



CITY OF
Guelph

ENERGY USAGE & GREENHOUSE GAS EMISSIONS

SUMMARY REPORT 2012

***Working towards achieving the energy and environmental goals set
out in the Guelph Community Energy Initiative***



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Background Information

The City of Guelph's Community Energy Initiative (CEI), created in 2007, outlines several goals that the City aims to accomplish before 2031. The CEI focuses mainly on reducing the City's energy consumption and greenhouse gas (GHG) emissions.

Guelph's goals under the CEI are to:

- use less energy in 25 years than in 2005
- consume less energy per capita than comparable Canadian cities
- produce less greenhouse gas per capita than the current global average

More specifically, the overall target of the CEI is to reduce both the energy consumption and GHG emissions in Guelph by 50% by the year 2031, using 2005 as the benchmark year. In order to track Guelph's progress toward meeting these targets, the CEI: Energy and Emissions Monitoring Report is prepared annually by The City of Guelph with the assistance of Guelph Hydro Inc.

In 2012, as in previous years, the data for the report is analyzed using the International Council for Local Environmental Initiatives (ICLEI) protocol. The ICLEI protocol allows the energy usage and GHG emissions data to be broken down into the residential, commercial, industrial, transportation, and community waste sectors. The data is also separated into different energy and GHG sources: electricity, natural gas, diesel, gasoline, and municipal solid waste (MSW). MSW is not considered to be an energy source however, only a source of GHG emissions. The data can then be analyzed for each separate sector and source, which enables the City of Guelph to direct their conservation programs to where they will have the most impact.

The CEI also emphasizes the importance of using locally created renewable resources and reducing the magnitude of the summer grid electrical peak by at least 40% by 2031. The CEI states that "within 15 years, at least a quarter of Guelph's total energy requirement will be competitively sourced from locally created renewable resources". This report therefore examines renewable electricity generation from biogas and solar photovoltaic, the two largest contributors to renewable energy in Guelph.



Transportation is responsible for a large portion of the GHG emissions and energy consumption in Guelph. The CEI has the goal of reducing the energy consumption of the transportation sector by 25% before 2031. Alternative types of transportation such as bicycles, public transit and hybrid and electric vehicles can help to reduce the energy consumption and GHG emissions from transportation, and are therefore discussed in this report.

Methodology

The CEI: Energy and Emissions Monitoring Report uses the ICLEI protocol for community reporting to analyze the City of Guelph’s energy usage and GHG emissions. The ICLEI model uses the information from the 1990-2011 National Inventory Report (NIR), published by Environment Canada. The NIR provides annually updated emissions factors for each energy source by province, but only provides electricity emissions factors up to 2011. Because of this, an average of the electricity emissions factor from 2009, 2010, and 2011 was used in the analysis.

The data used in this report was obtained from the City of Guelph, Union Gas Limited, Environment Canada, Guelph Hydro Electric Systems Inc., and Kent Marketing. The ICLEI Inventory Quantification Support Spreadsheet was used to calculate the energy usage and GHG emissions in Guelph by sector and by source. The spreadsheet was also used to create the visual representations of the data found in the report.

The information regarding renewable energy generation in Guelph was provided by Guelph Hydro Electric Systems Inc. and Envida Community Energy Inc. A telephone survey of local car dealerships was undertaken in order to determine the number of hybrid vehicles and electric vehicles that were sold in Guelph in 2012. The information regarding Guelph Transit and the cycling infrastructure was provided by the City of Guelph.



Energy and Emissions Analysis

Since the introduction of the CEI in 2007, the per capita GHG emissions and per capita energy usage figures have fallen continuously. At the same time, the population of Guelph has increased significantly every year. The city grew by nearly 1,400 people in 2012, reaching a population of 137,162 people. This represents a 21.7% increase since 2005, the benchmark year for the CEI.

The per capita energy usage and GHG emissions for 2012 and the six preceding years are shown in **Table 1**. The per capita energy usage reverted to its declining trend after increasing slightly in 2011, which is illustrated in **Table 2**.

The per capita GHG emissions continued to decline in 2012, falling by 0.5 tonnes of eCO₂* per capita, which is a drop of 6.6%. Per capita energy usage also declined by 6.3 GJ/capita, a 3.3% improvement. In total, the per capita energy usage has fallen by 17.6% since 2006, and the per capita GHG emissions have dropped by 26.3% in the same period.

Table 1 - Per Capita Energy Usage and GHG Emissions from 2006 to 2012

Year	Population	Energy Usage (GJ/Capita)	GHG Emissions (tonnes of eCO ₂ /Capita)
2012	137,162	181.7	7.0
2011	135,770	188.0	7.5
2010	131,605	186.7	7.8
2009	127,439	188.0	7.4
2008	123,274	202.3	8.5
2007	119,108	213.5	9.4
2006	114,943	220.4	9.5

* eCO₂ (equivalent carbon dioxide) is a common measure of greenhouse gas emissions that are derived from a variety of different fuels, each of which emits a different level and type of emissions.



Table 2 - Percent Difference in Per Capita Energy Usage and GHG Emissions from 2006 to 2012

Year	Population	Energy Usage Per Capita	GHG Emissions Per Capita
2011-2012	1.0%	-3.3%	-6.6%
2010-2011	3.2%	0.7%	-3.8%
2009-2010	3.3%	-0.7%	5.4%
2008-2009	3.4%	-7.1%	-12.9%
2007-2008	3.5%	-5.2%	-9.6%
2006-2007	3.6%	-3.1%	-1.1%

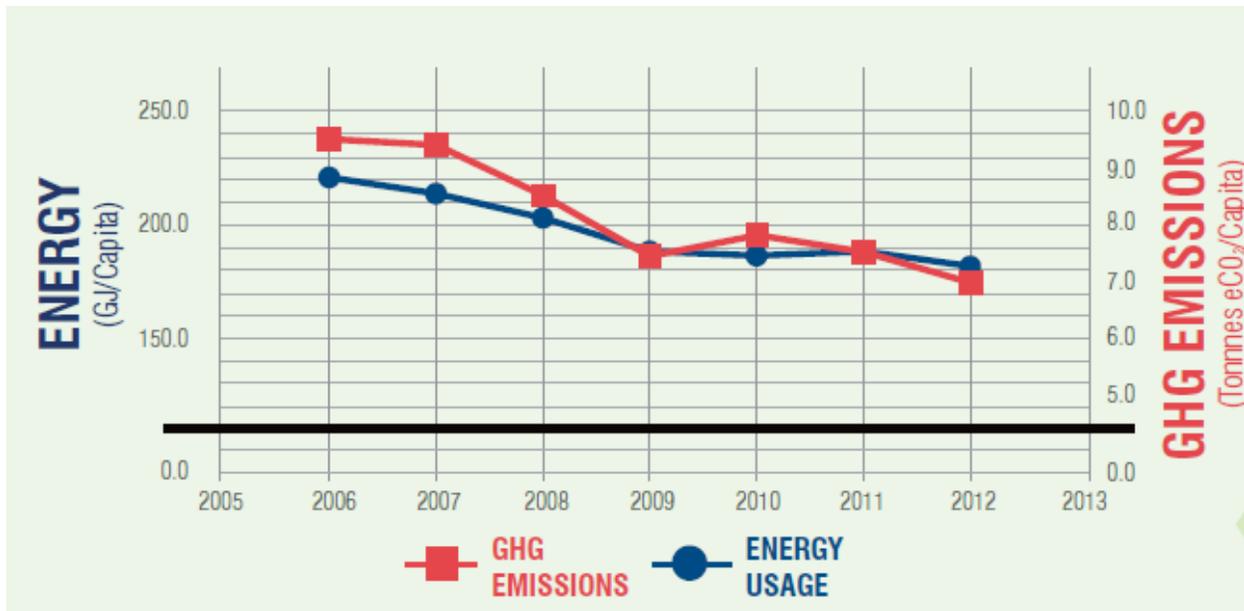


Figure 1 - Per Capita Energy Usage and GHG Emissions from 2006 to 2012

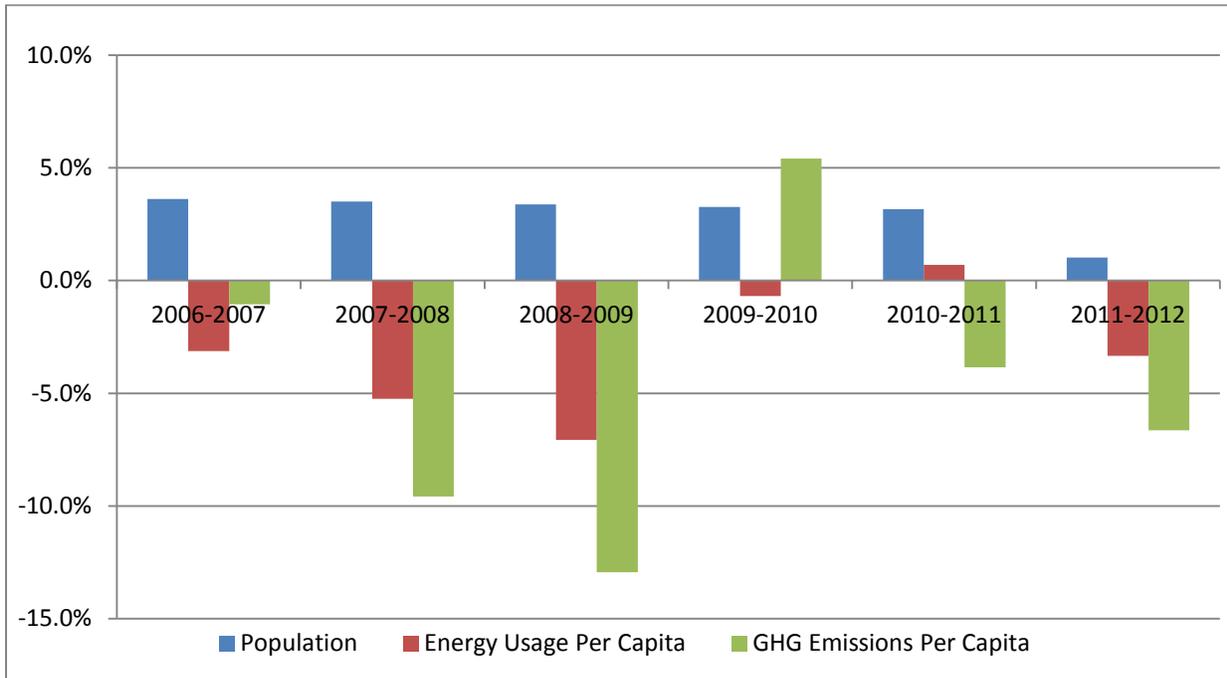


Figure 2 – Percent Change in Population, per Capita Energy Usage and GHG Emissions from Year to Year.

The data found in **Table 1** is represented in **Figure 1**. The graph shows that both the per capita energy usage and GHG emissions remained consistent between 2009 and 2011. In 2012 however, both the per capita energy usage and GHG emissions experienced a noticeable decline from the three previous years. The per capita GHG emissions fell to 7.0 tonnes of eCO₂ for the first time since the CEI was introduced.

The data found in **Table 2** is shown in **Figure 2**. It shows the percent changes in Guelph’s population, per capita energy usage and per capita GHG emissions from year to year.

The largest contributor to the GHG emissions was the transportation sector again in 2012. As illustrated in **Figure 3**, 30% of the eCO₂ emitted in Guelph came from transportation. Despite this, the eCO₂ emissions from the transportation sector actually fell by approximately 1,000 tonnes from 2011 to 2012, which corresponds to about 0.4% as illustrated in **Table 3**. When the eCO₂ emissions by sector from 2012 are compared to the same data from 2006, it can be observed that the commercial sector was responsible for a larger portion of the city’s emissions



in 2012 than in 2006. Conversely, the industrial sector accounted for less of the overall emissions in 2012 than in 2006. This is illustrated in **Figure 4**. The residential and transportation sectors still accounted for the same percentage of Guelph's emissions in 2012 as 2006. However, because Guelph's total emissions have decreased by about 126,000 tonnes, this means that emissions have been significantly reduced in both sectors.

The GHG emissions were reduced in all of the sectors considered in this report: residential, commercial, industrial, transportation, and community waste. The most significant decline in GHG emissions occurred in the commercial sector where the emissions were reduced by over 29,000 tonnes of eCO₂, or 11.7%. The GHG emissions of the residential sector also fell significantly, dropping by 10.2%. The emissions from Municipal Solid Waste were reduced by 43.6% in 2012, as a result of the opening of the new organic composting facility in the city. This facility helps to reduce the amount of waste that ends up in landfills. Overall, GHG emissions in Guelph fell by 5.2% in 2012, which is approximately 52,600 tonnes of eCO₂.

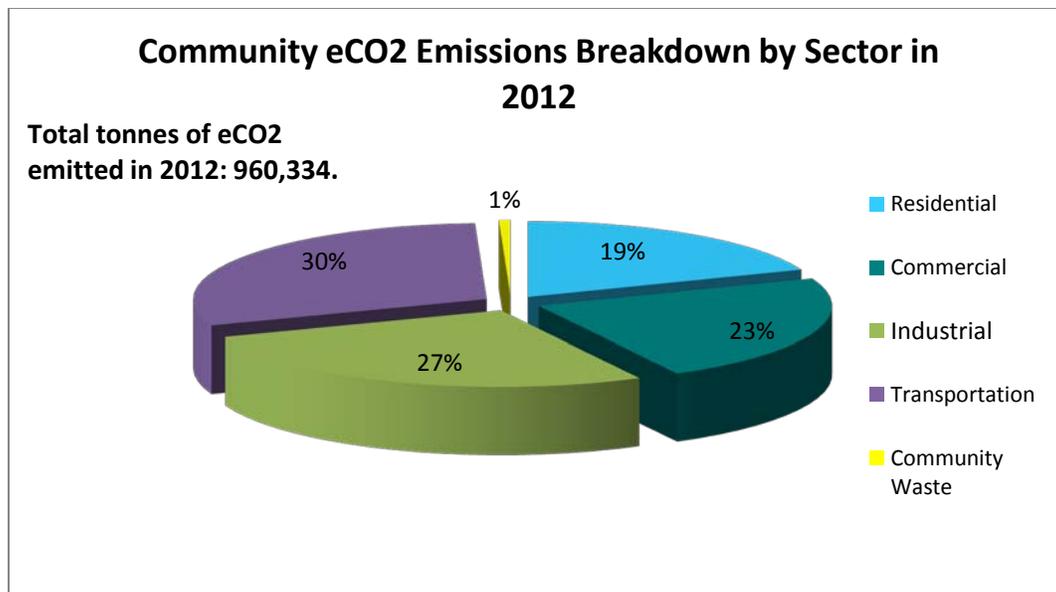


Figure 3 - GHG Emissions by Sector in 2012.

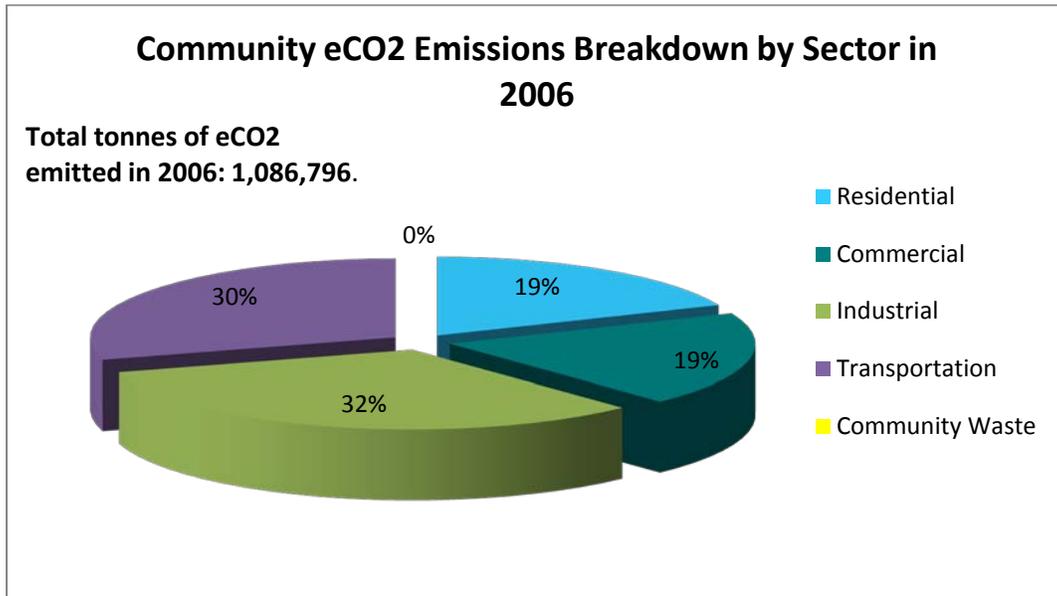


Figure 4 - GHG Emissions by Sector in 2006. (Community Waste values were not available for 2006)

Table 3 - Total GHG emissions by Sector in 2011 and 2012

Sector	2011	2012	Percent Difference Since 2011
	Total eCO ₂ (t)	Total eCO ₂ (t)	
Residential	204,369	183,566	-10.2%
Commercial	250,829	221,566	-11.7%
Industrial	257,629	260,889	1.3%
Transportation	289,226	288,169	-0.4%
Municipal Solid Waste	10,890	6,144	-43.6%
Total	1,012,943	960,334	-5.2%

In 2012, Guelph reduced its overall energy consumption by more than 640,000 GJ, which is approximately a 2.4% change from 2011. Of the four main types of energy used in Guelph, natural gas, diesel, and gasoline all saw a decrease in usage from 2011, as can be seen in **Table 4**. Electricity was the only energy source that experienced an increase in usage by about 1.7%, which is shown in



Table 5.

Table 4 - Total Energy Usage and Emissions by Source for 2011 and 2012

Energy Type	2011		2012	
	Total Energy Use (GJ)	Total eCO ₂ (t)	Total Energy Use (GJ)	Total eCO ₂ (t)
Electricity	11,387,820	220,965	11,583,399	212,952
Natural Gas	9,997,868	491,862	9,209,349	453,069
Diesel	162,756	11,403	151,222	10,788
Gasoline	3,985,947	277,824	3,979,595	277,381
Waste	N/A	10,890	N/A	6,144
Total	25,534,391	1,012,944	24,923,565	960,334

Table 5 - Percent Difference in Energy Usage and eCO₂ Emissions by source from 2011 to 2012

Energy Type	% Difference in Energy Use	% Difference in eCO ₂ Emissions
Electricity	1.7%	-3.6%
Natural Gas	-7.9%	-7.9%
Diesel	-7.1%	-5.4%
Gasoline	-0.2%	-0.2%
Waste	N/A	-43.6%
Total	-2.4%	-5.2%



As shown in **Figure 5**, natural gas is the largest source of eCO₂ emissions in Guelph. The combustion of natural gas accounted for 47% of the emissions in 2012. In

Table 6 it can be observed that the consumption of natural gas in the residential and the commercial sectors decreased by 11.7% and 13.9% respectively. Although the consumption was slightly increased in the industrial sector, the overall result was a reduction of 7.9%, or about 20.5 million cubic meters of natural gas since 2011.

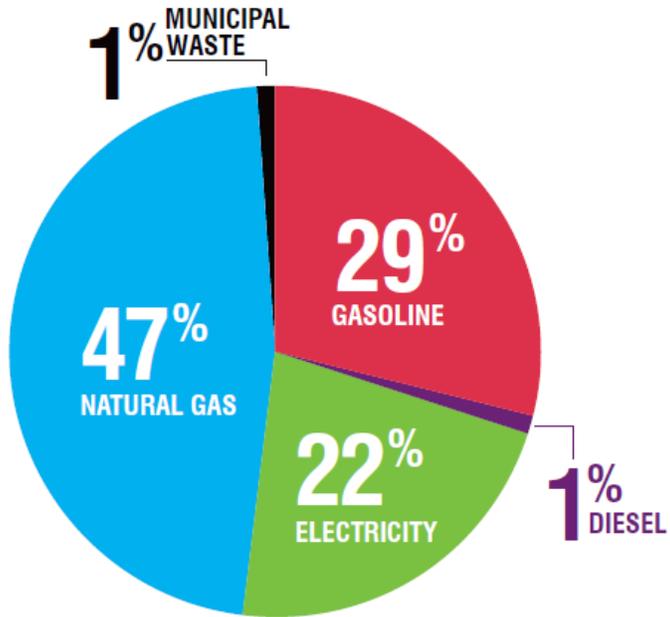


Figure 5 - GHG Emissions by source for 2012



Table 6 - Natural Gas Consumption by Sector for 2011 and 2012

Customer Class	2011 Consumption (m ³)	2012 Consumption (m ³)	Difference	% Difference
Residential	83,461,479	73,702,058	-9,759,420	-11.7%
Commercial	93,539,113	80,550,766	-12,988,347	-13.9%
Industrial	83,157,300	85,386,746	2,229,446	2.7%
Total m³	260,157,892	239,639,571	-20,518,322	-7.9%

Electricity on the other hand, experienced an increase in usage of about 1.7%, or 28.3 million kWh as show in **Table 7**. Both the residential and commercial sectors reduced their usage, while the industrial sector used 2.7% more electricity than in 2011. Despite the increase in usage, the GHG emissions from electricity actually fell by approximately 3.6%, shown earlier in *Table 5*. This surprising decrease in GHG emissions is perhaps due to coal being phased out and being replaced by natural gas and wind energy.

Table 7 - Electricity Consumption by Sector for 2011 and 2012

Customer Class	2011 Consumption (kWh)	2012 Consumption (kWh)	Difference	Percent Difference
Residential	349,307,450	349,125,274	-182,176	-0.1%
Commercial	554,857,656	546,905,606	-7,952,050	-1.4%
Industrial	748,650,373	785,170,819	36,520,446	4.9%
Total kWh	1,652,815,479	1,681,201,699	28,386,220	1.7%

The increase in electricity usage and the decrease in natural gas consumption can possibly be attributed to the weather in 2012. The winter months were exceptionally mild, and the summer was one of the hottest on record. As shown in **Table 8**, the number of Heating Degree Days in 2012 was approximately 600 less than the previous year, about 14%, and the number of Cooling Degree Days was up by about 9%. The mean temperature in 2012 was approximately 0.85 °C higher than in 2011. The lower number of Heating Degree Days between 2011 and 2012 would lead to less natural gas being used for heating. The higher number of Cooling Degree Days corresponds with the increase in electricity consumption in 2012 because air-conditioning would have been used more frequently.



Table 8 - Comparison of Community Weather Data for 2011 and 2012

	2011	2012
Heating Degree Days	4,194.8	3603.2
Cooling Degree Days	201.6	219.1
Mean Temperature (°C)	7.55	8.4

Renewable Energy in Guelph

One of the goals outlined in the Community Energy Initiative is that “at least a quarter of Guelph’s total energy requirement will be competitively sourced from locally created renewable resources.” Guelph has continued to expand its capacity to generate energy using renewable sources in an effort to meet the goals of the CEI and reduce GHG emissions.

As shown in **Table 9**, Feed-in Tariff (FIT) projects, supported by the Ontario Power Authority (OPA), gained popularity in 2012. The 18 new projects that were installed in 2012 brought the City’s total to 20 connected FIT projects. These new installations increased the nameplate capacity of FIT projects in Guelph by over 4,300 kW. These projects succeeded in generating more than 3 million kWh in 2012, a significant increase over the previous year.

2012 also saw an increase in the number of microFIT projects in Guelph. By the end of the year, there were 170 microFIT projects connected in Guelph. This increased the nameplate capacity by more than 50% from 603 kW in 2011 to 984 kW in 2012. The projects collectively generated just over 1 million kWh of renewable electricity.

In order to help meet the goal of generating a quarter of Guelph’s energy from local renewable sources, the CEI recommends installing the equivalent of 1,000 rooftops of solar panels in the city. Based on the installed solar PV generation capacity in the first two years of the microFIT program, the average size of a rooftop solar project in Guelph is 5.75 kW. This means that at the end of 2012, Guelph had installed the equivalent of 985 rooftops out of the recommended 1,000.



Table 9 - Renewable Energy Generation from FIT and microFIT projects in 2012

Renewable Energy Generation in 2012		
	FIT	microFIT
Number of Installations	20	170
Nameplate Capacity (kW)	4,685	984
Average System Size (kW)	234.25	5.8
Generation (kWh)	3,003,459	1,028,354

As stated above, one of the goals of the CEI is to supply at least 25% of Guelph’s total energy requirements from locally created renewable resources. Specifically for electrical energy, the CEI states that at least 20% of Guelph’s anticipated electricity requirements should be provided by solar photovoltaic resources. To meet this goal in 2012, 420,300,425 kWh of would have had to be generated. Solar photovoltaic installations have a capacity factor of approximately 16% in Guelph. Therefore, approximately 240,000 kW of capacity would be required. Given that the average size of a rooftop microFIT project in Guelph in about 5.75 kW, approximately 42,000 rooftops would be required to install 240,000 kW of solar PV panels. Currently, there are 5,669 kW of solar photovoltaic capacity installed in Guelph. Therefore, 42 times the capacity that is currently installed is required to meet the stated goal.

Another important source of renewable energy is the Eastview Landfill Gas Plant. It was opened in 2005 under the OPA’s Renewable Energy Standard Offer Program (RESOP). In 2012, the Eastview Plant produced 12,051,400 kWh of electricity in Guelph. When this is added to the generation totals for FIT and microFIT installations, Guelph produced approximately 16 million kWh of electricity from renewable fuels. This 16 million kWh represents approximately 0.96% of Guelph’s current electrical consumption, or about 0.29% of the city’s total energy needs from all sources. Landfill gas is a declining resource however, and its significance as an energy source in Guelph will fall off in the coming years. It will therefore be necessary for Guelph to expand its generation from other renewable sources.



Transportation

It has already been established that transportation is the sector which produces the most GHG emissions in Guelph. In an effort to reduce these emissions, the City of Guelph promotes alternative transportation modes to the use of cars. Public transit and cycling are two of the most important methods of transportation in Guelph, and the City's efforts to improve these services continued in 2012.

Through the Bicycle-Friendly Guelph Cycling Master Plan, the city has made a concerted effort to facilitate transportation by bicycle in the city. In addition to the 46 km of cycling infrastructure already present on many of the major roads in Guelph, 3.6 km of bicycle lanes were constructed in 2012. The use of the bike racks on Guelph Transit buses increased by 18% in 2012, indicating that cycling is quickly becoming a more viable method of getting around in Guelph.

Public Transit is also an important method of transportation in Guelph, and helps to reduce GHG emissions produced by the transport sector. Guelph Transit reached an impressive milestone in 2012, with ridership surpassing 7 million for the first time.

Hybrid and Electric Vehicles

In recent years the popularity of hybrid and electric vehicles has increased in Guelph. These vehicles emit much less greenhouse gas than their more conventional counterparts, and therefore have great potential to help Guelph meet its targets to reduce GHG emissions and energy consumption.

The estimated average annual emissions for electric, plug-in hybrid, hybrid and conventional gasoline vehicles in Ontario are shown in **Table 6**. The calculations are based on modeling produced by the U.S Department of Energy and the assumption that a vehicle is driven an average of 20,000 km in a year. It can be observed from the graph that hybrid, plug-in hybrid, and electric vehicles emit less eCO₂ than conventional vehicles do. In the case of electric



vehicles, they emit approximately 87% less greenhouse gases than conventional vehicles for the same distance travelled. The generation mix for Ontario in 2012, also shown in **Figure 6**, is provided by the Independent Electricity System Operator (IESO) and shows the fuels that are used to generate Ontario’s electricity. About 80% of Ontario’s electricity in 2012 was generated from sources with low carbon emissions, which helped to reduce the emissions from electric vehicles.

Energy Output by Fuel Type (2012)

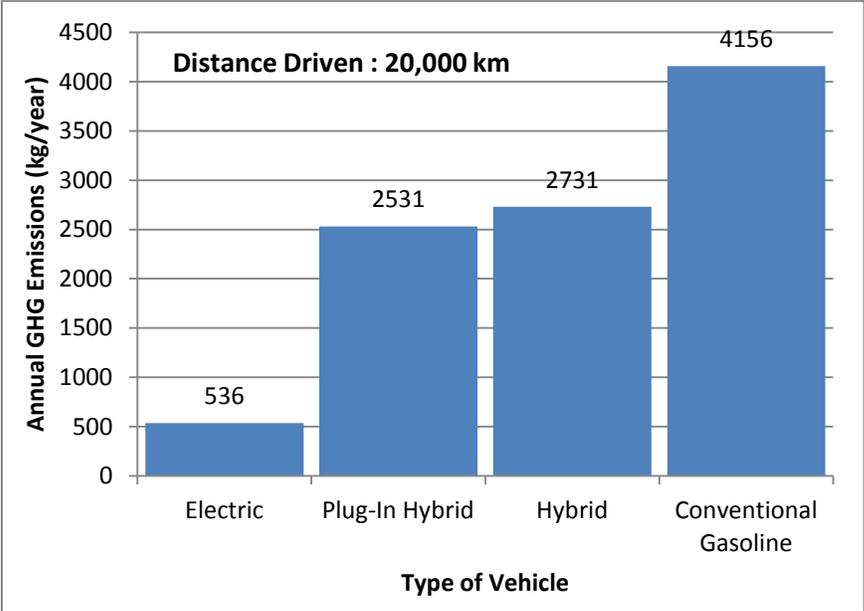
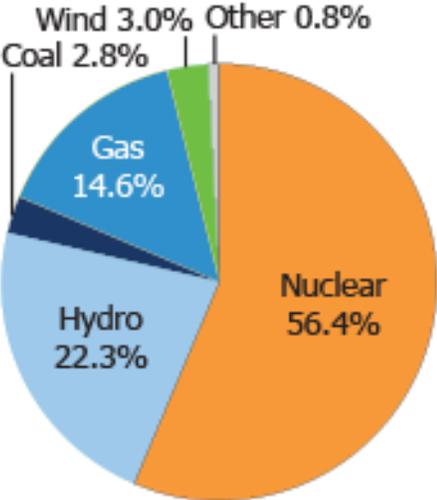


Figure 6 - Ontario’s Electrical Energy Output by Fuel Type in 2012 and the Annual GHG Emissions Estimates for Vehicle Types.

In order to track the popularity of hybrid and electric vehicles in Guelph, sales figures were obtained from six new car dealerships. There were approximately 107 hybrid and electric vehicles sold in 2012, a 78% increase over the 60 sold in 2011. This shows that interest in alternatives to traditional internal combustion engines is increasing rapidly, which may help to reduce Guelph’s energy consumption and GHG emissions in the future.



Conclusion

The City of Guelph has been continuously working to reduce its energy consumption and GHG emissions since the introduction of the CEI, and has made good progress. In 2012, the per capita energy usage fell to 181.7 GJ/capita and the per capita GHG emissions was just 7.0 tonnes of eCO₂/capita. Overall, Guelph used just under 25 million GJ of energy, 2.4% less than in 2011, and emitted about 960,000 tonnes of eCO₂. These statistics show that Guelph is slowly moving in the right direction in order to achieve the goals outlined in the CEI.

Reducing the energy and emissions used for transportation is an important goal of the CEI, one that the city has worked hard to address. Electric and hybrid vehicle sales increased by 78% in 2012 and public transit reached a milestone of 7 million riders in a single year for the first time. Continuing to improve and promote alternative transportation will allow Guelph to reduce energy consumption and emissions from the transportation sector.

Despite this success, Guelph still has a long way to go before the goals of the CEI are accomplished. Only 0.23% of the City's energy was locally supplied from renewable sources in 2012, where the City's target is 25%. The city has made important progress toward meeting its renewable energy goals however, with the city expected to accomplish the milestone of 1,000 rooftops of solar PV generation in 2013.

For further information about the data presented in this report, please contact:

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