



Partners for Climate Protection Program

Milestone 1: Inventory of Greenhouse Gas Emissions



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Introduction

The Partners for Climate Protection program is a partnership of the Federation of Canadian Municipalities (FCM) and The International Council for Local Environmental Initiatives (ICLEI) to support municipal government commitments to reduce greenhouse gas emissions at the corporate and community level. It incorporates 5 milestones:

1. Creating an inventory of emissions;
2. Setting the reduction target;
3. Developing the local action plan;
4. Implementing the plan; and
5. Measuring progress.

The milestones can be completed in any order and there are no formal reporting requirements to indicate their completion. Additional details about the program and the milestone can be found at the following web address: www.iclei.org/co2/canada_pcp.html and in staff report D&I-03/02.

Greenhouse gases such as carbon dioxide (CO₂), methane and nitrous oxide act as a blanket and reduce the amount of the earth's radiation that can escape into space. The result is an overall warming of the lower atmosphere and the earth's surface. The increase in the amounts of greenhouse gases emitted to the atmosphere is a result of the increased combustion of fossil fuels such as coal, oil and natural gas. This increase is expected to result in an increase in global temperatures and an increase in the severity and frequency of extreme weather events. Greenhouse gas emissions can also contribute to poor air quality.

The purpose of this report is to provide information on the results of the inventory (Milestone 1). The inventory is created to determine energy use and emissions for both corporate and community sources for 1994 to establish a baseline. It also establishes benchmarking data for 2003 to forecast energy use and emissions for the next 10 to 20 years for municipal operations and the community.

In 1997 Canada signed the Kyoto Protocol and agreed to reduce net greenhouse gas emissions by six percent below 1990 levels no later than 2012. The original baseline for the PCP program was 1990 to correspond with the protocol. It became a concern that it was too difficult for municipalities to obtain accurate data from 1990 so 1994 was selected by FCM as an acceptable year for the baseline data in the inventory.

The completion of this inventory is significant because it provides a starting point for staff to identify and assess areas where energy savings and emission reductions can be achieved. This information will be used to complete Milestones 2 and 3 of the PCP program. Milestone 2 involves setting reduction targets for both corporate and community emissions and Milestone 3 develops the Local Action Plan to determine the emission reduction strategies.

Sources of Data

The corporate information (energy consumption and costs) was obtained from Burlington Hydro, Union Gas, Superior Propane and Shell invoices. The energy information was compiled into a spreadsheet by service address and then sorted into categories and totalled. The building categories were determined based on function although some facilities did not fit neatly into one single category due to multiple functions.

The community information (energy consumption only) comes from a variety of sources. Burlington Hydro provided consumption figures for 1994. Union Gas was able to provide figures for 1991 and 1997 that were averaged to determine 1994 consumption. The information for additional energy sources such as fuel oil and propane was determined by using provincial consumption statistics from Statistics Canada and dividing by the provincial population in 1994 to give a per capita consumption. This value and Burlington's population in 1994 were used to determine consumption figures for the city.

The more current information (2003) was obtained through collaboration with a staff member in the finance department who is tracking energy information for budgeting purposes. Information was also obtained from the data entry work done for the Mayor's Megawatt Challenge and utility invoices from 2003. Community benchmarking information (for the year 2000) was collected in part from the draft edition of the State of the Environment Report (SOER) written by the Sustainable Development Committee.

Under the PCP program, each inventory (corporate and community) is divided into various sectors or areas outlined in Table 1.

Corporate Sector	Community Sector
Buildings	Residential
Vehicle Fleet	Commercial
Streetlights	Industrial
Water/Sewage	Transportation
Waste	Waste
Other	Other

Table 1. Corporate and Community Sectors designated by the PCP program

When the data was entered, the sectors were further broken down into categories. Details about the categories are provided in Appendix A. The Water/Sewage and Waste sectors were not included in the City of Burlington's corporate inventory as they are the responsibility of the Regional Municipality of Halton. Neither inventory required the use of the Other sector.

The software used to create the inventory provides the option of entering indicators that can be used to compare emissions by various criteria including population, floor space etc. The indicators section of each category is not mandatory in terms of calculating the emissions. They are used for comparison with other municipalities etc. They were completed where the information was available or applicable.

Assumptions/Challenges

The initial challenge with the inventory was due to the age of the data required (1994). Despite the recommended year being bumped up from 1990, it was still difficult to obtain some of the data from that far back. Additionally, it would have been much more helpful to choose a census year as the baseline to increase the availability of various types of information.

A population figure of 128,910 was used for the 1994 analysis and a figure of 150,000 was used for the benchmarking analysis (2003 for corporate, 2000 for community). The figures were obtained from the SOER and verified with staff as reasonable.

The data collected for the baseline section inventory was often calculated using assumptions and averages. Due to these assumptions, it is difficult to verify the accuracy of some of the baseline data. Therefore, the inventory can be a useful tool but caution should be used with regard to the “predictive” nature of the data.

Results

Sector	Equivalent CO₂ (tonnes)*	% eCO₂*	Cost (\$)	% Cost
Buildings	3891	37.2	1,131,180	43.2
Vehicle Fleet	5503	52.6	880,887	33.6
Streetlights	1054	10.2	605,076	23.2
TOTAL	10,448	100	2,617,144	100

Table 2. Corporate Emissions and Costs by Sector (1994)

* Equivalent CO₂ (eCO₂) is a unit that allows emissions of greenhouse gases of different strengths to be added together. For example, 1 tonne of CO₂ is the same as 1 tonne of eCO₂ but 1 tonne of nitrous oxide emissions is equal to 310 tonnes of eCO₂ (PCP software glossary).

The following tables provide details about the categories that make up each sector for both the corporate and community inventories. These lists indicate areas where potential emission and expenditure reduction initiatives would likely be the most effective.

There are 17 Building categories in total. A complete list can be found in Appendix A. Table 3 shows the top 5 categories both in terms of emissions and costs for the 1994 inventory.

Ranking	Top 5 Sources of Emissions (1- highest)	% Total Building Emissions	Top 5 Expenditures (1- highest)	% Total Building Energy Costs
1	Arenas	27	Arenas	34
2	Recreation Centres	12	City Hall	14
3	City Hall	11	Recreation Centres	12
4	Public Works	10	Park Facilities	7
5	Transit (building only)	8	Public Works	6

Table 3. Top 5 Categories, Building Sector, Corporate inventory (1994)

Table 4 outlines the categories in the Vehicle Fleet sector of the 1994 corporate inventory. There are 5 categories in total in this sector.

Sources of Emissions	% Total Vehicle Fleet Emissions	Expenditures	% Total Vehicle Fleet Energy Costs
Transit – Conventional	63	Transit – Conventional	61
Public Works	33	Public Works	34
Transit – Handivan	2.2	Transit – Handivan	2.6
Fire	1.7	Fire	1.7
Tyandaga Golf	0.1	Tyandaga Golf	0.7

Table 4. Vehicle Sector, Corporate Inventory (1994)

Table 5 outlines the categories in the Streetlight sector of the 1994 corporate inventory. There are only 3 categories in this sector.

Ranking	Sources of Emissions	% Total Streetlight Emissions	Expenditures	% Total Streetlight Energy Costs
1	Streetlighting	83	Streetlighting	83
2	Traffic Signals	16.6	Traffic Signals	16
3	Parks & Rec./Security	0.4	Parks & Rec./Security	1

Table 5. Streetlight Sector, Corporate Inventory (1994)

Table 6 illustrates the emissions calculated in the community portion of the 1994 inventory. The community inventory does not account for the cost of energy.

Sector	eCO ₂ (tonnes)	%
Residential	568,034	41.5
Commercial	344,376	25.1
Industrial	153,386	11.2
Transportation	290,152	21.2
Waste	14,342	1.0
TOTAL	1,370,289	100.0

Table 6. Community Emissions by Sector (1994)

Benchmarking

Table 7 outlines the benchmarking information (2003) for the corporate inventory. It should be noted that the Vehicle Fleet Sector is potentially not as representative as it was in the 1994

inventory due to different sources of data being used for each year. At the time of writing, this was the best information available to use for benchmarking purposes.

Sector	Equivalent CO₂ (tonnes)	% eCO₂	Cost (\$)	% Cost
Buildings	7444	59	2,563,549	59
Vehicle Fleet	3901	30.9	858,184	20
Streetlights	1276	10.1	928,565	21
TOTAL	12,621	100	4,350,298	100

Table 7. Corporate Emissions and Costs by Sector (2003)

Table 8 provides the benchmarking information for the community inventory. 2000 was chosen as the benchmark year because the information was readily available.

Sector	eCO₂ (tonnes)	%
Residential	700,995	37.0
Commercial	523,199	27.6
Industrial	317,106	16.7
Transportation	338,723	17.9
Waste	16,934	0.9
TOTAL	1,896,956	100.0

Table 8. Community Emissions by Sector (2000)

Analysis

Corporate 1994

Electricity represents 56% of the City's energy costs in 1994 but only 23% of its equivalent CO₂ emissions (eCO₂). Diesel represents 26% of energy costs but 42.2% of the emissions. This should be considered when investigating potential areas or programs of reduction. Focusing on electricity will likely save more money but focusing on diesel will have a greater impact on emissions.

The recommended PCP target is to reduce corporate emissions by 20% from 1994 levels by 2010. Based on the 1994 inventory information, this requires a reduction of 7,658 tonnes of eCO₂.

Community 1994

The residential sector has the highest emissions in the community inventory. It is also likely the most reliable data of the community sector. The other areas examined required significant use of averages and extrapolation and it is unclear how this affected the quality of the outcome. The residential are may also be the easiest for the Corporation to influence through initiatives such as

REEP. The transportation sector is likely responsible for more emissions than indicated due to limitations in the data.

The recommended PCP target is to reduce community emissions by 6% from 1994 levels by 2010. Based on the 1994 inventory information, this requires a reduction of 1,306,483 tonnes of eCO₂. As an example of a potential method to achieve that reduction, an average homeowner who completes a REEP audit and implements the subsequent recommendations will reduce their annual greenhouse gas emissions but 3 tonnes per year. It is anticipated that 255 homes will be audited in Burlington in 2004 and that of those, 204 (80%) will take action (Report DI-22-03). This would result in a potential reduction in emissions of 612 tonnes per year.

It should also be noted that for both the corporate and community inventories, measures implemented since 1994 are counted towards the target reductions. Corporate measures that could be included are: the use of bio-diesel for off-road equipment, the use of low sulphur fuel for fleet vehicles, the purchase of 10 new fuel efficient transit buses, the lease of two hybrid vehicles and the implementation of LED traffic signals.

The residential sector continued to have the highest emissions in the community inventory of 2000. The same limitation applies with respect to the transportation sector as in the 1994 information, it is likely responsible for more emissions than indicated.

Comparisons

Corporate

	1994	2003	% Increase
Emissions (tonnes eCO ₂)	10,448	12,621	21
Cost	\$2,617,144	\$4,350,298	66

Table 9. Corporate Comparison Figures

An overall comparison for corporate emissions and costs between 1994 and 2003 is shown in Table 9. The relatively low increase in emissions (compared with costs) may be due to different sources of data being used for the benchmarking information than for the original baseline inventory. It may also be due in part to measures implemented by the corporation such as LED traffic signal upgrades, alternative fuels, or building upgrades/renovations.

Table 10 shows the comparison between 1994 and 2003 across the various categories of the corporate inventory as well as the increase (or decrease) in both emissions and cost values. This represents a starting point to identify areas where initiatives might be best targeted. Due to differing sources of data for the 1994 inventory and the 2003 inventory, the categories may not be comparing exactly the same type or number of activities, buildings etc.

Sector	Category	1994		2003		Change	
		Equiv CO2	\$	Equiv CO2	\$	Equiv CO2	\$
Buildings	Admin	225	\$ 31,318	390	\$ 43,294	165	\$ 11,976
	City Hall	445	\$ 153,141	414	\$ 223,589	(31)	\$ 70,448
	Public Works	389	\$ 78,700	335	\$ 92,341	(54)	\$ 13,641
	Fire Stations	277	\$ 72,789	448	\$ 88,277	171	\$ 15,488
	Pumping Stns.	20	\$ 12,643	11	\$ 8,425	(9)	\$ (4,218)
	Parking Lots	0	\$ 826	2	\$ 1,806	2	\$ 980
	Arenas	1052	\$ 381,129	1637	\$ 525,230	585	\$ 144,101
	Arts	79	\$ 18,449	92	\$ 24,572	13	\$ 6,123
	Cemetery	13	\$ 3,071	24	\$ 2,859	11	\$ (212)
	Park Facilities	247	\$ 81,165	621	\$ 127,324	374	\$ 46,159
	Pools	79	\$ 23,822	1122	\$ 36,531	1043	\$ 12,709
	Rec Centres	455	\$ 139,344	1130	\$ 293,867	675	\$ 154,523
	Sports	269	\$ 68,453	118	\$ 73,458	(151)	\$ 5,005
	Transit	300	\$ 59,701	1099	\$ 73,885	799	\$ 14,184
	Subtotal	3850	\$ 1,124,551	7443	\$ 1,615,458	3593	\$ 490,907
	Vehicle Fleet		5503	\$ 880,887	3901	\$ 858,184	(1602)
Streetlights	Streetlighting	877	\$ 500,249	1050	\$ 755,012	173	\$ 254,763
	Traffic Lights	173	\$ 98,683	223	\$ 161,329	50	\$ 62,646
	PnR Lights	4	\$ 6,144.00	3	\$ 8,015	(1)	\$ 1,871
	Subtotal	1054	\$ 605,076	1276	\$ 924,356	222	\$ 319,280
TOTALS		10407	\$ 2,610,514	12620	\$ 3,397,998	2213	\$ 787,484

Table 10. Comparison of Corporate Inventories for 1994 and 2003.

Community

	1994	2000	% Increase
Population	128,910	150,000	16
Emissions (tonnes eCO ₂)	1,370,289	1,896,956	38
Per Capita Emissions (tonnes eCO ₂)	11	13	18

Table 11. Community Comparison Figures

The overall comparison for community emissions is shown in Table 11. The rate of increase in the amount of greenhouse gas emissions is double the rate of increase in population. In other words, for every 1% increase in population there was a 2% increase in emissions. Comparing

1994 and 2000 emission on a per capita basis is a good starting point but it is thought that other factors have likely contributed to the increase in emissions as well. One of the major factors is transportation. Much of the highway transportation that occurs along the Queen Elizabeth Way and Highway 407 is not a result of people who live and/or work in Burlington. As overall traffic passing through Burlington on these routes has increased, the emissions resulting from this sector will also increase but not necessarily in correlation with the population.

Forecasting

Corporate

The PCP recommended forecast year is 2010. The corporate forecasting module of the PCP software simply copies the baseline data into a new file. It is then up to the user to input whatever increases they feel are best suited to corporate operations. It is designed to be thought of in terms of specific plans for new and existing buildings, expansion of fleets etc. rather than in terms of an annual percent increase. For example, if the City plans to construct 1 new recreation centre by 2010, the estimated square footage of the new building can be used to compare with a current facility of the same size to provide very rough estimates of the energy consumption for the new building on an energy use per square footage basis. If “green” technologies were under consideration for the new building, the estimate could be adjusted to reflect the potential savings (both energy and financial) from using the technology.

For the City of Burlington, factors such as new technology, potential advances in existing technologies and changing utility price structures mean that this type of forecasting will not likely provide very useful information.

Community

In the community module, growth multipliers can be used to generate a set of forecast emissions data for 2010. The following information is required:

- Residential – growth in number of households
- Commercial – growth in total commercial floor area
- Industrial – growth in industrial sector employment
- Transportation – growth in population or employment
- Waste – growth in population

These factors are then multiplied with the 1994 baseline information to provide an estimate of future emissions from the community sector. Given the nature of the original data (1994), it is suggested that a focus on the residential sector and perhaps the waste sector will yield the most useful forecast information.

Forecasting in both the corporate and community sectors is not seen to be a valuable tool in this case. It is a reasonable assumption that as Burlington continues to experience growth and the associated increases that occur with that growth (such as transportation, waste etc), emissions and energy costs will continue to rise.

Recommendations/Next Steps

Based on the completion of this inventory and speaking with another municipality (Appendix B), it is suggested that the next steps in this project should be to move on to Milestone 3 (Developing the Local Action Plan). It appears to be not feasible to set actual target figures due to the growth in population Burlington continues to experience combined with the limitations of the inventory data.

The PCP program is flexible in terms of what a local action plan should include. Several other municipalities have completed a LAP and many of them are posted on the Internet or available in a paper copy.

One suggestion for Burlington's LAP is to use the baseline inventory as a starting point and detail what changes have been made since 1994. The inventory identifies areas where energy management measures would be effective in saving money and reducing greenhouse gas emissions. These areas could be highlighted in the LAP with potential projects outlined. A qualitative approach is likely easier to document than trying to set targets that may or may not be achievable. For example, any potential renovations to the Planning and Engineering departments could present opportunities to incorporate energy efficient designs and features. These plans could be discussed in the LAP.

Measures

The PCP software incorporates a feature whereby programs and initiatives that have been implemented since the baseline year (1994) can be accounted for and be quantified in terms of reduction of equivalent CO₂ emissions and financial savings. For both corporate and community initiatives the following information is required:

- Type of measure;
- Energy sources involved;
- Year implemented; and
- Implementation cost.

It is in this section that the Corporation would obtain credit for its previous or ongoing energy efficiency initiatives such as low sulphur fuel or replacement of traffic signals with LEDs.

Acknowledgements

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Respectfully submitted,

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Appendix A - Summary of Categories

The following is a summary (in alphabetical order) of what buildings or activities are included in each category of the baseline (1994) and benchmarking (2003) inventories.

Corporate

Sector	Category	1994	2003	Comments
Buildings	Administration	HQ Building, Animal Shelter, Brant Court Apts.	414 Locust St., Brant Court Apts., Municipal Court Office, Animal Shelter	
	Arenas	Skyway, Kiwanis, Mount Forest, Mainway, Central	Skyway, Kiwanis, Central, Appleby Line, Mountainside, Mainway	
	Arts	Music, Art and Drama Centres	Music, Art and Drama Centres	
	Cemetery	Greenwood	Greenwood	
	City Hall	Brant St	Brant St	
	Fire Stations	Hwy 5, Kilbride, Upper Middle, Cumberland, Appleby, Waterdown	Dundas, Kilbride, Upper Middle, Cumberland, Appleby, Waterdown, Fairview	
	Library	Kilbride Branch		Information available for Kilbride Branch only. Others in locations where the utilities are included in the rent. Due to a staff absence at Central Library, information was not obtained for this location.
	Misc. Recreation	Greenhouse, Hidden Valley Dance Hall, misc. RPM invoices	None	
	Parking Lots	Pearl, Locust, St. John and Elgin Sts	Brant St (2), Pearl St, 436, 500 & 527 Locust St, John St, Elgin St	

Buildings Cont'd	Park Facilities	Lowville, Nelson, Bridgeview, LaSalle, Hidden Valley, King Rd, Paletta (McNichol Estate), Sherwood Forest	Lowville, Sherwood Forest, Paletta, Sioux Lookout, Ireland, Lakeshore Rd, Millcroft Park Dr, Maple Ave, Bridgeview, Nelson, Greenwood Dr, LaSalle, Dundas St, Hidden Valley, King Rd	
	Pools	LaSalle Wading, Hidden Valley, Optimist Park, Mountainside Park	Optimist, LaSalle Wading	
	Public Works	Cumberland Ave	Cumberland Ave	
	Pumping Stations	N. Service Rd, Beach Strip, Walkers Line, Appleby Line	Beach Strip, Appleby Line, Walkers Line,	
	Recreation Centres	Kilbride, Brant Hills, Nelson, Rotary Youth Centre, Girls Gymnastics Club	Rotary Youth Centre, Tansley, Seniors Centre, Brant Hills, Kilbride, Girls Gymnastics Club,	
	Sports	Tyandaga Golf, tennis facilities, canoe club, sailing club, minor hockey office, baseball, football	Minor hockey office, New St facilities, canoe club, Tyandaga Golf,	
	Transit	Harvester Rd, John St Extension	Harvester Rd, John St (2)	
	Unknown	Residential Address – Brant St.	3455 Fairview St	2003 - Not a Parks & Rec. facility; Judi Baltzer doesn't have account number in her records.
Vehicle Fleet	Fire Department			
	Fleet Plan (Shell)		None	
	Public Works			
	Transit (Conventional)			
	Transit (Handi-van)			
	Tyandaga Golf			
Streetlights	Park and Recreation/Security	Football, floodlights, security	Football, floodlights, security	
	Streetlighting			

	Traffic Signals			
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Community

Sector	Comments
Residential	
Commercial	
Industrial	1994 – Coal: type of coal was not specified by StatsCan; used worst-case scenario (i.e. highest eCO ₂ value)
Transportation	VKT estimated using PCP average annual per capita value of 6000 multiplied by the relevant population
Waste	Tonnes to Landfill supplied by Halton Region. Waste share percentages are software defaults; actual figures not available

Appendix B- Mississauga Experience

The City of Mississauga completed their inventory for every year since 1990. They had information up to 1998; 1999 and 2000 were extrapolated. It should be noted however that the City has an energy management department that tracks energy usage on a daily basis. They made similar assumptions with regards to their community data (per capita method using provincial usage data). Their approach is to control the level of emissions rather than reduce the amount because of the growth that Mississauga continues to experience. Their results show that as the population has grown (along with corporate operations to support that growth), energy efficiency has kept pace. Burlington is likely to be in the same position as it has experienced similar growth over the past decade.

They have completed a Local Action Plan (Milestone 3) but have not yet set any targets (Milestone 2). Their LAP is a broad idea of where they should be going but how to measure their progress has not been addressed. They have not presented their results to Council and do not have any plans to do so soon. PCP is seen as a longer-term investment in terms of projects and infrastructure. Mississauga feels that they have completed the “obvious” projects (i.e. “easy” with a short payback period).

Their main concern is how to “sell” the results and recommendations internally without any direction from the federal government on the Kyoto Protocol. Kyoto is seen to be the big question. FCM can't help because they haven't received any direction from the federal government either. The targets outlined in Kyoto are not achievable from Mississauga's perspective. They are in favour of emissions trading as a way to balance the City's growth with their reduction goals/targets.

Appendix C – Examples of Potential Reduction Amounts

- 3000 tonnes eCO₂/year with a 1.8 MW turbine as proposed by Positive Power;
- 1300 tonnes eCO₂/year with implementation of initiatives in ICLEI's report "Energy Efficiency Opportunities in the City of Burlington's Corporate Building Stock" (2000);