City of Tracy

Baseline Greenhouse Gas Emissions Inventory and Forecast Report

Published December 2009

Conducted by Town-Green in Partnership with the City of Tracy

City of Tracy Baseline Greenhouse Gas Emissions Inventory

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Acknowledgements

This Greenhouse Gas Emissions Inventory Report was a collaborative effort between the staff members from the City of Tracy, local business representatives, and regional transportation organizations. We would like to thank staff members from ICLEI and ICF/Jones & Stokes and Fehr & Peers for their assistance, and the City of Tracy staff for their help in researching and compiling data for the analysis. City staff provided invaluable input and assistance in locating key data resources in the City. We would also like to thank Pacific Gas & Electric Company (PG&E) for its cooperation in providing data.

I. Introduction

It is widely known in the scientific community that as the world's population increases, we are globally releasing more greenhouse gases than can be absorbed back into nature. While there are some greenhouse gases that are produced naturally, the principal greenhouse gas emissions, which are a result of human activities, are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and Fluorinated Gases. Known as the greenhouse effect or global climate change, models show that this phenomenon will lead to a 2^oF to 10^oF temperature increase over the next 100 years. Already the Intergovernmental Panel on Climate Change warns that most of the warming observed over the last 50 years is attributable to human activities.

Changes in the earth's temperature will have impacts for residents of Tracy, California. These impacts could include:

- Increase in severe weather events
- Increase in annual rainfall of 20 to 30 percent leading to more serious storm events
- Rising sea levels that will threaten ecosystems and water supplies
- Decrease in the Sierra snow pack which will effect fresh water availability
- Increase in insect-borne diseases

It is essential that each city understand its own contribution to the cumulative effects of climate change. By understanding the major sources of the greenhouse gas emissions, cities may make informed changes to land use and transportation planning, waste management, and energy usage that impact emissions.

A. Baseline Emissions Inventory Report: Purpose

This report, conducted by Town-Green, presents the levels of greenhouse gas (GHG) emissions that the City of Tracy emitted in its base year, 2006, on a municipal level and a community-wide level. The emission forecast represents a business-as-usual (BAU) prediction of how GHG emissions may change the City of Tracy over time if no emissions reduction programs are implemented. This information will inform the city about the sources and severity of emissions as potential targets for reductions. The inventory will help the City tailor its emissions reduction strategies towards significant sources and meet specific State and community environmental and energy goals.

B. California Emerald Cities Program

The City of Tracy is the second participant in the Emerald Cities Pilot Program. Emerald Cities (EC) consists of a program to help transform California cities and counties, especially those underserved or at risk, into more environmentally, economically, and socially sustainable places. Under the general direction of the State Department of Conservation, with assistance from the non-profit National Charrette Institute (NCI) and the California Sustainability Alliance, Town-Green leads the Tracy pilot in collaboration with State and private technical consultants in the appropriate fields of sustainability.

EC is intended to significantly:

- Assist jurisdictions in meeting or exceeding local and state statutory requirements such as California's Assembly Bill 32 (AB32) and Senate Bill 375 (SB375);
- Help communities reduce their carbon footprint, preserve renewable resources, and decrease reliance on fossil fuels;
- Improve the community's ability to prepare for and adapt to economic (e.g., jobs, food, and utility costs), environmental (e.g., climate, air quality), and energy (e.g., power, fuels, reduce auto dependency) changes; and
- Help forge a community-supported policy, regulatory, programmatic, and implementation framework to achieve these desired outcomes

II. Emissions Inventory

A. Reasoning, Methodology & Model

The GHG inventory provides local governments with a baseline or benchmark for quantifying changes in their greenhouse gas emissions. By identifying stationary and mobile sources of CO_2 emissions, local governments may methodically focus on targeting the most significant emissions from energy use, transportation, and waste related activities at the community-wide scale and those resulting directly from municipal operations.

Once completed, these inventories offer a baseline to forecast BAU emissions. These forecasts inform the local government by estimating future emissions resulting from continued limited or inaction, and provide an incentive for setting reduction targets; the targets help policy-makers design and implement the corresponding greenhouse gas emission reduction measures.

1. Emissions Analysis Software

Town-Green employed International Council for Local Environmental Initiatives' (ICLEI) Clean Air and Climate Protection (CACP) software to calculate the emissions derived from energy consumption, transportation, and waste generation within Tracy. The methodology assumes that electricity and natural gas use, transportation, and solid waste generation will increase over time in proportion to population, number and type of jobs, and housing availability. It also assumes that fuel economy and the percentage of electricity generated from renewable sources remains constant throughout the forecast period.

The CACP software determines emissions using coefficients according to the type of fuel consumed. Emissions from different types of fuel consumption are converted into equivalent measures of carbon dioxide units, or CO_2e, in order to be able to compare different greenhouse gases more easily.

The methodologies that the CACP software uses to calculate current and predict future greenhouse emissions follow the same national and international standards established by national and international inventory standards established by the Intergovernmental Panel on Climate Change (1996 Revised IPCC Guidelines for the Preparation of National GHG Emissions Inventories), the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA for 1605), and, for emissions generated from solid waste, the U.S. EPA's Waste Reduction Model (WARM).

While the CACP software has been successfully used across the U.S. to calculate greenhouse gas emissions, it is important to note that the ICLEI software model and available community-wide field data on fuel consumption is limited. Therefore, some of the data requires assumptions to be made about the conditions of community-wide fuel consumption. While the numbers generated by this software are very close approximations, the computations may not reflect exact values. Forecasted information about both community emissions and municipal emissions are projected using a different methodology, as the CACP software was insufficient for accurate analysis. The community-wide forecast was calculated using a separate ICLEI spreadsheet that bases its forecast on population and employment growth. The municipal forecast calculated by Town-Green was based on municipal parks, infrastructure, and water and wastewater facility growth estimates provided by City of Tracy staff.

2. Inventory Sources and Data Collection Process

To conduct the greenhouse gas emissions inventory, Town-Green used 2006 as the designated year to collect information from several sources and energy sectors. PG&E provided data on electricity and natural gas consumption for the community and local government. Fehr & Peers provided fuel

consumption data for community travel, and Altamont Commuter Express (ACE) and the City's transit provider, Tracer, provided data on emissions from the regional passenger train and public transportation. Solid waste data was gathered from the Tracy Delta Solid Waste Management. City staff coordinated the City's overall municipal data collection process.

Town-Green aggregated this 2006 data to create a community emissions inventory and a municipal operations emissions inventory. The community inventory represents all the energy and transportation-related fuels used, and waste produced by non-government owned and operated establishments within the City of Tracy and its contribution to greenhouse gas emissions. The municipal inventory includes emissions derived from internal government operations and local government employee commute.

It is important to calculate community and municipal GHG emission inventories separately. This allows the local government to analyze its own impacts on climate change, and helps them to lead by example, demonstrating how it will exert control over its own reduction efforts. The City of Tracy will play a critical role in inspiring community members to change their energy consumption patterns and set an example for other local governments to address their greenhouse gas emissions and reduce their environmental impacts.

Tracy's community emissions inventory includes all electricity and natural gas consumption energy within the city limits, excluding energy consumption from County-owned facilities. This means that, even though the electricity used by Tracy's residents is produced elsewhere, the energy and emissions associated with it appears in Tracy's inventory. By calculating emissions to include the impacts of the source of their energy consumption, a community will look at their energy consumption more holistically and not limited by the city's political boundaries.

B. Inventory Results

The results below represent the City of Tracy's completion of the greenhouse gas inventory. The community-wide analysis will be discussed first and the municipal analysis will follow.

1. Community Emissions Inventory

In the base year 2006, the City of Tracy emitted approximately 1,336,869 tons of CO_2e from residential, commercial, industrial, transportation and waste sectors, as well as fugitive and refrigerant emissions. Fugitive emissions result as a byproduct of industrial processes. These are emissions of gases from pressurized equipment, generally from leaks and irregular releases of gases.

Burning fossil fuels in motor vehicles and for energy use in buildings and facilities represent the major contributor to Tracy's greenhouse gas emissions. This single largest source of emissions consists of fuel consumption in the transportation sector, contributing 63% of total emissions. Table (1) and Figure (a) below show Tracy's total greenhouse gas emissions from all major sources for the year 2006. The residential, commercial, and industrial sectors represent emissions that result from electricity and natural gas used in both private and public sector buildings and facilities. The transportation sector includes emissions from private and commercial vehicles driven within the City's geographical boundaries, commuter traffic, off-road emissions, as well as the emissions from trips taken by Tracy residents on ACE, the regional passenger train.

The Tracy "Citywide Travel Demand Model" covers all of the vehicle miles traveled (VMT) associated with trips completed within Tracy and half of the VMT generated by jobs and residences located within Tracy but that resulting in travel to/from external destinations. The model does not account for vehicles that pass through Tracy without either a point of origin or a destination within the city. Tracy assumes

emissions accountability for the VMT that occurs outside of the city borders only if is directly related to Tracy residents.

The emissions from transit vehicles and the city-owned fleet, Tracer, are included in the municipal emission summary.

Table (1): Tracy Community Emissions Summary

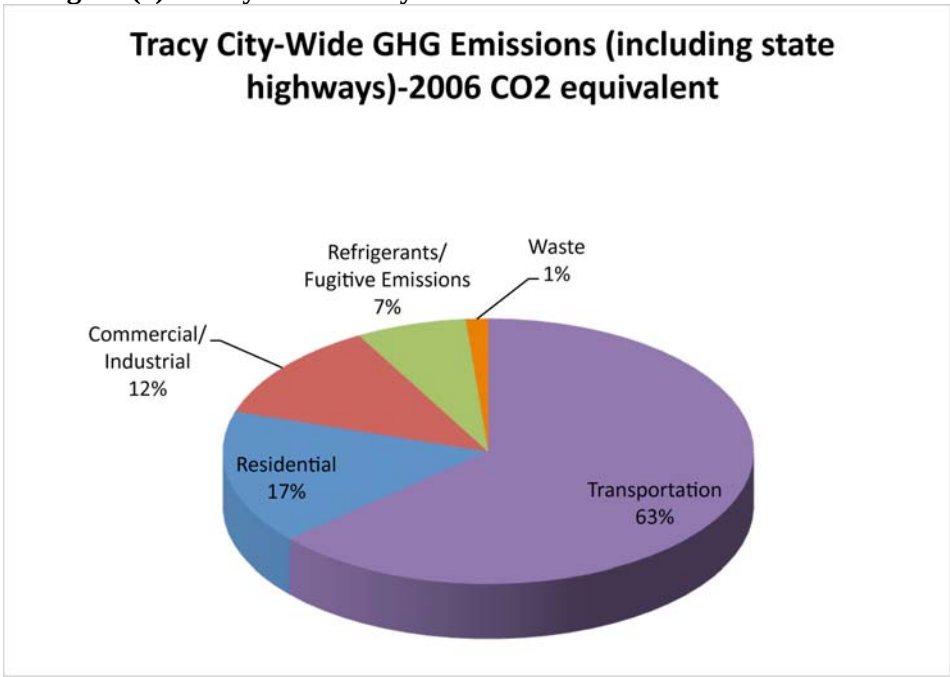
Potential Sources	**Equiv CO_2e (metric tons)***	**Energy (MMBtu)****
Residential	220,036	1,856,775
Commercial/Industrial	160,401	1,355,305
Transportation	848,009	10,816,752
Waste	18,190	0
Fugitive Emissions/Refrigerant	90,233	0
TOTAL	**1,336,869**	**14,028,832**

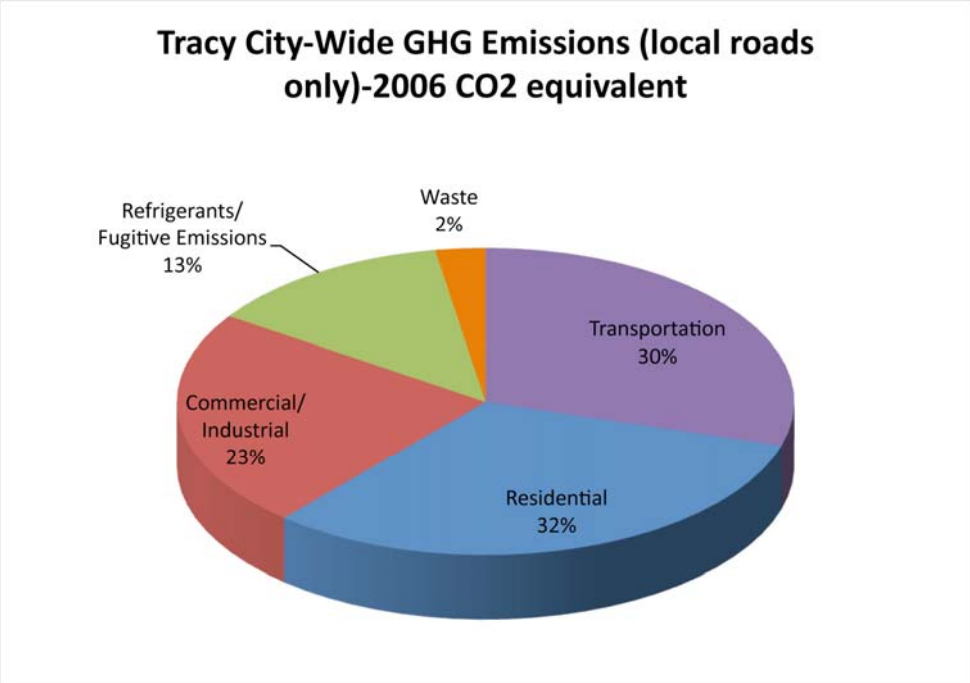
Source: CACP Model output

*Equiv CO_2e refers to equivalent carbon dioxide. It is standard international practice to convert other greenhouse gasses into CO_2e so that their impacts can be directly compared.

**Energy is measured in British Thermal Units. MMBtu represents one million BTUs.

Figure (a): Tracy Community Greenhouse Gas Emissions - Year 2006





Source: CACP Model output

Energy / Stationary Source Emissions

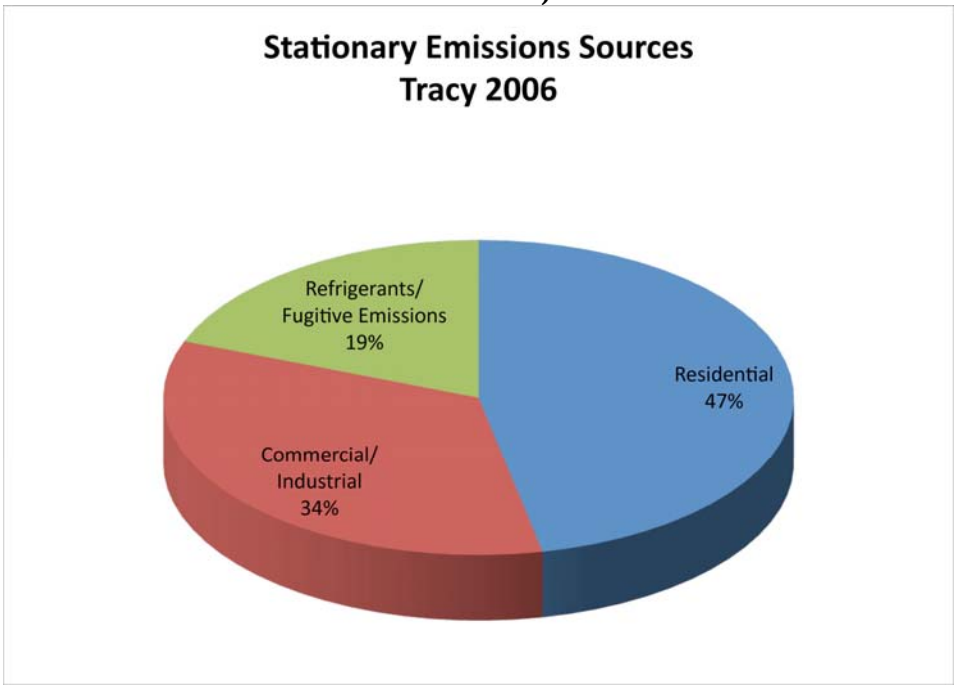
In 2006, Tracy's total stationary energy consumption was about 395,669,635 kWh of electricity and 18,616,718 therms of natural gas. Stationary energy use by all sectors (residential, commercial, industrial activities, and refrigerants/fugitive emissions) accounts for 35.21% of total greenhouse gas emissions in Tracy. These emissions are a result of the combustion of fossil fuel, but do not include fugitive emissions

or refrigerants. Tracy's stationary energy use resulted in a total of approximately 470,670 tons of CO_2e emissions in 2006.

The City of Tracy receives its electricity from Pacific Gas & Electric Company (PG&E). The 2006 emissions coefficients for electricity provided by PG&E are included in the notes in Appendix A (Data Summary Reports and Inventory Detailed Reports). The types of power sources that make up a utility's electricity generation mix have a significant impact on a city's greenhouse gas emissions. A coal fired power plant, for example, releases 1.3 tons of CO_2e per megawatt-hour of electricity generated versus 0.7 tons for gas turbines and 0 tons for renewable sources such as solar, wind, or hydroelectric power.

Figure (b) shows the breakdown of greenhouse gas emissions by sector for both electricity and natural gas combined. Of the total 470,670 tons of CO_2e emitted due to stationary energy use, 46.75% was from residential building, 34.08% was from commercial/industrial buildings, and 19.17% was from refrigerants and fugitive emissions.

Figure (b): Tracy Community Greenhouse Gas Emissions Breakdown (Residential and Commercial/Industrial) - Year 2006



Source: CACP Model output

Residential

In 2006, Tracy's 80,308 residents consumed 227,359,090 kWh of electricity, or about 9,103 kWh per household, and 10,808,054 therms of natural gas, or about 433 therms per household. This consumption resulted in a release of 220,036 tons of CO_2e. Major residential energy uses include refrigeration, lighting, and water heating.

Commercial/Industrial

In 2006, Tracy's commercial/industrial sector buildings consumed 678,989,309 kWh of electricity and 16,160,661 therms of natural gas. This consumption resulted in a release of 160,401 tons of CO_2e into the atmosphere.

While industrial establishments are located in Tracy, separating the emissions attributed to industrial facilities from those from commercial facilities is not possible. Calculating separate Commercial and Industrial energy consumption is constrained because PG&E is not permitted by the California Public Utilities Commission to release that aggregate data, under the '15-15 rule.' If any single private industrial customer makes up more than 15% of the total industrial usage or there are fewer than 15 total industrial customers, PG&E is required to "roll-up" or combine the industrial data into the commercial sector to prevent a 15-15 confidentiality violation.

Fugitive Emissions/Refrigerants

In 2006, Tracy's residential and commercial/industrial sectors use of refrigerants and leaking pressurized equipment resulted in a release of 90,233 tons of CO_2e. These emissions were measured at a 1.1 $MTCO_2e$ per capita rate based on data from the California Air Resources Board. The estimate is included in the inventory as refrigerants, but is defined broadly to include CFCs and HCFCs, and the emissions are considered "High Global Warming Potential GHGs." For more information regarding the methodology of how this was calculated, please refer to Appendix A. At the time this report was written, the City of Tracy did not have a standardized method of recording fugitive emissions and refrigerants emitted by the residential, commercial, or industrial sectors.

Stationary Sources

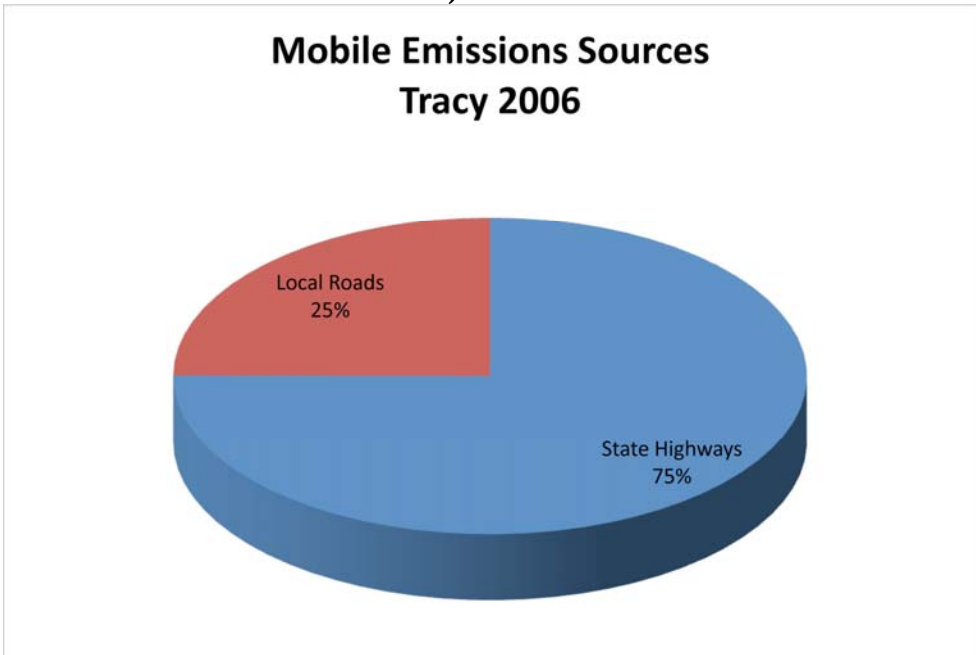
Commercial and industrial facilities consume both electricity and natural gas, and may consume other types of fuel onsite for operation of their equipment or vehicles. Information regarding propane and kerosene used by private entities was not tracked by the City of Tracy, and at the time of this inventory, was not available. However, the off-road emissions inventory from the Air Resources Board (ARB) show that construction, agricultural, recreational, and industrial equipment and vehicles consumed 1,852,417 gallons of diesel, 255,700 gallons of gas, and emitted 23,949 tons of CO_2e. Including aviation gas and jet fuel, the off-road emissions were responsible for emitting 24,873 tons of CO_2e. These off-road emissions are accounted for in the transportation emissions section.

Transportation Emissions

The community transportation sector, including travel on state highways, local roads, and the commuter train, as well as all off-road emissions, is responsible for approximately 63.43% of Tracy's greenhouse gas emissions. Motor vehicles driven within the City's geographical boundaries on both local and state roads emitted approximately 823,136 tons of CO_2e in 2006. The regional commuter train, ACE, plus aviation and jet fuel from the Tracy Municipal Airport contribute another 1,664 tons of CO_2e, or 0.2% of the transportation emissions. Off-road vehicles and equipment emitted approximately 24,873 tons of CO_2e in 2006, accounting for 2.9% of the transportation emissions. The VMT model used to help calculate the motor vehicle emissions does not account for travel passing through Tracy without either a point of origin or a destination within the city.

Figure (c) shows the breakdown of greenhouse gas emissions by vehicle miles traveled (VMT) from local roads and VMT from state highways. Of the total 823,136 tons of CO_2e emitted from transportation on all roads, 25% was from local roads and 75% was from state highways. This percentage does not include off-road emissions.

Figure (c): Tracy Community Greenhouse Gas Emissions Breakdown (Local Roads and State Roads) - Year 2006



Calculations for transportation emissions are based on figures for total VMT in the City of Tracy. Fehr and Peers supplied the necessary VMT data, the breakdown of vehicle types, and the percentage of vehicles in each speed-bin.

Solid Waste Emissions

In 2006, Tracy sent approximately 92,202 tons of solid waste to the San Joaquin County Foothill Landfill, resulting in 18,190 tons of CO_2 e emissions. Of this total landfilled waste, 66,600 tons were hauled by Tracy Delta Waste Management and passed through the Tracy Delta Facility. 25,602 tons of waste was hauled by individuals, landscapers, and construction companies. Tracy employs recycling measures to reduce the amount of waste sent to landfills.

Greenhouse gases are generated by landfilling the waste, and by the decomposition of the organic fraction, which produces methane. Methane is a greenhouse gas 21 times more potent than carbon dioxide. Table (2) shows the approximate breakdown of the materials Tracy sent to landfills in 2006. The WARM model estimates the CO_2e emissions released from the landfill based on the percentages of waste from a 2003 study for Cascadia, California. At the time this inventory was written, San Joaquin County had not conducted a more current waste characterization study.

Table (2): Tracy Waste Composition

Waste Type	Waste Share
Paper Products	21%
Food Waste	15 %
Plant Debris	14 %
Wood/Textiles	23 %
All Other Waste	27 %
TOTAL	**100 %**

Source: Tracy Delta Solid Waste Management

The U.S. EPA's Waste Reduction Model (WARM) model is used to estimate the greenhouse gas impacts of landfilling Tracy's waste. The WARM model makes the following assumptions in the analysis: 75% of landfill gas, methane, is collected and flared, so that only 25% escapes to the atmosphere. The flaring of methane converts it back into CO_2. The calculation does not account for any sequestration at the site. The landfill is 20 miles from the transfer station, so the model accounts for the energy used in the transfer of waste to the landfill.

The CACP software calculates waste disposal emissions using a model based on the WARM model and is therefore consistent with national standards.

However, the CACP software does not fully account for or reflect the emission reductions in the energy use from recycling and composting programs. This is important because recycling and composting programs can have a significant impact on reducing GHG emissions. Tracy Delta Solid Waste Management calculated that Tracy's recycling programs helped avoid 24,266 metric tons of CO_2e in calendar year 2006. Recycling also avoids GHG emissions by returning materials back into the production stream to replace the use of virgin materials that require additional energy use in the production of goods, and by recycling paper products that avoid cutting down forests.

2. Municipal Operations Emissions Inventory

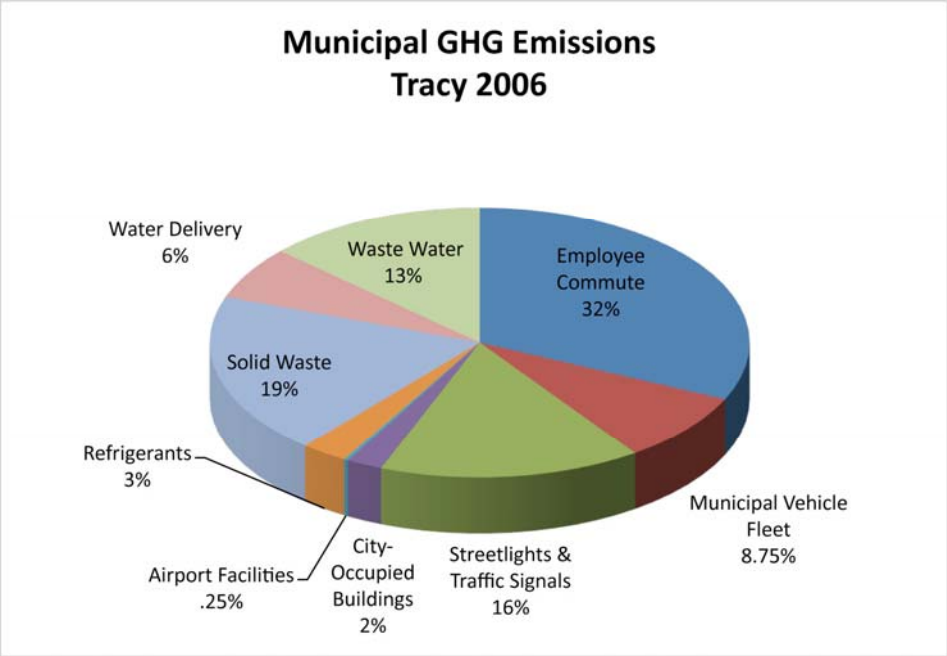
In the base year of 2006, Tracy's municipal operations generated 11,449 tons of CO_2e. As Table (3) and Figure (d) show, the emissions from City's employee commute accounted for the plurality of emissions at 32%.

Table (3): Tracy Municipal Emissions Summary

Potential Sources	Equiv CO_2e (tons)	Energy (MMBtu)
Buildings/Facilities	247	4,191
Vehicle/Transit Fleet	958	12,230
Employee Commute	3,650	46,671
Streetlights/Traffic Signals	1,798	26,696
Water Delivery	722	10,720
Wastewater	1,512	23,799
Solid Waste	2,211	5,009
Fugitive Emissions/Refrigerants	323	0
Airport Facilities	28	406
TOTAL	**11,449**	**129,722**

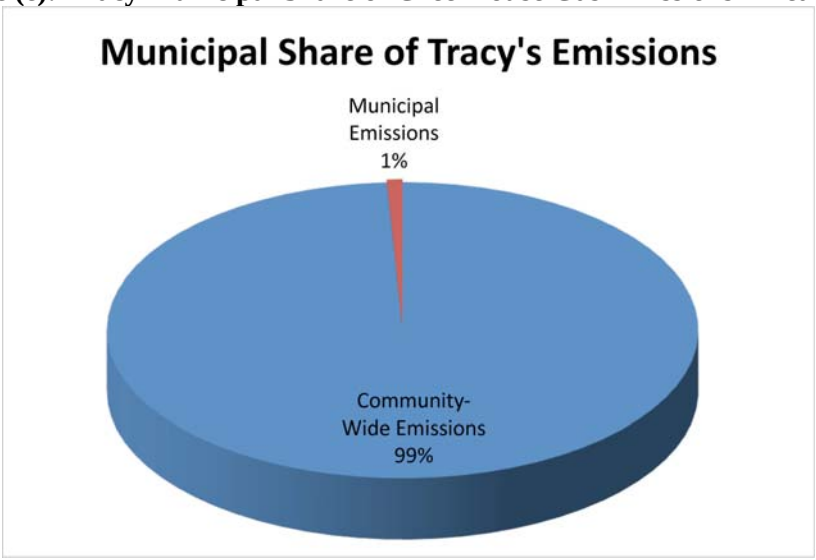
Source: CACP Model output

Figure (d): Tracy Municipal Greenhouse Gas Emissions – Year 2006



Source: CACP Model output

Figure (e): Tracy Municipal Share of Greenhouse Gas Emissions – Year 2006



Source: CACP Model output

Municipal emissions in Tracy constitute less than 1% of Tracy's total emissions. Local government emissions typically fall between one and five percent of overall community emissions. Appendix B shows the results of the CACP analysis. As a minor contributor to total emissions, actions to reduce municipal energy use may have a small impact on Tracy's overall community emissions levels. However, municipal action can help reduce operation costs and has symbolic value demonstrating leadership that extends beyond the magnitude of emissions actually reduced.

Energy/Stationary Source Emissions

In 2006, Tracy municipal buildings, facilities, streetlights, and water distribution consumed 11,115,896 kWh of electricity and 40,743 therms of natural gas, which resulted in a release of 2,795 tons of CO_2e emissions into the atmosphere.

Although the City manages the distribution of water supply, almost all water goes towards community water consumption. Only 1.3% of total water demand within the City is from institutional users. In 2006, imported and local water distribution consumed 3,140,931 KWh of electricity, which used 10,720 MMBtu and released 722 tons of CO_2e. No natural gas is used for water distribution. It should be noted that energy emissions from water distribution accounts for facilities and pumping within Tracy's boundaries, as well as from imported water from the Delta Mendota Canal and the Stanislaus River. According to Tracy's 2005 Urban Water Management Plan, surface water has historically comprised between 50 to 60% of the City's total water supply. All of the City's surface water is imported, and its ground water is taken from inside Tracy's boundaries. As groundwater supplies decrease and water demand increases, Tracy intends to increase its imported surface water supply, thus increasing the City's electricity consumption.

Transportation Emissions

The City's vehicle and transit fleet consumed 97,605 gallons of fuel and emitted about 958 tons of CO_2e. The municipal vehicle fleet includes all vehicles owned and operated by the City of Tracy plus some contractor vehicles performing City functions. The transit fleet includes Tracer, the public bus system.

Waste Emissions

The City of Tracy's wastewater and solid waste facilities consumed 4,647,311 kWh of electricity and 107,948 therms of natural gas. This consumption emitted 3,803 CO_2e emissions into the atmosphere. The Tracy Wastewater Treatment Plant processes approximately 8 million gallons of wastewater per day and releases approximately 375 tons of methane per year. This methane is not released into the atmosphere, but is used for heat generation in the two solid waste digesters.

Tracy Delta Solid Waste Management does not distinguish between municipal waste and community waste, therefore municipal solid waste production is rolled into the 92,206 tons of waste sent to the landfill. (See Waste section in the Community Analysis.) The City of Tracy has recycling programs that help to reduce waste stream and CO_2e emissions.

III. Forecast for Greenhouse Gas Emissions

Town-Green used Tracy's community and municipal operations emissions inventories developed for the base year 2006 to forecast future emissions for the year 2020 and 2050. The emission forecast represents a business-as-usual (BAU) prediction of how greenhouse gas (GHG) emissions may change in the City of Tracy over time.

Community Forecast

Projections of greenhouse gas emissions are based on the assumption that energy consumption will grow as population increases. For the community analysis, the forecast was conducted by applying population growth factors to Tracy's base year residential, commercial/industrial, and transportation data. Between 2006 and 2020, the forecast reported a 31.1% growth in emissions based on a BAU scenario. For the municipal operations analysis, the City's Public Works Department forecasts a 20% growth in emissions.

Transportation emission forecasts

The community forecast for transportation emissions were based on projected City land use for 2020 and 2050. For 2020, Fehr & Peers estimated the release of 1,106,620 tons of CO_2e, a 34.2% growth in

emissions from 2006. In 2050, it is predicted that there will be ___ tons of CO_2e, a ___% growth in emissions.

Refrigerant emissions forecast

Refrigerant emission numbers were based on the ARB's statewide growth in per capita emission estimates. The refrigerant emissions include ozone depleting substances (ODS) and HFC. The ARB used 2007 as their baseline for the per capita emissions, and assumes that the 2007 emissions are similar to the 2006 emissions. The ARB forecasts that in 2020, the metric tons of CO_2e will increase by 26.9%, from 90,233 metric tons of CO_2e in 2007 to 114,477 metric tons of CO_2e in 2020. Between 2007 and 2050, emissions will decrease by 9.1%, to 190, 264 metric tons of CO_2e. The 2050 estimate takes into account trends between 1990 and the present, and takes into account the Montreal Protocol phase-out of CFCs and HCFCs. It assumes that these refrigerants will be replaced by reduced-CO2e gases such as HFO-1234yf that have a very low global warming potential (GWP). See Appendix C for the methodology for this estimate.

Please note that the BAU scenario for Tracy's community-wide emission forecast assumes that the City's Growth Management Ordinance (GMO) remains constant over time. The City of Tracy adopted a GMO in 1987 and amended it in 2000. The GMO aims to help Tracy achieve a steady and orderly growth rate that allows for the adequate provision of services and community facilities, and includes a balance of housing opportunities. The GMO limits the number of Residential Growth Allotment (RGAs) and building permits to an average of 600 housing units per year for market rate housing, with a maximum of 750 units in any single year, although there are exceptions for affordable housing. This means that the estimated rate of fuel consumption for residential, commercial, industrial, and municipal facilities may be lower than the calculations predicted by the ICLEI model.

Municipal forecast

The municipal forecast was based on the growth expectations for buildings and facilities, parks, and infrastructure. Information available regarding the expected increase in square footage for municipal operations was very limited, and PG&E was unable to provide a forecast of energy consumption. City staff was able to provide the square footage and future construction plans for Tracy's fire facilities, the square footage of existing and planned park space, and the planned increases in the water and wastewater treatment plants' capacities. Public Works staff estimated that the wastewater treatment plant's capacity might increase by 33% by 2020, and by 78% by 2050. Assuming that the CO_2 emissions per KWh stay constant between 2006 and 2020, CO_2 emissions will increase by almost 40% in 2020, and 116% by 2050. However, when staff averaged these growth rates of CO_2 emissions with the growth rate of parks, the water treatment plant, and the firehouse facilities, a 20% increase in energy consumption and CO_2 emissions was estimated. The raw data considered in this estimate is included in Appendix D.

Water Supply emission forecasts

The ICLEI software forecast does not calculate the increased rate of GHG emissions from an increase in imported water from outside of Tracy's political boundaries. Based on the City of Tracy's 2005 Urban Water Management Plan, Tracy will consume 23,900 acre-feet in 2020, resulting in the consumption of 4,402,830 KWh, and the release of 1,012 metric tons of CO_2e. This represents a 2.87% increase from 2006 levels. The UWMP assumes a 9.21% increase in water consumption every five years from 2005-2020; this same growth rate was used to project a water demand of 40,537 acre-feet in 2050. This will result in the consumption of 7,467,679 KWh, and the release of 1,717 metric tons of CO_2e, representing a 3.13% increase from 2006 levels. These calculations do not factor in special energy conserving technology for water distribution that may be implemented in the future.

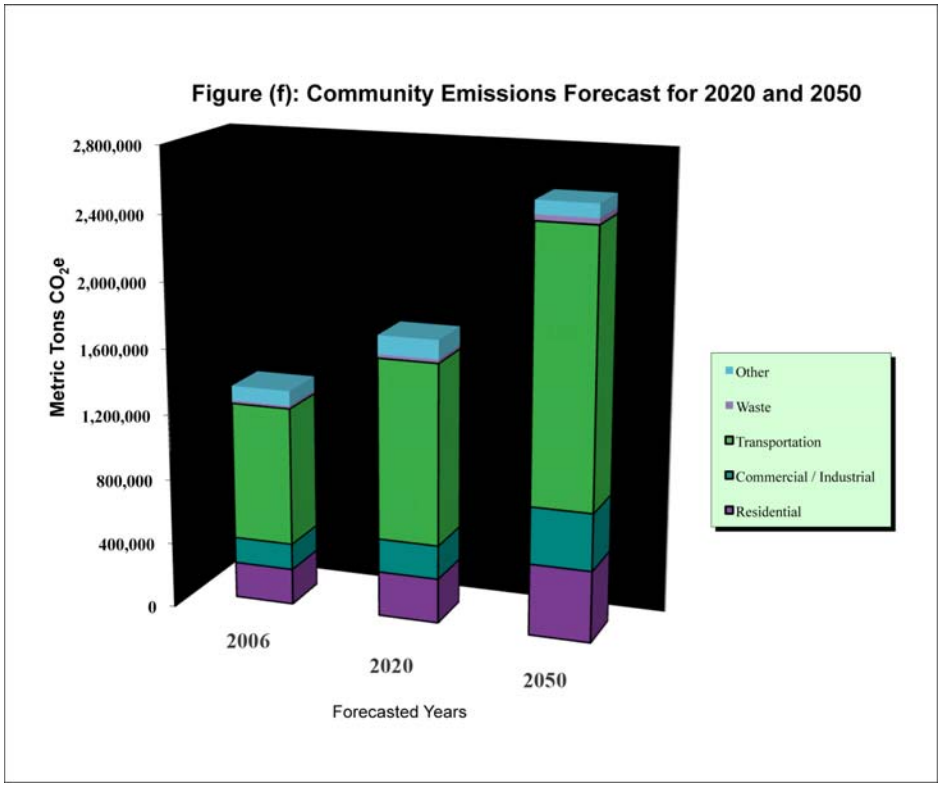
Table (4) provides an emissions summary for Tracy's base year and forecast year.

Table (4): Tracy's Emissions Summary

Tracy's Emissions Summary		
	Community Analysis	**Municipal Operations Analysis**
Base year	**2006**	**2006**
Indicators used to generate forecast	1.99 % (Annual population growth rate based on the April 2009 Draft Supplemental EIR for the General Plan Amendment)	1.42% (Annual rate based on increase in municipal operations)
Quantity of CO_2e emissions in base year (metric tons)	1,336,869	11,449
Forecast year	**2020**	**2020**
Business-as-usual projection of CO_2e emissions in *2020* (metric tons)	1,722,937; 28.9% increase over baseline	13,948; 21.8% increase over baseline
Forecast year	**2050**	**2050**
Business-as-usual projection of CO_2e emissions in *2050* (metric tons)	2,568,068; 92.1% increase over baseline*	21,291; 86% increase over baseline

Source: CACP Model Output

*Fehr & Peers will be providing the 2050 forecast for mobile transportation vehicles. The revised 2050 transportation forecast should be added to the Tracy Forecast Builder worksheet in order to calculate the 2050 community analysis' BAU projection.



Source: CACP Model output

Conducting an emissions forecast is essential for setting an emissions reduction target, since the amount of GHG emissions Tracy pledges to reduce will be derived from projected emissions. Appendix C provides the results of the CACP analysis.

IV. Conclusion

This greenhouse gas emissions inventory report represents a profile of the greenhouse gases that the City of Tracy emitted in its base year, 2006, from community and municipal sources. The report also estimates the greenhouse gases that the City will emit in the year 2020 and 2050, if the community and municipality continue to emit business-as-usual GHG emissions, without additional emission reduction actions or a growth management ordinance.

This inventory is a crucial tool for the City as it develops a climate action plan with new policies, regulations, programs, and practices to meet its emission reduction targets. The inventory serves to direct the City towards the major sources of greenhouse gas emissions. For example, the community inventory for the City of Tracy reveals that the transportation sector is responsible for 63% of total emissions. In response, the city might implement actions that reduce the frequency and length of motor vehicle trips, decrease fossil fuel consumption, and reduce the toxicity of tailpipe emissions. Potential action items may include improving the connectivity to and diversity of destinations for pedestrians and cyclists and increasing public transportation frequency and convenience.

The inventory demonstrates that the municipal government emissions comprise a minimal percentage of community emissions, less than one percent. However, the City of Tracy has the opportunity to exhibit strong and visible leadership role in addressing climate change by reducing its own emissions.

Appendix A – CACP Reports by Sector, Data Sources, Assumptions and Notes for the Community Inventory

See PDF files: Appendix A_Tracy Community-Wide CACP Reports.pdf, Appendix A_Fehr and Peers Community-Wide Transportation Report.pdf, Appendix A_Solid Waste Stream Worksheet.pdf, Appendix A_ARB Refrigerant Emissions Worksheet.pdf

Assumptions

The greenhouse gas inventory calculates emissions based on many assumptions.

- The population and job growth did not account for the recent economic depression. This data assumes that the population and job growth rate will be consistent with past trends. The BAU forecasts do take into account the Growth Management Ordinance that limits the residential growth allotment and building permits per year. This inventory assumes the Ordinance will not be significantly modified in the near future.
- Fugitive emissions and refrigerants from non-municipal or municipal operations are not documented in the City of Tracy. This data was extrapolated from California Air Resources Board's refrigerant calculations on a per capita basis. It was assumed that the consumption per capita rate of emissions is the same throughout California.
- The BAU forecast uses 2030 emissions factors which reflect projected improvements in vehicle efficiency but since it is based on the baseline General Plan land use plan, it does not reflect reductions in VMT due to progressive land use and transportation planning.
- Forecasts are based on "business-as-usual" projections. This does not take into account future changes in federal and/or state regulations which address energy consumption and greenhouse gas emissions
- BAU forecasts also do not consider any change in the electricity grid emission factor. The emission factor will likely change in the future as utilities use more renewable energy and as power plants become more efficient. Lastly, it also doesn't consider adjustments to the per capita energy use; these may increase or decrease according to a mix of technology and behavior changes.
- Forecasts for 2050 use the same the growth rate as that which was used for the period of 2006 – 2020. This is using the BAU assumptions, and assumes that the Growth Management Ordinance will continue to be enforced.

Community Analysis Methodology

The data entered into the ICLEI software came from numerous sources of information.

- The residential, commercial and industrial electricity and natural gas data came directly from PG&E.
- Industrial establishments: No energy information is available for industrial establishments under rule 15-15. If any one private industrial customer makes up more than 15% of the total industrial usage or there are fewer than 15 total industrial customers, PG&E is not permitted by the California Public Utilities Commission to release that aggregate data.
- Transportation: Transportation data came from a combination of sources: Fehr & Peers wrote a VMT report, ACE provided data on Tracy ridership and train fuel consumption, and the Tracy airport facilities provided data on aviation and jet fuel for the private airplanes and jets. The off-road emissions were calculated with the ARB's Off-Road Emission model. The model calculated off-road emissions for San Joaquin County. Approximately 0.2% of San Joaquin County's agriculture is in Tracy, therefore, 0.2% of the off-road agricultural equipment was assumed originate in Tracy. Based on data from the San Joaquin Council of Governments, 16% of construction in San Joaquin County is in Tracy, and 5.49% of industrial off-road equipment is in

Tracy. Tracy's population is 12% of San Joaquin County; this number was used as an approximation to calculate Tracy's consumption of fuel from recreation, and small utility vehicles.

- Solid Waste: Solid waste data was provided by Tracy Delta Waste Management. An additional analysis, provided by consultants Edgar and Associates, explains the amount of CO_2e emissions avoided by the City's recycling program. This information is explained in the appendix below.
- Refrigerants: Refrigerant information, under "other" category, was provided by the Air Resources Board (ARB), which calculated a detailed analysis of refrigerants per capita in Tracy, and also broke those emissions down into community and municipal use. The 1.1 $MTCO_2e$ per capita measurement includes CFCs and HCFCs. For more information, please refer to the detailed methodology below.
- Water**:** Emissions from water distribution and treatment are reported in the government analysis section because water is a city managed resource. However, only 1.3% of total water demand within the City is from institutional users.[1]

Waste Methodology

There is a discrepancy between the ICLEI software and the WARM model:

WARM calculates the methane generation potential of the landfilled waste and allocates that amount of methane generation in the year that the waste is placed, even though the landfill gas will be generated over many years. This is different than most landfill gas generation models, which use a first order decay equation to allocate the potential methane generation over future years in accordance with a decay constant for the waste.

Edgar & Associates produced a report detailing the waste stream handled by Tracy Delta Waste Management Company, and describing the CO_2 emissions avoided by the recycling and composting program. Their final number is slightly different than the number calculated through the ICLEI software, possibly because of the different calculation methods. Edgar & Associates report that the "net" result, which is emissions generated less carbon storage, is -12,258. The carbon storage amount is -33,595, so the actual emissions generated are 24,747 $MTCO_2e$. See PDF file, Appendix A_GHG Landfilling Transfer Tonnages.pdf

San Joaquin County has done no waste characterization studies since the state-wide study in 2003, so the Cascadia study was the best information available for waste stream information.

The percentages in the Cascadia study were applied to the 66,600 tons of waste that is landfilled, so that an assumed waste characterization embedded in the WARM model that is based on national averages isn't be relied on.

There is a difference between the tonnages reported by Tracy Delta for recyclables and landfilled waste and those that the city reported to the CIWMB as far as disposal and diversion.

In addition, the WARM model accounts for the energy used in the transfer of waste from the transfer station to the landfill, a distance of 20 miles. Due to modeling limitations, these trips are also counted in the transportation section.

[1] 2005 Tracy Urban Water Management Plan, page 13

Disposal Tonnages

Tracy Delta tracks the origin of all waste that passes through their facility. In 2006, total tons of outbound waste to the landfill was 104,885 and the amount originating in the City was 66,600 tons, meaning that 38,285 tons of landfilled waste managed by Tracy Delta originated outside of the City. The City of Tracy reported to the State that 92,202 tons were disposed in 2006, which is 25,602 tons greater than the 66,600. However, there is also waste that originates in the City that doesn't pass through the Tracy Delta facility and isn't hauled by Tracy Delta. For instance, individuals, landscapers, and construction companies may haul waste directly to the landfill themselves and those tonnages would not be known by Tracy Delta.

There is a State Disposal Reporting System that requires haulers and disposal facilities to report the tonnage of waste back to the jurisdiction of origin, so the City should have records of disposed waste by Tracy Delta and any other haulers. At the time this inventory was written, the City was not able to track down this information.

Recyclables

Tracy Delta collects garbage, recyclables and green waste in 3 separate containers. The weight of recyclables was 20,136 tons and green waste was 3,772 tons. For purposes of calculating greenhouse gas impacts, the green waste was assumed to lose half of its mass during composting.

Fugitive Emissions/Refrigerants Methodology

The ARB's source of data is the U.S. EPA Vintaging Model estimates for CFC, HCFC, HFC, Halon, and PFC emissions (attached). The national estimates to California's 12.5% share of population was scaled down. It was assumed that the per capita emissions in 2010 (estimated) would be about the same as those for 2006 or 2007.

For the large commercial refrigeration and AC systems (greater than 50 pounds charge of refrigerant), ARB's own methodology was used, as described in detail in Appendix B of the Initial Statement of Reasons of ARB's Refrigerant Management Plan (rule and appendices available on our website at: http://www.arb.ca.gov/cc/reftrack/reftrack.htm (go to "What's New"; click on that link, and scroll down to Appendix B "California Facilities and Greenhouse Gas Emissions Inventory".)

There was a discrepancy between the ICF estimates and ARB estimates of the fugitive emissions/refrigerants for the community analysis. This can be explained as followed:

ARB's per capita emissions included all sources of CFC, HCFC, HFC, Halon, and PFC emissions in California. ICF may be looking at HFC emissions only; as CFC and HCFC emissions are often not counted towards GHG inventories (CFC and HCFC are ODSs are supposed to be gradually eliminated through the Montreal Protocol, and therefore, are generally not counted towards GHG reduction goals). On the attached Vintaging Model spreadsheet, it is shown the HFC-only per capita emissions to be about 0.45 $MTCO_2e$ per Californian, which is closer to the ICF estimate of 0.36 $MTCO_2e$/person. When Refrigerant HFC emissions only are looked at, it is estimated to be 0.38 $MTCO_2e$/person, which is very close to the ICF estimate.

The methodology for estimating refrigerant emissions from large commercial refrigeration and AC systems is spelled out in great detail in Appendix B Initial Statement of Reasons for the Refrigerant Management Plan CARB will put forth for Board adoption December 9, 2009. All other sources (residential AC and appliances, insulating foam, consumer products, etc.) have been scaled down from national estimates based on the U.S. EPA Vintaging Model (data source: VM IO File_V4_3.25.08.xls) A description of the methodology used in the U.S. EPA Vintaging Model can

be found in EPA document 430-R-05-003 "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003". It's in Section 3.8, page 158 (available on US EPA website at http://epa.gov/climatechange/emissions/usgginv_archive.html.

If the methodology of the GHG inventory report calls for only HFCs from refrigerants, the most accurate per capita emissions to use are 0.36 to 0.38 MTCO2e/person (California average). To show HFC emissions from all sources (refrigerant plus non-refrigerant), use the estimate of 0.45 MTCO2e/person.

Appendix B – CACP Reports by Sector, Data Sources, Assumptions and Notes for the Municipal Inventory

See PDF file, Appendix B_Tracy Government Operations CACP Reports.pdf

Municipal Assumptions

- The population and job growth did not account for the recent economic depression. This data assumes that the population and job growth rate will be consistent with past trends. The BAU forecasts do take into account the Growth Management Ordinance that limits the residential growth allotment and building permits per year. This inventory assumes the Ordinance will not be significantly modified in the near future.
- Fugitive emissions and refrigerants from non-municipal or municipal operations are not documented in the City of Tracy. This data was extrapolated from California Air Resources Board's refrigerant calculations on a per capita basis. It was assumed that the consumption per capita rate of emissions is the same throughout California.
- The City of Tracy's 2005 Urban Water Management Plan (UWMP) states that future water contracts with other water districts and retailers are possible. New energy emissions will need to be calculated for future sources of imported water.
- Forecasts are based on "business-as-usual" projections. This does not take into account future changes in federal and/or state regulations which address energy consumption and greenhouse gas emissions
- BAU forecasts also do not consider any change in the electricity grid emission factor. The emission factor will likely change in the future as utilities use more renewable energy and as power plants become more efficient. Lastly, it also doesn't consider adjustments to the per capita energy use; these may increase or decrease according to a mix of technology and behavior changes.

Municipal Analysis Methodology

All of the data for the municipal analysis was collected from the individual departments related to each sector. Town-Green spoke with employees in the Public Works dept, Planning dept, Public Utilities, Airport, Solid Waste, Economic Development, and Tracer (the public bus system). All of these departments supplied us with information regarding fuel consumption. Much of this data had to be calculated further in order to isolate the information demanded by the CACP software. Should ICF or DC&E have questions regarding how specific numbers were arrived at, please contact Town-Green.

Methodology for calculating Embodied Emissions from Imported Water

In addition to the groundwater that is drawn from within the City boundaries, currently there are 2 sources of imported water: Mendota Canal (Central Valley Project), and the South San Joaquin Irrigation District. All water distribution uses electrical energy.

Delta Mendota Canal (DMC)

Approximately 7,500 ac-ft of water per year moves from the Shasta Dam, which produces electricity, to the WAPA power plant, which is directed by the *Bureau of Reclamation*. The water delivery to WAPA and to the Tracy Processing Plant is via gravity and uses minimal electricity. At the processing plant, there is one 250-foot lift, which uses a significant amount of electricity. This treatment plant's energy consumption is accounted for in Tracy's municipal PG&E bill.

South San Joaquin Irrigation District (SSJID)
The water for SSJID originates from 3 dams, all which generate energy. The water flows by gravity to the Woodward Reservoir and then to the Nick deGroot water treatment plant. Here, there is electricity consumption. 2006 electricity data was not available, therefore, 2007 data was used for SSJID imported water. In 2007, Tracy was responsible for 1,958,581 KWh being used. The water pump in Lathrop, which sends water to Tracy, used 3,313 KWh. Tracy was responsible for 1,961,894 KWh from SSJID water distribution.

Waste Water
The Tracy Waste Water Treatment Plant processes approximately 8 million gallons/day of wastewater. The WWTP emits between 90-116,000 cubic feet/day of CH4

Methane emission Calculations:
1 million cu. ft. of natural gas = 18.91 tons liquid

Therefore the methane content of digester gas is 60% of natural gas so then 1 Mcuft = 0.6 x 18.91 = 11.4 tons liquid

In one year the Tracy WWTP generates 90,000 cu. ft. x 365 days = 32,850,000 cu. ft. or 32.85 Mcuft or 375 tons liquid. The methane is not released into the air, but is used to generate heat for the 2 digesters.

Appendix C –Summary Report for the Community Emissions Forecast

See PDF file, Appendix C_2020 Tracy VMT Forecast Report.pdf, Appendix C_Tracy Refrigerant Forecast Worksheet.pdf, Appendix C_Tracy Forecast Builder.xls

Community Forecast
ICLEI recommended that we use their in-house forecast builder, rather than the forecast in the ICLEI software. The ICLEI software is limited in its prediction capabilities because PG&E does not predict the mix of energy types that will be used in the future, and therefore 2006 data was used in the forecasts. Please refer to the excel spreadsheet for the details of the Community Forecast for 2020 and 2050.

The data which Town-Green was required to input in the excel sheet is highlighted in red.

- The CO_2e numbers for 2006 came from the CACP software summary reports.
- The population calculation for 2006, 2020, and 2050 came from the General Plan.
- The job count for 2006 came from the April 2009 Draft Supplemental EIR for the General Plan Amendment. Data from the General Plan was used to calculate the annual growth rate, and this growth rate was used to calculate the projection for 2020 and 2050.

Transportation emission forecast
Fehr & Peers calculated the forecast for 2020 and 2050 using the baseline data for 2006. Please refer to PDF file, Appendix C_2020 Tracy VMT Forecast Report.pdf

Refrigerant emission forecast
Glenn Gallagher from the Air Resources Board estimated the forecast for 2020 and 2050 based on the ARB's statewide per capita emission estimates. Please refer to PDF file, Appendix C_Tracy Refrigerant Forecast Worksheet.xls

The summary table breaks out emissions by ODS versus HFC. They are measured in metric tons of CO_2e.

California Per Capita CFC, HCFC, and HFC emissions (and HFO-1234yf substitute in 2050):

Year	per capita total GHG emissions CFC, HCFC, HFC (MTCO2e) in CA	per capita HFC (Kyoto gas) MTCO2e only	per capita ODS (CFC + HCFC) MTCO2e	Note
2007	1.121	0.413	0.707	
2020	1.147	0.891	0.256	BAU
2050	1.175	1.009	0.165	BAU
2050	0.330	0.168	0.162	With HFC phase-out

ARB used a one percent per year growth rate for pounds of material used and a 1.56% annual population growth rate. The 2020 proportion of materials used is from the US EPA Vintaging Model estimates.

The 2050 proportion of materials used is a little more hypothetical, even assuming business-as-usual. CFCs, HCFCs, and even HFC usage will largely go away, to be replaced by new refrigerants such as HFO-1234yf, which has a global warming potential of 4. It was assumed that in 2050, 80 % of refrigerant usage is HFO-1234yf, or a similar very low GWP refrigerant; and 20 % is still HFC-134a. Although it is not for certain that HFC usage will be limited after 2020, all signs point to HFC usage being severely limited after 2020 either through a US climate bill or HFC's inclusion as a Montreal Protocol refrigerant with a timetable for its gradual elimination.

Appendix D – Summary Report for the Municipal Emissions Forecast

See PDF file: Appendix D_City Facilities Sq Ft 2009.pdf

Municipal Forecast

For reasons similar to the community analysis, the CACP software was not sufficient to forecast municipal CO_2e emissions. ICLEI did not have a forecast builder for municipal operations, therefore Town-Green has been working with the City of Tracy and PG&E to predict energy emissions for 2020 and 2050. This information is pending while PG&E looks for requested data. Although it will be helpful for the City of Tracy to know the forecasted growth of municipal operations, this data will not make up a huge portion of Tracy's overall future emissions. The municipal operations account for less than 1% of Tracy's emissions, so the BAU forecasts most crucial to understand will be from the Community sectors.

Water Delivery Emission Forecast

The following calculations were based off of the 2005 UWMP's water forecasts for 2020. Year 2050 was calculated using a 9.21% increase every 5 years, as was seen in the forecast for 2020-2050.

Year	Water Demand ac-ft/Year	Total KWh consumed	Total metric tons of CO_2e emitted	Percent Increase from Base Year
2020	23,900	4,402,830	1,012	2.87%
2050	40,537	7,467,679	1,717	3.13%

Water Demand forecasts:
Year 2020: 23,900 af-ft/year
Year 2050: 40,537.18 af-ft/year
KWh per ac-ft/year= 2005 total KWh (3,140,931 KWh: imported and local)/Total water for 2005 (17,050 ac-ft/yr) = 184.22 KWh/ac-ft per year.

2020 KWh=184.22 KWh/ac-ft*23,900 ac-ft=4,402,830 KWh
2020 BTUs=15,027
CO2e=1,012 metric tons
2050 KWH=184.22 KWh/ac-ft*40,537 ac-ft=7,467,679 KWh
2050 MBTUs=25,487
CO2e=1,717 metric tons