



West Lincoln
Your Future Naturally

Energy Conservation & Demand Management Plan Version 2.0

**Township of West Lincoln
Niagara Region**

August 2019

Schedule 'A'

Prepared by the Climate Change and Sustainability Coordinator

ENERGY CONSERVATION & DEMAND MANAGEMENT PLAN

The Corporation of the Township of West Lincoln (Corporation) recognizes the global and local impacts of climate change and understands its responsibility to help reduce Greenhouse Gas (GHG) emissions while also preparing its community to adapt to the changing climate. This Plan is one the Corporation's many efforts to become resilient to climate change, while also a way for the Corporation to lead by example.

The Corporation's Green Team led this Plan to completion by providing their valuable insights. The Green Team serves as an agency (1) to provide an opportunity for the flow of strategic advice and expertise between staff and Council for the continued implementation of the Plan to Mitigate Environmental Impacts and (2) to facilitate staff discussion on how particular environmental, economic, and social issues impact municipal operations as well as the broader community.



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The preparation of this Plan was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them. This Plan was prepared by Meghan Birbeck the Climate Change and Sustainability Coordinator for the Corporation of the Township of West Lincoln.



ACKNOWLEDGEMENTS

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ABBREVIATIONS

ECDM	Energy Conservation and Demand Management
FCM	Federation of Canadian Municipalities
GHG	Greenhouse gas
Ministry	Ministry of Energy, Northern Development and Mines
O. Reg.	Ontario Regulation
Township	Township of West Lincoln

1.0 INTRODUCTION

In February 2019, the Corporation of the Township of West Lincoln (Township) was awarded a staff support grant from the Federation of Canadian Municipalities (FCM). This grant is intended to supplement 80% of the salary of an employee through FCM's Municipalities for Climate Innovation Program. As a result of receiving the award, the Township has hired a Climate Change and Sustainability Coordinator to work on initiatives to reduce the Township's energy consumption. Part of the Township's requirement has been to develop a comprehensive five-year corporate Energy Conservation and Demand Management (ECDM) Plan that complies with the Ontario Regulation (O. Reg.) 507/18.

1.1 Background

The Province of Ontario (through the O. Reg. 507/18 of the *Electricity Act, 1998*) requires all public sector agencies to monitor, evaluate, and plan for energy conservation and demand related to their operations. The regulation does this by requiring that municipalities, among other public sector groups (e.g. schools and hospitals), report their annual energy use and submit an ECDM Plan every five-years to the Ministry of Energy, Northern Development and Mines. The annual reports are intended to identify the energy consumption and greenhouse gas (GHG) emission from the operations that the public sector heats and/or cools and those that are responsible for the treatment or pumping of water or sewage. Whilst, the ECDM Plans are designed to allow the public sector a chance to develop innovative sustainable energy conservation solutions that can benefit them in the long-run financially, environmentally, and socially.

The Provincial awareness, which O. Reg. 507/18 (Appendix A) aims to establish across public agencies, is necessary to foster government leadership in energy conservation. This leadership is intended to help reduce the production of anthropogenic sources of GHGs emissions, which are extremely likely to be the dominant cause of climate change. The creation of this regulation in December 2018, replaces the provinces previous legislative reporting requirements set out by O. Reg. 397/11 in the *Green Energy Act, 2009*. The *Green Energy Act, 2009* was repealed as of January 1, 2019.

The Township's original ECDM Plan was prepared prepared in consultation with a private consultant, in 2014, under O. Reg. 397/11. The requirements for the Township's updated ECDM Plan are generally consistent with those of the original requirements, plus a five-year review element. In general, the updated Plan is to include:

- A review of the effectiveness of energy conservation and demand management measures employed by the Township over the past five-year period.
- Energy information that is relevant to the Township, including strategies, goals, and reduction targets for managing its energy needs.
- Information about any renewable energy generating operation owned or considered by the Township.

Hard copies of this ECDM Plan are available at the main administrative building located at 318 Canborough Street, Smithville. This plan is valid from September 2019 – June 2024 and according to the Ministry the next update is required by July 1, 2024.

THREE PILLARS OF SUSTAINABILITY

Environmental



Social



Financial



1.2 Purpose & Scope

The purpose of this Plan is to document the legislated requirements related to the ECDM of the Township's operations, inclusive of the following scope:

- Review of the Township's past energy consumption and related GHG emissions up to the last full year (2018) for operations in which the Township heats or cools or are related to the treatment or pumping of water or sewage.
- Document past and current energy conservation measures completed for the Township operation.
- Review and propose future measures to conserve and manage the Township's energy consumption throughout its operations.
- Provide a summary document for interested parties and the municipality to review concerning the ECDM for the Township

1.3 The Township

In 1970, the Townships of South Grimsby, Caistor, and Gainsborough were amalgamated to establish the Township of West Lincoln (Figure 1). To date, West Lincoln is the largest lower-tier municipality within the Niagara Region at 387.81 square kilometres (95,830 acres) (Figure 2). Nearly 70% of the Township's landscape functions as farmland, which fortifies the area's rural characteristic. Due to the area's vast agricultural area, the Township has a relatively low population density (37.4 citizens per squared kilometre). The majority of the area's population resides within the Township's urban settlement area (Smithville) and 15 hamlets (Figure 1).

Despite the Township's rural nature, it has experienced a 10% growth over the past decade (5.1% from 2006-2011 and 4.8% from 2011-2016) and now has a recorded population of 14,500 citizens. The Regional Municipal Comprehensive Review estimates that this population is expected to double to 29,460 by 2041. However, since 2006, the Township's population has been ageing (Figure 3). To help adapt to the changing demographics, the Township has put together an Age-Friendly Advisory Committee. The committee's primary function is to advise council on ways to foster a society that enables seniors to age in place. With the Township's changing demographics and expected population growth, the Township presumes that there will be a significant change in the way that community operations function as well as the demand for energy to service the operation.



Figure 1: West Lincoln's Settlement Areas

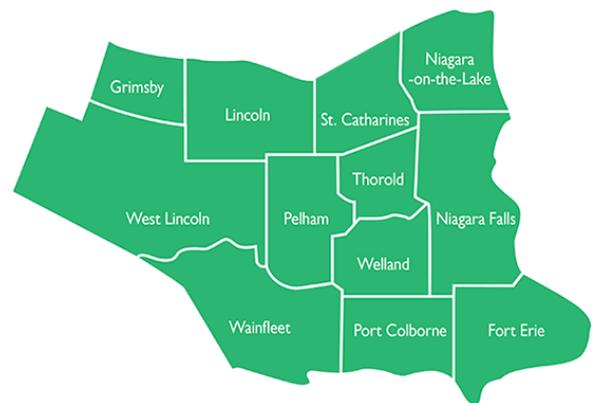


Figure 2: Niagara Region's Twelve Lower-tier Municipalities

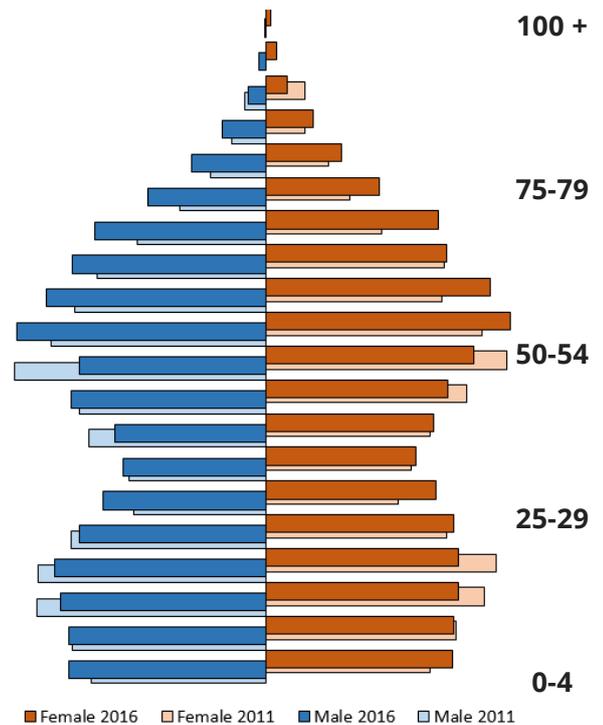


Figure 3: West Lincoln's 2006-2016 Population Pyramid



2.0 METHODOLOGY

To prepare the action items provided in this ECDM Plan the Township's Climate Change and Sustainability Coordinator analyzed several key documents (government documents and comparable municipal ECDM Plans) as well as the Township's utility bills. In addition, the coordinator held informal key informant interviews. Through the utilization of the identified methods, it is hoped that a 'Made-in-West Lincoln' approach was achieved and represented in the action items of this ECDM Plan. Action items are intended to be practical and applicable to the Township when implemented on a departmental level.

2.1 Document Review

The following documentation was reviewed with respect to the preparation of this Plan.

- EnviroEconomics' *Act Locally: The Municipal role in fighting climate change*, 2009
- Government of Canada's *Federal Greenhouse Gas Pollution Pricing Act*, 2019.
- Government of Canada's *International action on climate change (The Paris Agreement)*, 2016
- Government of Canada's *Pan-Canadian Framework on Clean Growth and Climate Change*, 2016.
- Independent Electricity System Operator's *Ontario Municipal Energy Profile*, 2018
- Ontario Regulation 507/18, *Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans*, 2018 (Appendix A).
- Town of Bancroft's *Energy Conservation and Demand Management Plan*, 2019.
- Township of Hornepayne's *Energy Conservation and Demand Management Plan*, 2019.
- Township of West Lincoln's *Energy Conservation and Demand Management Plan*, 2014.

2.2 Annual Energy Reporting

Each year the Township is required to report their annual energy consumption for each reportable operation to the Ministry. In 2016, the Township published its first report for the year 2014 and has been publishing them on an annual basis since. Data is delayed by two-years as the coefficients needed for the calculations in the reports come from the federal government's National Inventory Report, which likewise is published annually with a two-year delay.

The annual energy consumption data has come from the Township's monthly utility bills. Enbridge and Niagara Peninsula Energy Inc. are the Township's respective energy providers for natural gas and electricity. It is important to note that some inventory years for natural gas and electricity in this CMD Plan do not match the energy reports on the Township's website. This is because of three past errors:

- In 2014 the wrong electricity data was recorded off of the utility bills.
- In 2014 and 2015 the wrong natural gas data was recorded off of the utility bills.
- From 2016 until present the natural gas utility bills have had some months where inaccurate values were initially provided by Enbridge. These miscalculations were acknowledged by Enbridge in later bills. However, the recalculations of past bills were not noticed when records were initially made.

The re-calculated energy consumption, GHG emissions, and energy intensities are summarized for each reportable operation from 2014 - 2018 in Appendix B. A guide to these calculations can be found in Appendix C. Appendix B has normalized the energy intensity data of each operation relative to their geographic location to account for relative climate conditions.



2.3 Energy Intensity Data

As noted in Section 2.2, historical normalized energy intensity values from 2014 to 2018 can be found in Appendix B. Normalized data relative to the climate conditions (i.e. heating degree days (HDD)) for each facility's location has been determined by utilizing Energy Star's Portfolio Manager Degree Days Calculator. Of the six eligible facilities in this report, the four facilities that are located within the urban settlement of Smithville have been assessed using the Welland-Pelham 717520 weather station information (Figure 4). The remaining two facilities located in the hamlets of Caistor Centre and Caistorville have been assessed using the Hamilton 712630 weather station information (Figure 4). Energy values for the six facilities were then compared against the Ministry benchmarks to evaluate the facilities' overall performance for its operation type, on a pass/fail basis (Appendix B).

2.4 Plan Development

This ECDM Plan builds on the Township's first plan developed in 2014 and the experience gained in energy conservation over the last five years. In addition to this plan supporting the O. Reg. 507/18 it also supports the Township's capital plan, strategic plan, and asset management policy. The integration of this plan is essential for the Township to maximize the productivity of its operations, minimize energy costs, and reduce negative social, environmental, and economic impacts. This plan offers recommendations for building specific findings; record-keeping, procurement policy updates, staff-training, low energy retrofit programs, the potential future use of renewable energy technologies, and exchanging end of service life appliances and office equipment with new Energy Star replacements.

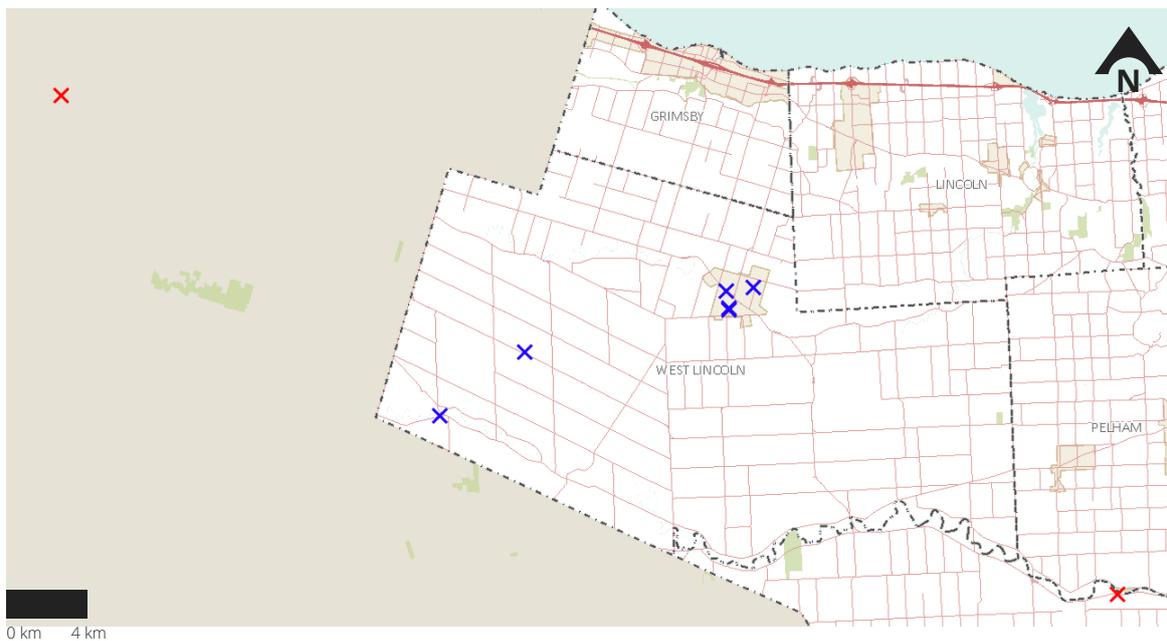


Figure 4: Reportable Operation (blue) verse Weather Stations (red)

2.5 Next Phases

This ECDM Plan is the first phase to the Township reducing its corporate energy consumption and simultaneously also reducing their GHG emissions. Figure 5 below identifies the Township next steps to pursuing the reduction of energy by 2024.

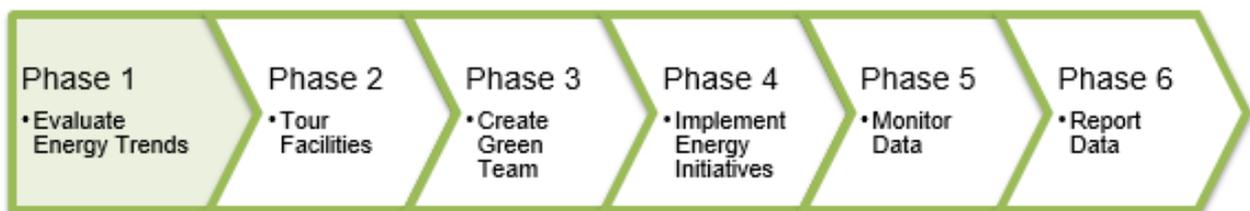


Figure 5: Next Phases

3.0 DOCUMENT ANALYSIS

3.1 Canada's Climate Change Plans

Both natural processes and human activities can cause climate change. Currently, human activity is widely considered to be attributing to global warming, primarily through the release of carbon dioxide and other GHGs into the atmosphere. A residual impact of climate change is an increase in extreme weather events, which can cause detrimental social, environmental, and economic impacts on communities.

While the Federal Government actively supports growing the nation's economy, it also has a goal of reducing its collective GHG emissions. In 2016, this was made apparent as Canada ratified the Paris Climate Accord. In this ratification, the nation pledged to reduce its GHG emissions by 30 percent from 2005 levels by 2030. To date, over 90% of the 197 parties around the globe have ratified the Paris Accord. By endorsing the Paris Accord parties agreeing to maintain a global temperature rise below 2 degrees Celsius above pre-industrial levels.

Reducing the amount of GHGs that the country emits is a way for Canada to mitigate against climate change. In addition to ratifying the Paris Accord, Canada also released its climate plan entitled Pan-Canadian Framework on Clean Growth and Climate Change in 2016. The climate plan is just one of the Federal Government's efforts geared to protecting the environment and developing initiatives that will facilitate healthy communities. The Federal Government identifies that Canada's collective GHGs emissions are a product of five main economic activities (Figure 6).

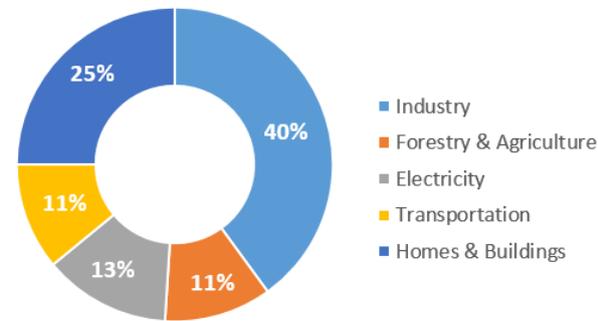


Figure 6: Canada's GHG Emissions by Economic Activities.

In 2009, EnviroEconomics was contracted by FCM to research how municipalities can help fight climate change. It was determined that municipalities have the potential to make energy reductions anywhere from 15-40%, which makes municipalities an important ally for the Federal Government to meet their national goal of reducing GHG emissions by 30 percent from 2005 levels by 2030.

3.2 Canada's Federal Greenhouse Gas Pollution Pricing Act, 2019

As of April 1, 2019, the Federal Greenhouse Gas Pollution Pricing Act, 2019, requires the Corporation of the Township of West Lincoln to pay a surcharge on GHGs emissions produced from Township facilities and operations. The purpose of this Federal Act is to support clean growth, reduce environmental impacts, and mitigate the potential adverse effects of climate change. Participation in the Federal-pricing scheme is mandatory (for all Provinces that lack their own) so that corporations and individuals consider the economic impact of the increase in natural gas and electricity prices and alter their behaviour to in turn support the environment.

Under the Greenhouse Gas Pricing Act, 2019, all consumption of fuel for energy in Ontario will be subject to the Federal tax surcharge. The tax will reflect in a charge of \$20 per tonne of carbon dioxide equivalent (CO₂e) in 2019 and rising by \$10 per tonne annually and up to \$50 per tonne by 2022. Specifically, the Act identifies that in the 2019 fiscal year, natural gas consumption will be charged at an additional \$0.0391 per cubic meter and annually increasing to a cost of \$0.0979 per cubic meter by 2022. If the Township of West Lincoln's approach to energy consumption is "business-as-usual" it is projected that there will be a burden both on the environment and economy from this taxation. Therefore, this carbon tax is intended to drive environmental change by dissuading people from making choices that cause emissions in the first place. Economists identify that carbon taxes are the most cost-effective way to reduce GHGs emissions. The Federal Government identifies that the tax will only puts an upfront financial burden on consumers to alter their behaviour and is intended to be returned to them in the form of rebates later on.

3.3 Ontario's Energy Profile

Energy costs historically have been relatively high in Ontario. Figure 7 respectively identifies the Ontario Energy Board's historic costs for electricity and natural gas over the last decade. The figures show that in the first half of the last decade Ontario experienced high natural gas costs. However, almost simultaneously as the natural gas costs fell midway through the decade electricity costs nearly doubled. The high energy costs have created a financial barrier for some Ontario municipalities to provide community services to their residents.

In 2018, the Independent Electricity System Operator published a report profiling the energy use of Ontario municipalities. The report identifies that in 2014, the primary source of energy for municipal operations was electricity (63%) and natural gas (35%). Further identifying that Municipalities spent an estimated \$917 million on electricity and \$105 million on natural gas in 2014.

Figure 8 respectfully showcase the distribution of energy consumption in Ontario for electricity and natural gas. The Independent Electricity System Operator's found that in 2014 social housing, water and sewage treatment, and street lighting were the biggest consumers of electricity. Whilst, social housing, multi-purpose facilities, and arenas were the biggest consumers of natural gas. Nevertheless, these facilities have many opportunities to become more energy-efficient, and even to generate renewable energy.

The Township of Hornepayne explained the need for managing municipal energy consumption effectively in their recent ECDM Plan. They stated that "managing municipal energy consumption efficiently means providing the same services with less energy. Energy conservation measures are often the lowest cost options for providing many other environmental, economic and social benefits. This also results in cost savings, lower environmental load by avoiding GHG and local air, water and land emissions associated with energy production and consumption, local economic development opportunities and associated new jobs, enhanced reliability of energy systems, and reduced-price volatility, and improved energy supply security."

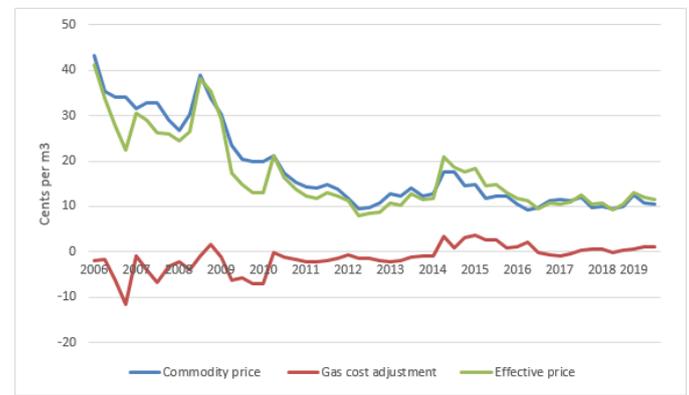
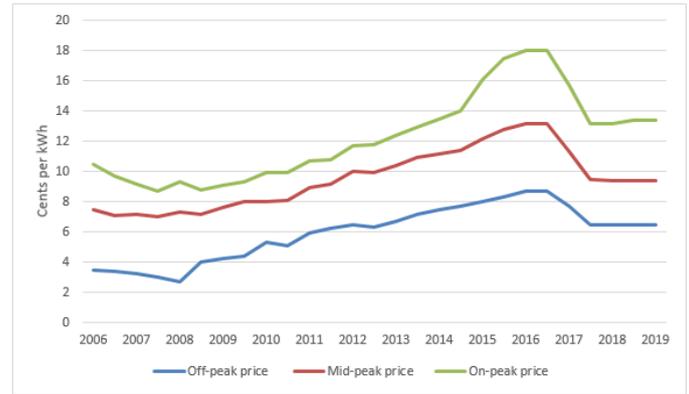


Figure 7: Ontario Energy Board's Energy Costs
* Top chart show electricity costs while the bottom chart shows natural gas costs*

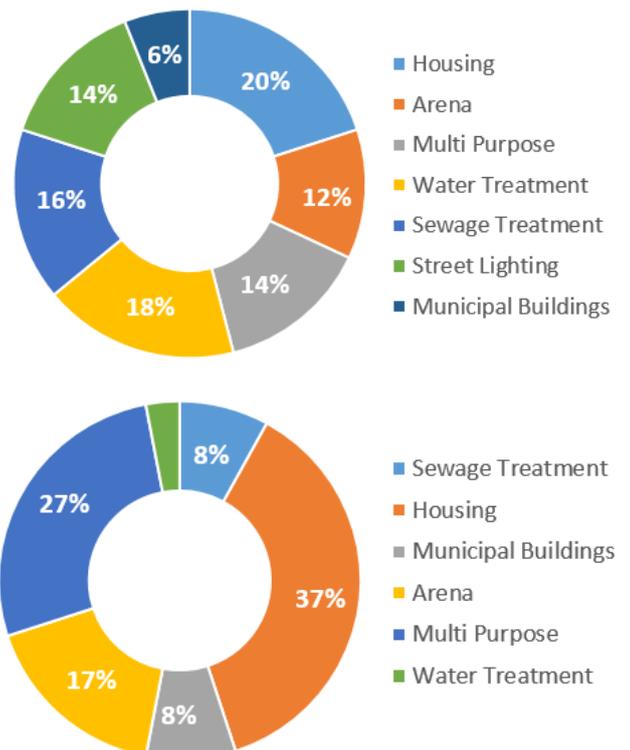


Figure 8: Municipal Energy 2014 Profile
* Top chart showcases electricity while the bottom showcases natural gas *

4.0 DATA ANALYSIS & RESULTS

4.1 Review of O. Reg. 397/11's Municipal Required Operations

At a minimum, the Regulation required the scope of the original ECDM Plan to include all municipal buildings and operations as described in Table 1 which excludes social housing, long-term care, streetlights, and fleet. However, a municipality was able to choose to voluntarily report on social housing, long-term care, streetlights, and fleet. Table 2 and 3 identify the Township's current owned and operated operations.

Table 1: Municipal Operations Required by O. Reg. 397/11

Type of public agency	Operation
Municipality	1. Administrative offices and related facilities, including municipal council chambers.
	2. Public libraries.
	3. Cultural facilities, indoor recreational facilities and community centres, including art galleries, performing arts facilities, auditoriums, indoor sports arenas, indoor ice rinks, indoor swimming pools, gyms and indoor courts for playing tennis, basketball or other sports.
	4. Ambulance stations and associated offices and facilities.
	5. Fire stations and associated offices and facilities.
	6. Police stations and associated offices and facilities.
	7. Storage facilities where equipment or vehicles are maintained, repaired, or stored.
	8. Buildings or facilities related to the treatment of water or sewage.
	9. Parking garages.

Table 2: Summary of Township Operations

Operation Type	Number	Total Area (sq. m.)
Reportable Operations		
Library (Wellandport opened 2018)	2	497.46
Fire Halls	2	1,616.75
Municipal Administration Buildings	2	2,053.00
Community Center (opened 2018)	1	8,895.80
Arena (demolished 2019)	1	1,748.06
Voluntary Reportable Operations		
Parks (with lighting)	2	-
Parkettes	1	-
Street Lighting	816	-
Bulk Fill Station	1	-

4.2 Review of Past Goals

The objective of the legislation and the development of an ECDM Plan is, in general, to provide a mechanism for annual accounting for energy consumption for its operations, and to consider measures that can be employed to decrease the Township's energy demand. In the 2014 ECDM Plan, the Township committed to a 4% reduction in energy by 2019, compared to their 2012 baseline year. The Township did and did not make this target. When only accounting for the operations that were functioning since 2014, a 14% energy reduction occurred by 2018 (Table 4). However; the Township added two new facilities to their stock in 2018, which ultimately increased their total energy consumption from 2014 by 5% (Table 5).

Table 3: Township Owned & Leased Operations

Required	Required	Required	Voluntary	Voluntary
				
Wellandport Library	First Station #1	Administration Office	Smithville Parkette	Abingdon Park
				
Caistorville Library	First Station #2	Public Works Office	Streetlights	Leisureplex
				
Arena	Community Center		Water-bulking Station	

Table 4: Annual Energy Consumption & GHG Emissions

	Electricity Consumption (kWh)	Natural Gas Consumption (m ³)	Total Energy Equivalence (ekWh)	Change from Previous Year (%)	GHG Emissions (kgCO ₂ e) [*]	Change from Previous Year (%)
2014	1,361,385	120,416	2,641,139.4	-	282,132.1	-
2015	1,351,334	112,930	2,551,528.9	-3.4	260,820.1	-7.6
2016	1,153,114	94,563	2,158,108.5	-15.4	219,774.3	-15.7
2017	1,079,391	103,816	2,182,724.3	1.1	214,948.6	-2.2
2018	1,232,446	145,415	2,777,884.2	27.3	296,244.4 ^G	37.8 ^G
Change	-9.5	20.8	5.2	-	5.0 ^G	-

^{*} The federal government's National Inventory Report is two years behind. So we have the most recent electricity emission factors are from 2017.

^G 2018 Total GHG Emissions are an educated guess using 2017 electricity emission factor coefficients

Table 5: Annual Energy Consumption & GHG Emissions for Operations that have Existed Since 2014

	Electricity Consumption (kWh)	Natural Gas Consumption (m ³)	Total Energy Equivalence (ekWh)	Change from Previous Year (%)	GHG Emissions (kgCO ₂ e) [*]	Change from Previous Year (%)
2014	1,361,385	120,416	2,641,139.4	-	282,132.1	-
2015	1,351,334	112,930	2,551,528.9	-3.4	260,820.1	-7.6
2016	1,153,114	94,563	2,158,108.5	-15.4	219,774.3	-15.7
2017	1,079,391	103,816	2,182,724.3	1.1	214,948.6	-2.2
2018	1,139,746	105,490	2,260,870.2	3.6	219,157.6 ^G	2.0 ^G
Change	-16.3	-12.4	-14.4	-	-22.3 ^G	-

^{*} The federal government's National Inventory Report is two years behind. So we have the most recent electricity emission factors are from 2017.

^G 2018 Total GHG Emissions are an educated guess using 2017 electricity emission factor coefficients

4.3 Review of Past Energy Measures

The 2014 ECDM plan developed 26 various action items that were anticipated to have beneficial impacts with respect to reducing energy consumption and cost. These action items were split between nine project types: monitoring and tracking, training and awareness, project identification, administration, building envelope, street lights, building lighting, HVAC system, and miscellaneous. After speaking with the Manager of Parks, Recreation, & Facilities, it has been identified that eight action items, which equals one-third of the items have been accomplished by June 2019. The items that were accomplished were primarily in regards to project identification (energy audit of the administration office), building envelope (maintenance of public works office), street lights (switch to LED bulbs), and building lighting (switching to more efficient bulbs).

4.4 Historical Data & Trend Analysis

Township operations have been analyzed to determine whether the energy measures employed have successfully resulted in reducing the Township's demand for energy. Appendix B and Appendix D present a summary of energy-related data for each operation from 2014 to 2018 and displays the associated trends. Figure 10, 11 and 12 provide an overview of the Township's total energy trends. The following is noted from an analysis of the data and associated trends.

1. The Township's total operations have been analyzed to now consume more natural gas equivalent kWh than electricity (Figure 9).

i. Note: One ekWh of Natural gas creates more GHG emissions than electricity.

2. Upgrading street lighting to LED bulbs was targeted to reduce consumption by 50%. Currently, the Township has converted over 80% of the streetlights and has developed new standards to ensure that all future streetlights are installed with LED bulbs.

a. Doing this has resulted in a 55% reduction in consumption, a 53% reduction in energy costs, and an 80% reduction in GHG emissions.

i. Note: costs savings are also a factor of the government reducing the cost of electricity.

3. Retrofitting the Public Works Office's bay lighting and outside lighting was targeted to reduce the operations electricity consumption by 25%, while replacing garage door/ weather stripping was projected to decrease the facilities heat loss.

a. These improvements have resulted in a 13% reduction in electricity, a 49% reduction in natural gas, a 23% reduction in total energy costs, and a 24% reduction in GHG emissions.

4. Replacing the Caistor Fire Station #2's roof and upgrading the facilities outdoor lighting was projected to have modest annual savings and conservation. In addition to these improvements, the facility heating was converted from natural gas to electricity in 2018.

a. These adjustments have resulted in a 228% increase in electricity, a 30% reduction in natural gas, a 9% reduction in energy costs, and 28% reduction in GHG emissions.

5. Upgrading the outdoor lights and HVAC system in the server room of the Administration Office were targeted to have minimal annual cost and energy savings.

a. These updates have resulted in a 14% total energy reduction, a 32% cost reduction, and a 31% reduction in GHG emissions.

6. The construction and opening of a community center and additional library has increased the Township's total demand for energy (Table 3).

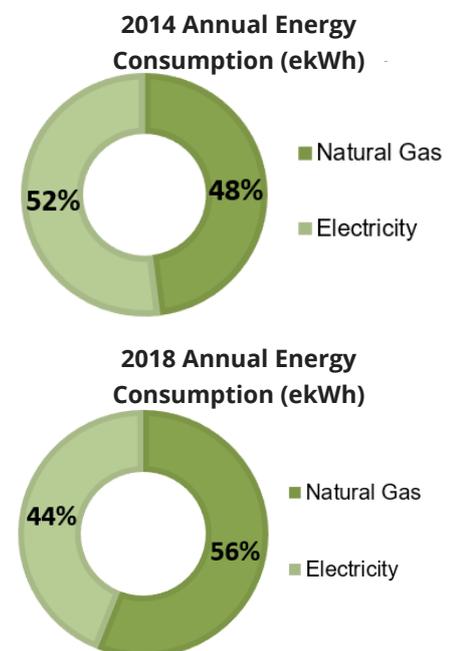


Figure 9: Comparing 2014 & 2018's Energy Consumption

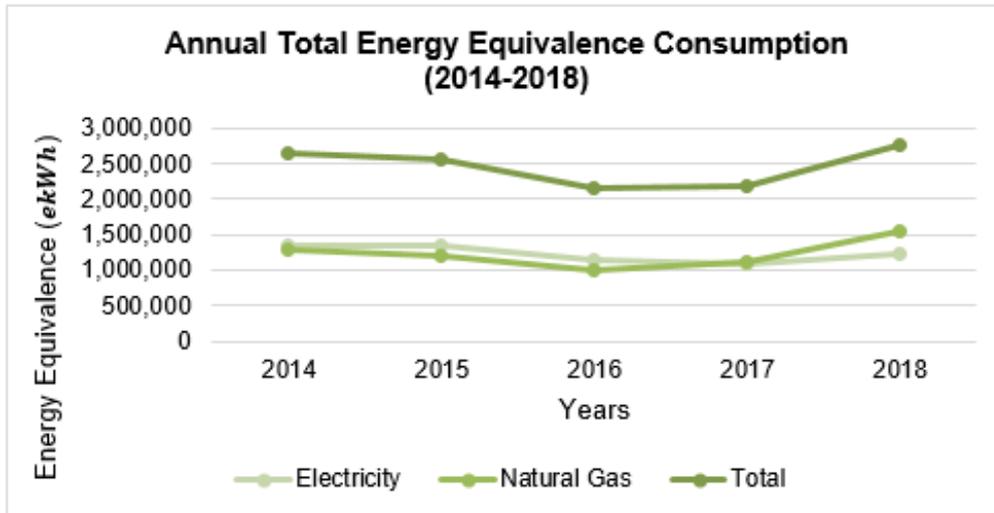


Figure 10: Annual Total Energy Consumption

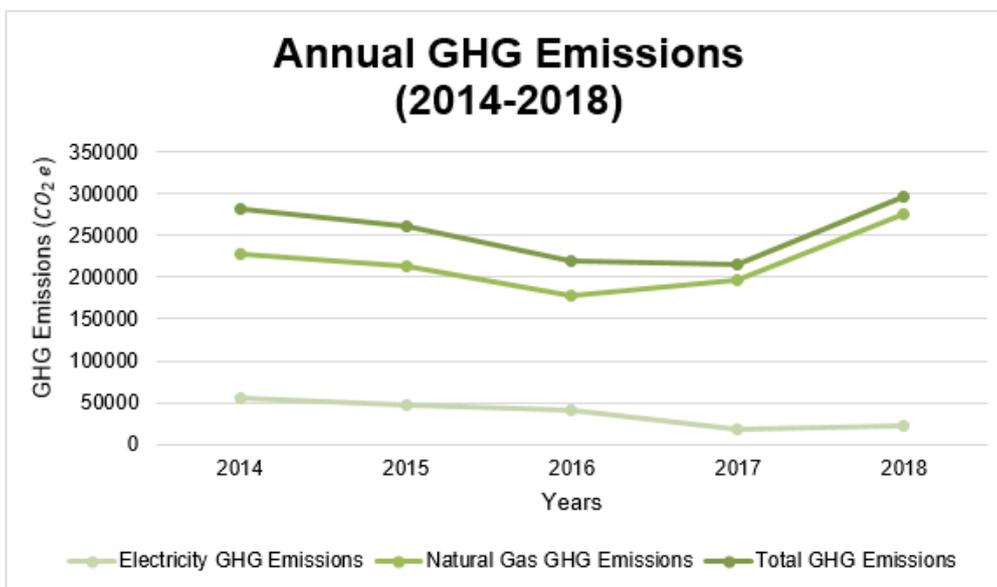


Figure 11: Annual GHG Emissions

* 2018 Total GHG Emissions are an educated guess using 2017 electricity emission factor coefficients*

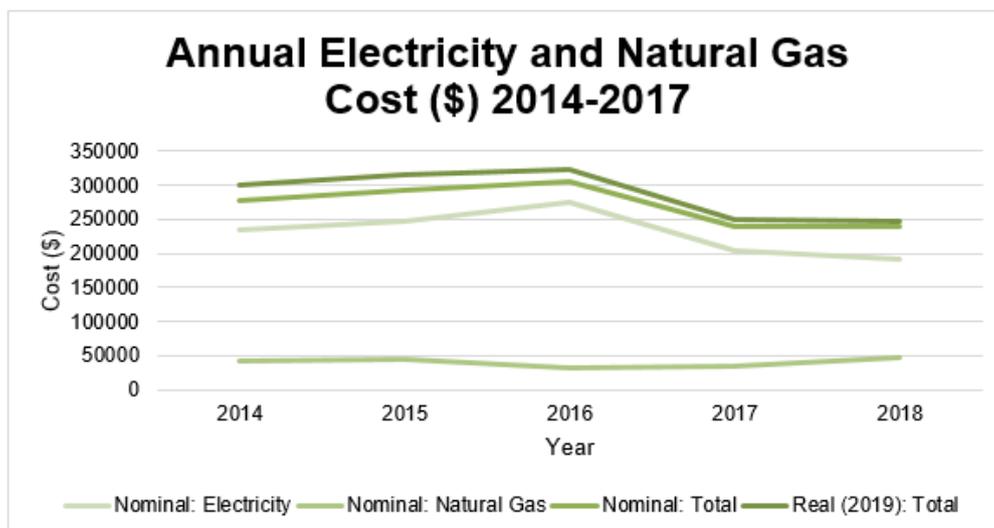


Figure 12: Annual Energy Costs

4.5 Performance Benchmarking

Respective building energy intensity values were compared against the Ministry's normalized benchmarks as presented in Appendix B. The following is noted from the benchmarking review.

1. With the exception of the Township's new community center and two libraries, all of the applicable buildings do not meet the normalized benchmarks for their respective building types.
2. The West Lincoln Arena had a significantly higher energy intensity (68%) than the benchmark value. However, as of May 2019 the building has been demolished as the Township's new Community Center offers a new arena for residents to use.
3. The Administration Office, Public Works Offices, and Fire Station #2 have consistently been above the provincial benchmark value in terms of energy intensity. In 2017 the Administration Office received an energy audit and the findings from the audit should be implemented to improve the buildings intensity.
4. The Caistorville Library consistently has shown to have low energy intensity values.
5. The Township's new Community Center and Wellandport Library have not been fully opened for one consecutive year. Therefore, monitoring should continue to be done to assess their energy intensity values.

4.6 Past Measures Review

Of the 26 proposed action items in the original 2014 ECDM Plan, 30% (n = 8) have been accomplished.

The following is a summary of action items that are still relevant and should be considered by the Township:

Project Type	Measure	Description	Project Annual Savings	Cost Estimate
Monitoring & Tracking	Energy Consumption Tracking	Create a plan to effectively recorded and reported energy data.	Indirect Savings	N/A
Training/ Awareness	Capacity Building / Communication	Create a long term training program that will help improve the energy consumption behaviour of staff.	Indirect Savings	N/A
Administrative	Policy Update	A procurement policy that to reflects energy conservation/ savings.	Indirect Savings	Internal Resources
Project Identification	Energy Audit	An audit for the Public Works Office.	Savings based on identified Opportunities	\$3,000 - \$5,000
Building Envelope	Building Insulation	Insulating the public works garage roof to reduce heat loss and energy demand.	Will depend on final design	TBD
	Windows	Installing window coverings in the Caistorville library to reduce heat gain in the summer.	Modest	TBD
Street Lighting	Updating	Continuing to switch the remaining 20% of streetlights to LED bulbs.	Switching cuts the costs by roughly 50%. + Reductions in maintenance costs.	TBD
Building Lighting	Controls	Install Occupancy sensors in the washroom, meeting rooms, and offices.	Potential reduction of 50% of kWh used	\$200/ sensor
HVAC Systems	Controls	Program HVAC thermostats for Township facilities.	3-4% savings for every Celsius setback.	\$0
	Upgrades	Investigating the installation of ceiling fans in Fire Station #2 loading bay.	Modest	\$2000.00
	Control	Change large bay door control such that only one pens not multiple in Fire Station #1.	TBD	TBD
Miscellaneous	Plug Load	Install Vending Machine Misers and Unscrew Lighting on Machines.	\$50	\$200
	DHW	Consider reducing the size of hot water tanks for Township facilities is still required.	75% of annual kWh used currently	\$450.00

5.0 MOVING FORWARD TOWARDS 2024

5.1 Review of O. Reg. 507/18's Municipal Required Operations

At a minimum, O. Reg. 507/18 requires the same operations to be reported as did O. Reg. 397/11, see Appendix A for the complete list. Similarly to O. Reg. 397/11, O. Reg. 507/18 allows municipalities to voluntarily report the energy-related data from social housing, long-term care, streetlights, and fleets. Therefore, the proposed measures in this plan are designed around both the required and voluntary operations outlined in Table 2.

5.2 Energy Consumption Forecast

In order to propose measures that will reduce the Township's energy consumption, GHG emissions, energy costs, and energy intensity the Township needs to first examine its projected energy consumption. Figure 13 below shows the Township's historic total energy consumption, current energy consumption path, and projected future consumption. The projected future consumption takes into account three main consumption paths: business-as-usual; annual decreases; annual increases.

The current path shows a peak in energy consumption between 2018 and 2019. This peak primarily derives from the Township building a new community center to replace their arena. The new community center not only offers an updated arena but also contains a library, basketball court, walking track, offices, and meeting rooms. The additional amenities improves the services that the Township can provide residents. It is important to note that the community center now demands more energy than the stand alone arena did. The peak in energy consumption is expected to drop in 2020 as the arena will no longer be serviced, since its demolition began in June 2019.

Additionally, Figure 13 acknowledges the energy consumption of the Township's baseline year (2014) and the energy consumption of its lowest recorded year (2016). For this ECDM Plan, it is first realistic to aim to deduce emissions to the baseline year (2014), then once that is met aim to further decrease emission to the Township's lowest recorded year (2016). If the Township commits to a 1% annual reduction in energy consumption they will meet their baseline year consumption by 2057 and will meet it by 2039 if their reduction is increased to 2% annually.

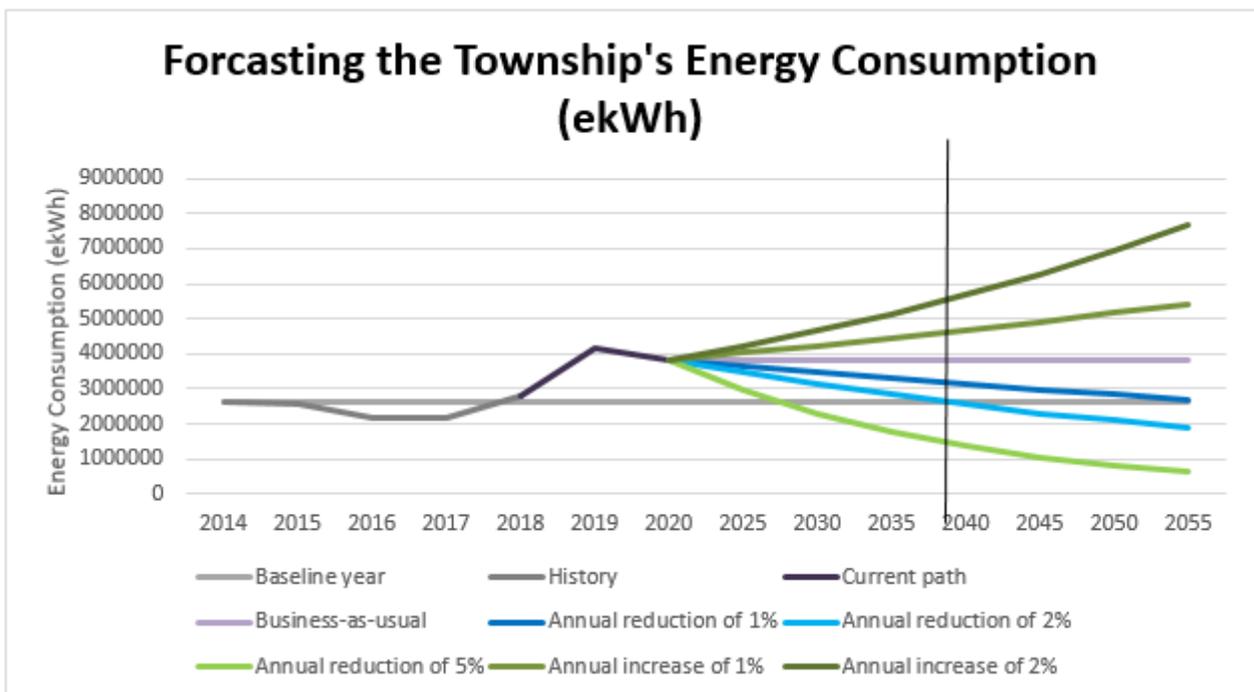


Figure 13: Forecasting the Township's Energy Consumption

5.3 Proposed Measures

The Climate Change Coordinator reviewed the eligible municipal operations for opportunities to reduce energy usage moving forward into the next five-year period. Consideration was given to the historical data review and trend analysis, buildings performance benchmarks, and past measures as noted above.

The following general measures are proposed to the Township for overall consideration. The proposed measures for each building will be specifically presented in phase 2 of this ECDM Plan (Figure 5).

Project Type	Measure	Description	Project Annual Savings	Cost Estimate	Completion Date
Monitoring & Tracking	Energy Consumption Tracking	Create a plan to effectively recorded and reported energy data.	Indirect Savings	N/A	Oct 2019
	Capacity Building	Build relationships with representatives from the NPEI and Enbridge.	Indirect Savings	N/A	Oct 2019
Training/ Awareness	Capacity Building / Communication	Establish a Green Energy Team	Indirect Savings	N/A	Oct 2019
		Create a long term training program that will help improve the energy consumption behaviour of staff.	Indirect Savings	N/A	Oct 2019
Administrative	Policy Update	A procurement policy that to reflects energy conservation/ savings.	Indirect Savings	Internal Resources	Q4, 2019
	Research	Research grant opportunities to purchase energy-efficient produces.	Indirect Savings	N/A	Oct 2019
Project Identification	Energy Audit	An audit for the Public Works Office.	Savings based on identified Opportunities	\$3,000 - \$5,000	Q3, 2020
Building Envelope	Building Insulation	Insulating the public works garage roof to reduce heat loss and energy demand.	Will depend on final design	TBD	TBD
	Windows	Installing window coverings in the Caistorville library to reduce heat gain in the summer.	Modest	TBD	Q2, 2020
		The administration buildings archive filing room has large bay doors that are not well insulated, staff should create a plan to remove doors and improve the facade of the building to reduce energy loss.	TBD	TBD	TBD
Street Lighting	Updating	Continuing to switch the remaining 20% of streetlights to LED bulbs.	Switching cuts the costs by roughly 50%. + Reductions in maintenance costs.	TBD	Ongoing
Building Lighting	Controls	Install Occupancy sensors in the washroom, meeting rooms, and offices.	Potential reduction of 50% of kWh used	\$200/ sensor	Q2, 2020
HVAC Systems	Controls	Program HVAC thermostats for Township facilities.	3-4% savings for every Celsius setback.	\$0	Q1, 2020
	Upgrades	Investigating the installation of ceiling fans in Fire Station #2 loading bay.	Modest	\$2000.00	Q3, 2022
	Control	Change large bay door control such that only one opens not multiple in Fire Station #1.	TBD	TBD	Q4, 2021
Miscellaneous	Plug Load	Install Vending Machine Misers and Unscrew Lighting on Machines.	\$50	\$200	Q1, 2020
	DHW	Consider reducing the size of hot water tanks for Township facilities is still required.	75% of annual kWh used currently	\$450.00	Q3, 2023

5.4 Anticipated Benefits

The completion of the proposed measures should lead to an overall decrease in energy consumption, energy costs, GHG emissions, and energy intensity for each building. Phase 2 of this ECDM Plan will identify the anticipated benefit for each of the measures, noting them as minimal, moderate, or significant. In larger buildings with multiple opportunities for energy reductions, the implementation of a specific measure could have a significant aggregate benefit.

6.0 RENEWABLE ENERGY CONSIDERATIONS

6.1 Existing Renewable Energy Generation

O. Reg. 507/18 requires the municipality to consider renewable energy as an alternative to reducing energy consumption and demand for its buildings/facilities.

The Township currently does not utilize any specific sources of renewable energy for its buildings. The Township should consider renewable and/or sustainable energy projects for all of its facilities or as stand-alone projects. The preferred energy sources for public agencies are described below.

6.2 Ground Source Energy

Ground source energy systems utilize the generally constant temperature of the ground in both the winter and summer months, which provides heating in the winter and cooling in the summer. Most ground source energy systems operate as hydronic systems and heat pump technologies which convert the energy from below the ground surface into heating/cooling energy.

The Township would consider ground source heat pump technology during the initial design stages of all planned heating and air conditioning (HVAC) system installations.

6.3 Solar Thermal Energy

Solar thermal technology uses solar heat energy gathered to provide heating for air or water and can also be used for energy production. Solar thermal energy is captured by concentrating the light from the sun to create heat. A device absorbs the sun's energy and uses the thermal properties to provide heat for air or water. Solar thermal energy can be used to simply heat domestic water or in a more advanced system, can be used to heat water to create steam to run a turbine generating system.

The Township would consider solar thermal technology during the initial design stages of all planned heating, ventilation and air conditioning (HVAC) or domestic hot water system installations.

6.4 Opportunities for Other Sources of Renewable Energy

The feasibility of implementing other types of renewable energy technologies (air source, etc.) with building systems should be evaluated when opportunities arise with building renewals, major renovations, etc.



7.0 UPDATED COMMITMENT

7.1 Updated Vision

With consideration of Sections 1.0 - 5.0 the following is the Township's updated energy conservation vision:

Promote: energy conservation to staff and the community

Consider: energy conservation with all Township purchases

Incorporate: energy conservation initiative through all Township departments

7.2 Updated Goals & Objectives

Table 6 outlines the goals and objectives that have been identified to complement the Township's vision over the next reporting period:

Table 6: Current Goals and Objectives

#	Goal	Objectives
1	Reduce energy consumption and GHG emissions in Township owned and operated facilities.	Reduce energy consumption by a minimum of 2% annually over the next reporting period for all Township facilities.
2	Promote energy conservation for users of Township owned and operated facilities.	Establish and create a Terms of Reference for a Green Team by the end of 2019. Through the help of the established Green Team provide promotion, education, and/or training to Township staff and facility users on a quarterly basis.
3	Monitor and review energy consumption in the Town owned and operated facilities.	Annually, in September, update council about the corporate energy trends (i.e. consumption, cost, GHG emissions, and energy intensity values). Annually in September discuss with the Senior Management Team (SMT) ways to take action to meet Township established energy benchmarks for each Township building.
4	Explore the usage of alternative and renewable energy.	When appropriate consider the feasibility of implementing new, alternative, and renewable energy systems in Township owned and operated facilities.
5	Secure funding to implement energy efficiency savings.	Before budgeting and implementing an energy conservation measure, research and secure available funding for energy-related measures.

7.3 Updated Energy Policy

This energy management plan shall pertain to all Township operations that are owned or leased and billed accordingly to the Township. This will include procurement practices, financial management, investment decisions, facility capital, operations, and maintenance.

7.4 Updated Energy Management Leadership

The Township is currently working to develop a Green Team where energy conservation will be an essential topic of conversation. This team will help with the development and implementation of this ECDM Plan. The current Climate Change and Sustainability Coordinator of the Township of West Lincoln will be responsible for authorizing and compiling the team.

- **Green Leader** – Climate Change and Sustainability Coordinator (Meghan Birbeck) will be the designated Green Leader as the committee gets started. The lead will have the overall responsibility for corporate energy management planning. The leader ensures compliance regulations are met and works closely with council to make required changes.
- **Green Team** – Staff members from various departments who carry out significant responsibilities for energy performance who can provide essential input to the energy management process.
- **Energy Training** – Communication strategy to educate all employees in conservation and efficiency opportunities associated with specific job functions.

In addition, all Town staff will develop an understand that they each play a role in sharing the responsibility of managing energy consumption as activities across all departments and buildings impact the GHGs emissions that the Township emits.

7.5 Updated Energy Reduction Target

The absolute target for the Township of West Lincoln's ECDM Plan will be to reduce consumption of natural gas electricity, and GHG emissions by a minimum of 2% annually between January 2019 and December 2023.



8.0 CONCLUSION

With due consideration of the 2014 Plan and progress made to the current 2019 review, the following conclusions are presented.

1. The Township has made progress in reducing its energy consumption and GHG emissions from 2014 to 2018, with a combined reduction of approximately 14% for operations that have been functioning since 2014.
2. Low-capital cost measures to reduce energy consumption should continue to be employed to realize the return on investment benefits. Continued upgrades to exterior and interior lighting, programmable devices to control energy use on HVAC and hot water storage systems, and the replacement of door seals.
3. Subject to longer-range building and facility planning, the building envelope of the municipality's administration building and Caistor Fire Station #2 should be upgraded to reduce the thermal losses and energy consumption.
4. Subject to longer-range building and facility planning, consideration should also be given to all facilities to use renewable energy when possible.
5. Where applicable, consideration of energy-efficient equipment should form part of the equipment specification and procurement process.
6. It is recommended that staff receive employee education to maximize the potential benefits of energy conservation and demand management.

8.1 Recommendations

The proposed measures noted in this report should be implemented by the Township as applicable and as opportunities are available to do so, considering building and facility asset planning, financial considerations, and other aspects of municipal asset management.



APPENDIX A: REGULATION

ONTARIO REGULATION 507/18

made under the

ELECTRICITY ACT, 1998

Made: December 12, 2018

Filed: December 14, 2018

Published on e-Laws: December 14, 2018

Printed in The Ontario Gazette: December 29, 2018

BROADER PUBLIC SECTOR: ENERGY REPORTING AND CONSERVATION AND DEMAND
MANAGEMENT PLANS

Definitions

1. In this Regulation,

"municipal service board" means,

- (a) a municipal service board or joint municipal service board established or continued under the Municipal Act, 2001,
- (b) a city board or joint city board established or continued under the City of Toronto Act, 2006, or
- (c) a joint board established in accordance with a transfer order made under the Municipal Water and Sewage Transfer Act, 1997; ("commission de services municipaux")

"post-secondary educational institution" means a university in Ontario, a college of applied arts and technology in Ontario or another post-secondary educational institution in Ontario, if the university, college or institution receives an annual operating grant; ("établissement d'enseignement postsecondaire")

"public hospital" means,

- (a) a hospital within the meaning of the Public Hospitals Act, or
- (b) the University of Ottawa Heart Institute/Institut de cardiologie de l'Université d'Ottawa; ("hôpital public")

"school board" means a board within the meaning of the Education Act. ("conseil scolaire")

Application

2. Sections 4, 5 and 6 apply only to public agencies prescribed by section 3.

Public agencies

3. The following are prescribed as public agencies for the purposes of sections 25.35.2 and 25.35.3 of the Act:
 1. Every municipality.
 2. Every municipal service board.
 3. Every post-secondary educational institution.
 4. Every public hospital.
 5. Every school board.

Energy conservation and demand management plans

4. (1) A public agency shall prepare, publish, make available to the public and implement energy conservation and demand management plans or joint plans in accordance with section 25.35.2 of the Act and with this Regulation.

(2) An energy conservation and demand management plan is composed of two parts as follows:

1. A summary of the public agency's annual energy consumption and greenhouse gas emissions for its operations.
2. A description of previous, current and proposed measures for conserving and otherwise reducing the amount of energy consumed by the public agency's operations and for managing the public agency's demand for energy, including a forecast of the expected results of current and proposed measures.

Summary of annual energy consumption and greenhouse gas emissions

5. (1) Subject to subsections (2) and (4), a summary of the public agency's annual energy consumption and greenhouse gas emissions must include a list of the energy consumption and greenhouse gas emissions for the year with respect to each of the public agency's operations that are set out in Table 1 of this Regulation for the type of public agency to which the public agency belongs and that are conducted in buildings or facilities the public agency owns or leases that,

(a) are heated or cooled and in respect of which the public agency is issued the invoices and is responsible for making the payments for the building or facility's energy consumption; or

(b) are related to the treatment of water or sewage, whether or not the building or facility is heated or cooled, and in respect of which the public agency is issued the invoices and is responsible for making the payments for the building or facility's energy consumption.

(2) If only part of a building or facility where an operation is conducted is heated or cooled, the public agency's summary referred to in subsection (1) must only include energy consumption and greenhouse gas emissions for the part of the building or facility where the operation is conducted that is heated or cooled.

(3) The public agency's summary referred to in subsection (1) must be prepared using the form entitled "Energy Consumption and Greenhouse Gas Emissions Reporting" that is available from the Ministry and must include the following information and calculations for each of the public agency's operations:

1. The address at which the operation is conducted.

2. The type of operation.

3. The total floor area of the indoor space in which the operation is conducted and, in cases where subsection (4) applies, the total indoor floor area of the building or facility in which the operation is conducted.

4. A description of the days and hours in the year during which the operation is conducted and, if the operation is conducted on a seasonal basis, the period or periods during the year when it is conducted.

5. The types of energy purchased for the year and consumed in connection with the operation.

6. The total amount of each type of energy purchased for the year and consumed in connection with the operation.

7. The total amount of greenhouse gas emissions for the year with respect to each type of energy purchased and consumed in connection with the operation.

8. The greenhouse gas emissions and energy consumption for the year from conducting the operation, calculating, i. the annual mega watt hours per mega litre of water treated and distributed, if the operation is a water works, ii. the annual mega watt hours per mega litre of sewage treated and distributed, if the operation is a sewage works, or iii. per unit of floor space of the building or facility in which the operation is conducted, in any other case.

(4) If a public agency conducts, in the same building or facility, more than one operation set out in Table 1 for the type of public agency to which the public agency belongs, it shall allocate the total amount of energy purchased and consumed for the year to the operation that occupies the most indoor floor area in the building or facility, and if more than one operation occupies the same amount of indoor floor area, may allocate the total amount of energy to any one of them.

(5) In preparing its annual Energy Consumption and Greenhouse Gas Emissions Reporting form, a public agency may exclude its energy consumption and greenhouse gas emissions relating to its temporary use of an emergency or back-up generator in order to continue operations.

(6) On or before July 1 in each year, every public agency shall submit to the Minister, publish on its website and intranet site, if it has either or both, and make available to the public in printed form at its head office the public agency's Energy Consumption and Greenhouse Gas Emissions Reporting form for operations conducted in the year following the year to which the last annual form related.

(7) The following information, if applicable, must also be submitted, published and made available to the public with every Energy Consumption and Greenhouse Gas Emissions Reporting form:

1. If the operation is a school operated by a school board,
 - i. the number of classrooms in temporary accommodations at the school during the year, and
 - ii. whether there is an indoor swimming pool in the school.
2. If the public agency is a public hospital, whether a facility operated by the public hospital is a chronic or acute care facility, or both.

Energy conservation and demand management measures

6. (1) Every public agency shall publish on its website and intranet site, if it has either or both, and make available to the public in printed form at its head office,

(a) the information referred to in subsection 25.35.2 (3) of the Act with respect to each of the public agency's operations set out in Table 1 of this Regulation for the type of public agency to which the public agency belongs;
(b) the information referred to in paragraph 2 of subsection 4 (2) of this Regulation with respect to each of the public agency's operations set out in Table 1 of this Regulation for the type of public agency to which the public agency belongs; and

(c) the following information:

- (i) information on the public agency's annual energy consumption during the last year for which complete information is available for a full year,
- (ii) the public agency's goals and objectives for conserving and otherwise reducing energy consumption and managing its demand for energy,
- (iii) the public agency's proposed measures under its energy conservation and demand management plan,
- (iv) cost and saving estimates for its proposed measures,
- (v) a description of any renewable energy generation facility operated by the public agency and the amount of energy produced on an annual basis by the facility,
- (vi) a description of,
 - (A) the ground source energy harnessed, if any, by ground source heat pump technology operated by the public agency,
 - (B) the solar energy harnessed, if any, by thermal air technology or thermal water technology operated by the public agency, and
 - (C) the proposed plan, if any, to operate heat pump technology, thermal air technology or thermal water technology in the future,
- (vii) the estimated length of time the public agency's energy conservation and demand management measures will be in place, and
- (viii) confirmation that the energy conservation and demand management plan has been approved by the public agency's senior management.

(2) In addition to publishing and making available the required information with respect to the operations mentioned in clauses (1) (a) and (b), a public agency may also publish information with respect to any other operation that it conducts.

(3) On or before July 1, 2019 and on or before every fifth anniversary thereafter, every public agency shall publish on its website and intranet site, if it has either or both, and make available to the public in printed form at its head office all of the information that is required to be published and made available under subsection (1), the Energy Consumption and Greenhouse Gas Emissions Reporting form that is required to be submitted and published on or before July 1 of that year and the following information:

1. A description of current and proposed measures for conserving and otherwise reducing energy consumption and managing its demand for energy.
2. A revised forecast of the expected results of the current and proposed measures.
3. A report of the actual results achieved.
4. A description of any proposed changes to be made to assist the public agency in reaching any targets it has established or forecasts it has made.

Commencement

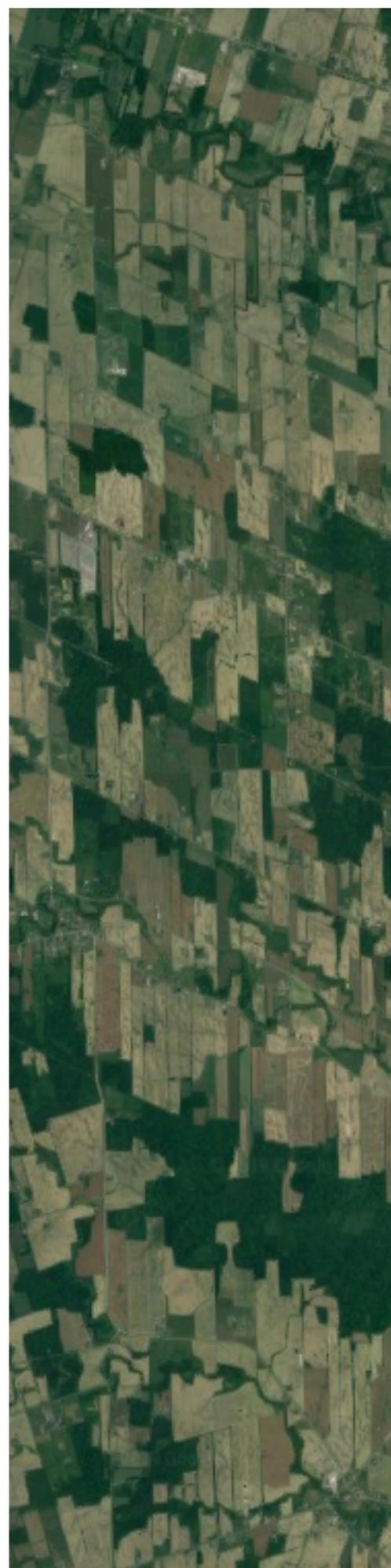
7. This Regulation comes into force on the later of the day section 2 of the Green Energy Repeal Act, 2018 comes into force and the day this Regulation is filed.

Item	Type of public agency	Operation
1.	Municipality	<ol style="list-style-type: none"> 1. Administrative offices and related facilities, including municipal council chambers. 2. Public libraries. 3. Cultural facilities, indoor recreational facilities and community centres, including art galleries, performing arts facilities, auditoriums, indoor sports arenas, indoor ice rinks, indoor swimming pools, gyms and indoor courts for playing tennis, basketball or other sports. 4. Ambulance stations and associated offices and facilities. 5. Fire stations and associated offices and facilities. 6. Police stations and associated offices and facilities. 7. Storage facilities where equipment or vehicles are maintained, repaired or stored. 8. Buildings or facilities related to the treatment of water or sewage. 9. Parking garages.
2.	Municipal service board	<ol style="list-style-type: none"> 1. Buildings or facilities related to the treatment of water or sewage.
3.	Post-secondary educational institution	<ol style="list-style-type: none"> 1. Administrative offices and related facilities. 2. Classrooms and related facilities. 3. Laboratories. 4. Student residences that have more than three storeys or a building area of more than 600 square metres. 5. Student recreational facilities and athletic facilities. 6. Libraries. 7. Parking garages.
4.	School board	<ol style="list-style-type: none"> 1. Schools. 2. Administrative offices and related facilities. 3. Parking garages.
5.	Public hospital	<ol style="list-style-type: none"> 1. Facilities used for hospital purposes. 2. Administrative offices and related facilities.

APPENDIX B: DATA

Building Name	Operation Type	Address
Required		
Administration Building	Administrative offices and related facilities, including municipal council chambers	318 Canborough Street
Public Works Operations Centre	Administrative offices and related facilities, including municipal council chambers	6218 London Road
West Lincoln Arena	Indoor sports arenas	177 West Street
Smithville Fire Station #1	Fire stations and associated offices and facilities	344 Canborough Street
Caistor Fire Station #2	Fire stations and associated offices and facilities	8635 Regional Road 65
Caistorville Library	Public libraries	9549 York Road
Wellandport Library	Public libraries	5042 Canborough Road
West Lincoln Community Centre	Community centres	177 West Street

Building Name	Total energy consumption (ekWh)					change
	2014	2015	2016	2017	2018	
Required						
Administration Building	476048	410764	374502	385571	410130	-13.8468
Public Works Operations Centre	326829	292085	221219	264267	202192	-38.1352
West Lincoln Arena	863071	859450	803603	879929	929935	7.74717
Smithville Fire Station #1	219429	246891	215558	221691	261290	19.0775
Caistor Fire Station #2	128961	121776	118190	100500	124830	-3.20354
Caistorville Library	56858.3	51954.7	48491.3	47772.7	52663.6	-7.37748
Wellandport Library					53544.3	n/a
West Lincoln Community Centre					463470	n/a



Building Name	Total costs					4- year trend	change
	2014	2015	2016	2017	2018		
Required							
Administration Building	42670.2	36768.1	39658.4	35666.5	29204.5		-31.558
Public Works Operations Centre	19982.5	21989.4	19735.3	19040	15381.5		-23.025
West Lincoln Arena	83258.3	90291.7	91363.8	91131.7	92298.1		10.8575
Smithville Fire Station #1	14531.4	16240.9	15520	14174.6	14517.4		-0.0962
Caistor Fire Station #2	6877.73	7230	6789.76	7288.82	9580.84		39.3024
Caistorville Library	5153.47	5393.74	5947.13	4815.93	4658.14		-9.6116
Wellandport Library					4637.82		n/a
West Lincoln Community Centre					17597.6		n/a

Building Name	GHG Emissions				4- year trend	change
	2014	2015	2016	2017		
Required						
Administration Building	56343.0089	48279.5752	41127.7148	38692.3643		-31.3271
Public Works Operations Centre	44632.6395	39157.3863	27562.4727	33880.2524		-24.0909
West Lincoln Arena	98033.9382	91449.7503	82551.8538	87795.3271		-10.4439
Smithville Fire Station #1	31909.425	35907.734	30454.9675	30373.6583		-4.81289
Caistor Fire Station #2	21072.6277	19834.595	19258.6323	14054.6298		-33.3039
Caistorville Library	7336.44731	6283.48618	5433.23014	5257.19323		-28.3414
Wellandport Library						
West Lincoln Community Centre						



Building Name	Energy Intensity					4- year trend	2016 Benchmark Values &
	2014	2015	2016	2017	2018		
Required							
Administration Building	7.982222938	7.379535	7.403231	7.478889	7.411121		6.2
Public Works Operations Centre	10.82530561	10.36557	8.638463	10.12563	7.217269		6.2
West Lincoln Arena	11.28390988	12.03917	12.38648	13.3082	13.10251		7.8
Smithville Fire Station #1	4.344733913	5.23767	5.031843	5.077816	5.575472		5.4
Caistor Fire Station #2	5.975683378	6.152255	6.513319	5.423855	6.293857		5.4
Caistorville Library	5.57040731	5.549579	5.649997	5.451115	5.614012		6.4
Wellandport Library					4.731735		6.4
West Lincoln Community Centre					1.283201		5

	Total energy consumption (ekWh)					change
	2014	2015	2016	2017	2018	
Voluntary						
Streetlighting	504307	507583	320672	225685	226319	-55.12277
Christmas Lights	97	97	0	194	97	0
Leisureplex	43560	41280	39480	45000	41400	-4.958678
Caistor Park	2219	1897	1453	1335	2220	0.0450653
West Lincoln Park	9655	5436	3920	1070		-100
St. Catharines Parkette	521	546	584	2197	2605	400
Farmers Market	72	72	72	72	72	0
Water Pumping Station	9513	11697	10363	7440	7117	-25.18659



	Total costs					4- year trend	change
	2014	2015	2016	2017	2018		
Voluntary							
Streetlighting	80554.2	89721.1	66109.1	46394.9	37953.2		-52.885
Christmas Lights	3619.35	4126.48	0	3427.17	3370.36		-6.8794
Leisureplex	13671.6	12946.6	14753.6	11744.7	10960.1		-19.833
Caistor Park	1093.42	1112.41	1204.35	1066.06	1123.15		2.71899
West Lincoln Park	2543.33	2140.83	2212.46	1096.85			-100
St. Catharines Parkette	572	584.88	658.94	818.45	806.71		41.0332
Farmers Market	515.17	520.99	574.58	518.47	508.23		-1.3471
Water Pumping Station	1744.6	2121.71	2294.2	1608.74	1353.25		-22.432

	GHG Emissions				4- year trend	change
	2014	2015	2016	2017		
Voluntary						
Streetlighting	20177.8274	17770.9884	11399.2483	3903.89913		-80.6525
Christmas Lights	3.881067	3.396067	0	3.355812		-13.5338
Leisureplex	1742.87916	1445.25408	1403.43504	778.41		-55.3377
Caistor Park	88.784409	66.415867	51.651244	23.09283		-73.99
West Lincoln Park	386.306205	190.319796	139.34816	18.50886		-95.2088
St. Catharines Parkette	20.845731	19.116006	20.760032	38.003706		82.3093
Farmers Market	2.880792	2.520792	2.559456	1.245456		-56.7669
Water Pumping Station	380.624643	409.523667	368.383924	128.69712		-66.1879



APPENDIX C: CALCULATIONS

GHG Emissions (Kg)

Equation: Business-as-usual

$$CO_2 e_a = (x_a \times CO_2 eEF_a)$$

Description:

$CO_2 e_a$ = Total CO_2 equivalent emissions produced from a building consuming energy source 'a' in the inventory year;

x_a = Amount of energy source 'a' consumed in one year; and

$CO_2 eEF_a$ = The CO_2 equivalent emission factor for energy source 'a'.

Energy-Use Intensity

Equation:

$$EUI_a = \frac{eWh}{\frac{sqft}{HDD}}$$

Description:

EUI_a = Total intensity from an energy source 'a' used in a building in the inventory year;

eWh = The equivalent Watt hours is used to compare energy sources;

$sqft$ = Total square footage that an energy source 'a' services in a building in the inventory year; and

HDD = Heat Degree Days

Important Coefficients

Year	Electricity		Natural Gas		HDD***	
	$CO_2 eEF_a^*$	$ekWh^{**}$	$CO_2 eEF_a^*$	$ekWh^{**}$	Hamilton Weather Station	Welland-Pelham Weather Station
2011	0.098040	1.0000000	1.8906270	10.6277770	3621	3855
2012	0.096096	1.0000000	1.8906270	10.6277770	3229	3409
2013	0.076012	1.0000000	1.8906270	10.6277770	3734	4009
2014	0.040011	1.0000000	1.8906270	10.6277770	4065	4335
2015	0.035011	1.0000000	1.8906270	10.6277770	3794	3976
2016	0.035548	1.0000000	1.8906270	10.6277770	3448	3645
2017	0.017298	1.0000000	1.8906270	10.6277770	3514	3722
2018	-	1.0000000	1.8906270	10.6277770	3772	3984

* and ** were provided via the Ministry of Energy, Northern Development, and Mines
 *** provided by Energy Star Portfolio Manager Degree Days Calculator

Example**Township Hall Administration Building 2014**

Notes:

- Building has a total floor area of 1,363.00 square meters;
- Used 205560 kWh of electricity and 25451 adjusted m³ of natural gas;

1. GHG Emissions

$$CO_2 e_a = (x_a \times CO_2 eEF_a)$$

$$CO_2 e_a = (electricity \times CO_2 eEF_a) + (natural\ gas \times CO_2 eEF_a)$$

$$CO_2 e_a = (205560 \times CO_2 eEF_a) + (25451 \times CO_2 eEF_a)$$

$$CO_2 e_a = (205560 \times 0.040011) + (25451 \times 1.8906270)$$

$$CO_2 e_a = 56343.00894$$

2. Energy Intensity

$$EUI_a = \frac{eWh}{\frac{sqft}{HDD}}$$

Step A: Finding eWh per energy source

Note: 1 kWh = 1000 ~~Wh~~

$$eWh = (x_a \times ekWh) * 1000$$

$$eWh = [(electricity \times ekWh) + (natural\ gas \times ekWh)] * 1000$$

$$eWh = [(205560 \times ekWh) + (25451 \times ekWh)] * 1000$$

$$eWh = [(205560 \times 1.0000000) + (25451 \times 10.6277770)] * 1000$$

Step B: Finding EUI_a per energy source

$$EUI_a = \frac{476047552.4}{\frac{sqft}{HDD}}$$

*** Building is 1,363.00 square meters. This has to be converted not to squared feet ***

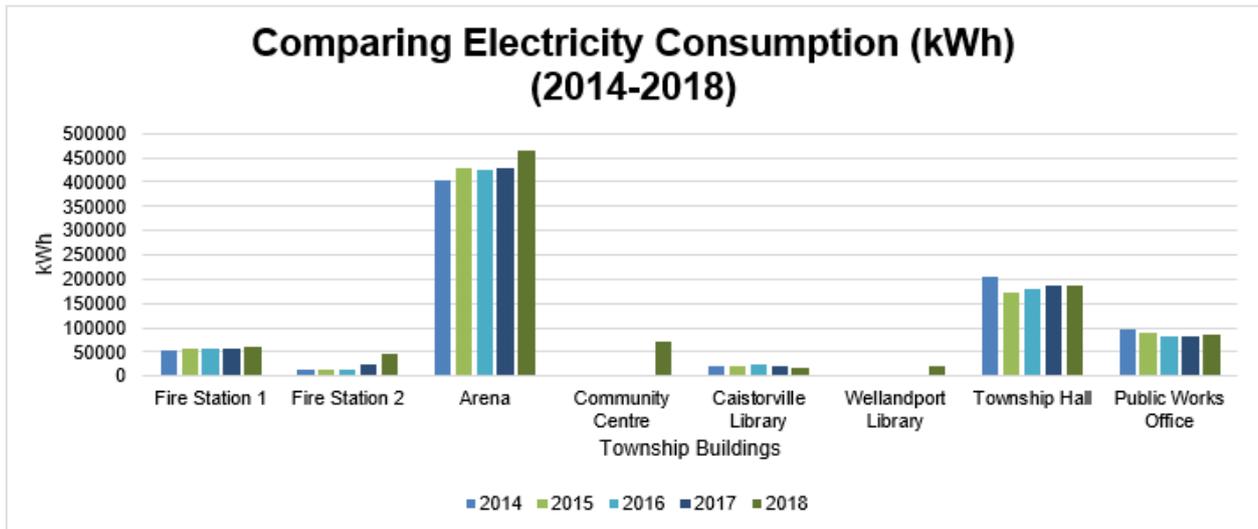
1 square metre = 10.7639 square feet | 1,363.00 square metre = 14671.21 square feet

$$EUI_a = \frac{476047552.4}{\frac{14671.21}{HDD}}$$

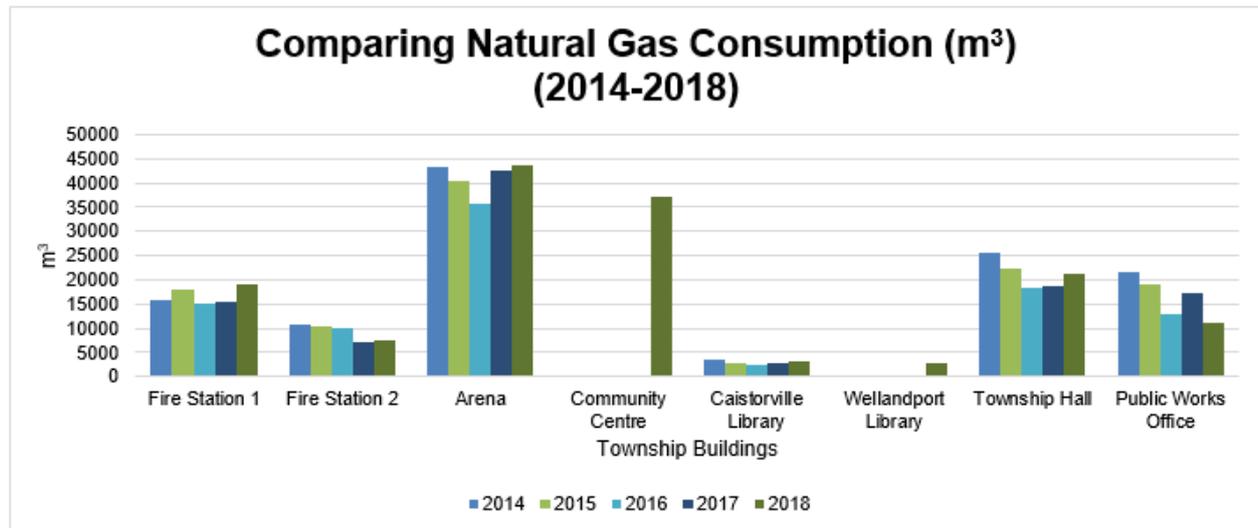
$$EUI_a = \frac{476047552.4}{4065}$$

$$EUI_a = 8.0$$

APPENDIX C: COMPARING OPERATIONS

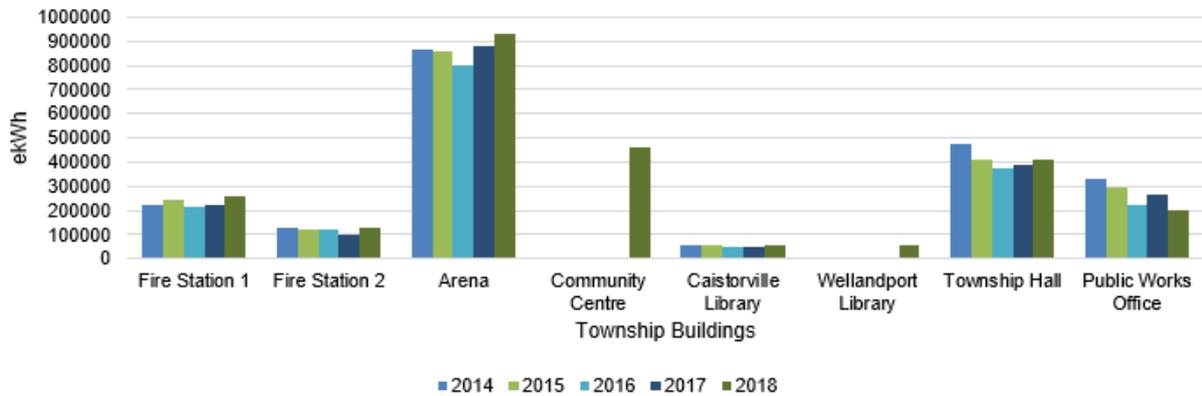


	Fire Station 1	Fire Station 2	Arena	Community Centre	Caistorville Library	Wellandport library	Township Hall	Public Works Office
2014	51,680	13,554	402,527	-	20,150	-	205,560	97,970
2015	56,080	12,799	430,013	-	20,709	-	173,520	89,605
2016	55,440	12,412	424,351	-	22,432	-	179,100	82,835
2017	56,440	23,810	428,025	-	20,183	-	186,173	81,767
2018	59,320	44,590	466,266	70,497	18,676	22,203	186,309	84,755
Change	14.8	228.9	15.8	-	-7.3	-	-9.4	-13.5



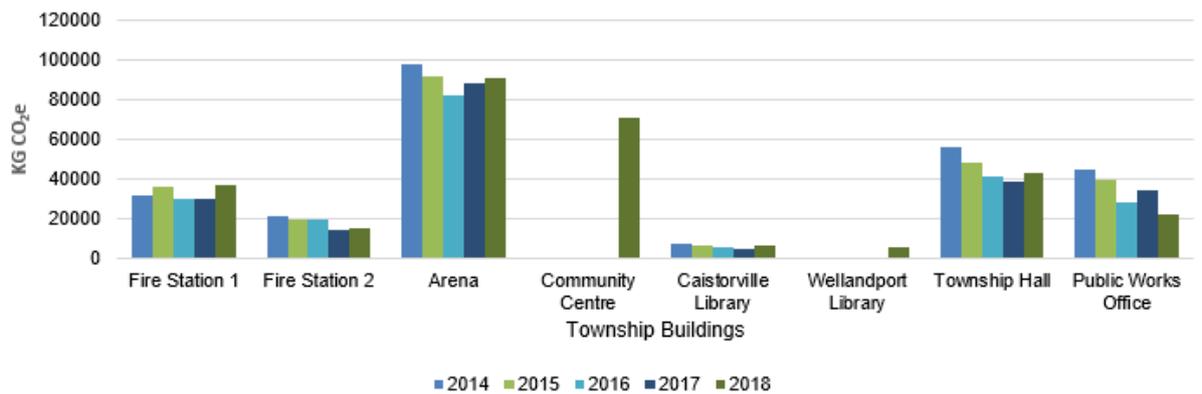
	Fire Station 1	Fire Station 2	Arena	Community Centre	Caistorville Library	Wellandport library	Township Hall	Public Works Office
2014	15,784	10,859	43,334	-	3,454	-	25,451	21,534
2015	17,954	10,254	40,407	-	2,940	-	22,323	19,052
2016	15,066	9,953	35,685	-	2,452	-	18,386	13,021
2017	15,549	7,216	42,521	-	2,596	-	18,762	17,172
2018	19,004	7,550	43,628	36,976	3,198	2,949	21,060	11,050
Change	20.4	-30.5	0.7	-	-7.4	-	-17.3	-48.7

Comparing Energy Equivalent Consumption (ekWh) (2014-2018)



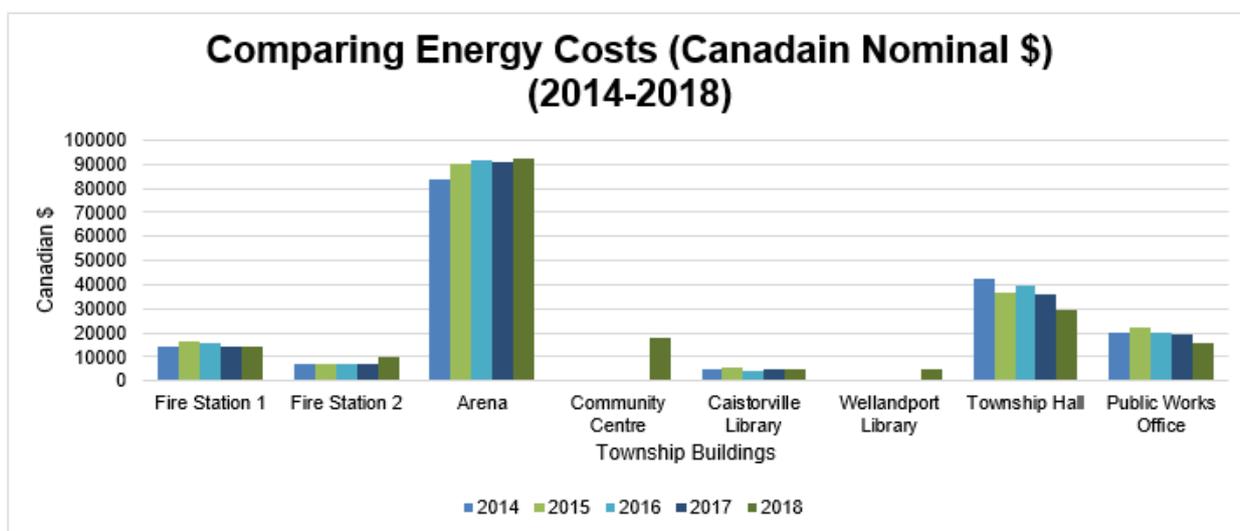
	Fire Station 1	Fire Station 2	Arena	Community Centre	Caistorville Library	Wellandport Library	Township Hall	Public Works Office
2014	219428.8	128961.0	863071.1	-	56858.3	-	476047.6	326828.5
2015	246891.1	121776.2	859449.6	-	51954.7	-	410763.9	292085.4
2016	215558.1	118190.3	803603.2	-	48491.3	-	374502.3	221219.3
2017	221691.3	100500.0	879928.7	-	47772.7	-	385571.4	264267.2
2018	261290.3	124829.7	929934.7	463469.6	52663.6	53544.3	410130.0	202191.9
Change	19.1	-3.2	7.7	-	-7.4	-	-13.8	-38.1

Comparing GHG Emissions (KG of CO₂e) (2014-2018)



	Fire Station 1	Fire Station 2	Arena	Community Centre	Caistorville Library	Wellandport Library	Township Hall	Public Works Office
2014	31,909.4	21,072.6	98,033.9	-	7,336.4	-	56,343.0	45,013.3
2015	35,907.7	19,834.6	91,449.8	-	6,283.5	-	48,279.6	39,566.9
2016	30,455.0	19,258.6	82,551.9	-	5,433.2	-	41,127.7	27,930.9
2017	30,373.7	14,054.6	87,795.3	-	5,257.2	-	38,692.4	34,008.9
2018 ^G	36,955.6 ^G	15,045.6 ^G	90,549.7 ^G	71,127.3 ^G	6,369.3 ^G	5,959.5 ^G	43,039.4 ^G	22,357.5 ^G
Change ^G	15.8 ^G	-28.6 ^G	-7.6 ^G	-	-13.2 ^G	-	-23.6 ^G	-50.3 ^G

^G 2018 Total GHG Emissions are an educated guess using 2017 electricity emission factor coefficients



	Fire Station 1	Fire Station 2	Arena	Community Centre	Caistorville Library	Wellandport Library	Township Hall	Public Works Office
2014	14531.37	6877.73	83258.34	-	5153.47	-	42670.18	19982.54
2015	16240.86	7230	90291.65	-	5393.74	-	36768.14	21989.44
2016	15520.03	6789.76	91363.79	-	4447.13	-	39658.35	19735.31
2017	14174.59	7288.82	91131.66	-	4815.93	-	35666.46	19039.96
2018	14517.39	9580.84	92298.12	17597.55	4658.14	4637.82	29204.48	15381.49
Change	-0.1	39.3	10.9	-	-9.6	-	-31.6	-23.0