

Partners for Climate Protection

National Measures Report 2010

Demonstrating Results:
Municipal Initiatives to
Reduce Greenhouse
Gases



Photo credit: Resort Municipality of Whistler

Acknowledgements

The *2010 Measures Report* was made possible through the dedication and hard work of participating municipal governments. Participants invested considerable time and resources collecting the required information and completing the data collection forms. This commitment from municipal staff was essential, and provided a solid foundation on which to build the Report.

Many thanks to the following municipalities that contributed data:

- Town of Annapolis Royal
- Town of Banff
- City of Bathurst
- City of Burlington
- City of Calgary
- City of Coquitlam
- Cowichan Valley Regional District
- Municipal Corporation of Delta
- Town of East Gwillimbury
- City of Edmonton
- City of Fernie
- City of Fredericton
- City of Kingston
- Township of Langley
- Town of Markham
- Metro Vancouver
- District of Mission
- City of Mississauga
- City of Nanaimo
- Town of New Glasgow
- Town of Newmarket
- City of North Vancouver
- District of North Vancouver
- City of Ottawa
- City of Pickering
- City of Port Alberni
- City of Revelstoke
- District of Saanich
- City of Saskatoon
- Regional Municipality of Stanley
- City of Greater Sudbury
- City of Surrey
- City of Toronto
- City of Vancouver
- Resort Municipality of Whistler
- City of Yellowknife
- York Region

Likewise, the PCP would like to acknowledge the work of both FCM and ICLEI staff in the production of this report. Thank you to: Muni Ahlawat, Leya Barry, Devin Causley, Jonathan Connor, Lisa Hatina, Ewa Jackson, Peter Martens, Daniel Ronaghi, Holly Vaughan, and Andrew Wickham for their continuing work in supporting municipalities in their reporting efforts.

All across the country, municipal governments are implementing innovative solutions to reduce GHG emissions and mitigate the effects of global climate change. These efforts are commendable, and should be recognized, shared, and celebrated in order to encourage continued action toward climate change mitigation. It is our sincere hope that the *2010 Measures Report* will give credit where credit is due, and provide Canadian municipal governments with the information and motivation required to achieve deep and lasting GHG reductions.



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A message from FCM's Chief Executive Officer:

Municipalities are acting locally on climate change! Canada's cities and communities, which operate with limited financial resources, are actively working with local businesses, community organizations, and developers to create and carry out sustainable development practices in communities large and small. Up to half of Canada's greenhouse gas (GHG) emissions are under the direct or indirect control or influence of municipal governments, including waste management, transportation, and commercial and residential building design.

The Federation of Canadian Municipalities provides programs and services to support municipalities in their efforts to grow more sustainable through the Green Municipal Fund™ (GMF) and Partners for Climate Protection. Thanks to over 200 committed municipalities, the PCP program, established in 1998 in partnership with ICLEI, is leveraging funds provided through GMF to act now on climate change by reducing greenhouse gas (GHG) emissions.

Clearly municipalities have matured, not only in their ability to carry out, real, tangible projects but also in their ability to track their results. Every year, PCP collects data from its members on the actions they have carried out. This report celebrates the success of PCP members who are reducing GHG emissions to help mitigate climate change through a variety of measures and projects; many of which have shown financial savings to the municipality!

This report profiles some of the innovative measures being taken across Canada by communities large and small who have committed to reducing their GHG emissions. You may notice a focus in this report on profiling the activities of smaller Canadian communities. Small and rural municipalities dominate membership in the PCP program: about 66 per cent of member municipalities have populations under 50,000, and about half of these have populations under 10,000. Small communities are clearly doing their part! This year PCP wanted to draw focus to these communities and celebrate their success.

I hope that this report will inspire more participation in the PCP program and even more action on climate change by the program's existing members. I salute all municipalities setting an example for Canadians and the global community by taking responsibility for their impact on the environment, whether in Canada or abroad.

Brock Carlton

Chief Executive Officer
Federation of Canadian Municipalities

A message from ICLEI Canada's Director:

From year-to-year, Canadian local governments are consistently proving that they are leaders in the fight against climate change. Hundreds of Canadian municipalities have successfully reduced their greenhouse gas emissions, while saving money and investing in their communities. The *2010 PCP Measures Report* is a testament to the varied activities underway from coast to coast to coast.

You've spoken and we've listened! We understand that in these years of fiscal restraint, resources can be limited; as such we strive to support PCP Members in reporting on their successes and achievements. Through assistance in the collection of technical data relating to the dollars invested and the emission reductions achieved, it is our aim to empower municipalities to report on their good work. We hope that the individual measures collected in this report inspire and help build further capacity for more measures to be implemented, resulting in deeper reductions in greenhouse gas emissions, and continued Canadian municipal leadership.

Canada's local governments control the day-to-day activities that determine the amount of energy used and waste generated as well as the long-term planning for our communities – from land use and zoning decisions to infrastructure investment to the management of parks and recreation areas. Local government leaders are so uniquely positioned to influence citizen behaviours – their transportation options, energy consumption patterns and general consumer decisions.

I encourage you to continue sharing your successes with ICLEI so we can ensure that the lessons you've learned on the ground in your community are shared with your peers across the country and around the globe.

Local Action Moves the World. Join the Movement!

Megan Meaney

Director, Canada Office
ICLEI – Local Governments for Sustainability

Executive Summary

The *2010 Partners for Climate Protection Measures Report* looks at 182 measures that were collected from 37 municipalities across Canada. The annual greenhouse gas reductions associated with these initiatives total 350,000 tonnes and represent more than \$145 million in investments. Additionally, the measures reported annual cost savings of nearly \$3.5 million. Unfortunately, due to the difficulty in measurement, not all of the measures collected reported information on each of these criteria; thus, the actual emission reductions, monetary investments and cost savings are considerably larger. The gap in data reported for each measure is something that must be improved in order to have a complete picture of the climate change mitigation activities being taken by communities across the country.

The PCP program is a network of Canadian municipalities that are working together to address climate change by reducing greenhouse gas (GHG) emissions in their communities. Municipal governments are well positioned to take up this challenge, and many have been leading by example in reducing the environmental footprint of their communities. This report provides a snapshot of the measures that PCP members have carried out to reduce GHG emissions at both the corporate and community levels.

Established in 2008, the *National PCP Measures Database* now contains over 500 measures. This database houses information on a variety of municipal GHG reduction initiatives collected over the last three years. Together, these initiatives represent nearly \$400 million of investment into mitigation activities, and have reduced GHG emissions by 1.5 million tonnes. The database is a repository of information that can be used to highlight and share municipal best practices in energy and GHG management.

A wide variety of measures were collected in 2010, ranging from energy conservation and LEED® accredited facilities to landfill gas recovery systems and renewable energy initiatives. The measures were classified as either 'corporate' or 'community' based on ICLEI's *International Local Government GHG Emissions Analysis Protocol*.¹ Corporate emissions are those that are emitted from sources that are under the direct control of a municipal government, while community emissions are those produced by the community at large. The measures were further categorized into sectors to allow for a more refined comparison of measures. Under corporate emissions, the sectors include: buildings, streetlights, vehicle fleet, corporate solid waste, and water and wastewater. Community emissions were categorized as residential, industrial, commercial, and institutional (ICI), transportation, and community solid waste.

Measures targeting corporate emissions accounted for 70 per cent of the measures collected and 81 percent of the reported GHG reductions. This is likely due to the fact that municipalities exert greater influence over their own operations than they do in the community at large. As a result, many PCP participants prefer to develop corporate GHG inventories and corporate action plans before tackling community-wide emissions. Measures in the corporate sectors include building retrofits, fleet greening initiatives, waste heat recovery systems at arenas and sports complexes, upgrades to outdoor public lighting, and many more. Municipal governments are clearly showing leadership by reducing the carbon footprint of their operations.

Community measures cover a wide range of initiatives, including anti-idling by-laws, public engagement and awareness raising, waste diversion programs, and the promotion of alternative transportation solutions—to name a few. While the mitigation effects of by-law changes and education programs may be difficult to calculate, these measures should not be overlooked as they can lead to significant long term emission reductions for the community.

The *2010 PCP Measures Report* provides detailed examples of what Canadian municipalities are doing to reduce GHG emissions in their own operations and the wider community. Details on costs, energy savings and GHG reductions are discussed across each of the corporate and community sectors. Informative case studies are also provided, along with information on implementation, funding and replicability. This information is meant to inspire and help build capacity within municipal governments to mitigate the effects of climate change by taking substantive actions to reduce GHG emissions at the local level.

Glossary

Combined heat and power (CHP): The method of simultaneously generating heat and power from the same source. The concept, also known as *cogeneration*, can be applied to power plants of various sizes. *Micro CHP* refers to small-scale installations in homes or small businesses. *Mini CHP* systems produce up to 500 kW equivalency and can power a medium sized building.

District heating: A centralized system in which heat is generated at a single location. The heat is then transferred to a heat carrying fluid, such as hot water or steam, and distributed to a group of buildings via a network of insulated piping. A heat exchanger, located in each serviced building, connects the customer's heating system to the network

Geothermal heat pump: Also known as *ground source heat pump*. Refers to a heating or cooling system in which heat is pumped either to or from the ground. Heat stored in the earth can be used as a heat source in the winter or as a heat sink in the summer.

Greenhouse gas (GHG): Gases that trap heat in the Earth's atmosphere. This report focuses primarily on carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).

Leadership in Energy and Environmental Design (LEED®): A third-party certification program that recognizes sustainable building and development practices. Different levels of certification (certified, silver, gold and platinum) are awarded based on a building's performance in five key areas of human and environmental health.

Solar water heating (SWH): Refers to a variety of systems that use the sun's energy to heat water. Solar hot water systems are used most commonly in domestic hot water systems and to heat swimming pools.

Solar photovoltaics (PV): Panel installations that convert solar radiation into electrical power.

Waste heat recovery: The process of collecting heat generated from a primary source that would otherwise be wasted and using this heat for a secondary purpose. This is achieved through the use of a variety of different capturing methods, such as recuperators, heat pipe exchanges, heat pumps and regenerators.

Waste-to-energy: Technologies that convert waste matter, including municipal solid waste, industrial waste, agricultural waste, and waste by-products, into various forms of fuel that can be used to supply energy. This can be achieved through a variety of physical, thermal or biological technologies.



Introduction

Climate change is already being felt in communities across the country. Average temperatures are rising, snow and ice cover are declining, and there is a growing incidence of natural disasters, such as storms, wildfires and floods. If left unchecked, the impacts of further warming on human and environmental systems will be profound. Fortunately, there is a growing movement of municipal and regional governments that is committed to climate change mitigation and environmental sustainability. Hundreds of Canadian municipalities have answered the call to action by taking concrete steps to reduce greenhouse gas (GHG) emissions at the local level. In the absence of national and international leadership, these municipal governments are emerging as key players in the field of climate change mitigation.

The Partners for Climate Protection (PCP) program is a joint partnership between ICLEI – Local Governments for Sustainability (ICLEI) and the Federation of Canadian Municipalities (FCM). The program aims to provide municipal and regional governments with the support they require to identify and address local sources of GHG emissions. Guided by a five milestone framework, municipal government participants strive to establish GHG inventories, set GHG reduction targets, develop and carry out local action plans, and monitor results. Over 200 municipal governments are members of the PCP program, the Canadian component of ICLEI's international Cities for Climate Protection Campaign, which engages more than 1000 cities worldwide in the same five milestone process.

The *2010 PCP Measures Report* is a compilation of the various measures that PCP members from across Canada have taken to reduce their GHG emissions. Following PCP protocol, each measure is categorized as 'corporate' (municipal) or 'community.' Corporate measures are those involving municipal government operations, including buildings, street lighting, water and wastewater treatment, fleet vehicles, and corporate solid waste. These are areas over which municipalities have direct control or influence. Community measures are those targeting the industrial, commercial, and institutional (ICI) sectors, community transportation, residential energy and water consumption, and community solid waste. These are areas over which the municipal government may not have direct control, but can nevertheless exert its influence. Each of these sectors is described in detail below, along with a series of corresponding mitigation activities.

This report has three main objectives: to take stock of municipal government action on climate change, to build capacity so that municipalities are better able to report on their results, and to encourage continued action to achieve deep reductions in GHG emissions. The report builds upon previous reporting initiatives by continuing to outline the quantitative and qualitative results of municipal government efforts to reduce GHG emissions. These results position municipalities as achievers of significant emissions reductions, solution providers and best practice leaders in the field of climate change mitigation. Municipal governments are well positioned to address the challenges of global climate change, and with continued financial and technical support, they will play a vital role in steering development toward a sustainable and carbon neutral future.



"Some Tilt Shift effect" Flickr/ Imnop88a

This report positions municipalities as solution providers and best practice leaders in the field of climate change mitigation.

Methodology

The 2010 PCP Measures Report unfolded over several stages. Data on GHG reduction measures were collected between March and July 2010. During this period, municipal government liaisons were contacted by the PCP Secretariat with an initial offer of participation, followed by detailed instructions and a data collection form. PCP participants were encouraged to submit information on any municipal government initiative—either corporate or community—that has had a net reduction on GHG emissions.² Naturally, this process of voluntary data submission presented several methodological challenges. Should the PCP Secretariat impose a minimum information requirement for data submissions? Should reported GHG reductions be standardized according to a particular methodology or a common set of emissions factors? These and other aspects of the report's development are discussed below.

Data Collection

A standard data collection form was sent to all municipal governments participating in the PCP program (see [Appendix 1](#)).³ The form solicited information on a variety of project details, including total implementation cost, annual savings in energy (or waste diverted), project payback and the annual reduction in GHG emissions achieved as a result of the initiative. In addition to these project specifics, participants were asked to list their data sources as well as any assumptions that were made with respect to the data. The inclusion of these data fields allowed PCP staff to assess the reliability of the data received and to verify reported calculations.

The PCP Secretariat did not impose a minimum information requirement for data submissions. Participants were provided with a set of 'best practice' guidelines for data submission, and were encouraged to submit as much information per measure as possible. In the end, however, all submissions were accepted regardless of 'completeness.' Consequently, the measures submitted by PCP participants vary considerably in terms of the level of detail and the reliability of data provided. Some participants were able to provide accurate and thorough data for each of the fields requested. Other participants were unable to provide details on key fields, such as project costs, annual energy savings and GHG reduction. Similarly, some participants chose to report their GHG reductions as estimates or projections, while others reported their reductions based on real consumption data. Several measures also included data on other environmental benefits, such as savings in water consumption.

Reported GHG reductions were verified, wherever possible, according to the emissions factors provided in *Canada's National Inventory Report 1990-2008*.⁴ In cases where there was a large discrepancy between the reported reductions and those calculated by PCP staff, the participating municipal government was contacted for clarification. In general, however, PCP staff did not alter the information and calculations provided by participants. In other words, the information included throughout this report appears as it was submitted by the municipal government participants.

Carbon Dioxide Equivalent

There are several gases that have a warming effect on the atmosphere; these are commonly referred to as greenhouse gases (GHGs). Some of the most common GHGs are carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, and several hydrofluorocarbons and perfluorocarbons. Each of these gases has a different capacity to trap heat in the atmosphere. For example, methane is approximately 21 times more potent than carbon dioxide. This warming capacity is known as the Global Warming Potential (GWP), and can be applied to different gases to provide a standard GHG value, measured in carbon dioxide equivalent (CO₂e).⁵ The GHG reductions listed throughout this report are reported in CO₂e.





Analysis

Following the methodology outlined in ICLEI's International Emissions Analysis Protocol (IEAP), each measure was categorized according to area, sector and subsector (see **Table 1**).⁶ This categorization made the data manageable, allowing PCP staff to make observations and discern trends. PCP staff also analyzed the data in relation to participant information (i.e. population size, geographic location, etc.), cost savings, and the relationship between money invested and GHG reduction. It should be noted, however, that the uneven level of detail between data submissions limited the ability of PCP staff to make definitive observations.

Table 1: Categorization of PCP measures

Sample Measure	Area	Sector	Subsector
<i>A solar hot water system was installed at the Sports Complex.</i>	Corporate	Buildings	Alternative Energy

Determining the relationship between investment, savings and GHG reduction was particularly difficult. Of the 182 measures collected, 61 did not include information on GHG reductions. Similarly, more than half of the 182 measures lacked information on cost savings and implementation cost. PCP staff therefore had to narrow the data to only those entries that included information on each of these three fields. This left a total of 43 measures available for a cost-reduction analysis.

Another problem that PCP staff encountered was the distinction between incremental costs and total project costs. For example, the cost of constructing a new facility to LEED® standards can range well over \$10 million. However, this figure typically represents the cost of the entire facility; it does not necessarily represent the cost of the facility's environmental features. A similar example can be made with the purchase of a hybrid vehicle. Participants tended to list the cost of the entire vehicle (i.e. \$30,000) rather than the incremental cost of purchasing a hybrid (i.e. \$5,000). These data entries ultimately distort the relationship between money invested and GHG reduction because they create unusually long payback periods as well as GHG reductions that are relatively small compared to the amount of money invested.

Given these methodological challenges, PCP staff did not make general statements on the relationship between dollar investment and GHG reduction (i.e. average investment per tonne reduction, average payback period, etc.). Instead, PCP staff compiled a list of 10 measures that were deemed notable in terms of their relative GHG reductions and payback periods. This sampling (see 'General Findings and Trends') should give readers a very general idea of what is achievable with different levels of investment. The remaining data analysis was relatively straightforward. Sector specific methodologies can be found in the corresponding sections of this report.

Important Considerations

There is a great deal of information in these pages. Numbers, figures and graphics appear frequently throughout the report. While readers are welcome (and very much encouraged) to make use of this data, there are several things to keep in mind. First and foremost, readers should remember that this report is the product of voluntary data submissions. As noted in the previous section, municipal government participants were asked to complete a lengthy data collection form for each measure submitted. Municipalities looking to participate in this report therefore had to invest a considerable amount of time and resources collecting information and completing the forms. As a result, most participants were only able to submit information on a select number of measures. It is also likely that many PCP members simply did not have the resources to participate in the data collection process.

For these reasons, the *2010 Measures Report* should not be seen as representative of all municipal government initiatives to reduce GHG emissions. Indeed, the results of this study demonstrate that when it comes to local action on climate change, the possibilities are almost endless. There are, undoubtedly, many different types of measures that have not been captured in this report.

How to Use This Data

To make the best use of the information provided in the following sections, it is helpful to understand the aims and objectives of this report. These can be summarized as follows: to *take stock* of municipal government action on climate change, to *build capacity* so that municipalities are better able to report on their results, and to *encourage action* to achieve deep reductions in GHG emissions.

Taking Stock

In 1998, Canada signed the Kyoto Protocol, pledging to reduce GHG emissions to six per cent below 1990 levels by 2012. As of 2008, national emissions stood at 734 million tonnes, roughly 31.5 per cent above the Kyoto pledge.⁷ Evidently, greater commitments are required from every level of government in order for Canada to make progress toward these targets. In this context, municipal governments have emerged as key players in the field of climate change mitigation. All across the country, municipalities are developing local action plans to reduce GHG emissions. By taking stock of these diverse initiatives, the *2010 Measures Report* aims to show that municipal governments are at the forefront of climate change abatement policy in Canada.



'Living Wall -- Detail' - Flickr/DCZwick

Building Capacity

Municipalities are implementing a variety of different measures to reduce GHG emissions. However, many of these initiatives are going unreported. The field of emissions accounting is relatively new, and in many cases, municipal staff do not have the tools or the resources needed to quantify the GHG reductions associated with certain projects. Calculating the climate change impact of a waste diversion initiative or that associated with energy awareness training is no easy feat! One of the advantages of the *Measures Report* is that it provides participating municipalities with a standard template to track and report on these types of initiatives. It also facilitates the sharing of technical knowledge between PCP staff and municipal liaisons. In this way, the *PCP Measures Report* aims to build capacity among municipal government officials so that they are better able to report on their achievements.

Encouraging Action

Last but not least, this report aims to inspire. There are, quite literally, hundreds of options that municipal governments can pursue to reduce GHG emissions. Municipalities lacking experience in climate change planning will find a variety of information in this report. Details on costs, energy savings and GHG reductions are discussed across each of the corporate and community sectors. Informative case studies are also provided, along with information on implementation, funding and replicability. Municipalities looking for further inspiration can also consult PCP's GHG Reduction Initiative of the Month, a monthly publication that shares information on environmental and economic results, lessons learned and next steps. These summaries can be found at <http://gmf.fcm.ca/Partners-for-Climate-Protection/GHG-initiative-of-the-month.asp>.



There are, quite literally, hundreds of options that municipal governments can pursue to reduce GHG emissions.

General Findings and Trends

This year's data collection process saw a total of 182 measures added to the *National PCP Measures Database*. These measures were collected from 37 municipalities in 7 provinces and one territory (see **Table 2**). Municipalities in British Columbia and Ontario were by far the largest contributors, together accounting for over 75 per cent of the data submitted.⁸ The remaining measures were collected from municipalities in Saskatchewan (10%), Alberta (4%), Manitoba (3%), Nova Scotia (3%), New Brunswick (1%), and the Northwest Territories (1%).

Table 2: 2010 measures by province

Province/Territory	Number of Measures	Money Invested
British Columbia	86	\$65,049,954
Alberta	8	\$39,300,000
Saskatchewan	18	\$4,848,565
Manitoba	6	Data not submitted
Ontario	56	\$33,515,921
New Brunswick	2	\$480,500
Nova Scotia	5	\$760,059
N.W.T.	1	\$313,000
Total	182	\$144,267,999

Collectively, the initiatives reported in 2010 amount to \$145 million in investments. Their aggregate GHG reduction is roughly 350,000 tonnes per year—the equivalent of removing 88,000 cars from the road!⁹

Figure 1: Distribution of participating municipalities



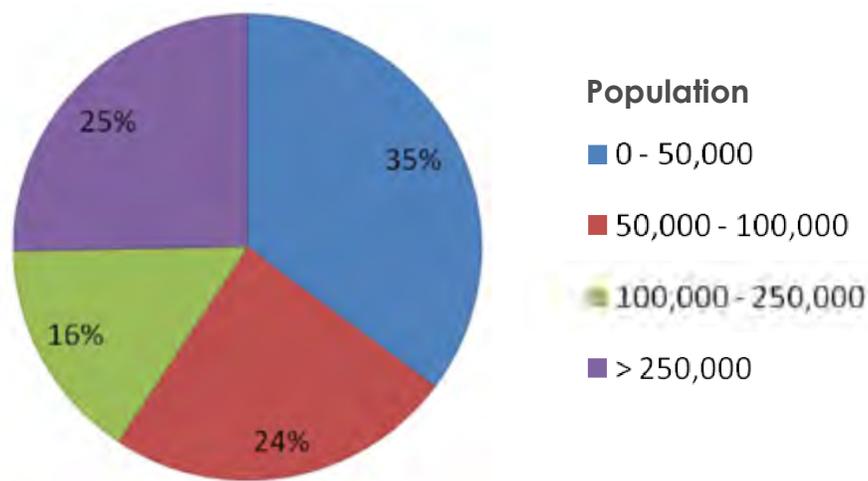
Participant Profile

Municipal government participants varied widely in size (population), organization and capabilities. Of the 182 measures collected, 64 (35%) were submitted by municipalities with a population of 50,000 or less (see **Figure 1**). The Town of Annapolis Royal was the smallest municipality to participate in this year's report. With less than 600 inhabitants, the municipality appears to be punching well above its weight. Canada's large urban centres were also well represented among participants. In total, these municipal and regional governments provided 25 per cent of the reported measures. The remaining initiatives were submitted by mid-sized cities with populations ranging between 50,000 and 250,000.

Observations on 'Cost-Effectiveness'

On average, smaller investments tended to have shorter payback periods. For example, investments that were less than \$25,000 had an average payback period of 2.8 years. Many of these smaller investments also proved to be quite

Figure 2:
Percentage breakdown of measures by municipality size



'effective' in reducing GHG emissions. That is, they were able to achieve relatively significant GHG reductions when compared to the initial dollar investment (see **Table 3**). In absolute terms, however, the GHG reductions associated with small projects were almost invariably lower than those associated with higher project investments. For example, the average GHG reduction for pro-

jects with an investment of \$25,000 or lower was six tonnes per year. In contrast, projects with an investment of \$200,000 or greater had an average GHG reduction of 201 tonnes per year. That being said, the cumulative effect of small investments should not be overlooked. Indeed, several well-placed, smaller projects might lead to larger reductions for lower costs!

Measures at a glance

- Most of the reported measures targeted municipal operations. In total, corporate measures accounted for 70 per cent of all measures received.
- Measures targeting the corporate building stock formed the largest sector, accounting for 36 per cent of reported measures. The municipal fleet was the second largest sector, collecting 21 per cent of reported measures. Traditionally, these two sectors are the largest contributors to corporate GHG emissions.
- The largest GHG reductions were achieved in the corporate and community solid waste sectors. The benefits of methane recovery—either for flaring or for waste-to-energy purposes—are substantial. A combination of these two systems has been implemented with great success in the City of Vancouver. The City's Landfill Gas Recovery System is currently reducing GHG emissions by 250,000 tonnes per year.
- Project investments ranged from \$249 to over \$36 million, demonstrating that no measure is too small (or too large)!

Table 3: Notable cost-effective measures

Description of Measure	PCP Member	Cost	Annual Energy Savings	*GHG Reduction (t/yr)	**Payback
A programmable timer was installed on the hot water boiler heating system at Historic Beban House.	Nanaimo, BC	\$249	4,852 m ³ natural gas	9	1 month
A crank timer and sensor were installed on the oil furnace at the Public Works Yard Casting Shed.	Nanaimo, BC	\$546	1,352 L fuel oil	4	4 months
The Town adopted a policy of no idling of internal combustion engines for Town residents, visitors and employees.	Annapolis Royal, NS	\$1,500	10,000 L gasoline	23	1 year
Insulation was added to attic and basement of Historic Beban House. Chimneys were capped, and soffit vents were also added.	Nanaimo, BC	\$5,599	2,680 m ³ natural gas	5	4 years
Efficient lighting was installed at the 12,800 ft ² City Hall building.	Fernie, BC	\$8,000	57,687 kWh electricity	1	2 years
40 High Intensity Discharge (HID) light fixtures were replaced with 27 8-lamp T5 fluorescent high bay lighting fixtures at the Nelson Arena Indoor Rink.	Burlington, ON	\$28,410	54,758 kWh electricity	12	5 years
A thermal extraction system, designed to capture renewable energy from groundwater, was installed at the Aldergrove Water Treatment Plant.	Township of Langley, BC	\$100,000	35,040 m ³ natural gas 55,609 kWh electricity	70	7 years
An innovative waste heat recovery system, which extracts waste heat from hot ammonia refrigerant used in rink ice-making, was installed at Iceland Arena.	Mississauga, ON	\$178,000	51,000 m ³ natural gas 13,000 kWh electricity	102	7 years
An ice plant heat recovery system, designed to capture and reuse waste heat, was installed at the Multiplex Arena	Yellowknife, NT	\$313,000	40% reduction in heating oil	250	2 years
A combined ground source heat pump (GHX) and solar hot water (SHW) system was installed at the Sports Centre in order to reduce the primary energy load on the building.	Whistler, BC	\$931,320	175,000 m ³ natural gas	450	6 years

* Note that in some cases GHG reductions are projections and have yet to be confirmed.

** Payback takes into consideration grants and external funding.

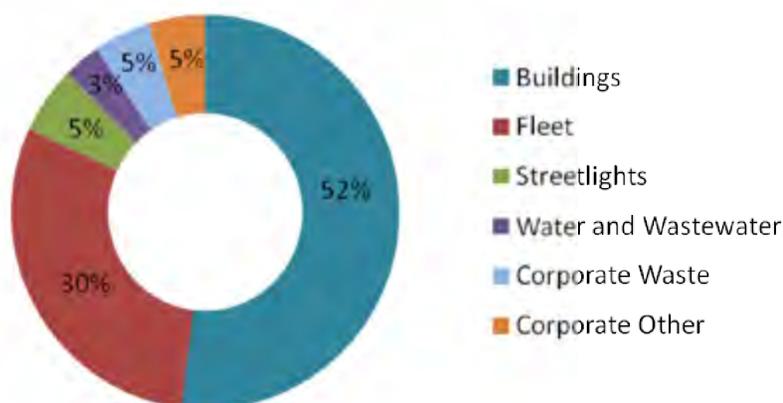
Corporate Measures

Over the years, the roles and responsibilities of Canadian municipal governments have expanded considerably. In addition to being key providers of essential daily services, municipal governments are often responsible for welfare and public housing, health programs, mass transit systems, community recreation, waste management and a host of planning and development functions. Each of these operations produces energy-related GHG emissions. Solid waste disposal sites can also generate large amounts of methane (CH₄) depending on a municipality's waste management practices. The good news is that many municipalities have already started to look inward to decrease energy consumption and eliminate waste. Municipal governments across the country reported undertaking a variety of different activities to curb GHG emissions from corporate operations. These initiatives are summarized and discussed throughout this section.

General Corporate Trends

Corporate measures accounted for 70 per cent of all the measures collected in 2010. This is likely due to the fact that municipalities exert greater influence over their own operations than they do in the community at

Figure 3:
Percentage breakdown of corporate measures by sector



large. As a result, many PCP participants prefer to develop corporate GHG inventories and corporate action plans before tackling community-wide emissions. This type of approach can have strategic benefits. For example, by greening their own operations, municipal governments may find that they are better positioned to advocate change in their communities. That being said, most municipalities undertake corporate and community GHG reductions simultaneously.

Most of the reported corporate measures were implemented in the buildings sector (see **Figure 2**). Measures targeting the vehicle fleet

formed the second largest sector, accounting for 30 per cent of all corporate measures. Streetlights, water and wastewater, and corporate waste were less popular sectors, each representing roughly five per cent of corporate measures. Interestingly, the largest GHG reductions were achieved in the corporate waste sector (see **Table 4**). One measure in particular, Vancouver's Landfill Gas Recovery System, had an annual GHG reduction of 250,000 tonnes. Notable reductions were also achieved in the water and wastewater sector. On average, measures in this sector had an annual GHG reduction of 5,431 tonnes.

Table 4: Summary of corporate measures by sector

Sector (Number of Measures)	Money Invested (CDN dollars)	Annual GHG Reduction (tonnes)	*Average GHG Reduction per Measure
Buildings (66)	\$79,465,899	11,648	224 tonnes/yr
Fleet (38)	\$8,117,235	1,657	69 tonnes/yr
Streetlights (7)	\$2,624,000	389	56 tonnes/yr
Water and Wastewater Treatment (4)	\$100,000	21,723	5,431 tonnes/yr
Corporate Waste (6)	Data not available	250,033	83,345 tonnes/yr
Other (6)	\$60,000	30	N/A
Total (127)	\$90,367,134	285,480	N/A

*The 'average GHG reduction per measure' was calculated using only those measures that included details on GHG reductions.

Buildings

The corporate building stock is one of the largest sectors in the municipal GHG inventory. It is also one of the most diverse sectors in that it contains a variety of different facilities—each with its own shape, size and services. In general, any facility that is owned or operated by the municipal government is included in this sector. This includes, among others, administrative and public works buildings, libraries, halls and warehouses, as well as pools, ice rinks and sports centres. Each of these facili-

ties has a different energy profile depending on the equipment in use (i.e. computers, machinery, etc.), the type of lighting in place, and the HVAC and hot water requirements of the building. The variety of buildings and the differentiated energy consumption in this sector provide municipal governments with an almost endless range of opportunities to reduce their GHG emissions.

Needless to say, measures targeting the corporate building stock form the

largest sector in this year's report. In total, PCP staff collected 66 of these measures. This figure represents more than half of all corporate actions, and corresponds to roughly 36 per cent of all measures collected in 2010. The aggregate investment in this sector was nearly \$80 million, or roughly 55 per cent of the money invested across all corporate and community sectors.

Altogether, corporate building initiatives are reducing GHG emissions by 11,648 tonnes per year!

CASE STUDY City of Burlington Solar Heating and Waste Heat Recovery

The City of Burlington recently installed seasonal solar heating and a year-round waste heat recovery system at its Tansley Woods Community Centre. The 90-panel solar installation covers an area of 398 m², and is capable of supplying up to 325 kW of thermal energy—roughly 25 per cent of the energy used to heat the centre's swimming pool. The solar hot water system also delivers heat to the pool showers when there is solar energy available and the swimming pool is at its set temperature. The energy supplied by the solar panels is complemented by a waste heat recovery system that collects warm water from the pool's drains. The warm drain water is then used to heat incoming cold city water, which helps to reduce the heating load on the facility's natural gas-fired boiler.

The total implementation cost of this measure was \$116,970. Some of these costs were funded by the Government of Canada's ecoENERGY for Renewable Heat Program (\$11,610), the Ontario Solar Thermal Heating Incentive (\$11,610), and the Electrical Retrofit Incentive Program (\$28,875). As a result of this initiative, the city should expect to see annual cost savings of \$28,275, with the system paying for itself in a little over two years.

The alternative energy systems will not only save the City money, but will also contribute to significant GHG reductions. The local utility provider, Burlington Hydro, estimates that the measure will save 24,138 m³ of natural gas and 101,000 kWh of electricity per year. These energy savings amount to 67.5 tonnes of avoided GHG emissions!



Tansley Woods Community Centre, Burlington

Municipalities interested in implementing a similar measure should consider undertaking a comprehensive roof assessment study that looks at the roof's size and structural limitations, its physical condition and warranty, and the distance to the pool. They should also investigate incentive programs and their requirements, along with building permit specifications. Lastly, municipalities should get in touch with their local energy distribution company and network with other municipal staff to gather technical information.

CASE STUDY City of Mississauga Ammonia Heat Recovery System

In 2009, the City of Mississauga installed an innovative waste heat recovery system at its Iceland Arena. The system works to extract waste heat from hot ammonia refrigerant used in rink ice-making—a task traditionally performed by large cooling fans that consume electricity. The recovered heat is then used to preheat domestic hot water for the facility's showers and for the ice resurfacing machines, which now only have to heat water from 100°C to 140°C instead of starting at the typical 60°C .

Each year, the system saves the City 51,000 m³ of natural gas in avoided water heating and 13,000 kWh of electricity from the reduced operation of cooling tower fans. Together, these savings lower the City's GHG emissions by 102 tonnes per year. The project was deemed so successful that it won the City of Mississauga Award for Excellence in Environment.



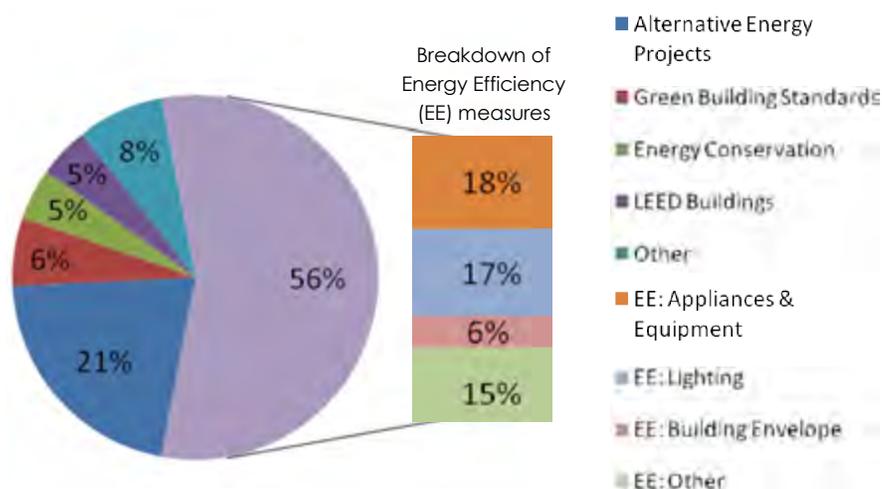
The initiative cost the City approximately \$178,000. However, with annual energy savings of \$24,500, the project should pay for itself in just over seven years. Municipalities interested in undertaking a similar initiative should consider the feasibility of implementing the system in multiple pad arenas that operate year-round.

Analysis and Discussion

When it comes to reducing GHG emissions from the buildings sector, municipal governments generally have two options. One option is to reduce overall energy consumption. This can be achieved by implementing energy efficiency retrofits at existing facilities or by introducing energy conservation measures, such as instructing staff to turn computers off at night. Municipal governments can also adopt “green” building standards in order to limit energy consumption in newly constructed facilities. In each of these examples, the municipal government targets inefficient or unnecessary energy consumption to reduce GHG emissions and save money.

The other option available to municipal governments is to focus on the energy source itself. By switching to lower carbon energy sources, municipalities can reduce their GHG emissions somewhat independently of their consumption levels. In short, municipalities looking to reduce emissions from the buildings sector can focus on the demand for energy or its supply—or both! The two approaches are not mutually exclusive,

Figure 4: Percentage breakdown of building measures by subsector



and in most cases they complement one another.

Most of the reported building measures focused on reducing energy consumption. Efficiency retrofits formed the largest subsector, accounting for 56 per cent of all building measures (see Figure 3). The most common retrofits were upgrades to lighting, appliances and equipment. Lighting retrofits generally focused on the replacement of incandescent and halogen fixtures with light emitting diodes (LEDs) or energy-saving fluorescents.

The appliance and equipment retrofits focused primarily on HVAC and hot water systems. One of the most popular measures in this category was the installation of programmable timers on hot water boilers, furnaces and thermostats. In a small number of cases, the building envelope was targeted for efficiency improvements. These measures included the installation of low emission ceilings, window replacements and the addition of insulation to attics, basements and chimneys.

CASE STUDY City of Fernie Aquatic Centre Energy Retrofit

In 2010, the City of Fernie achieved major GHG reductions through a series of improvements to the Fernie Aquatic Centre. First, the facility's HVAC system was retrofitted with a dehumidification reclamation system designed to extract heat from



Photo credit: Briana Schenk

moist air circulating in the pool area. Following dehumidification, the extracted thermal energy is used to heat water in the centre's three swimming pools. A separate component was also installed to extract heat from the facility's exhaust air, which is then used to heat incoming out-door air circulating throughout the building. Remarkably, the Aquatic Centre also relies on a solar domestic hot water system, which is used to heat water in the facility's change rooms, meeting area and washrooms.

The comprehensive energy retrofit cost a total of \$592,000, but was entirely funded through grants provided by the federal government! The measure is expected to save \$76,000 per year, which the City plans to invest in a new energy reserve fund that will help finance similar initiatives. The solar and waste heat recovery systems currently displace 5,816 GJ (approximately 155,000 m³) of natural gas per year. With an annual GHG reduction equivalent to 300 tonnes, these savings represent nearly 75 per cent of the City's commitment to become carbon neutral in corporate operations by 2012.

Municipalities looking to undertake a similar initiative should consider that these types of projects are highly specialized and therefore require the experience of a skilled contractor. It is also important to note that these energy systems tend to yield larger returns when implemented at large, multi-use facilities. Finally, municipalities should conduct research into similar initiatives and potential funding opportunities. For example, projects may be eligible for funding via the Federal Gas Tax Transfer.

Although less popular than efficiency retrofits, alternative energy projects were not insignificant. In fact, these measures formed the second largest subsector, representing 21 per cent of all building measures. The term 'alternative energy' is used here to refer to renewable energy sources as well as unconventional generation and distribution methods. The category is deliberately broad so as to include combined heat and power (CHP) and district energy projects. Although these systems are often powered by fossil fuels, they can achieve considerable energy savings as a result of their highly efficient generation and distribution methods. Waste heat recovery projects are

also considered to be unconventional, and are included in this category.

The most common alternative energy projects were solar hot water (SHW) and waste heat recovery systems. Most of the solar projects were implemented at community pools and sports centres, where they displaced natural gas used to heat shower and pool water. There was considerable variety among the waste heat recovery systems, although these were also popular at sports centres and arenas. Many of these projects focused on capturing and recycling the excess energy used to maintain ice rinks.

Sample Building Measures

- Green roofs
- Geo-exchange heat and cooling
- Solar domestic hot water systems
- District energy
- Waste heat recovery devices
- Turn-it-off electricity challenges
- Programmable thermostats
- Replacement of inefficient HVAC equipment
- Energy efficient windows and insulation
- LEDs and fluorescent lighting
- LEED® accreditation for buildings
- Low-flow water fixtures

Spotlight on District Heating

In Canada, 60 to 80 per cent of the energy consumed by municipal and community buildings is used for space and water heating.* This heat is typically produced on-site by a gas-fired boiler or furnace, and circulated throughout the building via a network of pipes, ducts or vents. In this type of system, the generation of thermal energy (heat) is 'decentralized', meaning it is produced independently in each individual home, office or building.

In a district heating system, heat is generated at a single location, such as a cogeneration (combined heat and power) plant or a heat-only boiler station. The heat is then transferred to a heat carrying fluid, such as hot water or steam, and distributed to a group of buildings via a network of insulated piping. A heat exchanger, located in each serviced building, connects the customer's heating system to the network.

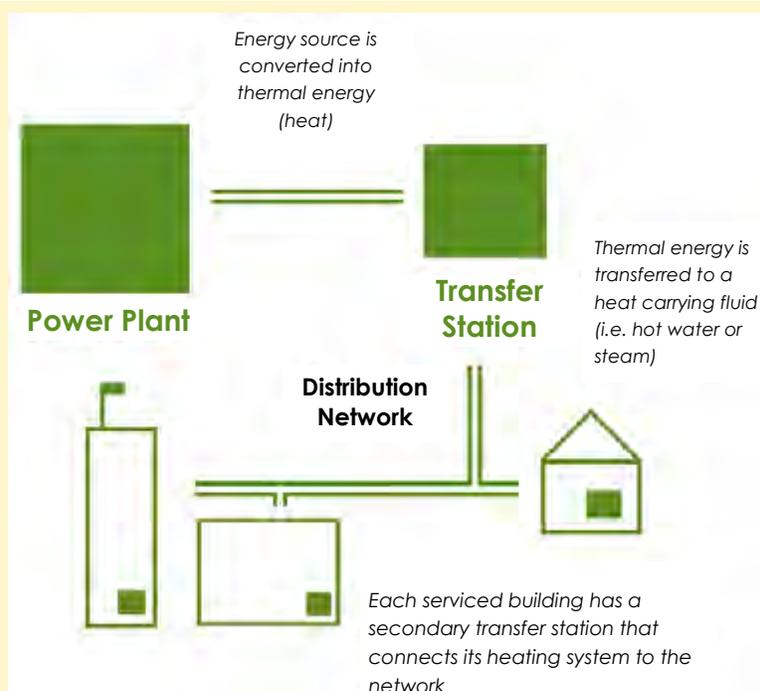
The primary advantage of district heating is the higher efficiency associated with larger power plants. These systems can be advantageous in densely populated urban areas, where heat losses in the distribution network are small, as well as in communities with lower densities. District energy systems also have access to a much wider array of energy sources. They can be powered by traditional fossil fuels, such as coal or natural gas, or by alternative energy sources, such as biomass, geothermal or solar energy. Excess waste energy from industrial processes can also be used for district heating, depending on the amount of heat and the temperature at which it is released into the environment.

District heating is well established in many European countries, in some cases dating back to the 14th century. Although less common in North America, the concept is quickly gaining popularity. There are approximately 80 district heating networks currently operating in Canada. The first of these system was developed in Winnipeg's commercial core in 1924.**

This year's *Measures Report* includes three district heating initiatives. In the City of Revelstoke, British Columbia, wood residue from a nearby sawmill is used to generate heat for several buildings; the biomass powered system saves approximately 3,200 tonnes of GHG emissions per year! In 2009, the City of North Vancouver expanded its award-winning district energy system to include more than 50,000 m² of residential and institutional space. The system is powered primarily by condensed natural gas, although it also benefits from a large solar installation located on the roof of the City's public library. The City of Calgary has also developed a district energy system. For more information on this initiative, please see the case study located on page 28.

*Ghafghazi, S., Sowlati, T., Sokhansanj, S., & Melin, S. "A multicriteria approach to evaluate district heating system options." *Applied Energy* 87, no.4 (2010): 1134-1140.

**Marinova, M., Beaudry, C., Taoussi, A., Trépanier, M., Paris, J. "Economic Assessment of Rural District Heating by Bio-Steam Supplied by a Paper Mill in Canada." *Bulletin of Science Technology & Society* 28, no.2 (2008): 159-173.



Streetlights

Municipal governments own and operate a variety of outdoor public lighting. They provide power and maintenance for overhead streetlights, they manage traffic signals, and they are generally responsible for sport and recreational area lighting at several different locations (i.e. parks, field lights, footpaths, etc.). At first glance, these activities may seem insignificant in relation to overall energy consumption and GHG emissions. However, outdoor public lighting systems operate, on average, between 10 and 13 hours per day, 365 days per year. In addition, these systems typically represent thousands of individual light fixtures. Consider, for example, the City of Toronto, which operates more than 160,000 streetlights!¹⁰ In this context, measures targeting streetlights and outdoor public lighting can have a very noticeable impact on energy consumption and GHG emissions.

They can also result in substantial cost savings.

The majority of measures reported in this sector involved streetlights and traffic signal retrofits. Measures targeting street lighting generally focused on the replacement of incandescent and mercury vapour bulbs with high pressure sodium (HPS) or LED systems. LED technology has evolved considerably in recent years, and there is a growing body of evidence to support its application in outdoor lighting systems. The primary advantage of these installations is that they consume much less electricity than conventional streetlights. LED streetlights also have lower maintenance and replacement requirements, which can help to offset implementation costs.

In total, the measures collected in this sector represent more than 16

GWh (16 million kWh) in annual electricity savings. In provinces like British Columbia, where the electricity supply is predominantly hydroelectric, these savings amount to 320 tonnes of avoided GHG emissions. However, in provinces like Ontario or Alberta, which rely more heavily on fossil fuel power stations, a reduction of this magnitude could reduce annual GHG emissions by 2,700 to 14,000 tonnes!

Table 5: Summary of streetlight measures

Measures Reported	7
Annual Energy Savings	16 GWh electricity
Annual Cost Savings	\$1,594,202
Total GHG Reduction	389 tonnes

CASE STUDY Town of Annapolis Royal LED Streetlight Project

In 2009, the Town of Annapolis Royal replaced 139 high pressure sodium and mercury vapour streetlights with light emitting diode (LED) technology. The project was part of a larger, province-wide initiative, in which LED streetlights were installed in 11 different municipal units across Nova Scotia. Annapolis Royal was the only town to be completely retrofitted with LED lighting, at a total implementation cost of \$200,000.

The only actual expense incurred by the Town was staff time. Municipal staff began conducting research in 2006, and spent approximately 1,000 hours on the project from start to finish. Equipment and installation costs were funded entirely through ecoNova Scotia and Conserve Nova Scotia, two provincial agencies working to reduce air emissions and improve energy efficiency. The project has reduced electricity consumption by 58,000 kWh per year, resulting in annual cost savings of \$15,506. The LED retrofit is also credited with reducing corporate GHG emissions by 47 tonnes per year!

Municipalities interested in pursuing a similar initiative should ensure that all streetlights are accounted for prior to implementation so that none get overlooked. It is also important to consider the impact of decorative lighting on energy consumption and GHG emissions. In the Town of Annapolis Royal, for example, bulbs have been removed in favour of non-illuminating decorations.



mentation so that none get overlooked. It is also important to consider the impact of decorative lighting on energy consumption and GHG emissions. In the Town of Annapolis Royal, for example, bulbs have been removed in favour of non-illuminating decorations.

Fleet

Like the corporate buildings sector, the municipal fleet warrants particular attention. It often accounts for a large portion of corporate GHG emissions (in some cases more than 80 per cent), and offers many opportunities for emission reduction activities. All vehicles and motorized equipment that are owned and operated by the municipal government are captured in this sector. These include light-, medium- and heavy-duty trucks, passenger vehicles, police and fire equipment, sanitation and street sweeping vehicles, construction and grounds-keeping machinery, and any aircraft or maritime vehicles. The fleet sector also includes municipal staff and their daily commute, as well as public transit systems that are owned or operated by the municipal government.

Fleet measures were well represented among the data submissions. In total, PCP collected 38 of these measures. This figure represents approximately 30 per cent of corporate measures and 21 per cent of all measures submitted. The aggregate investment reported for this sector

was approximately \$8 million, a figure that was surpassed only by corporate buildings and the industrial, commercial and institutional (ICI) sector.

Sample Fleet Measures

- Transit pass reimbursement
- Bicycle racks on transit vehicles
- Secure bike parking
- Employee shuttle bus services
- 'Smart commute' programs and commuter challenges
- Anti-idling policy
- Purchase of hybrid and electric vehicles
- Vehicle 'rightsizing'

To help municipal fleet managers green their fleets, FCM is expanding the PCP program with the Enviro-Fleets pilot project. Through Enviro-Fleets, FCM aims to help municipal fleet managers reduce GHG and CAC emissions associated with the operation of heavy-duty diesel fleet vehicles. The project runs from December 2009 to March 2011, and is supported by Environment Canada. Find out more about the Enviro-Fleets pilot project by visiting www.fcm.ca/gmf and clicking on Enviro-Fleets in the left navigation menu.

CASE STUDY City of Sudbury Hybrid Cars

Over the course of 2008 and 2009, the City of Greater Sudbury replaced a number of its fleet vehicles with fuel efficient hybrids. In total, 22 Toyota Prius hybrids were purchased to replace the City's Ford Crown Victorias and Chevrolet Impalas. The City also bought 9 Ford Escape hybrids to replace its larger pick-up trucks. The total implementation cost of this initiative was \$960,000. However, the new vehicles provide annual cost savings of \$93,000, and are likely to pay for themselves in approximately 10 years. Each of the hybrid vehicles boasts nominal maintenance costs—with many requiring less maintenance than their conventional counterparts.

In addition to these financial savings, the new hybrids are helping to reduce energy consumption and the production of harmful emissions. The 22 Toyota Prius vehicles are achieving up to 62 mpg (4.6 L/100km), a fuel economy that is roughly three times better than the other cars in Sudbury's fleet. The Ford sport utility vehicles (SUVs) are also proving to be an improvement on those they replaced, boasting a fuel economy as high as 42 mpg (6.7 L/100km). Altogether, these vehicles are expected to save 62,000 L of gasoline annually—roughly 2,000 L of fuel per unit. With an annual GHG reduction of 146 tonnes, Sudbury's investment in hybrid technology makes both environmental and economic sense!



"Prius-RightFront" Flickr/Beige Alert

CASE STUDY City of Saskatoon Hybrid Buses

The City of Saskatoon is achieving significant GHG reductions by reducing the amount of diesel used in its public transit bus fleet. The municipality purchased eight diesel-electric hybrid buses between 2006 and 2008. Each bus cost approximately \$600,000, bringing the total implementation cost to \$4.8 million.

Compared to the City's conventional buses, the fuel efficient hybrids save approximately 11 per cent in diesel fuel. These savings amount to 37,595 L in avoided diesel consumption, which has helped to eliminate roughly 100 tonnes of annual GHG emissions.



City of Saskatoon

The City has gone a step further by ensuring that the buses are on a preventative maintenance schedule. Vehicle 'tune-ups' are conducted regularly, which helps to maintain optimal performance levels. Four of the new buses also have diesel particulate filters (DPFs) that trap and prevent soot from being released into the atmosphere. This additional feature works to reduce harmful air emissions.

Analysis and Discussion

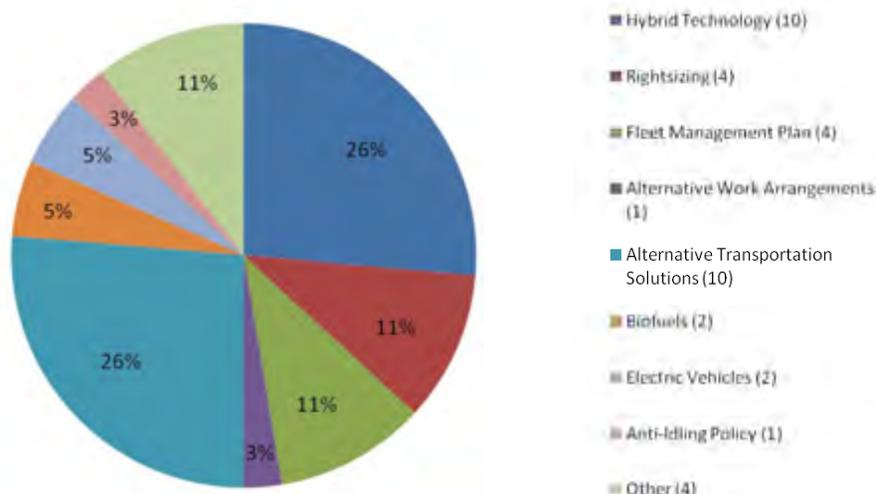
Fleet initiatives cover a broad range of activities (see Figure 4). The most common types of fleet initiatives undertaken by municipal government participants were hybrid vehicle purchases and alternative transportation initiatives targeting municipal staff. The term alternative transportation is used here to refer to carpooling, public transit and active transportation, such as walking, cycling or in-line skating. Most of the alternative transportation initiatives reported in this sector focused on providing incentives for cyclists. These initiatives involved constructing

secure and sheltered bicycle parking at municipal offices, installing bicycle carrying racks on public buses, using department bicycles for on-the-job travel between work sites, and promoting various 'commuter challenges' and staff awareness campaigns. Other alternative transportation initiatives involved transit pass reimbursements for staff, shuttle bus services between municipal facilities, and the purchase of new buses for public transit.

Despite the high level of activity in this sector, GHG reductions associated with fleet initiatives were rela-

tively low. This is likely due to several factors. Compared to other sectors, the GHG reductions associated with fleet measures can be difficult to quantify. Real consumption data is often unavailable or not applicable, which means that municipal officials must rely on activity estimates, such as avoided vehicle kilometres travelled or comparisons in vehicle fuel efficiencies. These types of calculations can present numerous challenges for municipal staff with little or no experience in GHG reporting. Of the 38 fleet measures submitted, only 24 (63%) included data on GHG reductions.

Figure 5: Fleet measures by subsector



It is also worth noting that many fleet measures were implemented (or reported) at a relatively small scale. For example, many of the measures contained within the fleet sector are single vehicle purchases, such as vehicle rightsizing initiatives or the purchase of a hybrid vehicle. The combined GHG reductions associated with these types of measures are therefore much smaller than those associated with comprehensive building retrofits or community-wide streetlight initiatives.

Corporate Solid Waste

The corporate solid waste sector is relatively complex. In some cases, municipal governments are directly responsible for supplying solid waste services in their communities. This can include activities such as collecting and transporting waste, sorting waste, overseeing compost and recycling programs, and managing landfills. However, it is not uncommon for municipal governments to contract for these services or to deposit waste at a facility located in

another jurisdiction. The type of activities included in this sector can therefore vary depending on a municipal government's operational control and its ability to implement or influence environmental policies at municipal solid waste (MSW) facilities. For the purposes of this report, the corporate solid waste sector includes any facility that is owned or operated by the municipal government. It also includes solid waste generated by corporate operations.

and the adoption of paperless council and committee meetings. A ban on bottled water at core municipal facilities also saw the elimination of roughly 2,500 plastic water bottles per year.

In terms of GHG emissions, the most significant measure in the corporate solid waste sector was a landfill gas recovery system implemented by the City of Vancouver. Indeed, one of the key findings to emerge from this report is the mitigation potential of methane recovery and waste-to-energy systems. Whether implemented at wastewater treatment plants or MSW facilities, these initiatives account for some of the largest GHG reductions recorded in the *National Measures Database*.

Sample Waste Measures

- Landfill gas recovery
- Paperless office
- Lunchroom composting
- Banning bottled water
- Trenchless sewer technology

PCP collected data on six corporate waste initiatives. These initiatives focused on a variety of activities, ranging from paper consumption and food waste to landfill gas and construction material. Notable paper-saving strategies involved digital file storage at administration buildings

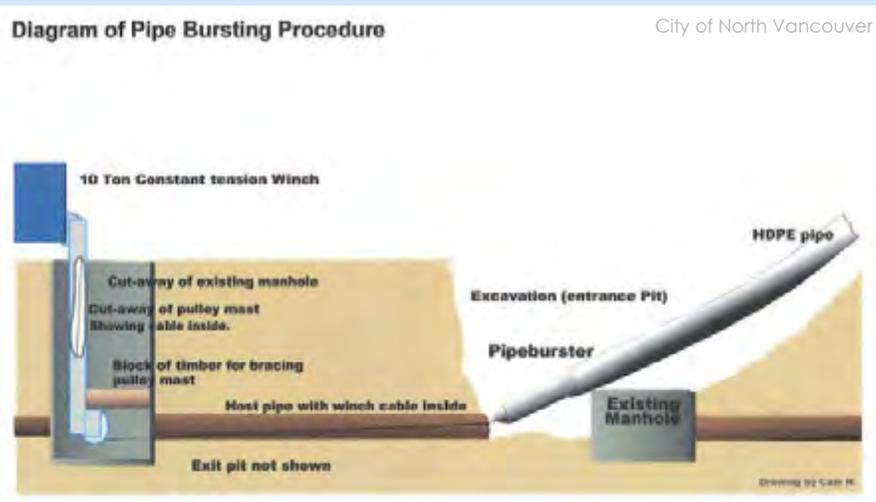
CASE STUDY City of North Vancouver Trenchless Technology

The City of North Vancouver recently used an innovative approach to replace a sanitary sewer. It was determined that the conventional open trench method, costing \$110,000 and requiring the excavation of approximately 1,200 tonnes of soil, would present too many challenges in the narrow laneway of the project site. The City therefore opted for a trenchless technology called *pipe bursting*, which pulls a new pipe through the old one using a pneumatic head attached to the replacement pipe. The existing pipe is subsequently broken into many small pieces and forced into the surrounding soil.

Unlike conventional approaches to sewer replacement, the trenchless method does not require a full-length excavation; the process can be completed using access pits at up- and downstream manholes.

By adopting this approach, the City reduced the amount of waste transported offsite by 1,050 tonnes—or roughly 85 per cent. This impressive reduction translates into approximately 33 tonnes of avoided GHG emissions. The project also saved the City \$44,200, and was completed in just four days—with none of the disruptions associated with the open trench method.

Municipalities interested in implementing a similar measure should consider some of the logistics involved in a project such as this. Before using the trenchless method, it is important to examine the depth of the sewer line to be replaced. Municipalities should also consider the number of lateral service lines and other utilities that may cross the trench line, as well as the type of surface treatments that will require restoration.





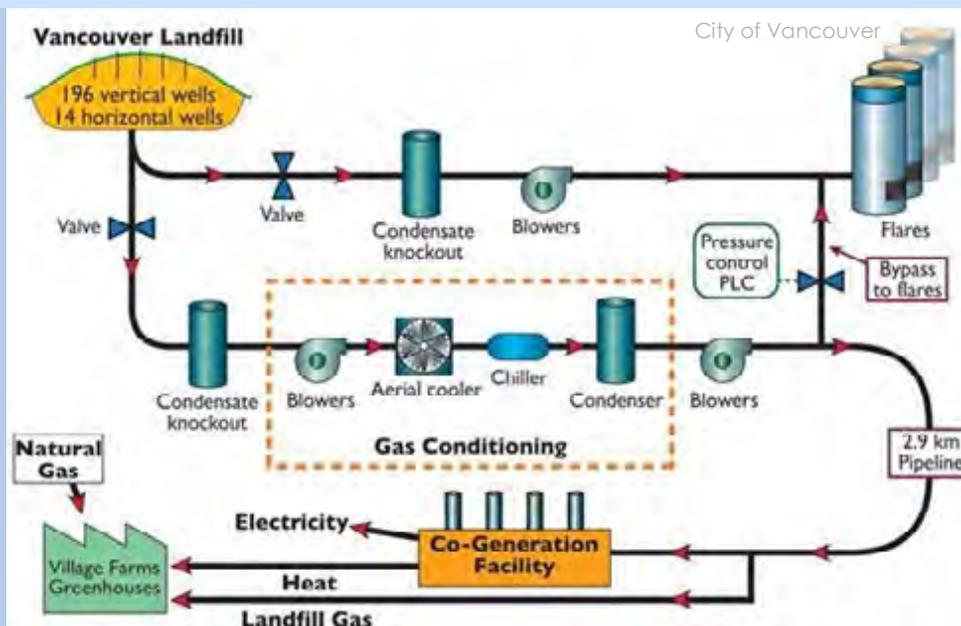
CASE STUDY City of Vancouver Landfill Gas Recovery System

The City of Vancouver owns and operates a large municipal solid waste facility located in Delta, British Columbia. Prior to the 1990s, methane gas released from the decomposition of organic waste accounted for roughly five per cent of the City's total GHG emissions. In 1991, the City began collecting this landfill gas via an active gas collection system. At first, the City simply flared the gas, thus converting methane into carbon dioxide, a less potent GHG. Since 2003, however, the City has been piping a portion of the landfill gas to a nearby cogeneration facility, where it is used to generate both electricity and heat. The electricity is sold to BC Hydro, and is used to power 7,000 homes. The heat is used to warm several nearby greenhouses, and can also provide space and water heating for the Landfill Administration buildings.

The system works to reduce GHG emissions in two key ways: by avoiding direct emissions of landfill gas (methane), and by displacing emissions from conventional electricity and heat generation (i.e. natural gas fired boilers). In 2008, the recovery system collected 38,971,000 m³ of landfill gas, of which 82 per cent was allocated for beneficial use; surplus gas continues to be flared.

The project is currently the largest GHG reduction initiative in the Lower Mainland, eliminating more than 250,000 tonnes in annual GHG emissions. In addition to these impressive reductions, the project also generates considerable revenue. The City currently earns \$400,000 annually through an agreement with MAXIM Power.

Municipalities interested in undertaking a similar initiative should consider the advantages of joint ventures. These include access to experienced third party operators and a predictable revenue stream. It should be noted, however, that landfill gas recovery is generally thought of as an opportunity to reduce odour and GHG emissions, rather than a guaranteed moneymaking venture.



Water and Wastewater

Most municipal governments are responsible for providing potable water and wastewater services to their communities. These services can encompass a variety of different facilities, including lift and pumping stations, reservoirs and storage tanks, water and wastewater treatment plants, and vast networks of sanitary sewers and water mains. At each of these sites, energy is required to pump, move or treat water and sewage effluent. Anaerobic wastewater treatment facilities also produce methane, a potent greenhouse gas. Measures targeting the water and

wastewater sector can therefore have a significant impact on corporate GHG emissions.

In total, PCP collected data on four water and wastewater initiatives. These initiatives include a comprehensive energy efficiency retrofit (lighting and equipment), two methane recovery projects, and an innovative 'water-to-air' thermal extraction system (see [Township of Langley Case Study](#)). The methane recovery projects were implemented at wastewater treatment facilities. These facilities use sealed (oxygen-

free) digester tanks to break down waste solids into methane, carbon dioxide and stabilized digested sludge. The methane gas is then collected and used as fuel to generate electricity or heat. Excess methane can also be flared, which reduces its climate change impact considerably.

Sample Water Measures

- Methane recovery
- Groundwater heat recovery
- Efficiency retrofits (lighting and equipment)

Collectively, water and wastewater initiatives have reduced GHG emissions by 21,723 tonnes!

CASE STUDY Township of Langley Water Treatment Plant

In 2010, a thermal extraction system was installed at the Township of Langley's Aldergrove Water Treatment Plant. One of the first applications of its kind, this innovative system extracts 100 per cent renewable energy from groundwater being pumped through the water treatment plant. The energy acquired by the water-to-air heat pump is capable of heating and cooling the 750 m² building—a task that was previously done using natural gas.

The total implementation cost of the measure was approximately \$100,000, two thirds of which was provided by federal and provincial sources. The initiative is expected to save the Township \$8,600 in annual utility costs, leading to a simple project payback of seven years. The project's annual energy savings should amount to 55,609 kWh of electricity and 1,300 GJ (35,000 m³) of natural gas— representing an annual GHG reduction of 70 tonnes! The initiative will also be credited with improving local air quality.



Success at the Aldergrove Water Treatment Plant has taught the Township of Langley an important lesson: emission reduction opportunities are not always readily apparent. For example, an initial study undertaken for the Township revealed only limited opportunities to reduce energy consumption within the Utilities Department. Had the municipality not taken a more focused look at the heating demand of its water treatment plant, the opportunity to implement an innovative alternative energy project would have been missed. Municipalities should therefore try to identify emission reduction opportunities in *all* aspects of their operations.

Community Measures

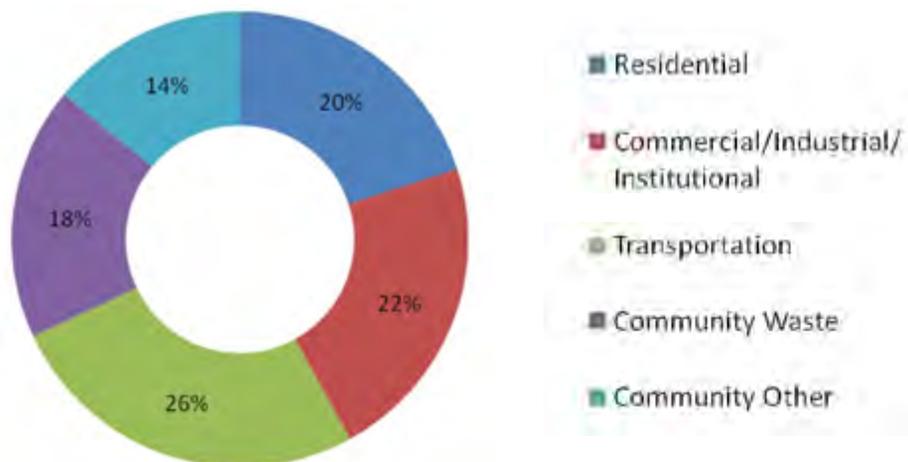
Decisions taken by private community residents are influenced, to a large extent, by municipal government policy. Consider, for example, community transportation patterns. Many individuals opt for single occupancy vehicles because they are unsatisfied with the public transit alternatives. In many communities, these systems are perceived as overcrowded and unreliable. Consequently, community transportation patterns remain heavily in favour of personal automobile travel.

Municipal governments looking to reduce community GHG emissions have a variety of mechanisms at their disposal. Through smart urban planning, regulation and leadership, municipalities can steer community development toward sustainability. This section examines municipal government initiatives across four community sectors: residential, industrial, commercial and institutional (ICI), transportation, and community solid waste.

General Community Trends

Community measures accounted for 30 per cent of all measures collected

Figure 6: Breakdown of community measures by sector



in 2010. These measures were distributed fairly evenly between each of the community sectors (see **Figure 5**). Many of the reported initiatives can be categorized as incentives designed to reduce energy consumption, conserve water and eliminate (or divert) waste. These were directed primarily toward homeowners, businesses and community organizations. Education and public outreach campaigns also formed a substantial portion of community measures.

As with the corporate measures, solid waste initiatives achieved the largest GHG reductions (see **Table 6**). Monetary investments were greatest for LEED® certified buildings and alternative energy projects. However, these measures have demonstrable cost savings based on lower electricity and heating requirements. Significant investments were also made to promote public transit or to encourage active transportation, such as walking and cycling.

Table 6: Summary of community measures by sector

Sector (Number of Measures)	Money Invested (CDN dollars)	Annual GHG Reduction (tonnes)	*Average GHG Reduction per Measure
Residential (10)	\$5,284,000	2,846	356 tonnes/yr
ICI (11)	\$45,282,120	3,255	814 tonnes/yr
Transportation (13)	\$3,224,300	355	51 tonnes/yr
Community Solid Waste (9)	Data not available	59,167	7,396 tonnes/yr
Other (7)	\$110,445	800	266 tonnes/yr
Total (50)	\$53,900,865	66,423	N/A

*The 'average GHG reduction per measure' was calculated using only those measures that included details on GHG reductions.

Residential

Canada's residential sector has changed significantly over the past 50 years. Increasing average wealth, smaller families and a higher standard of living have reduced the average household size from 4.0 persons in 1951 to 2.6 persons in 2001. As a result, the number of Canadian households has grown much faster than the increase in population. Today, the residential sector accounts for roughly six per cent of national GHG emissions.¹¹ At the local level, this figure tends to be much larger. In some regions, for example, the residential sector accounts for

more than 60 per cent of community GHG emissions.

Much like corporate buildings, Canadian households consume energy for lighting, appliances, and space and water heating. Although municipal governments do not exert direct control over private energy consumption, they can implement a variety of policies to help curb GHG emissions from the residential sector. Through regulation, municipalities can set benchmarks for energy efficiency in new housing developments. Municipal governments can

also provide a range of educational and financial resources in order to encourage conservation and efficient energy use.

Sample Residential Measures

- Residential retrofit programs
- Building permits requiring efficiency standards
- Energy awareness handbooks
- Water conservation handbooks
- Provision of rain barrels
- District energy systems
- LEED® neighbourhoods
- Solar water heating

CASE STUDY City of Toronto Solar Neighbourhood

In 2009, the City of Toronto set out to install 100 solar domestic hot water (SDHW) systems in one neighbourhood of the City. These systems differ from conventional solar photovoltaic (PV) systems in that they use the sun's energy to heat water, rather than to generate electricity. SDHW collectors are generally more efficient at converting sunlight into energy than PV systems. For example, it would take fourteen 150 watt PV panels (14 m²) to produce the same amount of energy generated by two SDHW panels (5.8 m²). In addition, SDHW systems are less costly than many PV systems.

The pilot unfolded in Ward 30, a community with a strong history of environmental activism and a housing stock largely built before 1946. The program provided incentives, such as zero-interest financing, to homeowners and residents of low-income housing to install the solar system on their roofs. The goal of 100 local SDHW installations was achieved in November 2009, including 70 private home installations and 30 installations on low-income, single-family housing owned by Toronto Community Housing. Approximately 68 per cent of participants opted for the zero-interest financing in order to lessen the upfront capital costs.

The total implementation cost of the project was \$684,000, of which \$400,000 was paid by the Portlands Energy Centre (PEC) as per its agreement with the Ontario Ministry of the Environment. A portion of the investment by PEC was used to provide conservation and air quality education in the selected neighbourhood. Collectively, the project will reduce GHG emissions by 60 tonnes annually.

Municipalities interested in implementing a similar initiative should ensure that the regulatory requirements associated with solar installations are well understood, and that a clear system is in place to issue building permits at an affordable cost. It is also helpful to create a list of pre-qualified contractors to give a choice to customers and reassure them. If possible, participants should be made aware of the different costs associated with different system. Finally, programs should be designed to integrate existing incentives, or to provide an incentive that reduces system costs to a level that is attractive to participants.

City of Toronto



CASE STUDY City of Saskatoon Rain Barrels

In 2010, the City of Saskatoon offered residents the opportunity to purchase household rain barrels. The barrels have been promoted to residents as a form of water conservation, relieving pressure on local water systems and indirectly reducing GHG emissions from the treatment and distribution of water. A large barrel (to which a hose or watering tin can be attached) is a simple yet effective way to eliminate the use of outdoor drinking water.

In Saskatoon, the rain barrel initiative was met with resounding success. The City sold each of the 1,030 barrels it had initially purchased by May, 2010. In response to the high demand, a tender was issued for an additional 500 barrels, to be sold at the City's compost depot locations. Residents that were unable to purchase barrels at City locations were offered a \$10 subsidy toward barrels purchased at local retail outlets. In total, the City has sold over 1,500 units—not including those bought through private retailers. Based on a similar program implemented by the City of Edmonton, the 1,500 rain barrels sold by the City of Saskatoon have the potential to reduce annual GHG emissions by 94 tonnes.*

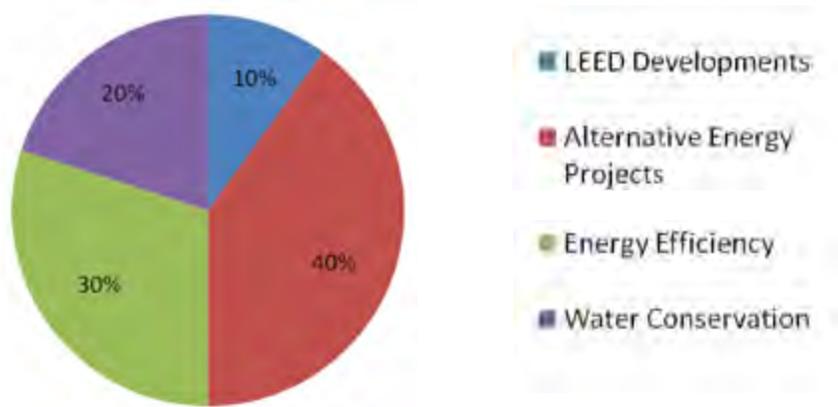


*Based on a house with a 102 m² roof surface, from April to October inclusively, the average rainwater collected is 35.8 m³. GHG emissions can be calculated using a water and sewer factor of 62.77 kg of GHG emissions/m³. (Source: City of Edmonton. Rain Barrel Water Collection Calculations. Accessed electronically from: <http://208.123.216.11/environmental/programs/rain-barrel-water-collection-calculations.aspx>).

PCP collected a total of 10 residential measures. These initiatives ranged from outreach and energy awareness training for homeowners to a government-sponsored LEED® subdivision (see Figure 6). The largest investment reported in this sector was a district energy system implemented by the Resort Municipality of Whistler. The \$4 million system uses alternative energy to provide space heating, cooling, and domestic hot water for 50,000 m² of residential space.

In addition to residential energy saving initiatives, municipal governments can also help to reduce household water consumption. A notable measure in this category is the City of

Figure 7: Residential measures by subsector



Saskatoon's rain barrel program, which has helped to reduce outdoor use of potable water. By decreasing the demand for pumped and treated water, these types of initia-

tives can indirectly reduce GHG emissions from the water and wastewater sector. They also help to alleviate pressure on local water systems.

The measures reported in the residential sector represent more than \$5 million in investments. Altogether, they are reducing GHG emissions by 2,846 tonnes per year!



"Newmarket 14" Flickr/Sean_Marshall

CASE STUDY Town of Newmarket LEED® Platinum Homes

In 2003, the Town of Newmarket purchased a 36-hectare lot for the purpose of building a multi-use community recreation centre. Over a two-year period, the Town worked with residents to develop a comprehensive plan for the entire property. Town and community participants outlined a variety of important initiatives, including the preservation of a historic farmhouse, the retention of significant open space areas, and the creation of a 160-lot subdivision, of which 34 lots were to be set aside with the intention of developing environmentally progressive housing. In 2006, Rodeo Fine Homes responded to the Town's request for proposals, purchasing the lots under the condition that development would meet stringent environmental criteria.

The 34 homes were completed and certified LEED® Platinum in November 2009. Customers can select single- and two-storey designs between 2,000 and 3,500 ft², starting from \$550,000. The new homes boast several environmental features, including rainwater collection with underground storage to flush toilets and irrigate gardens, excellent insulation, air-tight construction for added draft-proofing, heat recovery ventilation, and high efficiency lighting and appliances—to name a few. The homes also received permission from the Province to use the harvested rainwater for laundry purposes. The results are impressive: the homes draw 50 per cent less water, and produces 35 per cent less wastewater compared to conventional housing. The new LEED® units also use 60 per cent less energy than conventional homes!

The Town of Newmarket invested \$500,000 in the project. The initiative also benefited from a \$5,000 Affordability and Choice Today (ACT) grant, which was used to develop a Technical Field Review Manual. The 34-unit subdivision is Canada's first occupied neighbourhood of LEED® Platinum homes. In 2009, the development was awarded the FCM-CH2MHill Sustainable Community Award in the Buildings category.



Town of Newmarket

Industrial, Commercial and Institutional (ICI)

Municipal governments conducting community GHG inventories often have the most difficulty accounting for the industrial, commercial and institutional sectors. Targeted action in these areas is complicated by a number of factors. For example, accurate and reliable energy consumption data is not always avail-

able. Municipal governments also lack regulatory control over many institutional facilities, such as hospitals, schools, etc. Nevertheless, the ICI sector is a major source of community GHG emissions, and there are a variety of ways in which municipal governments can exert their influence.

Sample ICI Measures

- District heating system
- Building operator training
- Energy audits
- Energy efficiency upgrades
- LEED® certification for building retrofits and new construction

CASE STUDY Town of East Gwillimbury LEED® Emergency Shelter

In 2006, Housing York Inc., a non-profit housing corporation operated by the Regional Municipality of York, acquired a site in East Gwillimbury to develop a much needed emergency shelter. The 60-bed emergency facility was completed in 2009, at a total cost of \$2.9 million. The site is currently operated by Blue Door Shelters, a registered charitable agency that serves families that are homeless or at risk of being homeless. The shelter offers accommodations and basic needs, supportive counselling, and life skills learning opportunities for visitors.

Built to meet LEED® certification, the Leeder Place Family Shelter is an initiative where social and environmental principles overlap. It is the first emergency shelter facility in Canada to apply for LEED® certification, and includes the following environmental features:

- Recycled content in building materials
- Energy efficient lighting controlled by occupancy sensors
- Water-saving toilets, faucets and showerheads
- Front-loading washers
- Green housekeeping practices

The project benefited from a broad range of financial support. The Regional Municipality of York contributed \$2.2 million toward the project's total costs. The shelter also received a grant totalling \$583,000 from the provincial Developing Opportunities for Ontario Renters, as well as \$118,000 from the federal Supporting Communities Partnership Initiative. In addition, the Town of East Gwillimbury waived local development charges of approximately \$15,000.

Photo credit: Kristin Griffith/Blue Door Shelters



Environmental initiatives such as these are set to become increasingly commonplace in the Town of East Gwillimbury. In 2006, the Town passed a motion that requires all new Town facilities, as well as new industrial, commercial, and institutional (ICI) buildings within the municipality to be built to achieve a minimum LEED® Silver rating. The Leeder Place Family Shelter was constructed before this policy came into effect, and is therefore an excellent example of how municipalities can work with community organizations to promote sustainable development.

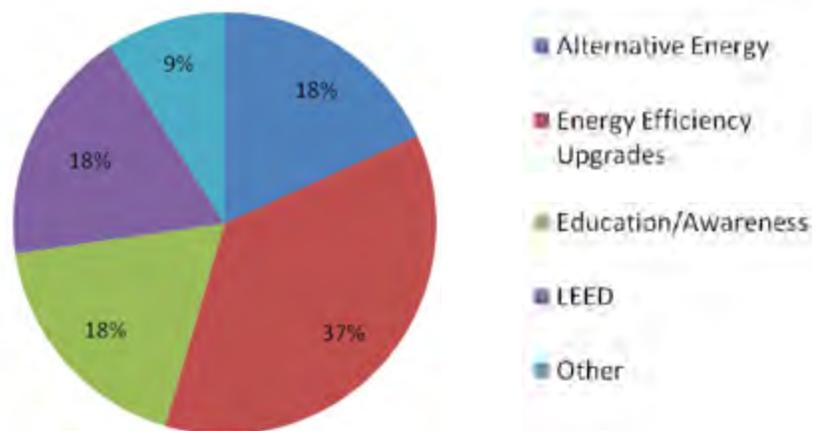
PCP collected data on 11 ICI measures. A large portion of these initiatives were energy efficiency upgrades implemented at community non-profit organizations (See **Figure 7**). These projects focused primarily on lighting and HVAC systems such as boilers, furnaces and air conditioners. Two of the measures reported in this sector involved large-scale district energy systems capable of supplying heat to several commercial buildings. PCP also collected data on two new facilities that were constructed to meet LEED® standards. The remaining ICI measures involved education and awareness raising programs geared toward building operators and small to medium business owners.

With over \$45 million in investments, the ICI sector was the second largest sector in terms of money invested. This figure is largely attributable to

the City of Calgary's Downtown District Energy System, which, given its scale, had relatively high implementation costs. Large investments were also reported for each of the two LEED® measures. The new LEED® facilities incorporate a variety of environmental features, including energy efficient lighting controlled by sensors, storm and wastewater handling systems, water saving appliances,

and passive solar heating and shading. These facilities are not carbon neutral; however, they produce far less GHG emissions than conventional buildings of similar size. They also have the added benefit of reducing water consumption, creating jobs and increasing local knowledge of sustainable building practices.

Figure 8: ICI measures by subsector



CASE STUDY City of Calgary District Energy Centre

The City of Calgary recently developed a district energy centre that generates energy through the use of natural gas, rather than coal. The system became operational in March 2010, and is capable of supplying heat for up to 930,000 m² (10 million ft²) of new and existing commercial and residential space.

The City's Municipal Building was the first facility to be connected to the district energy system. The switch has allowed the City to replace seven aging boilers, and to profit from both lower energy and maintenance costs. These savings bode well for future connections anticipated in the community.

The district energy system cost approximately \$31.8 million to develop. The project was made possible through the Canada-Alberta Municipal Rural Infrastructure Fund (CAMRIF), with federal and provincial contributions of \$10 million each. Construction involved approximately 165,000 people hours over a period of 18 months. The system is owned by the City of Calgary's subsidiary ENMAX, and is registered for LEED® Silver certification.



Spotlight on LEED®

Leadership in Energy and Environmental Design (LEED®) is an internationally recognized third-party certification program that promotes adherence to sustainable green building and development practices. The program was developed by the US Green Building Council (USGBC) in 1998 in order to provide building owners and operators with a standardized green building certification system. In Canada, LEED® certification is administered by the Canadian Green Building Council (CaGBC), which has developed a green rating system tailored specifically to Canadian developments.



The CaGBC works to:

- improve industry standards
- develop best design practices and guidelines
- advocate for green buildings
- develop educational tools to support sustainable design and construction practices

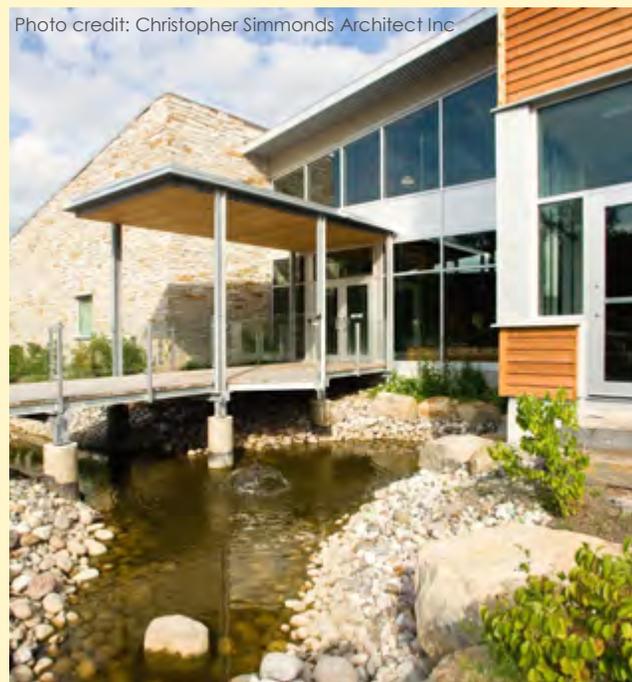
LEED® advocates for a whole-building approach to sustainability, emphasizing the need for performance in five key areas of human and environmental health. These include:

- sustainable site development
- water efficiency
- energy efficiency
- materials selection
- indoor environmental quality

Certification is awarded based on a points system; however, with four possible levels of accreditation (certified, silver, gold, and platinum), LEED® is able to accommodate a wide variety of green building strategies.

The benefits of LEED® accreditation are vast. Compared to conventional buildings, LEED® facilities consume far less energy and water resources. These facilities also provide a platform for showcasing green building practices in the community, and work to increase the knowledge-base for implementing sustainable building and development practices. As of August 2010, there were 196 LEED® certified projects in Canada.

This year's *Measures Report* includes six LEED® initiatives. In the Resort Municipality of Whistler, a public library was built to meet LEED® Gold standards. The facility boasts a variety of environmental features, including geothermal heating and cooling. The Town of Banff recently constructed a new facility to house its hybrid-electric bus fleet. The LEED® silver facility has an innovative rainwater collection system that saves over one million litres of water per year. In the City of Ottawa, the new Paramedic Services Headquarters was built using locally-sourced and recycled materials. Another facility, also located in Ottawa, integrates water and watershed themes into the building design and landscape by using swales, native plants, settling ponds and a constructed wetland. The facility currently houses the Rideau Valley Conservation Authority.



Transportation

The transportation sector captures on-road vehicle emissions generated by residents, local businesses, and various community organizations. These activities are generally one of the largest sources of community GHG emissions, and can easily overshadow emissions generated by other sectors. Nationally, emissions from road transportation have risen by 38 per cent—roughly 37 million tonnes—since 1990.¹² Municipal government initiatives are therefore essential to reduce both the length and frequency of personal vehicle trips.

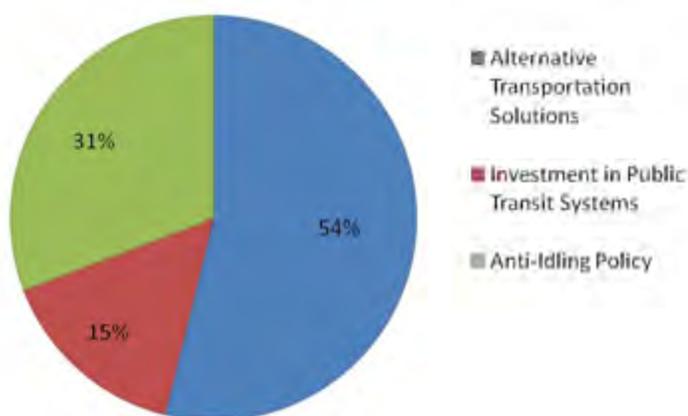
The measures collected in this sector represent approximately 26 per cent of the reported community initiatives. In total, municipal government participants invested more than \$3 million in community transportation programs. The largest expenditure in this sector was a public transit initiative undertaken by The Town of Banff. In 2008, the Town purchased four bio-diesel hybrid-electric buses at a total cost of \$2.6 million.

Most of the reported transportation initiatives focused on Alternative Transportation Solutions (See **Figure**

8). These measures include 'commuter challenges' and 'bike-to-work' campaigns, as well as the construction of dedicated cycling infrastructure and enhanced pedestrian routes. The remaining transportation initiatives focused on public transit systems and unnecessary vehicle idling.

Altogether, these efforts have reduced GHG emissions by 355 tonnes. They have also contributed to improved air quality and the promotion of a healthy, active citizenry.

Figure 9: Transportation measures by subsector



Sample Transportation Measures

- Grants to community-based sustainable transportation organizations
- Anti-idling bylaws
- Improvements to public transit systems
- Commuter challenges
- Dedicated cycling infrastructure
- Sustainable transportation plans

CASE STUDY Town of Annapolis Royal Anti-Idling Policy

In 2008, the Town of Annapolis Royal adopted a strict anti-idling policy that prohibits unnecessary vehicle idling longer than three consecutive minutes. The policy targets internal combustion engines, and applies equally to Town visitors, residents and staff. To ensure compliance, the Town spent \$1,500 disseminating details of the policy throughout the community. These efforts involved signage and documentation, as well as extensive consultations between Town staff and residents.

According to Town staff, who spent 12 months canvassing the community, the anti-idling policy has been met with great acceptance. Vehicle idling has been reduced by two thirds, eliminating roughly 10,000 L in annual gasoline consumption. This remarkable achievement has reduced annual GHG emissions by 23 tonnes!



"No Time to Idle in Westmount" / Flickr jbcurio



"City Bikers in San Francisco" Dreamstime.com/ ©Canbalci

CASE STUDY City of North Vancouver Alternative Transportation Projects

The City of North Vancouver's Transportation Plan aims to promote alternative methods of transportation by enhancing pedestrian routes, greenways and bike corridors, and improving accessibility to public transit. Over the course of 2008 and 2009, the City dedicated considerable resources toward improving its cycling infrastructure and promoting policies that encourage the use of bicycles. These efforts have led to numerous benefits, including healthy, active citizens, vibrant streets, lower GHG emissions, and improved air quality.

In conjunction with various cycling initiatives taking place across the Lower Mainland, the City of North Vancouver has developed dedicated cycling infrastructure to connect corridors both within and outside of the municipality. Between 2008 and 2010, the City created approximately 4,000 meters of bike lanes at a total implementation cost of around \$565,000. The investment in these projects was shared between the City, TransLink (an organization responsible for the regional transportation network of Metro Vancouver), the Insurance Corporation of B.C., and the Province of B.C. In 2010, a substandard bridge over the MacKay Creek was replaced with a wider bridge to improve pedestrian and cyclist connections at a total cost of \$140,000. The City and Translink each contributed \$35,000 with the remaining \$70,000 financed by Western Economic Diversification Canada, a federal department working to promote development and economic diversification in Western Canada.

In addition to these newly created bicycle lanes, the City has outlined various support initiatives designed to enhance the appeal of cycling. Providing secure and sheltered bicycle storage has been identified as a key priority, and the City is striving to provide both short and long term options in order to protect bicycles from theft and weather damage.



City of North Vancouver

Another key element of the City's Transportation Plan is its Travel Demand Management strategy (TDM). This strategy aims to discourage the use of single occupancy vehicles by promoting transportation alternatives, such as cycling, transit, and rideshare programs. The TDM strategy encompasses municipal programs and policies, as well as regional and private sector initiatives. Although it is difficult to calculate the GHG reductions associated with a large and comprehensive Transportation Plan, there can be no doubt that these types of measures contribute positively to the City's long-term vision of sustainability.

Community Waste

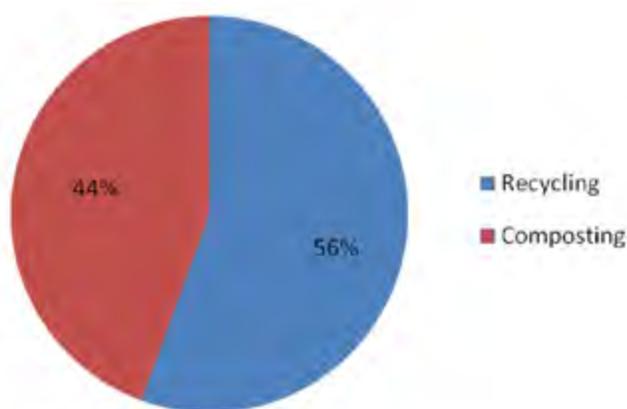
In instances where the municipal authority does not own or operate a landfill, GHG emissions generated by the decomposition of waste are allocated to the community solid waste sector. These emissions typically represent five per cent of a community's GHG emissions, and can be targeted using a variety of waste management strategies.

The measures collected in this sector were primarily waste diversion programs. These efforts were divided fairly evenly between compost and recycling initiatives (see **Figure 9**). Notable compost measures include supplying backyard composters, as well as creating compost depots where community members are able to deposit food and yard waste. Recycling initiatives ranged from

general blue box programs to targeted outreach directed at single- and multi-family households.

In 2009, these initiatives successfully diverted more than 23,000 tonnes of waste from municipal landfills. The result is an annual GHG reduction equivalent to 59,000 tonnes!

Figure 10: Community waste measures by subsector



Sample Waste Measures

- 'Take it back' programs
- Curb-side pickup programs
- Recycling drop-off depots
- Compost drop-off depots
- Backyard composters
- Outreach and education programs

CASE STUDY City of Port Alberni Blue Box Recycling Program

In September 2008, residents of The City of Port Alberni began participating in the City's newly implemented Blue Box Recycling Program. The program offers biweekly curbside pickup for various recyclables, including newspaper, cardboard, mixed paper, metal and plastics. Prior to the initiative, these materials were sent to landfill.

The City estimates that between 2008 and 2009, 315 tonnes of waste were successfully diverted from landfill, leading to a total GHG reduction of 280 tonnes. The cost of this program is not directly funded by the City; instead, the program is financed via a yearly payment of \$30 per resident.



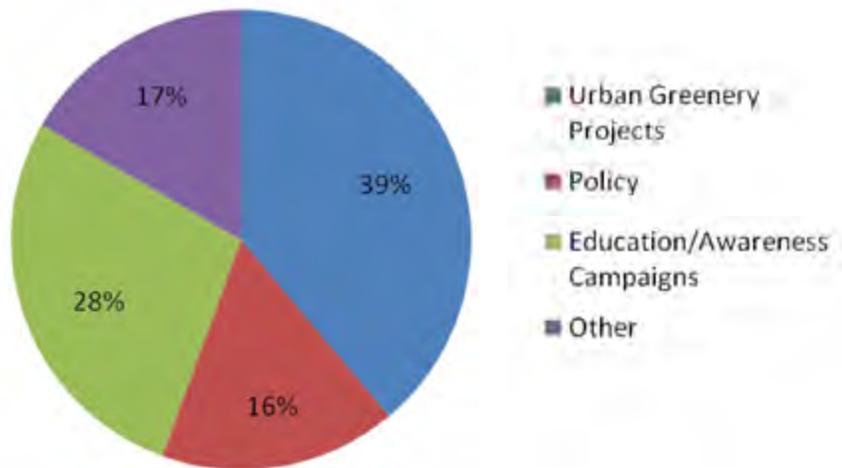
"Neat recycling bins" Flickr/ Dano

Other Measures

The corporate and community sectors outlined above focus on the primary sources of GHG emissions at the municipal level. Transportation patterns, energy consumption in buildings, solid waste management — these types of activities form the bulk of a community's GHG emissions. That being said, a sector-based approach like the one used in this report cannot capture every single source of community GHG emissions. Global climate change is the result of many different decisions taken by many different actors. Municipal governments looking to reduce GHG emissions are by no means limited to the traditional service areas and the community sectors outlined above.

This section examines some of the other measures undertaken by PCP participants. The most common measures in this category were urban forestry and green space initiatives (See [Figure 10](#)). In total, PCP collected seven of these measures. Projects ranged from tree planting and urban forest expansions to

Figure 11: Other measures by subsector



municipal grants supporting small-scale community parks. Notable measures include a Living Wall pilot project implemented by the City of Mississauga, as well as an Urban Agriculture program undertaken by the City of North Vancouver (see [case studies](#)). The City of Toronto has also set an ambitious goal to double tree canopy from 17 to 34 per cent.

Measures in this section also focused on public education and awareness

raising. Municipal government participants reported undertaking a variety of initiatives to engage and educate residents on issues surrounding climate change. For example, several municipalities participated in the 2010 Earth Hour, a campaign organized by the World Wildlife Fund (WWF) that encourages households and businesses to turn off lights and electrical appliances for one hour.

Altogether, these 'other' initiatives have reduced GHG emissions by 830 tonnes.



CASE STUDY **City of North Vancouver Community Gardens**

In 2002, the City of North Vancouver adopted an Official Community Plan, which outlined the City's long-term sustainability vision. The City has worked toward this objective through a number of important initiatives, including the promotion of urban agriculture and community gardens.

Building on the success of the Lower Lonsdale Community Garden, which was built in 2004, the City recently added a second community garden located near the Queen Mary Elementary School. The Queen Mary Community Garden gives residents and garden enthusiasts the opportunity to plant and grow local produce. Individual plots in the 1,700 m² garden are assigned using a lottery system that is administered by the Queen Mary Community Garden Society. To make the garden accessible for all residents, the City constructed several raised beds, which are given priority to wheeled gardeners. Similarly, a demonstration garden was built for the Edible Garden Project, a local non-profit organization that uses the garden to grow produce for its food recovery and donation programs.

In addition to these community garden initiatives, the City has also committed to a five year urban agriculture pilot project in partnership with the University of British Columbia's 'Greenskins Lab'. Initiated in 2009, the project aims to introduce farms into the urban landscape of North Vancouver. Urban farms differ from community gardens in that they provide locally grown food for a large number of people. They offer numerous economic advantages, including local job creation, micro-enterprises and community farmers' markets, increased property values, and reduced transportation costs.

The environmental benefits associated with urban farms are equally large. These can include:

- reduced 'food miles', which minimize GHG emissions arising from transportation and refrigeration
- reduced packaging and waste
- promotion of composting and community organic waste management
- increased crop diversity
- creation of habitats for various species
- rainwater recycling and renewable energy production
- potential to reduce use of fertilizers and harmful pesticides

A unique aspect of the pilot project is the proposed project site: the 4,500 m² farm will be situated in a public park, giving residents the opportunity to participate and engage with farmers working the land. This direct interaction is meant to provide a link between food and table, while at the same time educating community residents on the importance of local food production. The pilot is intended to be a self-sustaining project, generating enough revenue to support two on-site farmers, as well as the maintenance of the farm itself.



City of North Vancouver

CASE STUDY City of Mississauga Living Wall Noise Barrier

The City of Mississauga is promoting environmental stewardship through the use of innovative urban forestry as an alternative to traditional concrete noise barriers. The Living Wall pilot project, which was implemented in 2010, is a non-conventional and ecological way of addressing the common problem of noise attenuation. The barrier contains two rows of fast-growing willow shoots secured by geotextile and a timber cribbing framework that is filled with an earthen core base. The trees that make up the barrier work to absorb sound, as opposed to conventional concrete barriers, which simply deflect noise.

The Living Wall offers several advantages when compared to typical noise attenuation barriers. For example, it requires no painting and will remain free of graffiti. The trees are easy to grow, require little maintenance, and have a life expectancy of more than 50 years. Moreover, they have the additional benefit of absorbing carbon dioxide and creating a visibly 'greener' community.

The Living Wall project cost approximately \$60,000, which is roughly 30 per cent higher than the cost of a traditional concrete barrier. In the short term, the trees will also require annual maintenance costs of \$4,600. The project was made possible in part by a \$15,000 grant from the TD Green Streets program, administered in partnership with Tree Canada. The Living Wall project will also benefit from community support. Two organizations located near the barrier have agreed to water and provide general upkeep at the site.

Municipalities interested in a similar initiative must consider a number of factors:

- Site suitability is important, as the Living Wall requires a water source connection during the initial year of planting.
- Snow loading effects, distance from roadways, and separation from sidewalks should all be considered as the growth width of the living wall is rather large.
- Public acceptance and/or education can influence the success of a project.
- The long term maintenance of a living wall project, both financially and in terms of long-term replacement, are important considerations.
- Industry supply of living wall products is currently limited, and "sole sourcing" may be difficult for municipalities to govern.



Moving Forward

In 2007, a national PCP inventory database was created to track the cumulative impact of the program Canada-wide. Each year, inputs to the database are sought from all PCP members in an effort to track the GHG reduction activities of participating municipal governments. Collection is an ongoing effort, as municipal activities continue to be designed and implemented year after year.

The data provided by PCP Members helps FCM and ICLEI determine and report on:

- the types of GHG reduction measures being implemented at the municipal government level
- the GHG reduction potential associated with specific mitigation measures
- the combined GHG reduction impact of participating communities
- the total cost of GHG reduction measures
- the co-benefits associated with different GHG reduction activities. Co-benefits include, but are not limited to, energy and cost savings, job creation, improved air quality, and citizen engagement
- the total municipal contribution to GHG reductions and the “untapped” potential of further reductions given additional investment

The compilation of the *2010 Measures Report* has identified opportunities that will continue to improve the data collection process and provide our members with more relevant and practical information. To further increase the quantity of measures reported and to address the discrepancies in the detail of the data collected, Secretariat staff will:

- work to lessen the data collection burden faced by municipalities
- improve the data collection mechanism (i.e. online and email forms) and provide more detailed instructions to participants
- look for opportunities to collect data on an ongoing basis rather than once per year
- try to communicate directly with smaller municipalities to help increase their participation
- continue to provide technical support to municipalities

Municipalities that collected data as part of the project implementation were able to provide the most details on investments, cost savings, energy savings, GHG reductions, etc. These details enabled them to track the benefits of any measures, which could be communicated to stakeholders to increase support for future measures. To support this, PCP staff will support and profile the importance of reporting on emission reduction activities throughout Milestone Three (Developing a Local Action Plan) and help municipalities to set the required baselines and indicators as part of the project planning phase.

Through the above-mentioned activities PCP will continue to take stock of municipal government action on climate change, to build capacity so that municipalities are better able to report on their activities, and to encourage action to achieve deep reductions in GHG emissions.



Conclusions

Canadian municipalities small and large have been answering the call to fight climate change. Many significant measures are being implemented at the local level all across Canada, which are meaningfully reducing GHG emissions.

Since its establishment in 2007, the *National PCP Measures Database* now contains over 500 measures. This database houses information on a variety of municipal GHG reduction measures collected over the last 3 years. Together, these initiatives represent nearly \$400 million of investment into mitigation activities and GHG savings of 1.5 million tonnes. The database can be used to provide examples of potential GHG reducing activities. The *2010 Partners for Climate Protection Measures Report* looks at over 180 measures that were collected from 37 municipalities across Canada. The greenhouse gas reductions associated with these initiatives total 350,000 tonnes per year and represent more than \$145 million in investment. Additionally, the measures reported an annual cost savings of nearly \$3.5 million. Unfortunately, due to the difficulty in measurement, not all of the measures collected reported information on each of these criteria. Thus the actual emission reductions, monetary investments and cost savings are considerably larger. The gap in data provided for each measure is something that must be improved in order to have a complete picture of the mitigation actions being taken by communities across the country.

There are countless options to reduce GHG emissions in both the corporate and community sectors. We hope that this report has highlighted the variety of options available to municipalities. Investments in emission reducing measures do not always have to be large to make a difference and can save municipalities money in the long term. Often starting with smaller projects can help gain traction and support to pursue larger projects; in many cases, the projects pay for themselves in less than 10 years.

Canada's municipal governments currently have direct or indirect control over approximately 44 per cent of GHG emissions in Canada. In 2006, this represented control over 315 megatonnes (Mt) of carbon dioxide equivalent of a national total of 718 Mt. It is estimated that municipalities have the potential to supply between 20 and 55 Mt of emission reductions, equivalent to 15 to 40 per cent of Canada's 2020 emission reduction target.

Clearly municipalities have a key role to play in helping Canada meet its commitments for both significant and long-term GHG emission reductions. We hope that this report has shown that municipal leadership in this area is already contributing substantial and cost-effective GHG reductions in every region of the country.



"Stanley Park" Dreamstime.com/ © Bradcalkins

1. Launched in 2007, ICLEI's International Protocol (IEAP) has been reviewed by ICLEI member cities, stakeholders and key peer organizations from around the world, including the United Nations Environment Program, World Resources Institute, International Energy Agency, California Climate Action Registry, and the Federation of Canadian Municipalities. It is informed by developments such as ISO 14064, as well as the Greenhouse Gas Protocol developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The protocol is available online at: http://www.iclei.org/fileadmin/user_upload/documents/Global/Programs/GHG/LGGHGEmissionsProtocol.pdf
2. Note that the measures collected in the 2010 Measures Report were not necessarily implemented in 2010. The Report showcases initiatives implemented prior to and including 2010.
3. At the time of data collection, there were 206 municipal governments participating in the PCP program.
4. Environment Canada, National Inventory Report 1990-2008: Greenhouse Gas Sources and Sinks in Canada, 2010. This document is available on Environment Canada's website at: <http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=0590640B-1>.
5. IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.
6. The IEAP outlines the general principles and methodology that PCP members should adhere to when managing and accounting for local GHG emissions. It identifies the emission sources that should be included in a local GHG inventory, as well as the methods used to quantify these sources. The corporate inventory includes municipal buildings, streetlights, fleet vehicles, water and wastewater treatment, and government solid waste. The community inventory includes the industrial, commercial and institutional (ICI) sectors, the residential sector, the transportation sector and community solid waste.
7. Environment Canada, A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act, 2010. Available online at: http://www.ec.gc.ca/Publications/AD9054AB-6F3E-4A78-9557-E4010A980D92%5CKPIA_2010.pdf
8. British Columbian municipalities contributed 86 (47%) measures to the database. Municipalities in Ontario contributed 56 (31%) of the total 182 measures collected in 2010.
9. The average light duty vehicle produces approximately four tonnes of GHG emissions annually. This figure is based on an average fuel efficiency of 10.8 L/100 km, and an average distance travelled of 15,797 km per year. These averages are taken from Natural Resources Canada's Canadian Vehicle Survey 2007: Summary Report, which is available online at: <http://oee.nrcan.gc.ca/Publications/statistics/cvs07/index.cfm>.
10. Toronto Hydro Energy Services, Streetlight Service Request. Accessed electronically on September 25, 2010 from: http://www.torontohydroenergy.com/street_form.asp.
11. Snider, B. "Home heating and the environment." *Canadian Social Trends* (Spring 2006): 15-19.
12. Environment Canada, National Inventory Report 1990-2008: Greenhouse Gas Sources and Sinks in Canada, 2010. This document is available on Environment Canada's website at: <http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=0590640B->.

Appendix 1 Sample Measures Form



PCP Data Collection Form

Please note that this form is also available in an embedded email format. We strongly suggest completing the email version of the form, as it allows your information to feed directly into the PCP Measures Database. If, however, you are unable to use the email form, please complete the following and return it to pcpmeasures@iclei.org. Depending on your computer software, you may not be able to save a *completed* version of this form. If this is the case, please print a completed copy of the form and fax it to 416-642-0954. You can also print a copy for your own records. Before completing this form, we recommend that you read the **PCP Measures Reporting Guidelines**. It contains helpful instructions on the type of data requested for each question. Thanks for your cooperation and support!

Name of project/measure:

Type any combination of numbers and letters up to 255 characters.

Municipality:

Type any combination of numbers and letters up to 75 characters.

Implementing authority (if different from municipality):

Type any combination of numbers and letters up to 255 characters.

Province:

Type any combination of numbers and letters up to 15 characters.

Submitted by (your name):

Type any combination of numbers and letters up to 100 characters.

Email:

Type any combination of numbers and letters up to 100 characters.

Phone:

Type any combination of numbers and letters up to 50 characters.

Year project implemented:

Type a numeric value.

Area (type either 'Corporate' or 'Community'):

Type any combination of numbers and letters up to 50 characters.

Sector:

Type any combination of numbers and letters up to 150 characters.

Please provide a brief description of the measure:

Type any combination of numbers and letters up to 255 characters.

Indicators:

Type any combination of numbers and letters up to 255 characters.

Total implementation cost (\$ CAN):

Type a numeric value.

Consulting costs (\$ CAN):

Type a numeric value.

Equipment costs (\$ CAN):

Type a numeric value.

Staff costs (or description of staff involved):

Type any combination of numbers and letters up to 255 characters.

Are GMF funds supporting this measure?:

Type Yes or No.

Annual cost savings as a result of the project (\$ CAN):

Type a numeric value.

Payback period (years):

Type any combination of numbers and letters up to 255 characters.

Affected energy type 1 (i.e. gasoline, electricity, etc.):

Type any combination of numbers and letters up to 50 characters.

Annual savings in energy type 1 (i.e. quantity of gasoline saved):

Type a numeric value.

Unit of measurement 1 (i.e. kWh, L, m3, etc.):

Type any combination of numbers and letters up to 50 characters.

Affected energy type 2 (i.e. gasoline, electricity, etc.):

Type any combination of numbers and letters up to 50 characters.

Annual savings in energy type 2 (quantity of energy saved):

Type a numeric value.

Unit of measurement 2 (i.e. kWh, L, m3, etc.):

Type any combination of numbers and letters up to 50 characters.

eCO2 Reduction (tonnes)

Type a numeric value.

How was your data obtained?:

Type any combination of numbers and letters up to 255 characters.

Please list any assumptions that were made:

Type any combination of numbers and letters up to 255 characters.

Additional notes/comments:

Type any combination of numbers and letters up to 255 characters.

Appendix 2 Municipalities that Submitted Measures in 2010

Municipality*	Measures Collected
Annapolis Royal, NS	x
Banff, AB	x
Bathurst, NB	x
Burlington, ON	x
Calgary, AB	x
Coquitlam, BC	x
Cowichan Valley Regional District, BC	x
Delta, BC	x
East Gwillimbury, ON	x
Edmonton, AB	x
Fernie, BC	x
Fredericton, NB	x
Kingston, ON	x
Langley (Township), BC	x
Markham, ON	x
Metro Vancouver (Regional District), BC	x
Mission (District), BC	x
Mississauga, ON	x
Nanaimo, BC	x
New Glasgow, NS	x
Newmarket, ON	x
North Vancouver (District), BC	x
North Vancouver, BC	x
Ottawa, ON	x
Pickering, ON	x
Port Alberni, BC	x
Revelstoke, BC	x
Saanich (District), BC	x
Saskatoon, SK	x
Stanley (Regional Municipality), MB	x
Sudbury, ON	x
Surrey, BC	x
Toronto, ON	x
Vancouver, BC	x
Whistler, BC	x
Yellowknife, NT	x
York Region, ON	x

*Municipalities in bold have also submitted measures for previous reports

Appendix 3: Notes on Data Certainty

Explaining the data collection process.

Data on municipal GHG reductions was collected between March and July 2010. During this period, municipal government liaisons were contacted by the PCP Secretariat with an initial offer of participation. Detailed instructions and a data collection form followed. PCP participants were encouraged to submit information on any municipal government initiative – either corporate or community – that has had a net reduction on GHG emissions.

The data collection form solicited information on a variety of project details, including total implementation cost, annual energy savings (or waste diverted), project payback and annual GHG emissions reductions achieved through the initiative.

Participants were also asked to list their data sources and data assumptions. Including these data fields allowed PCP staff to assess data reliability and in some cases, verify reported calculations.

Most municipal participants used the data collection form provided by PCP. Other municipalities decided to submit information via existing documents, such as project proposals, reports to council, press releases or spreadsheets. PCP staff then extracted the required information on the municipality's behalf. In a few cases, PCP staff collected measures via independent website research.

Each measure was reviewed by PCP staff and added to the National Measures Database. This involved editing, rewording and rearranging

information, as the database has character limitations. In some cases, notes and comments were added for clarity. PCP staff also assessed the reliability of the information provided. Were the reported energy savings based on activity estimates or real consumption data? What emissions factors were used to obtain GHG reductions? Where possible, GHG reductions were compared against energy savings to ensure accuracy and consistency. Each measure was then ranked in terms of data certainty (see table below). Measures were also categorized according to area (corporate or community), sector (i.e., buildings) and sub-sector (i.e., alternative energy).

Degree of Certainty	Description	Example	Prevalence
Incomplete	Measure was not fully implemented at time of submission.	<i>"5-10 rooftop A/C units to be replaced in 2010."</i>	4% (8)
Low	Submission lacks information required to calculate GHG reduction.	Submission does not list annual energy savings, etc.	26% (47)
Medium	GHG reduction is based on partial data or estimates.	<i>"The system is projected to cut 170 tonnes of GHGs annually."</i>	53% (97)
High	GHG reduction is based on real consumption data, and is verified by ICLEI.	<i>"Data on electricity usage was provided by Nova Scotia Power. GHG reduction was calculated using the 2007 electricity intensity values for Nova Scotia (0.00081)."</i>	12% (22)
N/A	Measure was more qualitative, and a GHG reduction was simply not applicable. Some measures were also too 'high level'—meaning they could be broken down into smaller measures.	Sustainable procurement policies, green building standards, etc.	4% (8)

Was there a minimum information requirement for data submissions?

The PCP Secretariat did not impose a minimum information requirement for data submissions. Participants were provided with a set of best practices guidelines for data submission, and were encouraged to submit as much information per measure as possible. In the end, however, all submissions were accepted, regardless of their level of completeness. Consequently, the measures submitted by PCP participants vary considerably in terms of detail level and reliability of data provided. Some participants were able to provide accurate and thorough data for each field requested. Other participants were unable to provide details on key fields, such as project costs, annual energy savings and GHG reduction. Similarly, some participants chose to report their GHG reductions as estimates or projections, while others reported their reductions based on real consumption data.

Did PCP alter or modify the data submitted by municipalities?

Reported GHG reductions were verified, wherever possible, according to the emissions factors provided in Canada's National Inventory Report 1990-2008. In cases where there was a large discrepancy between the reported reductions and those calculated by PCP staff, the participating municipal government was contacted for clarification. In general, however, PCP staff did not alter the information and calculations provided by participants. In other words, the information included throughout the report appears as it was submitted by the municipal government participants.

How did PCP analyze the data?

Most of the data analysis was conducted at the sector level. Measures were grouped according to each corporate and community sector

(i.e., buildings, fleet, streetlights, etc.). This allowed PCP staff to determine the cumulative GHG reduction and money investment for each sector. The average GHG reduction per sector (i.e., "The average measure in the buildings sector reduces GHG emissions by X...") was also calculated. It should be noted, however, that not all measures included information on GHG reduction. Of the 38 fleet measures, for example, only 24 (63%) measures included information on GHG reduction. In this context, the average GHG reduction per fleet measure only reflects 24 fleet measures.

Within each sector, measures were also categorized according to subsectors. The list of subsectors varied depending on the sector. For example, subsectors in the buildings sector include, among others, alternative energy projects, energy efficiency retrofits, LEED® construction, and energy conservation initiatives. Similarly, corporate fleet measures were categorized according to hybrid or electric technology, biofuels, rightsizing initiatives or broader fleet management plans.

PCP staff also analyzed the data in relation to participant information (i.e., population size, geographic location, etc.), cost savings, and the relationship between money invested and GHG reduction. It should be noted, however, that the uneven level of detail between data submissions limited the ability of PCP staff to make definitive observations. Determining the relationship between investment, savings and GHG reduction was particularly difficult. Of the 182 measures collected, 61 (34%) did not include information on GHG reductions. Similarly, more than half of the 182 measures lacked information on cost savings and implementation cost. PCP staff therefore had to narrow the data to only those entries

that included information on each of these three fields. This left a total of 43 measures available for a cost-reduction analysis.

Another problem that PCP staff encountered was the distinction between incremental costs and total project costs. For example, the cost of constructing a new facility to LEED® standards can range well over \$10 million. However, this figure typically represents the cost of the entire facility; it does not necessarily represent the cost of the facility's environmental features. A similar example can be made with the purchase of a hybrid vehicle. Participants tended to list the cost of the entire vehicle (e.g., \$30,000) rather than the incremental cost of purchasing a hybrid (e.g. \$5,000). These data entries ultimately distort the relationship between money invested and GHG reduction, because they create unusually long payback periods as well as GHG reductions that are relatively small compared to the amount of money invested.

Given these methodological challenges, PCP staff did not make general statements on the relationship between dollar investment and GHG reduction (i.e., average investment per tonne reduction, average payback period, etc.). Instead, PCP staff compiled a list of 10 measures deemed notable in terms of their relative GHG reductions and payback periods. This sampling (see "General Findings and Trends") should give readers a very general idea of what is achievable with different investment levels.

The remaining data analysis was relatively straightforward. Sector-specific methodologies can be found in the corresponding sections of this report.

How does the 2010 Measures Report relate to ICLEI's International Emissions Analysis Protocol?

Launched in 2007, ICLEI's International Emissions Analysis Protocol (IEAP) has been reviewed by ICLEI member cities, stakeholders and key peer organizations from around the world, including the United Nations Environment Program, World Resources Institute, International Energy Agency, California Climate Action Registry, and FCM. The IEAP is informed by developments such as ISO 14064, as well as the Greenhouse Gas Protocol developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The protocol is available online at: http://www.iclei.org/fileadmin/user_upload/documents/Global/programs/GHG/LGGHGEmissionsProtocol.pdf

The IEAP outlines the general principles and methodology PCP members should adhere to when managing and accounting for local GHG emissions. In addition, the IEAP identifies the emissions sources that should be included in a local GHG inventory, as well as the methods used to quantify these sources. The 2010 Measures Report is organized according to the categorization scheme outlined in the IEAP. Corporate emissions are defined as those belonging to local government operations and include the following sectors: buildings, vehicle fleet, streetlights, water and wastewater, and corporate solid waste. Community emissions are those generated by activities within the community, and include: residential, industrial, commercial and institutional, transportation, and solid waste.

It should be noted, however, that the IEAP is meant for developing local GHG inventories, not necessarily to monitor specific GHG reductions. There is some overlap between these two activities. For example, the methods used to calculate the energy footprint of a building would not differ substantially from those used to calculate the GHG reduction associated with an energy efficiency retrofit conducted at a municipal facility. That being said, many reduction initiatives fall outside the scope of the IEAP. Consider, for example, a ban on bottled water in municipal facilities. Calculating the GHG reduction associated with this initiative might involve a lifecycle analysis, in which the upstream energy used in manufacturing and transportation is considered.