Fort Collins

Community Greenhouse Gas Emissions Quantification

2005, 2006, 2007, 2008 Inventory and 2020 Forecast

July 2009

City of Fort Collins

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For questions or comments pertaining to this document, please contact the City of Fort Collins Natural Resources Department at (970) 221-6600.

I. Description of Fort Collins Community

Fort Collins, Colorado, USA is located in northern Colorado in the foothills of the Rocky Mountains. The 50 square mile city lies ~5000 feet above sea level. Residents enjoy a moderate, four season climate with an average of 300 days of sunshine and 14.5 inches of precipitation a year. Fort Collins is a regional center for employment, shopping, and healthcare, and provides a small town life style with all the amenities of a larger city. Fort Collins has a population of 127,686 residents (August, 2005) with a median age of 29.4 (based on 2006 US Census American Communities Survey).

Fort Collins offers a unique blend of natural beauty, cultural and recreation opportunities, a strong economic base and diverse employment opportunities. Major employment sectors include education, health care, and high tech industries. Fort Collins is a home rule city with a Council/Manager form of government with an operating budget of $465 million (2005). Fort Collins has a municipal electric and water utility.

II. Updated Community Greenhouse Gas Accounting Methodology

Greenhouse gas 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 we are using current best practices for community inventories. 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.) City staff considered and adopted several recommendations including:

- Increase modeled average on-road fuel efficiency to better reflect current national averages.
- Include airline travel by Fort Collins residents.
- Calculate landfill emissions using the Intergovernmental Panel on Climate Change and California Air Resources Board's First Order Decay model that accounts for "waste in place" at the landfill as well as annual additions.
- Add embodied energy from recyclable materials to align with CAP reduction strategies.
- Report community inventory in metric tons CO_2e ($mtCO_2e$) rather than short tons.

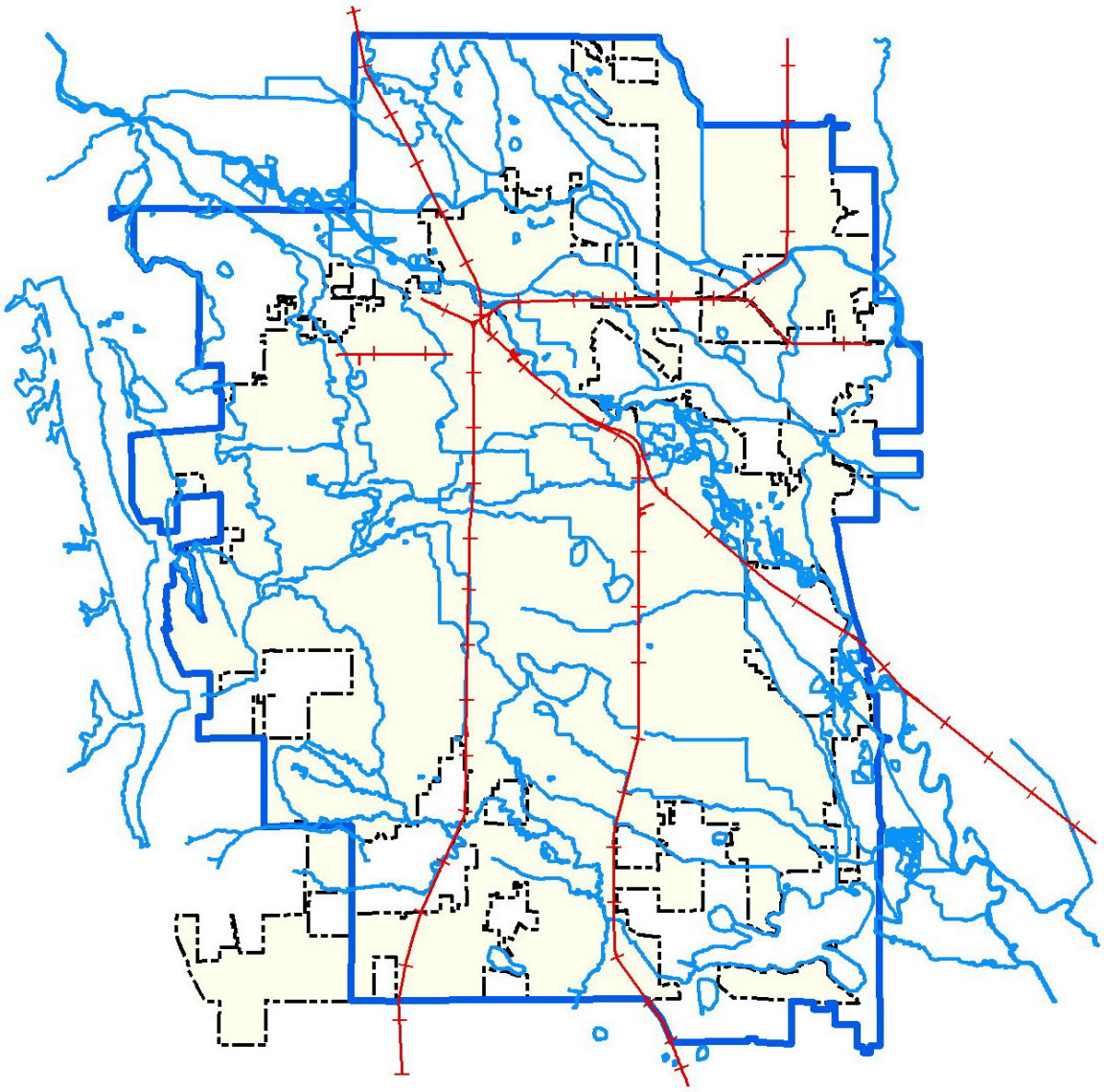
The 2005 baseline and subsequent inventories were revised to reflect those modifications.

Fort Collins joins many other communities in conducting periodic reviews and updates. As federal regulations are promulgated, protocols will continue to evolve, and additional updates to the methodology are anticipated. According to the City's policy, any future changes that would alter the 2005 baseline by more than 5% will trigger an update in the baseline inventory.

III. Inventory Boundaries

Figure 1 below identifies Fort Collins City Limits and Growth Management Area as of 2009. For the purposes of the community GHG inventory, the City Limits provides the geo-political boundary for electricity and natural gas usage data. The Growth Management Area provides the geopolitical boundary for transportation data.

Figure 1. Fort Collins City Limits and Growth Management Area



Growth Management Area
City Limits

IV. Baseline Year Selection

The year 2005 was selected as the Fort Collins community baseline year because of the form of the community reduction goals. The 2020 reduction goal is to reduce 2005 emissions 20% below 2005 levels. The 2050 reduction goal is to reduce emissions 80% below 2005 levels.

Baseline Recalculation Policy

The baseline year emissions will be recalculated if there are structural changes in the organizational boundary and/or changes in accepted calculation methodologies that would result in a 5% or greater change to the baseline year emissions. For example, if a large segment of land were annexed into Fort Collins and the 2005 activity data from that area caused the 2005 baseline to increase by 5% or more, the baseline and subsequent year inventories would be re-calculated. Similarly, if a new methodology was adopted for accounting for greenhouse gas emissions from landfill waste that, if applied to the 2005 baseline year, would cause it to change by 5% or more, the baseline and subsequent year inventories would be re-calculated according to that policy.

V. Emissions Quantification

A…ELECTRICITY

Boundary (City Limits)

Fort Collins Utilities (FCU) is the electricity provider for the Fort Collins community and serves accounts within City Limits. There are a small number of accounts outside of City Limits served by FCU, most of which are in the area of Link Lane, which are also included in the inventory. An estimated 99%+ of the data reported by FC Utilities is from within the City Limits. Some areas recently annexed by the City are not yet served by FCU but will be included soon (per communications with Fort Collins Utilities staff). The community inventory does not include emissions from the Water Treatment Plant, located outside the City Limits. These emissions are included in the local government emissions reporting, however.

There are also a few electricity accounts in Fort Collins served by Xcel Energy that are also included in the inventory. 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).

Activity Data

1) Electricity provided by Fort Collins Utilities

Source: Fort Collins Utilities, , Ellen Switzer, (970) 221-6714

The electricity data provided in Table 1 data are not weather normalized. These data do not include the Water Treatment Plant, which is served by Xcel Energy and is outside City Limits.

Table 1. Fort Collins' Electricity Data from Fort Collins Utilities

Energy Sales - City of Fort Collins **Provided by Ellen Switzer, June 3, 2009**

	2005 kWh	2006 kWh	2007 kWh	2008 kWh
Residential	453,821,891	467,812,034	484,963,794	472,383,132
Commercial	473,927,646	481,341,081	492,908,700	499,601,183*
Industrial	464,277,920	454,720,330	464,359,890	457,192,996*
Traffic	907,818	910,631	628,640	620,223
Street Lighting (Provided at no cost)	8,123,199	8,235,645	8,421,683	8,546,092
Total	1,401,058,474	1,413,019,721	1,451,282,707	1,438,343,626
Distribution Losses	31,507,064	29,872,500	33,673,950	33,524,826
Purchases from PRPA	**1,432,565,538**	1,442,892,221	1,484,956,657	1,471,868,452

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

2) Electricity provided by Xcel Energy

Source: Xcel Energy, Glenn Monroe, (303)294-2392; Glenn.monroe@xcelenergy.com

Table 2. Fort Collins' Electricity Data from Xcel Energy

FORT COLLINS TOTAL ELECTRIC SALES by Xcel Energy

Year	kWh		Notes
2005	497,001	**	This number may be lower than the actual because of the switch from the CIS to CRS accounting system.
2006	693,826		
2007	821,718		
2008	975,824		

Methodology

Emissions Factors for Community Electricity Use

Fort Collins electricity related emissions inventory is estimated using a conversion factor based on Platte River Power Authority's resource mix without renewable energy or RECs included. The factor for this mix is 1,812 pounds of CO2 per megawatt-hour (wholesale) for 2005 and 2006.

Table 3. Calculation of Localized 2005 and 2006 Electricity Emissions Factor

Source	Scheduled Energy (MWh net)	CO2 Emission Rates (lb/MWh net)	CO2 Emissions (tons)
Hydro	576,685	0	0
Gas (CTs)	13,668	1,467	10,025
Rawhide	989,375	2,112	1,044,754
Craig	1,275,997	2,310	1,473,777
Wind (scheduled)	13,187	2,112	13,925
Other (e.g., purchases) [NOTE 1]	194,595	1,883	183,211
Totals	**3,063,507**		**2,725,692**
Net emission rate	(lb/MWh net)	1,779	
Transmission losses		1.80%	
Wholesale emission rate	(lb/MWh whsl)	1,812	

Table 4. Calculation of Localized 2007 and 2008 Electricity Emissions Factor

Source	Scheduled Energy (MWh net)	CO2 Emission Rates (lb/MWh net)	CO2 Emissions (tons)
Hydro	642,223	0	0
Gas (CTs)	79,532	1,383	54,996
Rawhide	1,120,270	2,112	1,182,976
Craig	1,248,087	2,310	1,441,540
Wind (scheduled)	22,470	2,112	23,728
Other (e.g., purchases)	127,014	1,883	119,584
Totals	**3,239,596**		**2,822,824**
Net emission rate	(lb/MWh net)	1,743	
Transmission losses		1.80%	
Wholesale emission rate	(lb/MWh whsl)	**1,775**	

The table above show the estimated generation mix that is delivered to Fort Collins provide by PRPA in March 2009. It is based on hour-ahead scheduled energy deliveries. Actual deliveries may differ, but are not tracked on a source-by-source basis. In this table, wind is also a scheduled value and does not represent the actual quantity of wind energy or RECs delivered to Fort Collins. Rather, this energy is assumed to come from coal-fired generation. The emissions factor changed in 2007 because new, more efficient gas turbines came online at Rawhide.

Emissions Factors for Metered Wind Energy and RECs

Metered renewable energy, such as that delivered from the Medicine Bow wind site, is converted to carbon emissions reductions using Fort Collins fraction of Platte River's renewable energy and a standardized conversion factor. The factor is 1,618 pounds of carbon dioxide avoided per megawatt-hour of electricity savings. It is based on 2007 Environmental Protection Agency (EPA) "eGRID" non-baseload emission rate calculations for Western Electric Coordinating Council (WECC) Rockies subregion.

Renewable energy credits are reported in electricity units of megawatt-hours. 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-baseload emissions factors for each NERC region from which Platte River purchased RECs, weighted according to the amount purchased from each region, as follows:

NERC Region Energy Delivered to	Energy (MWh)	% Energy	Marginal CO2 Emission Rate (lb/MWh)
Western Electricity Coordinating Council Rockies (RMPA)	47,923	37%	1,618
Southwest Power Pool South (SPP)	70,000	53%	1,379
Midwest Reliability Organization West (MRO)	13,038	10%	2,159
TOTALS	130,961		
AVERAGE			**1,544**

Conversion to CO2e

Tons CO2e are calculated as follows: (MWh purchased x emissions factor)/2000 = tons CO2e

B. NATURAL GAS

Boundary (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 (per communications with Xcel Energy staff).

Activity Data

Source: Xcel Energy, Glenn Monroe, Xcel Energy, (303)294-2392; Glenn.monroe@xcelenergy.com

The weather-adjusted "Normal Sales" are used in the inventory. Transport gas, provided by other gas vendors but delivered through Xcel lines, is included in the inventory.

Table 5. 2005 Fort Collins Natural Gas Use from Xcel Energy

2005	ACTUAL SALES	NORMAL HDD	ACTUAL HDD	WEATHER NORMAL FACTOR	BASE LOAD	HEATING LOAD	WEATHER ADJ HEATING LOAD	NORMAL 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

Table 6. 2006 Fort Collins Natural Gas Use from Xcel Energy

2006	ACTUAL SALES	NORMAL HDD	ACTUAL HDD	WEATHER NORMAL FACTOR	BASE LOAD	HEATING LOAD	WEATHER ADJ HEATING LOAD	NORMAL 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

Table 7. 2007 Fort Collins Natural Gas Use from Xcel Energy

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

Table 8. 2008 Fort Collins Natural Gas Use from Xcel Energy

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

Methodology

Decatherms (1 DTH = 1 MMBtu) are multiplied by the sector-specific emissions factor that includes CO_2, CH_4 and N_20, to calculate total CO2e emissions. Sector-specific factors are given in the table below, and conform to factors used in IPCC and The Climate Registry.

Table 9. Natural Gas Emissions Factors

Emission Factor Source	CO_2 (ton/MMBtu)	CH_4 (lb/MMBtu)	N_2O (lb/MMBtu)	Combined Factor CO2e (tons/MMBtu)
The Climate Registry (TCR) Assuming heat content of 975-1,000 Btu/Standard Cubic Foot				
Residential	0.0595	0.011	0.0002	0.0597
Commercial	0.0595	0.011	0.0002	0.0597
Industrial	0.0595	0.011	0.0002	0.0596

C. GROUND TRANSPORTATION

Boundary (Growth Management Area)

The vehicle miles traveled (VMT) modeling data that supports the calculation of GHG emissions from transportation activities comes covers the Fort Collins Metropolitan Attainment/Maintenance Area for Carbon Monoxide, as defined by the Colorado department of Public Health and Environment. The nonattainment area boundary is essentially the same as the City's growth management area (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 non-attainment boundary.

Activity Data

Source: City Transportation Planning (Kurt Ravenschlag) 12/27/07

GHG emissions from the Fort Collins community from ground-based transportation are based on modeled estimates of vehicle miles traveled in the Fort Collins. Two slightly different data sets exist for Fort Collins' VMT estimates. One is dataset used by the MPO for determining

conformity of transportation plans. The other was developed by the City for the Mason Corridor project. The City dataset used the same model but relies on socioeconomic assumptions provided by the City's Advance Planning Department, which modifies the allocation of growth, compared to the assumptions used in the MPO model.

Both datasets are generated using the TransCAD model. The TransCAD model is periodically calibrated against ground count data. 2005 was a calibration year. Both the Mason Corridor and the MPO data sets used **3,022,486 as a daily VMT for Fort Collins,** and this is the VMT data used for the 2005 community inventory baseline.

Table 10. Fort Collins Vehicle Miles of Travel Estimates

Year	Daily VMT	X 330 =annual
2000	**2531071**	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)

Methodology

GHG emissions for each vehicle type were calculated as followed, and then summed.

Tons CO2e (vehicle type) = daily VMT * 330 * %VMT * MPG * MMBTU/gallons * Tons CO2/MMBTu

1) Multiply daily VMT by 330 to calculate Annual VMT
   Annual VMT for 2005 = 997,420,380

2) Identify VMT Percent – This apportions total VMT among the percentage of vehicle types in Fort Collins estimated by the Colorado Department of Public Health and Environment (CDPHE) for emissions modeling purposes. The most recent VMT percent was provided by the NFRMPO in June 2004. (See Table 7.)

3) Identify Average MPG - Multiply the annual number of miles driven by average fuel economy (MPG) for that vehicle class to yield gallons consumed. (See Table 7.)

4) Calculate gallons of fuel for each vehicle type.

5) Identify emissions coefficients to convert from gallons of fuel to BTU's to MMBTU and then tons CO_2. (See Table 12).

Table 11. Revised Fleet Fuel Economy (MPG) by Vehicle Type

Vehicle type	GVW	VMT percent	Original Inventory MPG	CACP2009 - (for 2005 vehicles) MPG	Revised MPG	Source
Gasoline car	<3750	0.5	19.7	18.61	**22.1**	DOE Transportation Data Book Table 4.1
Gasoline light truck	3750-8500	0.38	14.3	13.717	**17.7**	DOE Transportation Data Book Table 4.2
Gasoline heavy truck	8500<	0.036	8	4.843	**13.9**	DOE Transportation Data Book Table 4.3
Diesel car	<3750	0.001	30	19.378	**19.378**	CACP2009
Diesel light truck	3750-8500	0.002	17	16.859	**16.859**	CACP2009
Diesel heavy duty	8500<	0.081	5	5.634	**5.634**	CACP2009
Weighted Average			16.04	15.20	**18.79**	

Table 12. Vehicle Conversion Factors

Vehicle type	Conversion factor	Conversion factor
Gasoline car	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Gasoline light truck	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Gasoline heavy truck	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Diesel car	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu
Diesel light truck	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu
Diesel heavy duty	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu

** The fuel economy estimates by vehicle class were updated in 2009 to better reflect estimated on-road fleet fuel economies provided by FWHA, Bureau of Transportation Statistics and the Energy Information Administration.

D. AIR TRAVEL

Boundary (GMA)

This methodology estimates the emissions from air travel by Fort Collins residents traveling out of DIA and the Fort Collins/Loveland Airport. Since it relies on zip coded enplanment data from DIA, it probably best represents travel from citizens in the Fort Collins GMA.

Activity Data

Source: Jannell Barrilleaux, Director of Environmental Programs at DIA, (303)342-2730 (office), Janell.Barrilleaux@flydenver.com.

Table 13. Fuel Consumption at Denver International Airport

Denver Fuel Facility		**2005**	**2006**	**2007**	**2008**
Jet Fuel	gallons	393,749,978	401,950,955	423,115,977	417,075,677
Gasoline	gallons	547,430	546,670	569,960	510,427
Diesel	gallons	395,762	447,607	610,521	665,223
Av Gas	gallons	22,526	19,912	12,297	9,479

Methodology

Jet fuel consumption at DIA and the Fort Collins-Loveland airports is allocated to passengers originating trips in Fort Collins in the following manner. Total fuel consumption at DIA was 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.

Fort Collins' emission from the Fort Collins/Loveland airport are estimated as a function of population, relative to 2008 data on population and jet fuel consumed by Allegiant Air. In 2008, approximately 148,000 gallons of jet fuel were consumed at the Fort Collins-Loveland Airport. Airport personnel estimated that 85% of passengers from the region, defined as a 35 mile radius around the airport. Therefore 125,800 gallons of fuel are attributed to regional passenger enplanements. Fort Collins population is 25.5%% of the regional population and therefore, 25.5% of the 125,800 gallons of jet fuel are attributed to Fort Collins passengers.

Table 14. Calculation Approach for Fort Collins' 2005 Airline Travel Emissions

Parameter	Data	Unit	Notes/Source
Total Fuel Consumption at DIA, 2005	393,749,978	gallons	DIA
Percentage DIA passenger connecting	45%		DIA
Percentage of DIA enplaned/deplaned passenger from Larimer County	6%		Denver International Airport Master Plan Update Studies Passenger Surveys
Fraction of DIA Larimer County passengers from Fort Collins	0.67		Data provided by consultant that completed above plan, 60 of 89 County respondents from Fort Collins
DIA Fuel consumed by Fort Collins passengers	9,172,517	gallons	
Total Fuel Consumption at Allegiant Air, FC-Loveland, 2008	148,000	gallons	FC-Loveland
Percentage of FC-Loveland enplaned from 35-mile region	85%		FC-Loveland
Jet Fuel from Regional enplanements	125,800	gallons	
Regional population	500,000	people	
FC Population	127,686	people	City Advanced Planning
Ratio of FC population	0.255372		
Total Fuel consumed by Fort Collins passengers (DIA + FC-Loveland)	32,126	gallons	
Total Fuel consumed by Fort Collins passengers (DIA + FC-Loveland)	9,204,643	Gallons	
Emission factor	9.6	kg CO2e/gal	The Climate Registry
Resulting emissions	88,088	mt-CO2e	

E. SOLID WASTE

Boundary (City Limits)
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 (per conversations with City of Fort Collins staff).

Activity Data
Two activity data sets are used.

1) Tons of trash 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 Skumatz Economic Research Associates (SERA) in 2005. Unaccounted tons include: commercial tons not collected by licensed trash haulers (e.g., Colorado State University maintains its own trash trucks and hauls materials directly to Larimer County Landfill) and "self-hauled" trash to Larimer County Landfill. Community trash 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 Natural Resources Department solid waste reduction strategic planning efforts. This approach used the original 2004 SERA data to develop estimates of community trash tonnages.

Source: John Armstrong, City of Fort Collins Natural Resources

Table 15. Fort Collins Short Tons Municipal Solid Waste

Year	ShortsTons MSW
2005	237,747
2006	224,700
2007	227,842
2008	187,510

The drop in solid waste reduction tonnages seen in 2008 is mirrored in numerous landfill data from around the country.

2) Total tons waste deposited in the Larimer County Landfill, as input to the LandGEM model.
Source: Steve Harem, Larimer County

Table 16. Input to "CARBs Implementation of the IPCC's Mathematically Exact First-Order Decay Model"

	Waste	
	Waste Deposited	
Year	Tons	% ANDOC
2000	187,736	0.052999
2001	171,057	0.052999
2002	183,659	0.052999
2003	179,413	0.052999
2004	158,822	0.052999
2005	155,348	0.052999
2006	147,125	0.052999
2007	151,378	0.052999
2008	141,154	0.052999

Methodology

1) Run the CARB First Order Decay Model.

The Climate Registry endorses an implementation of the IPCC's first-order-decay model such as the one made available by the California Air Resources Board. This model was applied to the Larimer County Landfill with the following inputs:

- Landfill specific percentage of anaerobically degradable carbon (ANDOC%) based on the Two-Season Waste Composition completed for Larimer County in May 2007. Resulting ANDOC% is 5.3.
- Historical waste input data from the LandGEM model provided by the County.
- Assumption that the daily cover materials of dirt and a slurry of recycled newspaper and tacky additive have very little degradable content and therefore do not contribute to ANDOC%.
- K-value of 0.02 which corresponds to an annual average rainfall of <20 inches/year.

- Extract metric Tons CH4 (expressed at CO2e) output from the "California Air Resources Board's Implementation of the IPCC's Mathematically Exact First-order Decay Model", released March 29, 2009. (The direct CO2 emissions from the landfill biomass degradation are not included in the inventory per standard GHG accounting protocols.)

Table 17. Outputs of "CARBs Implementation of the IPCC's Mathematically Exact First-Order Decay Model"

Model Output: Methane and Carbon Dioxide Emissions (metric tones CO2e)		
Year	**CH_4**	**CO_2**
1990	17,261	2,757
1991	19,306	3,083
1992	21,275	3,398
1993	23,049	3,681
1994	24,683	3,942
1995	26,375	4,212
1996	28,075	4,484
1997	29,735	4,749
1998	31,169	4,978
1999	32,514	5,192
2000	34,077	5,442
2001	35,632	5,690
2002	37,026	5,913
2003	38,475	6,144
2004	39,844	6,363
2005	40,989	6,546
2006	42,037	6,713
2007	42,762	6,829
2008	42,135	6,729

2) Convert to short tons (1 MT x 1.1023 = 1 short ton)
3) Enter short tons deposited to LC landfill
4) Develop a conversion factor (short tons CO2e/ tons waste to landfill)
5) Enter short tons waste from entire community
6) Multiply short tons waste from community by conversion factor to calculate short tons CO2
7) Convert short tons CO2e to metric tones (1 metric tonne = 0.9072 short ton)

Not all of Fort Collins trash goes to the Larimer County landfill. Some (approximately 35%) is taken by Waste Management to a private landfill in Ault. The following formula is used to estimate total ton CO2e from community-generated waste. It assumes the Ault landfill operates under the same conditions as the LC Landfill.

$$\frac{\text{Tons waste in LC landfill}}{\text{Tons CO2e emitted by LC Landfill}} \textbf{ X } \text{Tons waste from entire FC community} = \text{Total Tons CO2e}$$

Table 18 illustrates the steps used to calculate Fort Collins 2005 GHG emissions from trash.

Table 18. Steps Used to calculate Fort Collins 2005 emission from solid waste.

Step #	Data	Unit
1	40,989	MTCO2e from LC landfill (from CARB FOD Model)
2	45,182	short ton CO2e from LC Landfill
3	155,348	short ton waste disposed at landfill (from Larimer County staff)
4	0.290845844	short ton CO2e/ton landfill waste (calculated ratio)
5	237747	short ton waste disposed by community (from City of Fort Collins staff)
6	69,148	short ton CO2e from all FC waste
7	**62,731**	**MT CO2e**

F. EMBODIED ENEGY IN RECYCLABLE MATERIALS

Boundary (City Limits)
Solid waste service is provided by numerous private haulers. The City of Fort Collins collects data on hauling that is conducted within City Limits (per conversations with City of Fort Collins staff).

Activity Data
Tons of trash 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 Skumatz Economic Research Associates (SERA) in 2005. Unaccounted tons include: commercial tons not collected by licensed trash haulers (e.g., Colorado State University maintains its own trash trucks and hauls materials directly to Larimer County Landfill) and "self-hauled" trash to Larimer County Landfill. Community trash 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 Natural Resources Department solid waste reduction strategic planning efforts. This approach used the original 2004 SERA data to develop estimates of community trash tonnages. See Table 15 above.

Source: John Armstrong, City of Fort Collins Natural Resources

Methodology
This element of the baseline inventory accounts for the upstream GHG emissions contained in recyclable materials that are currently being thrown into the landfill, in order to align with the reductions calculated in the 2008 CAP from recycling materials, where the upstream emissions are counted.

The life-cycle GHG emissions associated with materials can be broken down into five components:
Upstream:

1) (+) CO2 from energy and non-energy related emissions from extraction and transportation of raw materials.
2) (+) CO2 from energy and non-energy related emissions from manufacturing and transportation of the product.
3) (+) CO2 from reduced carbon sequestration (for paper/wood-based materials)

Downstream:

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.

Table 19 below illustrates the calculation steps for 2005 emissions.

1) By applying the most recent (2006) waste characterization at the Larimer County Landfill, it is estimated that over 30% of total incoming waste at the landfill, by weight, is material types that are addressed by diversion measures in the CAP. The EPA's Waste Reduction Model (WARM), provides source reduction factors that combine the three upstream emissions sources for the

materials in question. The WARM model is one of the sources for the emission factors in ICLEI's CACP and the source of recycling factors applied in the CAP.

1) Calculate the annual weight of "recyclable materials going into the landfill by applying the percent of recyclable material to the total waste generated in Fort Collins.
2) Calculate the "upstream emissions", or "source reduction" emissions, for each type of material then sum.

Table 19. Illustration of Fort Collins 2005 Emissions Calculation from Recyclable Materials

Material	Source Reduction Emissions Factor* (MTCE/t)	Source Reduction Emissions Factor- Calculated in Short Tons (tCO2e/t)	Percentage from Waste Characterization**	Weight in 2005 (tons)***	Upstream Emissions (tCO2e)	Upstream Emissions (MTCO2e)
Cardboard	1.52	6.13	7.80%	18,544	113,689	103,138
Glass	0.16	0.65	2.00%	4,755	3,069	2,784
Aluminum	2.24	9.03	0.90%	2,140	19,332	17,538
Steel	0.87	3.51	0.90%	2,140	7,508	6,812
Plastic	0.5	2.02	1.40%	3,328	6,712	6,089
Newsprint	1.33	5.36	4.30%	10,223	54,840	49,751
Mixed Office Paper	2.18	8.79	6.30%	14,978	131,697	119,476
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	368,440

* 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 2005 = **237,747 tons.**

Annual emissions from this sector are identified in Table 20.

Table 20. Fort Collins GHG Emissions from Recyclable Materials Now Being Thrown in the Landfill

Year	Shorts Tons MSW	Metric Tons CO2e
2005	237,747	368,440
2006	224,700	348,221
2007	227,842	353,090
2008	187,510	290,587

F…DeMINIMUS EMISSIONS

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, that are not currently included in the inventory. These potential sources include:

- CO_2 from beer production
- Composting
- Biomass combustion
- Fertilizer application
- Livestock
- Non-road and off-road vehicles and equipment
- Propane
- Refrigeration equipment

This assessment has not been completed yet but will be planned as additional resources for GHG accounting become available to the City.

VI. INVENTORY RESULTS

2005 Baseline Emissions

Table 21 below identified the community baseline GHG emissions, as broken into scopes.

Table 21. Fort Collins Community-wide GHG Emissions

Source	tons CO2e	MT CO2e	Type
Electricity (Gross)	**1,298,355**	1,177,867	Indirect (Scope 2)
Natural Gas	454,595	412,409	Direct (Scope 1)
Ground Transport	631,833	573,199	Direct (Scope 1)
Air Travel	95,826	86,933	Indirect (Scope 3)
Landfill Gas	69,148	62,731	Indirect (Scope 3)
Recyclable Materials Energy	406,128	368,440	Indirect (Scope 3)
Total (Gross)	**2,955,886**	**2,681,579**	
Benefit of Metered Wind	11,568	10,494	
Total (NET)	**2,944,318**	**2,671,085**	
Benefit of RECs	13,279	12,047	
Benefit of Known Offsets	0	0	
Revised Total	**2,931,039**	**2,659,038**	

The two figures below show the net community emissions in 2005.

Figure 2. Fort Collins 2005 GHG Emissions by Source

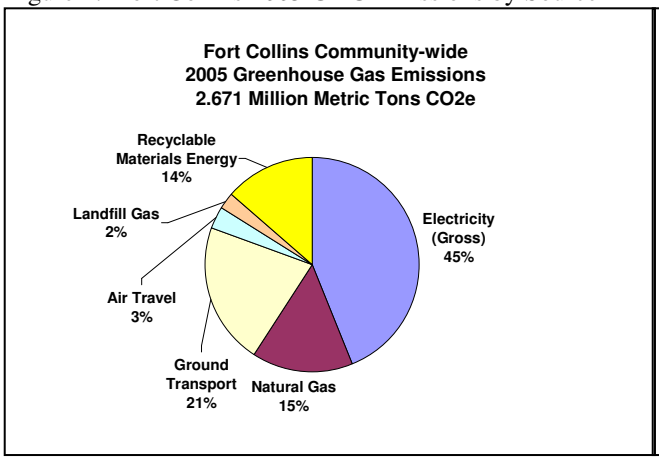
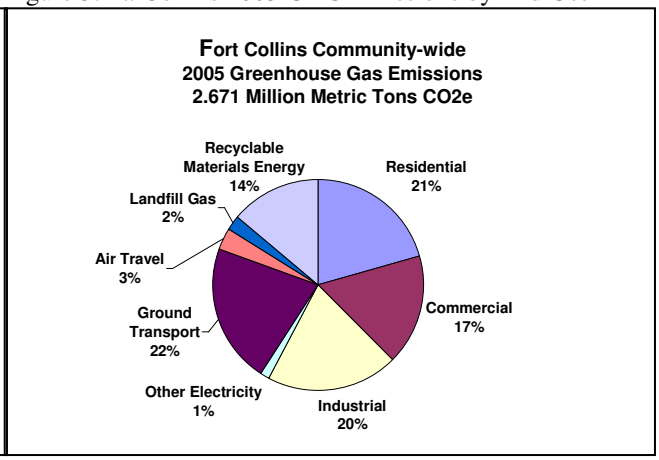


Figure 3. Ft. Collins 2005 GHG Emissions by End User



2006 Community GHG Emissions

Table 22. Fort Collins Community-wide 2006 GHG Emissions

Source	tons CO2e	MT CO2e	Type
Electricity (Gross)	**1,307,889**	1,186,517	Indirect (Scope 2)
Natural Gas	451,090	409,229	Direct (Scope 1)
Ground Transport	639,584	580,231	Direct (Scope 1)
Air Travel	97,820	88,742	Indirect (Scope 3)
Landfill Gas	70,770	64,202	Indirect (Scope 3)
Recyclable Materials Energy	383,841	348,221	Indirect (Scope 3)
Total (Gross)	**2,950,993**	**2,677,141**	
Benefit of Metered Wind	13,370	12,130	
Total (NET)	**2,937,623**	**2,665,012**	
Benefit of RECs	23,139	20,992	
Benefit of Known Offsets	0	0	
Revised Total	**2,914,484**	**2,644,020**	

2007 Community GHG Emissions

Table 23. Fort Collins Community-wide 2007 GHG Emissions

Source	tons CO2e	MT CO2e	Type
Electricity (Gross)	**1,318,628**	1,196,260	Indirect (Scope 2)
Natural Gas	475,528	431,399	Direct (Scope 1)
Ground Transport	647,429	587,348	Direct (Scope 1)
Air Travel	102,959	93,405	Indirect (Scope 3)
Landfill Gas	71,326	64,707	Indirect (Scope 3)
Recyclable Materials Energy	389,208	353,090	Indirect (Scope 3)
Total (Gross)	**3,005,079**	**2,726,207**	
Benefit of Metered Wind	13,370	12,130	
Total (NET)	**2,991,708**	**2,714,078**	
Benefit of RECs	59,037	53,559	
Benefit of known Offsets	0	0	
Revised Total	**2,932,671**	**2,660,519**	

2008 Community GHG Emissions

Table 24. Fort Collins Community-wide 2008 GHG Emissions

Source	tons CO2e	MT CO2e	Type
Electricity (Gross)	**1,307,149**	1,185,846	Indirect (Scope 2)
Natural Gas	485,517	440,461	Direct (Scope 1)
Ground Travel	655,370	594,552	Direct (Scope 1)
Air Travel	101,501	92,082	Indirect (Scope 3)
Landfill Gas	64,337	58,367	Indirect (Scope 3)
Recyclable Materials Energy	320,312	290,587	Indirect (Scope 3)
Total (Gross)	**2,934,187**	**2,661,895**	
Benefit of Metered Wind	12,640	11,467	
Total (NET)	**2,921,547**	**2,650,428**	
Benefit of RECs	59,734	54,191	
Benefit of Known Offsets	255	231	
Revised Total	**2,861,558**	**2,596,006**	

VII. Use of RECS in the Community Inventory

Fort Collins Utilities renewable energy strategy targets meeting policy initiatives to increase use of renewable energy and customers who volunteer to subscribe for additional renewable energy.

The *2003 Electric Energy Supply Policy* set a goal of a minimum of 2% renewable energy, increasing to 15% in 2017. The State of Colorado also has a Renewable Energy Standard (RES) that covers Fort Collins. The Colorado RES requires Fort Collins to have a minimum of 1% renewable energy through 2009, increasing to 3% in 2011, 6% in 2015 and 10% in 2020.

Utilities has offered renewable energy to customers since 1998. In 2007, the *Wind Power Program* went through a re-branding to the *Green Energy Program*. This program is a premium-priced rate option for customers who wish to have all or a portion of their electricity generated from renewable sources. The amount of energy purchased through the Green Energy Program varies from year to year, but has been approximately 2.5% of community electricity use.

Fort Collins Utilities purchases all renewable energy from Platte River Power Authority under their Tariff 7, sufficient to meet the requirements of both policy and the Green Energy Program. In 2008, the City's renewable program was supplied from two types of sources. Wind turbines at Platte River's Medicine Bow Wind Project in Wyoming provide both energy and Renewable Energy Credits (combined). In addition, Renewable Energy Credits (RECs) with no associated energy are purchased by Platte River from multiple renewable sources in the region. RECs in the Tariff 7 portfolio are certified by Green-e, as is Fort Collins Utilities' Green Energy Program.

In 2008, RECs accounted for 83% of the renewable energy purchased for Fort Collins. Platte River Power Authority plans to reduce the fraction of their renewable energy portfolio supplied by RECs over time by increasing investment directly in wind energy projects. The most recent addition to the portfolio, in April 2009, was 12 megawatts of wind in southern Wyoming. The annual content of the Fort Collins green energy product is reported on the City's web site at http://www.fcgov.com/conservation/green-pwr-label.php .

What is a REC? The Offset Quality Initiative defines a REC as "a certificate that is issued when one mega-watt hour of electricity is generated and delivered to the grid from a qualifying renewable energy source such as wind, solar or biomass." (OQI, 6/09) RECs are typically contracted and reported in units of MWh. However, guidance on how RECs can be used in GHG accounting currently varies significantly. Various viewpoints are summarized below. Because of the lack of consensus on how RECs should be handled in community-wide GHG reporting, the City currently reports emissions both with and without RECs factored in.

It is important to recognize that the primary objectives of reporting greenhouse gas emissions at the community level are to identify emissions sources and therefore reduction opportunities, to raise awareness, and to track progress on community goals. Unlike the local government itself and individual companies or organizations, the "community" is not likely to become a regulated entity. The community inventory does not represent any claim of community ownership to emissions or reductions reported.

A. Perspectives Opposed to Quantifying RECs as GHG Reduction

1. The Offset Quality Initiative (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 REC 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 reduction are being conveyed with RECs and that the emission 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 emission reductions that would not have otherwise occurred. The OQI paper claims that if the additionally of an 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.

2. 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.icleiusa.org/action-center/tools/lgo-protocol-1, 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 emission 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."

B. Perspectives That Provide Guidance on Quantifying RECs as GHG Reductions

1) 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 a 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.

2) 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.

3) 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 greenhouse gas emissions reductions held to a different set of additionally 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.]

4) Community-wide GHG Reporting
Many communities including Denver, Boulder, Boulder County and Portland, OR. all include RECs and carbon offsets when calculating their net community greenhouse gas inventories.

VIII. 2020 Forecast

The community-wide Fort Collins greenhouse gas emissions forecast for CO2e was developed to estimate future emissions in the absence of any conservation measures implemented after 2008. It holds all the CO2 emissions factors constant at the 2008 level. The following updates were made to the 2020 emission forecast to reflect current growth predictions.

Table 25. Fort Collins GHG Emissions Forecast Revisions

Emissions Source	Old Growth Assumptions	New Growth Assumptions
Electricity (from Fort Colins Utilities)	Estimated 30% growth in MWh purchased from 2008 through 2020.	Estimates 23% growth in MWh purchased from 2009 through 2020.
Natural Gas (from Xcel Energy)	Estimated 2% annual growth	Estimates 0.1% annual growth with the benefits of their demand side management programs factored in.
Population	Estimated 2% annual growth	Estimates 1.5% annual growth
Solid Waste Airline Travel Energy in Recyclable Materials	Based on population growth estimates	Based on population growth estimates

The forecast will be updated biennially along with preparation of the Climate Action Plan's Biennial Status report.

A) Electricity

Table 25 below provides the electricity forecast to 2020 prepared by the Fort Collins Utility in March 2009.

Table 26. Fort Collins Purchase Power Projection (Linear forecast, 10 yr basis, no efficiency adjustment)

Year	Mwh purchases	% Change Mwh	Summer * Demand (Mw)	% Change Summer *
2007	1,484,957	2.9%	295.8	5.9%
2008	1,471,878	-0.9%	285.2	-3.6%
2009	1,544,852	5.0%	312.6	9.6%
2010	1,577,435	2.1%	321.9	3.0%
2011	1,610,017	2.1%	331.2	2.9%
2012	1,642,600	2.0%	340.4	2.8%
2013	1,675,183	2.0%	349.7	2.7%
2014	1,707,766	1.9%	359.0	2.7%
2015	1,740,348	1.9%	368.3	2.6%
2016	1,772,931	1.9%	377.6	2.5%
2017	1,805,514	1.8%	386.9	2.5%
2018	1,838,096	1.8%	396.2	2.4%
2019	1,870,679	1.8%	405.4	2.3%
2020	1,903,262	1.7%	414.7	2.3%

= History

Prepared by: Bob Micek, John Phelan (3/5/09)

The GHG emissions for the forecast were calculated conservatively, using the 2008 PRPA wholesale average emission factor, excluding all renewables. This factor is 1,775 # Co2/MWh. See Table 4 above for details. 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

This forecast growth rate was provided by Xcel Energy during the summer 2008. The forecast uses weather-normalized usage data, and states 0.1% annul growth, with Demand Side Management programs accounted for.

The factor used to convert DTH to Tons CO2e is 0.597 Tons CO2e/DTH/ (residential and commercial factor),instead of the 0.596 commercial factor. This is a stable, nationally recognized factor, and this factors is not likely to change significantly in the future.

C) Ground Transportation

Transportation forecast data (daily estimated VMT) were provided by the City of Fort Collins Transportation planning staff and LSA Associates. It uses the 2010, 2015 and 2020 projections and a linear interpolation for the interim years between each modeled data point (shown in bold below).

Table 27. Estimated Future Vehicle Miles of Travel in Fort Collins

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%
2011	3,251,865	1,073,115,545	1.23%
2012	3,291,753	1,086,278,345	1.23%
2013	3,332,129	1,099,602,600	1.23%
2014	3,373,001	1,113,090,290	1.23%
2015	**3,414,374**	1,126,743,420	1.23%
2016	3,448,441	1,137,985,655	1.00%
2017	3,482,849	1,149,340,061	1.00%
2018	3,517,599	1,160,807,757	1.00%
2019	3,552,697	1,172,389,874	1.00%
2020	**3,588,144**	1,184,087,553	1.00%

(See …/AUDIT/Forecast/VMT interpolationMARCH2008.xls)

Table 28 below identifies the assumptions used in the transportation modeling.

Table 28. Fort Collins Growth Assumptions in Transportation Modeling

	Annual VMT Growth (Air Quality Boundary)			Annual Household Growth (MPO Fort Collins Subarea)	
Year	Model VMT	Annual Growth Rate		Households	Annual Growth Rate
2005	3,022,489	n/a		63,764	n/a
2015	3,414,374	1.2%		71,767	1.2%
2025	3,770,758	1.0%		80,914	1.2%
2035	4,103,400	0.8%		87,703	0.8%

In order to calculate the 2008 emissions from VMT, the following factors were applied to the 2008 VMT estimate. The "VMT percent" is based on VMT distribution provided by the MPO from 2004. The average fuel efficiencies for gasoline vehicles are from the DOE Transportation Data Book, Table 4.1, 4.2 and 4.3. The fuel economy factors for diesel vehicles are taken from ICLEI 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.

Table 29. Vehicle Conversion Factors

Vehicle type	VMT percent	Avg MPG	Conversion factor	Conversion factor
Gasoline car	50.0	22.1	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Gasoline light truck	38.0	17.7	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Gasoline heavy truck	3.6	13.9	0.125 MMBtu/gallon	0.0824 tons Co2/MMBtu
Diesel car	0.1	19.378	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu
Diesel light truck	0.2	16.859	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu
Diesel heavy duty	8.1	5.634	0.122 MMBtu/gallon	0.086 tons Co2/MMBtu

Based on 2008 data, a conversion factor was calculated as follows:

$$\frac{655{,}370 \text{ Tons CO2e}}{1{,}304{,}576{,}424 \text{ Miles}} = 0.00063367 \text{ Tons CO2e/mile.}$$

This proportional factor was applied to all future VMT estimates from 2009 through 2020.

D) Airline Travel

Based on 2008 data, a conversion factor was calculated as follows:

$$\frac{101{,}501 \text{ Tons CO2e}}{134{,}743 \text{ Population}} = 0.75 \text{ TonsCO2 / Person}$$

Fort Collins population growth is estimated at 1.5%/year from 2008 forward. The tons CO2e for future years were calculated by applying the factor above to the estimated population tons trash. The future emissions from airline travel are not likely to change significantly unless an improved methodology or data emerges. The future trend likely to be slightly downward with increasing fuel economy of airlines.

E) Landfill Gas from Solid Waste
Based on 2008 data, a conversion factor was calculated as follows:

64,337 Tons CO2e / 187,510 Tons Trash from Fort Collins = 0.36876967 TonsCO23 / Tons Trash

Tons of Solid Waste was grown at 1.5%/year from the 2008 level. The tons CO2e for future years were calculated by applying the factor above to the estimated tons trash.

Table 30. Fort Collins Municipal Solid Waste Projections

Year	Tons MSW
2005	237,747
2006	224,700
2007	227,842
2008	187,510
2009	190,323
2010	193,177
2011	196,075
2012	199,016
2013	202,002
2014	205,032
2015	208,107
2016	211,229
2017	214,397
2018	217,613
2019	220,877
2020	224,190

Note: If the waste input rate is constant, the landfill gas from solid waste will increase over time, due to the cumulative impact of ongoing decomposition of solid waste deposited in previous years.

F) Energy in Recyclable Materials
Based on 2008 data, a conversion factor was calculated as follows:

320,312 Tons CO2e / 134,743 Population = 2.37720029 TonsCO2 / Person

Fort Collins population growth is estimated at 1.5%/year from 2008 forward. The tons CO2e for future years were calculated by applying the factor above to the estimated energy from recyclable materials in 2008.

Activity Data Projections used in Fort Collins 2020 Emissions Forecast
The table below provides the complete forecast data.

Table 31. Activity Data Projections Used to Generate Future Fort Collins Emissions Forecast

Year	Electricity Purchases, incl. Xcel (MWh)	Natural Gas (DTH)	Estimated Annual Vehicle Miles Traveled	Short Tons Municipal Solid Waste	Airline Miles (Short TONS CO2)	Recyclable Materials (short Tons CO2)	Population
2005	1,433,063	7,619,775	997,421,370	237,747	95,826	406,128	127,686
2006	1,443,586	7,561,049	1,009,655,708	224,700	97,820	383,841	129,511
2007	1,485,778	7,970,363	1,022,040,113	227,842	102,959	389,208	132,101
2008	1,472,844	8,137,860	1,034,576,424	187,510	101,501	320,312	134,743
2009	1,545,828	8,145,998	1,047,266,505	190,323	103,352	326,152	137,200
2010	1,578,411	8,154,144	1,060,112,242	193,177	104,902	331,044	139,258
2011	1,610,993	8,162,298	1,073,115,545	196,075	106,475	336,010	141,347
2012	1,643,576	8,170,460	1,086,278,345	199,016	108,073	341,050	143,467
2013	1,676,159	8,178,631	1,099,602,600	202,002	109,694	346,166	145,619
2014	1,708,742	8,186,809	1,113,090,290	205,032	111,339	351,358	147,803
2015	1,741,324	8,194,996	1,126,743,420	208,107	113,009	356,629	150,020
2016	1,773,907	8,203,191	1,137,985,655	211,229	114,704	361,978	152,271
2017	1,806,490	8,211,394	1,149,340,061	214,397	116,425	367,408	154,555
2018	1,839,072	8,219,606	1,160,807,757	217,613	118,171	372,919	156,873
2019	1,871,655	8,227,825	1,172,389,874	220,877	119,944	378,513	159,226
2020	1,904,238	8,236,053	1,184,087,553	224,190	121,743	384,190	161,615

Source: /…/TBG-NewRecommendations-May27-2005Revised