Energy and Greenhouse Gas Emissions Inventory and Reduction Targets

for the

City of Prince George

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Executive Summary

In 2001 the City of Prince George made a voluntary commitment to participate in the Partners for Climate Protection (PCP). Council's commitment to the PCP demonstrates their leadership amongst BC municipalities to improve the quality of life for all residents by taking action on climate change mitigation. PCP is led by the Federation of Canadian Municipalities (FCM) and ICLEI-Local Governments for Sustainability. Over 125 municipalities across Canada have committed themselves to achieving the five milestones of the PCP and more than 600 additional communities around the world have committed to ICLEI's Cities for Climate Protection (CCP), the international equivalent of the PCP.

The Five milestones of the PCP are:

Milestone One:	***Create a Greenhouse Gas Emissions Inventory and Forecast***
Milestone Two:	***Set a Reduction Target***
Milestone Three:	***Develop a Local Action Plan***
Milestone Four:	***Implement the Local Action Plan***
Milestone Five:	***Measure Progress and Report Results***

Up to half of Canada's greenhouse gas (GHG) emissions are under the direct or indirect control or influence of municipal governments. Municipalities are an important component of the Government of Canada's strategy to meet its commitments to the Kyoto Protocol. Canada has committed to a 6% reduction in GHG emissions from 1990 levels by 2012.

Signatories of the Kyoto Protocol entered into a binding agreement to meet their GHG emission reduction targets between 2008 and 2012; the Protocol took affect in February 2005. While municipalities are not required to make GHG reductions under Canada's plan to honour the Kyoto Protocol, the Federal Government has recognized the important role of local governments to support emission reductions of stakeholders in their communities. Recognizing significant leadership by municipalities in this area, the Federal Government's Kyoto strategy includes new funding for sustainable infrastructure under the New Deal for Cities and Communities. Funding provided in the New Deal presents opportunities for municipalities that are committed to climate change action. In addition to new funding opportunities, new venues for support and idea sharing amongst municipal climate change leaders are developing.

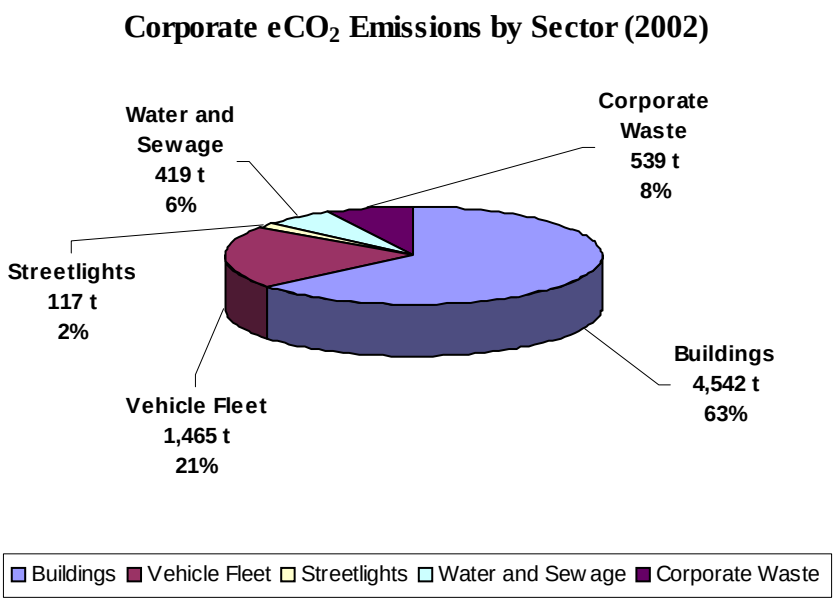
In British Columbia, the impacts of climate change will manifest themselves in a number of ways that will present both new challenges and opportunities to communities like Prince George. Climate change models predict that average annual temperatures will increase up to four degrees Centigrade by the end of the 21st century. These warmer temperatures will impact the character of the province's ecosystems and could result in adverse affects to salmon species in the Fraser River. Glacial retreat and earlier spring thaws may result in lower summer flows on streams and rivers, resulting in less water for agriculture, energy generation and other economic activities. Higher temperatures and drier summer conditions may increase the risk of forest fire, disease and pests. While there will be economic costs associated with taking action on climate change, there will also be new opportunities for innovative technologies and job creation (source: Government of Canada). By recognizing that climate change is a significant issue, the City of Prince George will be positioned to take advantage of new opportunities for climate change mitigation and adaptation to impacts that will occur in the future.

This report was commissioned by the City of Prince George to complete Milestone One and Two of the PCP. The requirement to receive recognition for Milestone One of the PCP is to develop a GHG inventory and forecast of emissions for both the City's operations and the community at large. Corporate and community inventories were developed for the year 2002 and forecasts for both inventories were developed for 2012 (approximately ten years after the City's commitment to the PCP). The requirement to receive recognition for Milestone Two of the PCP is to develop GHG emission reduction targets. Reduction targets have been suggested from the results of a modeling exercise that predicts GHG emission reductions as an outcome of implementing various reduction measures. The inventories, forecasts and the reduction targets are presented separately in the main body of the report and are summarized in the pages that follow.

Executive Summary cont.

Corporate Inventory, Forecast and Target Summary

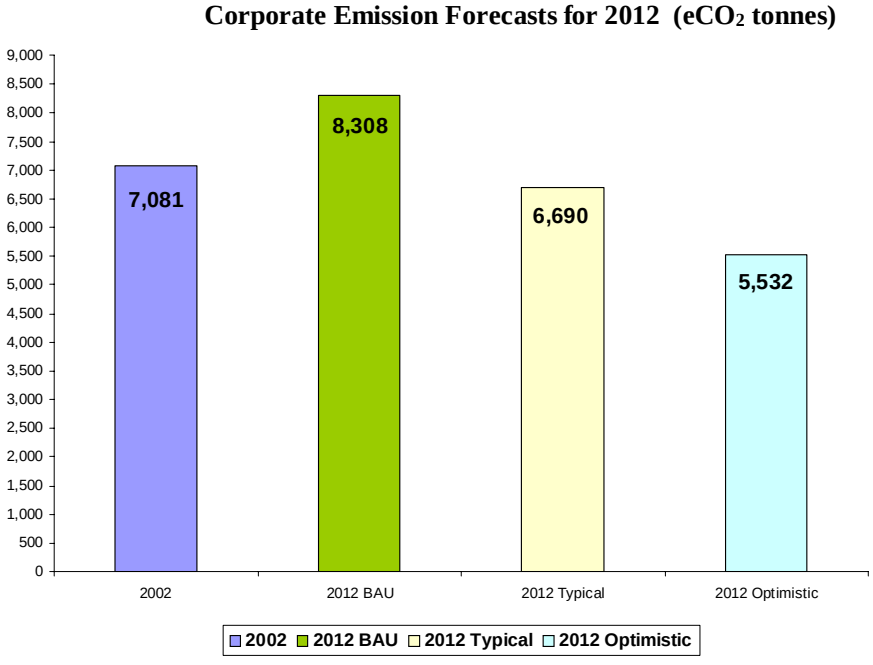
The corporate GHG inventory was developed by gathering various datasets for buildings, streetlights, vehicle fleet, water & sewage and solid waste. In total, these five sectors produced 7,081 tonnes of GHG emissions in 2002. The City's buildings generated the greatest volume of greenhouse gas emissions - approximately 63% of total emissions or 4,542 tonnes. The vehicle fleet was the second largest contributor of greenhouse gas emissions, having produced 21% of total emissions.



The project team used growth estimates and infrastructure development projections for the City to develop a forecast of emissions to 2012. Several forecasts were created for the City. The business-as-usual (BAU) forecast is based on the assumption that municipal services will expand to meet projected population growth and that the City will not implement any new GHG mitigation measures. Two additional scenarios were also created: a 'typical', and 'optimistic' scenario. The 'typical' scenario is based on the BAU forecast minus emission reductions that could be achieved if the City implemented new measures, which resulted in reductions typical of those achieved in other Canadian communities. The 'optimistic' forecast is based on the BAU forecast minus emission savings that could be achieved if the City implemented new measures, which achieve the levels of GHG reductions evident in the best case scenarios found in other Canadian municipalities. The results of the typical and optimistic scenarios provide the City with a range of reductions that could be achieved depending upon the outcomes of implementing specific reduction measures.

The graph to the right summarizes the results of each forecast, including the total emissions that will result under each scenario.

From the modeling exercises developed in Section 4 and 5, it is recommended that the City adopt a corporate GHG reduction target of 6% below 2002 emission levels by 2012.



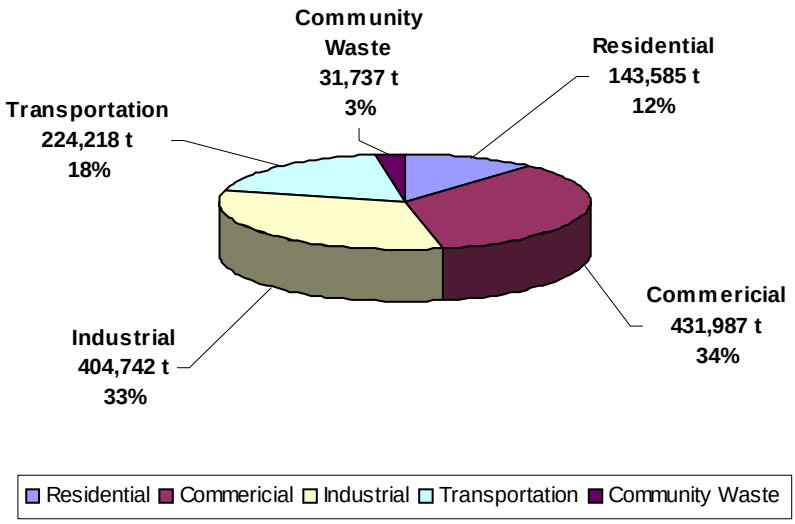
Executive Summary cont.

Community Inventory, Forecast and Target Summary

The community GHG inventory was developed by gathering various datasets for the residential, commercial, industrial, transportation and waste sectors within the City of Prince George. These emissions are under the direct control of community stakeholders, however the City can influence these sectors by providing education and outreach, and program and policy support for reduction measures in each sector.

In 2002, the community produced approximately 1,236,270 tonnes of GHGs. The chart to the right outlines the relative contribution of each sector to total community emissions. The industrial and commercial sectors contributed the greatest proportion of total emissions.

Community eCO_2 Emissions by Sector (2002)

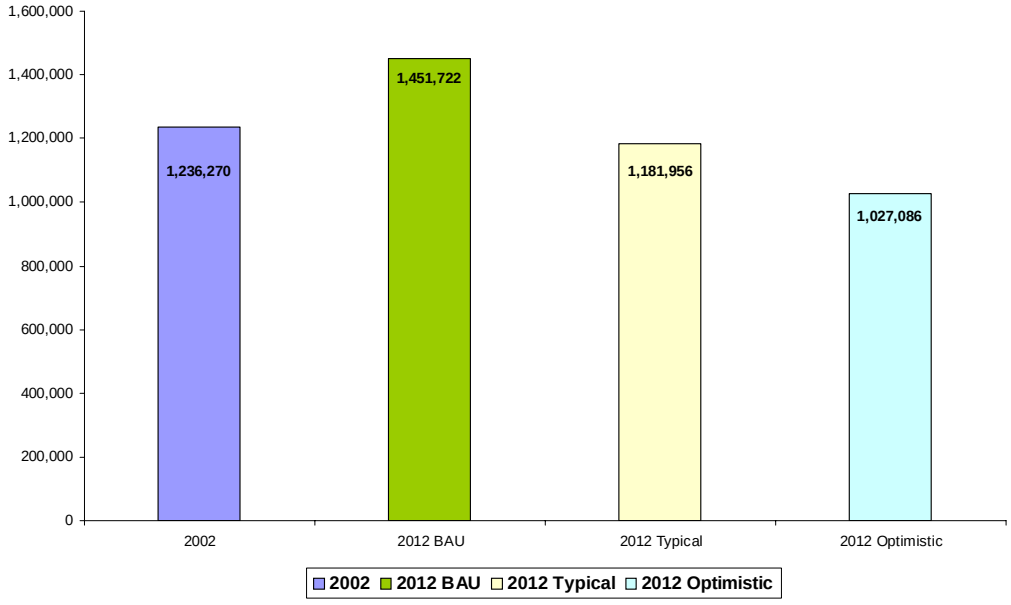


The project team also developed forecasts for GHG emissions in the community sector for 2012. Like the corporate emissions forecasts, these three scenarios are based on population forecasts and assumptions about the development and implementation of new measures aimed at GHG reductions in the community. The graph below outlines the BAU, typical, and optimistic 2012 forecasts for the community sector in Prince George.

The actual emission reductions achieved by the community will depend on a number of factors including economy, the availability of supportive programs for GHG reductions, the availability of alternative fuels and technologies, and leadership demonstrated by the City.

It is recommended that the City adopt a community GHG reduction target of 4% below 2002 emission levels by 2012.

Community Emission Forecasts for 2012 (eCO_2 tonnes)



Contents

1 Introduction

1.1 Prince George and the Challenge of Climate & Air Quality

Climate change is occurring and depending upon the relative affect across the country, it may have an impact on the decisions made by Canadian municipalities. Every region of the country will be affected by this change in one form or another. Every community is faced with tough challenges in responding to the need to curb the current trend of greenhouse gas emissions (GHG) and adapt to the environmental changes that will result from climate change. In British Columbia, the impacts of climate change will manifest themselves in a number of ways that will present both new challenges and opportunities to communities like Prince George. Climate change models predict that average annual temperatures will increase up to four degrees Centigrade by the end of the 21st century. These warmer temperatures will impact the character of the province's ecosystems and could be harmful to salmon populations in the Fraser River. Glacial retreat and earlier spring thaws will result in lower summer flows on streams and rivers, resulting in less water for agriculture, energy generation and other economic activities. Higher temperatures and drier summer conditions may increase the risk of forest fire, disease and pests. There will also be costs associated with taking action on climate change (source: Government of Canada).[1] While investments in new technologies to mitigate climate change will result in job creation, these costs will also have some negative implications for growth in other sectors of the economy. Given the strong ties of Prince George's economy to natural resource development, these changes could affect the well-being of the community.

1.2 Global Climate Change and Greenhouse Gas Emissions

The Earth's climate is a dynamic and complex system that is responsible for altering the earth and its inhabitants over the millennia. In modern times, the rate of global climate change has become an increasingly important issue for all levels of government since its effects impact ecological, economic, and social systems in all corners of the world. Internationally, it is accepted that increasing greenhouse gas emissions from human activities is causing the climate to change and scientists and world leaders have recognized that strategies to address global climate change are required.

The most significant piece of the climate change puzzle is the greenhouse gases. Carbon dioxide is a naturally occurring greenhouse gas that, in conjunction with naturally occurring water vapour, methane and nitrous oxide, traps the suns' heat energy as it reflects from the surface of the earth. This phenomenon, known as the "greenhouse effect", allows life to thrive on the majority of the planet by

[1] http://www.climatechange.gc.ca/english/affect/prov_territory/

stabilizing global temperature. Conversely, man-made greenhouse gas emissions have been strongly linked to the rapid and continual increase in the earth's atmospheric temperature. If allowed to continue, profound effects on the earth's ecosystem and its inhabitants are predicted.

The key strategic lever adopted world wide is to reduce and/or limit greenhouse gas emissions into the earth's atmosphere. A series of conventions and summits have been convened over the last 15 years that have resulted in the development of climate control strategies to reduce greenhouse gas emissions.

The 1992 Earth Summit in Rio de Janeiro, Brazil, was followed by the signing of the United Nations Framework Convention on Climate Change; Canada was amongst the signatories. In December 1997, Canada and more than 160 other countries met in Kyoto, Japan, and agreed on targets to reduce GHG emissions. The agreement that set out those targets, including the options available to countries to achieve them, is known as the Kyoto Protocol. Canada's target is to reduce its GHG emissions to 6% below 1990 levels in the period 2008 to 2012. This target is comparable to the targets of our major trading partners. The Kyoto Protocol entered into force on February 16, 2005. For more information, visit *http://www.climatechange.gc.ca/english/newsroom/2005/kyoto_feb16.asp*

Up to half of Canada's greenhouse gas emissions (350 million tonnes annually) are under the direct or indirect control or influence of municipal governments. For example, the use of electricity and fossil fuels in municipal facilities and vehicle fleets and emission from landfills contribute a combined total of 22 million tonnes of harmful greenhouse gases annually.

The adverse consequences associated with climate change are issues for all Canadian Citizens, not just senior government agencies. The majority of Canada's population lives in cities and outlying areas of metropolitan areas.

1.3 Partners for Climate Protection Program

1.3.1 Voluntary Commitment to Reducing Greenhouse Gas Emissions

Prince George City Council endorsed participation in the Partners for Climate Protection (PCP) initiative in the winter of 2001. The PCP is an umbrella initiative that fosters municipal participation in greenhouse gas emission reduction initiatives and overall sustainability. Its goal is to assist municipalities with their greenhouse gas management initiatives by providing tools and logistical support.

The Intergovernmental Panel on Climate Change has concluded that the rapid increase in the concentration of greenhouse gas emissions in our atmosphere is expected to increase the earth's temperature, change our climate, alter our environment and endanger our health (Government of Canada, 2002).

The PCP initiative not only focuses on reducing existing greenhouse gas emissions, but also encourages municipalities to influence future greenhouse gas emissions through a variety of sustainable mechanisms such as land use and transportation planning, building codes, and permitting.

By participating in the PCP initiative, municipalities receive up-to-date information on global climate change and important information regarding strategies to reduce greenhouse gas emissions, including innovative financing strategies and sample action plans. Participating municipalities also make a commitment to complete five milestones (see Sections 1.3.5 and 1.3.6).

Methods for Milestone One are described herein and a brief description for Milestone Two is provided. Reporting protocols are referenced when required and reduction initiatives are briefly discussed.

1.3.2 Relevance of the PCP to the Kyoto Protocol

The Federation of Canadian Municipalities (FCM) has been the voice of Canadian municipalities to the Federal government since 1901. In April 2003, the FCM and the City of Regina hosted a Municipal Leaders' Forum on Climate Change in Regina, Saskatchewan. The Forum was initiated in response to Canada's commitment to the Kyoto Protocol. Recommendations of the Municipal Leaders' Forum would guide the FCM and its members in ongoing policy development on federal, provincial/territorial and municipal implementation of the Kyoto Protocol. This forum was an important step in bridging the gap between the federal process and the municipal process, and it has brought further relevance to the PCP initiative.

The following principles, approved by FCM members, guide policy development on the implementation of the Kyoto Protocol.

1 *No region of the country bears an unreasonable cost related to reducing greenhouse gas emissions;*
2 *Greenhouse gas emissions related to producing oil, gas and electricity are allocated to consuming jurisdictions and sectors, rather than producing jurisdictions;*
3 *Sinks in the forest and agriculture sectors, particularly in Western Canada, are pursued as part of a national strategy to diversify rural economies through development of a bio-economy;*
4 *Investment in research and development, pilots and commercialization of technologies and processes that remove carbon dioxide from waste streams (i.e., coal gasification, injection into reservoirs); and that*
5 *Canada's action plan to meet the Kyoto target maximizes improvements in productivity and competitiveness.*

Adopted at the 2002 FCM Annual Conference, Resolution ENV02.2.04 - A Municipal Proposal for Ratifying the Kyoto Protocol.

Efforts to link the Kyoto Protocol and the municipal process will be further developed at the 4th Municipal Leaders Summit on Climate Change, in December 2005. It will be held on the occasion of the United Nations Eleventh Session of the Conference of Parties and First Meeting of the Parties to the Kyoto Protocol in Montreal, Canada.

1.3.3 Local Benefits of Reducing Greenhouse Gas Emissions

Although the co-benefits of reducing energy use and greenhouse gases are varied and are dependent upon the manner in which energy is currently used, a managed approach to implementation of reduction measures will have positive effects on air pollution, job creation, and expenditures for energy.

For municipalities, reducing operating costs, improving public transit and traffic mobility, enhancing open spaces, improving livability and local economic development are additional co-benefits for local government when implementing greenhouse gas emission action plans. Many of the strategies that reduce greenhouse gas emissions affect other cost and livability factors throughout the community at large. For example, less money spent on electricity and fuel costs translates into more disposable income available to the local economy.

Reducing greenhouse gas emissions has the additional benefit of reducing particulate matter, nitrous oxides, sulphur oxides and volatile organic compounds - all common air contaminants that contribute to degrading air quality.

1.3.4 Regional and Local Context

Known as BC's northern capital, Prince George is situated at the crossroads of Highway 97 (north-south) and Highway 16 (east-west), and at the confluence of the Fraser and Nechako Rivers (Figure 1). The City of Prince George covers an area of approximately 316 square kilometres and is made up of over 77,000 residents.

In addition to the issues of climate change, air quality issues also present the City with a more immediate challenge related to climate change. Prince George lies in a valley that acts as a trap for air pollution. Criteria air contaminants (CACs) such as sulphur oxides, nitrogen oxides, particulate matter and ground-level ozone are the precursors to smog and acid rain.[2] Environment Canada expresses potential health risk trends from air quality as a percentage of time each year ozone and PM_{10} exceed the references levels for that pollutant. Refer-

√ Greenhouse gas emissions are reduced by reducing energy use. Residents and local businesses reduce energy use, save money, and at the same time, reduce greenhouse gas emissions

√ Reinvesting savings into the local community helps to protect existing jobs and to create new jobs

√ By reducing greenhouse gas emissions, air quality can also be improved as air pollutants are reduced concurrently

√ Emissions from transportation sectors are a significant source of greenhouse gases. By reducing our dependence on automobiles, the quality of life improves as traffic congestion is also improved

[2]Volatile organic compounds (VOC), carbon monoxide (CO) and ammonia (NH_3), and secondary particulate matter (PM) are also identified as CACs by Environment Canada. Source: Clean Air Online.

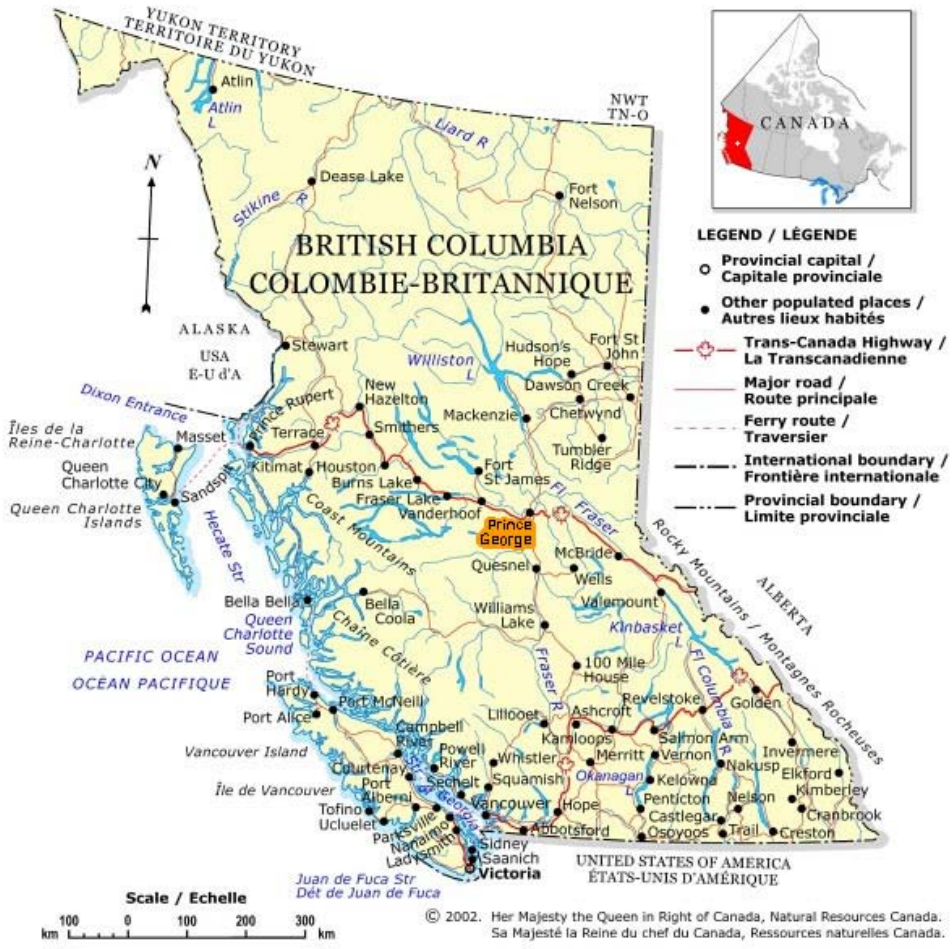


Figure 1. Regional Map illustrating the location of the City of Prince George .

ence levels are defined as "the lowest ambient ozone and particulate matter concentrations at which statistically significant increases in human health effects have been detected." Between 1994 and 2002, ozone exceeded reference levels over 50% of the time and particulate matter exceeded reference levels 25% of the time within the City of Prince George.[3] Higher levels of smog and longer periods of exposure to increased levels result in higher health risks. The detrimental impacts of air pollution are also more immediate and felt locally. Asthma, lung cancer, cardiovascular disease, allergies and many other human health problems have been linked to poor local air quality. In addition, the economic costs and benefits of air quality action, are mixed. Mitigation and clean-up will place additional costs on certain sectors of the economy while the development of air quality solutions will foster new jobs.

For more detailed information, see, 'Our Profile' at *http://www.city.pg.bc.ca/pages/ourcity/*

[3] http://www.ecoinfo.ec.gc.ca/env_ind/region/smog/smog_e.cfm

Many of the processes that emit greenhouse gas emissions also result in the release of criteria air contaminants (e.g., transportation and stationary fuel combustion such as residential heating). By taking action to reduce greenhouse gas emissions, the City may also reduce criteria air contaminants. Reductions in CACs will result in improved local air quality. However, while some GHG reduction measures will reduce the production of CACs, other GHG measures may increase the release of one or more of the CACs. For example, the use of biodiesel in vehicles can reduce the amount of carbon dioxide (a GHG) released, but biodiesel could result in greater nitrogen oxides (a CAC). In such instances, decisions to decrease one while increasing another must be weighed against local conditions, emissions loading, and the relative affect of individual GHGs and CACs.

As the City of Prince George moves forward with its climate change action and clean air planning, it will need to balance these goals, seeking out common solutions to both challenges where possible and making appropriate tradeoffs where necessary.

1.3.5 Milestone One: Emissions Inventory

Milestone One, or the emissions analysis, is an essential component of the greenhouse gas emissions reduction plan. In order to implement an effective strategy to reduce greenhouse gas emissions it is necessary to develop an inventory of the emissions. In its absence, municipalities lack a starting point from which progress can be measured. Further, they will not be able to forecast future emissions and predict the benefits of proposed reduction measures.

The emissions analysis is partitioned into a corporate emissions inventory and a community wide emissions inventory. The corporate sector is defined by all activities and operations of the municipality. The community sector is defined by all activities of stakeholders within the community. Each inventory is further separated into sectors and sources.

A review of emissions by sector allows an analysis of the activity or operation responsible for various emissions. Corporate emissions by sector include those resulting from municipal buildings, fleet vehicles and other motorized equipment, traffic signals and street lighting, potable water, storm and sanitary sewers, and solid waste generated at municipal facilities. Community emissions by sector include those resulting from residential, commercial and industrial buildings and their operations, transportation within the community and solid waste generated within the community. Table 1 summarizes corporate and community sectors and typical fuel sources or direct emissions from each sector.

***Milestone One**: Taking Stock. Complete GHG and energy use inventories and forecasts for both municipal operations and the community as a whole.*

***Milestone Two**: Set Reduction Targets. Suggested PCP targets are a 20 per cent reduction in GHG emissions from municipal operations, and a minimum six per cent reduction for the community, both within 10 years of making the commitment.*

***Milestone Three**: Develop a Local Action Plan. Develop a plan that sets out how emissions and energy use in municipal operations and the community will be reduced.*

***Milestone Four**: Implement the Plan. Create a strong collaboration between the municipal government and community partners to carry through on commitments, and maximize benefits from greenhouse gas reductions.*

***Milestone Five**: Measure Progress. Maintain support by monitoring, verifying, and reporting greenhouse gas reductions.*

Corporate Inventory (Municipal)		Community Inventory	
Sectors	**Emission Source**	**Sectors**	**Emission Source**
Buildings	*Electricity, natural gas, fuel oil (wood is excluded)*	Residential Buildings	*Electricity, natural gas, fuel oil (wood is excluded)*
Fleet Vehicles	*Gasoline, diesel fuel, natural gas, propane*	Commercial Buildings	*Electricity, natural gas, fuel oil (wood is excluded)*
Streetlights	*Electricity*	Industrial Buildings	*Electricity, natural gas, fuel oil (wood is excluded)*
Water/Waste Water	*Electricity*	Transportation	*Gasoline, diesel fuel, natural gas, proprane*
Solid Waste	*Methane emission*	Solid Waste	*Methane emission*
Other	*Direct sources from specific operation(s)*	Other	*Direct sources from specific operation*

Table 1 - Summary of corporate and community sectors and typical fuel sources or direct emissions from each sector.

A review of emissions by source allows an analysis of the origin of various emissions. The origin of the emission is attributed to the type of fuel burned while carrying out the activity or operation. There is no difference between sources of corporate and community emissions, although the sectors they belong to may be different. Major sources of greenhouse gas emissions include electricity, natural gas, diesel fuel, and gasoline. Greenhouse gases are emitted as these fuels are burned. Methane from the decomposition of waste in landfills is also a major source of greenhouse gas emissions, but is a direct emission.

Given the sectors to which the source of emissions can be attributed, the volume of greenhouse gas emissions are calculated. This information forms the data from which an action plan is derived, and upon which evaluation of progress can be measured.

In order to relate data and strategies from region to region and country to country, an international unit of measure has been adopted. Given that carbon dioxide occurs naturally in the atmosphere, and is predominantly responsible for the greenhouse effect, an equivalent measure of CO_2 has been adopted as the international unit when reporting greenhouse gas emissions. To aid with the task of developing the emissions analyses, spreadsheets are used to convert energy inputs (e.g., electricity use such as kilowatt-hours) to a unit of equivalent CO_2, or eCO_2.

Energy consumption values are converted to 'equivalent CO_2', or eCO_2, a standardized unit for reporting greenhouse gas emissions.

Although the PCP initiative suggests a base year of 1994, data for 1994 is not available and therefore a more recent inventory was produced from 2002 data.

1.3.5.1 Corporate Emissions Inventory

To gather corporate emissions data, an interdepartmental work team was established and consists of City staff members with access to data for the base year of 2002 (see Section 1.3.5.3). BC Hydro and Terasen Inc. provided consumption values and costs for consumption of electricity and natural gas for the inventory years of 2002. All energy use and direct emissions data were entered into an emissions calculation spreadsheet and the emissions baseline was established for 2002.

Solid waste from municipal operations was derived from the volume of bins at municipal facilities and the frequency of pick-up of the bins.

1.3.5.2 Community Emissions Inventory

The community inventory consists of gross energy values for electricity and natural gas consumed by the municipality. These values include consumption by customers in the residential, commercial, and industrial sectors. BC Hydro and Terasen Inc. provided electricity and natural gas consumption data respectively.

The transportation sector emissions were calculated using gross fuel sales of gasoline and diesel fuel within the municipal boundaries. Although other methods are possible, gross fuel sales data is appropriate for the City of Prince George since there are no neighbouring municipalities to confound the disaggregating of fuel sales. Data for propane used for vehicles is not available and its use in vehicles is insignificant.

Solid waste data was obtained from tipping slips from waste collection throughout the community.

1.3.5.3 Data Sources

The main sources of data for both emissions inventories was BC Hydro and Terasen Inc. BC Hydro supplied electricity consumption data for the corporate and community inventories while Terasen Inc. supplied natural gas consumption data for the corporate and community inventories.
The following City of Prince George staff contributed to the data sets:

- Greg Anderson – corporate buildings data and corporate solid waste data
- Diane Flannagan – corporate fleet data
- Tom Kadla – community solid waste data

- John Land – fire department buildings and fleet data
- Gina Layte Liston – community demographics, employee statistics
- Richard Merrison - corporate streetlights and traffic signals
- Betty Murphy - personal vehicle mileage
- Tony Pirillo – corporate wastewater and water data,

1.3.6 Milestone Two: Emission Reduction Targets

Reduction targets are established as part of Milestone Two. The PCP initiative suggests reduction targets of 20% for municipal operations and 6% for community wide emissions, both within 10 years of joining the PCP initiative.

An emissions projection is accomplished by forecasting emissions from a year in which real emissions data exists. The forecast is based on population growth estimates provided by the City and senior government agencies and can be referred to as a 'business as usual' projection. The target for emissions reduction is the difference between the base year emissions value and the percentage of the base year emissions reduction target adopted by Council.

1.3.7 Reporting Protocols and Inventory Methods

ICLEI - Local Governments for Sustainability, provides a protocol document to assist PCP participants with quantifying and reporting greenhouse gas emissions and reductions. By developing common conventions and a standardized approach, protocols make it easier for PCP members to fulfill their commitments to the PCP. Further, methods contained in the FCM's draft inventory and standards guidance document[4] were employed.

1.3.8 Selection of Reduction Initiatives

The objective of this project is to develop a solid foundation on which to complete Milestone Three of the PCP – a greenhouse gas emissions reduction plan. This report provides a number of measures for reducing greenhouse gas emissions from the sectors and sources identified in the emissions analyses. The emissions analysis is useful for the development of an emission reduction strategy as it allows city staff to focus their attention on the greatest sources of emissions. As an example, if a significant amount of a city's corporate emissions originate from the building sector and a significant amount of emissions are generated by the burning of natural gas, it follows that reduction measures relative to the consumption of natural gas in the building sector should be explored.

[4] Partners for Climate Protection: Developing Inventories for Greenhouse Gas Emissions and Energy Consumption: A Guidance Document for Canadian Municipalities. October 2005. Federation of Canadian Municipalities, Ottawa, Ontario. 41 pp.

1.3.9 Quantitative vs. Qualitative Reduction Initiatives

Milestone Three, or the greenhouse gas action plan, proposes reduction measures that translate into increasing energy efficiency and reducing greenhouse gas emissions. Strategies are either quantitative or qualitative.

Although both quantitative and qualitative reduction initiatives have an overall affect of reducing greenhouse gas emissions, only the quantitative initiatives can be measured. As emissions are tracked over time, the success of quantitative reduction initiatives can be evaluated by reviewing consumption data directly associated with the emissions.

Quantitative indicators are identified in the datasets and form part of the activity level that is responsible for the relative magnitude of the emissions reported. For example, if 200,000 kWh of electricity is used for 20 traffic signal arrays and the consumption increases five years into the future, it is highly likely that the number of traffic signal arrays or the total number of traffic signals has increased. In this regard, quantitative initiatives are easily evaluated over time and easily explained as long as quantitative indicators are available. Generally speaking, quantitative indicators provide easy explanations for emissions increases as they are usually directly associated with the municipalities' response to a growing community (i.e, service levels are enhanced as the community grows).

In the case of qualitative reduction initiatives, many factors may affect changes in emissions over time. Qualitative indicators must be developed for qualitative reduction initiatives that are to be implemented in the future. Although sometimes subjective, these indicators allow for an assessment of the performance of an initiative or at the very least may identify trends that may be the cause of changes in emissions over time. For example, a reduction initiative such as a street tree planting program is considered qualitative as measuring carbon sequestration is highly inaccurate. Many qualitative reduction initiatives can be measured, but doing so would be largely impractical. An example is a reduction initiative that is designed to reduce community vehicle kilometres traveled. Although measurable, the scale of an accurate measure is not practical. In lieu of actual measurement, a sample of the population would be taken through a community survey and the error with survey respondents reported.

1.3.10 Importance of Indicator Data

The importance of indicator data is apparent as it offers explanations for the relative change in overall emissions over time by reviewing actual consumption data and qualitative indicator data. Accordingly, gathering quantitative indicator information is important as inventory data is gathered. As well, qualitative indi-

cators must be developed for qualitative reduction initiatives so that performance of qualitative reduction measures can be evaluated.

Making progress towards sustainability and more specifically, climate change mitigation, requires systematic evaluation of whether a community's policies are adequate and whether they are having the desired effects. To be effective in determining performance, indicators should directly respond to the policy whose effect is to be measured. As the City moves towards integrating its climate change mitigation and sustainable development goals into day-to-day decision-making, it will require a process for assessing its achievements. The choice of indicator will also be influenced by a number of factors, including resources available for monitoring, other indicators currently tracked by the City, and the scheduling of reporting requirements. Performance indicators measure aspects of the performance of organizations, sectors or cities and are intended to be identified with specific policies or oals. With an established GHG target for both the corporate and community sectors, the City will be able to easily develop indicators by which the City can track its progress towards its GHG reduction target.

From the project team's experience in monitoring and evaluation, a strong indicator has four criteria:

1. Feasible – the collection and compilation of related data should be feasible given resource constraints upon the municipality; wherever possible existing monitoring, auditing and reporting data should be used;

2. Frequently Measurable – the ability to monitor performance and trends over time requires consistent, comparable time-series data. This data must be available frequently enough to aid decision making at key times;

3. Valid – Indicators must be based on quality data and accepted measurement standards if they are to be accepted and recognized by stakeholders;

4. Relevant to Local Residents – indicators should relate to things that are understood and valued by their users.

With these criteria in mind, the project team will work together to establish indicators for each corporate and community sector that can be monitored to ensure the City is on course to meeting its GHG reduction target.

2 Corporate Inventory

2.1 Corporate Inventory Summary

In 2002, the City of Prince George produced 7,081 tonnes of GHGs. These emissions are equivalent to those generated by approximately 2,000 passenger cars, each driven 20,000 km for one year or the amount of carbon sequestered by over 150,000 seedlings during a ten year growth period. Figure 2 illustrates the relative contribution of each type of infrastructure to the City's total emissions. The City's buildings generated the greatest volume of greenhouse gas emissions - approximately 63% of total emissions or 4,542 tonnes. The vehicle fleet was the second largest contributor of greenhouse gas emissions, having produced 21% of total emissions.

Figure 2 - Corporate eCO_2 Emissions by Sector (2002)

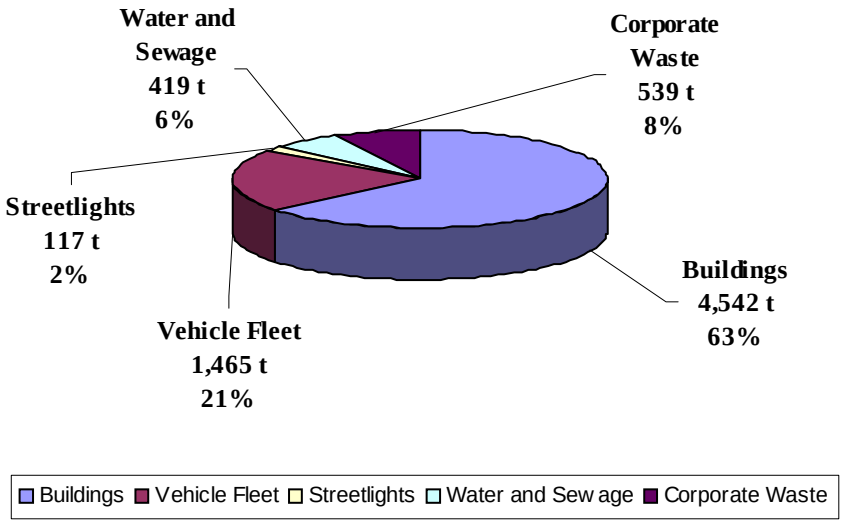


Table 2 - Energy, Costs, and Emissions by Sector (2002)

Sector	Total Energy (GJ)	Total Cost	Total eCO_2 (t)
Buildings	65,523	$1,545,572	4,542
Vehicle Fleet	21,247	$300,823	1,465
Streetlights	16,692	$562,103	117
Water and Sewage	52,865	$791,376	419
Corporate Waste		-	539
Total	**156,327**	**$3,199,874**	**7,081**

The City's total 2002 energy costs were approximately $3,199,874. Buildings were the most expensive to operate and accounted for $1,545,572 or approximately 48% of total energy costs. Energy costs for water and waste water treatment were $791,376 or 25% of total energy expenditures (Table 2).

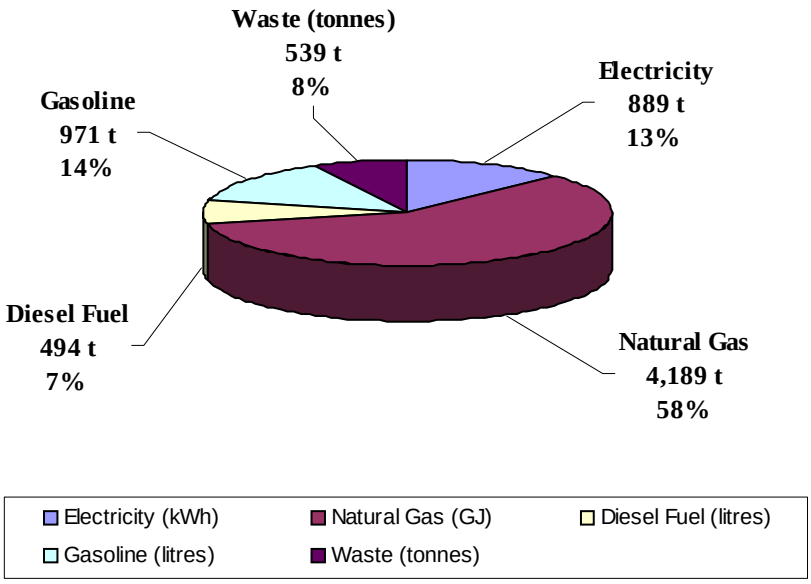
The greatest source of corporate emissions is the combustion of natural gas (59% of total emissions), followed closely by the combustion of gasoline (14% of total emissions). Figure 3 illustrates the relative contribution of each source to total emissions.

2.0 Corporate Inventory Cont.

In section 5 of this report, we will discuss measures that the City can take to reduce its energy consumption and costs. In this discussion, we will attempt to find a balance between those corporate activities that produce the most emissions (vehicle fleet, buildings, waste) and those corporate operations that have the highest annual energy costs (buildings, water and waste water treatment, streetlights). This strategy will enable the City to optimize its greenhouse gas reductions, and maximize costs savings from reduced energy use.

In the pages that follow, data for each of the corporate sectors are provided.

Figure 3 - Corporate eCO_2 Emissions by Source (2002)



2.2 Buildings

Overall, the City's corporate buildings consumed 139,989 GJ of energy and produced 4,542 tonnes of eCO_2 in 2002. The City paid $1,545,572 to power these facilities. Approximately 91% of the emissions were produced by natural gas consumption and 9% by electricity; however, both natural gas and electricity costs were relatively even at 51% and 49% respectively (see Table 3 for details).

Table 3 - Energy Consumption, Costs, and Emissions by Fuel Type for Buildings (2002)

Fuel Type	Energy Use (GJ)	Cost ($)	Total eCO_2 (t)
Electricity	58,546	$759,887	402
Natural Gas	81,444	$785,685	4,140
Total	**139,989**	**$1,545,572**	**4,542**

2.3 Vehicle Fleet

The vehicle fleet includes all motorized on-road vehicles operated by the City of Prince George, excluding transit vehicles which are included in the community inventory. In 2002, the City's vehicles (including 90 employee vehicles used for City business) produced 1,465 tonnes of eCO_2 and fuel costs were $300,823. Table 4 provides a breakdown of greenhouse gas emissions, costs and volume consumed by fuel and vehicle type.

Table 4 - Vehicle Fleet Fuel Use, Costs, and Emissions (2002)

Vehicle or Vehicle Group Name	Gasoline (L)		Diesel Fuel (L)		Total		Total eCO_2 (t)
	Total Use	Total Cost ($)	Total Use	Total Cost ($)	# of Vehicles	Total Cost ($)	
Car (includes 5 vehicles for Fire Services)	9,452	$4,900			10	$4,900	22
Cars (personal mileage)[1]	9,993	$5,180			39	$5,180	24
Van and Jeep (includes 3 vehicles for Fire Services)	43,268	$22,935			20	$22,935	102
Pickup Truck (includes 5 vehicles for Fire Services)	212,468	$110,158			89	$110,158	502
Pickup Truck (personal mileage)[1]	100,182	$51,941			51	$51,941	237
Light Dump Truck and Flat Deck	35,685	$18,507			10	$18,507	84
Heavy Dump Truck			46,089	$21,076	15	$21,076	126
Fire Department Pumper			18,911	$12,938	4	$12,938	52
Packer			92,194	$42,271	10	$42,271	252
Flusher and Sweeper			23,787	$10,918	9	$10,918	65
Off-road Backhoe, Grader, Loader, Excavator[2]			35,778	$15,971	17	$15,971	98
Misc. Equipment[2]	2,041	$1,051	15,064	$7,363	20	$8,414	46
subtotal not included in emissions inventory	2,041	$1,051	50,841	$23,334		$24,385	144
Total (vehicles in bold)	**411,048**	**$213,620**	**180,981**	**$87,203**	**257**	**$300,823**	**1,465**

[1] car and pickup truck personal mileage provided. Fuel use estimated based on average for car and pickup truck fleet.

[2] not included in total as this vehicle class is not counted in municipal GHG inventories as per protocol.

There may be considerable error in the calculation of personal vehicle use since only vehicle kilometres traveled (VKT) was available. VKT was converted to fuel volumes using average fuel efficiency factors for similar fleet vehicles owned by the City. Further, a breakdown of fuel type used by personal vehicles was not possible (e.g., gasoline vs. diesel fuel). Therefore, it was assumed that personal vehicles used for City business consume gasoline. An actual breakdown of VKT, fuel type, and fuel efficiency for each vehicle in use is necessary to refine the dataset and provide a higher level of confidence in the total emissions allocated to the City's vehicle fleet.

In terms of operating costs, the use of personal vehicles for City business is cost effective. Not only does the city save capital and maintenance costs, but staff using a personal vehicle may perform their tasks more effectively if they are given the discretion to start and finish work at the jobsite if an opportunity for efficiency presents itself. For this reason, the use of personal vehicles for City business may have the overall effect of reducing both corporate and community emissions.

2.4 Streetlights

This sector includes all outdoor lighting, such as traffic signals, streetlights, and ornamental lights. Overall, the City's streetlights consumed 16,692 GJ of electricity (4,636,724 kWh), resulting in the production of 117 tonnes of eCO_2 at a cost of approximately $562,103. Streetlights accounted for 2% of total corporate greenhouse gas emissions.

Table 5 - Energy, Costs, and Emissions by Lighting Type (2002)

Lighting Type	Electricity Use (kWh)	Cost ($)	Total eCO_2 (t)
Ornamental Lighting	2,648,497	$153,775	67
Park Lights	1,629	$169	0
Street Lights	1,585,433	$384,593	40
Traffic Signals	401,165	$23,566	10
Total	**4,636,724**	**$562,103**	**117**

Table 5 provides an estimate of energy use, cost and emissions by lighting function. The most expensive types of lighting, both in terms of finances and emissions were ornamental and street lights. The City spent over $500,000 on these two types of lighting in 2002.

2.5 Water & Wastewater

In 2002, energy consumption and costs for the water and wastewater treatment facilities amounted to 14,684,627 kWh of electricity and 955 GJ of natural gas resulting in the release of 419 tonnes of greenhouse gas emissions at a cost of $791,376. Water and wastewater treatment accounted for 11% of total greenhouse gas emissions. A detailed summary of energy consumption, costs, and resulting emissions is presented in Table 6.

Table 6 - Water and Wastewater Energy, Costs, and Emissions (2002)

Electricty (kWh)			Natural Gas (GJ)			Total	
Total Use	Total Cost ($)	Total eCO_2 (t)	Total Use	Total Cost ($)	Total eCO_2 (t)	Total Cost ($)	Total eCO_2 (t)
14,684,627	**782,304**	**370**	**955**	**9,073**	**49**	**791,376**	**419**

2.6 Solid Waste

Solid waste accounts for 8% of total corporate emissions. Solid waste information was estimated by calculating the volume of waste delivered to the landfill from the volume of bins at municipal facilities and the frequency of their pickup. In 2002, the City produced 1,118 tonnes of municipal waste from its corporate operations which resulted in 539 tonnes of eCO_2 (Table 7).

Table 7 - Solid Waste Emissions and Indicators (2002)

Waste to Landfill (t)	1,118
Total eCO_2 (t)	539

2.7 Corporate Inventory – Conclusions

From the inventory information gathered, the City can draw a number of conclusions about its own energy use and the potential for greenhouse gas emission reductions. These conclusions are summarized as follows:

- The majority of corporate emissions are from the City's buildings (63%). Although lighting retrofits have been undertaken in most buildings, other retrofits may be possible (e.g., HVAC). Deeper building retrofits should be investigated to reduce emissions from corporate buildings;

- Emissions attributed to the City's fleet vehicles account for 21% of corporate emissions. Personal vehicles used for city business is a significant component of vehicle fleet emissions (e.g., 18%). A breakdown of VKT, fuel type, and fuel efficiency of personal vehicles used for City business would eliminate the error(s) associated with the personal vehicle use component of the fleet vehicle sector;

- The City has retrofitted its traffic signals using light-emitting diodes (LEDs). These lights are 90% more efficient than incandescent traffic lights. It should be noted that the emissions reductions from the traffic signal retrofit are not accounted for in the inventory as this program did not begin until late 2002. Regardless, the actual savings will not be accounted for on billing information from BC Hydro until the cost savings have paid for the capital cost of the retrofits;

- Corporate waste may be overestimated since the calculation assumes that waste bins are at capacity when they are picked up. Note: accurate data for corporate waste can only be obtained if a municipality tracks the tipping of their corporate waste separately from the tipping of their community waste. The City of Prince George does not track these waste streams separately, nor is it common for municipalities to do so.

3 Community Inventory

3.1 Community Inventory Summary

In 2002, the community of Prince George produced approximately 1,236,270 tonnes of eCO_2. These emissions are equivalent to those produced by approximately 267,591 passenger cars driven for one year or the amount of carbon sequestered by almost 32 million seedlings over ten years of growth. The commercial sector emitted the greatest volume of emissions in 2002, having produced approximately 35% of total community emissions, followed closely by the industrial sector, which contributed 33% of total emissions (Figure 4). It should be noted that Northwood Pulp and Paper has been excluded from the emissions inventory in accordance with PCP protocols (see section 1.3.7).

Figure 4 - Community eCO_2 Emissions by Sector (2002)

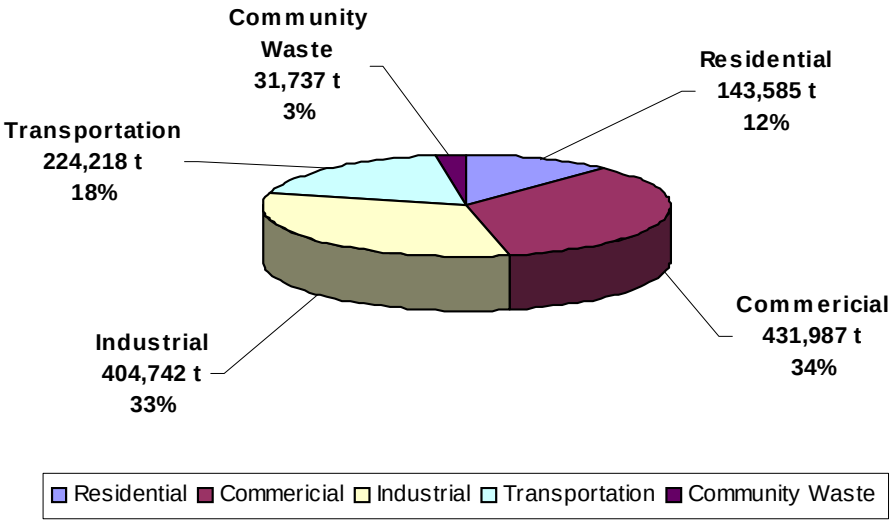
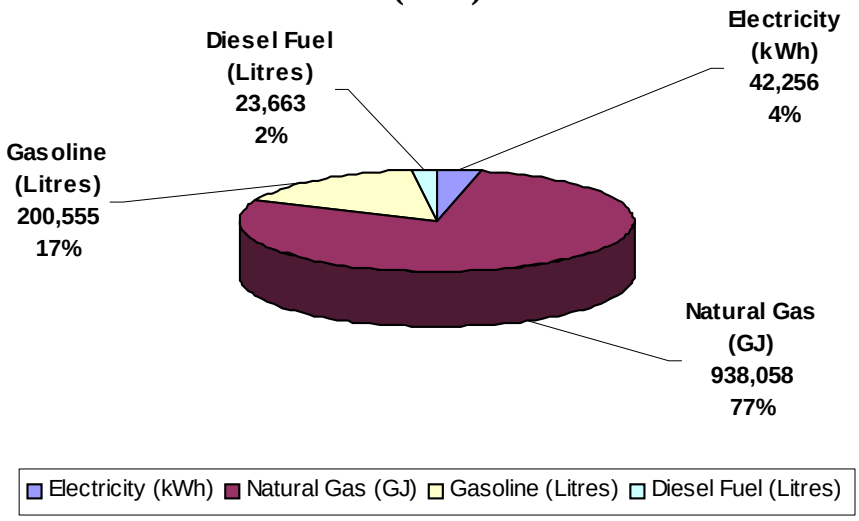


Figure 5 - Community eCO_2 Emissions by Source (2002)



The greatest source of emissions was natural gas, followed by much smaller emissions from gasoline, electricity, solid waste, and diesel fuel (Figure 5).

3.0 Community Inventory Cont.

Table 8 and Table 9 illustrate the breakdown of the City's community emissions by sector and source for 2002.

Table 8 - Energy and Emissions by Sector (2002)

Sector	Total Energy (GJ)	Total eCO_2 (t)
Residential	3,701,199	143,585
Commericial	9,416,618	431,987
Industrial	11,370,128	404,742
Transportation	3,278,284	224,218
Community Waste	NA	31,737
Total	**27,766,229**	**1,236,270**

Table 9 - Energy and Emission by Source (2002)

Energy Type	Total Use	Total eCO_2 (t)	Total Energy (GJ)
Electricity (kWh)	1,676,400,697	42,256	6,035,043
Natural Gas (GJ)	18,452,903	938,058	18,452,903
Gasoline (Litres)	84,912,947	200,555	2,943,083
Diesel Fuel (Litres)	8,666,007	23,663	335,201
Waste	NA	31,737	NA
Total	**-**	**1,236,270**	**27,766,229**

3.2 Residential

BC Hydro provided electricity consumption data for the residential, commercial, and industrial sectors. Terasen Gas provided natural gas consumption data for the residential, commercial, and industrial sectors. Natural gas data was not available for 2002. Accordingly, 2003 consumption data was adjusted using 2002 population figures.

In 2002 the residential sector consumed approximately 3,701,199 GJ of energy and produced 143,585 tonnes of eCO_2. The majority of these emissions were produced by natural gas combustion (see Table 10).

Table 10 - Consumption, Emissions and Total Energy by Energy Source (Residential 2002)

Fuel Type	Total Use	Total eCO_2 (t)	Total Energy (GJ)
Electricity (kWh)	282,420,895	7,119	1,016,715
Natural Gas (GJ)	2,684,484.2	136,466	2,684,484
Total	**-**	**143,585**	**3,701,199**

Indicators	*Indicator Values*	*Total eCO_2/Indicator*
Population:	*75,150*	*1.9*
Households:	*31,000*	*4.6*

The average household electricity and natural gas use in 2002 was 33 GJ and 87GJ respectively. An average Prince George household produced five tonnes of greenhouse gas emissions.

3.3 COMMERCIAL

Overall commercial activities produced 431,987 tonnes of eCO_2 in 2002. The majority of commercial emissions were produced by natural gas combustion (see Table 11 for details).

Table 11 - Consumption, Emissions and Total Energy by Energy Source (Commercial 2002)

Fuel Type	Total Use	Total eCO2 (t)	Total Energy (GJ)
Electricity (kWh)	296,003,590	7,461	1,065,613
Natural Gas (GJ)	8,351,005	424,526	8,351,005
Total	-	**431,987**	**9,416,618**

3.4 INDUSTRIAL

Forestry is the principal industry in Prince George, however, two chemical plants, an oil refinery, a brewery, machine shops, mining and other manufacturing also add to the community's economy. In 2002, these industries consumed approximately 11,370,128 GJ of energy resulting in 404,742 tonnes of eCO_2 (see Table 12). Note that Northwood Pulp and Paper was excluded from this inventory as it is a large, final emitter and is subject to greenhouse gas emission reduction requirements by the Federal government.

Electricity and natural gas consumption for the industrial sector ranked within the top five in British Columbia; this ranking is both a testament to the high level of economic activity in this sector in Prince George and the potential for energy efficiency improvements to enable industry to maximize returns while lowering operating costs associated with energy use.

Table 12 - Consumption, Emissions and Total Energy by Energy Source (Industrial 2002)

Fuel Type	Total Use	Total eCO2 (t)	Total Energy (GJ)
Electricity (kWh)	1,097,976,212	27,676	3,952,714
Natural Gas (GJ)	7,417,414	377,066	7,417,414
Total	-	**404,742**	**11,370,128**

3.5 TRANSPORTATION

Transportation sector fuel consumption was obtained by the research team from a private sector research company that collects fuel sales data from local fuel stations. In 2002, the community purchased 84,912,947 litres of gasoline and 8,666,007 litres of diesel fuel resulting in a total of 224,218 tonnes of eCO_2 (see Table 13). Transportation accounted for 18% of total community emissions.

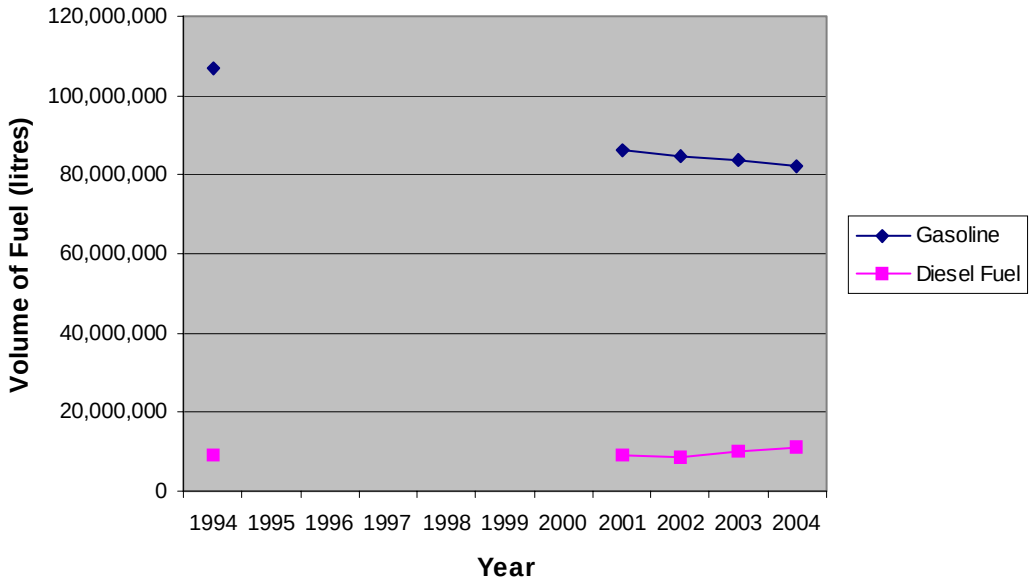
3.0 Community Inventory Cont.

Since 1994, gasoline fuel sales have been declining, while diesel fuel sales are on the rise (see Figure 6). This trend is common amongst communities where trucks are favoured over cars as personal vehicles. To confirm this trend, the City would need to review vehicle registration data during the same time period, or a significant subset of the period.

Table 13 - Community Fuel Sales by Fuel Type and Year

Total Community Fuel Sales by Year	Gasoline (L)		Diesel Fuel (L)		Total eCO_2 (t)
	Total Use	Total eCO_2 (t)	Total Use	Total eCO_2 (t)	
1994	106,912,196	252,515	8,831,762	24,116	276,631
2001	86,235,739	203,679	8,935,124	24,398	228,078
2002	**84,912,947**	**200,555**	**8,666,007**	**23,663**	**224,218**
2003	83,915,277	198,199	10,121,328	27,637	225,836
2004	82,275,158	194,325	10,894,889	29,750	224,074

Figure 6 - Fuel Sales for Gasoline and Diesel Fuel



3.6 Solid Waste

The methane commitment method was used to calculate landfill gas emissions produced by community waste. This method accounts for emissions of methane from solid waste collected in the inventory year as apposed to the alternate method – waste in place - that calculates the cumulative emissions from the time the waste was deposited to present. The methane commitment method was chosen over the waste in place method since accuracy in the later method requires data on the composition of waste in the landfill, which was not available. In 2002, the community produced 65,886 tonnes of waste, which resulted in the production of 31,737 tonnes of eCO_2.

3.7 Community Inventory – Conclusion

From the inventory information gathered, the City can draw a number of conclusions about community emissions in the City of Prince George and the potential for greenhouse gas emission reductions. These conclusions are summarized below.

- Natural gas combustion is the largest source of community emissions in the City of Prince George;
- Industrial and commercial sectors produce the majority of the community's emissions even though Northwood Pulp and Paper has been excluded from the emissions inventory (the PCP protocol allows municipalities to exclude large final emitters);
- Residential and transportation related emissions account for over 25% of community emissions.

According to Environment Canada, Canadians produced approximately 23 tonnes of eCO_2 per capita in 2002.[5] The community of Prince George produced 16 tonnes of eCO_2 per capita in 2002. While the City is significantly below the national average for per capita emissions, most BC municipalities also fall into this category since BC's emissions from electricity produced mainly by hydroelectric plants, are significantly lower than other provinces.

[5] There are a few discrepancies between the accounting system that Environment Canada uses and the methodology used by the PCP. For example, Environment Canada includes emissions from air travel in its community assessments whereas these emissions are not taken into account in the PCP method.

4 Emissions Outlook – GHG Forecast

The results of Milestone One provides an important baseline which the City can use over time to measure its success in reducing greenhouse gas emissions. The forecast of emissions provides insights to the level of emissions that the City may generate in the future if current patterns of energy consumption and activity continue. Three types of forecast scenarios have been generated as follows:

1. ***Business as usual (BAU)*** – the BAU emissions forecast is developed for the year 2012, as the PCP recommends that participants commit to meeting their emission reduction targets within 10 years of joining the PCP. The premise for the BAU forecast is that greenhouse gas emissions will increase as population size increases. No significant GHG reduction measures will be undertaken.

2. ***Typical*** – new GHG mitigation measures will be implemented in both the corporate and community sectors thereby reducing emissions from the BAU scenario. The level of rigour and the scope of these measures will result in reductions typically found in other PCP communities across Canada.

3. ***Optimistic*** – new GHG mitigation measures will be implemented in both the corporate and community sectors thereby reducing emissions from the BAU scenario. The City and community stakeholders will increase the level of rigour with which they implement these measures and the scope of implementation of each measure. The result is reductions that exceed those typically encountered and are therefore considered optimistic.

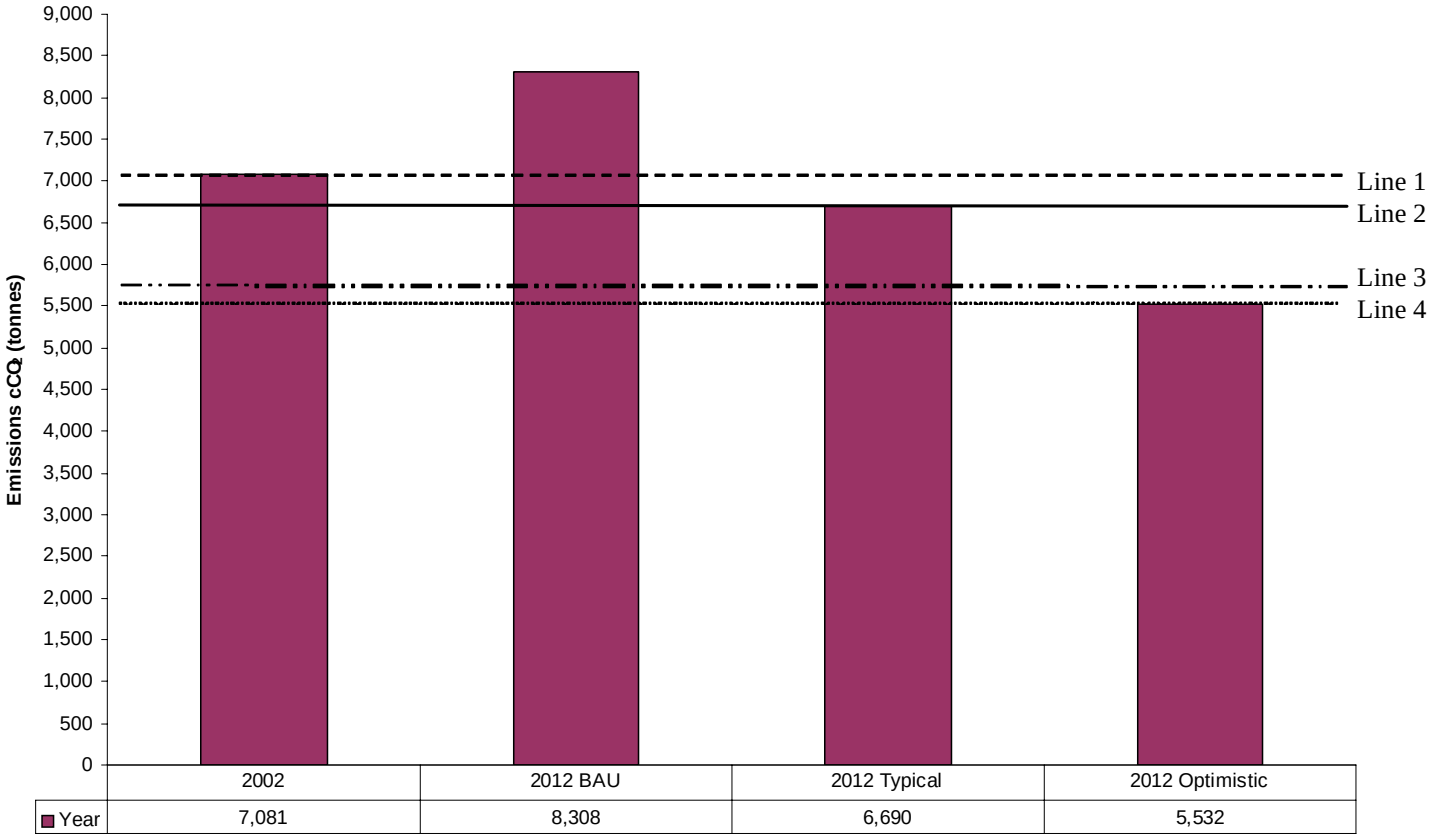
The typical and optimistic forecasts are based on implementation of a number of reduction measures outlined in Section 5 and 6. The results of implementing a specific reduction measure is unknown until the specific measure has been evaluated. In essence, the typical and optimistic forecasts provides a range of possible emissions reductions over time.

4.1 Corporate Emissions Forecasts

Between 2002 and 2012, the population of Prince George will increase approximately 17%, from approximately 75,000 to 88,000. It is expected that growth in municipal services and operations will be directly influenced by population growth. The BAU scenario is based on the assumption that the City will provide these services with the same level of efficiency as it has in the past. Figure 7 illustrates GHG emissions that could be generated by the corporate sector in 2012 under the scenarios produced for this report. Four lines are shown which include the 2002 baseline emissions (Line 1; 7,081 tonnes eCO_2), a 6% typical emissions target from the modeling exercise (Line 2; 6,690 tonnes eCO_2), the FCMs recommended 20% emissions target (Line 3; 5,665 tonnes eCO_2), and a 22% optimistic emissions target from the modeling exercise (Line 4; 5,532 tonnes eCO_2). Each of the scenarios is described on the pages that follow.

4.0 Emission Outlook - GHG Forecasts Cont.

Figure 7 - Corporate GHG Emissions Forecast



Lines:

1. 2002 Baseline Emissions (7,081 tonnes eCO_2)
2. 6% Emissions Target from 'Typical' Modeling (6,690 tonnes eCO_2)
3. FCM 20% Emissions Target (5,665 tonnes eCO_2)
4. 22% Emissions Targets from 'Optimistic' Modeling (5,532 tonnes eCO_2)

4.1.1 BAU Forecast

This forecast assumes that municipal operations will expand in order to meet the needs of the projected population within the City of Prince George. If Prince George's population increases by 17%, so will municipal services and if no new efforts are made to increase the efficiency of municipal service delivery, energy use and GHG emissions will rise proportionately. Under this scenario, emissions would rise 17% above 2002 levels by 2012.

4.1.2 Typical Forecast vs. Optimistic Forecast

If the City implemented reduction measures designed to improve the efficiency of its services and lower overall corporate emissions, Prince George could reduce its projected GHG emissions. In the absence of detailed study on each measure, a 'typical' and 'optimistic' reduction forecast is offered. Each scenario represents a range of forecasted reductions and will be dependent upon the following:

- the type of measures selected and the sectors targeted for reductions
- the number of measures implemented;
- the scope of the measure;
- the rigour with which each measure is applied;
- the uptake of each measure;
- the rate of introduction of new technologies that increase energy efficiency;
- the availability of alternative energy sources and new technologies;
- the cost to implement the measure.

By implementing reduction measures, the City would demonstrate its leadership in climate change action amongst Canadian communities and reduce projected emissions ranging from 25% to 45% below the baseline.

Table 14 - 2012 Forecasted Emissions Growth in Corporate Sectors Relative to 2002 Emissions Levels

Year	GHG Emission (t)	Growth from 2002
2002	7,081	NA
2012 BAU	8,308	17%
2012 Typical	6,690	-6%
2012 Optimistic	5,532	-22%

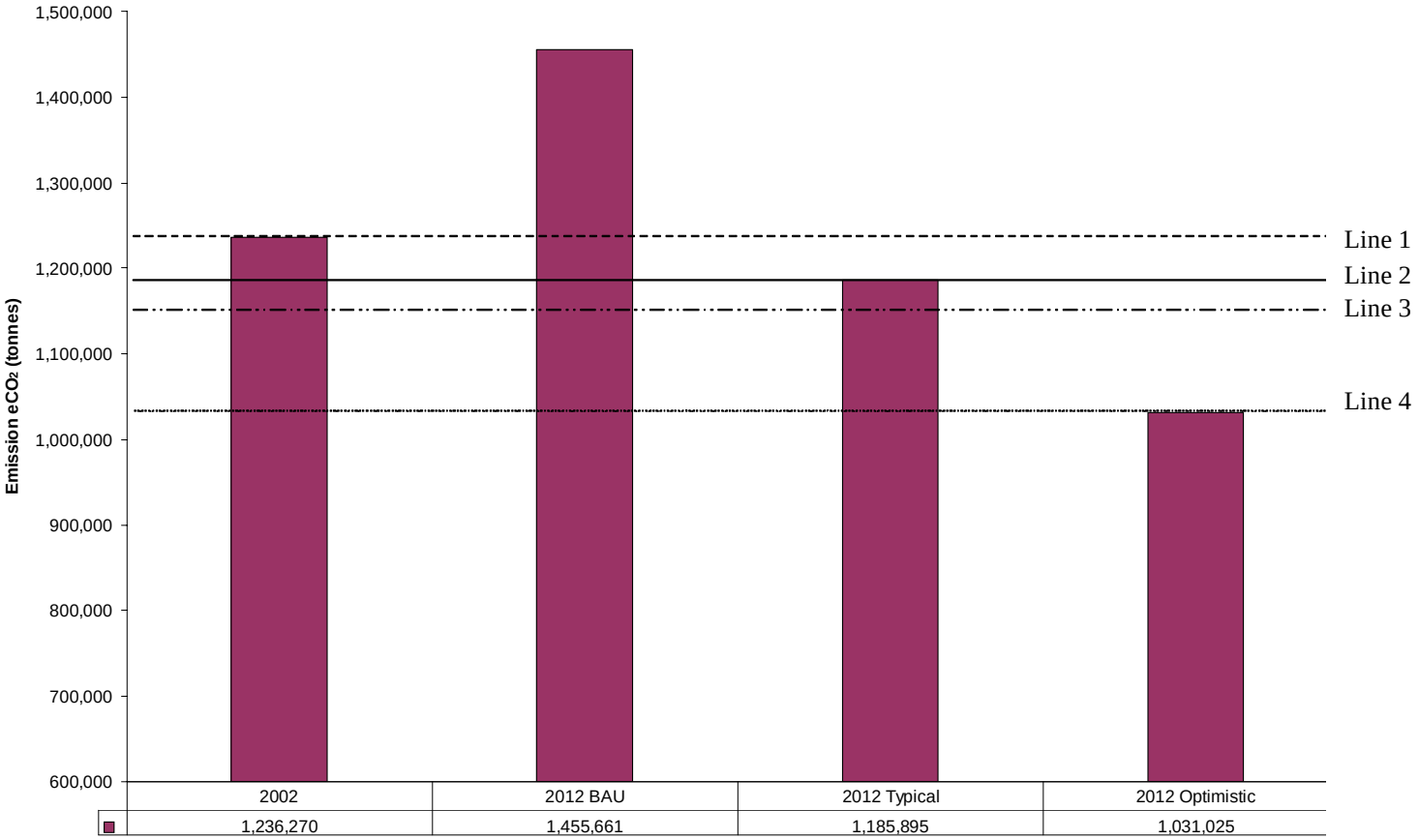
Table 14 summarizes projected 2012 GHG emissions by volume for each scenario described above and emissions growth relative to 2002 emissions.

4.2 Community Emissions Forecasts

Community GHG emission were forecasted for the community sector under the assumption that emissions would increase proportionately to population growth. Figure 8 illustrates the GHG emissions projected under each of the three scenarios. Four lines are shown which include the 2002 baseline emissions (Line 1; 1,236,270 tonnes eCO_2), a 4% typical emissions target from the modeling exercise (Line 2; 1,181,956 tonnes eCO_2), the FCMs recommended 6% emissions target (Line 3; 1,162,093 tonnes eCO_2), and a 17% optimistic emissions target from the modeling exercise (Line 4; 1,031,025 tonnes eCO_2). Note that the recommended target from the modelling excercise is 4%, and not 6% as the FCM recommends (see Section 8). Each of the scenarios is described in more detail herein.

4.0 Emission Outlook - GHG Forecasts Cont.

Figure 8 - Copmmunity GHG Emissions Forecast



Line:

1. 2002 Baseline Emissions (1,236,270 tonnes eCO_2)
2. 4% Emissinos Target from 'Typical' Modeling (1,185,895 tonnes eCO_2)
3. FCM Recommended 6% Emissions Target from Modelling (1,162,093 tonnes eCO_2)
4. 17% Emissions Target from 'Optimistic' Modelling (1,031,025 tonnes eCO_2)

4.2.1 BAU Forecast

This forecast assumes that the number of electricity and natural gas consumers within the City of Prince George will increase with population growth in proportion to the number of consumers in 2002 and that average energy use per consumer will remain constant. Under this scenario, no new GHG measures would be implemented in the City. Emissions would increase to 1,451,722 tonnes or 17% above 2002 levels.

4.2.2 Typical Forecast

If community stakeholders implemented several new measures designed to improve the efficiency of businesses and promote more sustainable choices and patterns of behaviour, community emissions could be reduced by 4% below the 2002 baseline by 2012.

4.2.3 Optimistic Forecast

If community stakeholders implemented several new measures and each of the factors affecting the success of the measures were optimal, an optimistic forecast would result. Together, these measures would result in annual GHG reductions of approximately 17% below the 2002 baseline year.

Table 15 - 2012 Forecasted Emissions Growth in Community Sector Relative to 2002 Emissions Levels

Year	GHG Emission (t)	Growth from 2002
2002	1,236,270	NA
2012 BAU	1,455,661	17%
2012 Typical	1,185,895	-4%
2012 Optimistic	1,031,025	-17%

Table 15 below summarizes projected 2012 GHG emissions by volume for each scenario described above and emissions growth relative to 2002 emissions.

The range of reductions from the City's baseline emissions ranges from 6% to 22%. It is recommended that the City adopt a corporate reduction target as per the 'typical' scenario of 6% below 2002 emissions levels by 2012.

The range of reductions from the Communities' baseline emissions ranges from 4% to 17%. It is recommended that the City adopt a community GHG reduction target as per the 'typical' scenario of 4% below 2012 emission levels by 2012.

5 Corporate GHG Reduction Measures

In this section of the report, the results of the target modeling are summarized and a number of GHG reduction measures that the City of Prince George could implement are presented. Measures that have been implemented do not form part of the reduction model.

The measures are summarized in tables that have been developed for each sector (i.e. buildings, streetlighting, etc.). Within each table, we have provided estimates of typical and optimistic reductions for each measure. In some sectors, measures reduce emissions from the existing infrastructure (baseline emissions) but not future infrastructure (growth emissions), whereas other measures only reduce emissions from the growth portion of the emissions projection. It could be argued that some measures reduce both the baseline and growth emissions, but we've chosen to keep that type of complexity (e.g., weighted calculations) out of the analytical model.

5.1 Building Measures

City staff identified a number of reduction measures that could be implemented within the municipality. These measures would result in a range of 15% to 25% reductions in emissions from the 2012 baseline (Table 16).

Table 16 – Estimated Impact of Corporate Buildings Measures on 2002 and 2012 Baseline Emissions

Corporate Buildings Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Undertake comprehensive municipal building retrofits	Baseline	1136	1363	**1468**	**1887**	**15%**	**25%**
Retrofit lighting in city-owned buildings where other retrofits are not feasible	Baseline	3	4				
Undertake regular maintenance of lighting, heating, ventilation, and air conditioning systems	Baseline and Growth	136	227				
Adopt energy-efficient building guidelines for city-owned, new buildings	Growth	154	232				
Increase the efficiency of energy consumption data retrieval from energy utilities to allow more effective management of energy use	Growth	8	15				
Adopt a comprehensive energy management policy and/or establish an energy management office, which includes / supervises building recommendations and guidelines	Growth	31	46				

Note: the projection for buildings is underestimated if the proposed worksyard building is constructed.

The City has implemented the following measures in this sector: lighting retrofits in 11 of the larger facilities; low E ceilings installed in all five ice arenas; energy management control systems installed in eight facilities; pony brine pumps installed in all six arenas; and, variable frequency drives installed in HVAC and condenser fans.

5.2 Vehicle Fleet Measures

There are a number of measures in the vehicle fleet sector that the City could implement that would further reduce corporate emissions. The estimated emissions reductions achievable through these measures are summarized in Table 17 below. These measures could reduce projected 2012 emissions by 27% to 48%.

Table 17 - Estimated Impact of Corporate Vehicle Measures on 2012 Baseline Emissions

Corporate Fleet Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Reduce Vehicle Kilometres Traveled (VKT) by staff while on the job by 10%	Growth	71	106	**649**	**957**	**27%**	**48%**
Examine opportunities to replace vehicles with electric vehicles, hybrid vehicles, flexible fuel vehicles, and ultra-low emission vehicles	Growth	55	66				
Utilize sustainable and alternative fuel options for passenger vehicles and heavy trucks currently using diesel fuel (pilot with B5)	Growth	47	70				
Include greenhouse friendly action in Driver Instruction Procedures for all municipal staff (improve fuel efficiency by 10% and decrease the volume of fuel used by 5%)	Growth	137	206				
Anti-idling policies	Growth	69	103				
Vehicle procurement policies (e.g. size and fuel efficiency criteria)	Growth	27	41				
Vehicle optimization measures (e.g. which vehicle for which task)	Growth	27	41				
Encourage alternative transportation methods for corporate tasks (bylaws)	Growth	7	10				
Increase awareness of fuel consumption in municipal departments	Growth	3	5				

The City implemented the following measures in this sector in 2005: anti-idling; fleet driver training; fleet maintenance; efficient driver; and, biodiesel pilot.

5.3 Streetlights & Traffic Signals Measures

By implementing a number of new measures designed to improve the energy efficiency of its streetlights and traffic signals, the City of Prince George can reduce the GHGs produced by its corporate operations by 40% to 57% from projected 2012 emissions (Table 18).

Table 18 - Estimated Impact of Corporate Streetlight & Traffic Signals Measures on 2012 Baseline Emissions

Corporate Streetlights and Traffic Signals Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Replace all streetlights with more efficient lamps or lower wattage bulbs. Consider solar powered standards for specialized and/or remote applications	Baseline	6	10	**66**	**86**	**40%**	**57%**
Retrofit light standards to incorporate reflective devices	Baseline	3	5				
Replace all red/green traffic lights with LEDs	Baseline	5	6				
Replace all ornamental lighting with LEDs	Growth	48	60				
Adopt energy-efficient streetlighting policy and include purchase and replacement. legislative measures for streetlighting requirements in new developments	Growth	4	6				

The City has implemented the following measures in this sector: incandescent traffic signal lights replaced with LEDs (actual savings equates to 6.8 tonnes/annum); mercury vapour streetlights replaced with metal halide/high pressure sodium; all light standards replaced and fully shielded fixtures installed; and, low voltage LEDs for ornamental streetlights.

5.4 Water & Wastewater Measures

Table 19 summarizes the potential GHG emissions that could be achieved with the implementation of several measures in the water and wastewater sector. With these measures, GHGs could be reduced by approximately 25% to 46% below projected 2012 emissions.

Table 19 - Estimated Impact of Water & Wastewater Measures on 2012 Baseline Emissions

Corporate Water and Wastewater Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Install low-flow toilets, dual flush toilets, and other water-saving devices in municipally operated structures	Growth	63	95	**155**	**232**	**25%**	**46%**
Reduce potable water consumption (e.g. through installation of water meters, flowbase charges once water meters installed, and introduction of inverted block rate structure for metered sectors)	Growth	27	41				
Implement mandatory lawn-watering restrictions	Growth	14	20				
Install centrally-controlled irrigation systems	Growth	3	4				
Reduce liquid waste (e.g. through on-site composting and primary treatment, constructed wetlands, use of aggregate or membrane filtration and solar aquatic sewage treatment systems and integration of liquid waste systems with other forms of infrastructure	Growth	2	4				
Optimization of wastewater treatment motors and pumps	Growth	12	18				
Install variable speed pumps on potable water system	Growth	18	28				
Increase water conservation awareness (e.g. through school campaigns, public awareness programs (such as the Kamloops WaterSmart program), etc.)	Growth	6	9				
Conduct industrial/commercial water audits, implement residential water audits	Growth	9	14				

The City has implemented the following measures in this sector: 400 commercial metres installed, vountary metering is approved, and all new home construction will be metered in the future; bylaw enforcement for watering restrictions - education first and fines for future infractions; and, school campaigns for water conservation
.

5.5 Solid Waste Measures

Table 20 summarizes a number of measures that City staff have recognized for their potential to reduce solid waste produced by City operations. By increasing the efficiency of business within the City and reducing the amount of solid waste produced, the City could reduce its corporate emissions from 35-61% below the 2012 baseline.

Table 20 - Estimated Impact of Corporate Solid Waste Measures on 2012 Baseline Emissions

Corporate Solid Waste Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Provide recycling and/or composting facilities for municipal staff in all municipal buildings	Growth	126	189	**280**	**420**	**35%**	**61%**
Require all departments to sort waste prior to disposal and train staff regarding sorting and recycling requirements	Growth	126	189				
Hold an interdepartmental waste reduction challenge, and launch an expanded waste reduction program strategy	Growth	25	38				
systems (e.g., electronic distribution of digital information)	Growth	3	4				

City staff have indicated that their abiltiy to recycle within municipal facilities may be limited by a lack of recycling facilities.

The City has implemented the following measures in this sector; cardboard and paper are separated for recycling and limited facilities for recycling are available.

5.6 Summary of Corporate Emission Reductions

There are many opportunities for new GHG reductions within the City's operations in addition to the City's current efforts. These measures could enable the City to reduce its projected 2012 emissions by 25-44% (see Table 14). Table 21 provides a summary of the reductions that are possible in each corporate sector.

Table 21 – Summary of Estimated Impact of Corporate Measures

Sector	2002 Total eCO_2 (t)	2012 Projected eCO_2 (t)	Total Typical GHG Reductions from Emissions after Projected Growth (2012)	Total Optimistic Reductions Affecting Projected Emissions (2012)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Buildings[1]	4,542	5,314	1,468	1,887	7%	19%
Vehicle Fleet[2]	1,465	1,714	649	957	27%	48%
Streetlights[3]	117	137	66	86	40%	57%
Water and Sewage[4]	419	490	155	232	25%	46%
Corporate Waste	539	630	280	420	35%	61%
Total	**7,081**	**8,285**	**2,618**	**3,582**		

[1]The projection for buildings will be underestimated if the proposed worksyard building is constructed. The estimated emissions for the proposed worksyard building is 81 tonnes eCO_2 per annum which would increase the 2012 projected emissions to 966 tonnes eCO_2.
[2]The optimistic reductions for vehicle fleet may be grossly underestimated given the technological breakthroughs expected in this sector within the next 5 years.
[3]The reductions from the traffic signal measure are absolute and the typical reduction does not differ from the optimistic reduction.
[4]Modelling is grossly estimated in this sector since volume of potable water and wastewater was not available and must be used as an indicator for specific measures.

6 Community GHG Reduction Measures

In this section of the report, we have summarized a number of emissions reduction measures that could be implemented within the community sector to reduce greenhouse gas emissions.

6.1 Residential Measures

There are several new measures that could be implemented to reduce GHG emissions from residential buildings. Home retrofit programs, energy efficient appliances and other energy efficiency measures have been successfully implemented in a number of PCP communities to reduce GHGs. Table 22 summarizes the potential GHG reductions associated with these measures. Projected 2012 emissions could be reduced by 6% to 23% with these actions.

Table 22 - Estimated Impact of Residential Measures on 2012 Baseline Emissions

Residential Buildings Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Retrofit of residential buildings[1]	Baseline	12,090	18,135	32,563	58,090	6%	23%
Encourage and suggest increased efficiency of lighting and appliances (e.g. washers, dryers, stoves, refrigerators, etc.)	Baseline	862	1,723				
Upgrade the level of insulation in residences (e.g. attic, walls and basement)	Baseline	862	1,723				
Pursue partnership projects and work collaboratively with the residential sectors and key stakeholders to reduce current and potential greenhouse gas emissions and energy consumption	Baseline	4,308	8,615				
Encourage developers constructing community buildings to employ energy efficient construction and resource efficient construction.	Growth	2,197	4,394				
Adopt R2000/PowerSmart performance standards	Growth	2,929	5,858				
Promote minimum energy performance ratings for all new residential buildings	Growth	1,322	1,652				
Encourage community energy systems in land use bylaws	Growth	1,465	2,929				
Adapt floor space ratio calculations to exclude exterior walls	Growth	732	1,465				
Encourage district energy systems, and renewable energy supply through Smart Growth	Growth	732	1,465				

[1]assumes 10%-15% of homes retrofitted to 2012 and an average of 3.9 tonnes/retrofit

Note: table extends onto page 38. Totals refer to all measues combined

6.1 Residential Measures cont.

There are several new measures that could be implemented to reduce GHG emissions from residential buildings. Home retrofit programs, energy efficient appliances and other energy efficiency measures have been successfully implemented in a number of PCP communities to reduce GHGs. Table 22 summarizes the potential GHG reductions associated with these measures. Projected 2012 emissions could be reduced by 6% to 23% with these actions.

Table 22 - Estimated Impact of Residential Measures on 2012 Baseline Emissions cont.

Residential Buildings Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Encourage EnerGuide ratings in MLS property listings	Growth	293	586	**32,563**	**58,090**	**6%**	**23%**
Encourage high-density, mixed-use building developments, energy-aware landscaping methods, building for passive solar gain, etc.	Growth	732	1,465				
Adopt a comprehensive energy management policy and/or establish an energy management office, which includes / supervises building recommendations and guidelines	Growth	732	1,465				
Promote minimum energy performance ratings, and establish a solar access regulation requiring that all new buildings be oriented for passive solar gain and that existing buildings preserve their solar access	Growth	293	586				

Note: table extends onto this page from page 38. Totals refer to all measues combined

6.3 Commercial Measures

There are many new measures that could be implemented to reduce emissions from commercial sector buildings. These actions are summarized in Table 23 below. Projected 2012 commercial sector emissions could be reduced by 9 to 22% with these new measures.

Table 23 - Estimated Impact of Commercial Measures on 2012 Baseline Emissions

Commercial Buildings Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Undertake cost-effective building energy retrofits (e.g. space heating and cooling, office and computer equipment, energy management systems, lighting upgrades, and building shells)	Baseline	69,118	103,677	**108,282**	**163,084**	**9%**	**22%**
Take advantage of incentives within NRCan's CBIP program incentives for new commercial buildings	Growth	17,279	25,919				
Incorporate bylaws that require the installation of energy system equipment when rezoning for high-density areas	Growth	2,938	4,406				
Take advantage of incentives within NRCan's REDI program for increased use of technologies in the areas of biomass, active solar hot-water and air-heating systems, and ground-source heating	Growth	1,322	2,644				
Adopt the C-2000 building code for commercial buildings	Growth	17,625	26,438				

6.3 Industrial Measures

It is often difficult to determine the emission reduction potential of programs within the industrial sector because industrial processes are very specific to each industry. However, energy efficiency practitioners do have a strong idea of the range of emission reductions that are achievable with a number of existing programs designed to improve the efficiency of industrial buildings. By implementing the measures outlined in Table 24, 2012 emissions in the industrial sector can be stabilized to 2002 levels or even reduced by nine percent.

Table 24 - Estimated Impact of Industrial Measures on 2012 Baseline Emissions

Industrial Buildings Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Undertake cost-effective building energy retrofits (e.g. space heating and cooling, office and computer equipment, energy management systems, lighting upgrades, and building shells, heat recovery systems, increase plant efficiency)	Baseline	64,759	97,138	**68,887**	**105,395**	**0%**	**9%**
Implement community energy systems and identify opportunities for Community Energy Systems by identifying local sources of waste heat	Growth	413	826				
Pre-service industrial areas for waste-heat recovery and district heating systems	Growth	413	826				
Take advantage of incentives within NRCan's CBIP program incentives for new industrial buildings	Growth	2,064	4,128				
Take advantage of incentives within NRCan's REDI program for increased use of technologies in the areas of biomass, active solar hot-water and air-heating systems, and ground-source heating	Growth	1,239	2,477				

6.4 Transportation Measures

By implementing a number of transportation measures, the City of Prince George could limit the amount of growth in the transportation sector to 7% or reduce 2012 projected business-as-usual emissions by one percent. These measures are summarized in Table 25 below.

Table 25 - Estimated Impact of Transportation Measures on 2012 Baseline Emissions

Transportation Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Reduce vehicle kilometres traveled by vehicle type (e.g. heavy trucks, light trucks, multi-passenger vehicles, single-passenger vehicles, etc.) and/or reduce total fuel volume sales throughout community	Growth	20,000	25,000	**47,000**	**72,000**	**-7%**	**1%**
Implement Responsible Automobile Ownership Education Program to encourage citizens to undertake regular vehicle maintenance, avoid idling, maintain proper tire pressure, observe speed limits, trip planning, and ride sharing	Growth	9,000	12,000				
Promote consumer purchase of most fuel efficient vehicle to meet transportation needs and set objective to reduce average fuel efficiency of vehicles by X%	Growth	3,000	5,000				
Work with private sector to implement wide-scale production and distribution of biodiesel and ethanol-blended fuels	Growth	10,000	20,000				
Encourage public transit fuel switching and expansion of energy-efficient means of public transportation. Ecourage trip reduction measures (e.g. vanpool and rideshare programs, employer trip reduction programs, car-share cooperatives)	Growth	5,000	10,000				

6.5 Solid Waste Measures

Curb-side recycling and waste reduction measures could be implemented to reduce emissions produced by the community's waste. Projected 2012 waste sector emissions could be reduced by 24 to 65% (see Table 26 for details).

Table 26 - Estimated Impact of Solid Waste Measures on 2012 Baseline Emissions

Solid Waste Measures	Reduction Measure Applies to Baseline Emissions or Growth Emissions	Typical Reduction (tonnes eCO_2)	Optimistic Reduction (tonnes eCO_2)	Total Typical Reductions (tonnes eCO_2)	Total Optimistic Reductions (tonnes eCO_2)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
System to reduce quantity of household waste sent to landfill sites (e.g. through Leaf, yard waste, Christmas tree pickup, cumbersome objects, promote provincial household hazardous waste depot, tires, gypsum)	Growth	5,570	11,140	**13,034**	**26,067**	**24%**	**65%**
Provide public recycling facilities in municipal buildings	Growth	1,782	3,565				
Door-to-door selective pick-up of recyclable material	Growth	5,570	11,140				
Distribute bids and proposals electronically	Growth	111	223				

6.6 Summary of Community Emission Reductions

There are many opportunities for new GHG reductions within the Community as summarized above. These measures could enable the City to reduce its projected 2012 community emissions by 4% to 17% (see Table 15 for a detailed summary). Table 27 provides a summary of the reductions that are possible in each corporate sector.

Table 27 - Summary of Estimated Impact of Community Measures

Sector	2002 Total eCO_2 (t)	2012 Projected eCO_2 (t)	Total Typical GHG Reductions from Emissions after Projected Growth (2012)	Total Optimistic Reductions Affecting Projected Emissions (2012)	Typical Percent Reduction From Projected Emissions (2012)	Optimistic Percent Reduction From Projected Emissions (2012)
Residential Buildings	143,585	167,282	32,563	58,090	6%	23%
Commercial Buildings[1]	431,987	514,708	108,282	163,084	9%	22%
Industrial Buildings	404,742	471,537	68,887	105,395	0%	9%
Tranportation	224,218	261,221	47,000	72,000	-7%	1%
Solid Waste	31,737	36,975	13,034	26,067	24%	65%
Total	**1,236,270**	**1,451,723**	**269,766**	**424,636**		

[1]The projection for commercial buildings was provided by Grant Bain - Long Range Planning, City of Prince George.

7 Required Investment, Savings & Payback

In order to achieve any of the corporate emission reduction targets outlined within this report, the City of Prince George will need to invest in projects and programs that will improve the overall efficiency of the City's service delivery. To provide a rough estimate of the investment required by the City, the GHG emission reduction measures associated with each 2012 forecast have been aggregated into a comprehensive plan with a single investment and payback goal. This deep retrofit approach will allow for an aggregated payback of up to seven years. It is assumed that short-term paybacks in the two to three year range would offset the cost of longer-term paybacks over the seven-year target. See Appendix A - Principles of a Deep Retrofit Approach, for an explanation of the principles of a deep retrofit approach.

For each of the corporate forecasts developed in section 4.1, the potential cost savings and the initial investment required to realize these savings were determined based on the deep retrofit approach. The results of these calculations are summarized in Table 28. Annual cost savings range from approximately $1,024,812 to $1,514,410 and investment requirements range from approximately $7,173,683 to $10,600,872.

Table 28 – Annual GHG, Energy & Cost Savings, and Investment Requirements of 2012 Corporate Emission Forecasts

Forecast	GHG Reductions (t)	Energy Reduction (GJ)	Annual Savings ($)	Investment Required ($)
Typical	1,348	64,892	1,026,562	7,185,934
Optimistic	1,992	95,894	1,516,997	10,618,977

While the investment requirements associated with climate change action may seem daunting, there are many funding opportunities available to mediate some of these costs. Some of the associated costs of administering a program of climate change mitigation (staff, office space and etc.) are already provided for within the City's operational budget. Additionally, because many climate change actions are focused on improving energy efficiency and energy efficiency projects are paid back through annual savings in energy costs, some of these actions will pay for themselves. There are also many potential sources of funding from other levels of government and other organizations that the City can leverage to support its actions to meet its PCP commitment. A summary of funding programs that might be able to assist Prince George in meeting its GHG reduction target and improving the efficiency and quality of its service delivery is provided in Appendix A - Principles of a Deep Retrofit Approach.

In addition, climate change action will yield benefits not calculated here, including improved local air quality, job creation and improved quality of life amongst others. While it is difficult to put a price on these associated benefits, their value should be weighed into any decision-making on funding options for climate change mitigation in Prince George's corporate sector.

8 GHG Reduction Target Recommendations

In order to complete milestone two of the PCP, the City of Prince George must commit to a GHG reduction target for both its corporate and community sectors. Establishing this target is no easy task; Council will be required to weigh its desire to demonstrate leadership amongst Canadian PCP communities, with the fiscal challenges and opportunities associated with climate change action and the competing interests of other municipal business.

In the simplest sense, three questions must be answered to define a GHG emission reduction target:

1. What will the baseline year be?
2. What will the forecast year be?
3. What will the GHG emission reduction target be?

Most PCP members who have adopted GHG emission reduction targets, have adopted the PCP recommended targets of a 20% reduction in emissions from municipal operations and a 6% reduction in emission from community operations within ten years of joining the program. The corporate target is more rigorous and reflects the direct control municipalities have over their own operations and the need for municipal leadership on climate change to serve as an impetus for community action. A less aggressive community target is based on Canada's commitment to the Kyoto Protocol.

In order to demonstrate leadership in the area of climate change action and establish targets that are reasonable and achievable, the project team recommends that the following targets be adopted by the City of Prince George:

Corporate Sector:

For the corporate sector, it is recommended that the City of Prince George adopt a GHG emission reduction target of 6% reduction below 2002 levels by 2012 as per the typical 2012 forecast presented within this report. Should the City meet this objective earlier than expected, it could continue to strive for the optimistic target of a 22% reduction in corporate emissions below the 2002 baseline.

Community Sector:

For the community sector, it is recommended that the City of Prince George initially adopt a GHG emission reduction target 4% below 2002 levels by 2012. Once this target has been achieved, the community can consider pressing on in its GHG reduction efforts towards the optimistic target of a 17% reduction in emissions below the 2002 baseline.

9 Conclusions & Recommendations

In this report, Prince George has been provided with a summary of 2002 corporate and community emissions and several strategies for further GHG emission reductions that could help the City meet its emission reduction goals and improve the overall economic, social and environmental well-being of the community.

In order to achieve the PCP milestones and to build upon the momentum demonstrated by the staff and stakeholders who contributed to this study, it is recommended that Council approve the greenhouse gas reduction targets for both the corporate and community inventories.

Further, it is recommended that the City undertake the following:

1. Consider implementing each of the new measures identified by the project team in Sections 5 and 6 of this report;

2. Work with each of its departments to develop corporate and community greenhouse gas action plans that will enable the City to meet its GHG reduction targets while exploiting the unique opportunities and mitigating the challenges that will faced by each department;

3. Explore ways in which to integrate its climate change mitigation goals with the achievement of its broader planning and development objectives (e.g. including climate change mitigation and sustainability objectives in the City's Official Plan).

10 Works Cited

Environment Canada. Fraser Valley Smog An Indicator of Potential Air Quality Health Risk. Online: http://www.ecoinfo.ec.gc.ca/env_ind/region/smog/smog_e.cfm.

Environment Canada. Pollutants. Clean Air Online. Online: http://www.ec.gc.ca/cleanair-airpur.

Federation of Canadian Municipalities. Partners for Climate Protection. Developing Inventories for Greenhouse Gas Emissions and Energy Consumption: A Guidance Document for Canadian Municipalities. Ottawa, Ontario. October 2005.

Appendix A - Principals of a Deep Retrofit Approach

After estimating the energy and GHGs emissions savings potential available in the Prince George's buildings, vehicle fleets, and streetlights, the costs related to achieving these savings can be estimated given a payback period. Most municipalities use simple paybacks to assess whether or not to proceed with a recommended measure, by examining its implementation cost and predicted annual energy savings.

Simple Payback = Cost / Savings

Municipalities tend to take a safe approach to measure implementation, investing in measures with short payback periods (typically two to five years) and high rates of return. Figure 9 illustrates the relationship between payback periods and rates of return. Essentially, a shorter payback period equates to a longer useful life and higher rate of return. A two-to five-year payback corresponds to a 15 to 45 percent return on investment, which is considered exceptional.

With low-risk investments such as energy efficiency, most investors tend to settle for a much lower rate of return. The most effective approach to energy and GHGs emissions reduction is not necessarily to obtain high rates of return and short payback periods. In fact, this approach known as 'cream skimming'; can actually make it more difficult to perform comprehensive retrofits in the future.

Figure 9. Rate of Return vs. Payback[1]

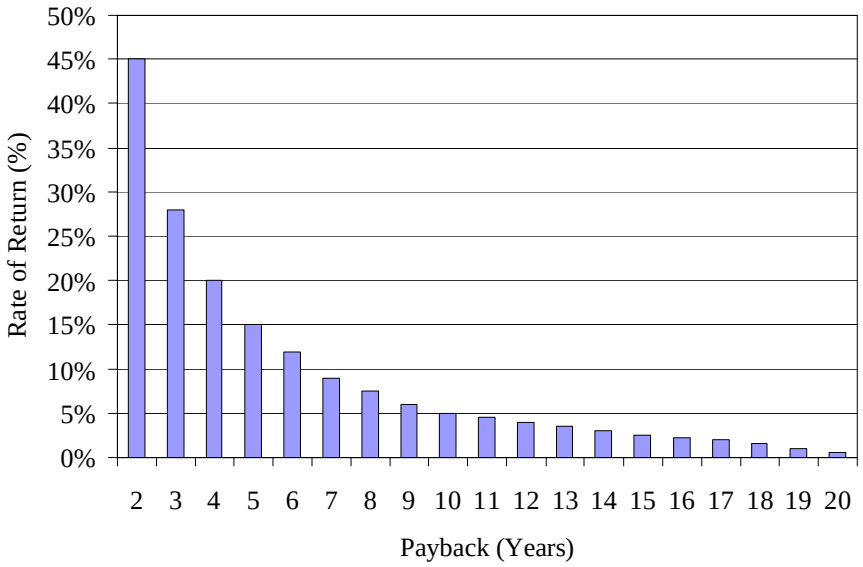
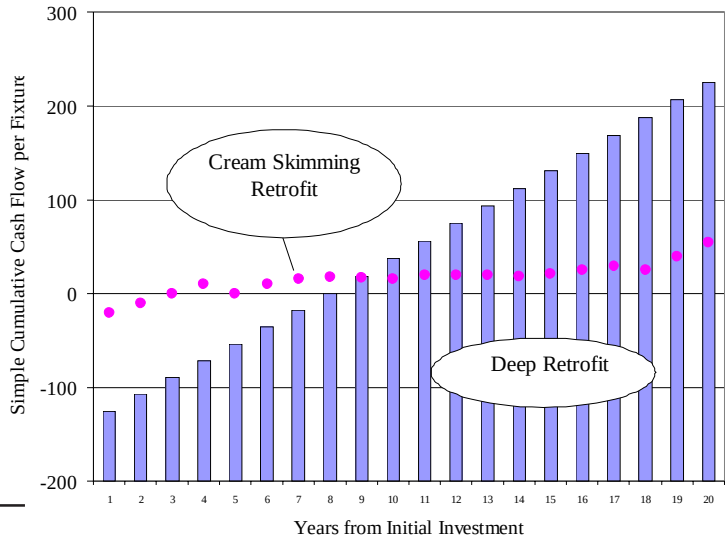


Figure 10 illustrates that measures that produce the greatest energy savings take longer to 'breakeven'. The overall benefits of 'deeper' retrofits in relation to energy and costs savings will be far greater in the long-term than those of short-term payback measures.

By expecting high rates of return like 15 to 45% only 20 to 35% of the total gross potential savings available are achieved. At lower rates of return energy savings start to rise. Municipalities that want to get the most out of their investments over the long-term should therefore consider rates of return comparable to other capital investments, in the order of 5 to 10% (which translates to a 7- to 10-year payback).

Figure 10. Cream Skimming vs. Deep Retrofits[2]



[1] ICLEI, Profiting from Energy Efficiency! A Financing Handbook for Municipalities, ICLEI Policy & Practice Series, September, 1993.
[2] Ibid.

Appendix B - Opportunities for Funding and Financial Incentives

A brief summary of climate change action funding programs is provided here. Municipalities are eligible for many of these funds, and others are geared towards other sectors, which Prince George may wish to promote among its citizens, business and industries. Those that are available to municipalities have been marked with a "*". New funding program are continually being offered and existing funding opportunities may come and go. The City of Prince George may wish to conduct a regular scan for new funding opportunities.

1. FCM Green Funds *

The Green Municipal Enabling fund will provide up to 50% of the costs for feasibility studies that address the following priority areas: cutting GHGs, improving local air, waste and soil quality, and promote renewable energy. The funds also provide loans to municipalities to support the implementation of projects addressing these priority areas.

2. One-Tonne Challenge Communities *

The federal government provided funding to communities across Canada to deliver the One-Tonne Challenge in their communities. It has yet to be determined whether this was one-time funding, or if it will be made available to more communities in the future.

3. Moving on Sustainable Transport (MOST) Program *

Transport Canada's Moving On Sustainable Transportation (MOST) program was created to promote awareness of sustainable transportation issues and the development of new tools and approaches to encourage concrete action by Canadians. Eligible pilot projects workshops, and education and outreach programs can receive funding for 50% of the project costs.

4. Climate Change Impacts and Adaptation Program * (Natural Resources Canada)

The Climate Change Impacts & Adaptation Program provides funding for targeted research and activities that will contribute to a better understanding of Canada's vulnerabilities to climate change and provide information necessary for the development of adaptation strategies.

5. Tree Canada Foundation *

Green Streets Canada is the flagship program of the Tree Canada Foundation – the only nationally based municipal forestry innovation program. The purpose of the program is to encourage the adoption of innovative best management practices and policies in municipal forest management on as wide a regional basis as possible. It provides municipalities with the opportunity to expand and enhance tree-planting programs by providing one-time funding up to $25,000.

6. TD Friends of the Environment Community Fund

The TD Friends of the Environment Community Fund supports community-based initiatives that make a positive contribution to the Canadian Environment. They consider project related to preservation, youth, and cross-organizational cooperation. Most projects are funding at $10,000, but consideration is given to projects up to $25,000.

7. Canada Mortgage and Housing Corporation (CMHC) Mortgage Loan Insurance Refund

CMHC offers a 10% premium refund on its mortgage loan insurance premiums, as well as extended amortization to a maximum of 35 years, to individuals who use CMHC-insured financing to purchase an energy efficient home, purchase a home and make energy-saving renovations, or renovate their existing home to make it more energy efficient.

8. EnerGuide for Houses Evaluation

Evaluations of homes' energy efficiency, subsidized by Natural Resources Canada, are offered by a nationwide network of approved service organizations. Each evaluation involves a test for air leakage, a comprehensive walk-through tour, and computer modeling. The evaluation report provides customized recommendations for renovations such as upgrades to heating systems, insulation and/or windows and doors, and a standardized EnerGuide for Houses energy efficiency rating.

9. EnerGuide for Houses Retrofit Grant

Natural Resources Canada provides a grant to homeowners who undertake renovations that improve the energy efficiency rating of their home as determined by an EnerGuide for Houses evaluation. The amount of the grant is expected to be approximately $619 on average, and at most $3,348, depending on the amount by which the home's energy rating improves as a result of the renovations.

10. Kidney Car Program

The Kidney Foundation of Canada provides tax receipts in exchange for old cars, which it will tow, free-of-charge. In most cases the tax receipt is for a fixed value of $60, although the amount can be higher if the vehicle can be sold for a higher amount.
The Kidney Foundation of Canada is a national, volunteer organization dedicated to improving the health and quality of life of people living with kidney disease**.**

11. ENERGY STAR Qualified Products Grants

Many utility companies across Canada provide rebates or credits when customers purchase ENERGY STAR equipment in place of less energy efficiency equipment. The Province of Ontario also offers residents a tax rebate on ENERGY STAR qualified refrigerators, dishwashers and clothes washers.

12. Commercial Transportation Energy Efficiency and Fuels Initiative

The Commercial Transportation Energy Efficiency and Fuels Initiative is one of the many initiatives in the Government of Canada's implementation of the Climate Change Plan for Canada. It includes a rebate for devices that reduce engine idling in the on-road commercial transportation sector.

13. Canadian Industry Program for Energy Conservation (CIPEC)

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-government partnership that is committed to promoting and encouraging energy efficiency improvements and reductions in eCO2 emissions through voluntary action across Canada's industrial sectors. CIPEC provides technical guidebooks, newsletters on the latest energy efficiency information from Natural Resources Canada and industry, and opportunities to network with other industrial energy managers. Companies are encouraged to sign up as Industrial Energy Innovators (IEI) and make a company-level commitment to energy efficiency improvements and GHG emission reductions.

14. Commercial Building Incentive Program (CBIP) *

Natural Resources Canada's Commercial Building Incentive Program (CBIP) provides a financial incentive to owners who incorporate energy efficient measures into the design of new buildings (including multi-residential, retail food, and arenas) provided the design exceeds the requirements of the Model National Energy Code for Buildings (MNECB) by at least 25 percent.

15. Energy Innovators Initiative (EII) *

The Energy Innovators Initiative (EII) encourages commercial businesses and public institutions to invest in energy efficiency and reductions in eCO2 emissions in existing buildings. The target group for the EII is multi-residential buildings and commercial/ Institutional buildings. It helps building owners invest in energy-saving retrofits by providing financial incentives, information, advice, audits and planning assistance.

16. Energy Retrofit Assistance (ERA) Funding *

The Energy Innovators Initiative (EII) facilitates investment in energy efficiency initiatives in the commercial and industrial sectors via the Energy Retrofit Assistance (ERA) fund. The amount of funding a project is eligible for is tied to the energy savings projections.

17. ENERGY STAR Qualified Products Grants

Many utility companies across Canada provide rebates or credits when customers purchase ENERGY STAR equipment in place of less energy efficiency equipment, such as windows, furnaces, boilers and general household appliances.

18. Industrial Energy Audit Incentive (IEAI)

Natural Resources Canada's Industrial Energy Audit Incentive encourages companies in the industrial sector to carry out energy audits to identify potential areas for reducing energy consumption. Energy audit projects must meet the conditions of a technical evaluation conducted by an independent consultant.

19. Renewable Energy Deployment Initiative (REDI) *

REDI provides grants to help stimulate demand for renewable energy systems. REDI focuses on promoting renewable energy systems for space and water heating and cooling, such as active solar hot water systems, active solar air heating systems, high efficiency biomass combustion systems, and ground-source heat pumps.

20. Wind Power Production Incentive (WPPI) *

WPPI is an incentive program to encourage electric utilities, independent power producers and other stakeholders to gain experience in wind power production. WPPI will provide financial support for the installation of 1,000 megawatts of new capacity over the next five years. The incentive will cover approximately half of the current cost of the premium for wind energy in Canada compared to conventional sources.