CITY OF BRANTFORD

Corporate Energy Management Plan 2019-2024








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Corporate Energy Management Plan: 2019-2024

The City of Brantford

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CONTEXT

The Corporate Energy Management Plan is an update of the 2014 plan adopted by the City of Brantford. It is designed to meet the requirements of Ontario Regulation 507/18 under the *Electricity Act*, and to serve as a roadmap for initiatives over the period from July 1, 2019 to June 30, 2024 to reduce energy use and greenhouse gas emissions in City operations.

The plan is developed in the context of three key considerations:

- Growing concerns about climate change and the need to aggressively reduce greenhouse gas emissions
- Rising energy prices and possible supply constraints
- The availability of financial incentives to assist the City in taking action.

SCOPE AND METHODS

The plan considers energy use and greenhouse gas emissions within the corporation of the City; community initiatives are outside the scope of the plan. The plan addresses buildings, parks, water and wastewater pumping and treatment facilities, streetlighting, and transportation fleets. Energy use and opportunities in social housing are not addressed by the plan.

The plan reviews energy use and emissions for 2014 to 2018, and plans for energy use and greenhouse gases over the period from July 1, 2019 to June 30, 2024.

Greenhouse gas emissions are based on a Scope 2 analysis, which includes direct emissions from the burning of natural gas, diesel fuel and gasoline, and indirect emissions resulting upstream from the generation of purchased electricity. The assessment does not include energy embedded in products purchased, employee commuting, or other activities considered as 'Scope 3'. Greenhouse gas emissions consider only energy use; land use changes, for example, are not considered.

The development of the plan involved a range of activities, including:

- A review of energy use patterns in the City over the last five years (2014-2018)
- Interviews with representatives of departments with responsibility and control over major energy using activities, including: Environmental Services, Recreation Facilities & Operations, Engineering Services, Fleet and Transit Services, Facilities & Asset Management, and Social Housing.

- Consultation with the Environmental Policy Advisory Committee (EPAC) at project initiation and the draft report stages
- Workshops with departmental representatives on Brantford's future, and actions to get there
- A review of practices in other municipalities.

MAJOR ASSUMPTIONS

- Although the Brantford population is expected to grow by approximately 10% between 2019 and 2024, a comparable increase in energy for municipal services is not expected
- Resources will be available to execute the plan
- It will be possible to resolve contractual issues that are preventing the use of biogas from the wastewater treatment facility in the landfill cogeneration facility
- Greenhouse gas intensity of grid electricity in 2018 was the same as in 2017.

STATUS OF DATA

- Historic data are from utility bills and are deemed to be accurate.
- Projected emission savings and costs are based on the literature and assumptions about savings and costs. More detailed assessment of potential costs and savings will need to be developed as specific projects are identified.
- Greenhouse gas estimates are based on the average GHG intensity of purchased electricity. This overstates emissions associated with night-time electricity using activities (like streetlighting), and understates emissions attributable to electricity using activities that occur during peak demand times.

MAIN FINDINGS

- Staff and EPAC would like to see the City substantially reduce its greenhouse gas emissions, and increase its use of renewable energy sources.
- A target set in the 2014 plan called for a reduction of energy use per square foot of 4.9% This target was not met. The primary reason is the impact of the Wayne Gretzky Sports Centre was not fully understood at the time of the previous plan. WGSC is a very large facility and is the largest user of

energy in the municipality. If that centre is excluded, energy reductions in buildings exceeded the target.

- A second target was to reduce greenhouse gas emissions by 5.3%. Reductions were estimated at 10.2%, largely because of changes in the carbon content of electricity. If electricity had the same carbon content today as in 2014, usage would be up by 3.3%
- In the 2014 plan, targets were not set for other energy uses in the City. However, energy intensity and use for water and wastewater dropped, as did electricity for streetlighting. Use of gasoline and diesel increased.
- There were numerous projects undertaken which resulted in significant energy savings, and ultimately energy cost reductions for the municipality.
- The major uses of energy are for fleets (21%), which is mostly for transit vehicles; the Wayne Gretzky Centre (20%), and water and wastewater treatment and pumping (26%).
- Most greenhouse gas emissions (47%) result from transportation fuel use, and most of the remaining greenhouse gas emissions arise from the use of natural gas (46%). The Wayne Gretzky Sports Centre uses about 36% of all natural gas.
- Staff identified several barriers to realizing additional energy savings:
    - There is unclear distribution of responsibility for realizing energy savings. Although the Facilities Department nominally had responsibility for the plan, it is only directly responsible for about 7% of overall energy use.
    - Staff identified significant resource constraints limiting their ability to undertake additional actions. These restraints include both time to plan, manage, monitor and evaluate projects, and money to pay for projects. On the financial side, the conflict between initial capital cost and life-cycle cost was acknowledged, and initial capital cost was seen as dominating technology choices.
    - Staff do not have good information on the patterns and sources of energy use, and therefore where actions should be taken.

CONCLUSIONS & RECOMMENDATIONS

To address the challenges associated with climate change, and rising energy prices, Brantford needs to promote a change in corporate culture towards a 'culture of conservation'. This requires a comprehensive approach to energy that consists of six key components:

1. **Governance and accountability** – which requires measures related to policies, targets and resources required to enable energy management and other actions.
2. **Partnerships and collaboration** – this involves measures related to networking, relationship-building, information sharing, and best practices.
3. **Communications and training** – related to measures to encourage behaviours and operating procedures that reduce energy use and greenhouse gas emissions
4. **Funding and procurement** – which relate to the identification, prioritization, funding and procurement of energy and renewable technologies
5. **Monitoring and tracking** – to ensure that data on energy use and emissions are collected, analyzed, and shared
6. **Advanced technology and energy efficiency standards** – which will involve technology and policy measures that impact new and existing buildings, fleets, streetlighting and traffic lights, and other operations that use energy and produce emissions.

These six components support new energy targets for the 2019-2024 timeframe that are set out in Table 1.

Table 1 Energy reduction targets for 2019-2014

Source	Current (GWh)	2019-2020	2021-2022	2023-2024	Total
Buildings - electricity	17.2	1.0%	4.0%	4.0%	9.0%
Buildings - gas	19.6	1.0%	4.0%	4.0%	9.0%
Water - electricity	9.3	2.0%	6.0%	4.0%	12.0%
Water - gas	4.8	1.0%	4.0%	4.0%	9.0%
Wastewater - electricity	9.2	2.0%	10.0%	20.0%	32.0%
Wastewater - gas	2.6	1.0%	4.0%	4.0%	9.0%
Fleet transit (ML)	1.14	0.0%	0.0%	0.0%	0.0%
Fleet non-transit (ML)	0.7	1.0%	4.0%	4.0%	9.0%
Streetlights	7.59	5.0%	15.0%	15.0%	35.0%
Overall electricity	43.29	2.1%	7.6%	9.3%	19.1%
Overall natural gas	27	1.0%	4.0%	4.0%	9.0%
Overall diesel and gasoline	19.20	0.3%	1.2%	2.4%	4.0%

A set of actions related to each of the key considerations and which support realizing the targets are identified in the plan. These are summarized in Table 2.

Table 2 Summary of major actions by key plan component

Key plan component	Summary of major actions
Governance & accountability	• Establish and commit to long-term and short-term targets • Hire new full-time, permanent staff positions, initially including a Climate Change Officer, and an Energy Manager/Technician • Establish an interdepartmental corporate energy steering committee • Create an energy working group for the Wayne Gretzky Sports Centre • Report annually to senior management, Council and the public on progress of the CEMP
Partnerships & collaboration	• Meet twice a year with EPAC, Brantford Power, IESO, and Union Gas • Participate in the Corporate Energy Managers Community of Practice • Establish connections with sustainability personnel in other Brantford organizations • Collaborate and exchange information with other municipalities
Communications & training	• Communicate to all staff about the CEMP and progress • Develop training modules for all staff • Provide specific training for staff who operate and maintain buildings or vehicles • Encourage staff to participate in conferences, tradeshows and other events, and to share learnings from these with colleagues
Funding & procurement	• Identify opportunities to piggyback efficiency improvements on planned capital projects • Review the criteria for prioritizing and budgeting, including life-cycle financial analysis and a shadow price for carbon • Develop purchasing criteria that address life-cycle costs, energy efficiency, and GHG emissions • Formalize responsibility for seeking incentives • Reinvest incentives received for efficiency projects in the energy reserve fund, and ensure staff are aware of how to access this fund
Monitoring & tracking	• Acquire an Energy Management System to facilitate tracking and reporting on energy use • Develop a plan for analysing and using energy data • Develop an EMS dashboard for departmental managers and operators • Sub-meter major energy using equipment • Assess whether energy data needs are being met and whether there are adequate resources to collect, manage and analyze data
Advanced technology & energy efficiency standards	• Continue upgrading existing equipment with efficient equivalents • Review and pilot alternatives to fossil fuels, such as ground source heat pumps, electric pick-up trucks, and heavy-duty electric vehicles (including transit) • Review and pilot alternative energy systems, such as solar, or anaerobic digestion of organics

Based on a very preliminary assessment of needs at 0.25 $/kWh, funding required to meet the targets is set out in Table 3.

Table 3 Preliminary assessment of funding requirements to meet targets

Year	Funding requirement
2020	$320,000
2021	$600,000
2022	$600,000
2023	$700,000
2024	$700,000

Introduction

The City of Brantford *Corporate energy management plan* (CEMP) provides a roadmap for energy management in the City of Brantford. The CEMP describes the energy management activities that the City as a corporation can take over the next five years to increase its energy efficiency, reduce its energy demand, and minimize its environmental footprint. It is also designed to help the City comply with the energy conservation and demand management planning requirements of Ontario *Regulation 507/18* under the *Electricity Act (1998)*. This plan updates and builds on the previous plan adopted in 2014.

CONTEXT

The CEMP occurs in the context of some important changes within the larger environment within which Brantford is situated, with three issues in particular being particularly significant:

- Growing concerns about climate change and the need to aggressively reduce greenhouse gas emissions
- Rising energy prices and possible supply constraints
- The availability of financial incentives to assist the City in taking action.

Climate change

Climate change is largely driven by the use of energy, and in particular fossil fuels used for space heating, electricity generation and transportation. Within the international scientific community, there is growing concern about severe impacts of climate change caused by greenhouse gas emissions on human society. In the fall of 2018, the Intergovernmental Panel on Climate Change released its assessment of what is needed to avoid catastrophic impacts on human society and concluded with high confidence: "Limiting warming to 1.5ºC implies reaching net zero CO_2 emissions globally around 2050 and concurrent deep reductions in emissions of non-CO_2 forcers, particularly methane." (Rogelj et al., 2018). An assessment of climate change impacts in Canada concluded: "Both past and future warming in Canada is, on average, about double the magnitude of global warming." (Environment and Climate Change Canada, 2019a) In addition, the Bank of Canada has identified climate change as one of the key vulnerabilities to the Canadian economy: "Climate change continues to pose risks to both the economy and the financial system. These include physical risks from disruptive weather events and transition risks from adapting to a lower-carbon global economy." (Bank of Canada, 2019)

To address these challenges, numerous municipalities in Canada and around the world have declared a 'climate emergency'. As of May 12,

2019, such a declaration has been made by 31 Canadian municipalities including: Kingston, Hamilton, London, Burlington, Ottawa, St. Catharines, and Halton Hills. (Random Acts of Green Inc., 2019) Climate emergencies have also been declared by the United Kingdom, Ireland, and at the time of writing is being debated in the Canadian House of Commons.

Many municipalities, as well as the provincial and federal government, have set aggressive targets for reducing greenhouse gas emissions that contribute to climate change, some of which are summarized in Table 4.

Table 4 Greenhouse gas emission reduction targets of a selection of Ontario municipalities, Canada and Ontario

Municipality	Target	by	Relative to	Set in
Toronto	30%	2020	1990	2017
Toronto	65%	2030	1990	2017
Toronto	80%	2050	1990	2017
Burlington	Carbon neutral	2040		2015
Oxford County	100% renewable energy	2050		2015
Hamilton	20%	2020	2005	2014
Hamilton	50%	2030	2005	2014
Hamilton	80%	2050	2005	2012
Guelph	28%	2031	2011	2012
Markham	Net zero emissions	2050		2011
York Region	6%	2021	2014	2016
York Region	17%	2031	2014	2016
York Region	44%	2041	2014	2016
York Region	72%	2051	2014	2016
St. Catharines	30%	2030	2011	2014
Durham Region	80%	2050	1990	2012
London	10%	2020	2014	2014
Oakville	20%	2030	2014	2014
Oakville	80%	2050	2014	2014
Kingston	15%	2020	2011	2014
Kingston	30%	2030	2011	2014
Kingston	50%	2041	2011	2014
Vaughan	22%	2031	2013	2016
Ottawa	80%	2050	2012	2016
Greater Sudbury	80%	2050	1990	2016
Windsor	40%	2041	2014	2017

Region	Target	by	Relative to	Set in
Canada	40%	2030	2005	2017
Canada	80%	2050	2005	2017
Ontario	17%	2020	2005	2009
Ontario	30%	2030	2005	2018
Ontario	80%	2050	2005	2017

Rising energy prices and possible supply constraints

The costs of energy are a significant burden on municipalities. In 2018, Brantford spent approximately $10,000,000 on energy, most of which was on electricity. The Ontario electricity system faces a number of factors that are likely to drive up costs, including nuclear refurbishment (a cost in and of itself), and the cost of meeting demand while that refurbishment is occurring with other sources of electricity, the recent

cancellation by the provincial government of some energy efficiency programs, which were a highly cost effective means of matching supply and demand, and possible capacity constraints that may occur as early as 2023. With the political pressure to limit electricity rates, the provincial government may transfer some of these cost drivers to the tax base, tempering increases in electricity prices. (Province of Ontario, 2019)

The Independent Electricity System Operator is responsible for long-term planning for the electricity system, and has indicated a potential supply constraint beginning in 2023 under its reference demand outlook and planning reserve assessment. (Independent Electricity System Operator (IESO), 2018) That assessment in turn depends on a growing contribution from energy efficiency programs. As mentioned, some of those programs have been cancelled, and the committed framework for programs only runs through 2020.

Prices for natural gas, diesel and gasoline are driven by the international price of oil, which has been in a slump in recent years. Since December, gasoline prices in Ontario have risen by 21%, and energy overall by 12%. (Statistics Canada, 2019) The federal government has also announced that carbon prices will rise each year through 2022 by 10 $/t of carbon dioxide equivalent. (Environment and Climate Change Canada, 2017) This will add an additional cost to Brantford's energy bill in 2022 of approximately $500,000 over what it was in 2018.

Availability of incentives

A factor affecting municipal corporate energy planning is the availability of financial incentives from utilities and other levels of government. Incentives are offered by Ontario gas and electric utilities and the federal government. It is unclear whether incentives available today will be available over the longer term. Electricity incentives were recently reduced. The Ontario 2018 climate change plan has a significant dependence on natural gas conservation through 2030, but there are no details on how this will be achieved or the role of incentives. (Ministry of the Environment, Conservation and Parks, 2018) Incentives are available from the federal government and through the Federation of Canadian Municipalities. Today's federal government expects that increasing funds for greenhouse gas reducing projects will be available for municipalities and others to apply for as the carbon charges increase through 2022.

PLANNING HORIZON AND SCOPE

The CEMP for the City of Brantford is a 5-year plan covering the period from July 2019 to June 2024.

The CEMP provides a roadmap for energy management at all City facilities.[1] As can be seen in Figure 1, it addresses the use of electricity and natural gas in City facilities, streetlights and traffic lights, and fuel for fleets. Biogas from the wastewater treatment plant and landfill gas are also considered, though they were not addressed in the 2014 plan.

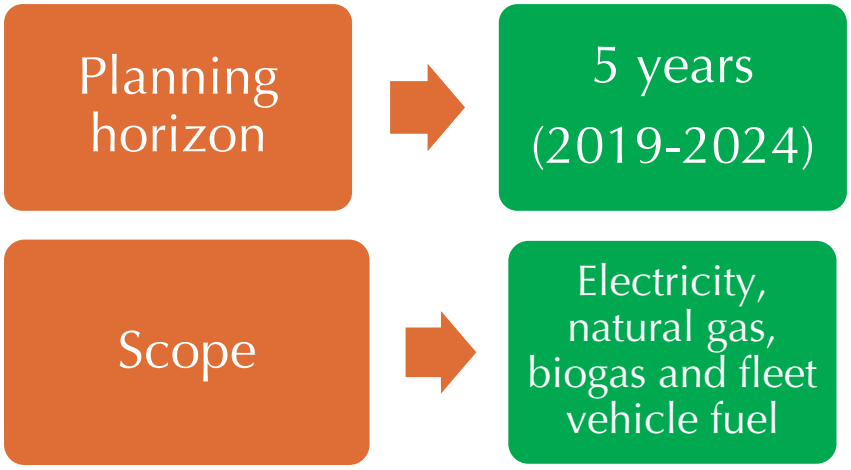


Figure 1 Planning horizon and scope

PLANNING PROCESS

Figure 2 depicts the major steps in the planning process that were used to develop the City's *Corporate energy management plan*. Inputs to the planning process included:

- Review of 2014 through 2018 energy and GHG data for all City facilities, excluding housing and long term care facilities,
- Review of the City's existing policies, plans, and past energy efficiency projects,
- Benchmarking of City facilities against comparable facilities,
- Interviews with City staff (including department directors and managers),
- Two strategic planning sessions with key City staff, and
- Consultation with the Environmental Policy Advisory Committee.

[1] Excluding the City of Brantford's Housing portfolio.

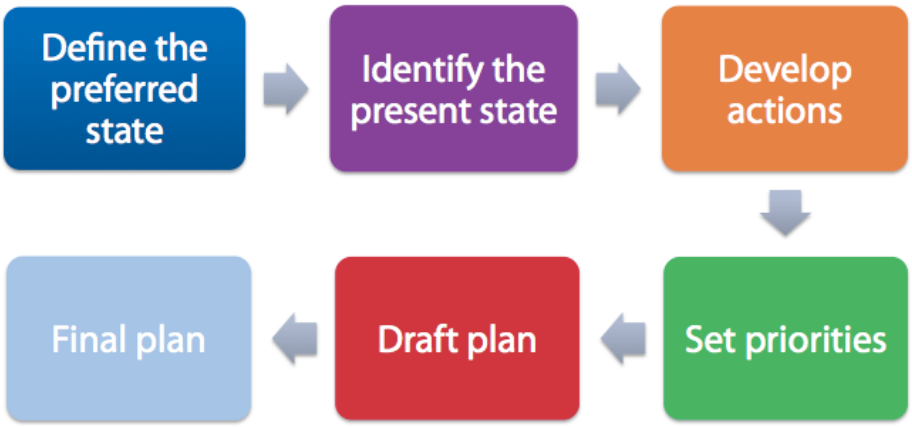


Figure 2 Overview of the planning process

Defining the preferred state involved exploring where the City of Brantford would like to be with respect to energy management. The elements of the preferred state were identified through interviews with staff, a review of jurisdictional best practices, and during the strategic planning sessions. The preferred state informed the CEMP's objectives, targets, and actions.

Identifying the present state involved exploring where the City is now with respect to energy management. Energy data analysis; interviews; a review of the City's existing policies, plans, and past energy efficiency projects; and benchmarking were among the inputs that were used to identify the present state. While buildings were audited for the 2014 CEMP, there were no buildings audited for the 2019 CEMP.

Developing actions involved identifying organizational measures (i.e. measures related to corporate processes) and technical measures. The organizational measures enable the technical measures. Actions were identified through interviews, the strategic planning sessions, and the jurisdictional review of best practices. They were grouped according to the following categories:

- Governance and accountability,
- Partnerships and collaboration,
- Communications and training,
- Funding and procurement,
- Monitoring and tracking,
- Advanced technologies and energy efficiency standards.

Setting priorities involved determining the timeframe for implementation of each action in the CEMP. Organizational and technical measures were prioritized based on their importance and ease of implementation.

Preparing the Draft and Final Plan involved documenting the results of the planning process. The CEMP will be reviewed annually and updated at the end of the five years.

FRAMEWORK FOR PLANNING

The City's CEMP addresses buildings, fleets, and technologies, including street and traffic lights, and renewable energy – as well as people, processes, and information. As illustrated in Figure 3, the CEMP centers on the City's facilities, fleets, and technologies. It aims to ensure that existing and any new facilities are built and operated as efficiently and sustainably as possible. The City's supporting organizational policies and processes, monitoring and tracking systems, training initiatives and communication and engagement tools allow this to happen.

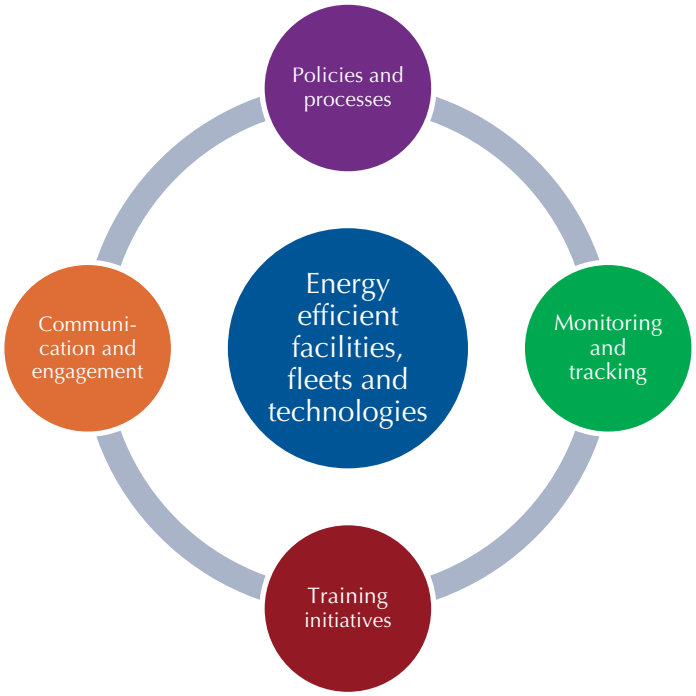
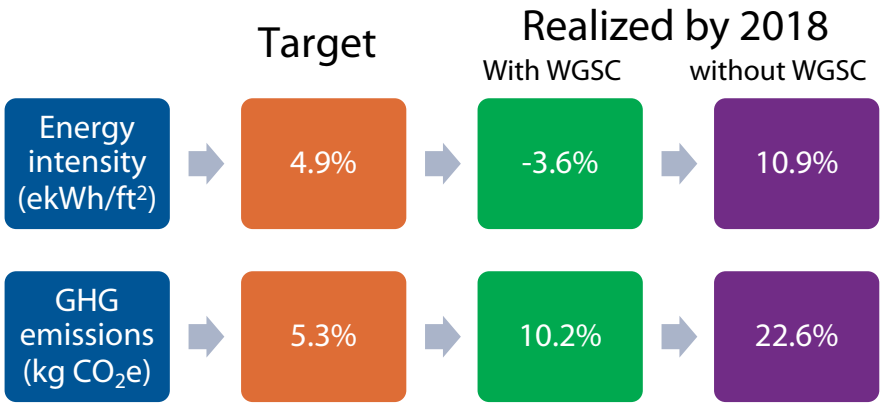


Figure 3 Framework for planning

PROGRESS SINCE THE PREVIOUS PLAN

The 2014 plan set out targets for energy efficiency reductions by 2019 in energy use per square foot for buildings and greenhouse gas reductions for facilities, including buildings and water and wastewater facilities. These targets, and progress to the end of 2018 are as follows:



The chart shows progress with and without the Wayne Gretzky Sports Centre (WGSC) which came on-stream in 2014. The plan was based on data from 2011 and 2012, before the expanded WGSC had opened.

As of the end of 2018, an additional breakdown of the progress towards these targets is set out in Table 5.

Greenhouse gas emissions are what is known as Scope 2 emissions, that is they include both direct emissions from combustion of natural gas and liquid fuels, and indirect emissions associated with upstream electricity production. Although electricity use went down by 2.6% between 2014 and 2018 the upstream greenhouse gas emissions dropped by 57% due to changes in the mix of fuels used by the Ontario electricity system.[2]

[2] For the purpose of this document, the average greenhouse gas intensity in each year has been used. There is a significant difference between the average and marginal intensity. The emissions associated with electricity use at off-peak times (e.g. for streetlights which are on at night) will be lower than estimated here, while emissions from electricity used during other times may be considerably higher than estimated here. Consistent with Ministry of Energy, Northern Development and Mines, generation intensity is used in the calculations.

Table 5 Progress against targets, components of targets and areas not covered by the targets

	Target reduction for 2019	Actual reduction 2018	2014*	2018
Energy use in buildings (ekWh/ft^2)	4.9%	-3.6%	31.0	32.2
Facility greenhouse gas emissions (t CO_2eq)	5.3%	10.2%	6,038	5,423
Greenhouse gas emissions (t CO_2eq) buildings		3.3%	4,398	4,255
Greenhouse gas emissions (t CO_2eq) W&WW		28.8%	1,640	1,168
Greenhouse gas emissions (t CO_2eq) fleets		-10.6%	4,511	4,990
Greenhouse gas emissions (t CO_2eq) streetlighting		57.3%	308	131
Greenhouse gas emissions (t CO_2eq) overall		2.9%	10,856	10,544
Details				
Buildings (ekWh/ft^2)		-3.6%	31.0	32.2
Total ekWh		-3.6%	38,095,524	39,473,540
Floor area (ft^2)			1,227,190	1,227,190
Buildings excluding WGSC (ekWh/ft^2)		10.9%	26.6	23.7
Total ekWh		10.9%	24,101,031	21,481,393
Floor area (ft^2)			907,190	907,190
Greenhouse gas emissions (t CO_2eq)		19.1%	2,933	2,372
Wayne Gretzky Sports Centre (kWh/ft^2)		-28.6%	43.73	56.23
Total ekWh		-28.6%	13,994,493	17,992,147
Floor area (ft^2)		0.0%	320,000	320,000
Greenhouse gas emissions (t CO_2eq)		-28.5%	1,466	1,884
Water treatment & pumping (ekWh/ML)		5.8%	1,051	990
Total ekWh		6.2%	12,677,457	11,885,779
Total flow (ML)		0.5%	12,064	12,007
Floor area (ft^2)			90,100	90,100
Greenhouse gas emissions (t CO_2eq)		25.0%	821	615
Wastewater treatment & pumping (ekWh/ML)		0.6%	901	896
Total ekWh		1.7%	11,573,675	11,376,185
Total flow (ML)		1.1%	12,843	12,696
Floor area (ft^2)			60,900	60,900
Greenhouse gas emissions (t CO_2eq)		32.5%	819	552
Fleets (L/100 km)		-2.8%	45.1	46.4
Total litres		-10.6%	1,684,621	1,862,548
Total distance (km)		-7.5%	3,733,698	4,015,176
Streetlighting (kWh)**		1.3%	7,688,146	7,591,073

* 2015 for fleet data
** use in 2018 includes additional fixtures due to municipal boundary adjustments, without those additions use would be -2.36%

Note: negative numbers indicate that energy use or emissions increased

TRENDS IN ENERGY USE

Although the overall quantity of energy purchased has increased slightly since the last plan was adopted, the change varies from year to year and energy type to energy type.[3] The trends of overall energy purchases are shown in Figure 4, along with heating degree days, an indicator of heating demand.

[3] In addition to energy purchased, energy is generated from landfill gas and sold to the grid, and from the wastewater treatment facility, used to generate heat. This is discussed later in the plan.

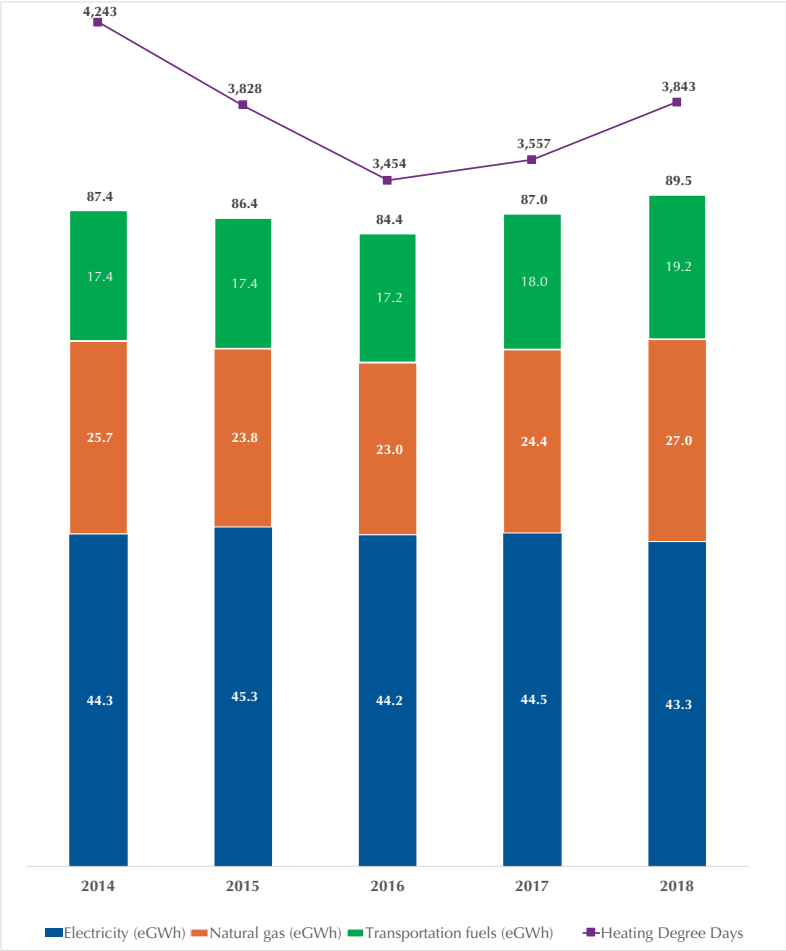


Figure 4 Trends in energy use in Brantford, 2014-2018

Figure 4 demonstrates that weather is not the major determinant of the increase in natural gas use in recent years: gas use rose in 2018 to levels higher than were used in 2014 which was a colder year. The differences are primarily attributable to the increased gas use at the Wayne Gretzky Sports Centre. When total energy use for facilities *other than* the Wayne Gretzky Sports Centre, overall use is considerable lower, and natural gas use tracks heating degree days closely, as indicated in Figure 5.

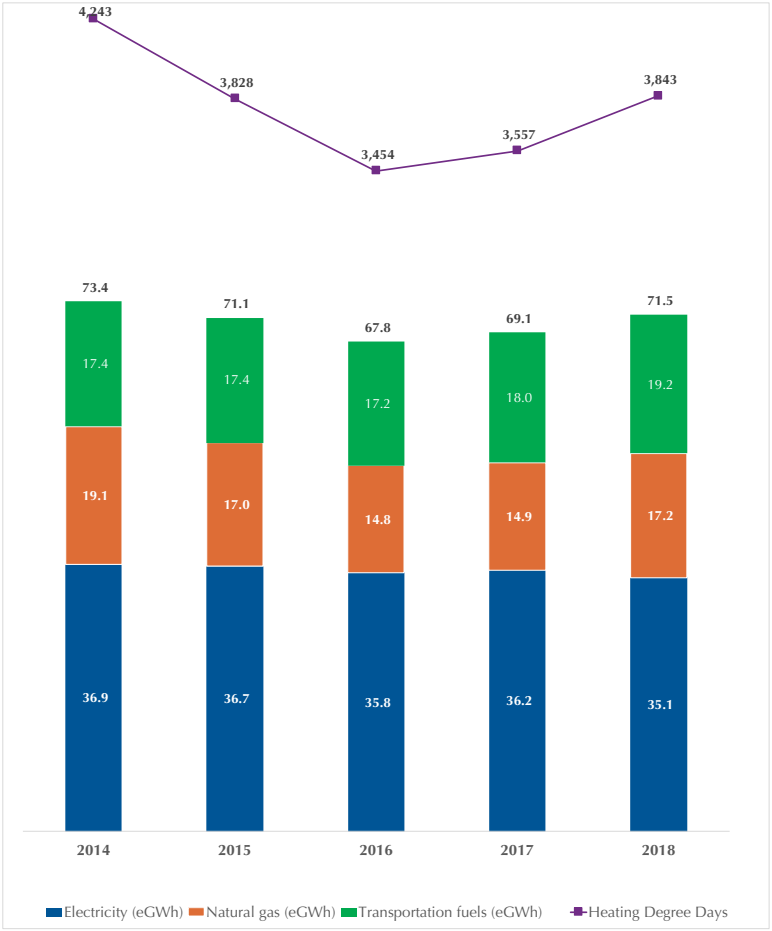


Figure 5 Trends in energy use in Brantford excluding the Wayne Gretzky Sports Centre, 2014-2018

Energy is used by facilities, including buildings, water and wastewater operations; streetlights; and by fleets. The split across types of uses is shown in Figure 6. Facilities account for 71% of total energy use.

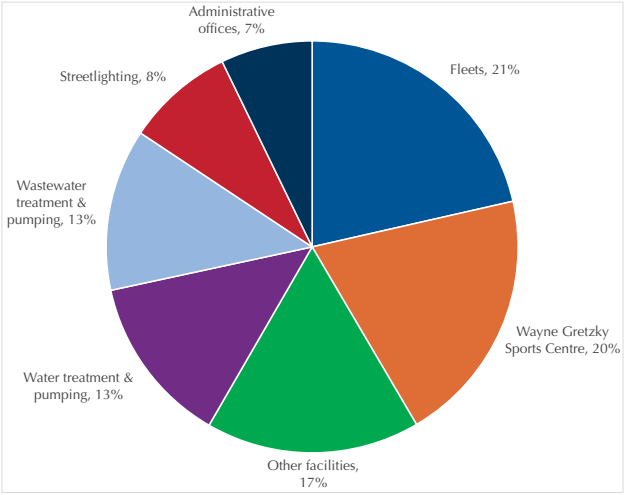


Figure 6 The distribution of energy use in Brantford in 2018

Within facilities, ten facilities account for 80% of the facility energy use. The highest energy using facilities are shown in Figure 7.

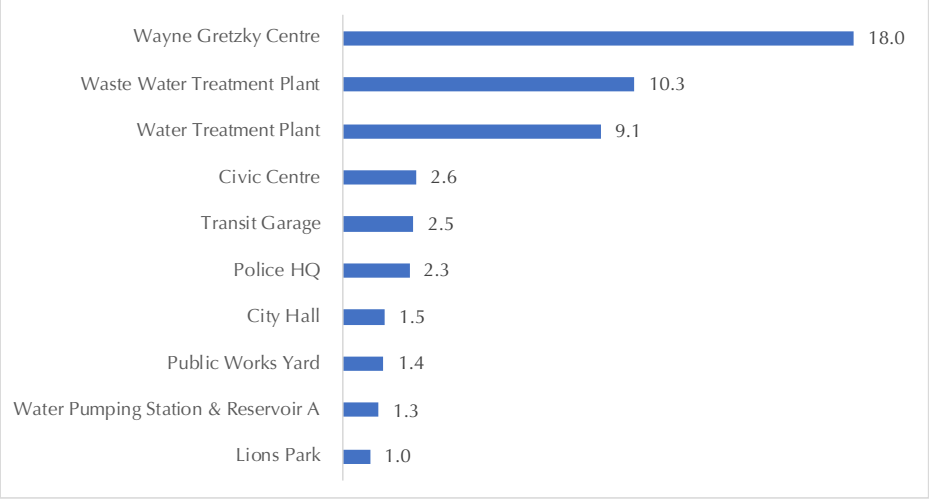


Figure 7 The ten highest energy using facilities in 2018 (GWh)

The expanded Wayne Gretzky Sports Centre, which opened in 2014, accounts for 20% of total energy use, 30% of *facility* energy use and 36% of natural gas use in facilities.

Detailed trend information by facility from 2011 to 2018 is appended.

The other major use of energy is for fleets, and most energy used by fleets is for transit. A breakdown of fleet energy use is in Table 6.

Table 6 Trends in fuel use by fleets 2015-2018 (Litres)

Service	2015	2016	2017	2018
Brantford Transit	1,006,534	1,005,440	1,072,043	1,135,693
Brantford Lift	128,764	125,440	120,865	131,152
Operational Services	303,890	281,636	285,179	315,388
Parks & Recreation	121,152	127,517	130,205	142,619
Environmental Services	97,747	78,264	91,476	93,122
Remainder of fleet	26,534	50,331	49,024	44,574
Total	**1,684,621**	**1,668,628**	**1,748,792**	**1,862,548**

TRENDS IN GREENHOUSE GAS EMISSIONS

The greenhouse gas emission trends are shown in Figure 8. Although there was a slight decrease in total emissions in 2018 relative to 2014, that drop was smaller than the drop in electricity related emissions caused primarily by the changing composition of the energy mix used to generate electricity; the greenhouse gas intensity measured in grams of carbon dioxide equivalent per kilowatt-hour fell from 35.5 to 17.3 from 2016 to 2017. (Environment and Climate Change Canada, 2019b)

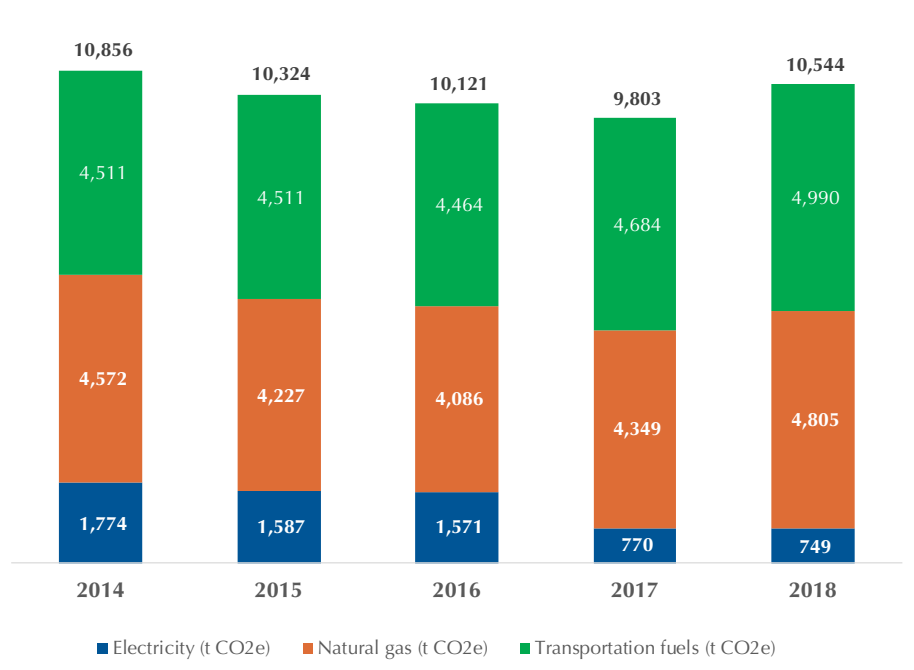


Figure 8 Trends in greenhouse gas emissions, 2014-2018[4]

Emissions associated with natural gas use rose by 233 tonnes of carbon dioxide equivalent (t CO_2eq) between 2014 and 2018.[5] As noted on Table 5, although greenhouse gases increased by 3.3% overall, they fell by almost 5% at facilities other than the Wayne Gretzky Centre, where emissions associated with natural gas use rose by 573 t, in part due to the expanded facility becoming fully operational and in part due to longer service periods.

The distribution of greenhouse gas emissions is shown in Figure 9. Given that Ontario's electricity is relatively clean since the phase out of coal-fired generation in 2014, it is not surprising that greenhouse gas emissions are primarily associated with those services that rely on fossil fuels: fleets, and natural gas use in buildings.

[4] Fuel use by fleets in 2014 is not available. The 2015 consumption is assumed for 2014.

[5] There are multiple gases that contribute to climate change, and their contribution varies depending on the timeframe being considered. Climate scientists use 'carbon dioxide equivalents' for greenhouse gases other than carbon dioxide to indicate an impact over a specified time horizon of an equivalent amount of carbon dioxide. For example, methane (CH_4) has a global warming potential (GWP) over 100 years of 25, indicating that 1 g of methane has the same impact on global warming over 100 years as 25 grams of carbon dioxide.

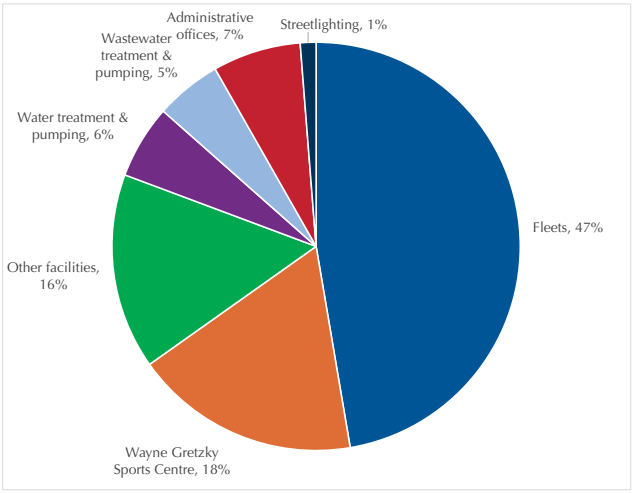


Figure 9 The distribution of greenhouse gas emissions associated with energy use (2018) [6]

ENERGY MANAGEMENT INITIATIVES THAT HAVE BEEN IMPLEMENTED

Although Brantford's targets were not met, energy use and emissions would have been even higher were it not for numerous projects undertaken that reduced energy use. Projects to reduce electricity use in buildings are shown in Table 7. Other projects focused on reducing natural gas use. For example, a dehumidification project for the pool at Wayne Gretzky Centre reduced natural gas use by an estimated 115,637 m^3.

Table 7 Projects undertaken to reduce electricity use

Project type	Number of projects	Annual energy savings (kWh)
Lighting projects in 12 municipal buildings	13	959,124
Pool dehumidification	1	5,720
Street lights	2	184,674
Total	16	1,149,518

Other projects undertaken have included adding two electric vehicles to the fleet, LED streetlights installed for all new developments and road construction projects, and an ongoing program to convert streetlights to LEDs, while upgrading the lighting distribution and lumen output to modern standards.

[6] The reader is reminded that these calculations are based on the average greenhouse gas intensity of electricity over the year. Some uses will be lower than indicated (e.g. streetlights), others will be higher.

Preferred state of energy management

PREFERRED STATE

Brantford has a long-term vision for energy supply and demand in the City, and how that is to be attained. Key elements of the vision are set out in the highlighted box below.

City of Brantford preferred state for energy and greenhouse gas emissions

Governance and accountability
Brantford has long-term and short-term targets for energy savings, greenhouse gas reductions, and renewable energy with an ultimate goal of zero greenhouse gas emissions and 100% renewable energy.

Brantford has clear delineation of responsibilities for energy management and target attainment.

Brantford promotes a culture of conservation through the City.

Partnerships and accountability
Brantford develops partnerships across City departments and with outside organizations to share experiences and best practices, and to leverage influence with other levels of government and the broader community.

Communications and training
Brantford ensures that information about energy use in the City is available throughout the organization in an understandable and useful format.

Brantford ensures that staff are trained to use energy efficiently and reduce greenhouse gas emissions while providing excellent service to the community in their job functions.

Funding and procurement
Brantford ensures that its funding and procurement decisions take into account getting the best overall value for the City, thus taking into account capital and operating costs, and accounting for externalities, such as carbon emissions.

Monitoring and tracking
Brantford ensures that data on energy use and greenhouse gas emissions are collected, analyzed and made available to those needing the information, and that the impacts of initiatives are evaluated to build on successes.

Advanced technologies and efficiency standards
Brantford evaluates and pilots advanced technologies and standards to ensure continual improvement in its energy performance.

Brantford procures and uses buildings, vehicles and equipment that are energy efficient and cost-effective.

The 2019-2024 plan is concerned with moving towards this preferred state.

TARGETS

To move towards the preferred state, targets have been set for the plan period, and those are outlined on Table 8.

Table 8 Energy saving targets 2019-2024 (%)

Source	Current (GWh)	2019-2020	2021-2022	2023-2024	Total
Buildings - electricity	17.2	1.0%	4.0%	4.0%	9.0%
Buildings - gas	19.6	1.0%	4.0%	4.0%	9.0%
Water - electricity	9.3	2.0%	6.0%	4.0%	12.0%
Water - gas	4.8	1.0%	4.0%	4.0%	9.0%
Wastewater - electricity	9.2	2.0%	10.0%	20.0%	32.0%
Wastewater - gas	2.6	1.0%	4.0%	4.0%	9.0%
Fleet transit (ML)	1.14	0.0%	0.0%	0.0%	0.0%
Fleet non-transit (ML)	0.7	1.0%	4.0%	4.0%	9.0%
Streetlights	7.59	5.0%	15.0%	15.0%	35.0%
Overall electricity	43.29	2.1%	7.6%	9.3%	19.1%
Overall natural gas	27	1.0%	4.0%	4.0%	9.0%
Overall diesel and gasoline	19.20	0.3%	1.2%	2.4%	4.0%

The targets are relative to the current (2018) use. In the case of electricity use for water, wastewater and streetlights, more aggressive savings are proposed based on planned projects. The 2024 electricity target assumes that contractual issues around the RESOP contract for the landfill cogeneration facility can be resolved, and landfill gas can be used to generate electricity for use by the wastewater treatment plant. That would also mean that annual renewable generation would increase by approximately 2.75 GWh.

Although the targets are expressed in percentage reductions of energy use, for information, Table 9 provides the target reductions in energy units, mass of greenhouse gases and energy intensity.

Table 9 Targets in energy units, and greenhouse gas and energy intensity reductions

	2019-2020	2021-2022	2023-2024	Total
Energy reductions (eGWh)	1.4%	5.2%	6.2%	12.8%
Overall electricity	0.9	3.3	4.0	8.3
Overall natural gas	0.3	1.1	1.1	2.4
Overall diesel and gasoline	0.1	0.2	0.5	0.8
Total	1.3	4.6	5.6	11.5
Greenhouse gas reductions (t CO_2e)	0.7%	2.9%	3.6%	7.3%
Overall electricity	15.9	57.2	69.9	143.0
Overall natural gas	48.3	193.0	193.0	434.3
Overall diesel and gasoline	14.6	58.6	117.2	190.4
Total	78.8	308.8	380.1	767.7
Building energy intensity reduction (ekWh/ft2)				
Buildings - electricity (GWh)	0.172	0.688	0.688	1.548
Buildings - gas (GWh)	0.196	0.784	0.784	1.764
Buildings total (GWh)	0.368	1.472	1.472	3.312
Floor area (ft^2)	1,378,190	1,378,190	1,378,190	1,378,190
Energy use intensity (ekWh/ft^2)	0.3	1.1	1.1	2.4

Note: GHG emissions based on 2017 CO_2e/kWh values (generation)

Getting to the preferred state of energy management

A suite of actions is required to move towards the preferred state in the next five years. The actions are grouped into the same six categories used in the Preferred State:

- **Governance and Accountability** – measures related to policies, targets, and resources required to enable energy management and other actions;
- **Partnerships and Collaboration** – measures related to networking, relationship-building, information sharing, and best practices;
- **Communication and Training** - measures related to encouraging behavioural modifications to save energy;
- **Funding and Procurement** - measures related to identification, prioritization, funding, and procurement of energy and renewable technologies;
- **Monitoring and Tracking** – measures related to collecting, monitoring, evaluating, and sharing energy data;
- **Advanced Technologies and Energy Efficiency Standards** – measures, both technical and policy based, that impact new and existing buildings, fleets, streetlights and traffic signals;

These actions are categorized into three time periods for implementation:

1. Priority Actions – Year 1 (July 2019 – June 2020)
2. Medium-Term Actions – Years 2 and 3 (July 2020 – June 2022)
3. Longer-Term Actions – Years 4 and 5 (July 2022 – June 2024).

Many of the priority actions are foundational and put in place the structures and practices that will facilitate on-going energy efficiency within the City.

ACTIONS RELATED TO GOVERNANCE

Actions related to governance over the three time periods are presented in Table 10, Table 11, and Table 12. The actions are numbered for convenience in referencing them. Numbering is not indicative of priority or importance.

Table 10 Governance and accountability actions (2019-2020)

1. Formally reaffirm a commitment to sustainability including energy management and greenhouse gas (GHG) reduction targets as a strategic priority for the long-term benefit of the City. This would include adopting a science-based target for greenhouse gas emission reductions.
2. Designate oversight of the Energy Management Program as a Corporate Initiative to be administered by the Climate Change Officer in the Office of the CAO.
3. Assign the Climate Change Officer responsibility for championing the CEMP, tracking energy initiatives, and implementing the behaviour change programs to staff with input from other stakeholders.
4. Reinstate a Corporate Steering Committee with staff representatives from each department to formalize an energy strategy across all City departments and identify roles and responsibilities.
5. Establish an energy working group to focus on the Wayne Gretzky Sports Centre
6. Formally adopt interim and 5-year targets for energy intensity and GHG Reduction Targets.
7. Review and establish science-based, long-term, measurable carbon reduction targets in addition to the specific five-year targets.[7]
8. Review and establish a measurable target for renewable generation in consultation with Brantford Power.

[7] Targets to reduce greenhouse gas (GHG) emissions are considered "science-based" if they are in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement – to limit global warming to well-below 2°C above pre-industrial levels and pursue efforts to limit warming to 1.5°C. There is a specific program for companies to commit to science-based goals but at present it is not accepting commitments from cities and local governments. Nevertheless, the Science Based Targets organization has developed methodologies that are relevant to municipalities. (**http://sciencebasedtargets.org**)

Table 11 Governance and accountability actions (2020-2022)

9. Develop a framework for including energy management and sustainability in relevant corporate plans and policies, including the Strategic Asset Management Policy, through the Manager of Corporate Initiatives.
10. Identify roles and develop a framework for energy management accountability within each Commission and Department that will review energy usage and expenditures.
11. Establish full-time permanent Climate Change Officer and Energy Manager/Energy Technician roles responsible for implementing the policy and technical actions of the CEMP respectively on a go forward basis.
12. Track and assess progress on interim targets and years 1-2 actions. Report annually on the progress and key milestones achieved towards meeting the established energy targets to City Council and the Environmental Planning Advisory Committee. Update targets, if required, to reflect progress.
13. Ensure compliance with the *Electricity Act* reporting requirements and report the results of the Broader Public Sector (BPS) Annual Energy Interim Report to the Ministry of Energy, Northern Development and Mines (MOENDM).

Table 12 Governance and accountability actions (2022-2024)

14. Incorporate energy management and sustainability in relevant corporate plans and policies, including the Strategic Asset Management Plan, through the Manager of Continuous Improvement.
15. Implement Energy Management Accountability within each Commission and Department e.g. review of total energy usage/spend
16. Review staffing and resource requirements to effectively implement the CEMP.
17. Track and assess progress on interim targets and years 3-4 actions. Report annually the progress and key milestones achieved towards meeting the established energy targets to City Council and the Environmental Planning Advisory Committee. Update targets, if required, to reflect progress.
18. Ensure compliance with the *Electricity Act* reporting requirements and report the 2024-2029 CEMP Update and results of the Broader Public Sector (BPS) Annual Energy Report to the Ministry of Energy, Northern Development and Mines (MOENDM).

ACTIONS RELATED TO PARTNERSHIPS AND COLLABORATIONS

Actions related to partnership and collaborations over the three time periods are presented in Table 13, Table 14, and Table 15.

Table 13 Actions related to partnerships and collaborations (2019-2020)

19. Meet bi-annually with EPAC to provide an update on status and seek guidance and alignment of strategies and initiatives.
20. Continue to meet bi-annually with Brantford Power, IESO and Union Gas to discuss opportunities to work together on energy efficiency initiatives, including accessing available incentives.
21. Continue to participate in the municipal Corporate Energy Managers Community of Practice (CEM COP) facilitated by the Clean Air Partnership.
22. Research relevant industry sector working groups for departmental managers and staff participation.
23. Develop a process for tracking and reporting Partnership and Collaboration activities.

Table 14 Actions related to partnerships and collaborations (2020-2022)

24. Connect with relevant local sustainability personnel in other community organizations, e.g. Wilfrid Laurier University Brantford Campus (WLU), Grand Erie District School Board (GEDSB), Brant Haldimand Norfolk Catholic District School Board (BHNCDSB), Brantford General Hospital (BGH).
25. Introduce departmental managers and staff to the IESO and Union Gas representatives to discuss opportunities to work together on energy efficiency initiatives, including accessing available incentives.
26. Seek collaboration opportunities with Energy Managers from other municipalities to share information, best practices, and tour facilities.
27. Identify relevant industry sector working groups to departmental managers and staff for participation.
28. Implement a process for tracking Partnership and Collaboration activities.

Table 15 Actions related to partnerships and collaboration (2022-2024)

29. Develop a communication and outreach plan for communicating about energy use and reporting to the community e.g. soliciting ideas through crowdsourcing, enhanced website
30. Coordinate regular site visits and meetings for departmental managers and staff with other municipalities and local sustainability personnel (WLU, GEDSB, BHNCDSB, BGH) to share information and tour facilities.
31. Follow up with departmental managers and staff on participation in relevant working groups and encourage information sharing.
32. Collaborate with local sustainability personnel (WLU, GEDSB, BHNCDSB, BGH) on events, activities, group trainings to generate greater exposure for City and influence in the energy management community.
33. Assess whether partnerships and collaboration are producing tangible benefits to energy management in the City.

ACTIONS RELATED TO COMMUNICATIONS AND TRAINING

Actions related to communications and training over the three time periods are presented in Table 16, Table 17, and Table 18. Effective communication is essential both to ensure commitments are being kept, and efficient operations. Training contributes to ensure that operations are efficient.

Table 16 Actions related to communications and training (2019-2020)

34. Communicate the updated CEMP and annual reporting results to all City staff with the assistance of the Corporate Communications Department.
35. Develop a communication plan with the Corporate Communications Department for communicating the City's energy reduction programs and initiatives to staff.
36. Develop a general training module on energy and energy efficiency awareness with the Human Resources Department to be included in the online orientation training process for all new hires.
37. Develop an operator level energy contact in each division.
38. Ensure building/energy staff are well trained through access to conferences, trade shows, and opportunities for information sharing and education on best practices, including the requirement for staff to provide a summary of the takeaways and how they apply to the City, along with potential recommendations for action.

Table 17 Actions related to communications and training (2020-2022)

39. Communicate the updated annual reporting results to all City staff with the assistance of the Corporate Communications Department.
40. Formalize and implement a communication plan with the Corporate Communications Department for communicating the City's energy reduction programs and initiatives to staff.
41. Formalize general training on energy and energy efficiency awareness with the Human Resources Department to be included in the training process for all new hires.
42. Conduct an assessment of the needs of new and existing staff who operate and maintain specific buildings with a goal of having an operator identified in each building who has primary responsibility for energy management (where required).
43. Develop an employee engagement process pilot for all staff who operate and maintain facilities.

Table 18 Actions related to communications and training (2022-2024)

44. Communicate the updated annual reporting results to all City staff with the assistance of the Corporate Communications Department.
45. Implement a communication plan with the Corporate Communications Department for communicating the City's energy reduction programs and initiatives to staff.
46. Incorporate the general training module on energy and energy efficiency awareness into the Human Resources Department's online orientation training process for all new hires.
47. Ensure that all new and existing staff who operate and maintain buildings or vehicles are appropriately trained on energy efficiency in their building or vehicle.
48. Implement an employee engagement process for all staff based on the pilot program implemented in Years 2-3.

ACTIONS RELATED TO FUNDING AND PROCUREMENT

Actions related to funding and procurement over the three time periods are presented in Table 19, Table 20, and Table 21.

Table 19 Actions relating to funding and procurement (2019-2020)

49. Review the 10-Year Capital Budget Forecast and Annual Capital Projects List to identify and pursue projects that could incorporate energy efficiency and reduce long term operating costs.
50. Review the criteria for prioritizing and budgeting projects. Criteria should include, where applicable, life-cycle costing using the federal shadow price for carbon,[8] available incentives, need for replacement, occupant comfort, regulatory requirements, ease of implementation, achievable energy savings, and contribution to demonstrating leadership. Priorities of criteria should align with the Strategic Asset Management Policy.
51. Develop a clear and well-publicized process for funding smaller projects from the Energy Reserve Account or other Capital/Operating budget accounts where appropriate e.g. Federal Gas Tax, Capital Reserves.
52. Develop a framework with Purchasing Department to find effective ways of procuring energy efficient technologies e.g. standardized corporately piloted/reliable products including situations where only one vendor can offer a particular product.
53. Refine the process and formalize roles and responsibilities for monitoring and applying for available incentive/grant programs.

[8] Shadow carbon pricing is a method of investment or decision analysis that adds a surcharge for carbon dioxide that would be released to market prices for projects that involve significant carbon emissions. The federal government is using a price of 50 $/t and Treasury Board will provide guidance on future carbon pricing. (Treasury Board of Canada Secretariat, 2018)

Table 20 Actions related to funding and procurement (2020-2022)

54. Review the 10-Year Capital Budget Forecast and Annual Capital Projects List to identify and pursue projects that could be optimized through energy efficiency.
55. Apply criteria using the metrics for prioritizing and budgeting projects. Criteria should include life-cycle costing using federal shadow price for carbon, available incentives, need for replacement, occupant comfort, regulatory requirements, ease of implementation, achievable energy savings, and contribution to demonstrating leadership. Priorities should align with criteria developed as part of the Strategic Asset Management Policy.
56. Develop a clear and well-publicized process for budgeting and funding larger projects.
57. Implement with Purchasing Department effective processes to procure energy efficient technologies e.g. standardized corporately piloted/reliable products including situations where only one vendor can offer a particular product.
58. Develop a framework through which available incentives or grants from energy projects are re-invested into the Energy Reserve Account.

Table 21 Actions related to funding and procurement (2022-2024)

59. Review the 10-Year Capital Budget Forecast and Annual Capital Projects List to identify and pursue projects that could be optimized through energy efficiency.
60. Implement criteria and metrics for prioritizing and budgeting projects. Criteria should include life-cycle costing using federal shadow price for carbon, available incentives, need for replacement, occupant comfort and regulatory requirements, ease of implementation, achievable energy savings, and contribution to demonstrating leadership. Develop an appropriate weighting framework for these criteria.
61. Develop a clear and well-publicized process for budgeting and funding energy efficiency pilots.
62. Implement mechanism through which available incentives or grants from energy projects are re-invested into the Energy Reserve Account.
63. Conduct an assessment to ensure that the identification, prioritization, funding, and procurement of energy and renewable technologies needs are being met, and that systems and resources are adequate to sustain the processes.

ACTIONS RELATED TO MONITORING AND TRACKING

Actions related to partnership and collaborations over the three time periods are presented in Table 22, Table 23, and Table 24. Like communications and training, monitoring and tracking are essential to ensuring that commitments are fulfilled, and staff have the information they need to ensure efficient operations.

Table 22 Actions related to monitoring and tracking (2019-2020)

64. Review key performance indicators (KPIs) and tracking mechanisms to monitor and report on progress towards interim and 5-year targets.
65. Continue using EnergyStar® PortfolioManager as a benchmarking system to monitor the energy performance of buildings.
66. Pilot the generation of high-level EnergyStar® PortfolioManager Report Cards on the annual energy consumption and benchmarking of each building.
67. Develop a plan for analysis and use of energy data e.g. Energy Manager/Energy Technician collects data centrally and informs staff who operate and maintain buildings of results and anomalies.
68. Develop terms of reference and functional requirements for an energy management system (EMS), including provisions for social housing energy data, water and waste water flow data, as well as fleet, street lighting, and traffic signal data into the EMS.

Table 23 Actions related to monitoring and tracking (2020-2022)

69. Establish a budget estimate and commence with procurement and implementation of an EMS.
70. Provide department managers and operators with access to an EMS dashboard with relevant information on energy use.
71. Generate and distribute to department managers and operators high-level EnergyStar® PortfolioManager Report Cards on the annual energy use and benchmarking of each building.
72. Identify high energy users based on benchmarking, and select candidates for energy assessments, building and system audits/studies, and sub-metering permanently installed on major equipment e.g. WGSC and water/wastewater plants.
73. Develop a process for evaluating and reporting the savings achieved from energy efficiency projects based on data e.g. sub-metering, and statistical processes, such as linear regression and/or CUSUM.

Table 24 Actions related to monitoring and tracking (2022-2024)

74. Continue to use and optimize the EMS to track and analyze energy use at the building level.
75. Develop and implement a process to smoothly integrate EMS energy data with EnergyStar® PortfolioManager for benchmarking.
76. Develop and implement an efficient process for collecting and inputting water and waste water flow data as well as fleet, street lighting, and traffic signal data into EMS.
77. Procure energy assessments, building and system audits/studies, and sub-metering permanently installed on major equipment e.g. WGSC and Water/Waste Water Treatment Plants.
78. Conduct an assessment to ensure that energy data needs (EMS, Environmental Services PLC, and Fleet telemetrics) are being met, and that staff resources are adequate to collect, manage and analyze the data.

ACTIONS RELATED TO TECHNOLOGY AND STANDARDS

Actions related to partnership and collaborations over the three time periods are presented in Table 25, Table 26, and Table 27.

Table 25 Actions related to advanced technologies and energy efficiency standards (2019-2020)

79. Continue to review and implement general/specialized LED lighting and lighting control retrofits in applicable buildings/arenas/pools/sports fields/street lighting/traffic signals, where considered cost effective.
80. Continue to review and implement building HVAC and VFD settings and measures in applicable buildings, where considered cost effective.
81. Continue to review and upgrade air sealing, and insulation measures in applicable buildings, where considered cost effective.
82. Continue to review and implement compressed air measures in applicable buildings, where considered cost effective.
83. Continue to investigate and implement purchasing the right-sized electric/energy efficient fleet vehicles including life-cycle costing.

Table 26 Actions related to advanced technologies and energy efficiency standards (2020-2022)

84. Review alternatives to fossil fuels and collect data required to assess opportunities, e.g. for ground source heat pump (GSHP) technologies for heating and cooling applications e.g. John Noble Apartments.
85. Investigate opportunities for pilot projects using alternatives to fossil fuels for broader applicability e.g. converting the City greenhouse boiler to ground-source heat pump (GSHP) technology, electric pick-up trucks and electric heavy-duty vehicles, including transit buses.
86. Standardize energy provisions for new and major renovation construction projects to include at budget stage e.g. alternatives to fossil fuels, LED lighting/controls, high-efficiency equipment, low-flow fixtures, commissioning, and electric vehicle charging stations for light-duty and heavy-duty electric vehicles. Charging facilities should be considered as part of the Yards Accommodation strategy and implementation.
87. Review the feasibility and availability of funding programs for installing solar or other renewable and alternative energy technologies on City-owned land or in City-owned facilities.
88. Continue to pursue permission to use WWTP digester gas to allow for full utilization of the landfill gas co-generation facility.

Table 27 Actions related to advanced technologies and energy efficiency standards (2022-2024)

89. Pilot projects using alternatives to fossil fuels to assess the broader applicability e.g. converting the City greenhouse boiler to GSHP technology, electric pick-up trucks and heavy-duty electric vehicles (including transit vehicles).
90. Standardize energy provisions for all projects to include at budget stage e.g. alternatives to fossil fuels, LED lighting/controls, high-efficiency equipment, low-flow fixtures, commissioning, and electric vehicle charging stations.
91. Pilot projects installing solar or other renewable and alternative energy technologies on City-owned land or in City-owned facilities.
92. Review feasibility of food organic (green bin) anaerobic digestion and processing facility to allow for full utilization of the landfill gas co-generation facility.
93. Updating of advanced technologies and energy efficiency standards (every 5 years).

Capital costs

Details of the incremental cost associated with all of the actions need to be developed and refined over the duration of the plan. Table 28 provides an estimate of the funding required to meet the targets set out in the plan based on a typical cost for energy savings of 0.25 $/kWh. Actual funding needs will require additional assessment of projects and their associated costs, and may be significantly different from those shown here.

These costs also do not account for any renewable energy generation that the City may choose to install.

Table 28 Preliminary estimates of costs of implementing the plan by year

Source	2020	2021	2022	2023	2024
Buildings - electricity	$43,000	$86,000	$86,000	$86,000	$86,000
Buildings - gas	$49,000	$98,000	$98,000	$98,000	$98,000
Water - electricity	$47,000	$70,000	$70,000	$47,000	$47,000
Water - gas	$12,000	$24,000	$24,000	$24,000	$24,000
Wastewater - electricity	$46,000	$115,000	$115,000	$230,000	$230,000
Wastewater - gas	$7,000	$13,000	$13,000	$13,000	$13,000
Fleet transit (ML)	$0	$0	$0	$0	$0
Fleet non-transit (ML)	$19,000	$37,000	$37,000	$37,000	$37,000
Streetlights	$95,000	$142,000	$142,000	$142,000	$142,000
Overall electricity	$230,000	$410,000	$410,000	$510,000	$510,000
Overall natural gas	$70,000	$140,000	$140,000	$140,000	$140,000
Overall diesel and gasoline	$20,000	$40,000	$40,000	$40,000	$40,000
Total	**$320,000**	**$600,000**	**$600,000**	**$700,000**	**$700,000**

Renewables and alternative energy

Brantford makes use of two kinds of renewable energy: landfill gas and biogas generated at the wastewater treatment plant (WWTP).

LANDFILL GAS

The City operates a landfill gas recovery program that collects landfill gas and uses it to drive a cogeneration unit that generates electricity. Electricity generated by the facility is sent to the Ontario grid. The project was developed under the Renewable Energy Standard Offer Program (RESOP), an incentive program – no longer offered – that made it easier for small renewable energy generating facilities to participate in the electricity supply system by providing a stable pricing regime under a 20-year contract.

In addition to generating useable energy from an otherwise wasted resource, burning the landfill gas significantly reduces greenhouse gas emissions since the primary component of landfill gas – methane – contributes about 25 times as much to climate change as the carbon dioxide that results from its combustion.

Over the last three years, significant quantities of gas were collected, as shown on Table 29.

Table 29 Landfill gas collection and electricity generation

Year	Gas collected (m3)	Electricity generated (kWh)
2016	4,847,134	6,545,905
2017	3,608,630	5,584,901
2018	4,535,955	7,585,006

Waste heat from the cogeneration facility is not being used.

BIOGAS

The Brantford wastewater treatment plan (WWTP) uses anaerobic digestion to treat the waste, and this results in biogas, which is primarily methane; the typical composition of biogas is about 60% methane.(Environment and Climate Change Canada, 2019b) About 35% of the biogas generated is used for heating the plant. Generation and use are shown on Table 30.

Table 30 Biogas generated and used at the wastewater treatment plant, energy and volume

Year	Gas generated (eGWh)	Gas used (eGWh)	Gas generated (m3)	Gas used (m3)
2014	11.8	6.1	1,846,775	959,200
2015	11.7	7.1	1,831,525	1,110,956
2016	9.8	4.6	1,542,002	722,091
2017	9.1	3.9	1,430,003	618,333
2018	10.0	4.6	1,563,140	716,690

Note: assumes gas is 60% methane

Unused biogas is being flared, which converts the methane to carbon dioxide. As this carbon dioxide is deemed to come from short-cycle carbon, rather than fossil carbon use, this carbon dioxide is generally not considered a contributor to climate change.

The wastewater treatment plant is in close proximity to the landfill and the unused biogas could be used to generate electricity in the landfill gas cogeneration facility, however this is not permitted by the RESOP contract. Ways of addressing this contractual barrier are being explored.

Findings and conclusions

The City of Brantford did not meet the energy intensity target set out in the previous plan. Although some important projects were undertaken, they were not sufficient to reduce demand according to the expectations. A major reason was the significant increase in use related to the expanded Wayne Gretzky Sports Centre (WGSC), which opened after the targets were established.

Facilities other than WGSC did realize substantial savings. Costs to the City would have been substantially higher in the absence of these initiatives.

City staff identified three barriers to achieving greater energy reductions:

- Unclear distribution of the responsibility for realizing energy savings
- Limited availability of resources to undertake initiatives, including staff time and financial resources
- Staff do not have good information on the patterns and sources of energy use, and therefore where action should be taken.

Although targets were not set for water and wastewater energy use, substantial savings were also realized in these areas. Water treatment had a 19.9% reduction in energy use per volume treated, and reductions in energy use per volume of treatment were also realized for the wastewater treatment operations.

Since the plan was established in 2014, there are additional compelling reasons for the City to adopt more aggressive targets for energy savings and emissions reduction. These include:

- There remain significant opportunities to realize cost-effective energy savings by investing in energy efficiency. In many cases, this does require up-front capital investment to realize the stream of savings that follow.
- Energy prices continue to be volatile and represent both a significant cost and a significant risk to the City. Electricity supply constraints are anticipated as early as 2023, and these – along with the province's curtailment of energy efficiency programs are likely to create upward pressure on prices. Natural gas and fuel prices are at historically low levels and can only be expected to increase. In addition, costs of climate change will increasingly be internalized into the price of those fuels; the federal government has already announced that fees on carbon will increase to 50 $/t by 2022.
- The climate change crisis is recognized as even more severe than it was in 2014, with the adoption by the world's nations of the Paris Agreement, major analyses by the Intergovernmental

Panel on Climate Change on the need for action, and huge increases in costs of insurance claims for damages that can be attributed to climate change.

- As mentioned above, the provincial government has already announced that several energy efficiency programs that could have benefitted the City have been cancelled. It is unclear whether funding available to the City now will still be available after 2020.

The plan sets out a series of actions to address the barriers encountered in meeting the previous targets, and that will be important in meeting newer, more aggressive targets. These actions include:

- a renewed commitment from Council and senior management to recognize energy efficiency and greenhouse gas reductions as a priority
- the hiring of a new Climate Change Officer to take overall responsibility for ensuring that actions in the plan are addressed
- establishment of an interdepartmental committee and assignment of responsibilities within individual facilities to ensure that energy efficiency and emissions reduction are seen as a priority
- provision of additional financial resources to meet the new targets.

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Appendix A. Present state

Attached are tables showing energy use in Brantford facilities from 2011 to 2018. Spark lines help to illustrate the trends.

Also attached is a table showing Brantford facilities relative to provincial values reported to the Broader Public Sector (BPS) reporting for 2016, the most recent year for which data are available. These data are values from the Ministry of Energy, Northern Development and Mines after doing some clean-up of the database. The benchmarks for water and wastewater facilities are from an analysis by Prosperity Group, which also drew on 'cleaned' BPS data. (Prosperity Group, 2018)

Energy use by Brantford facilities

Facility	2011	2012	2013	2014	2015	2016	2017	2018	
1. Sanitary Pumping Station	369,900	353,340	370,980	386,640	259,560	298,620	289,260	250,920	
2. Sanitary Pumping Station	55,080	48,000	47,357	53,067	50,893	48,890	45,191	55,443	
3. Sanitary Pumping Station	100,440	88,320	94,944	104,735	97,303	79,431	90,642	78,931	
4. Sanitary Pumping Station	203,640	209,160	247,560	253,440	234,960	169,560	215,520	227,280	
5. Sanitary Pumping Station	92,520	73,260	77,362	74,431	70,205	63,818	69,468	73,544	
6. Sanitary Pumping Station	32,520	34,108	34,253	35,499	27,046	24,023	21,466	30,536	
7. Sanitary Pumping Station	53,648	40,953	53,479	50,941	41,447	36,287	38,388	41,848	
8. Sanitary Pumping Station	26,640	24,720	30,855	31,645	31,105	22,669	28,821	30,448	
9. Storm Pumping Stations	435,900	433,290	171,108	433,707	395,802	401,112	360,339	316,396	
Ambulance Station	97,191	85,442	86,249	113,906	100,174	77,613	81,543	106,609	
Arnold Anderson Stadium	10,466	17,965	35,760	37,800	41,280	32,040	28,680	27,360	
Arrowdale - Pro shop	49,044	36,754	35,671	38,180	39,266	31,678	35,589	35,465	
Arrowdale Club House	114,436	85,759	83,229	89,086	91,620	73,916	83,041	82,751	
Bell Homestead- Henderson	51,788	42,176	44,295	51,294	46,601	43,964	42,795	49,379	
Bell Homestead- Main Facility Complex	52,832	43,210	45,369	49,912	45,883	44,418	43,808	49,728	
Bell Homestead- Reception	83,417	63,583	76,891	89,870	78,812	63,574	65,434	79,575	
Beryl Angus Child Care	115,591	103,959	121,840	129,287	119,376	116,500	100,553	48,294	
Airport - Records Building	120,365	76,828	59,364	112,013	102,994	92,625	88,968	112,101	
Brantford Public Library	922,887	796,619	762,205	945,292	856,640	809,912	783,383	929,532	
City Hall	2,215,812	1,903,397	1,993,228	1,816,847	1,664,893	1,473,718	1,356,142	1,470,690	
Civic Centre	2,687,278	2,748,002	2,742,269	3,098,227	2,797,319	2,649,921	2,557,610	2,586,958	
Eagle Place Community Centre	330,887	240,944	266,851	316,175	308,440	234,265	250,469	316,050	
Earl Haig	114,959	173,425	210,686	117,516	112,648	134,512	143,736	126,817	
Farmer's Market	235,924	254,318	245,499	277,701	256,031	244,725	220,673	248,121	
Fire Hall - 1	429,570	498,442	456,952	460,388	429,157	411,104	418,817	509,975	
Fire Hall - 2	107,602	98,944	112,731	113,702	102,121	92,904	97,626	118,556	
Fire Hall - 3	149,452	138,600	168,392	209,906	173,693	179,774	130,414	169,693	
Fire Hall - 4	217,963	194,244	212,233	237,708	233,408	193,734	204,621	244,587	
Glenhyrst Art Gallery- Coach House	84,534	91,927	105,637	66,237	65,215	58,673	58,240	72,523	
Glenhyrst Art Gallery- Main Building	84,534	91,927	105,637	66,237	84,462	131,406	149,485	165,150	
Harmony Square Garage	32,003	20,513	23,912	156,826	138,965	163,732	158,326	170,971	
Herbert Street Storage	46,420	33,373	34,960	34,308	27,897	42,724	56,664	82,388	
IT & Hydro Building	774,325	690,357	777,699	868,367	911,448	855,095	816,915	873,742	
Landfill Administration Building	31,535	28,499	29,137	34,037	31,080	30,413	15,063	-	
Landfill Scale House	5,458	4,970	5,635	7,599	7,159	6,222	6,596	7,458	
Lions Park	953,939	937,815	897,516	967,359	921,912	901,355	942,623	955,248	
Market Parkade	43,590	43,329	684,432	416,880	395,802	401,112	360,339	316,396	
Market Square Mall	1,051,118	1,015,338	1,004,290	1,274,835	887,572	873,649	729,570	774,335	
Mohawk Park Pavillion	218,799	180,931	181,276	207,387	208,844	153,649	152,602	167,235	
Mt. Hope Cemetery	50,009	44,026	47,848	54,319	52,365	46,656	42,906	46,381	
Northridge Golf Course - Club House	530,551	468,946	459,620	290,088	367,484	362,880	339,830	351,001	
Northridge Golf Course - Pro Shop	112,095	116,790	125,084	87,664	109,540	114,273	83,440	99,047	
Oakhill Cemetery	99,776	81,332	93,738	101,753	95,667	102,032	93,283	119,031	
Parks Head Office Buildings A	180,644	157,425	169,050	192,265	186,156	170,559	156,852	154,881	
Parks Head Office Buildings B	56,714	49,909	52,962	62,775	55,218	51,238	59,848	66,494	
Parks Workshop	76,374	69,230	59,190	77,171	62,358	56,487	61,566	71,018	
Police HQ	3,051,458	2,597,126	2,867,214	2,585,370	2,386,495	2,395,655	2,252,813	2,337,992	
Pollution Control / Facilities Group	366,977	301,406	393,831	379,707	374,014	351,648	297,402	394,654	
Provincial Offense Courthouse	451,909	364,923	482,347	543,883	507,148	456,913	427,061	454,907	
Public Works Yard	712,454	885,430	1,210,537	1,423,055	1,192,638	1,154,901	1,223,329	1,438,887	
Pumping Station Booster	61,600	55,200	61,600	64,000	60,800	55,200	60,800	60,000	
Sanderson Centre	991,618	811,047	868,632	843,524	781,456	440,384	426,464	446,322	
St. Paul Library	216,695	175,634	217,512	234,710	211,833	187,916	200,524	216,797	
T.B Costain Community Centre	465,174	390,828	457,367	496,356	443,579	397,190	423,809	471,285	
Traffic Services	524,259	443,724	456,406	568,379	557,588	433,111	422,953	500,611	
Tranquility Hall	33,794	56,312	58,378	66,988	76,233	41,085	47,354	76,425	
Transit Garage	2,148,678	2,028,230	2,479,856	2,628,467	3,316,126	1,952,675	2,085,077	2,494,130	
Transit Terminal	186,290	181,199	179,285	210,893	155,084	120,244	140,492	173,443	
Visitor & Tourism Centre	432,215	364,333	403,129	460,422	414,756	393,989	371,910	382,300	
Waste Water Treatment Plant	8,736,495	8,969,434	8,766,006	10,149,569	9,371,715	9,475,727	10,428,518	10,270,838	
Water Pumping Station & Reservoir A	1,024,281	1,022,096	2,543,961	1,225,611	1,215,415	1,205,374	1,213,416	1,259,836	
Water Pumping Station & Reservoir B	1,102,019	1,185,314	1,147,894	1,098,868	1,068,955	1,029,892	865,170	825,165	
Water Pumping Station & Reservoir C	647,426	666,198	540,764	619,946	592,824	599,624	672,085	658,789	
Water Treatment Plant	8,929,460	9,082,822	9,664,910	9,669,031	9,587,189	9,295,569	9,325,294	9,081,990	
Wayne Gretzky Centre	11,456,418	12,045,224	13,056,821	13,994,493	15,301,919	16,533,869	17,905,036	17,992,147	
Woodman Community Centre	353,137	307,220	360,670	388,362	361,950	358,733	373,266	288,103	
TOTALS	**55,965,238**	**55,118,582**	**59,962,355**	**62,346,656**	**61,395,535**	**59,547,161**	**61,339,920**	**62,735,504**	

Table 31 Benchmarking Brantford facilities against other Ontario facilities

Operation type (buildings)	Provincial mean 2011 (eWh/HDD/ft²)	Provincial median 2016 (eWh/HDD/ft²)	Brantford mean 2011 (eWh/HDD/ft²)	Brantford mean 2016 (eWh/HDD/ft²)	Brantford vs Provincial Mean 2011 (%)	Brantford vs Provincial Median 2016 (%)
Administrative offices	8.39	6.20	5.90	6.26	70%	101%
Ambulance stations	9.15	8.10	6.53	5.44	71%	67%
Community centres	6.78	5.00	5.56	5.98	82%	120%
Cultural facilities	7.18	5.10	5.04	3.85	70%	75%
Fire stations	6.97	5.40	7.41	7.26	106%	134%
Indoor recreational facilities	10.19	7.40	11.93	29.25	117%	395%
Police stations	9.67	7.90	12.31	10.08	127%	128%
Public libraries	7.11	6.40	6.97	4.09	98%	64%
Storage facilities or garages	8.19	5.80	4.55	5.66	56%	98%
Operation type (water and sewage)	**Provincial mean 2011 (ekWh/ML)**	**Provincial mean 2016 (ekWh/ML)**	**Brantford mean 2011 (ekWh/ML)**	**Brantford mean 2016 (ekWh/ML)**	**Brantford vs Provincial Mean 2011 (%)**	**Brantford vs Provincial Mean 2016 (%)**
Pumping of sewage	300	197	322	126	107%	64%
Pumping of water	659	244	654	398	99%	163%
Treatment of sewage	1047	851	597	812	57%	95%
Treatment of water	1207	307	711	787	59%	256%

Sources: Ontario Ministry of Energy, Northern Development and Mines (except as noted)
Prosperity Group, 2018 (2016 mean values for sewage and water operations)
2016 sewage and water operations are for large facilities, in case of sewage treatment anaerobic facilities

Appendix B. Municipal experience and best practices

This section reviews energy plans of nearby and leading jurisdictions. It reviews city energy initiatives for: The Town of Oakville, the City of Guelph, the City of Vancouver, and the City of Portland, Oregon.

These jurisdictions set targets and robust metrics that exceed provincial or state requirements and align with planetary boundaries. The ACEEE publishes a report on *City Energy Efficiency Scorecard* (Ribeiro et al., 2017). This report discusses local policies and actions advancing energy efficiency. Within the report, the energy efficient scoreboard compares and ranks cities across five policy areas:

- Local government operations
- Community-wide initiatives
- Building policies
- Energy and water utilities
- Transportation policies.

The city energy efficiency scorecard measures the progress of city policies and programs that save energy, benefiting the environment and economic growth. The report offers recommendations and strategies on how cities can improve on energy efficiency. The following strategies are recommended by ACEEE:

1. Adopt policies and plans to save energy in public sector buildings and fleets;
2. Include opportunities for improving energy plans, revisit timelines, set energy-saving targets, and allow the public access to energy information;
3. Ability to track, manage, and communicate energy performance;
4. Adopt stringent building codes, require energy audits, and implement energy performance requirements for building types;
5. Form partnerships with energy and water utilities to expand access to energy efficiency programs; and
6. Promote location-efficient development and improve access to decrease transportation energy usage.

Notable features of the plans reviewed are summarized in Table 9. There are municipalities that do not differentiate or fully separate between corporate and community responsibilities. Examples include the City of Vancouver and the City of Portland, Oregon. However, the overlapping of actions has allowed for effective implementation and action on energy management. After reviewing available resources within North American municipalities and cities, having a Sustainability Coordinator role that reports directly to the Chief Administrative Officer has been effective for recognizing the importance of building relationships among departments and bringing awareness to corporate energy management. Within Ontario, The City of Markham, The City of Barrie, and The City of Pickering has included this role within their city department.

Table 32 Energy conservation and best practices in the Town of Oakville, the City of Guelph, the City of Vancouver, and the City of Portland, Oregon.

Targets	Initiatives to reach goals and targets	Documents
Town of Oakville, Ontario, Canada		
o Achieve a 15% reduction of 2012 baseline energy use by 2019. o Under the corporate greenhouse gas emission reduction target update (2015-2050) the town set a corporate GHG emission reduction target of 80% below 2014 levels by 2050. o A corporate greenhouse gas per capita emission reduction of 20% below 2014 levels by 2030 & sub targets: I. 30% per capita reduction in building emissions from 2014 levels by 2030 II. 10% per capita reduction in fleet emissions from 2014 levels by 2030 III. 40% per capita reduction in streetlight emissions from 2014 levels by 2030	o Started a Drive Smart campaign for all staff, and energy efficiency driver-training program. o Installed solar PV on four town facilities: Town Hall, Glen Abbey Community Centre, River Oaks Community Centre and Sixteen Mile Sports Complex. o Installed a high-efficiency vertical geothermal bore field system in the LEED certified Oakville Transit building. o Through the Ontario Power Authority's Feed-In Tariff program, a unique project of 500-kW capacity rooftop solar array was created at Oakville-Trafalgar Memorial Hospital. The power generated will provide $6.35 million in revenue to the hospital over a 20-year period and achieved gold certification after earning 39 credits in the green building system. o Converted existing streetlights to LED bulbs, and made improvements to buildings, meeting the LEED silver certification or exceeding it. o Over the past few years, Town of Oakville Sixteen Mile sports complex and office spaces have achieved LEED Gold certifications. o Town staff and departments are required to follow the Sustainable Green Fleet Procedure on fleet greening to assist the Town's GHG emission reduction goals, reduce the use of non-renewable resources and improve fuel efficiency.	Energy Conservation and Demand Management (2014-2019) (Toth, Virdi, & Simcisko, 2014). Sustainable Green Fleet Procedure (Town of Oakville, 2019).

City of Guelph, Ontario, Canada		
o City corporate operations will be powered by 100% renewable energy by 2050.	o Added 10 hybrid gas-electric cars to City fleet (half of the City's fleet of cars). o From 2013-2016, the City completed 8 facility retrofits. o In 2015, The City ran a pilot to transition to LED street lights. After its success, in 2017 Council approved switching 13,119 street lights to LEDS. o The City has added a biogas-fueled cogeneration plant at the City's wastewater treatment plant. o Guelph Transit uses biodiesel in its fuel supply, and rainwater harvesting in bus washing operations. o **Based on progress review, energy use and emissions are expected to remain the same in 2050 as they are today in Guelph.**	Corporate Energy Business Plan (2013, City of Guelph).

The City of Vancouver, BC, Canada		
○ Under the Renewable City Strategy (2015-2050) the City plans to derive 100% of the energy from renewable sources before 2050. ○ Reduce greenhouse gas emissions by at least 80% below 2007 levels before 2050. ○ Buildings constructed from 2020 and onwards are to be carbon neutral in operations (To date there has been a decrease of 5% from the baseline value). ○ By 2030, 55% of energy use in Vancouver is derived from renewable sources.	○ Vancouver became the first city in Canada with a strategy that shifts to 100% renewable energy. ○ The City has implemented a comprehensive corporate waste reduction and diversion program for all City facilities ○ Achieved a 70% waste diversion in public-facing City facilities, and 90% waste diversion in all other City-owned facilities. ○ The City has implemented a program to significantly reduce greenhouse gas emissions as well as fossil fuel use in City-run buildings and vehicles and achieve carbon-neutral operations. ○ Upgrades to City facility lighting, building automation systems, and heating systems have resulted in significant energy savings and a reduction in GHG emissions. ○ The City had a 25% decrease in water use in City operations since 2006. ○ The City has fitted 107 idle-stop devices to its fleet vehicles to limit emissions form idling, and since 2008 has cut fleet emission by 10% and overall corporate emissions by 25%. ○ The City has a sustainable commuting program that offers incentives to City employees to engage in active transportation when travelling to and from work. The program is funded through a parking charge. ○ The City promotes efficient driving practices through driver training and staff education, “idle-free” signs, idle cut-offs to three minutes, a complete “no air conditioning” policy. ○ The corporate solid waste diversion program has a scope that includes zero waste meetings, zero waste and reduced consumption procurement, and waste minimization for all operations, programs and projects.	The Greenest City: 2020 Action Plan (2015, City of Vancouver). Renewable City Action Plan (2017, City of Vancouver). Renewable City Strategy (2015, City of Vancouver). Zero Waste 2040 (2018, City of Vancouver).

The City of Portland, Oregon, United States		
○ Under the 2030 Environmental Performance Objectives, the City aims to reduce carbon emissions form City operations by 53% below previous levels. ○ Set a 2030 target to annually generate or purchase 100% of all electricity for City operations from renewable resources. ○ Set a 2030 target of reducing fleet vehicle carbon emissions 10% below previous levels. ○ Set a 2030 goal of recovering 90% of waste from City operations, with a secondary goal of reducing total waste from City operations 25% below previous levels. ○ Set a target to reduce the total energy use of all buildings built before 2010 by 25%. ○ Set a target to supply 50% of all energy used in buildings from renewable resources, with 10% produced within Multnomah County from on-site renewable sources. ○ Set a target to reduce energy use in City and county government buildings by 2% annually (exceeded this goal by achieving a 2.7% reduction per year). ○ Set a target to reduce the lifecycle carbon emissions of fuels by 20% ○ Set a 2030 target to ensure that 80% of City-managed natural areas are in "healthy" or good condition.	○ The City of Portland has been working on the City Energy Challenge to cut energy use and save money in City operations. To date, completed energy efficiency improvements saved $5.5 million dollars each year. Cumulative savings have reached $42 million. ○ Since 2009, the City has installed 17 renewable energy systems which include biogas, solar electric, hydro, wind, solar hot water, and solar pool heating totaling 2,484 kW installed capacity. ○ In 2015, City Council adopted Resolution 37153 that added fossil fuel companies to the City's Corporate Securities do-not-buy list, committing the City to hold no financial stake in the 200 largest fossil fuel firms. ○ The City of Portland reduced city fleet emissions to 23% below previous levels, exceeding the 2030 Environmental Performance Objective. This decrease can be attributed to: an increase in use of low carbon fuels and new sources of biofuel. ○ City policy sets an ethanol and biodiesel use standards for all corporate vehicles. ○ The City used high blends (from 20 to 99 %) of regionally produced biodiesel in their diesel-powered vehicles and equipment since 2007. ○ The City's feet contain flex fuel vehicles that can run on gasoline blends containing 85% ethanol. ○ Exemplary transportation policies include mode share, vehicle-miles-traveled reduction goals, as well as several efforts to increase local efficiency.	2015 Sustainable City Governance Principles and 2030 Environmental Performance Objectives (2015, City of Portland). Portland Climate Action Plan (2015, City of Portland). Climate Action Through Equity (2016, City of Portland). Green Building Policy (2009, City of Portland). Sustainable Procurement Policy (2018, City of Portland). Idle Reduction Policy (2009, City of Portland). Biofuels Requirements for Petroleum-Based Fuels Sold in Portland and City-Owned Vehicles (2006, City of Portland).

The cities and towns identified in Table 32 are leaders in energy management because their plans go above and beyond the ability to identify potential improvements, building performance and alternative forms of energy. To achieve desired targets most towns and cities have developed strategies with specific actions that are ranked based on priority. The City of Guelph for example, has integrated these actions into its annual savings. Constant monitoring and benchmarking have led to effective energy conservation and cost savings. Having defined tasks and follow-through have allowed for effective progress on energy use and greenhouse gas emissions.

In addition, having energy management responsibilities distributed within departments facilitates successful plan implementation. The Town of Oakville has two people that would fall under the corporate banner for energy management, and an additional staff member that manages the Community Energy Plan.

B.1. SUMMARY OF KEY SUCCESS FACTORS

- A supportive council;
- Distributed energy responsibility among staff;
- Full implementation of energy monitoring and tracking system; and
- Adopting a robust methodology for establishing realistic energy reduction targets.

Appendix C. Financial incentives

This section describes the financial incentives that are available to the City of Brantford. These incentives include:

- utility incentives for electricity savings offered by the Independent Electricity System Operator (IESO)
- utility incentives for natural gas savings offered by Union Gas,
- those offered at the federal level,
- incentives offered by The Atmospheric Fund.

The City of Brantford can take advantage of these incentives to implement some of the suggested technical measures. Forming partnerships with energy utilities allows for the expansion and access to energy efficiency programs within the City.

C.1.INDEPENDENT ELECTRICITY SYSTEM OPERATOR (IESO)

Full details are available at: **https://saveonenergy.ca**.

Retrofit Program

The Retrofit programs provides incentives for electricity savings from lighting retrofits, lighting controls, HVAC redesigns, chiller replacements, variable speed drives, or improvements on thermal performance of a building envelope. There are two types of project applications: Prescriptive Track and Custom Track.

Process & Systems Program

This program provides incentives for innovative changes, equipment retrofits, financial assistance for engineering studies, technical expertise from energy managers.

Energy Performance Program

This incentive is ideal for improving the energy performance of an entire building.

C.2.UNION GAS

Full details are available at:

https://www.uniongas.com/business/save-money-and-energy/equipment-incentive-program

The Equipment Incentive Program

This program can help reduce costs, increase energy efficiency, and improve the return on investment for equipment related to space heating.

Incentive	Requirements	Incentive
Air curtains	Up to $4,000 per door	Natural gas heating, replacements not eligible
Condensing boilers	Up to $500 per unit in new construction Up to $6000 in existing buildings	Space or water heating, thermal efficiency >90%
Condensing make-up air units	Up to 0.40 $/CFM per unit (for unit with variable frequency drive) VFD bonus of $2500 for units over 5,000 CFM	Between 1500 and 14,999 CFM At least 90% thermal efficiency
Condensing unit heaters	$750 per unit	At least 90% thermal efficiency
Condensing furnaces	$200 per unit	AFUE ≥ 95% Non-residential Not part of a system with rooftop units or make-up air units
Demand control ventilation systems	$500 per roof top unit or make-up air unit with a CO_2 sensor	Natural gas space heating, single zone systems
Destratification fans	$1,000 per unit	Where there are ≥25′ ceilings with ceiling mounted natural gas forced air heating systems High-velocity low-speed fans of ≥20 foot diameter
	Up to $1.75 for new ERVs, or $1.15 for replacement ERV or new ERV required by code	Heat recovery effectiveness of at least 65% No demand control ventilation

Incentive	Requirements	Incentive
Energy & heat recovery ventilators (ERV)		
Infrared heaters	Up to $400 per unit	≤kBtu/h

Custom Engineering Incentive Program

The custom engineering incentive program that helps fund studies and pilots to identify energy-saving opportunities.

Engineering Energy Efficiency Feasibility Study

This financial incentive is for studies that analyze existing buildings to determine how to optimize energy.

New & Retrofitted Equipment and Process Optimization

This incentive will help fund projects that range from implementing boilers, high efficiency process equipment, building and process controls and building envelope technologies.

The Runsmart Building Optimization

The program offers incentives for retrofits that are low cost and/or no cost energy savings measures and activities that improve a building's natural gas use such as by reducing excessive exhaust quantities.

C.3.FEDERAL INCENTIVES

Full details are available at:

https://fcm.ca/en/programs

https://www.nrcan.gc.ca/cleangrowth/20254

The Federal Government of Canada offers funding, grants and incentive programs to encourage energy innovation, a clean economy, and to promote climate change action. The Federation of Canadian Municipalities (FCM) offers programs and tools to help municipalities build stronger communities. FCM supports a variety of opportunities such as plans, studies, pilot projects, capital projects, asset management grants, and partner grants. Additionally, through Natural Resource Canada's (NRCan) Innovation and Clean

Growth Programs, there are incentives for projects that support key energy innovative areas. Below is a description of each.

The Green Municipal Fund-Energy

Full details are available at:

https://fcm.ca/en/funding/gmf/pilot-project-retrofit-municipal-facilities

https://fcm.ca/en/funding/gmf/study-energy-recovery-district-energy

This program funds studies, pilot and capital projects for different environmental sectors. Both grants and loans are available for municipal projects. Recipients can receive additional grant of up to 15 percent of their loan amount. The Green Municipal Fund can fund pilot projects of retrofits that improve energy efficient by at least 30% in municipal facilities or provide the funding for capital projects where renewable thermal energy is used in new or existing facilities, to help the city reduce its greenhouse gas emissions.

The Green Municipal Fund-Reduce fossil fuel use in fleets

Full details are available at:

https://fcm.ca/en/funding/gmf/capital-project-reduce-fossil-fuel-use-fleets

This program is available for capital projects that avoid or reduce the use of fossil fuels in municipally owned vehicles and private vehicles delivering municipal services. Regular loans and grants can fund up to 80% of eligible costs. High-ranking projects loans and grants include a low-interest loan of up to $10 million and a grant worth up to 15% of the loan. This program is available for projects that reduce greenhouse gas emissions by 20% compared to an existing baseline measurement. Funding from this program can help municipalities fully transition to alternative fuel consumption.

2019 Federal Budget: Making zero-emissions vehicles more affordable

Full details are available at:

https://www.tc.gc.ca/en/services/road/innovative-technologies/zero-emission-vehicles.html

The 2019 federal budget proposes strategic investments for Canadians to choose zero-emission vehicles. The government will provide $300 million over the next three years to Transport Canada for the administration of a new program. Transport Canada will introduce a federal incentive of up to $5,000 for electric battery or hydrogen fuel cell vehicles with a manufacturer's suggested retail price of less than $55,000. This funding can aid municipalities in greening their corporate fleets.

Electric Vehicle Infrastructure Demonstrations

Full details are available at:

https://www.nrcan.gc.ca/energy/funding/icg/18386

The Electric Vehicle Infrastructure Demonstrations are available for projects that need to investigate and understand the impacts and potential hurdles in the deployment of the next generation of charging infrastructure for electric vehicles.

The Low Carbon Economy Fund

Full details are available at:

https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund.html

The Low Carbon Economy Fund supports the Pan-Canadian Framework on Clean Growth and Climate Change by leveraging investments in energy efficiency projects. The fund is designed to support projects that will generate clean growth, reduce greenhouse gas emissions, and align with Canada's Paris Agreement commitments. The fund is made up of two components:

1. Low Carbon Economy Leadership Fund
2. The Low Carbon Economy Challenge

The Low Carbon Economy Leadership Fund provides up to $1.4 billion dollars to provinces and territories that have adopted the Pan-Canadian Framework. This funding is available for projects that will help reduce greenhouse gas emissions. Based on population, both provinces and territories are eligible to receive $30 million plus for projects.

Similarly, the Carbon Economy Challenge can fund up to $500 million dollars for projects across Canada that adopt the Pan-Canadian Framework, reduce greenhouse gas emissions, and generate clean growth.

C.4.THE ATMOSPHERIC FUND INCENTIVES

High-Performance Buildings

Full details available at: **http://taf.ca/grants/high-performance-buildings/**

TAF furthers its goal of lowering regional emissions by offering grants. Among other criteria, the High-Performance Building program funds projects that increase the energy efficiency of existing buildings by:

- demonstrating innovative approaches to improving the energy efficiency of new construction;
- striving for near net-zero energy consumption;
- advancing policy and financing approaches to facilitate and scale energy-efficiency retrofits; and
- piloting demonstrations of promising energy efficiency and zero-emissions building technologies and management approaches.

Clean Transportation

Full details available at: **http://taf.ca/grants/clean-transportation/**

The Clean Transportation program supports high-impact solutions to electrification, shared mobility, and public transit investment. The grant is for applicants who go above

and beyond and offer solutions that provide co-benefits such as improved affordability and increasing the local job market are seen as more desirable.

Appendix D.Conversion and emission factors

Energy density of fuels

Energy source	To convert	to	multiply by	Reference
Natural gas	m3	ekWh	10.63	a
Natural gas	m3	MJ	38.26	a
Diesel	L	MJ	38.35	b
Diesel	L	ekWh	10.6527778	c
Gasoline	L	MJ	33.45	b
Gasoline	L	ekWh	9.29166667	c
Any energy source	kWh	MJ	3.6	b
Any energy source	MJ	ekWh	0.27777778	c

Global Warming Potential

GHG	CO2	CH4	N2O	Reference
GWP	1	25	298	d

Note: 100-year GWPs

Emissions of Ontario fuels

Fuel	CO2	CH4	N2O	CO2eq	Reference
Natural gas (g/m3)				1,890.6270	a
Propane (non residential g/L)				1,540.9840	a
Diesel (g/L)	2681	0.133	0.4	2,804	e
Motor gasoline (g/L)	2307	0.1	0.02	2,315	e
Propane vehicles (g/L	1515	0.64	0.028	1,539	e

CO_2eq is the sumproduct of the emission factor of each contaminant and the global warming pote

GHG intensity of Ontario electricity (g CO_2eq/kWh)

Year	Generation intensity	Reference	Consumption Intensity	Reference
2011	98.04	a	110	f
2012	96.096	a	110	g
2013	76.012	a	80	g
2014	40.011	a	40	g
2015	35.011	a	40	g
2016	35.548	a	40	g
2017	17.298	a	20	g
2018	17.298	g	20	h

Sources:

a. (A. Kirschbaum, personal communication, May 6, 2019).
b. (Statistics Canada, 2018), p.130
c. Calculated
d. (Environment and Climate Change Canada, 2019b). Part 1, p.18
e. (Environment and Climate Change Canada, 2019b). Part 2. p.226
f. (Environment and Climate Change Canada, 2018), Part 3, p.69
g. (Environment and Climate Change Canada, 2019b), Part 3, p. 65
h. 2017 values assumed for 2018

Appendix E. Conservation demand management plan checklist

The checklist below can be used to ensure that all of the required elements have been included in the CDM plan.

- ☐ The Energy use and Greenhouse Gas Emissions Template that is required to be submitted and published on or before July 1 of that year. For the first plan this will be the 2019 template
- ☐ A description of current and proposed measures for conserving and otherwise reducing energy use and managing demand for energy
- ☐ A revised forecast of the expected results of the current and proposed measures
- ☐ A report of the actual results achieved
- ☐ 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
- ☐ Cost and saving estimates for its proposed measures
- ☐ The estimated length of time the public agency's energy conservation and demand management measures will be in place
- ☐ 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
- ☐ A description of:
  - ☐ The ground source energy harnessed, if any, by ground source heat pump technology operated by the public agency
  - ☐ The solar energy harnessed, if any, by thermal air technology or thermal water technology operated by the public agency

- The proposed plan, if any, to operate heat pump technology, thermal air technology or thermal water technology in the future

- Confirmation that the energy conservation and demand management plan has been approved by the public agency's senior management

- The CDM plan has been made publicly available by:

  - Publishing it on the public agency's website (if there is one)
  - Publishing it on the public agency's intranet site (if there is one)
  - Making it available to the public in printed form at the head office

SOURCE: Ontario Ministry of Energy, 2013 pg. 29-30.

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