Report: PDL-CPL-16-38

Region of Waterloo

Planning, Development and Legislative Services

Community Planning

To: Chair Tom Galloway and Members of the Planning and Works Committee

Date: September 13, 2016 **File Code:** D06-80

Subject: 2012 – 2015 Corporate Greenhouse Gas Reduction Plan Progress

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Recommendation:

For Information.

Summary:

This report provides a progress update on the corporate Greenhouse Gas (GHG) emission reductions achieved under the Region's commitment to the Federation of Canadian Municipalities Partners for Climate Protection program and the local Sustainable Waterloo Region initiative. Emission reductions from Regional operations as of year-end 2015 were estimated to be 15% below the base year of 2009 despite significant increases in the size of Regional facilities and fleet of vehicles. The Region currently appears to be on track to meet its emission reduction target of 10% below 2009 emissions level by the year 2019. More detailed analysis of trends and key performance indicators as well as projections to the year 2019 are included within Attachment A.

Sustained efforts to control GHG emissions continue to be required to offset growth in Regional operations and to help reduce the rising costs of fuel, electricity and natural gas. This will likely be achieved via improved asset management as well as the use of efficiency measures, alternative technologies and renewable energy sources where appropriate. Increases in emissions from fleet and the landfill, as well as overall energy use, are expected over the next several years due to planned expansion of programs and operations servicing the needs of a growing local population. The Province of Ontario is also adding more regulatory controls for climate change which are briefly outlined within this report and will be addressed in more detail within reports to the Administration and Finance and Planning and Works Committees later this year.

Report:

Regional Council previously approved a Greenhouse Gas (GHG) Action Plan pertaining to corporate operations under the responsibility of the Region of Waterloo (report CR-FM-11-011, dated May 3, 2011). The action plan was part of a commitment to the national Partners for Climate Protection program administered by the Federation of Canadian Municipalities and the local Sustainable Waterloo Region initiative (CR-FM-10-007, dated April 6, 2010). Both of these voluntary initiatives require implementation of actions towards achieving a GHG emission reduction target. The Region's corporate GHG target is 10% reduction of 2009 emissions by the year 2019 (CR-FM-13-015.1, October 9, 2013). This current report provides a progress update on corporate GHG emission reductions achieved up to calendar year-end 2015.

Reducing Corporate GHG Emissions from Regional Operations

The overall goal of the Region's Corporate GHG Action Plan is to reduce emissions from operations while continuing to provide high quality community programs and services to a growing population. This goal will be reached by focussing on the following three objectives which incorporate the expectation that Regional operations are likely to grow along with increased community demand for various infrastructure, programs and services:

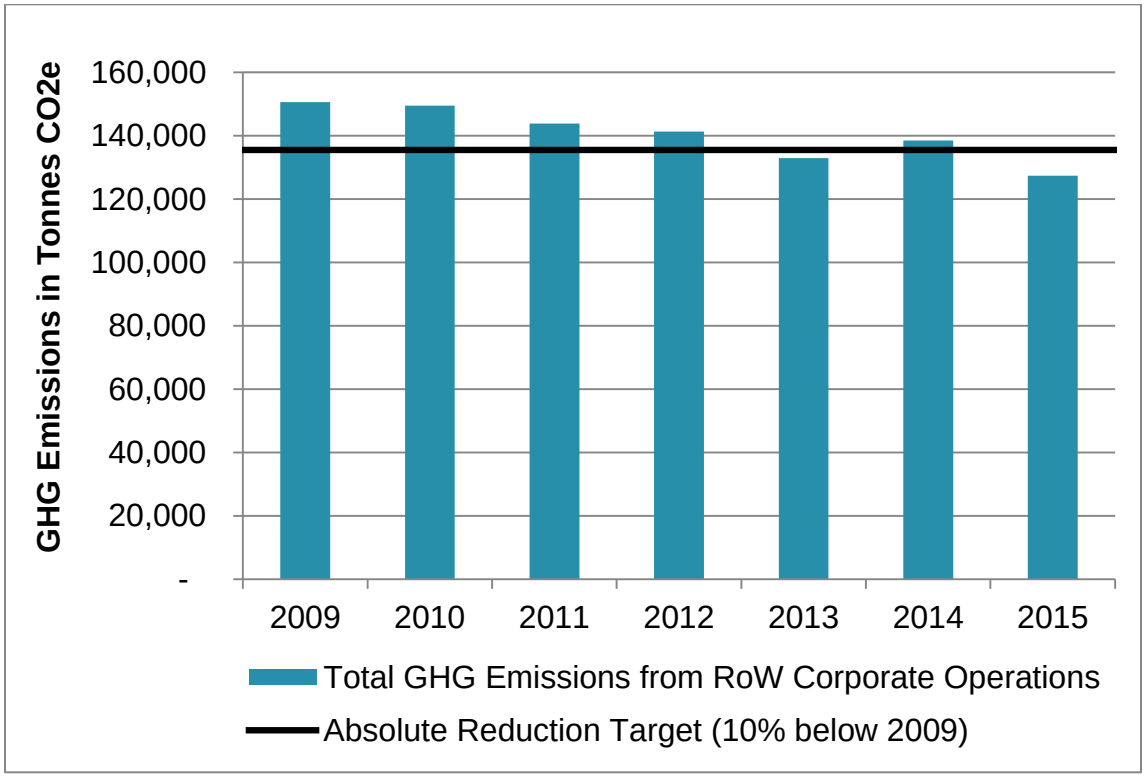
1. Optimize the efficient consumption of stationary energy (i.e., within Regional facilities and assets including the use of renewable energy where appropriate);

2. Manage the Region's fleet of vehicles to achieve ongoing improvements in fuel efficiency including the use of suitable alternative fuels and technologies; and

3. Ensure other Regional operations exploit opportunities to reduce GHG emissions where feasible such as solid waste management, wastewater treatment and biosolids using best management practices.

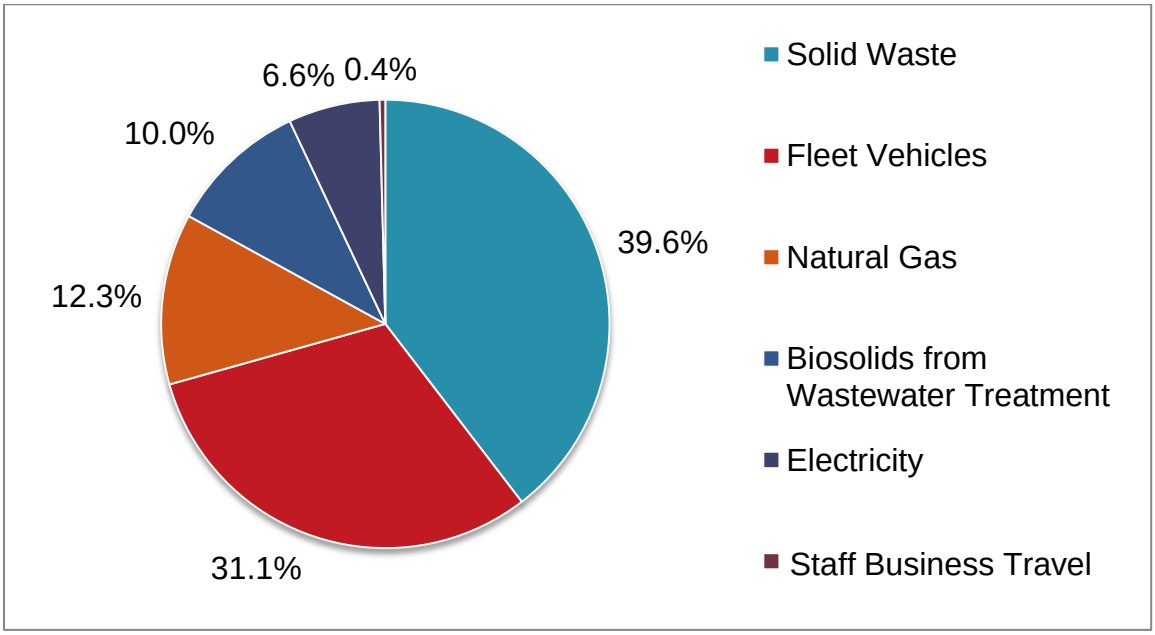
A previous progress report was provided to Regional Council in 2013 for emissions from corporate operations up to calendar year 2011 (CR-FM-13-015.1, October 9, 2013). Since then, Environment Canada has issued guidance to calculate GHG emissions coming from methane using a higher global warming potential value which consequently increases the estimates of GHGs coming from Regional landfills along with wastewater treatment and biosolids management. Previous years' emissions estimates were adjusted accordingly so that year-to-year comparisons can be made using this updated method. A reassessment of emissions from wastewater treatment and biosolids management was also incorporated in the values for 2009 – 2015. Figure 1 illustrates total emissions from Regional operations during this period.

Figure 1 - GHG Emissions (Tonnes) from Corporate Operations 2009 - 2015



Emissions were reduced by 15% as of year-end 2015 compared to base year estimates for 2009, a reduction of over 23,000 tonnes of GHGs. This reduction was achieved despite a 13% increase in the Region's facility space and fleet of vehicles that occurred during the same period. Figure 2 illustrates emissions by source for the year 2015.

Figure 2 - Region of Waterloo Corporate GHG Emissions by Source, 2015



Calculations were based on the International Local Government GHG Emission Analysis Protocol required by the Federation of Canadian Municipalities – Partners for Climate Protection program.

As indicated in Table 1 below, three of six sources of emissions decreased during 2009 – 2015, most significantly from electricity use and biosolids from wastewater treatment. The lower emissions from electricity use during this period was due to the significant decrease in GHG emissions within the provincial energy grid, whereas, the large reduction of emissions from biosolids were caused by planned operational improvements made to management practices within this area.

Table 1 - Region's Corporate GHG Emissions (Tonnes) by Source: 2009 - 2015

Source	**2009**	**2011**	**2013**	**2015**	**2009 -2015 change**
Landfills	53,668	42,743	49,748	50,828	-5%
Fleet (including contracted transport e.g. waste collection)	36,013	37,254	38,344	39,547	10%
Natural Gas Use	14,821	14,268	14,598	15,708	6%
Biosolids from Wastewater Treatment	27,955	34,530	17,860	12,737	-54%
Electricity Use	17,345	14,288	11,886	8,404	-52%
Staff Business Travel	519	490	459	518	0%
Totals (rounded)	**150,320**	**143,573**	**132,894**	**127,742**	**-15%**

Increases in emissions occurred within the Region's expanding fleet of vehicles from higher fuel consumption, whereas, those from natural gas consumption are due in part to expanding facility space in addition to the influence of weather variation year-to-year which affects space heating during cooler months. The Regional fleet is a challenging area with regard to reducing GHG emissions as more vehicles are used to service a growing population such as with GRT, Police and EMS which collectively account for 90% of the Region's fleet fuel consumption. The decrease in emissions from the landfill between 2009 – and 2015 are due partly to increased diversion of organic waste and a continually declining emission level from the closed Cambridge landfill site. However, emissions from the landfill may increase between 2015 and 2019 as more solid waste is deposited in the Waterloo landfill each year due to increases in population and economic activity.

Although the Region appears to be currently on track to meet its emission reduction target, continued growth in operations will provide upward pressure on annual emission values over the next few years. More detailed analysis of trends and key performance indicators, as well as projections to the year 2019, are included within Attachment A.

Sustained efforts to control GHG emissions continue to be required to offset growth in Regional operations and to help reduce the rising costs of fuel, electricity and natural gas. This will likely be achieved via improved asset management as well as the use of efficiency measures, alternative technologies and renewable energy sources where appropriate. Regional Council may want to consider establishing a longer-term (for example to the year 2050) and deeper emission reduction target for its Corporate GHG action plan in order to be consistent with other leading government entities across Canada and internationally. This could be considered when future progress reports are completed or when the plan is updated after the current target year of 2019.

Relevant Legislation

The Province of Ontario has been actively developing regulatory mechanisms to control GHG emissions. Bill 172, the Climate Change Mitigation and Low-Carbon Economy Act, 2016 was passed on May 18 to implement what is commonly known as the Cap and Trade legislation. Although this legislation will not directly require emission reductions from Regional operations, it is expected to indirectly impact the cost of energy such as vehicular fuel, natural gas and electricity. Staff in the Region's Corporate Energy Office within the Facilities Management and Fleet Services Division is planning to prepare a report for the Administration and Finance Committee later this year with more details and analysis on this issue.

The Province has also proposed changes to land use planning legislation and plans which may require municipalities to incorporate GHG emission reduction targets, as well as climate adaptation strategies within Regional and Municipal official plans. Planning, Development and Legislative Services staff is preparing a report for the Planning and Works Committee in the fall to address the implications of the proposed Growth Plan for the Greater Golden Horseshoe, 2016. An initial review of the proposed Growth Plan indicates that commitments within the Region's current Corporate Strategic Plan (Environment and Sustainable Growth Focus Area) is in alignment with the Province's general direction in terms of further developing and implementing climate change related strategies.

Corporate Strategic Plan:

This report directly addresses the Focus Area Environment and Sustainable Growth within the Region's Corporate Strategic Plan with respect to the following Strategic Objective and Action:

3.3 Enhance efforts to improve air quality.	**3.3.1** Reduce emissions of greenhouse gases (GHGs) from Regional operations, activities and facilities.

Actions referenced within this report and attachment also pertain indirectly to the following Strategic Objectives:

3.1 Increase the amount of waste diverted from the landfill.
3.2 Protect the quality and quantity of our water resources.

In addition, several actions from the Region's previous Corporate Strategic Plans (2007 – 2014) are reflected in some of the emission reductions captured within this report such as diversion of organic waste (expansion of green bin program), construction of new LEED buildings and development of an energy reduction plan for Water and Wastewater facilities to name a few.

Financial Implications:

The vast majority of actions referenced within this report and attachment are being implemented under previously approved operating and capital budgets of the corresponding lead departments. Examples of these actions include construction of new LEED buildings, implementation of the recommendations from the Fleet Services Program Review, diversion of organics through the green bin program and upgrades to water services and wastewater facilities. Those actions that require new financial support will follow the normal budget approval processes prior to implementation with priority given to those initiatives with strong business cases and where paybacks exist within the Region's useful life of the asset. In most cases if not all, actions identified within the plan provide operational / service improvements and/or cost savings as well as GHG emission reductions.

Other Department Consultations/Concurrence:

Staff in Transportation and Environmental Services and Corporate Services were involved in the review of the report and attachment.

Attachments:

Attachment A – Region of Waterloo Corporate GHG Progress Report 2012 - 2015

Prepared By: **David Roewade**, Sustainability Specialist

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Approved By: **Debra Arnold**, Acting Commissioner, Planning, Development and Legislative Services

Region of Waterloo Corporate GHG Progress Report 2012 - 2015

September 2016

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Background

Growing concentrations of greenhouse gases (GHGs) in the atmosphere threaten to disrupt climatic and ecological systems crucial to our quality of life. Governments, businesses and other organizations are attempting to mitigate their impacts on the global climate by reducing their emissions of GHGs. Not only is mitigation an important step to preventing further climate change, but reducing GHG emissions can also result in additional benefits to human health (e.g., reducing air pollution from combustion vehicles), the environment (e.g., more sustainably managing natural resources) and the economy (e.g., by saving money through energy conservation for more productive use elsewhere).

In May, 2011, Regional Council approved the Greenhouse Gas (GHG) Inventory and Action Plan for the Region of Waterloo's corporate operations (i.e., activities that are the responsibility of the Region). **The overall goal of the Action Plan is to reduce GHG emissions of operations while continuing to provide high quality community programs and services to a growing population**. Growing demand for various programs and services by the community often requires expansion of Regional operations and/or infrastructure, thereby increasing the potential for GHG emissions from corporate operations. The Region is taking responsibility for the effects of its activities on the environment and continues to monitor and continuously reduce its GHG emissions according to established reduction targets.

The original GHG reduction target set by Regional Council committed the Region to maintain corporate emissions at 2009 levels until 2019, with a forecasted overall reduction of more than 40,000 tonnes of GHGs measured in CO_2 equivalent (CO_2e), and a 14% per capita intensity-based reduction by 2019. In the previous Progress Report: Region of Waterloo Corporate GHG Inventory and Action Plan (CR-FM-13-015.1, October 9, 2013) Council adopted a more ambitious, yet still attainable GHG target of 10% below 2009 levels. With forecasted population growth, this is equivalent to a 23% reduction in per capita corporate GHG emissions. These absolute and intensity-based commitments were made with respect to the Federation of Canadian Municipalities (FCM) Partners for Climate Protection program (PCP) and Sustainable Waterloo Region (SWR) in their program to help local organizations reduce their carbon footprint. The Region reports on its GHG emissions performance to both of these organizations on an annual basis.

The Region's corporate scope GHG calculations only capture emissions from Regional operations and do not capture emissions generated in the overall community of Waterloo Region. The community scope is being addressed in collaboration with several local partners through an initiative called Climate Action WR. More information on this program is available at the following website: www.climateactionwr.ca/.

Region of Waterloo Corporate GHG Inventory for 2015

The emissions inventory was originally developed in 2010 in accordance with the International Local Government GHG Emission Analysis Protocol – Version 1.0 (October 2009), which is required by the FCM-PCP program. Emissions from the following Region of Waterloo operations are included within the scope of the emissions inventory based on the operational control approach defined within the protocol:

- Electricity used by buildings, street lighting and traffic signals, and water treatment facilities;
- Natural gas used by buildings;
- Fleet fuel use including GRT and contracted transport (e.g. waste collection/diversion);
- Staff business travel;
- Landfill gas emissions (flared and fugitive); and,
- Biosolids from Wastewater Treatment.

The inventory comprises annual activity data from various Regional divisions and applies the most recent emission factors for three of the leading contributors to climate change, including: Carbon Dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For the purpose of reporting, these GHGs are converted to equivalents of carbon dioxide (CO_2e) based on their recognized global warming potential. For example, methane has a global warming potential 25 times more potent than CO_2, meaning 1 tonne of methane is equivalent to 25 tonnes of CO_2e. Environment Canada[1] provides guidance on the global warming potentials of various chemicals.

Activity data was obtained from a number of existing Regional databases of energy consumption, fuel consumption, staff mileage claims, and other specialized operational databases. Emissions factors were applied to convert activity data (e.g. megawatt hours (MWh) of electricity consumption) into CO_2e; for example, the emissions factor used for 2015 electricity consumption is 0.057 tonnes of CO2e per MWh based on Independent Electricity System Operator (IESO) supply information for the year 2015. When Environment Canada formally publishes this emission factor for 2015 in their national inventory report next year, staff will adjust the emissions from electricity as necessary. Established engineering models were utilized to estimate emissions for more complex sources such as fugitive emissions from the Region's landfills and biosolids from wastewater treatment. A GHG inventory management database houses detailed calculations for all Regional emission sources.

In order to develop a GHG inventory, emissions forecasts and reduction targets, a

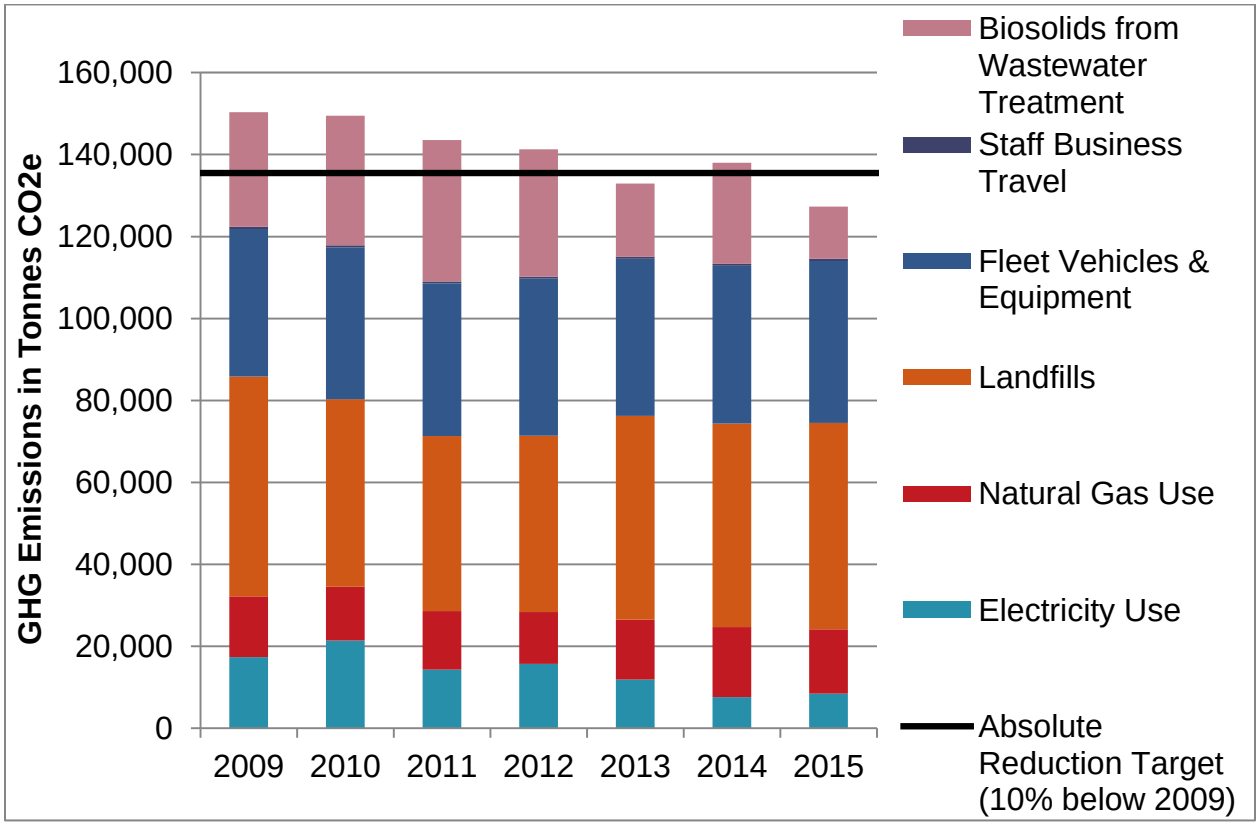
[1] Environment Canada. (2015). Global Warming Potentials. Retrieved August 9, 2016 from https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=cad07259-1

baseline year must be established to allow for comparisons and the measurement of continual improvement. The Region selected a baseline year of 2009 for the established 10 year target out to 2019 due to the availability of the most accurate and complete datasets.

Overall Performance and GHG Emissions

As Figure 1 illustrates, overall GHG emissions were below the reduction target (135,500 tonnes of CO2e) in both 2013 and 2015, as part of a clear downward trend in corporate GHG emissions since 2009. The 10% reduction target is a commitment under FCM's PCP program. This figure also shows the relative contributions of each emissions source to total GHG emissions for each year.

Figure 1 - RoW GHG Emissions from Corporate Operations by Emission Source, including Reduction Target 2009 - 2015



As shown in Figure 2, population has risen steadily since 2009 which influences Regional operations such as in transit ridership and new facilities. Despite installing new buildings and expanding services, GHG emissions per capita have declined at a faster rate (-21%) than the rate of increase in the local population (+7%). This means that even with more people, Regional operations serving the community are continually less GHG intensive on a per-person basis than in 2009. The per capita reduction target of 23% below 2009 levels is a commitment with Sustainable Waterloo Region's program.

Figure 2 - Percent Change in Population and Per-Capita Corporate GHG Emissions, 2009 - 2015

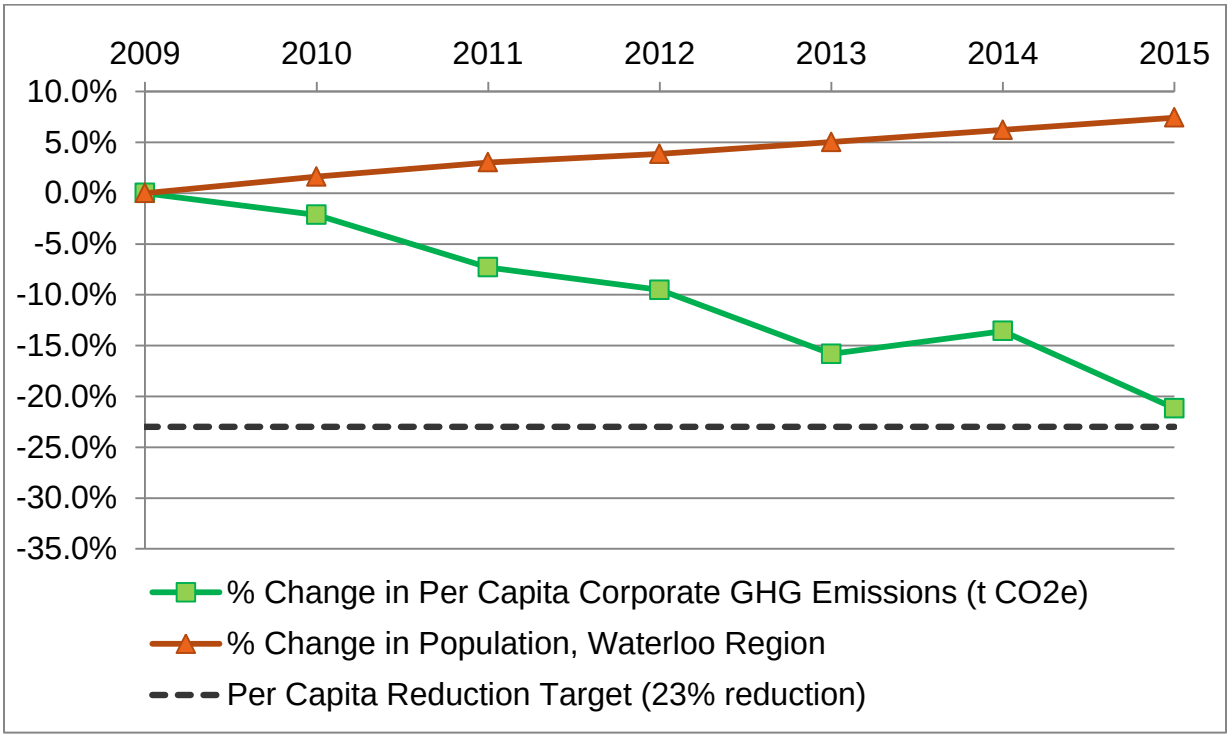
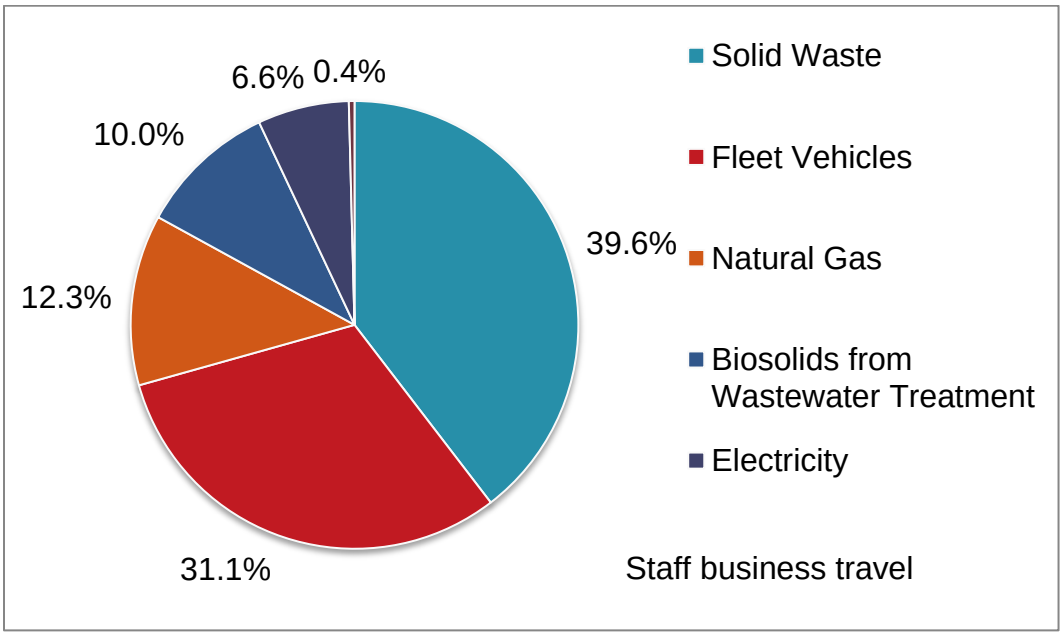


Figure 3 illustrates the relative sizes of each GHG emission source in 2015. Solid waste (i.e. decaying organic matter in Region-operated landfills) is the highest emitter at just under 40%, followed by fleet vehicles at 31.1%, and natural gas at just over 12%. Staff business travel was the lowest emitter at 0.4% of total GHG emissions.

Figure 3 - Proportion of RoW GHG Emissions by Source, 2015



Absolute emission numbers for each category in 2009 and 2015, with a comparison of the percentage differences between these two time periods, are presented in Table 1. Emissions from Electricity consumption and from Biosolids from Wastewater Treatment had the largest GHG reductions, more than 50% lower in 2015 compared to 2009 levels. Solid Waste saw a more modest reduction of 5% below 2009 levels, though for Solid Waste this translates to a significant absolute reduction (3,271 tonnes CO_2e). Two categories did contribute more GHG emissions in 2015 compared to 2009: Fleet Vehicles (with a 10% increase), and Natural Gas (with a 6% increase). More detail on these emissions, context and explanations for each source category can be found in the following sections.

Table 1 - Comparison of 2009 and 2015 Corporate GHG Emissions from Regional Operations

Emission Source	2009 GHGs	2015 GHGs	Difference
	(Tonnes CO_2e)		(%)
Solid Waste (Waterloo/Cambridge landfills)	53,668	50,828	-5%
Fleet/Transit Vehicles (including contracted transportation e.g., waste collection and diversion)	36,013	39,547	10%
Natural Gas (buildings/facilities)	14,821	15,708	6%
Biosolids from Wastewater Treatment (related to methane – not energy use)	27,955	12,737	-54%
Electricity (buildings/facilities, streetlights and traffic signals, leased space)	17,345	8,404	-52%
Staff Business Travel	519	518	-0%
Totals	**150,556**	**127,742**	**-15%**

Energy-Source GHG Emissions

Emissions can be roughly divided into those sources originating from the Region's consumption of energy resources (i.e. electricity, natural gas, diesel and gasoline from fleet vehicles and staff business travel) and emissions from operations that deal with decaying organic matter (i.e. landfilled solid waste, and biosolids from wastewater treatment). In terms of energy sources, Table 2 quantifies the Region's energy

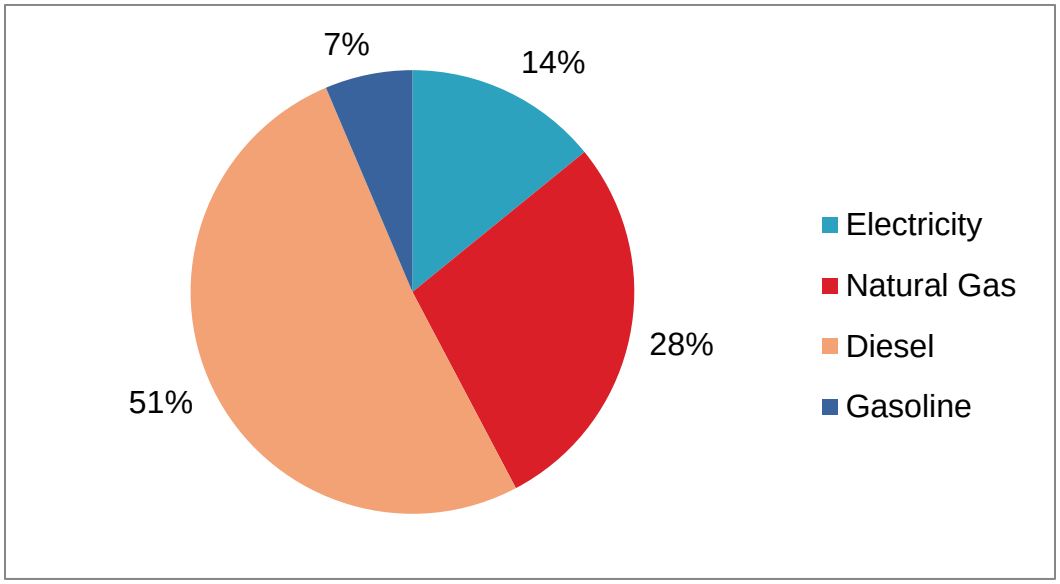
consumption and associated GHG emissions, and **Figure 4** visually illustrates the Region's GHG emissions by energy source.

Table 2 - CO_2e Emissions by Energy Source, 2015

Energy Source* (unit)	Quantity	Emissions (Tonnes)	Cost
Electricity (MWh)	138,357	7,886	$21,122,862
Natural Gas (m3)	8,261,256	15,708	$2,757,582
Diesel (L)	10,593,819	28,655	$9,358,602
Gasoline (L)	1,532,678	3,560	$1,418,952
Total		**55,809**	**$34,657,998**

*Excludes leased space, contracted transport and staff travel

Figure 4 - Proportional Emissions (tonnes CO2e) by Energy Source, 2015



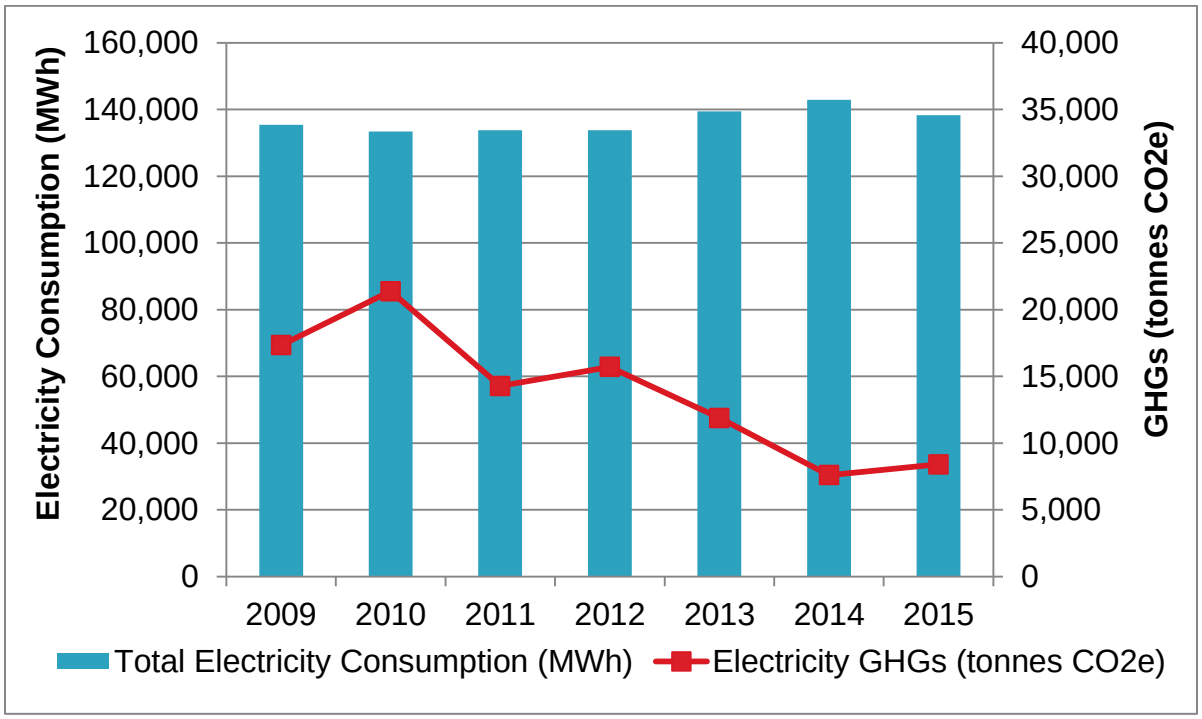
As Figure 4 illustrates, diesel fuel is the highest contributor to the Region's GHG emissions from energy consumption (51%), followed by natural gas (28%) and electricity (14%), while gasoline accounts for just 7% of emissions from energy consumption. More details are available in the following sections on Electricity, Natural Gas, Fleet Vehicles and Staff Business Travel.

Electricity

The Region's electricity consumption increased between 2009 and 2015; however, GHG emissions actually decreased significantly (Figure 5). The reason for this

discrepancy is a reduction of GHG-emitting energy sources in Ontario, which has decreased the electricity emission factor since 2010. Emission factors are updated annually by Environment Canada to reflect the varying composition of electricity generation in Ontario. Electricity in Ontario[2] is primarily a mix of nuclear (60%), hydro (24%), gas (9%), and non-hydro renewable sources (7%). The large reduction in emission factors (0.12 tonnes CO_2e/MWh in 2009, to 0.057 tonnes CO2e/MWh in 2015 – a 53% reduction) is largely due to the provincial phase-out of coal power plants which was completed in 2014.

Figure 5 - Total RoW GHG Emissions from Electricity Consumption, 2009 - 2015



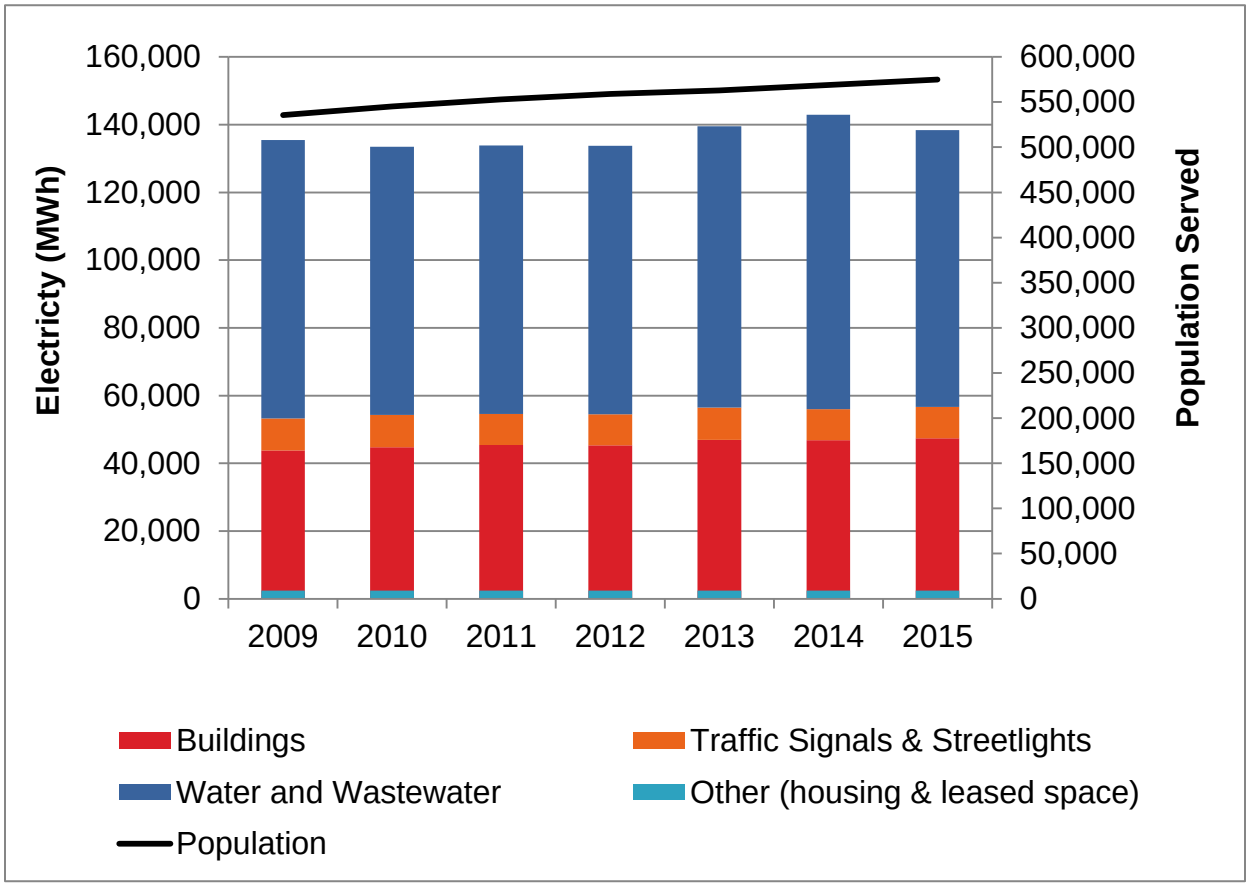
With a growing population, there have been increases in facility and service needs. New and expanded buildings will increase total electricity consumption, as will additional traffic signals and streetlights installed to better serve users of an expanding Regional road network. The largest consumer of electricity within Regional facilities is water and wastewater operations. This consumption is primarily attributed to pumping and treatment requirements within provincial regulations. Table 3 contains electricity consumption data with the percentage change between 2009 and 2015 for each corporate electricity-use category. Despite the 7% increase in population between 2009 and 2015, there was only a 2% increase in MWh consumed by Regional buildings, facilities and services. Trends for these categories are presented visually for each year between 2009 and 2015 in Figure 6.

[2] http://www.energy.gov.on.ca/en/archive/the-end-of-coal/

Table 3 - Electricity Consumption (MWH) by Source, with Population, 2009 - 2015

Source of Electricity Consumption	2009	2015	% Change 2009-2015
Buildings	43,784	47,393	8%
Traffic Signals & Streetlights	9,441	9,232	-2%
Water and Wastewater	82,240	81,732	-1%
Other (housing and leased space)[3]	9,073	9,073	0%
Total Megawatt Hours	**144,539**	**147,430**	**2%**
Population	**535,700**	**575,000**	**7%**

Figure 6 - Region of Waterloo Electricity Consumption by Category compared with Population Growth, 2009 - 2015



[3] A portion of these facilities are not captured within the Region's corporate energy database.

Building Electricity Consumption

Several new Regional buildings contributed to a 13% rise in square footage from 2009 to 2015; however, the amount of electricity consumption by these buildings increased by only 8% during the same period (see Table 4 for more detail).

Table 4 - Building Electricity Consumption (MWh) and Area (ft^2) - 2009 and 2015

	2009	2015	% Change 2009-2015
Building Electricity Consumption (MWh)	43,784	47,393	8%
Building Area (ft^2)	5,613,079	6,336,691	13%

Several energy conservation and efficiency projects were completed in 2015 resulting in an approximately 720 MWh reduction in electricity consumption. In addition, although overall facility space is increasing, ten new Regional facilities that were constructed between 2009 and 2015 have been built at least LEED[4] Silver certified levels (five of these are LEED Gold certified), which is a result of the Region of Waterloo's minimum sustainable design and construction standard for new Regional facilities with more than $500m^2$ (5,400 ft^2) of occupied space. LEED Certified new buildings save anywhere between 25 and 50%[5] compared to non-LEED buildings. A recent Facilities and Fleet Management report (COR-FFM-16-02, February 23, 2016)[6] details the Region's LEED designated buildings over the last 10 years.

Traffic Signals and Street Lights Electricity Consumption

Electricity consumption for street lights on Regional roads and traffic signals decreased by 2% between 2009 and 2015, with little variability in the years between. A retrofit of all streetlights to LED technology is expected to be implemented by 2017 / 2018.

Table 5 - Street Lights / Traffic Signal Electricity Consumption (MWh), 2009 - 2015

	2009	2015	% Change 2009-2015
Street Lights and Traffic Signal Electricity Use (MWh)	9,441	9,232	-2%

[4] LEED stands for Leadership in Energy and Environmental Design. For more information: http://www.cagbc.org/CAGBC/LEED/CAGBC/Programs/LEED/Going_green_with_LEE.aspx
[5] http://www.regionofwaterloo.ca/en/aboutTheEnvironment/greenbuilding.asp
[6] Pages 3 to 7 of http://www.regionofwaterloo.ca/en/regionalGovernment/resources/AF/FA2016-0223.pdf

Water and Wastewater Electricity Consumption

Water and wastewater treatment facilities mainly use electricity to process water and wastewater, with relatively little consumed by lights, office space, etc. For this reason, comparing electricity usage to floor area is not a good indicator of efficiency. Instead, this type of energy consumption is compared to overall water demand and wastewater flows as influential factors on water infrastructure operations.

Table 6 - Water Treatment Electricity Consumption (MWh) and Water Demand (Millions of Litres), 2009 - 2015

	2009	2015	% Change 2009-2015
Water and Wastewater Electricity Use (MWh)	82,240	81,732	-1%
Water Demand (Millions of Litres)	54,266	51,137	-6%
Wastewater Flow (m^3)	68,656,736	58,336,182	-15%

Electricity use has declined by approximately 1% since 2009 in water and wastewater management; however, total water demand has decreased by 6% over the same time period and wastewater flow has decreased by 15%. Wastewater flows do not follow the same trend as water demand as they are very weather dependent in terms of being significantly impacted by heavy precipitation events and the amount of runoff during spring snowmelts. Consequently, the difference in these rates of decline does not scale directly to the amount of water or wastewater processed.

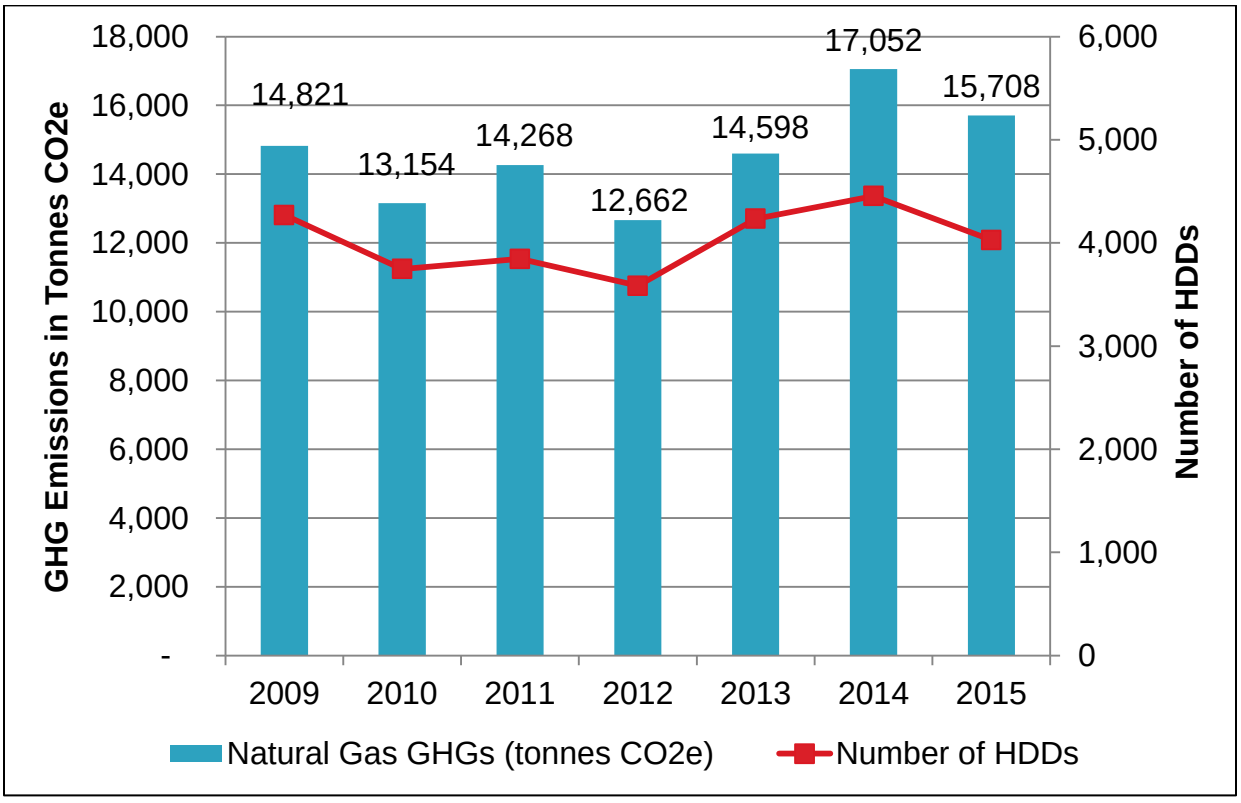
The overall change in energy consumption during this period can be explained by many factors. For example, one water pumping station was taken offline since spring of 2014 and for much of 2015 which reduced electricity consumption by over 3000 MWh. Another factor pertains to water conservation efforts which are clearly succeeding, as water demand has decreased even as Waterloo Region's population has continued to rise (Figure 2). Also, the Water Services division has implemented well pump upgrades, such as variable frequency drives, along with improvements to wastewater aeration control resulting in improved energy efficiency. In addition, new processes are coming online which are impacting electricity usage within water services due to ongoing capital upgrades to the different facilities (e.g. switching from chlorine to ultraviolet treatment of water which is a more effective form of treatment but uses more electricity).

Natural Gas

Natural gas is primarily used to heat regional buildings and facilities during periods of cool weather, meaning consumption is primarily driven by interior area (i.e. the amount of space that requires heating) and the effect of temperatures described below as Heating Degree Days or HDDs. HDDs are a simplified measure of the number of days below a baseline temperature (18 degrees C), and the number of degrees below that baseline. To illustrate, a period of three days with temperatures averaging 16 degrees (2 degrees lower than the baseline for each day) would be counted as 6 HDDs. If one year has more Heating Degree Days than another, we assume that part of an increase in natural gas use was necessary to counteract the weather, regardless of energy efficiency initiatives.

As Figure 7 illustrates, GHG emissions for natural gas follow a similar trend to the number of Heating Degree Days (HDDs).

Figure 7 - GHG Emissions (tonnes CO_2e) from Natural Gas Consumption, 2009 - 2015



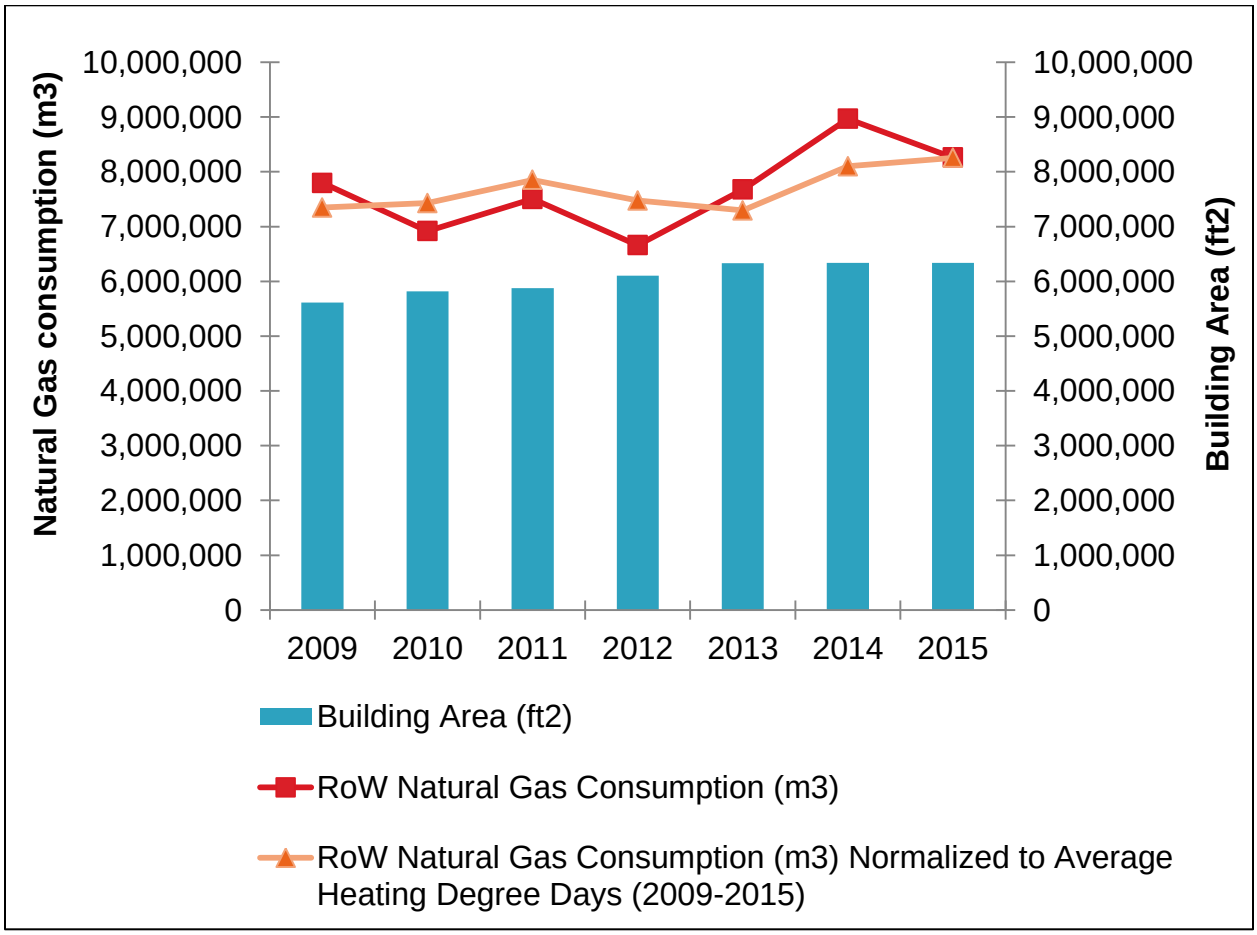
Natural gas consumption increased by 6% between 2009 and 2015, despite an increase in interior building area of 12.9% in the same time period (see Table 7), again demonstrating that building area is only one important factor of natural gas usage.

Table 7 - RoW Natural Gas Consumption (m^3) and Building Area (ft^2), 2009 - 2015

	2009	2015	% Change 2009 - 2015
RoW Natural Gas Consumption (m3)	7,795,073	8,261,256	6.0%
Building Area (ft^2)	5,613,079	6,336,691	12.9%

Regional consumption of natural gas fluctuates more than can be accounted for by floor space. In addition to showing floor space from 2009 to 2015, Figure 8 also shows the original natural gas consumption curve with a secondary consumption curve that has been normalized to account for HDDs (utilizing the average number of HDDs from 2009 to 2015). The normalized curve illustrates that if the number of HDDs had equal across the 2009 to 2015, the Region's natural gas consumption would have fluctuated much less. Given that there was an increase in facility space since 2009 as previously discussed, it is also important to note that conservation projects completed last year helped reduce 33,729 m3 of natural gas during 2015 alone.

Figure 8 - ROW Efficiency of Natural Gas Consumption (2009 - 2015)



Fleet Vehicles

The Region's fleet vehicles provide essential services to the community, such as public transit, police and EMS, as well as services related to road maintenance, waste and water management, airport operations, and more. More than 1,000 fleet vehicles consume significant quantities of gasoline and diesel fuel to support these services, resulting in tail-pipe emissions that impact our air quality and contribute to climate change. With volatile fuel prices, fuel efficiency is also an important opportunity for cost savings, as well as emissions control.

GHG emissions for all Region-operated fleet vehicles are presented in Table 8 which includes contracted transportation such as those used by waste collection and diversion or by suppliers delivering water management chemicals.

Table 8 - GHG Emissions (tonnes CO2e) of Fleet Vehicles, 2009 - 2015

	2009	2010	2011	2012	2013	2014	2015	% Change 2009-2015
Fleet Vehicle emissions (including contracted transport)	**36,013**	37,000	37,254	38,327	38,344	38,525	**39,547**	**10%**

Despite a 13.4% increase in the number of vehicles between 2009 and 2015, there was only a 10.7% increase in the amount of fuel consumed. Table 9 compares fuel consumption and vehicle counts between 2009 and 2015.

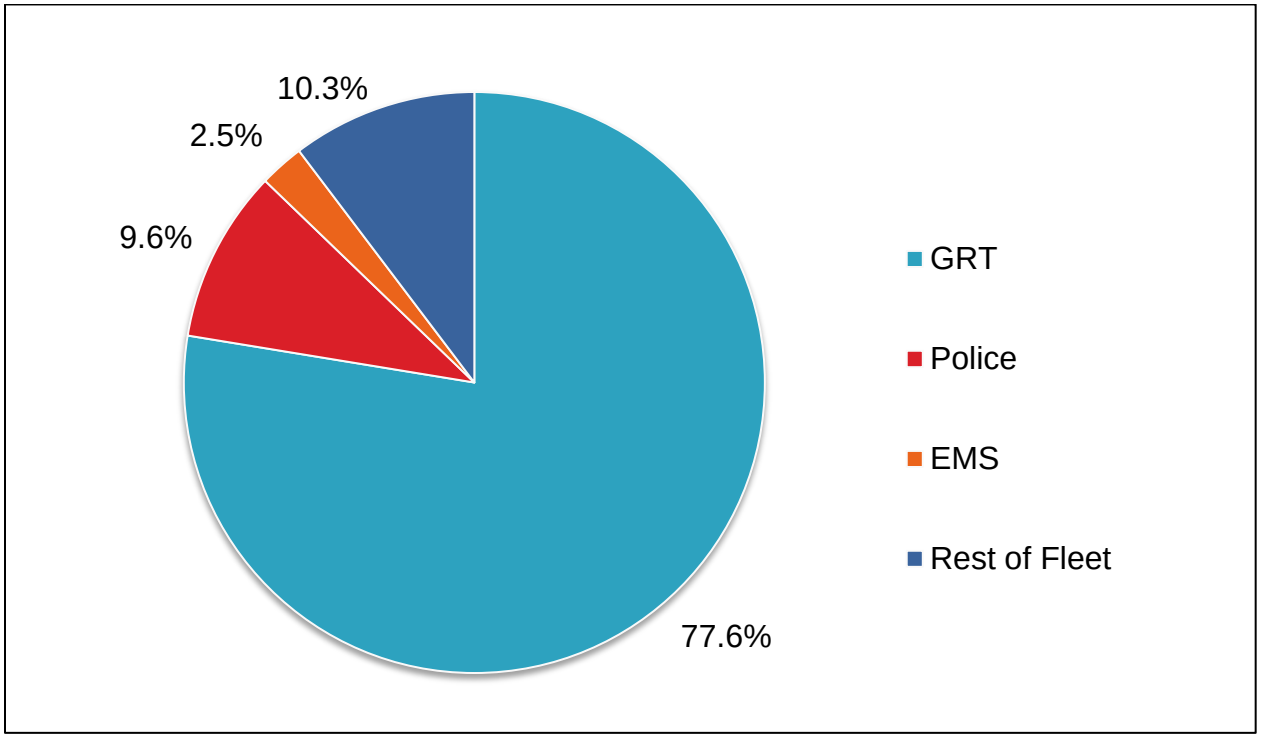
Table 9 - Change in Fleet Vehicle Fuel Consumption (L), 2009 - 2015

Fleet Vehicle Category	Fuel Use (L) 2009	Fuel Use (L) 2015	% Change Fuel Use 2009-2015	Vehicles (#), 2009	Vehicles (#), 2015	% Change Vehicles 2009-2015
GRT	8,106,566	9,401,375	**16.0%**	278	320	**15.1%**
Police	1,253,189	1,169,673	**-6.7%**	344	368	**7.0%**
EMS	271,442	301,728	**11.2%**	31	51	**64.5%**
Rest of Fleet*	1,316,608	1,249,535	**-5.1%**	300	342	**14.0%**
Totals	**10,947,805**	**12,122,311**	**10.7%**	**953**	**1,081**	**13.4%**

*Rest of Fleet includes vehicles and equipment used by the airport, facilities maintenance, transportation, waste, water, and other services.

Overall fuel consumption increased at a slower rate than the growth in the number of Regional fleet vehicles. Figure 9 illustrates a proportional comparison of fuel use by the same fleet category as the previous table. The largest consumer of fuel is Grand River Transit with approximately 9.4 million litres consumed in 2015, a 16% increase over 2009 which is similar to the growth of the transit fleet of vehicles. The 15% expansion of 42 new busses in this period is expected to correlate with increased adoption of public transit by the community as part of the Region's Transportation Master Plan. In this way, increased Regional GHGs from transit should have an offsetting decrease in a portion of the community's emissions associated with road travel by drivers within Waterloo Region.

Figure 9 - Proportion of RoW Fleet Vehicle Fuel Use (L) by Source, 2015



Police vehicles increased by 7%, and EMS vehicles increased by 64.5%, however, fuel use actually decreased by 6.7% for Police partly due to use of more fuel efficient vehicles. Emissions from EMS increased by only 11%, far less than the increase in the number of EMS vehicles during this period (64%) which is intended to better serve the community by improving ambulance response times. The rest of the fleet used 5.1% less fuel in 2015 than in 2009, despite increasing in size by 42 vehicles (a 14% increase). This performance is influenced by implementation of ongoing fleet management initiatives as part of a comprehensive program review conducted in 2013 and 2014.

Figure 10 - Total Fuel Use (L) of RoW Fleet Vehicles, and Number of Vehicles, by Source and Year

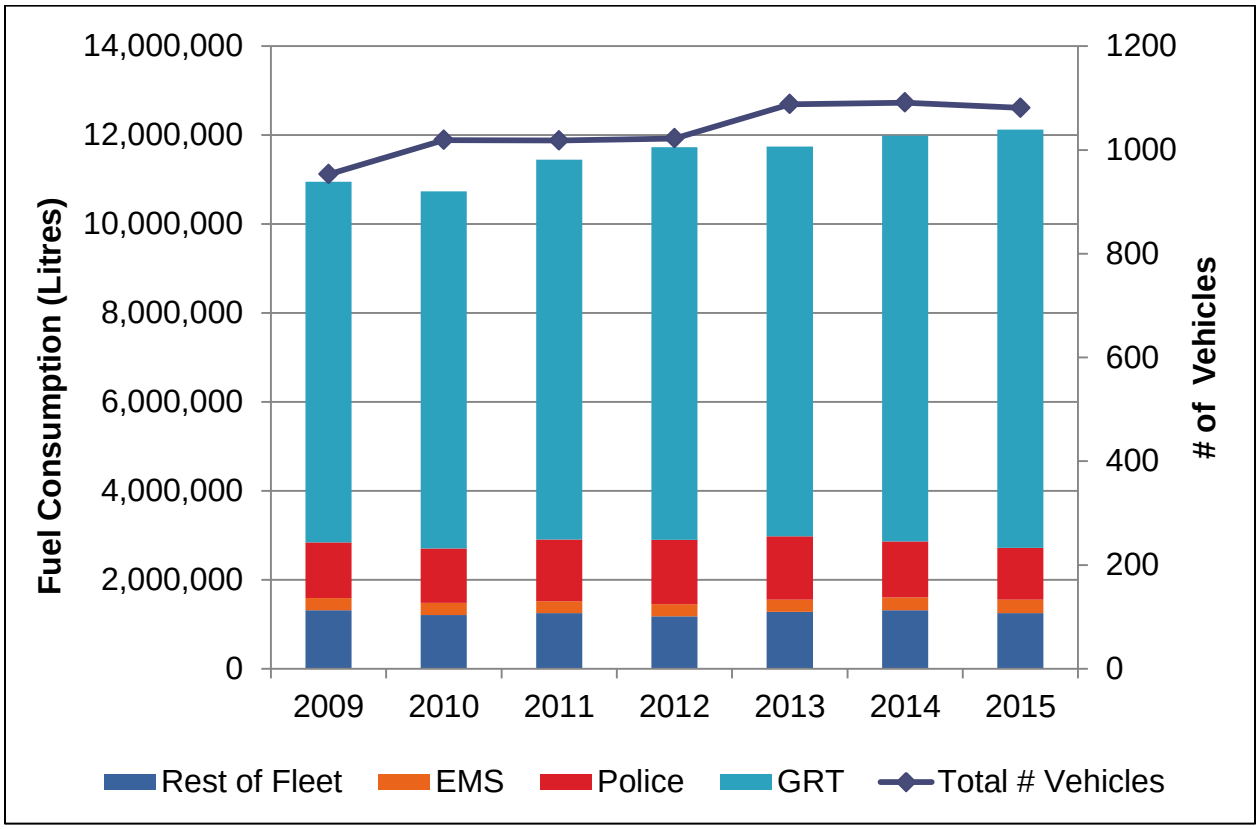


Figure 10 illustrates the impact of the various fleet vehicle categories on the Region's GHG emissions over time. The GRT consumes more fuel than other categories; however, this proportion is expected given the nature of public transit, where routes often run all day and connect the towns and cities of Waterloo Region. Another expected trend is that overall fuel use generally increases with the number of fleet vehicles.

The Region's Green Fleet Strategy, which dates back to 2011, sought to reduce operational fuel use (and consequent air and GHG emissions) while enabling Regional fleet operators to deliver quality service to a growing population. Programs delivered under this strategy included:

- Driver training of the environmental outcomes of vehicle operation and idling reduction;
- Fleet vehicle right-sizing (downsizing where appropriate, ensuring vehicles to not exceed needs);
- Improving fuel efficiency with new technologies; and,
- Reviewing fleet practices and routes to find new opportunities for efficiency.

Staff Business Travel

Although staff business travel makes up the smallest portion of the Region's overall corporate GHG emissions (0.4%), it is still an important component of the GHG inventory as staff can be ambassadors of the Regional Travelwise program promoted throughout the community. Data on business travel is very reliable, as Regional employees must claim their distance travelled in their personal vehicles while conducting Regional business in order to be eligible for mileage reimbursement. Staff business mileage is compared with the number of Regional employees which has gradually increased between 2009 and 2015 as shown in Figure 11.

Employees are making increased use of transit, car sharing, carpooling, as well as teleconferencing and video conferencing tools, which all help reduce travel distances and associated GHG emissions while still enabling staff to fulfill program and service requirements. Although staff travelled more in 2015, GHG emissions were very similar for 2015 and 2009 (Table 1). This is due to improved fuel standards during this time such as higher ethanol content in gasoline which emits fewer tonnes of GHGs per litre.

Figure 11 - Regional Staff Business Mileage (km), 2009 - 2015

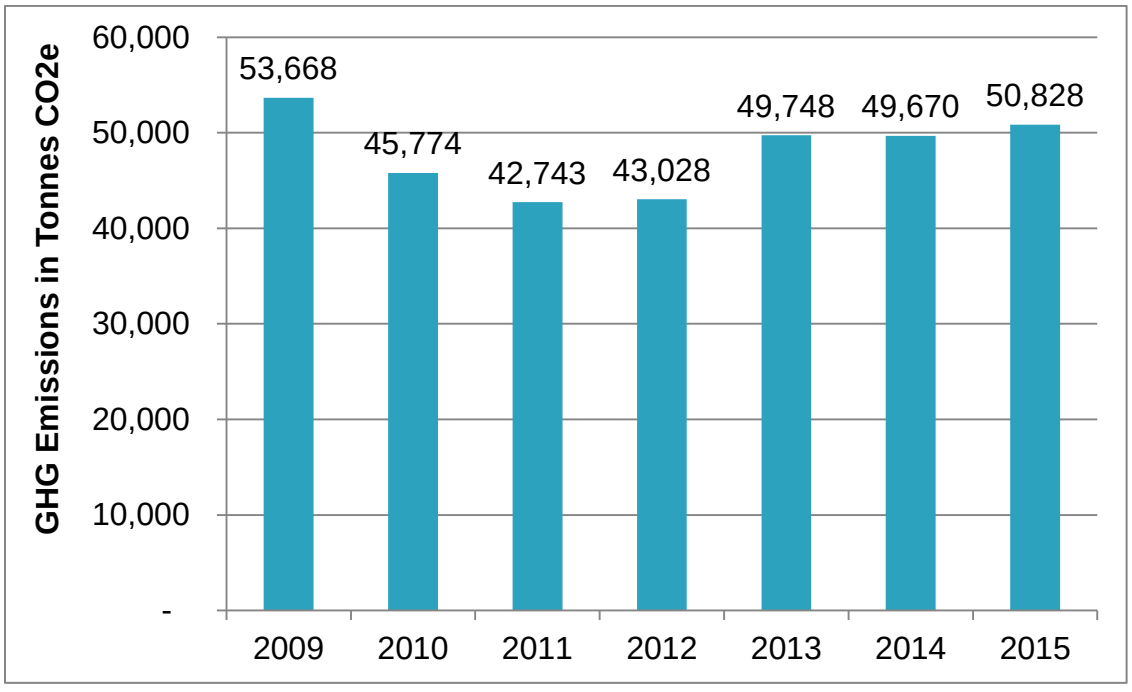
Solid Waste

The Region works to reduce GHG emissions from solid waste in two ways: by encouraging behaviour change in residential waste diversion, and by managing landfill gasses. Landfill gas is largely composed of methane. A landfill gas collection system at

the Waterloo landfill site, established in 1994, generates electricity by burning methane, which releases carbon dioxide (CO_2) – a GHG with a global warming potential 25 times less than methane. This plant generates approximately 4 Megawatts (MW) of electricity using landfill gas (LFG); however, the Region cannot include any emission reductions from this operation within the GHG emissions inventory as it was active long before the baseline year of 2009. Flaring is also performed to capture and burn landfill gasses, converting smaller amounts of methane into CO_2 but without generating electricity. Flaring efforts since 2010 have reduced landfill GHGs by approximately 20,000 tonnes CO_2e or roughly 4,000 tonnes per year on average up to year 2015.

Declining emissions from the Cambridge landfill closed in 2002 and an increase in organics diversion of approximately 5,000 tonnes in 2009 to almost 9,500 tonnes in 2015, has led to lower GHG emissions from Regional waste management operations than in 2009. As Figure 12 shows, emissions gradually decreased between 2009 and 2012, but then rose to close to 50,000 tonnes of CO_2e in 2013, 2014 and 2015. This increase is in line with a corresponding increase in total waste tonnage reaching the landfill over this time period (Table 10), and also coincides with a reduction of portable flaring activities which had led to significant reductions between 2010 and 2012. This type of flaring is dependant upon the location of landfilling and is typically undertaken as a short term odour control measure, as it is not intended to be a permanent operational control. More recently, permanent gas collection piping is being installed on a more frequent basis to allow for greater utilization of methane in the adjacent power plant.

Figure 12 - Total GHG Emissions from the Region's Cambridge and Waterloo Landfills, 2009 - 2015



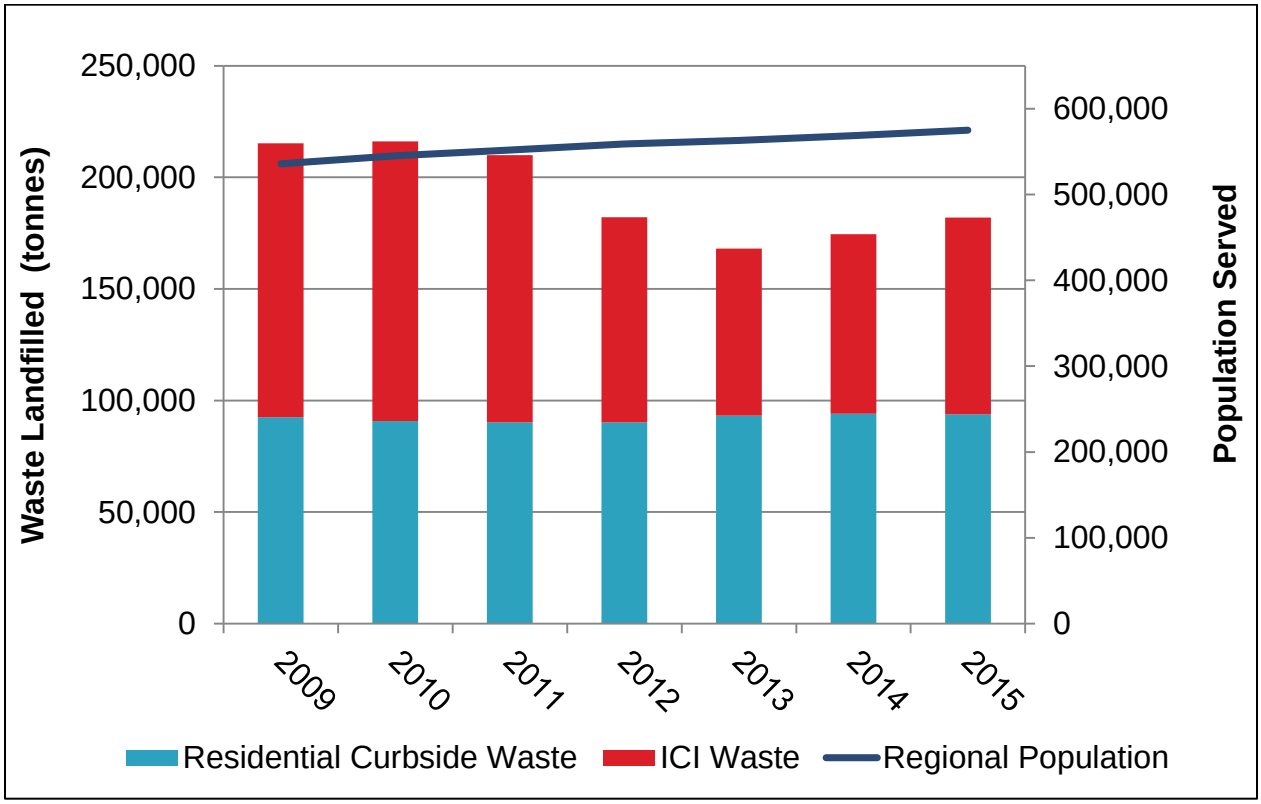
The Region[7] works to continually divert the amount of waste requiring landfill, including organic materials, which release methane as they decompose, from the green bin, yard waste and some industrial, commercial and institutional waste (ICI). Regional programs to encourage the diversion of waste from landfill are generally succeeding. Overall, there was a 15.5% decrease in waste tonnage sent to landfill between 2009 and 2015, despite a 7.3% increase in population (see Table 10).

Table 10 - RoW Landfilled Solid Waste (tonnes) and Population, 2009 - 2015

	2009	2015	% Change 2009 - 2015
Total Landfilled (Tonnes)	215,324	181,944	-15.5%
Regional Population	535,700	575,000	7.3%

As Figure 13 illustrates, landfilled residential waste has remained relatively steady since 2009 despite continued population growth. There was more variation in ICI waste with a low in 2013 and a gradual increase to 2015.

Figure 13 - Total Waste Landfilled in Waterloo Region 2009 – 2015



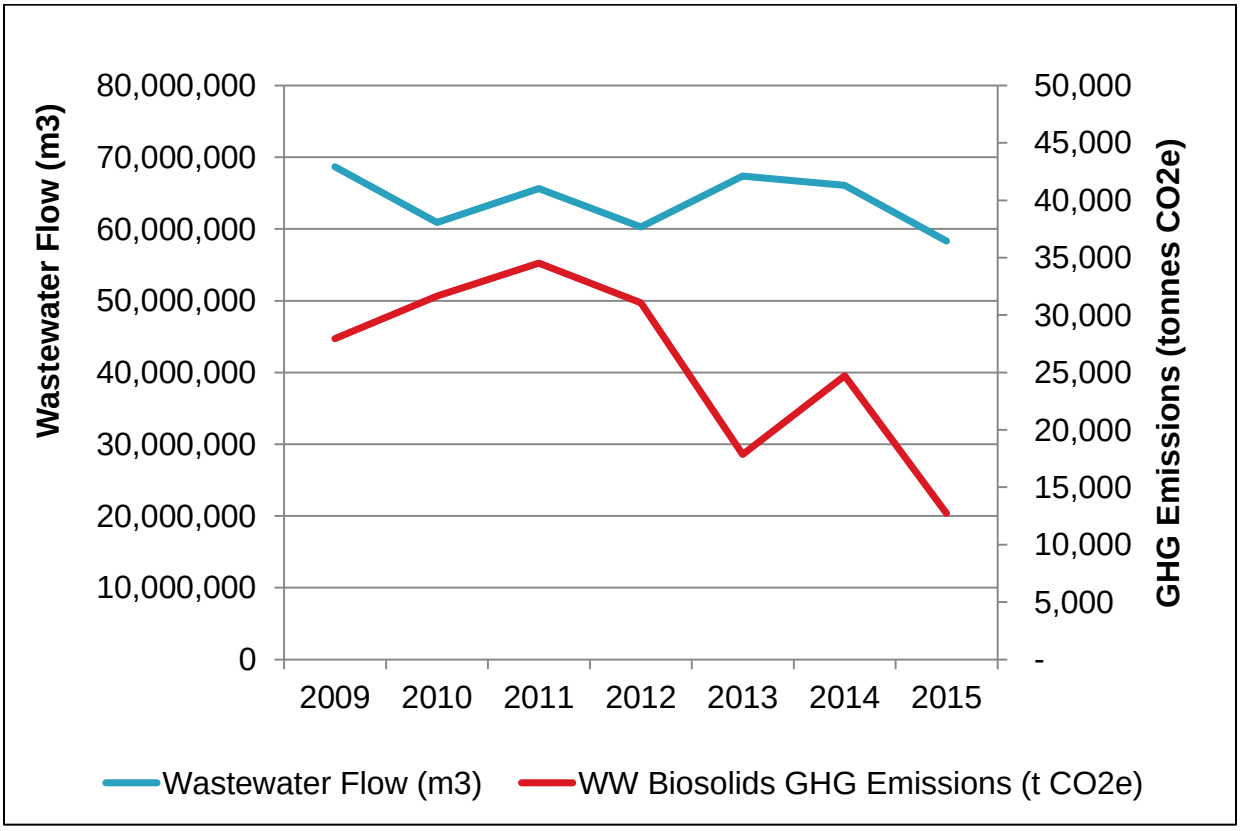
[7] http://www.regionofwaterloo.ca/en/aboutTheEnvironment/Waste2.asp

Biosolids from Wastewater Treatment

The Region of Waterloo provides wastewater treatment services[8] for the Region of Waterloo's serviced area. Wastewater makes its way to Regionally-owned treatment facilities which separate the liquid and solid material and treat them separately. The treated liquid effluent is discharged into local river systems, and the treated solid material (referred to below as biosolids) is either landfilled outside of the Region or beneficially used on agricultural land and/or mine reclamation tailing ponds. Emissions for wastewater treatment and discharge were estimated using the Biosolids Emission Assessment Model (BEAM) developed by CCME (2009).

One key factor of wastewater treatment emissions is the volume of wastewater, which influences the volume of biosolids produced. The end-of-life solution also greatly influences the GHG emissions, as landfilling biosolids emits more GHGs than beneficially using biosolids on land. Figure 14 compares wastewater flow volume against GHG emissions of biosolids between 2009 and 2015.

Figure 14 - Wastewater Flow (m3) and GHG Emissions (tonnes CO_2e) of Biosolids from Wastewater Treatment 2009 - 2015



[8] http://www.regionofwaterloo.ca/en/aboutTheEnvironment/wastewater.asp

While wastewater flow did decrease slightly from 2014 to 2015, the decrease in emissions is far more dramatic. The 2012 to 2013 increase in wastewater flow was also met with a substantial decrease in GHG emissions. Wastewater flow does not appear to be the most important driver of GHG emissions; rather, how biosolids are managed seems to be the most impactful. Values for GHG emissions of biosolids from wastewater are presented in Table 11.

Table 11 - Biosolids GHG Emissions (tonnes CO_2e), 2009 - 2015

	2009	2010	2011	2012	2013	2014	2015	% Change 2009-2015
Biosolids Emissions (tonnes CO_2e)	**27,955**	31,665	34,530	31,065	17,860	24,725	**12,737**	**-54%**

The management of biosolids has undergone several changes since 2009, most notably the upgrade of major facilities with dewatering capabilities. Dewatering of biosolids results in a substantial reduction in volume as compared to managing liquid biosolids, and leads to the increased beneficial use of biosolids rather than landfilling (for example land application as fertilizer). These changes are the largest contributor to enormous drops in GHG emissions in 2013 and 2015 as the volumes of biosolids being managed have decreased. Emissions in 2014 increased because the contractor could not store solid biosolids and consequently had to temporarily return to landfilling the material for that time period.

The beneficial use of biosolids helps improve soil fertility, reduces the need for commercial fertilizers (typically created using fossil fuel inputs), and avoids methane emissions due to organic matter decomposition in landfills. The manufacture, transport and use of municipal biosolids are regulated at the federal, provincial, territorial and/or municipal levels. Applicable safety, quality and management standards, requirements or guidelines for municipal biosolids, including the Ontario Nutrient Management Act, are all met at the Region of Waterloo.

Concluding Remarks

Although the Region appears to be currently on track to meet its emission reduction target, continued growth in operations will provide upward pressure on the annual emission values over the next few years. Table 12 provides a snapshot of upward and downward influences for each emission activity.

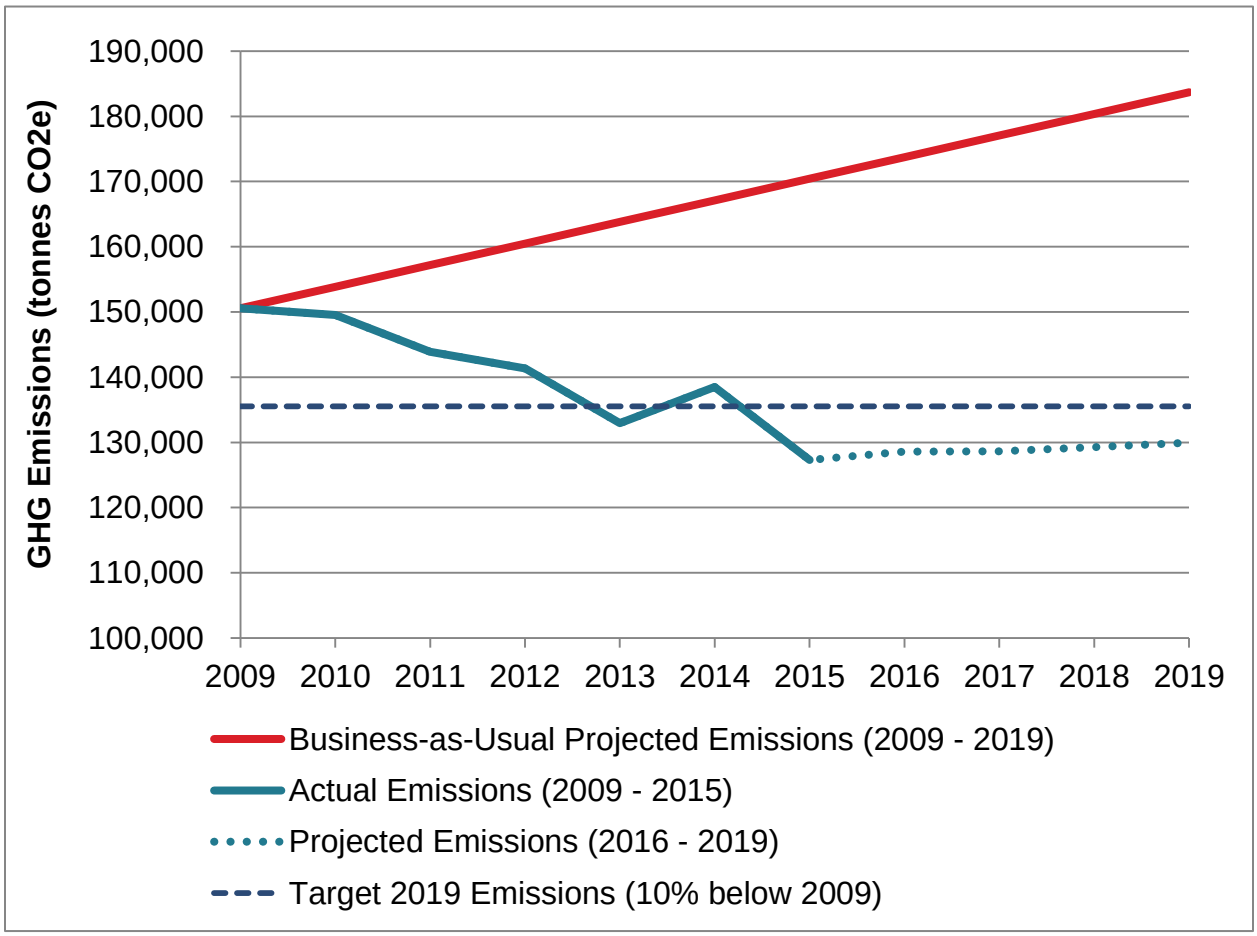
Table 12 - Forward Looking influences on Regional Emission Levels

Activity / Emission Source	Growth Factors	Reduction Influences	Status/Comments
Stationary Energy (electricity and natural gas consumption)	Expansion of facilities to serve a growing population, colder winters and springs	Implementation of energy conservation and efficiency measures and use of renewable energy	In progress as part of 10-year Corporate Energy Management Plan
Landfills (methane)	Population growth and more waste landfilled	Increased waste diversion particularly organics (green bin) and use of portable flaring of methane (when practical)	Increased green bin diversion expected with new residential collection rules starting in March 2017.
Fleet (fuel consumption)	Expansion of fleet to serve a growing population	Improved fleet management programs, use of alternative fuels and technologies	Recommendations from the Fleet Program Review are being implemented with a focus on improved management practices including annual fleet utilization reviews and optimization of fleet size.
Wastewater (WW) and Biosolids (methane)	Population growth and increased WW flow	More land application of biosolids and less sent to landfill	In progress but impacted by agricultural demand for fertilizer

Projected emissions to the target year of 2019 have been forecasted using an assessment of growth trends to date for Regional operations and emissions, launch of LRT in 2018, as well as, consideration of various growth and reduction factors summarized above.

Figure 15 illustrates these trajectories in relation to a business-as-usual forecast if the Region had not reduced any emissions since 2009.

Figure 15 - Actual and Projected GHG Emissions from Regional Operations



Current projections indicate that the Region will likely meet its reduction target depending on various factors occurring between 2016 and 2019. Projects previously identified within the Corporate GHG Action Plan have varying degrees of impact on the successful achievement of the reduction target as listed in Table 13. Implementation of the Region's corporate energy plan and changes to curbside waste collection starting next spring will help keep emissions lower. However, critical activities such as successfully increasing organic and ICI waste diversion, increasing land application of anaerobic biosolids instead of sending them to landfill, and assessment of alternative vehicle fuels and technology within the Regional fleet will likely make the difference in terms of the Region meeting its current emission reduction target. The influence of weather on natural gas consumption is beyond our control to directly influence but ongoing demand-side management initiatives and equipment retrofits are decreasing natural gas consumption. Combined heat and power (cogeneration) is also being explored to help offset demand for natural gas as a more efficient means to distribute energy services.

Table 13 - Status of Major Projects and Impact on 2019 Emission Target

Action	Status	Degree of Impact		Lead Division
		GHGs Reduced (Tonnes)	Cost Savings	
Buildings and Streetlights				
7 New LEED buildings	Complete	Medium (~ 2000 T)	Payback within useful life of asset	Various / Facilities
Replace Streetlights with LED bulbs	Planned for 2017/2018	Low (< 200 T)	Payback = 5 to 6 years	Roads
Planned furnace replacements in Regional housing units	Ongoing	Low (< 200 T)	Payback within useful life of asset	Facilities/ Housing
Energy efficiency projects	Ongoing	Low (300 to 400 T)	Average payback = 5 to 6 years	Facilities
Use of alternative energy sources (excluding FIT projects)[a]	Periodic assessment	Low – Medium	Case-by-case analysis	Facilities
Waste / Biosolids				
Organics Diversion (green bin)	Ongoing	Medium (2000 – 3500 T)	Conservation of landfill space	Waste Management
Portable flaring of landfill gas	Dependent upon location of landfilling	**High (4000 – 7000 T)**	Case-by-case analysis	Waste Management
Potential impact of planned changes in Wastewater Treatment and Biosolids operations to year 2019	In-progress	**High (6000 – 12000 T)**	NA	Water Services
Fleet				
Biodiesel in transit buses - B5 / B20 (winter/summer)	Not Implemented	Medium (~ 2600 T)	1-2% increase in operating costs	GRT
Idling reduction / telematics	Under consideration	Low – medium (~1000 T)	To be determined	Fleet Services, Transit, EMS
Green Fleet procurement and central fleet pool	Under consideration	Low (< 200 T)	To be determined	Various / Fleet Services

Note a) Renewable energy projects that sell power to the province under the Feed-in-Tariff program cannot be counted in corporate emission reductions as the 'credit' is claimed by the province.