APPENDIX A
(CR-FM-11-011)

CORPORATE GREENHOUSE GAS INVENTORY AND ACTION PLAN FOR REGION OF WATERLOO OPERATIONS

Summary Report

May 3rd, 2011

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BACKGROUND

Concern over the increasing trend in climate change and the degradation of air quality in urban areas has resulted in an international focus on the reduction of anthropogenic greenhouse gases (GHG) emissions worldwide (those caused by human activities). The concern is that growing atmospheric concentrations of GHG have been gradually increasing the global temperature beyond historic levels which, if this trend were to continue, could significantly disrupt climate and ecological systems and consequently our quality of life. There is a growing body of evidence to suggest these disruptions are already beginning to occur in different parts of the world.

As many sources of GHG emissions are energy based, efforts to reduce emissions from the consumption of electricity, natural gas and other fuels have the additional benefit of managing energy resources more sustainably. Energy conservation, using energy more efficiently and exploiting renewable sources of energy all can help achieve greater energy security in the future and often can achieve substantial operational savings. Combustion of non-renewable energy resources also emit air pollutants contributing to smog formation and threatening human health. Therefore reducing GHGs from human activities has a number of potential benefits for environmental, economical, as well as social sustainability.

The Region of Waterloo's *Corporate GHG Inventory and Action Plan* supports several components of the Environmental Sustainability Strategy approved by Regional Council in 2009. The Vision of the Environmental Strategic Framework describes Waterloo Region as a "…sustainable community for current and future generations." The Environmental Policy Statement commits the organization to "…embrace environmental considerations in all of its decisions...". By design, the GHG Inventory Action Plan also incorporates several of the Sustainability Strategy's Guiding Principles:

- *Think Globally and Act Locally - through local decisions and actions, efforts are needed to reduce potential negative environmental impacts to other geographic areas around the planet as well as within our own community.*
- *Balance - requires all plans and operations to strive to achieve the optimal beneficial balance between the environment, community needs and the fiscal capacity of the Region to reduce or mitigate the environmental impact.*
- *Leadership - the need "to walk the talk" by demonstrating environmental leadership within our Regional operations, planning and daily activities*.
- *Accountability, within the context of the Region's commitment to Sustainability, means developing and reporting on environmental progress indicators, setting targets, and striving to continuously improve our environmental track record*.

Additionally, the Environmental Sustainability Strategy includes goal statements such as "*effectively use and manage energy resources and reduce greenhouse gases and other air emissions from ROW activities."* Therefore the Region's Corporate GHG Inventory and Action Plan represents a significant step in enabling the Region to incorporate Sustainability within its operations.

INTRODUCTION

In the spring of 2010, Regional Council passed a resolution to participate in the national Federation of Canadian Municipalities Partners for Climate Protection program (FCM-PCP) as well as the local Sustainable Waterloo Regional Carbon Initiative. The PCP program, supported by over 200 municipalities across Canada, is comprised of five milestones that each participant commits to achieving for both their organizational scope as well as on a community scale. The five milestones are as follows:

1. Creating a greenhouse gas emissions (GHG) inventory and 10 year forecast;
2. Setting emissions reductions target 10 years from the base year;
3. Developing a local action plan;
4. Implementing the local action plan or a set of activities; and
5. Monitoring progress and reporting results.

The Regional Carbon Initiative was launched in 2009 to encourage and enable local organizations to develop an action plan to reduce their organization's GHG emissions. Sustainable Waterloo currently has 37 local members participating in the initiative from industrial, commercial and institutional sectors as well as support from local government. This initiative has created a local network of organizations engaged in mitigating the negative impact on Climate Change by reducing GHG emissions from activities within Waterloo Region.

The strategic partnerships with FCP-PCP and Sustainable Waterloo are inter-related as they will help the Region of Waterloo become a part of the action oriented environmental leadership being demonstrated in communities across Canada.

The Region has often reported on the environmental benefits of individual projects including GHG reductions on a case by case basis. Over the past decade or so, numerous Regional initiatives have resulted in thousands of GHG emission reductions. However, these achievements have not been measured consistently or tracked towards a reduction target in a consolidated manner to monitor progress on an ongoing basis.

In 2002, Public Health led an interdepartmental team of Regional staff that conducted an air emissions inventory of Regional operations and prepared an action plan however GHG were not within the scope of the project at that time. Therefore this is the first comprehensive account of the Region of Waterloo's organizational GHG footprint.

This document outlines the work carried out over the past year to complete PCP milestones 1-3 for the Region of Waterloo corporate scope. Specifically, a summary of the emissions inventory and forecast is provided along with an overview of the action plan and recommended reduction targets for both the PCP program and the Regional Carbon Initiative.[1]

[1] The community scope of the PCP program is proposed to commence later in 2011.

GHG EMISSIONS INVENTORY

The emissions inventory was developed in accordance with the International Local Government GHG Emission Analysis Protocol – Version 1.0 (October 2009) required by the FCM-PCP program. The following is the scope of Region of Waterloo operations included in the inventory based on the operational approach defined within the protocol:

- Buildings and facilities fuel and electricity usage (includes refrigerants in chillers)
- Fleet fuel use and contracted transport (e.g. waste collection/diversion)
- Staff business travel and commute
- Landfill gas emissions (flared and fugitive)
- Wastewater treatment and biosolids management
- Street lighting and traffic signals

The inventory was populated by collecting activity data from Regional operations and applying the most recent emission factors for the six leading contributors to climate change that include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6). For the purpose of reporting, these six chemicals are converted to equivalents of carbon dioxide (CO2e) based on their recognized global warming potential. For example, methane has a global warming potential 21 times more potent than CO2 and therefore one tonne of methane equals 21 tonnes of CO2e.

Activity data refers to the quantified information that is the input to calculating GHG emissions. This data was obtained from a number of existing Regional databases, such as energy and fuel consumption, and was estimated for other sources based on available information such as purchase records, equipment capacity and staff mileage claims. Established engineering models were utilized to estimate emissions for more complex sources such as fugitive emissions from the Region's landfill and air conditioning equipment.[2]

Emission factors convert inputs such as megawatt hours (MWh) of electricity consumed in a year to CO2e. For example, the figure of 0.170 tonnes CO2e per MWh was the emission factor applied to the Region's electricity consumption referenced from Environment Canada's GHG inventory for the year 2008 (published in the spring of 2010).[3] More detailed calculations for all Regional emission sources are currently housed within an Excel based inventory management database.

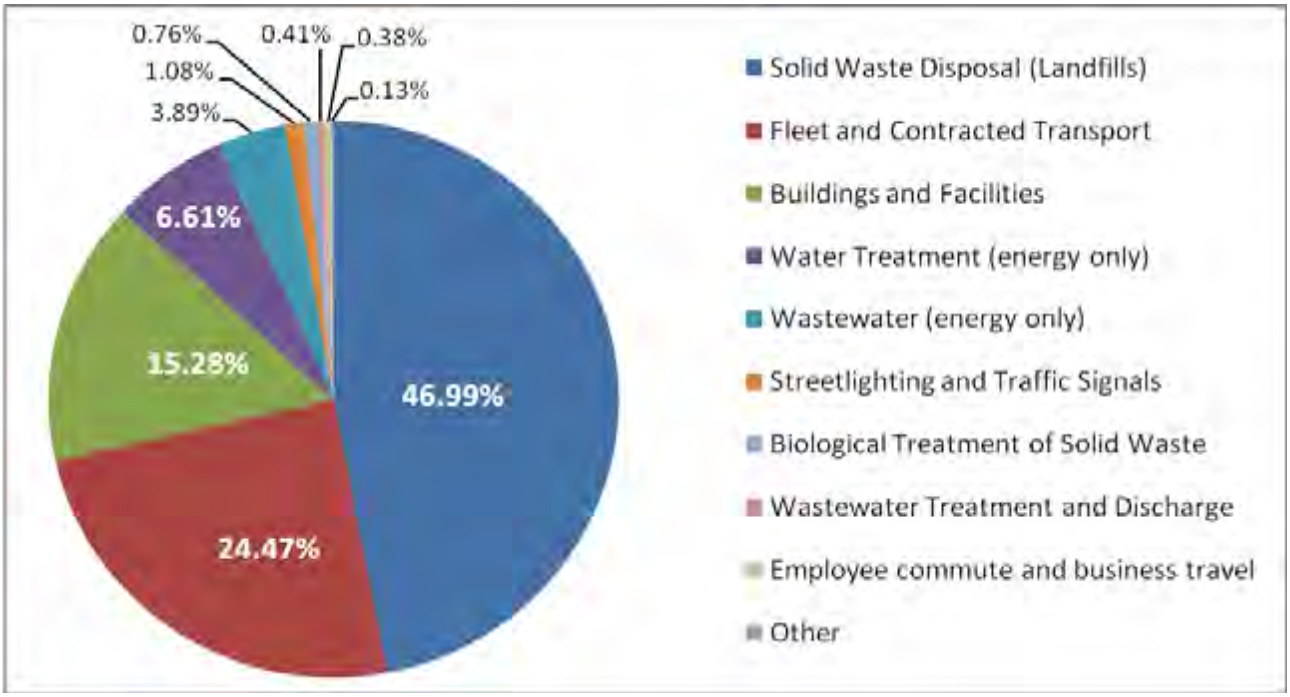
In order to develop a GHG inventory, emissions forecasts and reduction targets, a base year needs to be established. A base year of 2009 was chosen out of four options due to the availability of the most accurate and complete datasets.

[2] The complete inventory methodology is recorded in an Inventory Management Plan which is essentially a manual for ongoing database management, inventory replication in future years and quality control.

[3] Ontario power mix emission factor.

The inventory has been verified by a third party in order to receive a limited level of assurance that it was prepared in accordance with the appropriate international standards in terms of its accuracy and methodology.[4] Figure 1 provides a snapshot of the proportionate emissions by the major source categories within the scope of the inventory.

Figure 1. Region of Waterloo GHG Emissions from Operations (Year 2009)



Solid Waste Disposal (fugitive methane)	69,521	46.99%
Fleet and Contracted Transport	36,244	24.47%
Buildings and Facilities	22,636	15.28%
Water Treatment (energy only)	9,785	6.61%
Wastewater (energy only)	5,763	3.89%
Street Lighting and Traffic Signals	1,606	1.08%
Biological Treatment of Solid Waste*	1,122	0.76%
Wastewater Treatment and Discharge	609	0.41%
Employee commute and business travel	565	0.38%
Other (e.g. refrigerants in chillers, air conditioning units)	194	0.13%
TOTAL t CO2e	**148,138**	**100%**

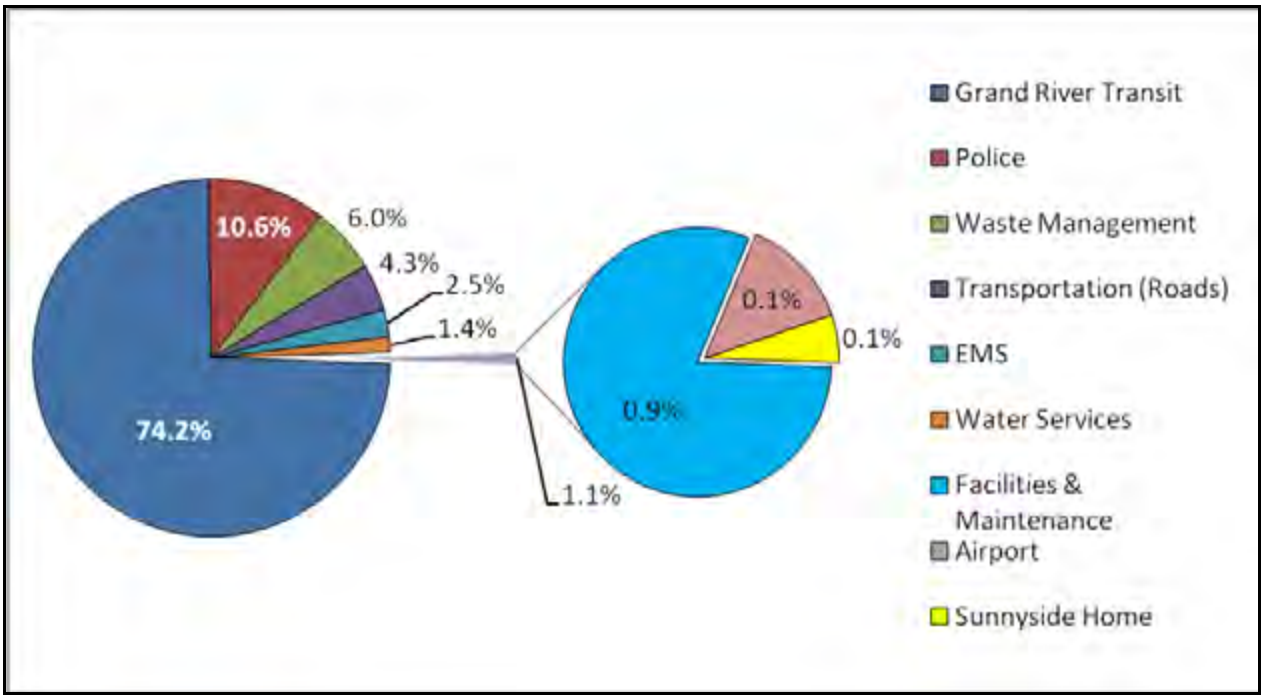
* Green bin materials, leaf and yard waste

[4] ISO 14064 – 3: *Specification with Guidance for the Validation and Verification of Greenhouse Gas Assertions,* 2005.

The top three sources of GHG emissions from Regional operations are fugitive landfill gas then transport (fleet) and buildings. There are significant amounts of landfill gas captured for use as energy at both the Waterloo and Cambridge landfills. However, a model used for the Region's compliance reporting to the National Pollutants Release Inventory indicates that 25% of the potential methane in landfills escapes as fugitive emissions before they are captured by gas collection systems. Due to the global warming potential of methane, this source dominates the inventory by accounting for almost half of the Region's GHG footprint.

The government transport emission source is comprised of 80% Regionally owned fleet vehicles and equipment with approximately 20% attributed to contracted transport of waste/recyclables and water treatment chemicals. Out of the Regionally owned fleet, three quarters of emissions are associated with operation of transit vehicles as illustrated in figure 2. This poses a significant challenge in planning emission reductions and setting targets as expansion of transit service is a core part of the Region's Transportation Master Plan and the Regional Official Plan. Up to 2009, FCM-PCP participants could include transit in the scope of their *community* inventories. However, the most recent protocol for the PCP program requires this emission source to be included in *corporate* inventories for those Municipalities responsible for providing transit service.

Figure 2. Corporate Fleet and Equipment CO2e Emissions (2009)



Buildings and facilities include all Regional owned housing units, day cares, operations buildings, museums, transit and airport terminals, library headquarters, Sunnyside, Police and EMS facilities and administrative offices (owned and leased). Emissions from water and waste water operations account for approximately 11% of the Region's total GHG emissions (including treatment and discharge). These figures were derived from parallel studies conducted as part of the Water Supply and Biosolids Master Plan review process.

EMISSIONS FORECASTS

The FCM-PCP program requires that a status quo forecasted emissions value be calculated for 10 years forward from the base year used in the emissions inventory. Influential variables considered in calculating the Region's emission forecasts include factors such as:

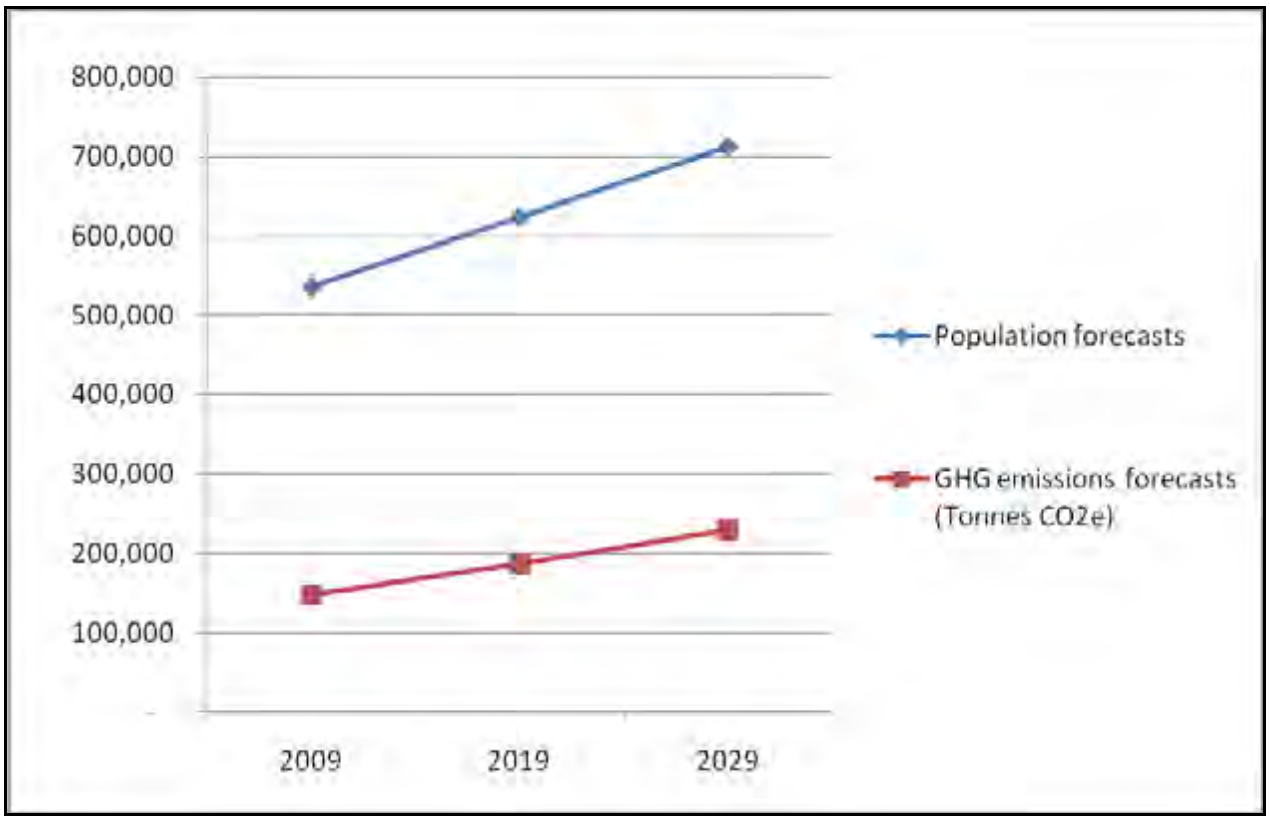
- planned expansion of Regional facilities and fleet (including transit);
- projected population growth and associated increased demand on services such as water and wastewater treatment, waste management;
- changes in the provincial energy mix (e.g. elimination of coal fired power plants), and;
- improvement in vehicle fuel efficiency and air conditioning (use of non-GHG refrigerants).

In addition to calculating projected emissions for the year 2019, forecasts were also calculated for 2014 and 2029 as indicated below in tonnes of CO2e to provide short-term and long-term values:

2009	2014	2019	2029
148,138	168,722	189,306	227,257

The trend line from the base year to 2029 is similar to the projected population growth during this period as can be seen in figure 3. These forecasts will need to be recalculated in the future as the inventory is updated periodically.

Figure 3. Regional Corporate GHG Emissions and Population Forecasts



ACTION PLAN

Action plans and targets are an integral part of the PCP program and Regional Carbon Initiative and act as the bridge from the accounting of emissions in the base year to the implementation of specific projects that reduce GHG in the years to follow. For any municipality that has an increasing population, the challenge is to reduce emissions while at the same time expanding operations to meet growing demand for community programs and services. Furthermore, as the Region of Waterloo has been implementing many emission reduction initiatives over the past decade or so, there is less "low-hanging fruit" that can be implemented quickly, easily and inexpensively.

The approach used by staff was to develop an action plan that is pragmatic in its focus and detail yet still ambitious enough to demonstrate progress from the status quo. Given the challenges and constraints identified within the Inventory and Forecast section of this document, ***the overall goal of the Region's Corporate Climate Action Plan is to reduce the GHG intensity of operations while continuing to provide high quality community programs and services to a growing population.***

The strategy incorporated into the development of the action plan is as follows:

1) Review existing or recently approved initiatives that are in progress of being implemented and quantify their expected impact on emissions;
2) a) Identify new initiatives, prioritizing the Region's three highest emission categories, and estimate their GHG reduction potential and cost of implementation;

   b) Include consideration of standard asset replacement schedules for incremental upgrades and improvements over a ten-year period;
3) Propose a reduction target based on numbers 1 and 2 above and obtain approval from Regional Council, and;
4) Follow-up with individual departments to further assess the feasibility and timing of implementing specific initiatives on an ongoing basis and report back periodically on projects already completed as well as those ready for implementation while highlighting any budget implications (see section entitled: Implementation, Monitoring and Reporting).

Initially, three different timeframes were identified within the action planning process:

- short-term including the years 2010 to 2014;
- mid-term: 2015 to 2019 and;
- long-term; 2020 – 2029.

However the focus was placed on the short and mid-term timeframes as there are too many uncertainties to assess specific emission reduction initiatives with a reasonable level of validity and accuracy in the long-term at this point in time.

Regional operational staff were engaged via surveys, interviews, workshops and site audits to provide input into the plan's development. This included a brief review of reduction initiatives that had been implemented over the past few years, compilation of relevant approved initiatives that are currently being implemented or being planned for implementation in the short-term as well as identification of

new initiatives that could be implemented in the next 10 years. Options were evaluated based on available information such as estimated cost, technical feasibility and emission reduction potential. Initiatives that were fully implemented before or during 2009 cannot be included in the emission reduction plan as they will already be accounted for in the base year inventory. In addition other large projects such as the methane gas capture at the Region's landfills and installation of solar panels on Regional buildings are also ineligible as the emission reduction technically belongs to other organizations.[5]

Over 100 actions were identified initially with approximately 50 remaining in the current proposed action plan. Those that were not included either lacked the necessary information for evaluation or were insignificant in reduction potential. Initiatives that are already approved and are in progress can be included as part of the targeted emission reduction if they were not accounted for within the 2009 inventory database. These 'committed' projects are incorporated within the action plan and were estimated to reduce approximately 16,000 tonnes of GHG when completed as listed below:

- Expansion of green bin program which reduces landfill methane gas production = reduction of 9600 Tonnes annually by the year 2019
- Solar flaring of methane at landfill for odour reduction (reduces fugitive methane emissions from landfill) = 4600 T/yr.
- Construction of six new LEED buildings (energy reductions compared with construction to model national building energy code) = 1600 T/yr.
- Purchase of 6 new hybrid diesel-electric transit buses (compared to conventional standard diesel GRT buses) = 80 T/yr.
- 100 Furnace upgrades in Regional Housing = 50 T/yr.
- Lighting and equipment retrofits in Regional administration buildings = 50 T/yr.
- Green energy purchase (LEED building) = 20 tonnes (years 2010 and 2011 only)

Including the impact of committed actions is important to acknowledge the effect of current environmental programs as well as more resource efficient buildings, equipment and vehicles being built or purchased as they will improve the sustainability of operations in the years to come. The following table summarizes the impact of both committed/approved actions as well as suggested new initiatives quantified within the action plan:

	Estimated Potential GHG Reductions in Tonnes (CO2e)			(rounded)
Emission source	**Short-term Initiatives 2011-2014**	**Mid-Term Initiatives 2015-2019**	**Totals**	**% of Current Action Plan**
Waste/Landfill	12,150	2,040	**14,190**	**61%**
Fleet	890	1,400	**2,290**	**10%**
Facilities/Streetlights	3,050	910	**3,960**	**17%**
WWTP/Biosolids	-	2,560	**2,560**	**11%**
Other	330	-	**330**	**1%**
TOTALS	**16,420**	**6,910**	**23,330**	**100%**

[5] The Region receives revenue for these initiatives instead of being credited with achieving the emission reduction.

As previously indicated within the committed projects list, two existing actions related to landfill emissions address the Region's largest single source of GHG emissions and represent the majority of potential reductions in tonnes. However, many of the new individual actions are in the Facilities and Fleet area and may require pilot projects for evaluation before full implementation is considered within the targeted operations. There are some projects which are also of a large scale and will require implementation to be phased-in over multiple years. The emission reduction potential of the initiatives quantified within the action plan are summarized in the following table and include estimated implementation costs and potential savings (several initiatives are bundled together here for brevity):

Suggested GHG Emission Reduction Initiatives: 2011 – 2019

Initiative	Estimated Annual* GHG Reduction (T CO2e)	Year(s) of Implementation	Estimated capital cost (annual = operational cost)	Estimated payback period
Water and Wastewater Systems				
Energy efficiency (process design) initiatives as part of Biosolids Master Plan (BMP)/ WW treatment review	2560	2014 – 2019	(Incl. in BMP implementation budget)	Not Applicable (NA)
Fleet Initiatives				
Use of B5 Biodiesel added to current GRT diesel fuel	1065	Pilot 2012 All Buses: 2014	$137,000/year	NA
Green Fleet Procurement (hybrids, after market technology)	525	2011 - 2019	$2.8 million	7-8 years
Vehicle data management[6], centralized fleet pool, training (e.g. idling reduction)	440	Pilot: 2011 Expanded: 2012 - 2019	$1.15 million	10 years
Use of B5 Biodiesel in corporate fleet	150	2012	$10,000 (capital) + $19,000/year	NA
Facilities and Streetlight Initiatives				
Retrofit streetlights on Regional roads	680	2014 – 2019	$3.4 million	10 years
Six different HVAC retrofit projects in various Regional buildings	480	2011 - 2019	$1,272,000	10 years
650 Furnace upgrades in Regional Housing units (within annual replacement schedule)	230	2011 - 2019	$260,000	10 – 12 years
Green Energy Purchase for a high profile public Regional building	670* (total for 3 yrs.)	2012 - 2014	$37,200	NA
Interior/Exterior lighting retrofits and upgrades at various Regional buildings	100	2011 - 2014	$1,164,000	10 – 15 years
Other Initiatives				
Accounting of Regional tree planting (e.g. in closed cells of landfill)	330* (total for 4 yrs.)	2011 - 2014	$10,000	NA
Other staff education related projects to reduce energy use and business travel	100	2011 - 2019	*unavailable*	*unavailable*
Total: 7330 Tonnes				

[6] Vehicle data management is a pre-requisite to effective monitoring of most Green Fleet initiatives.

Many action plan items will have payback periods in the 7-12 year range based on cost savings for reduced fuel or energy consumption whereas only a few initiatives are expected to influence a relatively small increase in annual operating costs. Preliminary capital costs calculations for new projects are based on pre-feasibility estimates and may not include more detailed studies required prior to implementation (see section Implementation, Monitoring and Reporting).

More complex, innovative or longer-term initiatives have yet to be assessed and incorporated within the current action plan. For example, staff plan to investigate:

- Greening the Region's information technology centre
- Cogeneration – combined heat and power, waste heat recovery
- Further renewable and alternative energy production opportunities
- Use of electric vehicles with renewable energy charging stations
- Alternatives to managing waste when the current landfill is full

Ongoing assessment of these and other initiatives will need to be a part of the continuous improvement process adopted by staff to keep the plan up to date, relevant and effective.

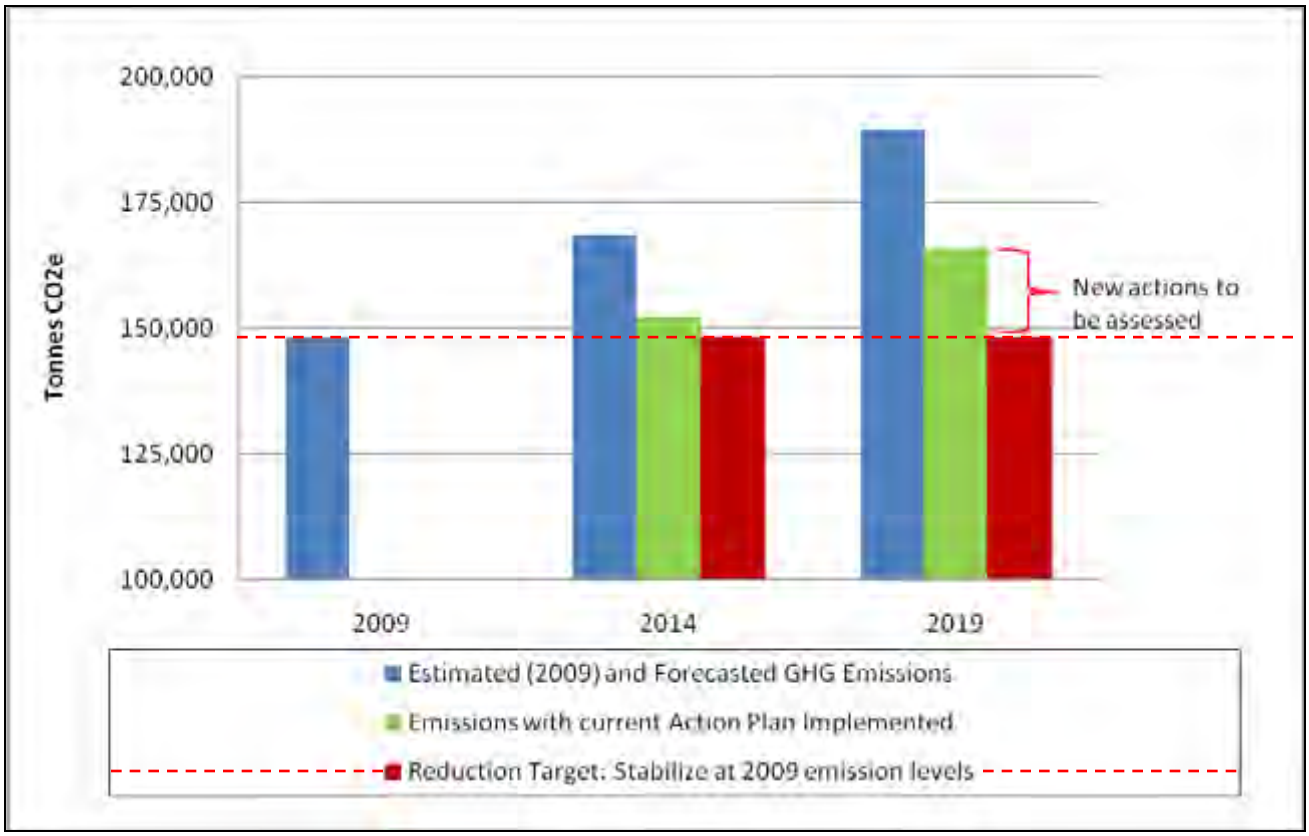
REDUCTION TARGETS

Several municipalities have considered different target reduction scenarios in establishing their commitment to the FCM-PCP. Status quo (i.e. no change in current operations) is the base scenario used in the forecasts which is not practical to maintain as there is a clear business case for many projects that have both financial and environmental benefits. Another option is to set a target based on an international protocol or established national/provincial GHG reduction targets which usually use 1990 as the base year. As the Region's base year is 2009, reduction target percentages established within senior government GHG plans are not suitable to adopt as the 1990 emissions levels for Regional operations are unknown.

FCM-PCP suggests a 20 per cent reduction below the baseline year GHG emissions for municipal operations within 10 years. As this would require a reduction of over 70,000 Tonnes of CO2e, this is not seen as practical due to the forecasted growth in the Region of Waterloo's emissions. Furthermore, discussions with FCM staff and review of other municipalities' progress reports indicate that many jurisdictions are not meeting their corporate targets. Although it is desirable to be aggressive on mitigating climate change, unrealistic targets are often beyond the practical reach of local government organizations given a variety of constraints (e.g. growing communities, budgets).

Another option is to offset the projected growth in emissions by stabilizing emissions at the base year level. This would yield an improvement in the GHG intensity of Regional operations (e.g. per square metre, per capita). Stabilizing the Region's emissions to 2009 levels is a reasonable yet ambitious stretch as it will require a substantial investment of time and financial resources. This target requires reductions of 41,000 tonnes of GHGs in the next 10 years to offset the projected 28% growth in emissions from Regional operations. ***Therefore the recommended mid-term target for the FCM-PCP program is to maintain 2009 emission levels through to 2019.*** Figure 4 illustrates this target in relation to emission projections and quantified actions within the proposed plan.

Figure 4. Forecasted GHG Emissions and Targeted Reductions



In the short-to-mid-term (2011-2019), the recommended target may not reduce the Region's total or absolute emissions but will improve them on a per capita basis as illustrated in the table below. ***A per capita GHG reduction of 14% by year 2019 is the recommended target for Sustainable Waterloo's Regional Carbon Initiative given that the Region's operations are so closely tied to providing programs and services to an increasing population.*** In the long-term (2020 – 2029) absolute reductions are more likely achievable with advances in technology, cleaner energy sources and ongoing integration of environmental considerations in Regional decision-making.

(Per capita figures rounded)		**Status Quo**	**Reduction to 2009 levels**	**% Reduction per Capita**
Year	**Population**	**T CO2e Per Capita**	**T CO2e Per Capita**	(compared to 2009)
2009	534,900	0.28	0.28	
2019	623,450	0.30	0.24	**14%**
2029	712,000	0.32	0.21	25%

It is recommended that the targets established for both the FCM-PCP program and Sustainable Waterloo be re-evaluated by Regional staff periodically to assess if more stringent targets are achievable as progress on implementing the action plan is made over time (see next section: Implementation, Monitoring And Reporting).

IMPLEMENTATION, MONITORING AND REPORTING

Actions that could potentially reduce over 23,000 tonnes of GHG by 2019 have been identified in the current action plan. However, several of these initiatives will still require feasibility assessments, pilot studies, various approvals as well as sources of funding to be identified. The balance of the 2019 target is proposed to be made-up of further best management practices review and more in-depth analysis of emission reduction opportunities within current asset management, operations and master plan review processes over the next 2-3 years. This will be accomplished by establishing an inter-departmental GHG Task Force similar to the one used from 2002 – 2005 for the Region's Clean Air Plan and more recently with the staff GHG workshops.

It is recommended that this new Task Force be established to:

a) monitor the progress of assessing and implementing GHG reduction initiatives;
b) complete assessment of additional actions to further reduce emissions in order to meet the 2019 target;
c) recommend long-term sources of funding to support implementation of new GHG actions.

It is further recommended that the Task Force be chaired by the Region's Sustainability Planner and report to the Environmental Leadership Committee periodically and the Corporate Leadership Team as appropriate. Each department will be responsible for leading the implementation of its initiatives within the action plan. The GHG Task Force will compile additional data as initiatives are assessed and/or implemented to aid in monitoring progress towards the Region's reduction targets. The GHG database will be managed by the Sustainability Planner.

As part of the public reporting required by the FCM-PCP program and Sustainable Waterloo's Regional Carbon Initiative, Regional Council will receive progress updates as the action plan is implemented. The inventory and forecasts should be recalculated every three years to ensure accurate monitoring of progress by using the most current actual input data and up to date forecast variables in relation to established targets. At that time, reduction targets can also be reviewed based on the performance achieved, and consideration given to revisions that would make the Region's reduction target more aggressive.