

# City of Terrace Corporate Energy & GHG Inventory

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## Summary

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An inventory of the City of Terrace's corporate energy consumption and greenhouse gas emissions (GHG) is compiled in this report. A corporate inventory represents the energy used and GHG emissions generated by the City through its municipal operations.

The City is a signatory to BC's Climate Action Charter, which requires local governments to achieve carbon neutrality in their municipal operations by 2012 through a combination of energy efficiency initiatives to reduce consumption (and GHG emissions) and offsets.

Energy sources included in the inventory are electricity, natural gas and propane (for buildings), as well as gasoline and diesel fuel for the fleet. Consumption of each energy source results in the creation of greenhouse gases (GHGs).

GHG emissions are also estimated for the disposal of solid waste collected from municipal facilities (which result from subsequent decomposition in landfills) and for municipal paper consumption (from the creation of the paper). These latter two sources are not included in the Climate Action Charter Commitments.

Key findings for the 2007 year include:

- Total energy consumption by *municipal facilities and operations* in 2007 was 5.55 million kWh of electricity, 17,000 GJ of natural gas, and 161,700 L of vehicle fuels for a total energy consumption of 43,120 GJ.
- Total GHG emissions applicable to the carbon neutrality commitment are estimated at 1,455 tonnes CO<sub>2</sub>e in 2007.<sup>1</sup>
- GHG emissions related to corporate waste generation and municipal paper consumption are estimated at 136 tonnes and 13 tonnes, respectively.

Figure S-1 shows energy consumption and Figure S-2 the GHG emissions for the City of Terrace.

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<sup>1</sup> The GHG emissions associated with electricity generation are currently estimated using a BC Hydro average 'intensity factor'. These emissions are tentative and ongoing work through the Climate Action Secretariat and the Western Climate Initiative will be defining these values more precisely. More information is expected by the end of 2008.

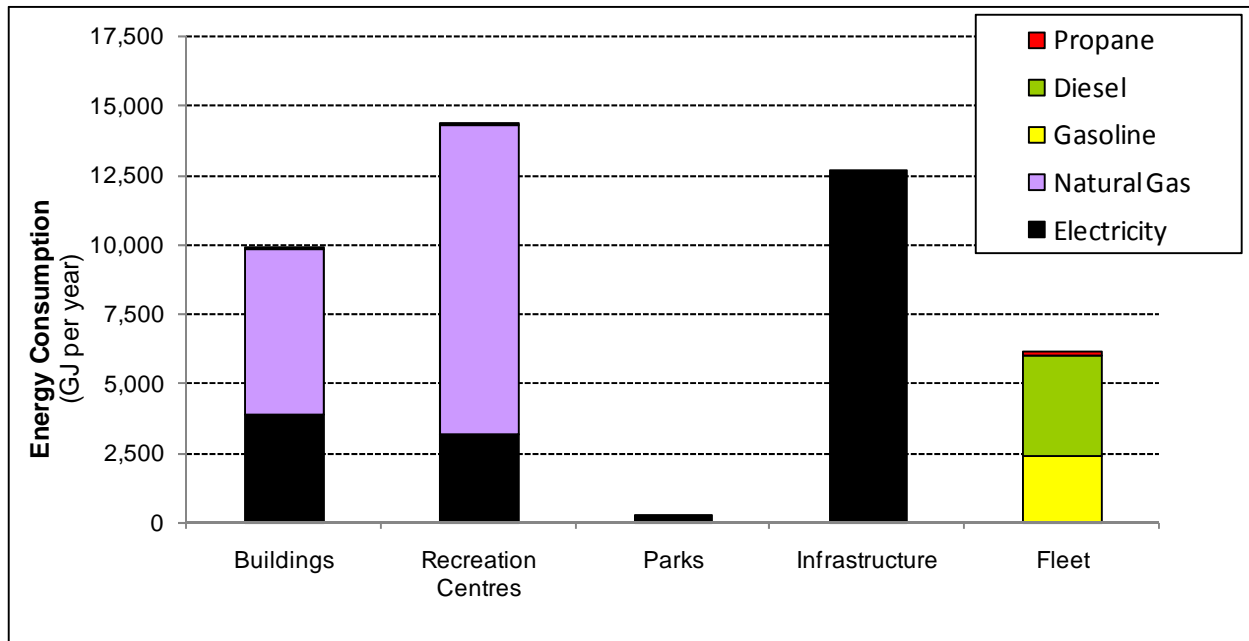


Figure S - 1: Corporate (i.e. Municipal Operations) Energy Consumption Profile (2007)

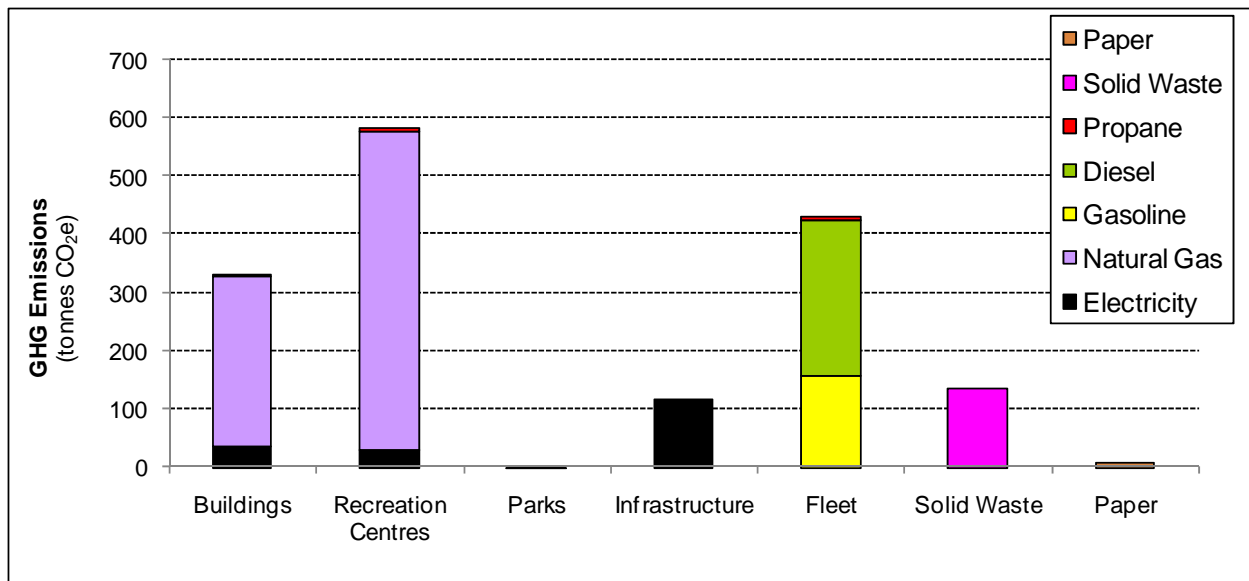


Figure S - 2: Corporate (i.e. Municipal Operations) GHG Emission Profile (2007)

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# 1 Introduction

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## 1.1 The Issue of Climate Change

For many years, there has been increasing evidence that global climate change resulting from emissions of carbon dioxide and other greenhouse gases (GHGs) is causing, or will soon cause, significant environmental impact on the ecology of the planet. There is a growing impetus for action by all energy consumers to reduce emissions of GHGs. Recent conclusions of the 2007 Intergovernmental Panel on Climate Change (IPCC) on the climate change trends observed to-date are that the human-caused contribution is “more likely than not”, and the expectation is that the human-caused impact in the future is “virtually certain”.

Climate change is a global issue, caused by the daily activities of billions of humans - primarily through the consumption of fossil fuel energy. A solution to the issue will require the activities of billions of humans to conserve energy and reduce GHG emissions. Municipalities have a role to play in finding these solutions. It has been estimated that in Canada, up to 50% of GHG emissions occur within municipal boundaries or within some degree of influence of municipal governments.

As a starting point, municipalities can put their own “houses in order” through proactive actions to reduce emissions from their direct operations (called ‘corporate’ emissions) and identify actions that can help to reduce emissions from community activities.

## 1.2 Addressing Greenhouse Gas Emissions in BC

In the past 2 years, the BC Government has embarked upon a number of initiatives to reduce GHG emissions in BC. The initiatives relevant to local governments include:

- Setting a target of a 33% reduction in total province-wide emissions by 2020 from 2007 levels.
- Requiring all ministries and other public sector organizations (PSOs) to become carbon neutral by 2010.
- Requiring municipalities to incorporate GHG reduction targets, and strategies to reach them, into their official community plans (OCPs).
- Encouraging municipal governments to become proactive in achieving carbon neutrality in their corporate operations by becoming signatories to the Climate Action Charter. The Charter commits local governments to achieve carbon neutrality in their municipal operations by 2012 through a combination of emission reductions and offsets. Terrace is a signatory to the climate action charter.

### 1.3 Community and Corporate Emissions

Actions to reduce energy consumption and greenhouse gas emissions are frequently divided into the realm of:

- **Corporate emissions** - those that the municipality creates through its activities (and which it has control over) such as municipal building operations, recreation centres, vehicle fleets, and utility services); and
- **Community emissions** - those occurring by the residents and businesses in the community which the municipality cannot directly control, but may be able to influence through planning and program activities.

#### What's a GJ?

A gigajoule (GJ - or one billion joules) is a measure of energy. We buy natural gas in GJ but other energy as kilowatt-hours (electricity) or litres of fuel.

One GJ is about the same energy as:

- natural gas for 3-4 days of household heating, or
- 26 - 27 litres of diesel or gasoline, or
- Two 20 lb propane tanks, or
- The electricity used by a typical house in ten days.

### 1.4 Objectives

The City of Terrace has undertaken this project to account for its energy consumption and GHG emissions for corporate operations (i.e. the delivery of municipal services). This will provide complete inventories of energy consumption and GHG emissions compiled for the year 2007 to assist in defining the current level of consumption and GHG emissions.

The scope of this project includes:

- To compile energy consumption data for corporate sectors for as many years that reliable data are available.
- Cross check and verify data and information for completeness and accuracy. For example, compare to lists of facilities with utility account descriptions etc.
- Present the results of energy consumption and GHG emissions by energy type, for all years for which reliable data are available.

## 2 Energy and GHG Emissions Inventories

This section presents the compiled data according to the source of the energy or GHG emissions.

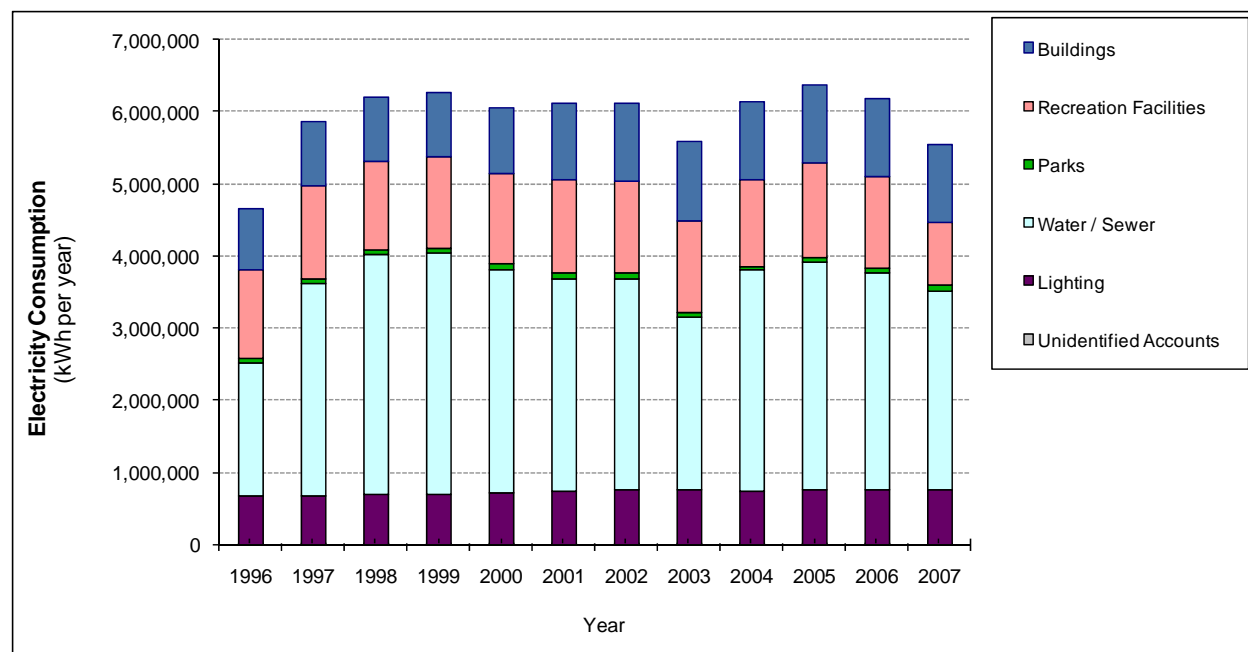
Appendix A contains the documentation of the data sources and methodology and Appendix B details the GHG conversion factors used.

### 2.1 Electricity Consumption

Electricity consumption in 2007 was 5.55 million kWh. Figure 1 shows the electricity consumption according to the types of end users.

Noted in this figure are that:

- The largest electricity consumption is related to the operation of water and sewer infrastructure. A decrease in electricity usage in 2003 can be attributed to one year drop in consumption by the Frank Rd pump house. There has also been significant year to year fluctuation in the electricity consumption by the River pump house.
- Unidentified accounts have not been classified with a grouping (e.g. lighting, parks etc.). These total less than 1% of the electricity consumption.



**Figure 1: Terrace Corporate Electricity Consumption**

Notes:

1. Unidentified accounts have not been classified with a grouping (e.g. lighting, parks etc.). These total less than 1% of the electricity consumption.
2. City Hall consumption may not have been accurately extracted prior to 2001 - data up to 2000 is indicative but may be incomplete.

## 2.2 Natural Gas Consumption

Total natural gas consumption in 2007 was 17,012 GJ. A detailing of the natural gas consumption is shown in Table 1 (section 2.4 below). The pool is by far the largest single natural gas user.

## 2.3 Propane Consumption

Data for propane consumption in the year 2007 was unavailable, and thus was estimated based on 2008 billing data. The 2008 consumption accounts for an expansion of the arena in September and most likely overestimates the amount of propane used in 2007. A total of 9,000 L of propane was consumed, with most of it being used by the arena and the Zamboni.

## 2.4 Facilities Summary

The complete list of municipal buildings is summarized in Table 1. These facilities account for approximately a third of the electricity consumed (35%), all of the natural gas and 44% of propane consumed by municipal operations.

**Table 1: Energy Consumption in the City of Terrace (2007)**

Use	2007		
	Electricity kWh	Natural Gas GJ	Propane GJ
Pool	76,020	8,614	-
Arena	804,240	2,472	81
Animal Shelter <sup>1</sup>	-	2,168	-
R.C.M.P.	327,200	1,391	-
Public Works	325,320	1,209	9
City Hall <sup>2</sup>	153,005	1,105	11
Library	171,600	-	0
George Little House	32,312	54	-
Old Terrace Co-op	45,600	0	-
Power station	14,368	-	-
Commercial lease	10,325	-	-
Municipal House	3,269	-	-
Farmer's Market	374	-	-
Kin Hut - leftover army building	0	-	-
Terrace Regional Museum (Heritage Park)	0	-	-
Heritage House	0	-	-
<b>Total of These Facilities</b>	<b>1,963,633</b>	<b>17,012</b>	<b>100</b>
Share of the Total Inventory	35%	100%	44%
Water / Sewer	2,773,270	0	0
Overhead Street Lighting	566,944	0	0
Ornamental Street Lighting	150,400	0	0
<b>Total</b>	<b>5,552,402</b>	<b>17,012</b>	<b>226</b>

Notes:

1. The animal shelter and Public Works facilities share electricity accounts.
2. City Hall shares facilities with a fire hall. The propane consumption at that address is for the fire hall only.

## 2.5 Fleet

The energy consumed in 2007 by City of Terrace's vehicle fleet amounted to 66,400 L of gasoline, 95,300 L of diesel and 4,200 L of propane. The Zamboni at the arena is the sole consumer of propane in the municipality's fleet. The 2007 fuel usage corresponds to energy consumptions of 2,390 GJ from gasoline, 3,622 GJ from diesel, and 106 GJ from propane (see Table 2).

**Table 2: Fleet and Equipment Fuel Consumption (2007)**

Fuel Type	2007	
	L	GJ
Gasoline	66,391	2,390
Diesel	95,304	3,622
Propane	4,229	106

## 2.6 Solid Waste from Municipal Facilities

Solid waste is included in some municipal inventories because the waste can degrade in landfills and create methane emissions. (Note that waste related emissions are not included in the carbon neutrality commitment of the Climate Action Charter).

Typically, waste from municipal operations is collected by private or municipal operators and cannot be discerned from other collected material. As such, waste generation at municipal facilities is estimated from the number of containers, their capacity, and the frequency of pickup.

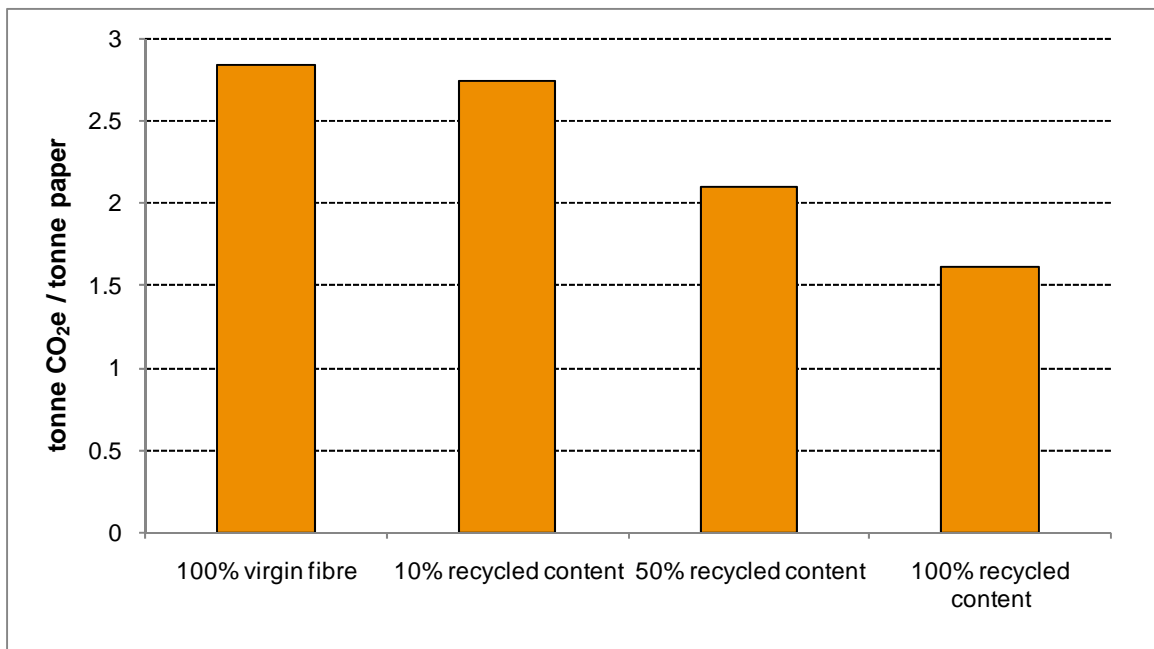
The City of Terrace's corporate operations generate an estimated 280 tonnes of solid waste annually.

Conversion of this waste generation is made using a reference conversion factor of 0.484 tonnes of CO<sub>2</sub>e per tonnes of waste generated. This is a Canadian typical average for waste disposed in a landfill, and does not include landfill specific factors, or waste specific factors such as the level of recycling or diversion for composting. This results in an estimated 136 tonnes of CO<sub>2</sub>e.

## 2.7 Paper Consumption at Municipal Facilities

The City consumes 129 cartons of paper per year, equivalent to roughly 2.9 tonnes of paper per year. The amount of paper consumed and solid waste generated remains generally consistent annually from the data provided by the City.

GHG emissions from paper consumption are shown in Figure 2 and depend on the recycled content. This ranges from 2.84 tonnes of CO<sub>2</sub>e per tonne of paper for 100% virgin fibre content to 1.632 tonnes of CO<sub>2</sub>e per tonne of paper for 100% recycled content paper ([www.papercalculator.org](http://www.papercalculator.org)). Note that these emissions occur upstream in the supply chain and not within the City. The City of Terrace uses 100% virgin fibre paper, with the 2.9 tonnes of consumed paper resulting in an estimated 8 tonnes of CO<sub>2</sub>e.



**Figure 2: GHG Emissions by Paper Type**

## 2.8 Greenhouse Gas Emissions

Greenhouse Gas emissions for each source of energy are derived by multiplying the energy consumption by the appropriate emissions factor. For example, the combustion of one GJ of natural gas results in approximately 0.05 tonnes of CO<sub>2</sub>e.

For electricity consumption the conversion is more complex. GHG emissions are not created at the point of consumption of electricity, but rather upstream at the place of power generation. While most electricity in BC is generated from hydro power, a component of it is generated from fossil fuels (natural gas turbines). For this work we have used an average GHG intensity factor for BC Hydro produced electricity. The corporate inventory is summarized in Table 3.

**Table 3: Corporate Energy and GHG Summary for the City of Terrace (2007)**

Use	Energy	Units of Purchase	Energy (in units purchased)	Energy (as GJ)	GHG Emissions (as CO <sub>2</sub> e)	Approximate Retail Value (\$)
Buildings	Electricity	kWh	1,083,373	3,900	36	\$70,000
	Natural Gas	GJ	5,926	5,930	293	\$71,000
	Propane	L	1,574	40	2	\$800
Recreation Facilities	Electricity	kWh	880,386	3,170	29	\$57,000
	Natural Gas	GJ	11,086	11,090	548	\$133,000
	Propane	L	3,228	80	5	\$800
Parks	Electricity	kWh	71,584	260	2	\$5,000
	Natural Gas	GJ	0	0	0	\$0
Infrastructure (lighting/water/sewage)	Electricity	kWh	3,510,574	12,640	116	\$228,000
Fleet	Gasoline	L	66,391	2,390	158	\$93,000
	Diesel	L	95,304	3,620	266	\$133,000
	Propane	L	4,229	110	7	\$3,100
<b>Total (before solid waste)</b>				<b>43,120</b>	<b>1,455</b>	<b>\$791,600</b>

Note: The retail value shown is based on actual consumption and typical retail energy prices. Specific billings will depend on the various rate codes and delivery charges. The approximate retail value shown is indicative and not exact.

## 2.9 Inventory Summary

The energy consumption and associated GHG emissions are shown graphically in Figure 3 (energy) and Figure 4 (GHG emissions). Total energy consumption for 2007 is estimated at just over 43,120 GJ (all sources converted to GJ) and the associated GHG emissions are estimated at **1,455 tonnes of CO<sub>2</sub>e**.

Some features to note from these figures are that:

- Recreation facilities consume the largest amount of energy (as GJ). The share of natural gas consumed by the pool means that it is the largest GHG emitter in the City of Terrace's operations. Electricity consumed by Terrace's recreation facilities account for 7% of all energy used and only 2% of net emissions. Natural gas consumed by these facilities accounts for 26% of all energy used by is responsible for 34% of net GHG emissions. The propane consumed by the arena accounts for less than 1% of the municipality's net energy and GHG emissions, but does not account for the propane used by the Zamboni at the arena.
- The vehicle fleet consumes less than 14% of the total energy, but produces 27% of the GHG emissions in 2007 (431 tonnes CO<sub>2</sub>e). Petroleum fuels have greater GHG emissions per unit of energy than other fuels.
- GHG emissions related to corporate waste generation and paper consumption are estimated at 136 tonnes and 8 tonnes, respectively.

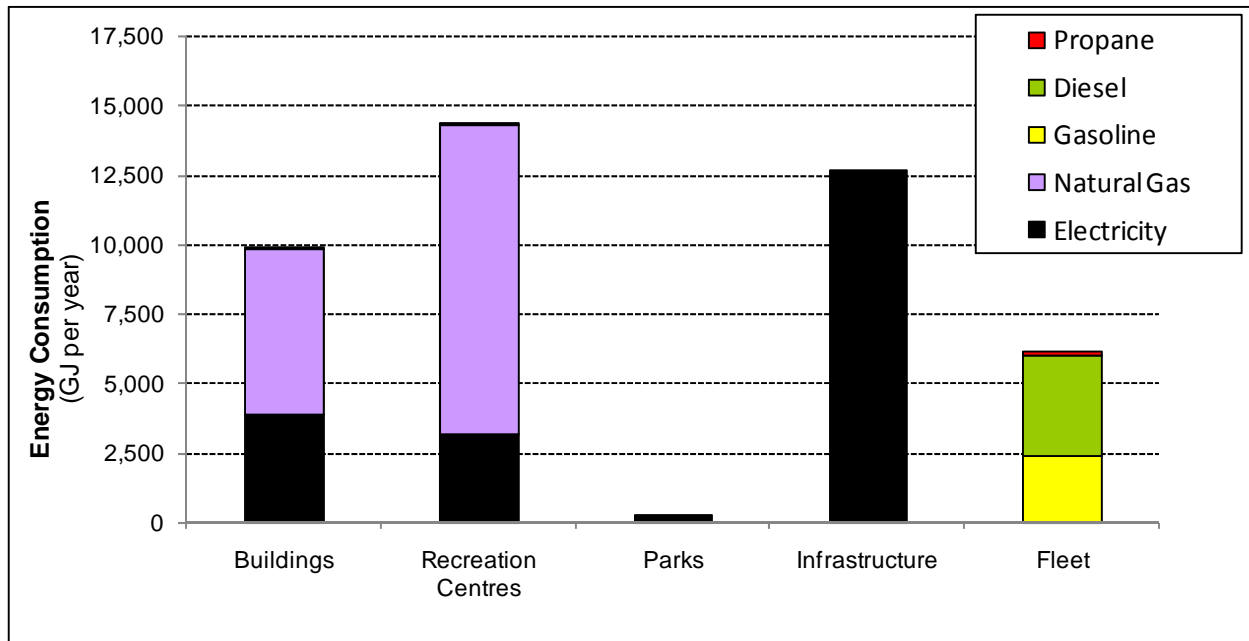


Figure 3: Corporate Energy Consumption Profile (2007)

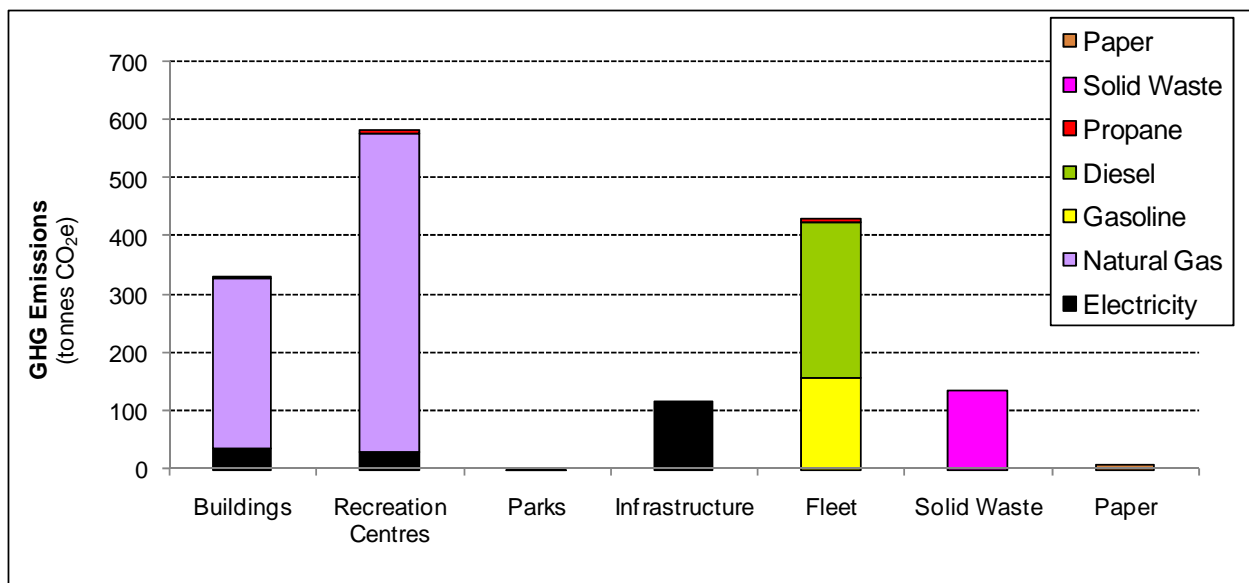


Figure 4: Corporate GHG Emission Profile (2007)

## 2.10 Carbon Neutral Commitments

The Province is working to define the precise requirements for the carbon neutrality requirement of the Climate Action Charter. That effort is being led by the Climate Action Secretariat and is working to define a standardized boundary for what is included.

There may be in the future, further information about the requirements for carbon neutrality which may change the actual amount of GHG tonnes that must be offset or reduced. These cannot be anticipated at this time.<sup>2</sup>

## 2.11 Targets

The Partners for Climate Protection (PCP) program (an initiative of the Federation of Canadian Municipalities - FCM) encourages the setting of a reduction target for reducing GHG emissions from municipal operations. The framework provides flexibility for municipalities to set a target appropriate to their conditions, but suggests that communities consider a target of a 20% reduction in corporate emissions within 10 years of joining the program.

A formal target typically includes:

- the amount of reduction (e.g. 10%)
- the baseline year (e.g. 2007)
- the year by which the target is to be achieved (e.g. 2012)

The Climate Action Charter establishes a target of carbon neutrality through reductions and offsets by 2012. A hypothetical example of how this might occur is shown in Figure 5. In the early years, carbon neutrality is achieved through some reductions but there are substantial remaining emissions which are “netted to zero” through the acquisition of offsets.

While the Climate Action Charter has set a target of zero emissions it does not specify how this is to be achieved. Establishing a target would be useful here as it commits the local government to make real energy and GHG reductions in their operations and not just use offsets to achieve reductions.

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<sup>2</sup> For example, there is discussion at the present time about how services that may be either contracted or performed in house are to be included. For example, waste collection may be done by municipal operations, by a contracted party, or by residents in small communities. Work is being done at the provincial level to help define how these various factors should be addressed by the local government.

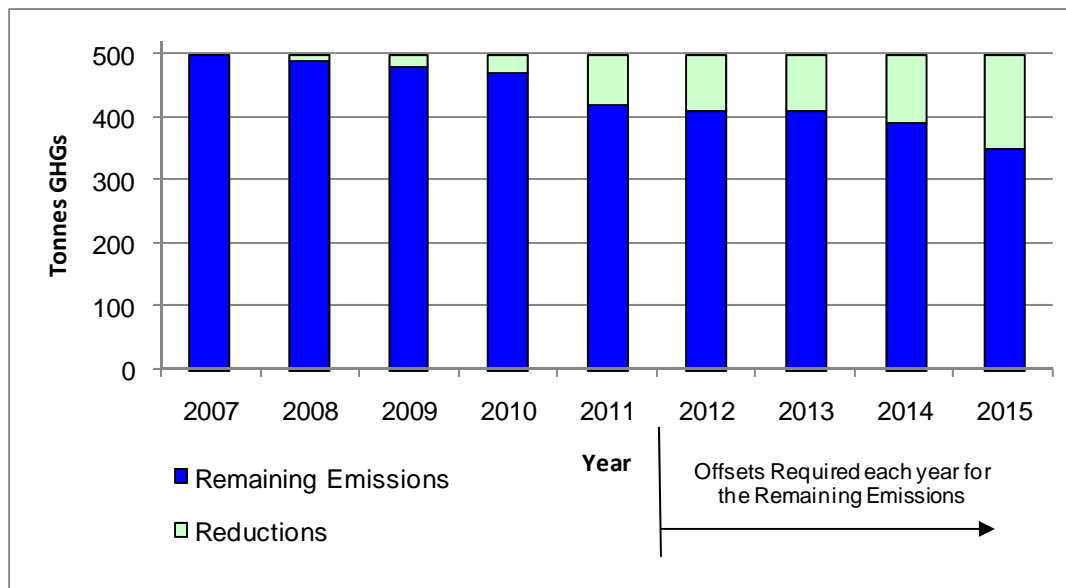


Figure 5: Hypothetical example showing how a community could achieve carbon neutrality

### Examples of Targets

Many municipalities have established reduction targets, with examples of these shown in Table 4. It is currently difficult, if not practically impossible, to obtain reliable estimates of the GHG emissions for older baseline years such as 1990 or 1995. In fact, reliable data is often only available for the most recent year or two and it is suggested that the 2007 year be used as the baseline.

Table 4: Examples of Corporate GHG Reduction Targets for Select Municipalities

Municipality	Reduction (%)	From (baseline year)	By (target year)
Targets Established Since the initiation of the Climate Action Charter (Sept 2007)			
Prince Rupert	10	2007	2012
Central Saanich	10	2007	2012
Ladysmith	10	2007	2012
Regional District of Nanaimo	4	2004	2012
Other Targets			
North Vancouver	20	1995	2010
Township of Langley	10	2000	2010
Whistler	10.5	2000	2010
Calgary	6	1990	2012
Edmonton	16	1990	2008
Prince George	10	2002	2012

## **Suggested Target**

Defining a target is a decision of the community based on the level of effort they wish to undertake, the potential opportunities in the community, and the resources available. Some activities can occur swiftly (idling reduction etc.) if there is staff time available to encourage and promote these activities. Other actions (e.g. a building review and retrofit project) can take two or more budget cycles to define and obtain funds for execution. From this perspective, 2012 is not very far in the future. As a starting point it is suggested that a reasonable target would be in the range of 10% to 20% reduction between now and 2012.

### 3 Conclusions

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This inventory compiled energy consumption and calculated GHG emissions for the year 2007. From the 2007 inventory, it can be concluded that:

- Total energy consumption by municipal facilities and operations in 2007 was:  
5.55 million kWh of electricity,  
17,000 GJ of natural gas, and  
161,700 L of vehicle fuels.
- Total GHG emissions are estimated at 1,455 tonnes CO<sub>2</sub>e (not including emissions related to solid waste). This estimate is the amount that must be reduced or offset in the municipality's commitment to the Climate Action Charter.
- Solid waste from municipal facilities is estimated at 280 tonnes collected, resulting in an estimated 136 tonnes of GHG emissions
- A total of 2.9 tonnes of 100% virgin fibre stock was consumed with a corresponding 8 tonnes of CO<sub>2</sub>e emissions.

Note that emissions from waste and paper are not part of the City's climate neutrality commitment through the Climate Action Charter.

## Appendix A - Data & Methodology

### General notes / Data limitations

The emission factor for electricity used in this inventory is the rolling average of 33 tonnes CO<sub>2</sub>e/GWh (0.0092 tonnes GHG/GJ) for BC production<sup>3</sup>, which does not account for imports & exports or IPP producers. The Climate Action Secretariate and the Western Climate Initiative are expected to define emissions factors in the near future.

### Utility Data Collection

For this project, data was collected as described in the following sections.

#### BC Hydro

Data for corporate (City) facilities were obtained from the key account manager responsible for the City's accounts. BC Hydro can provide a number of year's data at one time, and available data was retrieved for the years 1995 to 2008. Financial records for natural gas purchases were also provided by City staff for cross-checking. BC Hydro and City staff contact information is presented in Table A - 1.

We use rolling average factor (33 tonnes GHG/GWh) based on BC production, excluding imports/exports to calculate GHG emissions. The GHG Secretariat is expected to update this factor in near future. The revised factor could be as much 100 tonnes GHG/GWh, but could also be reduced given the Provincial plan for self-sufficiency (i.e. no electricity imports) and the directive that all new electricity generation is 100% green power.

**Table A - 1: BC Hydro Contact Information**

Name	Position/Agency	Contact
Andrea Waugh	Customer Care, BC Hydro	604 515-8598 <a href="mailto:andrea.waugh@byhydro.com">andrea.waugh@byhydro.com</a>

#### Terasen Gas

<sup>3</sup> A long term average electricity factor is preferred when comparing GHG emissions year to year, due to the natural changes in the electricity emission factor which in BC is highly dependent on stream flow/snow pack conditions (i.e. how much water is in our rivers), on the electricity market, and the source of our electricity imports. Year-to-year fluctuations in the electricity emission factor can greatly influence total GHG emissions allocated to a particular year, and can be misleading to the reader (e.g. electricity use increases but emissions decrease due to a lower emission factor than a comparable year), where emission appearing to be decreasing but the results cannot be attributed to actions undertaken by the community.

Terasen Gas data will be available from the Ministry of Environment or from the municipality's own online account access in future years.

**Table A - 2: Pacific Northern Gas Contact Information**

Name	Position/Agency	Contact
Tara Irwin	Sustainability Coordinator, City of Terrace	<a href="mailto:tirwin@terrace.ca">tirwin@terrace.ca</a> 250 615-4026

## Corporate Vehicle Fleet Fuel Consumption

A breakdown of total fuel consumption by fuel type was made available by the municipality's staff.

**Table A - 3: Corporate Vehicle Fleet Contact Information**

Name	Position/Agency	Contact
Tara Irwin	Sustainability Coordinator, City of Terrace	<a href="mailto:tirwin@terrace.ca">tirwin@terrace.ca</a> 250 615-4026

## Solid Waste

Corporate waste is collected by private collectors such as Waste Management in the case of Terrace's municipal facilities. The municipality's account summary was provided by staff regarding bin number, size and frequency of pick-up.

**Table A - 4: Municipal Solid Waste Contact Information**

Name	Position/Agency	Contact
Tara Irwin	Sustainability Coordinator, City of Terrace	<a href="mailto:tirwin@terrace.ca">tirwin@terrace.ca</a> 250 615-4026

## Paper

Information regarding paper consumption was provided by staff, tracking the number of cartons used per year, the weight of the paper and the recycled fibre content.

**Table A - 5: Paper Consumption Contact Information**

Name	Position/Agency	Contact
Tara Irwin	Sustainability Coordinator, City of Terrace	<a href="mailto:tirwin@terrace.ca">tirwin@terrace.ca</a> 250 615-4026

## Appendix B - Emission Factors

**Table B - 1 Emission Factors**

Energy Source <sup>1</sup>	GHG Emission Factor	Units
Electricity <sup>2</sup>	33	tonnes CO <sub>2</sub> e / GWh
Natural Gas <sup>3</sup>	0.049	tonnes CO <sub>2</sub> e / GJ
Propane	0.061	tonne CO <sub>2</sub> e / GJ
Gasoline	0.002	tonne CO <sub>2</sub> e / L
Diesel	0.003	tonne CO <sub>2</sub> e / L
B20 Biodiesel <sup>4</sup>	0.002	GJ / L
B5 Biodiesel <sup>4</sup>	0.003	GJ / L
Solid Waste (SW)	0.484	tonne CO <sub>2</sub> e / tonne SW
Paper (100% virgin fibre) <sup>5</sup>	2.84	tonne CO <sub>2</sub> e / tonne paper

Table Notes:

1. All emissions factors from Canada's GHG inventory (Aug 2003) unless otherwise noted. Jaques, A. (1992). Canada's Greenhouse Gas Emissions: Estimates for 1990. Environmental Protection, Conservation and Protection, Environment Canada. EPS 5/AP/4, December.
2. Electricity emissions factor calculated from BC Hydro's historical electricity emission factors for BC Hydro produced electricity.
3. Terasen Gas
4. United States Department of Energy National Renewable Energy Laboratory (NREL).
5. [www.papercalculator.org](http://www.papercalculator.org). Paper used contains 100% virgin fibre content.

## Appendix C - Compiled Data Spreadsheets

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To be provided electronically with final document.