup Truck, Chevrolet Astro Cargo Van, or similar)	Gas	107,937.46	66.80	63,868.32	39.53
	Flex Fuel	–	–	–	–
	Diesel	4,409.21	0.90	2,609.00	0.53
	Total	**112,346.67**	**67.71**	**66,477.32**	**40.06**
Medium-duty truck/SUV/pickups (e.g., Chevy Suburban, Ford Expedition, Lincoln Navigator, Ford E250/350/450, or similar)	Gas	185,583.65	137.90	109,812.81	81.60
	Flex Fuel	14,241.75	7.44	8,427.07	4.40
	Diesel	23,809.73	5.76	14,088.60	3.41
	Total	**223,635.13**	**151.10**	**132,328.48**	**89.41**
Total		**1,094,356.01**	**594.48**	**453,705.10**	**255.70**

Citations:

- California Air Resources Board 2007.
- California Air Resources Board 2010.

Notes on Methodology:

- Approximately 103 employees out of 327 current employees responded to the survey with usable information, meaning that all essential questions were answered. Answers with mileage left blank or with highly inconsistent data (ex: saying they walked three days to work, biked two, and drove five) were omitted. In addition, if a respondent did not describe their "other" category of transportation, the entry was omitted.
- Following calculations were completed to convert 2010 reported commute patterns for baseline activity:

- Entries were separated by vehicle and fuel type.

- For each group of vehicle and fuel type, miles driven to work were multiplied by 2 (to get round-trip estimate) and then by the number of "drive alone" days. Number of miles to work were then multiplied by the number of "carpool" days, which assumes another City employee in the car (half of the "drive alone" emissions). (Note: If a respondent entered that they motorcycle to work, but own a car as well, the motorcycle miles were moved to the motorcycle category.) Adjust for hybrids (see below).

- Adjust daily miles per vehicle and fuel type for annual travel by multiplying by 52.18 work weeks/year.

- Calculate the multiplier to adjust survey response data to the 2006 employee population. In 2006, there were 578 employees. This number, divided by the 103 survey entries, provides a multiplier of 3.17.

- Multiply the mileage per vehicle and fuel type by the multiplier.

- Because no hybrids were reported in the survey, no adjustments were made to account for the large increase in hybrid sales between 2006 and present day.

- Alternative Fuels: Additional data is necessary to quantify CNG vehicle emissions, including cubic feet of natural gas consumed. CNG vehicle miles excluded as de minimus (less than 1% of total miles). Flex fuel vehicles were assumed to represent consumption of E85 blend (of the 6 responses designating use of flex fuel, only 2 respondents indicated fuel type E85). Rate of consumption of flex fuel was assumed to be 85% ethanol and 15% gasoline, per the Protocol definition. For biofuel blends, combustion releases both emissions of fossil and biogenic CO_2e, as discussed by the Protocol (see California Air Resources Board 2010, section 7.1.2 for additional information).

  - Emissions coefficients are national averages taken from Local Government Operations Protocol v1.1, per Protocol guidance (California Air Resources Board 2010), consistent with those used in the fleet inventory. Note that EMFAC2007 provides county-wide averages that are relevant at an aggregated, community-wide scale, but inaccurate for a facility-scale inventory.

  - CO_2 emissions taken from Protocol Table G.11 for gasoline and diesel in units of kg/gallon. In order to utilize recommended Protocol calculations for CO_2, mileage was converted into gallons of fuel using county-wide average fuel efficiencies for each vehicle class from EMFAC2007 (as described below). For 85% of flex fuel mileage, assumes the emissions for ethanol (E100), the only ethanol default for emissions of CO_2 provided by the Protocol. Remaining 15% of flex fuels mileage was assumed to be attributed to gasoline emissions.

  - CH_4 and N_2O: Applies factors of emissions in grams/mile to total gallons consumed. Assumes average fuel efficiencies to apply emissions coefficients and utilize the Protocol's approach to calculate CH_4 and N_2O, and emissions coefficients provided in Protocol Tables G.12. and G.13. For gasoline passenger cars, assumes average emissions for all model years

through 2006 of passenger cars. For the ethanol portion of flex fuel mileage, assumes the emissions of ethanol light-duty vehicles. For gasoline and diesel light-duty trucks Categories 1 and 2, assumes average emissions for all model years through 2006 for light trucks for each fuel category, respectively. For gasoline and diesel medium heavy-duty trucks, assumes the average of heavy-duty vehicles for heavy-duty vehicles for each fuel category, respectively. For the ethanol portion of medium heavy-duty flex fuel mileage, assumes the emissions of ethanol heavy-duty vehicles.

- Fuel efficiencies determined using county-wide averages provided by EMFAC2007. Unlike assumptions for the fleet (in which detailed fleet lists directed exclusion of irrelevant vehicle categories), assumes more aggregated averages that account for all available vehicle populations, so as to more accurately reflect the vehicle stock of City employees at large. For gasoline and diesel passenger vehicles, assumes the average of light-duty autos (19.07 MPG and 33.33 MPG respectively). For flex fuel passenger vehicles, assumes the same fuel efficiency as gasoline passenger vehicles. For light-duty truck/SUV/pickup Category 1 for gasoline and diesel vehicles, assumes the average of light-duty trucks (3,751–5,750 lbs) (16.98 MPG and 29.17 MPG, respectively). For minivans and light-duty truck/SUV/pickup Category 2 gasoline and diesel, assumes the average of light heavy-duty trucks (8,501–10,000 lbs) (15.48 MPG and 50 MPG, respectively). For gasoline medium-duty trucks, assumes the average of medium heavy-duty trucks (10,001–14,000 lbs) (12.56 MPG on average). County-wide data on medium heavy-duty diesel trucks not available; therefore, assumes the same ratio of fuel efficiency in comparison with medium heavy-duty gasoline trucks as results when comparing fuel efficiencies of light-duty gasoline and diesel trucks (40.58 MPG). Assumes the average fuel economy for flex fuel vehicles assumed to be comparable to traditional gasoline fuel vehicles

Figure 4: Employee Commute Survey Questions

1. What is your approximate one way distance to work (in miles)? Please indicate the most direct distance to work, discounting midway destinations that would be taken whether or not you drove to work each day (i.e., dropping off children at school).

   _____ Miles

2. What type of transportation do you take to work? Please indicate the type of transportation you take to work each day in a typical two-week period. This question is intended to account for special work schedules, including those of the fire department, police department, and 9/80 or 8/80 work weeks.

   Week One

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
I do not work this day							
Drive Alone							
Carpool with fellow City employees							
Carpool with other drivers not employed by the City							

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Vanpool							
Public Transit							
Bicycle							
Walk							
Telecommute							
Other*							

3. Week 2

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
I do not work this day							
Drive Alone							
Carpool with fellow City employees							
Carpool with other drivers not employed by the City							
Vanpool							
Public Transit							
Bicycle							
Walk							
Telecommute							
Other*							

4. What type of vehicle do you drive?
   - Passenger Cars – Subcompact/compact, mid-size, and full-size autos, including:
     - Honda Civic, Accord
     - Toyota Corolla, Camry
     - Ford Focus, Taurus, Crown Victoria
     - Dodge Neon, Intrepid
     - Chevrolet Cavalier, Monte Carlo, Impala
     - Volkswagen Jetta, Passat
   - Light-Duty Truck/SUV/Pickup Category I – Examples:
     - Toyota RAV4
     - Chevrolet Tracker

  - Chevrolet S10 Pickup (4 cylinder)
  - Chrysler PT Cruiser
- Minivans and Light-Duty Truck/SUV/Pickup Category 2 – Examples:
  - All minivans
  - Ford Explorer
  - GMC Sonoma Pickup Truck
  - Chevrolet Astro Cargo Van
- Medium-Duty Truck/SUV/Pickup – Examples:
  - Chevy Suburban
  - Ford Expedition
  - Lincoln Navigator
  - Ford E250/350/450

5. What type of fuel or fuel technology does your vehicle from Question 3 use?

   ☐ Gasoline
   ☐ Diesel
   ☐ Biodiesel
   ☐ Hybrid
   ☐ Electric
   ☐ Other (please specify): _____

6. If you carpool or vanpool with fellow City employees, how many City employees ride with you? If you carpool with a different number each day, please indicate the average. If 'not applicable' please enter 0.

   _____ City employees

Table 7: Municipal Waste by Landfill

	Visalia	Woodville	Teapot	TOTAL
Municipal waste (tons)	318.41	203.09	215.60	737.10
$MTCO_2e$ from Municipal Waste by landfill	**77.4809**	**48.6308**	**36.3708**	**162.4825**

Citations:

- CalRecycle 2009.
- Nelson 2010b.

- CalRecycle 2009.

Notes on Methodology:

- Municipal waste is not tracked by the City of Tulare, the Consolidated Waste Management Authority, or Tulare County Solid Waste. To determine municipal waste, calculated average tonnage based on assumptions provided by Lew Nelson (2010b). Each City facility has one waste bin that is 6 cubic yards in size. Although there is variation in waste generated by department and frequency of pickup, an assumption of a weekly average pickup accounts for such variation (52 pickups per year).

- All 21 City facilities in operation in 2006 identified by the City include City Hall, Civic Affairs, Meitz Community Center, Meitz Pool, Activity Center, Womens Club, Tulare Library, Senior Center, Police Headquarters, PD Cedar Modular, Props. Club House, Corp. Yard Complex, Tulare Youth Center, Airport Hangars, Tulare Ag Flying Service, Tulare Mosquito Abatement, Blue Sky Aviation, Johnson Aircraft, Fire Station 1, Fire Station 2, and Fire Station 3.

- A volume-to-weight conversion factor was provided by CalRecycle 2009.

- Assumes that municipal waste emissions reflect the portion of community-wide waste generated by municipal facilities (refer to Memorandum dated August 27, 2010 (Seale 2010) for additional details).