Community Greenhouse Gas Emissions Inventory Quality Management Plan

September 2014

2013 and Previous Inventory Years

City of Fort Collins
Environmental Services

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I. Revision History

This section contains a history of **major** changes made to the City of Fort Collins Community greenhouse gas (GHG) inventory since 2005, the baseline year. A community inventory represents a useful tool for creating a quantitative understanding of emissions from community activities and provides a best estimate based upon current methodologies and data. That said - it is important to communicate to policymakers, staff, and community members that it does not represent a complete and unchanging picture of community emissions in the City of Fort Collins, nor does it represent asset ownership of emissions or reductions. It does represent a set of GHG emissions from community activities that local government exerts some control over. Inventories will evolve because the science, models, and data infrastructure behind available data are continually evolving, and for this reason, available data and emissions factors are continually being refined and made more accurate. Changes documented in this section generally include changes in overall methodology or significant changes in emissions factors, conversion factors, sources of activity data, or recalculations due to discovery of errors. A summary of the revision history is presented in Table 1:

Table 1. Revision History

Date	Revision No.	Where Published	Description of Changes	Impact on 2005 Baseline	Originator
2008	1	2008 Climate Action Plan (CAP) Status Report published July 2009	In 2009 the City undertook a project to review and update community GHG accounting procedures. Evaluation of the Community Inventory Methodology by the Brendle Group resulted in the following recommendations that were adopted: • Increased modeled average on-road fuel efficiency to better reflect current national averages • Included air travel by Fort Collins residents • Calculated landfill emissions using the Intergovernmental Panel on Climate Change and California Air Resources Board's (CARB) First Order Decay model that accounts for "waste in place" at the landfill as well as annual additions • Added embodied energy from recyclable materials to align with CAP reduction strategies • Reported community inventory in metric tons CO_2e	YES Revisions were made to 2005 through 2008 inventories to reflect these changes in methodology.	Recommendations by the Brendle Group were adopted by the City.

			rather than short tons. Annual GHG emissions were reported both with and without the carbon benefits of renewable energy certificates (RECs), however progress on the GHG goal is evaluated without considering the benefit of RECs.		
2009	2	2009 CAP Status Report	Three modifications were made to the emissions inventories to increase the consistency in reporting between the CAP, Fort Collins Energy Policy reporting, and the *Utilities for the 21st Century* Global Reporting Initiative (GRI) reporting. These changes affected the inventories from 2005 through 2008: • Community electricity usage data was updated to include "transmission" losses (line losses across Platte River Power Authority's (PRPA's) lines from the generation source to the distribution lines) • The electricity emissions factors were modified to include "owned wind generation" (i.e., Fort Collins' share of Medicine Bow and Silver Sage wind) in the factor • Community natural gas usage data was changed in all annual inventories to no longer be weather-normalized	YES The baseline inventory and subsequent inventories were revised to reflect these changes.	Recommendations from the Brendle Group and the Environmental Services Division (ESD) staff in order to increase consistency in reporting between various carbon accounting systems.
June 2010	3	2010 CAP Status Report	The vehicle miles traveled (VMT) distribution mix for the years 2008 and 2009 were updated to reflect new information from the Colorado Department of Public Health and Environment (CDPHE).	NO No changes to baseline.	ESD staff based on CDPHE updates.
April 2012	4	2011 CAP Status Report	The GHG Emissions Management System (GEMS) database was fully implemented and replaced most calculations in the Inventory Spreadsheet that was used in previous years to prepare the annual community GHG inventory. The following additional changes were made that affected the 2011 inventory: • Accounting for solid waste now includes new industrial sources of solid waste (e.g., concrete and asphalt,	YES Small change to the baseline as a result of activity data changes. However, revised solid waste	ESD staff based on improvements to inventory methodologies and data quality procedures.

			aggregates and wood waste from construction and demolition (C&D) projects, organics from breweries, and industrial landfill waste from City operations.) • VMT estimates changed based on a fall 2011 update of the Metropolitan Planning Organization (MPO) 2009 baseline model calibrated to local traffic counts and updated demographic data. • A revision of the Inventory Spreadsheet was used to perform a small subset of calculations (**Source:** H:/Environmental/Climate/2011 CAP Status/2011-Inventory_072612.xls) Small changes were made that affected the 2005 through 2010 inventories: • Small corrections were made to VMT distribution mix, residential electricity, and electricity distribution loss activity data during inventory years 2005 through 2009 as a result of an internal audit resulting in less than 0.05% change to any single year's total inventory emissions.	methodology did not change the 2005-2009 inventories because the data was not available for these years.	

Aug 2013	5	2012 CAP Status Report	The annual community GHG inventory was updated to incorporate all minimum requirements of the new ICLEI 2012 Community Protocol. The new methods incorporated into GEMS are:
			• 2012 ICLEI Community Protocol for Solid Waste Emissions
			  o Method SW.4 Fugitive CH_4 emissions from the community's materials that are disposed of in landfills regardless of where the landfilling occurs.
			  o Method SW.5 CO_2e emissions from process emissions associated with community-
				YES
				New methods were applied to the 2005 through 2012 inventories
					ESD staff based on updates to methods and inclusion of new methods to be compliant with the 2012 ICLEI Community Protocol

			generated waste sent to landfills. o Method SW.6 CO_2e emissions from collection and transport emissions. • 2012 ICLEI Community Protocol for Wastewater and Water Emission Activities and Sources o Method WW.1.a CH_4 emissions from combustion of anaerobic digester gas when fraction of CH_4 is known (Drake Water Reclamation Facility (DWRF)) o Method WW.2.a N_2O emissions from combustion of anaerobic digester gas when fraction of CH_4 is known (DWRF) o Method WW.7 Process N_2O emissions from wastewater plants with nitrification or denitrification (DWRF) o Method WW.8 Process N_2O emissions from wastewater plants without nitrification or denitrification (Mulberry Water Reclamation Facility (MWRF)) o Method WW.12 (alt) fugitive N_2O emissions from effluent discharge (both DWRF and MWRF) o Method WW.14 Energy-related emissions associated with water delivery and treatment (includes water conveyance, treatment, and distribution)		
2014	6	2013 Climate	No major revisions to methods.	YES < 0.1% change to	ESD staff

		Action Status Report		baseline and < 1% change to 2006 through 2012 inventories for minor changes in Vehicle Miles Travelled (VMT) distribution and/or water treatment data	
Note: Fort Collins community emissions inventories reported prior to calendar year 2005 are not discussed in this QMP because the new community carbon reduction goal, established by City Council in 2008, sets 2005 as the baseline year. The prior community carbon goal sets 1990 as the baseline year.					

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II. Introduction

Fort Collins, Colorado is located in northern Colorado in the foothills of the Rocky Mountains. The 55.58-square mile city lies approximately 5000 feet above sea level. The climate is moderate with four seasons and an average of 300 days of sunshine and 14.5 inches of precipitation a year. Fort Collins has a population of 151,330 residents (2013 estimate) with a median age of 29.3 (based the American Community Survey, 2008-2012 (5-year average).) Fort Collins is a home rule city with a Council/Manager form of government with an operating budget of $485 million (2013). Fort Collins operates its own municipal electric and water and wastewater utility.

This Quality Management Plan (QMP) was developed to provide a detailed reference document for the city-wide annual community greenhouse gas (GHG) emissions inventory and to provide complete transparency for the data sources, methods, and emissions and conversion factors used to prepare the inventory. The QMP also provides a record of major inventory revisions since the baseline year (2005) and establishes quality assurance and quality control (QA/QC) procedures to ensure data integrity. This QMP should be viewed as a "living document" that will be revised as necessary as changes occur and as new and improved methods become available for carbon accounting.

Contact Information for the Quality Management Plan (QMP)

Name of Community:	Fort Collins
Address:	Environmental Services Department 215 N. Mason, PO Box 580, Fort Collins, CO 50522-0580
Inventory Contact:	Bonnie Pierce, Environmental Data Analyst Phone: (970) 416-2648 Fax: (970) 224-6177 Email: bpierce@fcgov.com

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In 2008 Fort Collins' City Council renewed its commitment to climate protection by adopting Colorado's statewide goals to reduce greenhouse gas (GHG) emissions by:

20% below 2005 levels by 2020
80% below 2005 levels by 2050

III. Baseline Year Selection

The year 2005 was selected as the Fort Collins community GHG baseline year to measure future progress against. This aligns with Colorado's statewide goals.

Baseline Recalculation Policy

Previously the City's policy regarding recalculation of baseline year emissions was that recalculation was required if there were changes in accepted calculation methodologies that resulted in a 5% or greater change to the baseline year emissions. Since 2005 the emission factors and state-of-the-art of GHG accounting methodologies evolved substantially necessitating reassessment of the baseline recalculation policy. The following constitutes the revised baseline recalculation policy effective beginning 2011:

The following conditions will always trigger a baseline year recalculation:

a) Major changes in calculation methodology (e.g., new emissions factors)

The following conditions will only trigger a baseline year recalculation if the annual total of the following conditions exceed the 2% significance threshold:

a) Changes due to data accuracy and availability
b) Discovery of significant errors

IV. Boundary Conditions

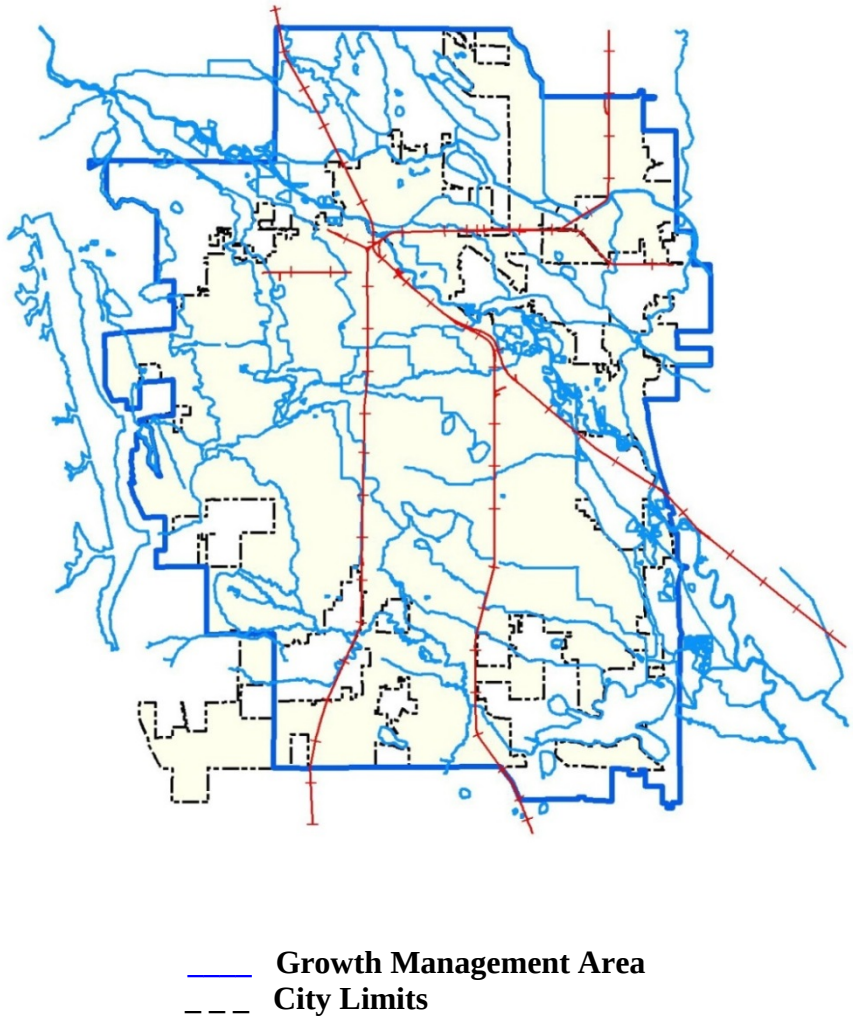
Community Boundaries

Figure 1 identifies the current City limits and Growth Management Area (GMA). For the purposes of the Community GHG Emissions Inventory, the City limit provides the geopolitical boundary for electricity and natural gas usage, solid waste, and recyclables data, and the GMA provides the geopolitical boundary for transportation data. Emissions that result from activities taking place within the geopolitical boundary of the community are emissions that can be controlled or influenced by City of Fort Collins policies and programs. In cases where a local government cannot maintain direct control of an emissions source within its boundaries, it is still important to inventory these emissions as local government policies and programs can still have an indirect influence on these emissions.

Many community emissions inventories have difficulty completely accounting for all emissions from a given community within defined boundaries because of indistinct boundaries that occur over time. However, the more exact a community can be in its accounting for deviations from defined boundaries, the greater the accuracy of the community GHG inventory. The following boundary assumptions and exceptions are noted for the City of Fort Collins community GHG inventory:

- 99%+ of data from Fort Collins Utilities (FCU) are from within City limits. A small number of electricity accounts are outside of City limits, most of which are in the area of Link Lane, which are included in the community inventory.
- Electricity usage data does not include the Water Treatment Plant, which is located outside City limits, however energy-related emissions associated with water delivery and treatment are accounted for using the ICLEI 2012 Community Protocol Method WW.14 since the City has direct influence over Water Treatment Facility operations.
- The vehicle miles traveled (VMT) modeling data that supports the calculation of GHG emissions from transportation activities covers the Fort Collins Metropolitan Attainment/Maintenance Area for Carbon Monoxide, as defined by the Colorado Department of Public Health and Environment (CDPHE). The maintenance area boundary is essentially the same as the City's GMA, with a very minor exception of a small parcel of land added to the southeast corner of the GMA that is not contained in the CO maintenance boundary.
- The method for calculating GHG emissions from air travel estimates the emissions from Fort Collins residents traveling out of Denver International Airport (DIA). It relies on zip coded enplanement data from DIA, to estimate travel from citizens in the Fort Collins area. The geographic coverage for Fort Collins' area zip codes is larger than the GMA.

Figure 1. Fort Collins City Limits and Growth Management Area



Greenhouse Gas Emissions Types

The GHG emissions types included in the inventory are shown in Table 2:

Table 2. Greenhouse Gas Emissions Types	
GHG	**City of Fort Collins Community Activities that Generate GHG Emissions**
Carbon dioxide (CO_2)	Mobile and stationary combustion; purchased electricity; natural gas for heating buildings; fuel consumption for transportation; jet fuel; solid waste disposal management, collection, and transport; and community water delivery, distribution, and conveyance
Methane (CH_4)	Natural gas; solid waste decomposition in landfills; jet fuel; and combustion of wastewater anaerobic digester gas
Nitrous oxide (N_20)	Natural gas; jet fuel; combustion of wastewater anaerobic digester gas; process emissions from wastewater denitrification, and conventional treatment methods including effluent discharge; and fugitive emissions from wastewater effluent discharge
Hydrofluorocarbons (HFCs)	Not included in inventory
Perfluorocarbons (PFCs)	Not included in inventory
Sulfur hexafluoride (SF6)	Not included in inventory

GHG Emissions Categorized by Scope

Emissions sources can be categorized according to where they fall relative to the geopolitical boundary of the community. Using this method, emissions sources are categorized as direct or indirect emissions: **Scope 1** – Direct Emissions, **Scope 2** – Indirect Electricity Emissions, or **Scope 3** – Other Indirect Emissions. The City reports the community inventory using gross GHG emissions that **exclude RECs and carbon offsets**. The Environmental Services Department (ESD) has determined which scopes to include in the inventory (Table 3) in consultation with the City's interdepartmental Community Carbon Team.

Scope 1 - Direct Emissions are from sources located within the geopolitical boundary of the City limits for emissions from natural gas usage and sources within the GMA for mobile combustion sources (e.g., ground travel), excluding rail.

Scope 2 – Indirect Emissions are associated with indirect GHG emissions from consumption of purchased electricity. Scope 2 emissions occur as a result of activities that take place within the defined geopolitical boundary of the local government, but occur at sources located outside of the government's jurisdiction (e.g., purchased electricity from Platte River Power Authority (PRPA) consumed by Fort Collins' citizens).

Scope 3 – Other Indirect Emissions result from activities such as the extraction and production of purchased materials and fuels, transport-related activities (i.e., air travel) for city residents that occur outside the boundary, outsourced activities, and solid waste.

Informational Category includes all other activities that affect net GHG emissions (e.g., benefit of RECs and known carbon offsets).

GHG emissions source scopes and data sources are detailed in Table 3:

Table 3. Greenhouse Emissions Scopes		
Emission Type	**GHG Emissions Category**	**Data Source**
Natural gas for residential, commercial, industrial, and transportation uses	Scope 1 - Direct	Xcel Energy
Ground travel	Scope 1 - Direct	City Transportation Planning, Northern Front Range Metropolitan Planning Organization (NFRMPO), and Colorado Department of Public Health and Environment (CDPHE)
Water Reclamation Facility process emissions	Scope 1 – Direct	Fort Collins Utilities[1]
Electricity for "Total Fort Collins Operational Control"	Scope 2 - Indirect	Platte River Power Authority (PRPA)
Electricity for residential, commercial, and industrial use *Note: This scope is a different way of looking at the nearly identical data presented under electricity for "Total Fort Collins Operational Control" above. No double counting occurs.*	Scope 2 - Indirect	Fort Collins Utilities
Electricity (50% for residential use and 50% for commercial use)	Scope 2 - Indirect	Xcel Energy
Solid waste	Scope 3 – Other Indirect	ESD's Waste Reduction and Recycling Program (WRRP)
Air travel	Scope 3 – Other Indirect	DIA and Fort Collins/Loveland Airport
Water Reclamation Digester gas	Scope 3 – Other Indirect	Fort Collins Utilities
Water Treatment and Distribution	Scope 3 – Other Indirect	Fort Collins Utilities
Total carbon offsets purchased by Fort Collins residents or businesses	Informational	Colorado Carbon Fund and Trees, Water & People, The Climate Trust
Renewable energy credits (RECs)	Informational	PRPA
"Embodied Energy in Recyclable Materials"	Informational	ESD's WRRP

[1] Fort Collins Utilities (FCU) is a municipally owned multi-service utility providing electric, water, wastewater, and stormwater services to the City of Fort Collins and surrounding areas. FCU receives electric generation and transmission services from PRPA, while FCU operates and maintains the electric distribution system facilities.

GHG Emissions Categorized by Sector

In addition to categorizing emissions by scope, communities can examine their emissions in the context of the sector that is responsible for those emissions. This sector-based approach can provide local governments with analyses more directly relevant to policy-making and project management, as it assists in formulating sector-specific reduction measures and climate action plan components. Table 4 describes the community sectors analyzed for the annual community inventory:

Table 4. Greenhouse Gas Emissions Categorized by Sector

Community Sector	Description
Residential	Electricity and natural gas usage in homes
Commercial	Electricity and natural gas usage in commercial businesses
Industrial	Electricity and natural gas usage in industrial businesses
Solid waste	Fugitive emissions at landfills, solid waste disposal management, collection, and transport,
Water and wastewater-related emissions	Community water delivery, distribution, and conveyance, combustion of wastewater anaerobic digester gas, wastewater denitrification, conventional wastewater treatment, and wastewater effluent discharge
Air travel	Fuel consumption from air travel by community residents
Ground travel	Fuel consumption from on-road vehicles by community residents within the GMA
Other electricity	Fugitive emissions associated with electricity transmission and distribution losses
"Recyclable Materials Energy"	Emissions associated with recyclable materials disposed of at landfills rather than recycled[2]

V. Emissions Quantification

Background

GHG accounting protocols have evolved rapidly over the past few years. In 2009 the City undertook a project to review and update the community greenhouse gas accounting methodology to ensure that current best practices for community inventories were used. Past accounting methodologies were evaluated by the Brendle Group with an eye towards relevance (percent of emissions total and ability to impact), completeness, consistency, transparency, and accuracy. (See http://www.fcgov.com/climateprotection/ for The Brendle Group report.) During 2012, the City transitioned from using spreadsheets to implementing the Greenhouse Gas Emissions Management System (GEMS) database to streamline inventory calculations, improve data management and QA/QC, and provide a long-term archive of inventory-related data. With the release of the final ICLEI Community Protocol in fall 2012, the City implemented changes in GEMS during early 2013 to incorporate its recommended methods for emissions from solid

[2] GHG emissions associated with this sector are related to the energy and non-energy related CO_2 emissions in the manufacturing process, transportation, and waste management.

waste disposal management, wastewater reclamation, and community water delivery, distribution, and conveyance into the 2012 community GHG inventory.

Fort Collins joins many other communities in conducting annual GHG inventory reviews and updates. As federal regulations are promulgated, protocols will continue to evolve, and additional updates to the methodology are anticipated.

Quantification Methods

A. Electricity

Current Electricity Method: The boundary for calculating GHG emissions from electricity is the City limits. Fort Collins Utilities (FCU) is the electricity provider for the Fort Collins community and serves accounts within City limits. An estimated 99%+ of the data reported by FCU is from within the City limits. When new areas are annexed by the City and served by FCU, they will be added to the community inventory. Beginning in 2013, the community inventory began including emissions from water delivery, distribution, and conveyance, based on population served (not based on direct electricity consumption), to the annual GHG inventory because it is a function that the City has operational control over and it is a requirement of the new ICLEI Community Protocol. Even though the Water Treatment Plant is located outside City limits, the City has direct control over energy efficiencies related to the Water Treatment Plant's operations. This change is consistent with the requirements of the new ICLEI 2012 Community Protocol, and the methodology is described under Scope 3 methods later in this section.

There are 3 differences in how FCU reports electricity GHG emissions and how the ESD reports them in the Climate Action Plan (CAP) annual Status Report for the Fort Collins community inventory:

- The first difference is that the ESD-generated community GHG emissions inventory also includes a few electricity accounts in Fort Collins served by Xcel Energy. Xcel's premise number includes a tax ID portion that identifies the entity to which Xcel will pay franchise fees for that premise. Using this tax ID, Xcel can identify the accounts it serves within City limits (per communications with Xcel Energy staff).

- A second difference in the community GHG emissions inventory reporting is that it only reports under the operational control boundary and not by an ownership boundary. FCU's Global Reporting Initiative (GRI) report for City Utilities includes reporting under **both** an operational control boundary and an ownership boundary as defined by the Climate Registry's Electric Power Sector Protocol.

- Lastly, the community GHG emissions inventory does not include RECs in the gross GHG inventory total, but only includes RECs for informational purposes, while the FCU GRI report includes the RECs in their operational control total.

Beginning with the 2011 community GHG inventory, the GEMS database was used to calculate emissions from electricity use. The annual activity data for FCU and Xcel Energy are directly entered into the Electricity Data Entry Form in GEMS and metric tons CO_2e are automatically calculated by multiplying the activity usage data by the local emissions factor. The following categories of data are required annually:

- FCU Residential usage
- FCU Commercial usage
- FCU Industrial usage
- FCU electricity for traffic signals
- FCU electricity for street lights
- FCU distribution losses
- FCU transmission losses
- Excel Energy total electricity usage
- PRPA renewable energy credits (RECs)
- PRPA local emissions factor used to calculate a new effective conversion factor that is entered into GEMS

B. Natural Gas

Current Natural Gas Method: The boundary for calculating GHG emissions from natural gas is the City limits. Xcel Energy provides natural gas service to Fort Collins. Xcel's premise number includes a tax ID portion that identifies the entity to which Xcel will pay franchise fees for that premise. Using this tax ID, Xcel can identify the accounts it serves within City limits. The activity data is taken from the annual summaries provided by Xcel Energy and entered into the GEMS database to calculate community GHG emissions by residential, commercial, and industrial use categories. GHG emissions are automatically calculated in GEMS by multiplying the activity usage data by the emissions factor.

C. Ground Transportation

Current Ground Transportation Method: The boundary for calculating GHG emissions from ground transportation for the Community GHG Inventory is the City's GMA. The vehicle miles travelled (VMT) modeling data that supports the calculation of GHG emissions from transportation activities covers the Fort Collins Metropolitan Attainment/Maintenance Area for Carbon Monoxide, as defined by the Air Pollution Control Division (APCD) of CDPHE. The maintenance area boundary for Carbon Monoxide is essentially the same as the City's GMA (with a minor exception – see Section IV, Boundary Conditions).

The ICLEI Community Protocol's recommended method for calculating emissions for passenger vehicles, freight and service trucks, and transit is to use the VMT output of a regional travel model developed by a Metropolitan Planning Organization (MPO). The Northern Front Range MPO (NFRMPO) updated the 2009 base year regional travel demand model during fall 2011 as a part of their Regional Transportation Plan. This model is a mode choice model that includes modeling of the transit system. The 2011 update included calibrating the base year model to match existing local conditions (e.g., using traffic counts, travel and transit surveys, and demographic data). The updated base year model was then used to forecast 2035 conditions. The NFRMPO updated 2035 travel demand model therefore considers the effects of growth upon the transportation system and meets the requirements of the Clean Air Act (CAA).

In addition to using the current VMT estimate, the current VMT distribution data for vehicles is obtained from the Emission Inventory Unit of the APCD of the CDPHE and entered into GEMS.

Table 5 provides fuel economy by vehicle type for input to the ground transportation calculations. The inventories apply the "revised MPG" that was updated in 2009 to better reflect estimated on-road fleet fuel economy provided by Federal Highway Administration (FHWA), Bureau of Transportation Statistics and the Energy Information Administration. These MPG values are the most current estimate and are used in GEMS for emissions calculations. The estimated GHG emissions from ground transportation are then calculated using Method TR.1.A. and Equation TR.1.A in Appendix D of the ICLEI Community Protocol.

Table 5. Fleet Fuel Economy (MPG) by Vehicle Type

Vehicle Type	Gross Vehicle Weight (GVW)	Revised MPG	Source
Gasoline car	<3750	22.1	DOE Transportation Data Book Table 4.1
Gasoline light truck	3750-8500	17.7	DOE Transportation Data Book Table 4.2
Gasoline heavy truck	8500<	13.9	DOE Transportation Data Book Table 4.3
Diesel car	<3750	19.378	CACP 2009
Diesel light truck	3750-8500	16.859	CACP 2009
Diesel heavy duty	8500<	5.634	CACP 2009
Weighted Average		18.79	

Source: H:/Environmental/Climate/2011 CAP Status/Seth-fuel economy comparison.xls that was developed by ESD staff with input from The Brendle Group.

D. Air Travel

Current Air Travel Method: The boundary for calculating GHG emissions from air travel for the Community GHG Inventory is the City's GMA. The air travel methodology estimates the emissions from air travel by Fort Collins residents traveling out of Denver International Airport (DIA). It relies on zip coded enplanement data from DIA, that best represents travel from citizens in the Fort Collins GMA.

Jet fuel consumption at DIA is allocated to passenger originating trips in Fort Collins in the following manner. Total fuel consumption at DIA is reduced 45%, the percentage of connecting flights through DIA. According to a 2007 DIA passenger survey, 6% of DIA enplaned/deplaned passengers were from Larimer County. Of that 6%, 67% were from Fort Collins.

On October 29, 2012, Allegiant Airlines decided to stop their service at the Fort Collins/Loveland Airport, so calculations for the 2013 Community GHG Emissions Inventory no longer include GHG emissions associated with travel by Fort Collins out of this airport. The GEMS database has been updated to automate calculations for air travel, so the actual gallons of jet fuel reported are now directly entered into the Community Air Travel data entry form.

E. Solid Waste

Current Solid Waste Methods: Solid waste service in Fort Collins is provided by numerous private haulers. The City of Fort Collins collects data on hauling that is conducted within City limits as a requirement of the "Pay as You Throw" ordinance, and these data determine the solid waste generated by the community that is deposited in landfills. During 2013, the City updated

its solid waste methods and the GEMS database to incorporate ICLEI's new methods from the 2012 Community Protocol for calculating emissions from solid waste disposal management. To be compliant with the 2012 Community Protocol, communities are required to estimate the emissions that result from waste disposed by the community regardless of whether or not the receiving landfills are located inside or outside of the community boundary. All previous GHG emissions inventories have been updated to be compliant with this new set of methods for solid waste. The 3 methods applicable for Fort Collins are SW.4, SW.5, and SW.6 and are described in the following paragraphs:

Method SW.4 Community-Generated Waste Sent to Landfills

Method SW.4 accounts for activity emissions that occur as a result of waste disposed by a community's population, regardless of whether or not the receiving landfills are located inside or outside of the community boundary. Method SW.4 attributes future landfill gas generation to the inventory year in which the community's waste was generated and deposited. This perspective is different from previous solid waste emissions methods in that it focuses the local decision making with regard to policies that can influence the generation and fate of solid waste from a community. Communities are better able to focus on tracking the progress made to reduce emissions by reducing the landfilling of wastes in subsequent inventory years rather than on landfill management practices. Other methods exist for communities with operational control of landfills located within their community boundaries.

The calculation method consists of the following steps:

- Determine the total mass of waste entering landfills during the inventory year attributed to the community. These data are compiled by the ESD WRRP from hauler records.
- If data are available, determine the waste characterization by waste type for the inventory year. If the data is unavailable, Table SW.5 in the 2012 ICLEI Community Protocol has default values that can be used. The waste characterization from the 2007 Larimer County Waste Composition Study was used for the 2012 GHG inventory.
- Use Equation SW4.1 to determine the CH_4 emissions as CO_2e associated with solid waste for the community (p. 24, Appendix E, 2012 ICLEI Community Protocol).
- Repeat each of the first 3 steps for each landfill that accepted waste from the community in the inventory year. The City of Fort Collins sent 56% of its waste to the Larimer County Landfill, which has a partial gas collection system during 2013. The other 44% of community waste in 2013 was sent to the Ault Landfill, which does not have a gas collection system.

Method SW.5 Process Emissions Associated with Landfilling

In order to get a complete picture of the emissions associated with landfilling, it is important to calculate process emissions. Process emissions come from CO_2 emissions associated with powering the equipment necessary to manage the landfill. This method is required for community generated waste process emissions from landfills outside a community's boundaries. The following steps are used to calculate emissions for the annual GHG emissions inventory:

- Determine the mass of solid waste that enters the landfill in the inventory year.

- Use Equation SW.5 to calculate the landfill process emissions (p. 27, Appendix E, 2012 ICLEI Community Protocol).

Both the Larimer County and Ault Landfills use diesel powered landfill equipment.

Method SW.6 Collection and Transportation Emissions

To further complete the picture of the emissions associated with landfilling, it is important to calculate emissions from collection and transportation emissions. Collection emissions consist predominately of CO_2 emissions associated with powering the equipment necessary to collect solid waste from within the community. Transportation emissions are similar, but instead cover the transportation of waste from the community to facilities located outside of the community. The following steps were used to calculate emissions for the 2012 GHG inventory:

- Determine the mass of solid waste managed at a facility in the inventory year.
- Determine the distance traveled to the waste management facility. Average haul distance to the Larimer County Landfill was estimated at 7.5 miles, and the average haul distance to the Ault Landfill was estimated at 13 miles.
- Use Equation SW.6 to calculate collection and transportation emissions (p. 29, Appendix E, 2012 ICLEI Community Protocol).

F. Water

Current Water-related Emissions Methods: Beginning in 2013, the City added emissions associated with energy used in delivery of water used within the jurisdictional boundary of the community, regardless of the location of the water delivery infrastructure. Because the Water Treatment Facility is located outside City limits, the inclusion of these emissions does not constitute double-counting of stationary emissions in the City's GHG inventory because the electricity usage is not included for calculation of direct emissions under Scope 1. Method WW.14, Energy-related Emissions Associated with Water Delivery and Treatment is required to be compliant with the ICLEI 2012 Community Protocol.

The consumption of water by a community's residents and businesses can have significant GHG implications depending on the source of the water, distances, and topography traversed in conveyance, and the treatment processes that occur before and after the end-use phase. Including these emissions in a GHG inventory allows a community to use water conservation measures as a GHG emissions reduction strategy. Method WW.14 first accounts for the embodied energy and the subsequent impact of water supply and conveyance, water treatment, and water distribution for the community. Energy consumption and resulting GHG emissions from the end-use phase are excluded because they are already accounted for in the stationary energy and electricity consumption sector. End Use consists of the electricity or fossil fuels used at community residences, commercial buildings, or industrial facilities for heating, cooling, and final dispersal of water.

Method WW.14 consists of the following steps:

Water Supply: Conveyance

- Obtain the proportions of groundwater and surface water used by the community (100% surface water for Fort Collins).
- Multiple the total population of the community by the fraction receiving surface water and the state's per capita use (found in Table WW.14.1 this is 198 gal/d/capita)
- Multiply the volume of surface water by the process energy consumed per unit of surface water to calculate total energy consumed for its conveyance to the treatment facility. The default water conveyance energy intensity used for the 2012 inventory is 110 kWh/MG (Table WW.14.3 in the 2012 ICLEI Community Protocol).
- Multiply total energy consumed for conveyance by the appropriate GHG emissions factor for the community. For the eGRID sub-region for our community, the emissions factor is 1,833.41 lb./MWh (Table WW.14.9).

Water Treatment

- Obtain the proportions of groundwater and surface water used by the community (100% surface water for Fort Collins).
- Multiple the total population of the community by the fraction receiving surface water and the state's per capita use (found in Table WW.14.1 this is 198 gal/d/capita)
- Multiply the volume of surface water for the community by the appropriate process energy consumed per unit of treated surface water to calculate total energy consumed by water treatment. The default water treatment energy intensity used for the 2012 inventory is 210 kWh/MG (Table WW.14.4 in the 2012 ICLEI Community Protocol).

Water Distribution

- Obtain the proportions of groundwater and surface water used by the community (100% surface water for Fort Collins).
- Multiple the total population of the community by the fraction receiving surface water and the state's per capita use (found in Table WW.14.1 this is 198 gal/d/capita)
- Multiple the volume of surface water for the community by the appropriate process energy consumed per unit of distributed surface water to calculate total energy consumed for distribution. The default water distribution energy intensity used for the 2012 inventory is 540 kWh/MG (Table WW.15.1 in the 2012 ICLEI Community Protocol).

G. Wastewater

Current Wastewater-related Emissions Methods: During calculation of the 2012 Community GHG Inventory, the City added emissions associated with wastewater treatment processes detailed in the 2012 ICLEI Community Protocol. These new methods are in addition to the existing method to account for emissions from actual power consumed to operate wastewater facilities located within the community (see industrial sector emissions). Regardless of the community size, demographics, or economic status, wastewater generation is unavoidable and these wastes must be treated before water is returned to the environment. The wastewater treatment protects watersheds and prevents the spread of waterborne diseases. The addition of the following 5 wastewater methods have been added because they are recommended by the 2012 ICLEI Community Protocol and because accounting for these emissions provides opportunities to offset GHG emissions from other sources such as generation of renewable power from biogas. There is no double counting of emissions by including these emissions in the community inventory.

Method WW.1.a, CH_4 Emissions from the Combustion of Anaerobic Digester Gas

This method involves calculating the stationary CH_4 emissions from devices designed to combust gas produced by anaerobic digesters based on site-specific data for the Drake Water Reclamation Facility (DWRF). The following steps were used to calculate emissions:

- Determine the total volume of digester gas produced per day by the digesters at DWRF.
- Determine the fraction of CH_4 in the gas.
- Use Equation WW.1.a. and the default values provided in the equation for kg CH_4 per million BTU combusted, Global Warming Potential (GWP), and unit conversions to calculate stationary CH_4 emissions from the incomplete combustion of digester gas in mt CO_2e.

Method WW.2.a, N_2O Emissions from Combustion of Anaerobic Digester Gas

N_2O is not generated in significant amounts in anaerobic digesters. However, other nitrogen containing compounds in the gas or nitrogen in the combustion air may be converted in small amounts to N_2O during combustion. The following steps were used to calculate emissions from these sources at DWRF:

- Determine the total volume of digester gas produced per day at DWRF.
- Determine the fraction of CH_4 in the gas.
- Use Equation WW.1.a. and replace the default values with the N_2O emissions factor, EF_{N2O} (6.3×10^{-4} kg N_2O per MMBTU) and replace the GWP with the N_2O GWP (310) to calculate stationary N_2O emissions from the incomplete combustion of digester gas in mt CO_2e.

Method WW.7, Process N_2O Emissions from Wastewater Plants with Nitrification or Denitrification

This method calculates the process N_2O emissions related to denitrification from the DWRF based on the population served in the community. The following steps were used to calculate emissions:

- Determine the community's population served by the wastewater facilities.
- Use F_{ind}-com value of 1. This indicates that no significant industrial users are served by DWRF per the EPA's National Pretreatment program definitions.
- Enter the values into Equation WW.7 and use the provided default values and unit conversions to calculate N_2O emissions.

Method WW.8, Process N_2O Emissions from Wastewater Plants without Nitrification or Denitrification

This method calculates the process N_2O emissions from all other wastewater treatment plants that do not support transient or complete nitrification or denitrification based on the population served. This method therefore applies to the Mulberry Water Reclamation Facility (MWRF). The following steps were used to calculate emissions:

- Determine the community's population served by the wastewater facilities.
- Use F_{ind}-com value of 1. This indicates that no significant industrial users are served by MWRF per the EPA's National Pretreatment program definitions.
- Enter the values into Equation WW.8 and use the provided default values and unit conversions to calculate N_2O emissions.

Method WW.12(alt) Fugitive N_2O Emissions from Effluent Discharge

This method calculates the process N_2O emissions from effluent discharge from wastewater treatment plants (WWTPs) based on site-specific data. Effluent discharge is treated wastewater that flows out from a treatment facility and is discharged into waterways. Effluent discharge originating from a conventional wastewater treatment facility without advanced processes is treated to secondary treatment standards and is therefore called secondary effluent. Conventional WWTPs are not able to remove all of the nitrogen content in wastewater, leaving about 10% in the effluent. However, N_2O is only present in trace amounts, if at all, in the effluent, and most of the nitrogen is in other forms. Only when this nitrogen containing effluent reaches a natural watershed will indirect N_2O emissions occur through side reactions. This methodology calculates these fugitive emissions for both the DWRF and the MWRF and uses the following steps:

- Determine the population served by the facilities.
- Use F_{ind}-com value of 1. This indicates that no significant industrial users are served by DWRF or MWRF per the EPA's National Pretreatment program definitions.
- Determine whether the WWTP employs nitrification or denitrification. For the DWRF use 0.7 for the fraction of N removed by the plant since they employ denitrification. For

the MWRF use 0.0 for the fraction of N removed because it does not employ nitrification or denitrification.

- Enter the values into Equation WW.12(alt) and use the default values provided for N-load, N uptake, BOD_5, EF, and F_{plant}, GWP, and unit conversions to calculate N_2O emissions from effluent discharge for both facilities.

H. Embodied Energy in Recyclable Materials

Current Embodied Energy in Recyclable Materials Method: The Brendle Group prepared a report, dated March 2009, *City of Fort Collins Community Greenhouse Gas Accounting Protocols,* which recommended inclusion of the upstream impact of key materials that were included in the Climate Action Plan (CAP) as quantified emissions reductions. The recommended methodology is a unique method based on the Demand-Centered, Hybrid Life Cycle protocol that has also been adapted for use by the City of Denver for "key urban materials." This approach provides a protocol for including some transportation, upstream, and downstream material emissions contained in recyclable materials that occur outside of the community inventory boundary, based on activity data collected from private haulers within the community boundary of the City limits.

In order to demonstrate the impact of solid waste diversion activities on the total community GHG emissions, it was necessary to include the energy associated with the materials (e.g., recyclables) as an informational line item in the community inventory, but not include the carbon emissions in the gross inventory total. This unique approach facilitates the inclusion of reduction measures (e.g., recycling and composting) that address these impacts in the community CAP. For Fort Collins, these "key" materials are a subset of recyclable materials (e.g., cardboard, wood, paper, aluminum, organics), and the energy associated with them is referred to as "embodied energy in recyclable materials." The life-cycle GHG emissions associated with these materials can be broken down into five components:

<u>Upstream:</u>

1. (+) CO_2 from energy and non-energy related emissions from extraction and transportation of raw materials.
2. (+) CO_2 from energy and non-energy related emissions from manufacturing and transportation of the product.
3. (+) CO_2 from reduced carbon sequestration (for paper/wood-based materials)

<u>Downstream:</u>

4. (+) CH4 emissions from decay of organic materials in the landfill
5. (-) CO2 from long-term carbon sequestration of organic materials placed in the landfill

By applying the most recent (2007) waste characterization at the Larimer County Landfill, it was estimated (during 2009) that over 30% of total incoming waste at the landfill, by weight, represents material types that could feasibly be recycled using diversion measures (e.g., recycling) described in the CAP. The Environmental Protection Agency's (EPA's) Waste Reduction Model (WARM), provides source reduction factors that combine the three upstream emissions sources for the recyclable materials being landfilled. The WARM model is one of the

sources for the emissions factors in the International Council for Local Environmental Initiatives (ICLEI's) Clean Air and Climate Protection (CACP) software and the source of recycling factors applied in the CAP and used in this method.
The Inventory Spreadsheet H:/Environmental/Climate/2011CAP Status/2011-Inventory_072612.xls demonstrates this unique method that was developed by the Brendle Group to calculate upstream emissions using recycling and source reduction emission factors. These calculations are now automated in the GEMS database, and the spreadsheet is no longer used. It is referenced here for transparency because these equations were used to calculate emissions from the embodied energy in recyclables. The actual calculation steps are as follows:

- Using the current waste characterization, determine the weight of the key recyclable materials that are disposed of in the landfill during the inventory year. These key materials are: cardboard, glass, aluminum, steel, plastic, newsprint, mixed office paper, magazines, and wood.
- Multiple each key recyclable material weight (tons) by the source reduction emissions factor, convert the results to metric tons, and then sum these emissions (mt CO_2e)

Beginning with the 2012 inventory, a new sold waste method was used to calculate landfill emissions (see Section E, Solid Waste). To avoid potential double-counting of landfill emissions, the emissions from embodied energy in recyclable materials are not rolled-up into the final community inventory emissions, but are now listed as a separate line item for informational purposes in the annual inventory.

Table 6 provides a summary of emissions from embodied energy in recyclable materials from 2005 to present.

Table 6. Summary of Fort Collins' Greenhouse Gas Emissions from Embodied Energy in Recyclable Materials

Year	Short Tons MSW	Metric Tons CO_2e from Recyclables
2005	237,747	368,440
2006	224,700	348,221
2007	227,842	353,090
2008	187,510	290,090
2009	159,708	247,502
2010	142,427	221,181
2011	132,018	204,590
2012	139,060	215,952
2013	133,931	207,987

I. Emissions Not Reported*

The Brendle Group's report evaluating Fort Collins' community-wide GHG accounting practices recommends performing a simplified estimation with readily available data sources to estimate the magnitude of emissions sources that are anticipated to be negligible or small (deMinimus emissions). Additionally, some activity data is not available to the City and/or further work needs to be completed to develop reliable methodologies for estimating GHG emissions. As a

result, these emissions from community activities and sources are not currently included in the community inventory:

- CO_2 from beer production
- HFCs, PFCs, and SF6 emissions (e.g., refrigeration equipment)
- Livestock
- Non-road and off-road vehicles and equipment
- Propane
- Industrial process emissions (e.g., electronics manufacturing, oil and gas production)
- Land use change
- Railroad system

*__Note__: Carbon Reductions: The 2012 ICLEI Community Protocol does not recommend including carbon reductions from GHG mitigation projects or recycling activities in the community inventory except for informational purposes. These project-specific reductions should not be deducted from the gross GHG inventory estimates. The City of Fort Collins typically reports these project specific reductions in the annual Climate Action Plan (CAP) status report.

Emissions Factors and Other Constants

A. Electricity

Current Electricity Emissions Factors
Table 7 below summarizes the various emissions factors for electricity.

Table 7. Summary of Greenhouse Gas Electricity Emissions Factors (EF)

Year	Electricity Inventory EF* (lbs./MWh)	REC Renewable Energy Factor** (lbs./MWh)
2005	1827	1218
2006	1829	1270
2007	1741	1307
2008	1669	1543
2009	1777	1536
2010	1610	1351
2011	1490	1453
2012	1672	1563
2013	1672	1651

* Based on PPRA resource mix with owned renewables but without RECS
**Based on Green-E method using weighted regional factors

Fort Collins' electricity related emissions inventory is estimated using a conversion factor based on PRPA's resource mix with owned renewable energy and without RECs included. Table 8 shows the data used to calculate the current electricity emissions factors.

Table 8. 2013 Operational Boundary Fort Collins Greenhouse Gas Emissions (Emissions Levels at Source)			
Resource	**Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs./MWh)**
WAPA	287,466		
Purchased Power	23,125	19,138	1,855
Renewable Owned Generation (Wind)	37,560		
Fossil Generation	1,178,009	1,138,073	2,130
Total Fort Collins Operational Control	**1,526,160**	1,157,212	1,672
RECs	38,440	-28,794	-1,651
Total Net Utilities Operational Emissions	1,526,160	1,128,418	1,630
Source: PRPA, 2013, H:/Environmental/Climate/2013 Carbon Data/PRPA_Data/2013 PRPA Data.xlsx			

Previous Emissions Factors for Community Electricity Use
These are summarized in Table 7, above, and supporting data for each inventory year may be found in the appendices of this QMP.

Emissions Factor for Renewable Energy Credits (RECs)
RECs are reported in electricity units of megawatt-hours (MWh). Carbon emissions reductions are estimated and reported here ***for information purposes only***. The calculation uses a method prescribed by Green-e for estimating GHG emissions reductions due to REC purchases. The marginal emission rate is based on the 2007 eGRID non-baseloads factors for each North American Electric Reliability Corporation (NERC) region from which PRPA purchased RECs, weighted according to the amount purchased from each region. The RECs emissions factors for each year are summarized in Table 7, above.

Current Electricity Conversion Factors
Tons CO_2e are calculated as follows: ((MWh purchased x emissions factor)/2000) x 0.907194) = metric tons CO_2e

B. Natural Gas

Current Emissions Factors for Natural Gas
Decatherms are multiplied by the emissions factor for CO_2, CH_4, and N_2O and then summed to calculate total CO_2e emissions. The emissions factors in Table 9 are recommended by the 2012 ICLEI Community Protocol.

Table 9. 2013 Natural Gas Emissions Factors		
mt CO_2/dth	**mt CH_4/dth**	**mt N_2O/dth**
0.05401	**0.000005**	**0.0000001**
Source: ICLEI Community Protocol, October 2012		

Current Natural Gas Conversion Factor
1 Decatherm (DTH) = 1 MMBtu

C. Ground Transportation

Current Transportation Emissions Factors
Table 10 presents the vehicle emissions factors used in the current inventory.

Table 10. Vehicle Emissions Factors	
Vehicle type	**Emissions factors**
Gasoline car	8.78 kg CO_2/gal
Gasoline light truck	8.78 kg CO_2/gal
Gasoline heavy truck	8.78 kg CO_2/gal
Diesel car	10.21 kg CO_2/gal
Diesel light truck	10.21 kg CO_2/gal
Diesel heavy duty	10.21 kg CO_2/gal
Source: ICLEI Community Protocol, October 2012	

Current Transportation Conversion Factors

Table 11. Vehicle Conversion Factors	
Vehicle type	**Conversion factor**
Gasoline car	0.125 MMBtu/gallon
Gasoline light truck	0.125 MMBtu/gallon
Gasoline heavy truck	0.125 MMBtu/gallon
Diesel car	0.122 MMBtu/gallon
Diesel light truck	0.122 MMBtu/gallon
Diesel heavy duty	0.122 MMBtu/gallon

D. Air Travel

Current Air Travel Emissions Factor
The current air travel emissions factor is 9.57 kg CO_2/gallon jet fuel (**Source:** Local Government Operations Protocol (LGOP) v1.1, 2010).

E. Solid Waste

Current Solid Waste Emissions Factor
The current emissions factors are derived from the ICLEI 2012 Community Protocol, Appendix E: Solid Waste Emission Activities and Sources and are summarized by method in Table 12 below.

Table 12. Current Solid Waste Emissions Factors			
Method Number/Name	**Component**	**Emissions Factor**	**Units**
SW.4 Decomposition	Mixed Municipal Solid Waste (MSW)	0.060	mt CH_4/wet short ton
SW.4 Decomposition	Newspaper	0.043	mt CH_4/wet short ton
SW.4 Decomposition	Office Paper	0.203	mt CH_4/wet short ton
SW.4 Decomposition	Corrugated Containers	0.120	mt CH_4/wet short ton
SW.4 Decomposition	Magazines/Third-Class Mail	0.049	mt CH_4/wet short ton
SW.4 Decomposition	Food Scraps	0.078	mt CH_4/wet short ton
SW.4 Decomposition	Grass	0.038	mt CH_4/wet short ton
SW.4 Decomposition	Leaves	0.013	mt CH_4/wet short ton
SW.4 Decomposition	Branches	0.062	mt CH_4/wet short ton
SW.4 Decomposition	Dimensional Lumber	0.062	mt CH_4/wet short ton
SW.4 Decomposition	Textiles	0.073	mt CH_4/wet short ton
SW/4 Decomposition	Construction/Demolition	0.012	mt CH_4/wet short ton
SW.5 Process	Diesel	0.0164	mt CO_2e/wet short ton
SW.6 Collection	Diesel	0.020	mt CO_2e/wet short ton
SW.6 Transport	Diesel	0.00014	mt CO_2e/wet short ton
Source: ICLEI Community Protocol, October 2012			

F. Water

Current Water-related Emissions Factors

The current emissions factors are derived from the ICLEI 2012 Community Protocol, Appendix F: Wastewater and Water Emission Activities and Sources and are summarized by method in Table 13 below.

Table 13. Current Water-related Energy Intensity and Emissions Factors			
Method Number/Name	**Component**	**Energy Intensity or Emissions Factor**	**Source**
WW.14.1 Energy-related emissions as a result of water consumption	Conveyance	110 kWh/MG	2012 ICLEI Community Protocol
WW.14.1 Energy-related emissions as a result of water consumption	Treatment	210 kWh/MG	2012 ICLEI Community Protocol
WW.14.1 Energy-related emissions as a result of water consumption	Distribution	540 kWh/MG	2012 ICLEI Community Protocol
WW.14.1 Energy-related emissions as a result of water consumption	Emissions Factor	1,833.41 lb./MWh	2009 eGRID Sub-region RMPA CO_2e Rates

G. Wastewater

Current Wastewater-related Emissions Factors
The current emissions factors are derived from the ICLEI 2012 Community Protocol, Appendix F: Wastewater and Water Emission Activities and Sources and are summarized by method in Table 14 below.

Table 14. Current Wastewater-related Emissions Factors				
Method Number/Name	**Component**	**Emissions Factor**	**Units**	**Source**
WW.1.a Combustion of digester gas	CH_4 emissions	3.2×10^{-3}	kg CH_4 per MMBTU	2012 ICLEI Community Protocol
WW.2.a Combustion of digester gas	N_2O emissions	6.3×10^{-4}	kg N_2O per MMBTU	2012 ICLEI Community Protocol
WW.7 Process emissions for plants with nitrification or denitrification	N_2O emissions	7	g N_2O/person equivalent/year	2012 ICLEI Community Protocol
WW.8 Process emissions – conventional treatment	N_2O emissions	3.2	g N_2O/person equivalent/year	2012 ICLEI Community Protocol
WW.12 Fugitive emissions from effluent discharge	N_2O emissions	0.005	kg N_2O-N/kg sewage-N discharged	2012 ICLEI Community Protocol

H. Embodied Energy in Recyclable Materials

Current Embodied Energy in Recyclable Materials Emissions Factors
Table 15 presents the emissions factors for embodied energy in recyclable materials used in the current inventory.

Table 15. Current Embodied Energy in Recyclable Materials Emissions Factors

Recyclable Material	Source Reduction Emissions Factor (metric tons C_e/ton)
Cardboard	1.52
Glass	0.16
Aluminum	2.24
Steel	0.87
Plastic	0.5
Newsprint	1.33
Mixed Office Paper	2.18
Magazines	2.36
Wood	0.55

Source: Archived in H:/Environmental/Climate/2011 CAP Status/2011-Inventory_072612.xls

VI. Data Management

Activity Data

A. Electricity

Current Electricity Activity Data (4 data sets are used)

Data provided by PRPA

PRPA provides data for "Total Fort Collins Operational Control" (MWh) and total RECs (MWh) purchased by Fort Collins. The data from the most recent PRPA annual report is provided in Table 8, above.

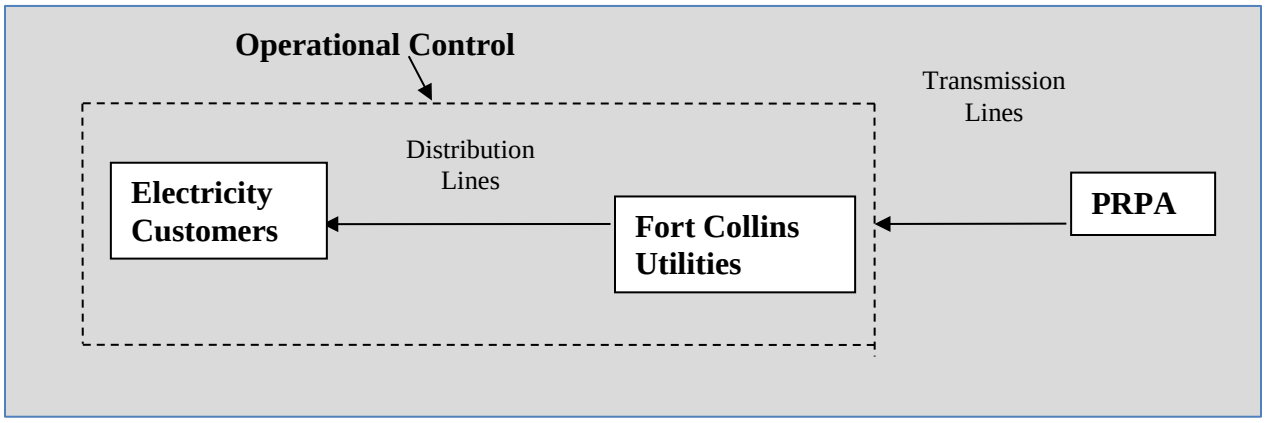
The City of Fort Collins Utilities Sustainability Reports indicate that its GHG inventory reporting methodology reflects an ownership and operational control boundary for reporting as defined by the Climate Registry's Electric Power Sector Protocol. Ownership-boundary results report an ownership allocation of all PRPA's direct generation emissions, including off-system electric sales. Operational-boundary reporting results in the emissions directly related to Utilities' purchased energy on behalf of all electric customers.

Table 5.1 of the Climate Registry's Electric Power Sector Protocol recommends reporting GHG emissions from the following indirect sources for local distribution companies:

- Scope 2 Indirect Emissions from:
  - Local transmission and distribution losses
  - Purchased and consumed electricity
- Scope 3 Indirect Emissions from
  - Specified purchases
  - Other purchases
  - Direct access
  - Power exchanges

Figure 2 visually depicts the definition of "operational control" for purposes of GHG accounting of emissions from electricity for the community of Fort Collins. One way that the community GHG inventory differs from the Fort Collins Utilities reporting of GHG emissions is that it only reports emissions associated with "operational control." For an explanation of additional differences between the community and Fort Collins Utilities inventories, please refer to Section V.A, Quantification Methods in this report.

Figure 2. Operational Control Boundary for Greenhouse Gas Emissions for Electricity



Data Provided By Fort Collins Utilities

Source: Fort Collins Utilities
The electricity activity data provided in Table 16 are not weather normalized. These data do not include data for the Water Treatment Plant, which is served by Xcel Energy and is outside City limits. The electricity activity data for previous years is located in appendices of this QMP.

Table 16. Total Electric Sales by Fort Collins Utilities (kWh)	
	2013
Residential	508,379,365
Commercial	502,003,301
Industrial	458,413890
Traffic	575,316
Street Lighting	8,500,793
Distribution Losses	22,342,396
Transmission Losses	25,944,939
Total	1,526,160,000
Source: Fort Collins Utilities Department	

Data Provided By Xcel Energy

Source: Xcel Energy
Table 17 shows the total electric sales values for the purchase of electricity from Xcel Energy.

Table 17. Fort Collins Total Electric Sales by Xcel Energy	
Year	**kWh**
2005	497,001*
2006	693,826
2007	821,718
2008	975,824
2009	1,372,325
2010	1,433,541
2011	929,895
2012	1,276,954
2013	1,242,709
Source: Xcel Energy	
* This number may be lower than the actual because of the switch from the CIS to CRS accounting system	

The Xcel electricity data was apportioned by ESD staff as 50% to the residential category and 50% to the commercial category.

Current Carbon Offsets

Source: The Climate Trust
The Climate Trust provides total carbon offsets purchased by Fort Collins residents or businesses for each calendar year (in metric tons CO_2e). Thus far, these data only represent a small fraction of offsets purchased. . It does not represent the large acquisitions that are made by CSU, PSD, New Belgium and other organizations. The total purchases for 2013 were 18 metric tons CO_2e.

Previous Electricity Activity Data

The appendices of this QMP contain electricity usage data for previous years.

B. Natural Gas

Current Natural Gas Activity Data

Xcel Energy provides the "Actual Sales" data for natural gas usage that are used in the community inventory. Transport gas, provided by other gas vendors but delivered through Xcel lines, is included in the inventory. Table 18 displays natural gas use from Xcel Energy for Fort Collins.

Table 18. 2013 Natural Gas Use from Xcel Energy

	Residential (dth)	Commercial & Industrial (dth)	Transport (dth)	Total (dth)
Actual Sales	3,905,638	1,464,959	2,929,408	8,300,005
Customers	49,028	4,175	230	53,434
Base Load	1,015,466	483,436		
Heating Load	2,890,172	981,523		
Normal Sales	3,793,442	1,426,856	2,929,408	8,149,706

Source: Xcel Energy, 2014

Previous Natural Gas Activity Data

The appendices of this QMP contain previous Fort Collins natural gas usage data from Xcel Energy.

C. Ground Transportation

Current Ground Transportation Activity Data

The City Transportation Planning Department provides data generated by their model runs and those from the Northern Front Range(NFR) MPO. The MPO model generated using the TransCAD system includes a base year model that is calibrated to match existing conditions for a certain year using traffic counts and travel and transit survey data. The MPO 2005 base year model was used to generate the community GHG inventory baseline estimating an annual VMT of 997,420,380 for 2005.

The NFRMPO next updated their base model in 2009. The City Transportation Planning Department used the MPO's 2009 base year model and did not change the model itself, but rather the inputs that represent 2035 conditions (e.g., population, employment, and transportation network assumptions) for the Mason Corridor project. However, the 2009 calibration year

analyses were not complete at the time of GHG reporting in 2010, so the inventory used the same conservative assumption as previous years that VMT was growing by 1.23%/year.

The MPO updated the 2009 base year model again in fall 2011 with local demographic data, traffic counts, and travel and transit surveys as part of their 2035 Regional Transportation Plan update. The new cycle of models gives a 2013 annual VMT of 1,127,016,602 and assumes a 0.94% annual growth rate.

Additional data on VMT distribution is also needed to complete GHG calculations for the community inventory. Data on the VMT distribution for the region is provided by the Modeling, Meteorology, and Emission Inventory Unit of the APCD of the CDPHE. Table 19 shows the VMT distribution used in the community GHG inventory used in the current inventory. In 2013, the CDPHE began using a new improved model, MOVES, to calculate the VMT distribution that has resulted in some changes to both gasoline and diesel heavy truck estimates. The previous years 2005 through 2012 were calculated using the Mobile6 model.

Table 19. Current Fort Collins Vehicle Miles Travelled Distribution

Vehicle Type	Percentage
Gas Car	49.38%
Gas Light Truck	44.66%
Gas Heavy Truck	0.34%
Diesel Car	0.09%
Diesel Light Truck	1.38%
Diesel Heavy Truck	3.71%
Total	99.57%

Source: CDPHE, 2014

Previous Ground Transportation Activity Data

The appendices of this QMP contain Fort Collins ground transportation activity data for previous inventory years.

D. Air Travel

Current Air Travel Activity Data

Jet fuel consumption data from the Denver International Airport (DIA) and the Fort Collins – Loveland (FCL) Airport are input to a calculation spreadsheet (H:/Environmental/Climate/2012 Carbon Data/2012-Inventory_022113.xlsx, see “Air Travel” tab) to calculate GHG emissions from air travel for the Fort Collins community. Table 20 contains the fuel consumption data for DIA and FCL Airport from 2005 to present.

Table 20. Fuel Consumption at Denver International Airport (DIA) and Fort Collins-Loveland (FCL) Airports		
Year	**DIA Jet Fuel (gals)**	**FCL Jet Fuel (gals)**
2005	9,051,825	32,126*
2006	9,240,356	32,585*
2007	9,666,931	33,237*
2008	9,528,928	33,901
2009	8,542,734	28,968
2010	9,366,696	61,288
2011	9,281,214	58,997
2012	9,417,385	54,370
2013	8,934,039	0
Source: Denver International Airport and Fort Collins-Loveland Airport		
***** Represents an estimate based on a change in methodology during 2008 to include data from this airport		

Previous Air Travel Activity Data

Air travel activity data for previous years is presented in Table 20, above.

E. Solid Waste

Current Solid Waste Activity Data

<u>Fort Collins community trash disposed at landfills (excluding recycling)</u>

ESD staff quantifies emissions from solid waste based on data collected from the following sources:

- Trash hauler reports (2x/yr.); hauler reports per ordinance for commercial, industrial, and residentially generated trash, regardless of which landfill is used for disposal
- Colorado State University (CSU) (annual); CSU Facilities Department
- Percent Larimer County Landfill citizen self-haul (annual); Larimer County Solid Waste Department

A summary of solid waste weights from 2005 to present for community solid waste are presented in Table 21.

Table 21. Fort Collins Community Solid Waste	
Year	**Short Tons Solid Waste**
2005	237,747*
2006	224,700
2007	227,842*
2008	187,510
2009	159,708
2010	142,427
2011	132,018
2012	139,060
2013	133,931
* Community trash data for 2005 and 2007 were derived from a model developed by Skumatz Economic Research Associates (SERA) in 2006 to support ESD's solid waste reduction planning efforts. This approach used data originally quantified in 2004 by SERA to develop estimates of community solid waste tonnages.	

Additional data collected and assumptions for the current inventory include:

- 56% of the community's solid waste was sent to the Larimer County Landfill and 44% was sent to the Ault Landfill during the current inventory (Source: ESD, 2014).
- Only the Larimer County Landfill has a gas collection system (partial system). The 2012 ICLEI Community Protocol uses a default gas collection system efficiency of 75%.
- Both landfills use diesel powered landfill equipment.
- The May 2007 Larimer County, CO Two-Season Waste Composition Study was used to characterize the waste.

Previous Solid Waste Activity Data

Solid Waste activity data for previous years are presented in Table 21, above.

F. Water

Current Water-related Activity Data

Table 22. 2013 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	141
Annual volume water processed (gallons/year)	7,788,198,450
Percent of water supplied from surface water	100%

G. Wastewater

Current Wastewater-related Activity Data

Table 23 shows the activity data used to calculate emissions from wastewater-related activities for the current inventory:

Table 23. 2013 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	122,392	0
Percent of CH_4 in gas	61.00	0
Average daily flow (MGD)	10.59	3.34
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2014		

H. Embodied Energy in Recyclable Materials

Current Embodied Energy in Recyclable Materials Activity Data

Source: City of Fort Collins ESD
Solid waste generated by the Fort Collins community are estimated based on the reported trash hauler tonnages (required per the City of Fort Collins "Pay as You Throw" ordinance) plus "unaccounted tonnage". These unaccounted tons were revealed by a 2004 solid waste survey completed by SERA in 2005. Unaccounted tons include commercial tons not collected by licensed trash haulers (e.g., CSU maintains its own trash trucks and hauls materials directly to the Larimer County Landfill) and "self-hauled" trash to the Larimer County Landfill. Community solid waste tons were calculated using this methodology for 2006 and 2008.

Community trash data for 2005 and 2007 were derived from a model developed by SERA in 2006 to support the ESD solid waste reduction strategic planning efforts. This approach used the original 2004 SERA data to develop estimates of community trash tonnages. The data for the remaining inventory years have been calculated by the ESD Waste Reduction and Recycling program based on hauler tonnages. The solid waste activity data in Section VI, E. Solid Waste, above, was used to calculate GHG emissions from embodied energy in recyclable materials for the current inventory year.

Previous Embodied Energy in Recyclable Materials Activity Data

Embodied energy in recyclable materials emissions were calculated using the solid waste activity data for previous years that are located in Table 21 above.

Normalization Factors
No data used in the preparation of the Community GHG Emissions Inventory are weather normalized.

Quality Assurance

The data collection process will be reviewed annually by the ESD Environmental Data Analyst during the annual inventory reporting process. ESD recognizes that there are potential sources for errors that are inherent to an annual inventory that encompasses a community the size of Fort Collins. For example, errors could occur when transferring data, converting from volumes to weights or metric units, or when calculating GHG emissions. To ensure that the data collected for the City of Fort Collins Community Inventory is accurate, the following measures will be taken at a minimum annually:

- The ESD Environmental Data Analyst will contact the City of Fort Collins Advanced Planning Office to identify whether there have been changes to the boundaries of the City Limit or the GMA.
- Inquiries to the Community Carbon and Municipal Sustainability teams will be made to identify new emissions sources within the boundaries of the community inventory.
- The ESD Environmental Data Analyst will review all annual activity summaries used in the annual GHG Community Inventory from:
    - Xcel Energy
    - PRPA
    - Fort Collins Utilities
        - Utility Financial Operations
        - Water Reclamation Division
        - Water Department
    - The Climate Trust
    - Trees, Water & People
    - City Transportation Planning
    - APCD, CDPHE
    - Environmental Programs at DIA
    - Fort Collins/Loveland Airport
    - ESD Waste Reduction and Recycling Program
- The ESD Environmental Data Analyst will review all emissions factors used as part of the annual inventory.
- ESD will request, to the extent possible, that data used to calculate GHG be provided in a form that allows an “actual” calculation, versus an estimate.
- At its discretion, ESD will conduct periodic reviews of the GHG Inventory and identify any areas that appear to be in error.

Data Security

Effective in 2011, information compiled for the purposes of conducting the community annual inventories, including activity data, emissions factors, conversion factors, normalization factors, and other information contained in this QMP, and any changes to the current quantification methods will be maintained both in electronic and printed form in secure locations by the ESD Environmental Data Analyst.

Community Reporting Frequency

Current data reporting is conducted on an annual basis to support an annual community GHG inventory and CAP Status report.

Document Retention and Control Policy

Effective in 2011, records used to calculate and document the GHG Inventory from 2006 through the end of the goal period will be maintained by ESD for a minimum of three years beyond the inventory reporting period, with the exception of data for the 2005 baseline inventory. Baseline inventory data will be maintained through the end of the goal period. After the three-year period following the end of the reporting period, ESD will dispose of supporting documents and only the final reports will be kept.

VII. Summary of Inventory Results

Appendices B through I provide details of the results of calculations to determine GHG emissions in metric tons CO_2e by source for the annual inventories from the baseline year 2005 through present. Table 24 is contains the current overall summary of GHG emissions, including all revisions through present, for the City of Fort Collins:

Current GHG Inventory Results:

Table 24. Summary of Gross Community Greenhouse Gas Emissions

Year	GHG (metric tons CO_2e)
2005	2,438,300
2006	2,445,654
2007	2,455,731
2008	2,323,547
2009	2,350,380
2010	2,200,302
2011	2,119,408
2012	2,233,783
2013	2,318,732

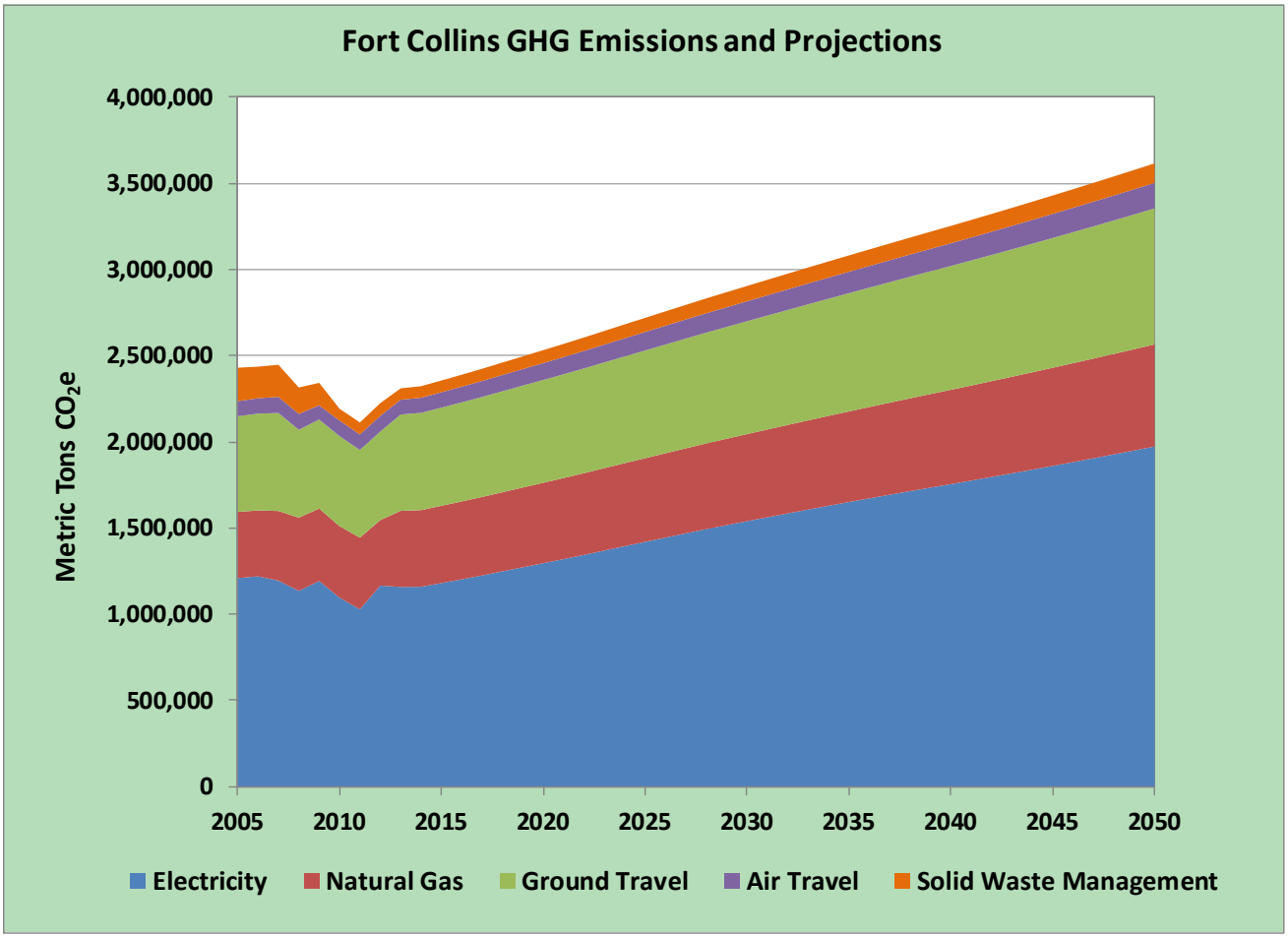
VIII. 2020 and 2050 Community Forecasts

The community-wide Fort Collins GHG Emissions forecast for CO_2e was updated in 2014 to reflect any forecast changes that occurred since 2012 reporting and to develop a "business as usual" (BAU) projection through 2050 to help support the development of new reduction strategies for the updated GHG emissions goals for the City and the CAP that is underway during 2014/2015. The BAU includes forecasted changes in existing programs, demographics, and from population, employment, and transportation models. The BAU does not include projections based on external factors (e.g., State policies, CAFÉ standards, PRPA BAU resource mix, etc.). Updates were made to the 2050 GHG emissions forecast to reflect current growth predictions and are summarized in Table 25 and represented in Figure 3. The underlying activity data and forecast calculations referenced below are archived at: H:/Environmental/Climate/Final 2014 Updated GHG Forecasts through 2050_072414.xlsx.

Table 25. Fort Collins Greenhouse Gas Emissions Forecast Revisions		
Emissions Source	**Growth Rate(s)**	**Notes**
Electricity (from Fort Collins Utilities including transmission losses and Xcel Energy)	0.87% growth from 2005-2013 1.75% growth from 2014-2020 1.23% growth from 2021-2030 1.01% growth from 2031-2040 0.92% growth from 2041-2050 1.19% average growth rate for 2014-2050	
Natural Gas (from Xcel Energy)	0.85% average growth rate from 2012-2050	Growth rate based on U.S. EIA energy consumption for the Mountain Region annual growth rates from 2011-2040
Vehicle Miles Traveled (NFRMPO	0.94% average growth rate from 2014-2050	Based on 2011 update to NFRMPO 2009 Base Year Model
Population (DOLA)	The period from 2014 to 2050 shows a net population growth of 54.8% percent and an average annual growth rate of 1.48%	Apply DOLA annual growth projections for Fort Collins/Loveland
Solid Waste (ESD WR&R)	1.48% average annual growth rate from 2014-2050	The solid waste project was based on the population growth rate and the 2013 solid waste per capita rate of 4.85 lbs. solid waste/person/day
Air Travel	There was an average -0.04% growth rate from 2005 to 2013, and 1.45% average annual growth rate is projected from 2014 through 2050	Projections based on population growth rate

The forecast will continue to be updated biennially along with preparation of the CAP's biennial status report.

Figure 3.



Tables 26 and 27, below, contain the revised activity data projected for the 2050 forecast and the resulting annual GHG emissions, respectively.

Table 26. Revised Actual and Projected Activity Data for the Revised 2050 Forecast				
Year	**Electricity (kWh)**	**Natural Gas (dth)**	**Ground Travel (VMT)**	**Solid Waste (tons)**
2005	1,459,322,001	7,228,151	997,420,380	237,747
2006	1,470,033,826	7,191,536	1,009,655,790	224,700
2007	1,513,028,718	7,601,955	1,022,040,113	227,842
2008	1,499,823,824	7,987,500	1,034,576,424	187,510
2009	1,479,538,325	7,909,579	1,047,266,505	159,708
2010	1,501,204,512	7,792,419	1,060,112,242	129,867
2011	1,521,720,895	7,816,810	1,106,233,329	132,018
2012	1,537,666,954	7,143,314	1,116,576,611	139,060
2013	1,527,402,709	8,300,005	1,127,016,602	133,931
2014	1,528,524,214	8,366,405	1,137,554,208	136,425
2015	1,556,813,051	8,433,336	1,148,190,339	138,944
2016	1,585,555,745	8,500,803	1,158,925,919	141,539
2017	1,615,172,356	8,568,809	1,169,761,876	144,290
2018	1,646,570,599	8,637,360	1,180,699,150	147,032
2019	1,677,857,792	8,706,459	1,191,738,687	149,763
2020	1,709,019,449	8,776,110	1,202,881,444	152,497
2021	1,740,224,562	8,846,319	1,214,128,385	155,334
2022	1,772,590,834	8,917,090	1,225,480,486	158,265
2023	1,806,045,516	8,988,427	1,236,938,728	161,165
2024	1,839,130,482	9,060,334	1,248,504,105	164,045
2025	1,871,995,005	9,132,817	1,260,177,619	166,914
2026	1,904,735,315	9,205,879	1,271,960,279	169,770
2027	1,937,334,292	9,279,526	1,283,853,108	172,582
2028	1,969,424,508	9,353,762	1,295,857,135	175,258
2029	1,999,955,623	9,428,593	1,307,973,399	177,910
2030	2,030,224,923	9,504,021	1,320,202,950	180,535
2031	2,060,180,177	9,580,053	1,332,546,848	183,135
2032	2,089,841,165	9,656,694	1,345,006,161	185,709
2033	2,119,222,552	9,733,947	1,357,581,968	188,247
2034	2,148,185,313	9,811,819	1,370,275,360	190,743
2035	2,176,658,244	9,890,314	1,383,087,434	193,204
2036	2,204,752,760	9,969,436	1,396,019,302	195,637
2037	2,232,510,419	10,049,192	1,409,072,082	198,045
2038	2,259,994,540	10,129,585	1,422,246,906	200,407
2039	2,286,948,916	10,210,622	1,435,544,915	202,733
2040	2,313,488,979	10,292,307	1,448,967,260	205,116
2041	2,340,682,480	10,374,645	1,462,515,104	207,537
2042	2,368,302,533	10,457,642	1,476,189,620	209,985
2043	2,396,248,503	10,541,303	1,489,991,993	212,463
2044	2,424,524,235	10,625,634	1,503,923,418	214,970
2045	2,453,133,621	10,710,639	1,517,985,102	217,507
2046	2,482,080,598	10,796,324	1,532,178,263	220,074
2047	2,511,369,149	10,882,695	1,546,504,129	222,670
2048	2,541,003,305	10,969,756	1,560,963,943	225,298
2049	2,570,987,144	11,057,514	1,575,558,956	227,956
2050	2,601,324,792	11,145,974	1,590,290,432	230,646

Table 27. Revised Actual and Projected Greenhouse Gas Emissions through 2050 (mt CO_2e)								
Data	**Year**	**Population**	**Electricity**	**Natural Gas**	**Ground Travel**	**Air Travel**	**Solid Waste**	**Total**
Actual	2005	130,902	1,209,371	384,220	554,926	87,542	194,027	2,430,086
Actual	2006	133,190	1,219,582	382,273	561,733	89,363	183,380	2,436,331
Actual	2007	135,361	1,194,857	404,090	568,623	93,480	185,944	2,446,994
Actual	2008	137,611	1,135,446	424,584	510,007	92,157	153,029	2,315,223
Actual	2009	140,087	1,192,570	420,441	516,265	82,605	130,339	2,342,220
Actual	2010	143,986	1,096,316	414,213	522,595	90,857	68,055	2,192,036
Actual	2011	146,573	1,028,471	415,510	509,035	90,012	69,182	2,112,210
Actual	2012	148,700	1,166,188	379,710	513,794	91,279	73,668	2,224,639
Actual	2013	151,330	1,158,404	441,195	558,915	86,097	65,717	2,310,328
Projection	2014	154,131	1,159,255	444,725	564,141	87,690	66,941	2,322,752
Projection	2015	156,976	1,180,709	448,283	569,416	89,309	68,177	2,355,894
Projection	2016	159,909	1,202,508	451,869	574,740	90,978	69,450	2,389,545
Projection	2017	163,017	1,224,970	455,484	580,113	92,746	70,800	2,424,114
Projection	2018	166,115	1,248,783	459,128	585,537	94,508	72,145	2,460,102
Projection	2019	169,200	1,272,511	462,801	591,012	96,264	73,485	2,496,074
Projection	2020	172,289	1,296,145	466,503	596,538	98,021	74,827	2,532,035
Projection	2021	175,494	1,319,811	470,235	602,116	99,845	76,219	2,568,226
Projection	2022	178,806	1,344,358	473,997	607,746	101,729	77,657	2,605,487
Projection	2023	182,081	1,369,731	477,789	613,428	103,592	79,080	2,643,620
Projection	2024	185,335	1,394,823	481,612	619,164	105,444	80,493	2,681,535
Projection	2025	188,576	1,419,748	485,465	624,953	107,288	81,901	2,719,354
Projection	2026	191,804	1,444,578	489,348	630,796	109,124	83,303	2,757,149
Projection	2027	194,981	1,469,302	493,263	636,694	110,932	84,682	2,794,873
Projection	2028	198,004	1,493,640	497,209	642,647	112,651	85,995	2,832,142
Projection	2029	201,000	1,516,795	501,187	648,656	114,356	87,297	2,868,291
Projection	2030	203,966	1,539,752	505,196	654,721	116,044	88,585	2,904,297
Projection	2031	206,903	1,562,470	509,238	660,842	117,714	89,860	2,940,125
Projection	2032	209,811	1,584,965	513,312	667,021	119,369	91,124	2,975,791
Projection	2033	212,679	1,607,249	517,418	673,258	121,001	92,369	3,011,294
Projection	2034	215,498	1,629,214	521,558	679,553	122,604	93,593	3,046,522
Projection	2035	218,279	1,650,809	525,730	685,907	124,187	94,801	3,081,434

Data	Year	Population	Electricity	Natural Gas	Ground Travel	Air Travel	Solid Waste	Total
Projection	2036	221,027	1,672,116	529,936	692,320	125,750	95,995	3,116,117
Projection	2037	223,748	1,693,168	534,175	698,793	127,298	97,177	3,150,611
Projection	2038	226,417	1,714,012	538,449	705,327	128,817	98,336	3,184,940
Projection	2039	229,045	1,734,455	542,756	711,922	130,312	99,477	3,218,921
Projection	2040	231,737	1,754,583	547,098	718,578	131,843	100,646	3,252,749
Projection	2041	234,471	1,775,207	551,475	725,297	133,399	101,834	3,287,212
Projection	2042	237,238	1,796,154	555,887	732,078	134,973	103,035	3,322,128
Projection	2043	240,038	1,817,349	560,334	738,923	136,566	104,251	3,357,423
Projection	2044	242,870	1,838,794	564,817	745,832	138,177	105,481	3,393,101
Projection	2045	245,736	1,860,492	569,335	752,806	139,808	106,726	3,429,166
Projection	2046	248,636	1,882,445	573,890	759,845	141,458	107,985	3,465,623
Projection	2047	251,569	1,904,658	578,481	766,949	143,127	109,259	3,502,475
Projection	2048	254,538	1,927,133	583,109	774,120	144,816	110,549	3,539,727
Projection	2049	257,542	1,949,873	587,774	781,358	146,525	111,853	3,577,383
Projection	2050	260,581	1,972,882	592,476	788,664	148,253	113,173	3,615,448

A. Electricity

Tables 26 and 27 provide the actual and projected activity data and greenhouse gas emissions electricity forecast through 2050. It is based largely on the projections provided by Fort Collins Utilities, but also includes local transmissions losses and the small additional electricity provided to customers by Xcel Energy.

The GHG emissions for the forecast were calculated using the 2013 PRPA emissions factor of 1,672 lbs. CO_2/MWh. The electricity forecast will be updated annually by Fort Collins Utilities. Overall, the trend is likely to be downward as the carbon intensity of electricity used in Fort Collins decreases.

B. Natural Gas

The growth rates were taken from the U.S. Energy Information Administration (EIA) projections in 2014 for the Mountain region. Tables 25, 26 and 27 describe the model assumptions and the actual and projected activity data and GHG emissions for natural gas. The factor used to convert dth to tons CO_2e is 0.597 tons CO_2e/DTH/ (residential and commercial factor), instead of the 0.596 commercial factor. This is a stable, nationally recognized factor, and this factor is not likely to change significantly in the future.

C. Ground Transportation

Transportation forecast data (daily estimated VMT) were estimated by the City of Fort Collins Transportation Planning and ESD staff using an MPO 2009 Base Year model calibrated with local data during fall 2011 and are contained in the following spreadsheet archived at: H:/Environmental/Climate/Final 2014 Updated GHG Forecasts through 2050_072414.xlsx. Tables 25, 26 and 27 describe the model assumptions and the actual and projected activity data and GHG emissions from ground transportation.

The following are the major assumptions used in transportation modeling for the 2011 update of the 2009 Base Year Model and 2035 projections:

- Annual VMT growth rate of 0.94% from 2009 through 2035
- Projected growth rate of 2.2% annually in number of households
- Projected growth rate of 2% annually in employment
- A significant increase in the senior population by 2030 and likely impacts of new retirees on the transportation system
- Projections based on a fiscally constrained plan

The average fuel efficiencies used in these calculations for gasoline vehicles are from the Department of Energy (DOE) Transportation Data Book, Table 4.1, 4.2, and 4.3. The fuel economy factors for diesel vehicles are taken from ICLEI's CACP Software, June 2009 version. No adjustments were made for the new fuel efficiency requirements of the 2007 Energy Independence and Security Act that requires new cars, light trucks, and SUVs sold in the United States to achieve a fleet wide average of at least 35 miles per gallon by 2020.

D. Air Travel

Tables 25, 26, and 27 provide the model assumptions and the actual and projected activity data and GHG emissions for air travel, respectively.

E. Solid Waste

Tables 25, 26, and 27 provide the model assumptions and the actual and projected activity data and GHG emissions for solid waste, respectively

F. Population Growth

The Fort Collins population growth projections in Table 27 are based on the Colorado DOLA "Preliminary Population Forecasts for Colorado Counties: 2000-2040" for Larimer County located at: http://www.colorado.gov/cs/Satellite?c=Page&childpagename=DOLA-Main%2FCBONLayout&cid=1251593346867&pagename=CBONWrapper. Table 27 contains the DOLA population projections.

Appendix A

Perspectives on Renewable Energy Credits

1. Perspectives Opposed to Quantifying RECs as GHG Reduction

A. The Offset Quality Initiative (OQI) (June 2009)

The OQI published a paper in June 2009 recommending that RECs should not be treated as equivalent to GHG offsets and purchasers of RECs should not make GHG reduction claims associated with RECs retired primarily for two reasons.

1) Double-Counting and Ownership - The OQI paper states that it is difficult to establish clear ownership of indirect reductions from grid-tied renewable energy projects, and that clearly documenting transfer of ownership is difficult when the reduction itself is not clearly defined. They state that in the USA, "it is not currently possible for a renewable energy generator selling RECs to assure that emissions reductions are being conveyed with RECs and that the emissions reductions are not being counted or claimed by other-grid-connected entities."
2) Additionality – If the purchasers of offsets use them in lieu of making their own emissions reductions, it is highly important that offsets represent emissions reductions that would not have otherwise occurred. The OQI paper claims that if the additionally of a REC cannot be determined, it is inappropriate to use it as an offset.

The paper therefore recommends that RECs should not be treated as equivalent to GHG offsets and that purchasers of RECS should not make GHG emissions reduction claims associated with the retirement of RECs.

B. ICLEI's "Local Government Operations Protocol" (September 2008)

ICLEI has prepared a draft GHG protocol for local government operations (as opposed to community-wide emissions). Version 1.0
(See http://www.iclei.org/fileadmin/user_upload/documents/Global/Progams/CCP/Standards/LGOP_USA_2008.pdf , page 43) states that purchases of RECs …

> "are encouraged and should be reported as supplemental information in your local Government Operations Standards Protocol Report. However these purchases may not be deducted from your Scope 2 emissions. Scope 2 emissions result from the power you consume directly, either from a dedicated plant or from the grid, and represent your actual emissions. The partner organizations strongly support the development of renewable energy resources and recognize its importance in the fight against climate change. We recognize the need to develop a specific accounting framework for green power purchases in order to encourage and incentivize emissions reduction efforts. There is not yet consensus on how to accurately and credibly track green power purchases…. The Climate Registry plans to devote significant time to this issue in the development of their Electric Generation Protocol, which should be completed in spring 2009. We will plan to review the outcome of this process and update this section appropriately."

2. Perspectives that Provide Guidance on Quantifying RECs as GHG Reductions

A. The Climate Registry's Electric Power Sector Protocol (finalized June 2009)
(See http://www.theclimateregistry.org/downloads/2009/05/Electric-Power-Sector-Protocol_v1.0.pdf)

On July 14, 2009, The Climate Registry announced the release of newly adopted protocols for GHG reporting by the electric power sector (EPS). Chapter EPS-3, page 107, states that "because of the size of the REC market and the value The Registry sees in promoting low emitting power sources of power, this protocol provides a method for appropriately recognizing purchases of RECs and special power certificates by EPS members." It goes on to say, "When an LSE [Fort Collins Utility is a load serving utility] purchases an unbundled special power certificate, the EPS protocol allows it to account for the effect the transactions have on the GHG intensity of the electricity mix that the LSE delivers to its customers." The protocol lists several eligibility requirements for RECs to be included. Step 4 on pages 109 and 110 outlines the process used to adjust the metrics to account for special power certificate purchases such as RECs.

B. EPA Climate Leaders Guidance (November 2008)
(See http://www.epa.gov/stateply/documents/greenpower_guidance.pdf)
The *Climate Leaders Greenhouse Gas Inventory Protocol Optional Modules Methodology for Green Power and Renewable Energy Certificates (RECS)*, Version 2.1, states that partners in the Climate Leaders Program may use external reductions, such as purchases of green power, to achieve their reduction goals as long as the green power generation has not been mandated for the generating facility. The guidance addresses the eligibility of green power purchases from both contracts with a utility and through RECs. A renewable source is considered to be 'additional' if it was constructed on or after January 1, 1997. A green power purchase is considered to be additional if it is not paid for in utility standard rates. For REC purchases, it stipulates that once a REC is unbundled from electricity, the electricity must not be marketed or sold in any way as 'renewable' or "green power' on the wholesale market, including as part of a state or regional public disclosure law. Other eligibility criteria are listed on page 10 of the guidance document. The guidance goes on to provide a method for calculating emissions inventory adjustments as a result of green power purchases.

C. Green-E's Method for Calculating Carbon Equivalencies
(See http://www.green-e.org/getcert_re_stan.shtml#coccdr)
Section VII (B) of Green-E Energy Code of Conduct and Customer Disclosure Requirements addresses *Communicating the Emissions Avoidance Value of a Green-e Energy Certified Product.* This section states that Green-E Energy Certified renewable energy products must be denominated in megawatt-hours (MWh) or kilowatt-hours (kWh) and that offsetting emissions from other sources must be made with GHG reductions held to a different set of additionality criteria. This can be accomplished with products certified by Green-E Climate. However, the policy allows Green-E Energy participants to make environmental equivalency claims associated with the renewable energy products that they sell. The policy goes on to provide a methodology to convert to tons of CO_2 emissions avoided. [Note: This is the method used to calculate emissions reductions associated with RECs as reported in the community-wide greenhouse gas inventory.]

D. Community-wide GHG Reporting

Many communities such as Denver, Boulder, Boulder County and Portland, OR include RECs and carbon offsets when calculating their net community greenhouse gas inventories.

Appendix B. – 2005 Base Year Inventory Results

Revised 2005 Baseline

2005 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	2,968,669	Dth	157,803
Natural Gas, Commercial:	1,207,770	Dth	64,200
Natural Gas, Industrial and Transportation:	3,051,712	Dth	162,217
Natural Gas Subtotal	*7,228,151*	*Dth*	*384,220*
Gas Car (assumes 22.1 mpg):	22,299,792	gal.	195,792
Gas Light Truck (assumes 17.7 mpg):	21,402,275	gal.	187,912
Gas Heavy Truck (assumes 13.9 mpg):	2,561,720	gal.	22,492
Diesel Car (assumes 19.378 mpg):	61,766	gal.	631
Diesel Light Truck (assumes 16.859 mpg):	94,660	gal.	966
Diesel Heavy Truck (assumes 5.634 mpg):	14,410,724	gal.	147,133
Water Reclamation Facility Emissions:	111,419	ft3/day	1,153
Scope 1 Subtotal			**940,299**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	454,070,392	kWh	376,298
Electricity, Commercial:	474,176,147	kWh	392,960
Electricity, Industrial:	464,277,920	kWh	384,757
Electricity, Street Lights:	8,123,199	kWh	6,732
Electricity, Traffic Signals:	907,818	kWh	752
Elec., Distribution and Transmission Losses:	57,766,526	kWh	47,872
Electricity Usage Subtotal:	*1,459,322,001*	*kWh*	*1,209,371*
Scope 2 Subtotal			**1,209,371**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	237,747	tons	194,027
Community Air Travel	9,083,951	gal.	87,542
Water Reclamation Disgester Gas	111,419	ft3/day	1,782
Water Treatment and Distribution	7,405,780,650	gal.	5,278
Scope 3 Subtotal			**288,630**

Total Metric Tons of CO2e:			**2,438,300**
Benefit of RECs:			-11,050
Benefit of Known Offsets:			0
Revised Total Metric Tons of CO2e:			**2,427,250**
Recyclable Waste Embodied Emissions	75,604	tons	369,208

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A. Electricity Data for 2005

Table 28 details the calculation of localized 2005 Electricity Emissions Factors by PRPA:

Table 28. Calculation of Localized 2005 Electricity Emissions Factor
Source of Table: PRPA, 2006

2005 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**2005 Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	319,594	-	-
Purchased Power	64,016	54,373	1,873
Renewable Owned Generation (Wind)	11,499	-	-
Fossil Generation	1,063,716	1,154,763	2,393
Total Fort Collins Operational Control	1,458,825	1,209,136	**1,827**
RECs	20,000	(11,053)	(1,218)
Total Net Utilities Operational Emissions	**1,458,825**	**1,198,083**	**1,811**

B. Natural Gas Data for 2005

Table 29 summarizes natural gas use during 2005:

Table 29. 2005 Fort Collins Natural Gas Use from Xcel Energy
Source of Table: Xcel Energy, 2006

								WEATHER	
2005					WEATHER			ADJ	
		ACTUAL	NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
		SALES	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL		2,968,669	6238	5519	1.13028	771,854	2,196,815	2,483,016	3,254,870
COMMERCIAL		1,207,770				398,564	809,206	914,629	1,313,193
IND & TRANSPORT		3,051,712							3,051,712
TOTAL		7,228,151							7,619,775

C. Ground Transportation Data for 2005

Tables 30 and 31 contain the activity data used to calculate emissions from ground transportation for the 2005 Baseline Inventory.

Table 30. Fort Collins Vehicle Miles of Travel Estimates
Source of Table: Transportation Planning Department, 2005

Year	Daily VMT	X 330 =annual
2000	**2,531,071**	835,253,430
2001	2,629,354	867,686,820
2002	2,727,637	900,120,210
2003	2,825,920	932,553,600
2004	2,924,203	964,986,990
2005	**3,022,486**	997,420,380

(In…\Audit\2005-2006\VMT-Projections.xls (2/23/08)

Table 31. 2005 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	49.41
LDGT – Gas light truck	37.98
HDGV – Gas heavy truck	3.57
LDDV – Diesel car	0.12
LDDT – Diesel light truck	0.16
HDDV – Diesel heavy truck	8.14
Source: CDPHE, 2005	

D. Air Travel Data for 2005

Table 20 of the QMP contains air travel activity data for 2005.

E. Solid Waste Data for 2005

Table 21 of the QMP contains the solid waste activity data for 2005.

F. Water-related Data for 2005

Table 32. 2005 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	155
Annual volume water processed (gallons/year)	7,405,780,650
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2005

Table 33. 2005 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	111,419	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	11.41	2.97
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2005

Table 34 presents the outputs from the GHG Emissions Inventory Spreadsheet for the baseline year 2005.

Table 34. 2005 Recyclable Materials Emissions
Source of Table: The Brendle Group, March 2009

Material	Source Reduction Emissions Factor* (MTCE/t)	Source Reduction Emissions Factor-Calculated in Short Tons (tCO_2e/t)	Percentage from Waste Characteri-zation**	Weight in 2005 (tons)***	Upstream Emissions (tCO_2e)	Upstream Emissions ($MTCO_2e$)
Cardboard	1.52	6.13	7.80%	18,544	113,689	103,137
Glass	0.16	0.65	2.00%	4,755	3,069	2,784
Aluminum	2.24	9.03	0.90%	2,140	19,332	17,537
Steel	0.87	3.51	0.90%	2,140	7,508	6,811
Plastic	0.5	2.02	1.40%	3,328	6,712	6,089
Newsprint	1.33	5.36	4.30%	10,223	54,840	49,750
Mixed Office Paper	2.18	8.79	6.30%	14,978	131,697	119,474
Magazines	2.36	9.52	1.50%	3,566	33,946	30,795
Wood	0.55	2.22	6.70%	15,929	35,336	32,057
		Total	32%	75,604	406,128	368,443

* Source reduction factor from EPA's WARM model
** Percentages from Larimer County Two Season Waste Composition Study, May 2007 (See http://www.larimer.org/solidwaste/Publications/WasteSort.pdf , page 39)
*** Fort Collins' total short tons waste in 2010 = 129,876 tons

Appendix C. – 2006 Emissions

Revised 2006 Inventory Results

City of Fort Collins

2006 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	2,922,660	Dth	155,357
Natural Gas, Commercial:	1,221,100	Dth	64,909
Natural Gas, Industrial and Transportation:	3,047,776	Dth	162,007
Natural Gas Subtotal	*7,191,536*	*Dth*	*382,273*
Gas Car (assumes 22.1 mpg):	22,573,345	gal.	198,194
Gas Light Truck (assumes 17.7 mpg):	21,664,817	gal.	190,217
Gas Heavy Truck (assumes 13.9 mpg):	2,593,145	gal.	22,768
Diesel Car (assumes 19.378 mpg):	62,524	gal.	638
Diesel Light Truck (assumes 16.859 mpg):	95,821	gal.	978
Diesel Heavy Truck (assumes 5.634 mpg):	14,587,501	gal.	148,938
Water Reclamation Facility Emissions:	135,962	ft3/day	1,183
Scope 1 Subtotal			**945,189**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	468,158,947	kWh	388,398
Electricity, Commercial:	481,687,994	kWh	399,622
Electricity, Industrial:	454,720,330	kWh	377,249
Electricity, Street Lights:	8,235,645	kWh	6,833
Electricity, Traffic Signals:	910,631	kWh	755
Elec., Distribution and Transmission Losses:	56,320,279	kWh	46,725
Electricity Usage Subtotal:	*1,470,033,826*	*kWh*	*1,219,582*
Scope 2 Subtotal			**1,219,582**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	224,700	tons	183,380
Community Air Travel	9,272,941	gal.	89,363
Water Reclamation Disgester Gas	135,962	ft3/day	2,175
Water Treatment and Distribution	8,361,668,200	gal.	5,966
Scope 3 Subtotal			**280,884**

Total Metric Tons of CO2e:			**2,445,654**
Benefit of RECs:			-16,833
Benefit of Known Offsets:			0
Revised Total Metric Tons of CO2e:			**2,428,821**
Recyclable Waste Embodied Emissions	71,455	tons	348,946

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A. Electricity Data for 2006

Table 35 below details the calculation of localized 2006 Electricity Emissions Factors by PRPA:

Table 35. Calculation of Localized 2006 Electricity Emissions Factor
Source of Table: PRPA, 2007

2006 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**2006 Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	276,825	0	0
Purchased Power	60,697	51,554	1,873
Renewable Owned Generation (Wind)	16,379	0	0
Fossil Generation	1,115,439	1,167,519	2,308
Total Fort Collins Operational Control	1,469,340	1,219,072	**1,829**
RECs	29,220	-16,833	-1,270
Total Net Utilities Operational Emissions	**1,469,340**	**1,202,240**	**1,804**

B. Natural Gas Data for 2006

Table 36 summarizes natural gas use during 2006:

Table 36. 2006 Fort Collins Natural Gas Use from Xcel Energy
Source of Table: Xcel Energy, 2007

								WEATHER	
2006					WEATHER			ADJ	
		ACTUAL	NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
		SALES	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL		2,922,660	6238	5550	1.12396	759,892	2,162,768	2,430,865	3,190,757
COMMERCIAL		1,221,100				402,963	818,137	919,553	1,322,516
IND & TRANSPORT		3,047,776							3,047,776
TOTAL		7,191,536							7,561,049

C. Ground Transportation Data for 2006

Table 37 contains ground transportation distribution data for 2006.

Table 37. 2006 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of mix
LDGV – Gas car	49.41
LDGT – Gas light truck	37.98
HDGV – Gas heavy truck	3.57
LDDV – Diesel car	0.12
LDDT – Diesel light truck	0.16
HDDV – Diesel heavy truck	8.14
Source: CDPHE	

D. Air Travel Data for 2006

Table 20 of the QMP contains air travel activity data for 2006.

E. Solid Waste Data for 2006

Table 21 of the QMP contains solid waste activity data for 2006.

F. Water-related Data for 2006

Table 38. 2006 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	172
Annual volume water processed (gallons/year)	8,361,668,200
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2006

Table 39. 2006 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	135,962	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	11.17	1.97
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2006

Embodied energy in recyclable materials emissions for 2007 was calculated using the solid waste activity data for 2006 contained in Table 21.

Appendix D. – 2007 Emissions

Revised 2007 Inventory Results

City of Fort Collins

2007 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,259,015	Dth	173,236
Natural Gas, Commercial:	1,312,612	Dth	69,774
Natural Gas, Industrial and Transportation:	3,030,328	Dth	161,080
Natural Gas Subtotal	*7,601,955*	*Dth*	*404,090*
Gas Car (assumes 22.1 mpg):	22,850,227	gal.	200,625
Gas Light Truck (assumes 17.7 mpg):	21,930,556	gal.	192,550
Gas Heavy Truck (assumes 13.9 mpg):	2,624,952	gal.	23,047
Diesel Car (assumes 19.378 mpg):	63,291	gal.	646
Diesel Light Truck (assumes 16.859 mpg):	96,997	gal.	990
Diesel Heavy Truck (assumes 5.634 mpg):	14,766,430	gal.	150,765
Water Reclamation Facility Emissions:	132,070	ft3/day	1,189
Scope 1 Subtotal			**973,902**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	485,374,653	kWh	383,306
Electricity, Commercial:	493,319,559	kWh	389,580
Electricity, Industrial:	464,359,890	kWh	366,711
Electricity, Street Lights:	8,421,683	kWh	6,651
Electricity, Traffic Signals:	628,640	kWh	496
Elec., Distribution and Transmission Losses:	60,924,293	kWh	48,113
Electricity Usage Subtotal:	*1,513,028,718*	*kWh*	*1,194,857*
Scope 2 Subtotal			**1,194,857**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	227,842	tons	185,944
Community Air Travel	9,700,168	gal.	93,480
Water Reclamation Disgester Gas	132,070	ft3/day	2,112
Water Treatment and Distribution	8,003,895,930	gal.	5,436
Scope 3 Subtotal			**286,972**

Total Metric Tons of CO2e:			**2,455,731**
Benefit of RECs:			-48,591
Benefit of Known Offsets:			0
Revised Total Metric Tons of CO2e:			**2,407,140**
Recyclable Waste Embodied Emissions	72,454	tons	353,826

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A. Electricity Data for 2007

Table 40 details the calculation of localized 2007 Electricity Emissions Factors by PRPA:

Table 40. Calculation of Localized 2007 Electricity Emissions Factors
Source of Table: PRPA, 2008

2007 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**2007 Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	281,198	-	-
Purchased Power	32,391	29,911	2,036
Renewable Owned Generation (Wind)	11,039	-	-
Fossil Generation	1,187,578	1,164,155	2,161
Total Fort Collins Operational Control	1,512,207	1,194,067	**1,741**
RECs	81,961	(48,591)	(1,307)
Total Net Utilities Operational Emissions	**1,512,207**	**1,145,476**	**1,670**

B. Natural Gas Data for 2007

Table 41 summarizes natural gas use during 2007:

Table 41. 2007 Fort Collins Natural Gas Use from Xcel Energy
Source of Table: Xcel Energy, 2008

								WEATHER	
2007					WEATHER			ADJ	
	ACTUAL		NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
	SALES	CUSTOMERS	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL	3,259,015	42,425	6238	5610	1.11194	847,344	2,411,671	2,681,633	3,528,977
									per
COMMERCIAL	1,312,612	3,872				433,162	879,450	977,896	1,411,058
IND & TRANSPORT	3,030,328	139							3,030,328
TOTAL	7,601,955	46,436							7,970,363

C. Ground Transportation Data for 2007

Table 42 contains transportation data used for the 2007 inventory:

Table 42. Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	49.41
LDGT – Gas light truck	37.98
HDGV – Gas heavy truck	3.57
LDDV – Diesel car	0.12
LDDT – Diesel light truck	0.16
HDDV – Diesel heavy truck	8.14
Source: CDPHE	

D. Air Travel Data for 2007

Table 20 of the QMP contains air travel activity data for 2007.

E. Solid Waste Data for 2007

Table 21 of the QMP contains solid waste activity data for 2007.

F. Water-related Data for 2007

Table 43. 2007 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	162
Annual volume water processed (gallons/year)	8,003,895,930
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2007

Table 44. 2007 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	132,070	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	10.94	3.38
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2007

Embodied energy in recyclable materials emissions for 2007 was calculated using the solid waste activity data for 2007 contained in Table 21.

Appendix E. – 2008 Emissions

Revised 2008 Inventory Results

2008 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,499,162	Dth	186,001
Natural Gas, Commercial:	1,357,919	Dth	72,182
Natural Gas, Industrial and Transportation:	3,130,419	Dth	166,401
Natural Gas Subtotal	*7,987,500*	*Dth*	*424,584*
Gas Car (assumes 22.1 mpg):	23,493,569	gal.	206,274
Gas Light Truck (assumes 17.7 mpg):	26,426,968	gal.	232,029
Gas Heavy Truck (assumes 13.9 mpg):	686,564	gal.	6,028
Diesel Car (assumes 19.378 mpg):	43,592	gal.	445
Diesel Light Truck (assumes 16.859 mpg):	109,384	gal.	1,117
Diesel Heavy Truck (assumes 5.634 mpg):	6,279,570	gal.	64,114
Water Reclamation Facility Emissions:	131,321	ft3/day	1,220
Scope 1 Subtotal			**935,811**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	472,871,044	kWh	357,988
Electricity, Commercial:	500,089,095	kWh	378,594
Electricity, Industrial:	457,192,996	kWh	346,119
Electricity, Street Lights:	8,546,092	kWh	6,470
Electricity, Traffic Signals:	620,223	kWh	470
Elec., Distribution and Transmission Losses:	60,504,374	kWh	45,805
Electricity Usage Subtotal:	*1,499,823,824*	*kWh*	*1,135,446*
Scope 2 Subtotal			**1,135,446**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	187,510	tons	153,029
Community Air Travel	9,562,829	gal.	92,157
Water Reclamation Disgester Gas	131,321	ft3/day	2,100
Water Treatment and Distribution	7,684,886,295	gal.	5,003
Scope 3 Subtotal			**252,289**

Total Metric Tons of CO2e:			**2,323,546**
Benefit of RECs:			-53,719
Benefit of Known Offsets:			-231
Revised Total Metric Tons of CO2e:			**2,269,596**
Recyclable Waste Embodied Emissions	59,628	tons	291,192

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A. Electricity Data for 2008

Table 45 details the calculation of localized 2008 Electricity Emissions Factors by PRPA:

Table 45. Calculation of Localized 2008 Electricity Emissions Factors
Source of Table: PRPA, 2009

2008 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	299,437	-	-
Purchased Power	58,728	50,161	1,883
Renewable Owned Generation (Wind)	16,247	-	-
Fossil Generation	1,124,435	1,084,715	2,127
Total Fort Collins Operational Control	1,498,848	1,134,876	**1,669**
RECs	76,753	(53,719)	(1,543)
Total Net Utilities Operational Emissions	**1,498,848**	**1,081,157**	**1,590**

B. Natural Gas Data for 2008

Table 46 summarizes natural gas use during 2008:

Table 46. 2008 Fort Collins Natural Gas Use from Xcel Energy
Source of Table: Xcel Energy, 2009

2008					WEATHER			ADJ	
	ACTUAL		NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
	SALES	CUSTOMERS	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL	3,499,162	43,643	6238	5981	1.04297	909,782	2,589,380	2,700,646	3,610,428
COMMERCIAL	1,357,919	3,910				448,113	909,806	948,900	1,397,013
IND & TRANSPORT	3,130,419	150							3,130,419
TOTAL	7,987,500	47,703							8,137,860

C. Ground Transportation Data for 2008

Ground transportation data for 2008 are included in Tables 47 and 48. Forecasted transportation data (daily estimated VMT) were provided by the City of Fort Collins Transportation Planning staff and LSA Associates.

Table 47. Estimated Future Vehicle Miles of Travel in Fort Collins **Source of Table**: Transportation Planning Department, 2008			
Prepared 3/6/08			
Year	**Estimated Daily VMT**	**Annual VMT**	**Annual percent change**
2005	**3,022,489**	**997,421,370**	
2006	3,059,563	1,009,655,708	1.23%
2007	3,097,091	1,022,040,113	1.23%
2008	3,135,080	1,034,576,424	1.23%
2009	3,173,535	1,047,266,505	1.23%
2010	**3,212,461**	**1,060,112,242**	1.23%
Source: H:/Environmental/Climate/2010CAP Status and GHG Inventory Files/VMT Interpolation march2008.xls that was developed by ESD using data from the 2035 RTP and from city of Fort Collins Transportation Planning staff.			

Table 48. 2008 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	50.19%
LDGT – Gas light truck	45.21%
HDGV – Gas heavy truck	0.92%
LDDV – Diesel car	0.08%
LDDT – Diesel light truck	0.18%
HDDV – Diesel heavy truck	3.42%
Source: CDPHE	

D. Air Travel Data for 2008

Table 20 of the QMP contains air travel activity data for 2008.

E. Solid Waste Data for 2008

Table 21 of the QMP contains solid waste activity data for 2008.

F. Water-related Data for 2008

Table 49. 2008 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	153
Annual volume water processed (gallons/year)	7,684,886,295
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2008

Table 50. 2008 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions(ft^3/day)	131,321	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	12.53	2.35
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2008

Embodied energy in recyclable materials emissions for 2008 was calculated using the solid waste activity data for 2008 contained in Table 21.

Appendix F. – 2009 Emissions

Revised 2009 Inventory Results

2009 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,582,743	Dth	190,444
Natural Gas, Commercial:	1,352,791	Dth	71,909
Natural Gas, Industrial and Transportation:	2,974,045	Dth	158,088
Natural Gas Subtotal	*7,909,579*	*Dth*	*420,441*
Gas Car (assumes 22.1 mpg):	23,783,849	gal.	208,822
Gas Light Truck (assumes 17.7 mpg):	26,749,672	gal.	234,862
Gas Heavy Truck (assumes 13.9 mpg):	694,662	gal.	6,099
Diesel Car (assumes 19.378 mpg):	44,138	gal.	451
Diesel Light Truck (assumes 16.859 mpg):	110,696	gal.	1,130
Diesel Heavy Truck (assumes 5.634 mpg):	6,356,595	gal.	64,901
Water Reclamation Facility Emissions:	131,845	ft3/day	1,266
Scope 1 Subtotal			**937,972**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	466,229,318	kWh	375,800
Electricity, Commercial:	492,961,393	kWh	397,348
Electricity, Industrial:	446,089,800	kWh	359,567
Electricity, Street Lights:	8,534,299	kWh	6,879
Electricity, Traffic Signals:	621,057	kWh	501
Elec., Distribution and Transmission Losses:	65,102,459	kWh	52,475
Electricity Usage Subtotal:	*1,479,538,325*	*kWh*	*1,192,570*
Scope 2 Subtotal			**1,192,570**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	159,708	tons	130,339
Community Air Travel	8,571,702	gal.	82,605
Water Reclamation Disgester Gas	131,845	ft3/day	2,109
Water Treatment and Distribution	6,902,786,925	gal.	4,785
Scope 3 Subtotal			**219,838**

Total Metric Tons of CO2e:			**2,350,380**
Benefit of RECs:			-56,684
Benefit of Known Offsets:			-85
Revised Total Metric Tons of CO2e:			**2,293,611**
Recyclable Waste Embodied Emissions	50,787	tons	248,017

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A. Electricity Data for 2009

Table 51 details the calculation of localized 2009 Electricity Emissions Factors by PRPA:

Table 51. Calculation of Localized 2009 Electricity Emissions Factors
Source of Table: PRPA, 2010

2009 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	291,999	-	-
Purchased Power	8,427	7,198	1,883
Renewable Owned Generation (Wind)	13,643	-	-
Fossil Generation	1,164,097	1,184,348	2,243
Total Fort Collins Operational Control	1,478,166	1,191,546	**1,777**
RECs	81,358	(56,684)	(1,536)
Total Net Utilities Operational Emissions	**1,478,166**	**1,134,862**	**1,693**

B. Natural Gas Data for 2009

Table 52 summarizes natural gas use during 2009:

Table 52. 2009 Fort Collins Natural Gas Use from Xcel Energy
Source of Table: Xcel Energy, 2010

									WEATHER	
2009						WEATHER			ADJ	
		ACTUAL		NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
		SALES	CUSTOMERS	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL		3,582,743	46,087	6238	5919	1.05389	931,513	2,651,230	2,794,105	3,725,618
COMMERCIAL		1,352,791	4,070				446,421	906,370	955,214	1,401,635
IND & TRANSPORT		2,974,045	167							2,974,045
TOTAL		7,909,579	50,324							8,101,298

C. Ground Transportation Data for 2009

Table 53 contains ground transportation data used for the 2009 inventory:

Table 53. 2009 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	50.19%
LDGT – Gas light truck	45.21%
HDGV – Gas heavy truck	0.92%
LDDV – Diesel car	0.08%
LDDT – Diesel light truck	0.18%
HDDV – Diesel heavy truck	3.42%
Source: CDPHE	

D. Air Travel Data for 2009

Table 20 of the QMP contains air travel activity data for 2009.

E. Solid Waste Data for 2009

Table 21 of the QMP contains solid waste activity data for 2009.

F. Water-related Data for 2009

Table 54. 2009 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	135
Annual volume water processed (gallons/year)	6,902,786,925
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2009

Table 55. 2009 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	131,845	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	14.43	0
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2009

Embodied energy in recyclable materials emissions for 2009 was calculated using the solid waste activity data for 2009 contained in Table 21.

Appendix G. – 2010 Emissions

Revised Inventory Results for 2010

City of Fort Collins

2010 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,543,627	Dth	188,365
Natural Gas, Commercial:	1,302,271	Dth	69,223
Natural Gas, Industrial and Transportation:	2,946,521	Dth	156,625
Natural Gas Subtotal	*7,792,419*	*Dth*	*414,213*
Gas Car (assumes 22.1 mpg):	24,073,446	gal.	211,365
Gas Light Truck (assumes 17.7 mpg):	27,079,248	gal.	237,756
Gas Heavy Truck (assumes 13.9 mpg):	703,510	gal.	6,177
Diesel Car (assumes 19.378 mpg):	44,682	gal.	456
Diesel Light Truck (assumes 16.859 mpg):	112,084	gal.	1,144
Diesel Heavy Truck (assumes 5.634 mpg):	6,434,565	gal.	65,697
Water Reclamation Facility Emissions:	134,187	ft3/day	1,301
Scope 1 Subtotal			**938,109**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	494,670,225	kWh	361,253
Electricity, Commercial:	500,618,901	kWh	365,597
Electricity, Industrial:	448,106,550	kWh	327,248
Electricity, Street Lights:	8,526,559	kWh	6,227
Electricity, Traffic Signals:	610,067	kWh	446
Elec., Distribution and Transmission Losses:	48,672,210	kWh	35,545
Electricity Usage Subtotal:	*1,501,204,512*	*kWh*	*1,096,316*
Scope 2 Subtotal			**1,096,316**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	129,867	tons	68,055
Community Air Travel	9,427,984	gal.	90,857
Water Reclamation Disgester Gas	134,187	ft3/day	2,146
Water Treatment and Distribution	7,673,013,940	gal.	4,819
Scope 3 Subtotal			**165,877**

Total Metric Tons of CO2e:			**2,200,302**
Benefit of RECs:			-32,737
Benefit of Known Offsets:			-331
Revised Total Metric Tons of CO2e:			**2,167,234**
Recyclable Waste Embodied Emissions	41,298	tons	201,676

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A. Electricity Data for 2010

Table 56 details the calculation of localized 2010 electricity emission factors by PRPA, and Table 57 shows the activity use by categories through 2010.

Table 56. Calculation of Localized 2010 Electricity Emissions Factors
Source of Table: PRPA, 2011

2010 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	289,839		
Purchased Power	29,365	25081.44412	1,883
Renewable Owned Generation (Wind)	42,579		-
Fossil Generation	1,138,157	1,070,505	2,074
Total Fort Collins Operational Control	1,499,940	1,095,587	**1,610**
RECs	53,421	(32,737)	(1,351)
Total Net Utilities Operational Emission	**1,499,940**	**1,062,850**	**1,562**

Table 57. Summary of Electricity Data from Fort Collins Utilities
Source of Table: Fort Collins Utilities Department, 2011

	2005 kWh	2006 kWh	2007 kWh	2008 kWh	2009 kWh	2010 kWh
Residential	453,821,891	467,812,034.00	484,963,794.00	472,383,132.00	465,543,155	494,037,969
Commercial	473,927,646	481,341,081.00	492,908,700.00	499,601,183.00	492,275,230	499,986,645
Industrial	464,277,920	454,720,330.00	464,359,890.00	457,192,996.00	446,089,800	448,106,550
Traffic	907,818	910,631.00	628,640.00	620,223.00	621,057	610,067
Street Lighting (Provided a	8,123,199	8,235,645.00	8,421,683.00	8,546,092.00	8,534,299	8,526,559
Total	1,401,058,474	1,413,019,721.00	1,451,282,707.00	1,438,343,626.00	1,413,063,541	1,451,267,790
Distribution Losses	31,507,064	29,872,500.00	33,673,950.00	33,524,826.00	38,495,582	21,672,785
Purchases from PRPA	**1,432,565,538**	1,442,892,221.00	1,484,956,657.00	1,471,868,452.00	1,451,559,123	1,472,940,575

*Note: 2 customers moved from Industrial to Commercial in 2008 because their average peak demands fell below 750 kW.

** Transmission losses were calculated based on Total Operational Control data.

Source: City of Fort Collins Utilities, archived at H:/Environmental/Climate/2010CAP Status and GHG Inventory Files/EllenSwitzer-Community-2005-2010 kWh by Class.xls)

B. Natural Gas Data for 2010

Table 58 summarizes natural gas use during 2010.

Table 58. 2010 Fort Collins Natural Gas Use from Xcel Energy

									WEATHER	
2010						WEATHER			ADJ	
		ACTUAL		NORMAL	ACTUAL	NORMAL	BASE	HEATING	HEATING	NORMAL
		SALES	CUSTOMERS	HDD	HDD	FACTOR	LOAD	LOAD	LOAD	SALES
RESIDENTIAL		3,543,627	46,700	6238	5714	1.0917	921,343	2,622,284	2,862,747	3,784,090
COMMERCIAL		1,302,271	4,126				429,749	872,522	952,532	1,382,281
IND & TRANSPORT		2,946,521	182							2,946,521
TOTAL		7,792,419	51,008							8,112,892

Source: Data archived at H:/Environmental/Climate/2010CAP Status and GHG Inventory Files/GlennMonroe-FtCollins2010GasSales.xls, see tab "Gas"

C. Ground Transportation Data for 2010

Table 59 contains the ground transportation VMT mix for the 2010 inventory.

Table 59. 2010 Fort Collins Vehicle Miles Travelled Distribution	
	Percent of Mix
LDGV – Gas car	50.19
LDGT – Gas light truck	45.21
HDGV – Gas heavy truck	0.92
LDDV – Diesel car	0.08
LDDT – Diesel light truck	0.18
HDDV – Diesel heavy truck	3.42
Source: CDPHE	

D. Air Travel Data for 2010

Table 20 of the QMP contains air travel activity data for 2010.

E. Solid Waste Data for 2010

Table 21 of the QMP contains solid waste activity data for 2010.

F. Water-related Data for 2010

Table 60. 2010 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	146
Annual volume water processed (gallons/year)	7,673,013,940
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2010

Table 61. 2010 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	134,187	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	13.9	0
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2010

Embodied energy in recyclable materials emissions for 2010 was calculated using the solid waste activity data for 2010 contained in Table 21.

Appendix H. – 2011 Emissions

Revised Inventory Results for 2011

2011 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,603,033	Dth	191,523
Natural Gas, Commercial:	1,359,080	Dth	72,243
Natural Gas, Industrial and Transportation:	2,854,697	Dth	151,744
Natural Gas Subtotal	*7,816,810*	*Dth*	*415,510*
Gas Car (assumes 22.1 mpg):	25,823,791	gal.	226,733
Gas Light Truck (assumes 17.7 mpg):	28,874,565	gal.	253,519
Gas Heavy Truck (assumes 13.9 mpg):	644,640	gal.	5,660
Diesel Car (assumes 19.378 mpg):	45,670	gal.	466
Diesel Light Truck (assumes 16.859 mpg):	118,110	gal.	1,206
Diesel Heavy Truck (assumes 5.634 mpg):	2,100,940	gal.	21,451
Water Reclamation Facility Emissions:	95,479	ft3/day	1,286
Scope 1 Subtotal			**925,831**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	493,810,336	kWh	333,747
Electricity, Commercial:	502,064,224	kWh	339,325
Electricity, Industrial:	451,082,970	kWh	304,869
Electricity, Street Lights:	8,532,694	kWh	5,767
Electricity, Traffic Signals:	576,847	kWh	390
Elec., Distribution and Transmission Losses:	65,653,825	kWh	44,373
Electricity Usage Subtotal:	*1,521,720,895*	*kWh*	*1,028,471*
Scope 2 Subtotal			**1,028,471**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	132,018	tons	69,182
Community Air Travel	9,340,211	gal.	90,012
Water Reclamation Disgester Gas	95,479	ft3/day	1,527
Water Treatment and Distribution	7,543,379,445	gal.	4,385
Scope 3 Subtotal			**165,105**

Total Metric Tons of CO2e:			**2,119,407**
Benefit of RECs:			-36,322
Benefit of Known Offsets:			-21
Revised Total Metric Tons of CO2e:			**2,083,064**
Recyclable Waste Embodied Emissions	41,982	tons	205,016

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A. Electricity Data for 2011

Table 62 details the calculation of localized electricity emission factors by PRPA, and Table 63 shows the activity use by categories for 2011.

Table 62. Calculation of Localized Electricity Emissions Factors
Source of Table: PRPA, 2012

2011 Operational Boundary Fort Collins GHG Emissions (Emissions Levels at Source)			
Resource	**Energy @ Generator (MWh)**	**Actual Emissions @ Generator (MT)**	**Emission Rate (lbs/MWh)**
WAPA	398,104		
Purchased Power	23,273	20,490	1,941
Renewable Owned Generation (Wind)	40,889		-
Fossil Generation	1,058,525	1,007,595	2,099
Total Fort Collins Operational Control	1,520,791	1,028,086	**1,490**
RECs	55,111	(36,322)	(1,453)
Total Net Utilities Operational Emissions	**1,520,791**	**991,763**	**1,438**

Table 63. 2011 Total Electric Sales by Fort Collins Utilities (kWh)	
	2011
Residential	493,345,388
Commercial	501,599,276
Industrial	451,082,970
Traffic	576,847
Street Lighting	8,532,694
Total	1,455,137,175
Distribution Losses	38,279,635
Purchases from PRPA	1,493,416,810
Source: Fort Collins Utilities Department, 2012	

B. Natural Gas Data for 2011

Table 64 summarizes natural gas use during 2011.

Table 64. 2011 Natural Gas Use from Xcel Energy				
	Residential	**Commercial**	**Industrial & Transport**	**Total**
Actual Sales	3,603,033	1,359,080	2,854,697	7,816,810
Customers	47,799	4,198	203	52,200
Weather Normal Factor	1.12174			
Base Load	936,789	448,496		
Heating Load	2,666,244	910,584		
Weather Adjusted Heating Load	2,990,833	1,021,439		
Normal Sales	3,927,622	1,469,935	2,854,697	8,252,254
Source: Xcel Energy, 2012				

C. Ground Transportation Data for 2011

Table 65 contains the ground transportation VMT mix for the 2011 inventory.

Table 65. 2011 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	51.59
LDGT – Gas light truck	46.20
HDGV – Gas heavy truck	0.81
LDDV – Diesel car	0.08
LDDT – Diesel light truck	0.18
HDDV – Diesel heavy truck	1.07
Source: CDPHE	

D. Air Travel Data for 2011

Table 20 of the QMP contains air travel activity data for 2011.

E. Solid Waste Data for 2011

Table 21 of the QMP contains solid waste activity data for 2011.

F. Water-related Data for 2011

Table 66. 2011 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	141
Annual volume water processed (gallons/year)	7,543,379,445
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2011

Table 67. 2011 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	95,479	0
Percent of CH4 in gas	60	0
Average daily flow (MGD)	11.88	3.53
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2011

Embodied energy in recyclable materials emissions for 2011 was calculated using the solid waste activity data for 2011 contained in Table 21.

Appendix I. – 2012 Emissions

Revised Inventory Results for 2012

City of Fort Collins

2012 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,201,407	Dth	170,174
Natural Gas, Commercial:	1,208,027	Dth	64,214
Natural Gas, Industrial and Transportation:	2,733,880	Dth	145,322
Natural Gas Subtotal	*7,143,314*	*Dth*	*379,710*
Gas Car (assumes 22.1 mpg):	26,065,243	gal.	228,853
Gas Light Truck (assumes 17.7 mpg):	29,144,542	gal.	255,889
Gas Heavy Truck (assumes 13.9 mpg):	650,667	gal.	5,713
Diesel Car (assumes 19.378 mpg):	46,097	gal.	471
Diesel Light Truck (assumes 16.859 mpg):	119,215	gal.	1,217
Diesel Heavy Truck (assumes 5.634 mpg):	2,120,584	gal.	21,651
Water Reclamation Facility Emissions:	125,084	ft3/day	1,303
Scope 1 Subtotal			**894,807**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	489,623,227	kWh	371,337
Electricity, Commercial:	507,604,045	kWh	384,974
Electricity, Industrial:	461,480,570	kWh	349,993
Electricity, Street Lights:	8,526,396	kWh	6,467
Electricity, Traffic Signals:	575,314	kWh	436
Elec., Distribution and Transmission Losses:	69,857,402	kWh	52,981
Electricity Usage Subtotal:	*1,537,666,954*	*kWh*	*1,166,188*
Scope 2 Subtotal			**1,166,188**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	139,060	tons	73,668
Community Air Travel	9,471,755	gal.	91,279
Water Reclamation Disgester Gas	125,084	ft3/day	2,001
Water Treatment and Distribution	8,955,457,500	gal.	5,841
Scope 3 Subtotal			**172,789**

Total Metric Tons of CO2e:			**2,233,784**
Benefit of RECs:			-37,251
Benefit of Known Offsets:			-308
Revised Total Metric Tons of CO2e:			**2,196,225**
Recyclable Waste Embodied Emissions	44,221	tons	215,952

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A. Electricity Data for 2012

Table 68 details the calculation of localized electricity emission factors by PRPA, and Table 69 shows the activity use by categories for 2012.

Table 68. 2012 Operational Boundary Fort Collins Greenhouse Gas Emissions (Emissions Levels at Source)

Resource	Energy @ Generator (MWh)	Actual Emissions @ Generator (MT)	Emission Rate (lbs/MWh)
WAPA	298,391		
Purchased Power	60,878	51,305	1,858
Renewable Owned Generation (Wind)	23,458		
Fossil Generation	1,153,663	1,113,687	2,128
Total Fort Collins Operational Control	**1,536,390**	1,164,992	1,672
RECs	52,542	-37,225	-1,563
Total Net Utilities Operational Emissions	1,536,390	1,127,737	1,618

Source: PRPA, 2012, H:/Environmental/Climate/2012 Carbon Data/PRPA_Data/2012 PRPA Data.xlsx

Table 69. 2012 Total Electric Sales by Fort Collins Utilities (kWh)

	2012
Residential	488,984,750
Commercial	506,965,568
Industrial	461,480,570
Traffic	575,314
Street Lighting	8,526,396
Distribution Losses	42,202,159
Transmission Losses	27,655,243
Total	1,536,390,000

Source: Fort Collins Utilities Department, 2013

B. Natural Gas Data for 2012

Table 70 shows the natural gas use for 2012.

Table 70. 2012 Natural Gas Use from Xcel Energy

	Residential	Commercial	Industrial & Transport	Total
Actual Sales	3,201,407	1,208,027	2,733,880	7,143,315
Customers	48,147	4,176	215	52,538
Base Load	832,366	398,649		
Heating Load	2,369,041	809,378		
Normal Sales	3,773,863	1,403,605	2,733,880	7,911,348

Source: Xcel Energy, 2013

C. Transportation Data for 2012

Table 71 shows the 2012 Vehicle Miles Traveled distribution mix.

Table 71. 2012 Fort Collins Vehicle Miles Traveled Distribution	
	Percent of Mix
LDGV – Gas car	51.59
LDGT – Gas light truck	46.20
HDGV – Gas heavy truck	0.81
LDDV – Diesel car	0.08
LDDT – Diesel light truck	0.18
HDDV – Diesel heavy truck	1.07
Source: CDPHE	

D. Air Travel Data for 2012

Table 20 of the QMP contains air travel activity data for 2012.

E. Solid Waste Data for 2012

Table 21 of the QMP contains solid waste activity data for 2012.

F. Water-related Data for 2012

Table72. 2012 Fort Collins Water-related Activity Data	
Data Type	**Activity Data**
Water use per capita (gallons/day)	165
Annual volume water processed (gallons/year)	8,955,457,500
Percent of water supplied from surface water	100

G. Wastewater-related Data for 2012

Table 73. 2012 Fort Collins Wastewater-related Activity Data		
Data Type	**DWRF**	**MWRF**
Digester gas emissions (ft^3/day)	95,479	0
Percent of CH_4 in gas	60.20	0
Average daily flow (MGD)	9.57	3.21
Type process	Anaerobic	Primarily Aerobic
Source: Fort Collins Utilities, Water Reclamation Division, 2013		

H. Embodied Energy in Recyclable Materials Data for 2012

Embodied energy in recyclable materials emissions for 2012 were calculated using the solid waste activity data for 2012 contain in Table 21.

Appendix J. – 2013 Emissions

2013 Community GHG Report

Scope 1 - Direct GHG Emission	Usage		Metric tons of CO2e
Natural Gas, Residential:	3,905,638	Dth	207,608
Natural Gas, Commercial:	1,464,959	Dth	77,871
Natural Gas, Industrial and Transportation:	2,929,408	Dth	155,716
Natural Gas Subtotal	*8,300,005*	*Dth*	*441,195*
Gas Car (assumes 22.1 mpg):	25,181,937	gal.	221,097
Gas Light Truck (assumes 17.7 mpg):	28,436,475	gal.	249,672
Gas Heavy Truck (assumes 13.9 mpg):	275,673	gal.	2,420
Diesel Car (assumes 19.378 mpg):	52,344	gal.	534
Diesel Light Truck (assumes 16.859 mpg):	922,524	gal.	9,419
Diesel Heavy Truck (assumes 5.634 mpg):	7,421,426	gal.	75,773
Water Reclamation Facility Emissions:	122,392	ft3/day	1,367
Scope 1 Subtotal			**1,001,477**

Scope 2 - Energy Indirect GHG Emissions	Usage		Metric tons of CO2e
Electricity, Residential:	509,000,720	kWh	386,033
Electricity, Commercial:	502,624,656	kWh	381,198
Electricity, Industrial:	458,413,890	kWh	347,668
Electricity, Street Lights:	8,500,793	kWh	6,447
Electricity, Traffic Signals:	575,316	kWh	436
Elec., Distribution and Transmission Losses:	48,287,335	kWh	36,622
Electricity Usage Subtotal:	*1,527,402,709*	*kWh*	*1,158,404*
Scope 2 Subtotal			**1,158,404**

Scope 3 - Other Indirect GHG Emissions	Usage		Metric tons of CO2e
Solid Waste	133,931	tons	65,717
Community Air Travel	8,934,039	gal.	86,097
Water Reclamation Disgester Gas	122,392	ft3/day	1,958
Water Treatment and Distribution	7,788,198,450	gal.	5,080
Scope 3 Subtotal			**158,852**

Total Metric Tons of CO2e:			**2,318,732**
Benefit of RECs:			-28,787
Benefit of Known Offsets:			-18
Revised Total Metric Tons of CO2e:			**2,289,927**
Recyclable Waste Embodied Emissions	42,590	tons	207,987

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Environmental Services