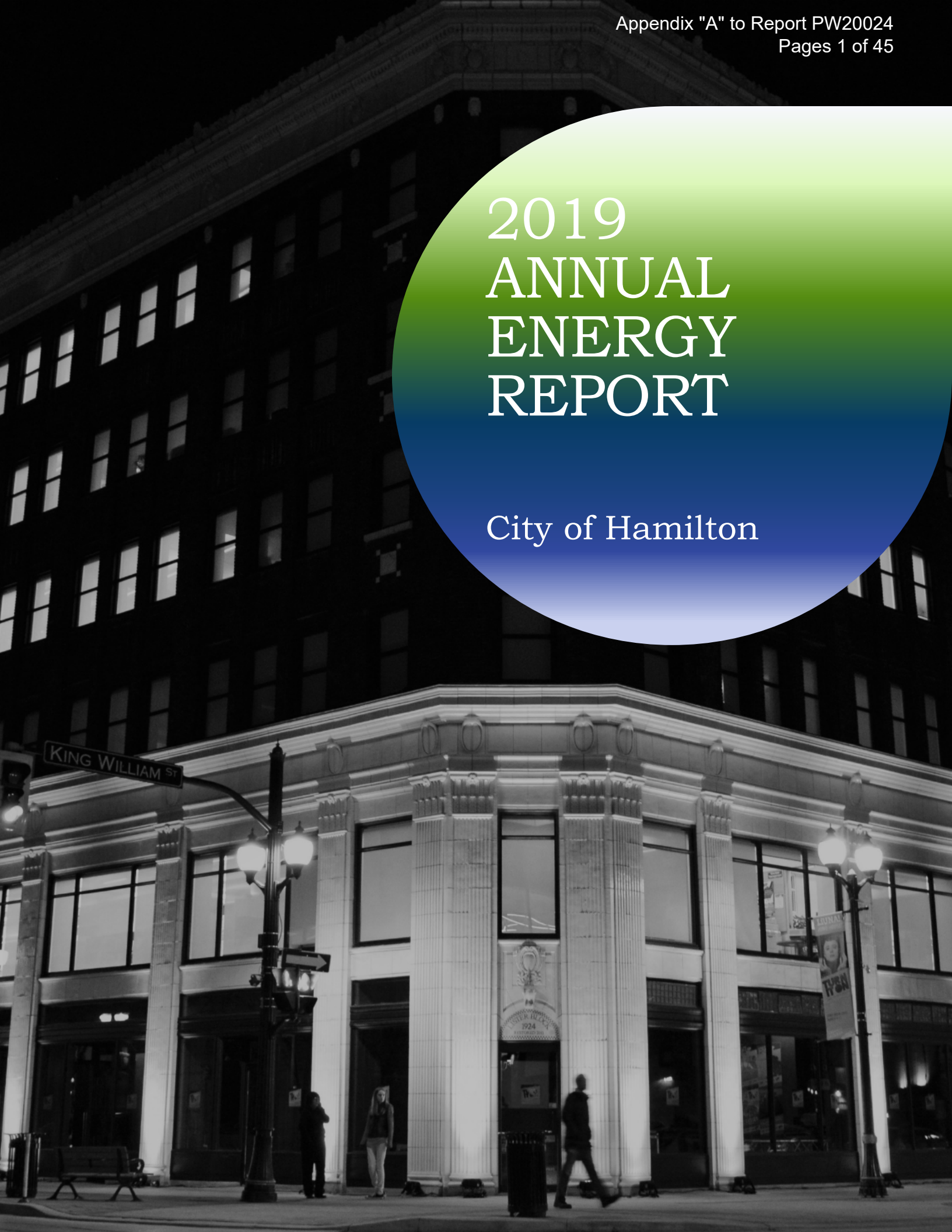


2019 ANNUAL ENERGY REPORT

City of Hamilton



2019 AT A GLANCE



**\$40.6M
SPEND ON
ENERGY IN
2019**



**CORPORATE GHG
EMISSIONS
REDUCTION OF
42%**



**ENERGY
INTENSITY
REDUCTION
OF 25%**



**CAFE
REDUCTION
OF 10%**



**25% MORE
CNG USE IN
BUSES**



**ENERGY
CONSERVATION
AND INCENTIVES
SAVINGS OF \$6.1M**



**HRPI
BENEFIT OF
\$1.2M FOR
2019**



**ENERGY STRATEGIES
AND PROGRAMS
SAVINGS & AVOIDED
COST OF \$14.5M**



**FORMATION OF
CORPORATE
CLIMATE
CHANGE TASK
FORCE**

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Introduction

The City of Hamilton has been dedicated to energy management and reporting on energy use over 14 years.

Over that time the City has maintained a commitment to managing the energy portfolio within the ever-evolving energy and regulatory environment, incorporating energy related policies and energy efficiency into project and operational decision-making and setting targets to achieve reductions in energy intensity and GHG emissions.

Hamilton's mission is to provide cost conscious public services that contribute to a healthy, safe and prosperous community in a sustainable manner. The City's ongoing management of its corporate assets through policy actions within its existing Corporate Energy Policy is one tool used to accomplish this mission, particularly as it relates to energy reduction. The declaration of a climate emergency by City council in 2019 has initiated a further focus on Greenhouse Gas emission reductions and resiliency for all of Hamilton, and how corporately, we can lay the groundwork for the City to meet its targets, reduce energy consumption and emissions and improve the City's energy portfolio overall.

Several initiatives are underway in 2020 to facilitate the meeting of energy targets and to lay framework for broader community strategies. A new Community Energy Plan is under development, the existing Corporate Energy Policy is being amended and new carbon reduction targets are considered.

Executive Summary

The report outlines the results for 2019 as it pertains to energy, including consumption and costs information, energy key performance indicators (KPI), fleet fuel consumptions and costs, conservation and demand management results. The report also details the 2018 corporate GHG emissions inventory.

There are two sets of KPIs identified within the report:

- Energy Strategies and Program KPIs
- Energy Performance KPIs

Energy Strategies and Program KPIs focus on initiatives to generate savings or avoid costs by taking action. This includes rate optimization activities, bill review, cost recovery, conservation project management and receiving incentives. The overall results are a \$14.5 million savings to the City for 2019.

Energy Performance KPIs focus on energy intensity (usage per square foot) for buildings, corporate average fuel efficiency (CAFE) (usage per 100 kilometers) for vehicles, energy usage and costs for usage. Overall the results are an energy intensity reduction of 25% compared to the base year 2005 and a CAFE reduction of 10% compared to its base year of 2012.

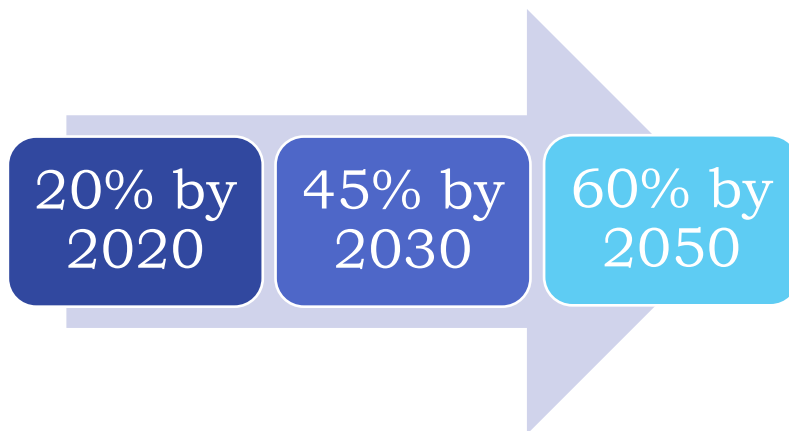
Results of these KPIs and further analysis are detailed within the report, as well as information on policy updates, regulatory impacts on usage and costs, conservation and demand management project activities, renewable energy and the GHG emissions inventory for 2018.

The overall results of the corporate emissions inventory for 2018 was a reduction of 42% as compared to the base year of 2005.

Corporate Energy Policy (CEP)

The policy as it exists today was approved by council in 2014 (PW14050). The policy is designed to act as a guideline for making energy and emissions related decisions for corporate assets and operations. The policy includes policy actions to support making building and operational improvements that lead to energy usage reductions and emissions reductions that impact the City environmentally and financially. The CEP identified targets for energy intensity reduction, greenhouse gas (GHG) emissions reductions and corporate average fuel economy (CAFE).

Figure 1: Corporate Energy Intensity Targets



Several global initiatives surrounding energy use, carbon footprint, climate impacts and resiliency have led municipalities to recognize a need for more robust policies to guide future development and operational activities within their cities. Although Hamilton has been ahead of the curve with its existing

policy to address and facilitate its corporate targets, an update to its policy is beneficial to further define its goals, targets and policy actions.

CEP Update

The CEP is currently undergoing its regularly scheduled review. The intent of the review is to better align the current energy policies to recent regulatory changes, City-wide community-based plans and the increased focus on climate change and resiliency.

Some updates to the policy are expected to include updates on building and operational standards; green fleet policy; Hamilton Water operations; and renewable energy considerations.

The targets for corporate energy intensity reductions will remain in place as identified in Figure 1 above. However, the target for reductions in GHG emissions currently in the policy are expected to be changed from 80% in 2050 to 100% by 2050. This will be confirmed when the revised policy is endorsed by council later this year.

Figure 2: Current Corporate Emissions Reduction Targets

Year	Emission Reduction & Offset Target
2020	20%
2030	50%
2050	80%

The policy aims to improve the likelihood of reaching long term targets for energy intensity reduction, CAFE reduction and emissions reductions by integrating energy usage reduction and emissions reduction actions across the organization particularly as it relates to managing physical assets and operational activities.

Energy Strategies and Program KPIs

The City has been tracking and reporting on data results for several years to evaluate the City's performance using key indicators related to decisions specifically around energy and utilities.

Cost reductions and the avoidance of costs are a result of the impacts of a variety of energy strategies and programs. Energy conservation, incentive programs, bill recovery from reviewing utility invoices or tax rebate programs, and utility rate optimization are a few of the factors that that contribute to cost savings or mitigation of costs for the City.

Overall, the total results from implementing the various energy strategies and programs in 2019 has resulted in a \$14.5M reduction. The cumulative results since 2006 were \$92.5M and are explained in greater detail below.

Utility Rates and Commodity Strategies

This category reports the results of the electricity and natural gas costs that would have been incurred by the City had no action been initiated to reduce costs. Actions include procurement, hedging strategies and optimizing utility rates including switching rate class to increase benefits from Global Adjustment (GA) savings opportunities. The 2019 results of natural gas commodity and hedging strategies were \$770,600. The 2019 results for GA rate optimization amounted to \$7.2 million, for a total of \$8.0 million savings and avoided costs in this category.

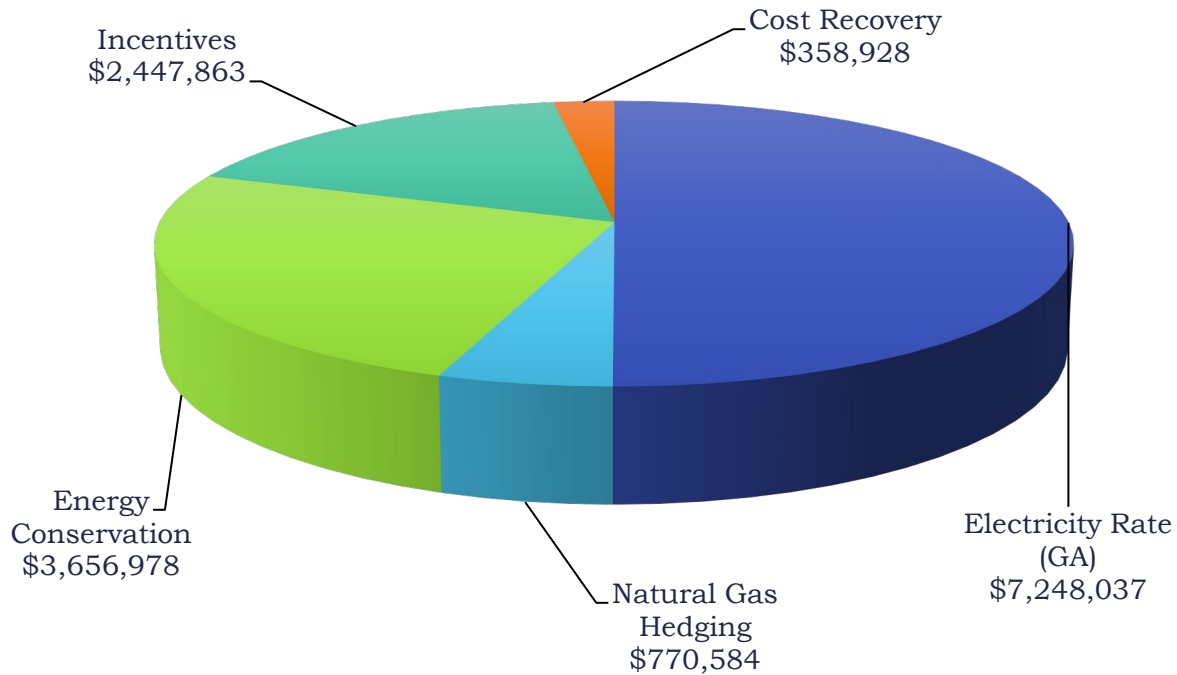
Cost Recovery

This category reports on the results of costs recovered due to the City's continuous efforts to review its utility accounts to correct any billing errors as well as recover credits from tax recovery programs. Cost recovery from billing or rate corrections in 2019 were \$358,900.

Energy Conservation and Incentive Programs

This category reports the results of the savings achieved from implementing energy efficiency measures, equipment and processes within the City's building assets that lead to reductions in energy consumption as well as financial incentives received for completing those projects. Incentives in this context refers to those from utility providers, the Independent Electricity System Operator (IESO) or provincial or federal funding options that are provided to eligible energy efficiency projects. In 2019, accumulated energy projects amounted to \$3.66 million in energy efficiency savings and the incentives received were \$2.45 million (includes \$1.87 million of street lighting incentives), with the total results in this category of \$6.1 million in 2019.

Figure 3: 2019 Breakdown of Energy Programs and Strategies



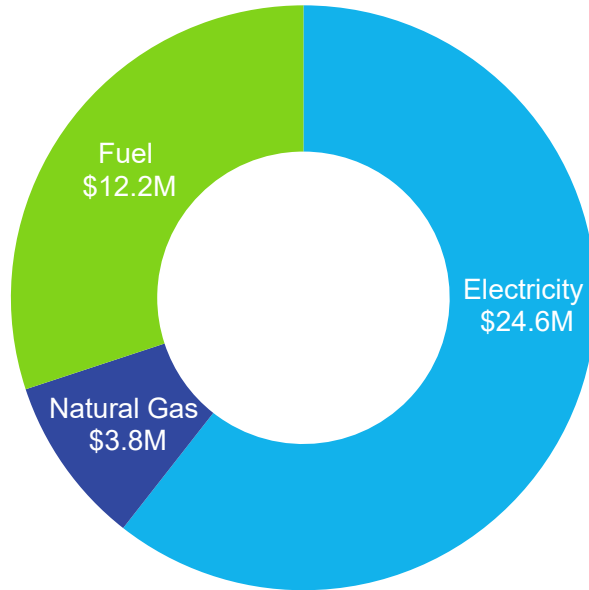
Overall Energy Costs

The City tracks costs and consumption to evaluate performance, but also to help budget for upcoming years. Costs for electricity, natural gas and fuels are compiled and measured against the previous year and compared to the baseline year of 2005. For this report, costs for sites connected to the district energy system (and supplied by HCE Energy Inc.) are included in electricity and natural gas costs.

Overall energy costs are a significant operating budget item for corporate buildings and vehicle assets. Although action to mitigate costs through completing energy efficiency projects that reduce consumption can have a positive impact on costs, costs themselves are impacted by more than usage. Regulatory changes, rate changes, inflation, global markets and weather can all impact costs despite reductions in usage. Costs for energy include regulated charges and market-based (commodity) charges.

In 2019, the total spend for consumption of electricity, natural gas and fuels (diesel, unleaded gasoline and compressed natural gas (CNG)) was \$40.6 million. This was a decrease of 2.8% from 2018.

Figure 4: Overall Energy Costs in 2019 in Millions (\$M)



Costs incurred by City-owned buildings/sites and exclude City Housing Hamilton. Utilities include Alectra Utilities, Hydro One Utilities and Enbridge Gas Inc. (formerly Union Gas Ltd). Sites linked to the district energy system with utility costs provided from HCE are included in electricity and natural gas respectively. Fuels include diesel, unleaded gasoline and CNG for all Transit and Fleet operations but does not include Hamilton Police Services or Darts. Sites with partial data may be excluded.

The year over year results are:

- Overall electricity costs were \$24.6 million in 2019 or 0.3% lower than 2018.
- Overall natural gas costs were \$3.8 million in 2019 or 3.6% lower than 2018.
- Overall fuel costs were \$12.2 million in 2019 or 7.3% lower than 2018.

The inclusion of buildings/sites included in the report may vary from year to year. In any given reporting period, buildings and vehicles could be added (built or purchased) or removed (sales or demolitions). Major renovations may decommission a site for a time and may be excluded as a full year data set may not be available. As such, square footage to include only reported sites are also adjusted.

Energy Performance KPIs

Costs alone cannot determine what might be happening within a building or across the City. As well, tracking only consumption and changes in consumption may be an indicator that costs *should* reduce or increase, but cost and consumption are influenced by several other factors that need to be considered.

Regulatory changes for both electricity and natural gas have impacted prices greatly over the past few years. After recurrent year over year increases of hydro rates, they have leveled off or reduced in the past couple of years through a variety of regulated price relief structures. Programs designed to tax emissions from fossil fuels have increased per unit costs to end-use users of natural gas and fuels.

Weather has one of the greatest impacts to consumption and costs year over year. With the increase in more extreme weather patterns emerging, hotter summers and colder winters lead to increased consumption for buildings and vehicles, with potentially higher prices, higher emissions and increased strain on energy grids.

Process and equipment improvements, changes in occupancy and programing at the buildings can further impact consumption patterns.

In the section below, we review the energy performance KPIs. Of importance is the energy intensity results, which is a KPI outlined specifically in the Corporate Energy Policy. Results in this section allow us to identify and focus on areas of concern and identify opportunities for improvement which support the City's Strategic Plan.

Electricity Consumption and Cost

Electricity is the largest energy expenditure for the City. Electricity costs themselves include charges for electrical commodity, distribution, transmission, regulatory and delivery. Hamilton is served by two local distribution companies (Alectra Utilities and Hydro One), both of which are regulated by the Ontario Energy Board. Utilities in Ontario must apply and receive approvals for any new rates, rate changes or invoice framework changes.

In 2019, electricity consumption in kilowatt hours (kWh) was on par with 2018, with a less than 1% increase in consumption overall. In addition, costs, though slightly lower were also within 1% of 2018.

Summer temperatures in 2019 were milder when compared to 2018, with 37% less cooling degree days. Cooling degree days are a measure of how much (in degrees) and for how long (in days) the outside temperature was higher than a base temperature. Cooling degree days in Ontario are high during the summer months and result in higher electricity usage during summer months. More information on the 2019 weather and degree day information is in Appendix A of this report.

Figure 5: Electricity Consumption and Cost Comparison

Electricity Overview	2005	2018	2019	Comparisons	
				2019 vs 2005	2019 vs 2018.
Total Electricity (kWh)	236,362,045	216,150,047	216,929,517	-8%	0.4%
Total Electricity (\$)	\$20,657,050	\$24,637,207	\$24,575,215	19%	-0.3%
Total Electricity (\$/kWh)	\$0.087	\$0.114	\$0.113	30%	-0.6%

Natural Gas Consumption and Cost

There is one natural gas distribution company that provides services in Hamilton, Enbridge Inc. (formerly Union Gas Ltd.). Natural gas costs comprise commodity, transportation and regulated costs for delivery and storage. Regulated costs for Enbridge Inc are also approved by the OEB.

Over the past two years, Ontario has seen some regulatory legislation that has impacted natural gas pricing. In October 2018 the Cap & Trade program was repealed by the provincial government with no replacement carbon program to address federal mandates. As Ontario lacked a comprehensive carbon reduction plan, it was subject to the Federal carbon tax program that was approved in April 2019. The charge began appearing on natural gas bills in August 2019, with approved annual increases every April. The federal plan is intended to be a funding instrument to drive emissions reduction programming but does increase the costs to heating and vehicle fuels for all Ontario consumers.

In terms of cost impact to budget, a variety of circumstances lessened the impacts of this major regulatory change for 2019 for the City. The City hedges a portion of its natural gas commodity to limit volatility and the budget was set to include the anticipated carbon-related charge, which only appeared in August of 2019, typically a time when natural gas use is at its lowest. Overall natural gas costs for 2019 were 3.6% lower than 2018.

In general, the City has benefited from relatively stable gas prices because of the disciplined hedging strategy purchases of natural gas on the wholesale

market. The per unit cost continues to reduce year over year largely due to hedging activities.

Consumption measured in cubic meters (m³) was 5.4% higher than 2018.

Weather, particularly prolonged low temperatures can impact the amount of natural gas used to heat buildings. The heating degree days, which is the measure of how much (in degrees) and for how long (in days) the outside temperature was lower than a base temperature was 1% higher than 2018 and 4% higher than the 5-year average.

Figure 6: Natural Gas Consumption and Cost Comparison

Natural Gas Overview				Comparisons	
	2005	2018	2019	2019 vs 2005	2019 vs 2018.
Total Natural Gas (m ³)	15,403,956	12,788,880	13,478,604	-12%	5.4%
Total Natural Gas (\$)	\$6,520,253	\$3,943,736	\$3,800,296	-42%	-3.6%
Total Natural Gas (\$/m ³)	\$0.423	\$0.308	\$0.282	-33%	-8.6%

Combined Consumption and Cost (Electricity & Natural Gas)

The total combined energy usage for electricity and natural gas is converted into equivalent kilowatt hours (ekWh) to compare year over year and to the base year. Consumption increased nearly 2% compared to 2018 which is in line with expectations, and costs were down almost 1%.

Figure 7: Combined Consumption and Cost Comparison (Electricity & Natural Gas)

Total Combined Energy Overview				Comparisons	
	2005	2018	2019	2019 vs 2005	2019 vs 2018.
Total Energy (ekWh)	400,722,256	350,049,621	356,567,857	-11%	1.9%
Total Energy Cost (\$)	\$27,177,303	\$28,580,942	\$28,375,511	4%	-0.7%
Total Energy (\$/ekWh)	\$0.068	\$0.082	\$0.080	17%	-2.5%

Energy Intensity (City-Owned Sites)

One of the targeted KPIs for energy performance is energy intensity. Energy intensity is the measurement of usage, converted to equivalent kilowatt hours (ekWh), per square footage (sqft) of conditioned space. Specifically, conditioned space is the usable, occupied space of the building (or sets of buildings) and not always the square footage of the entire site. An example would be the

measurement of a public building within a park. The building square footage would be used, not the square footage of the entire park. For this reason, operational usage is not included in the calculations of energy intensity. Street lighting, traffic lighting or park lighting are examples of operational usage. All use electricity but do not have a building footprint.

In addition, square footage does change with additions or deletions of City-owned sites.

Figure 8: Energy Intensity City Wide Comparison (for City-Owned Sites)

Energy Intensity			Comparisons		
	2005	2018	2019	2019 vs 2005	2019 vs 2018.
City Total (ekWh/sqft)	45.69	34.13	34.34	-25%	0.6%
City Total (\$/sqft)	\$2.67	\$2.33	\$2.37	-11%	1.7%
Reported Square Footage	5,138,852	5,708,246	5,926,831	15%	3.8%

Figure 9: Energy Intensity Comparison by Reporting Portfolio Category

Energy Intensity	ekWh/sqft			2019 vs 2005	2019 vs 2018.
	2005	2018	2019		
City/Town Halls	39.6	24.3	24.9	-37%	2%
Corporate Facilities	44.6	21.7	22.3	-50%	3%
Street Lighting	n/a	n/a	n/a	n/a	n/a
Traffic Lighting	n/a	n/a	n/a	n/a	n/a
Other City Operations	n/a	n/a	n/a	n/a	n/a
Hamilton Water	n/a	n/a	n/a	n/a	n/a
Yards	38.1	29.7	28.7	-25%	-3%
Arenas	51.3	43.3	41.9	-18%	-3%
Community/Senior Centers	31.1	24.8	24.3	-22%	-2%
Rec Centres/Pools	78.6	66.9	64.6	-18%	-3%
Tim Horton's Field	0.0	21.4	28.3	0%	32%
Rec Parks/Stadiums/Golf	36.5	31.0	30.9	-15%	0%
Lodges (Macassa, Wentworth)	113.6	43.5	45.4	-60%	4%
Culture	35.5	31.4	33.3	-6%	6%
Fire/ EMS	45.2	37.4	37.3	-17%	0%
Hamilton Public Libraries	25.2	31.4	33.0	31%	5%
First Ontario Centre	22.5	22.0	20.5	-9%	-7%
First Ontario Concert Hall	57.8	48.2	48.7	-16%	1%
Hamilton Convention Centre	37.2	32.5	30.2	-19%	-7%
Hamilton Police Services	59.8	36.4	35.1	-41%	-4%
City Wide Total	45.7	34.1	34.3	-25%	1%

Additional graphs and charts for with details for the specific reporting categories are found in the Appendix A of this document.

Vehicle Fuels

The City reports on the corporate fleet vehicles which include various vehicle types: buses, waste collection vehicles, snow removal trucks, street sweepers light weight departmental vehicles and Fire and EMS vehicles. The fuels used for these vehicles is diesel, unleaded gasoline and compressed natural gas (CNG). The performance of the fleet as it relates to its fuel usage is reported below.

Corporate Average Fuel Economy (CAFE)

One of the KPI measurement targets for fleet is to achieve an improvement in fuel consumption efficiency. That is, to reduce the amount of fuel consumed in diesel litre equivalent (DLE) per 100 kilometres of distance travelled. The long-term target is to reduce the CAFE by 20% by 2030 compared to the base year of 2012. As of 2019, there is a 10% reduction compared to the base year.

The City’s goals are to improve and manage fleet efficiency by utilizing vehicles with clean drive technology, improving operator behaviors and abiding fit-for purpose vehicle principles and City bylaws.

Figure 10: Corporate Average Fuel Economy 2019 to Base Year Comparison

Diesel Litre Equivalent (DLE) per 100 KM	BASE (2012)	2019
Unleaded Gasoline	20.7	20.1
Diesel	54.5	43.2
CNG	66.2	69.6
Total	46.2	41.6
Overall % Changed in DLE/100 KM		-10%

Data provided for the purpose of reporting on fuel analytics, such as mileage and usage for CAFE are based on data collected by Fleet. Improvements in data collection is pertinent to accurately tracking the usage and mileage of vehicle operators. With fueling stations throughout the City, managing the data continues to be an identified area of concern.

Fuel Consumption and Cost

Fuel for the City’s fleet of vehicles is purchased on wholesale markets. This allows for economies of scale around bulk purchasing. Most of the vehicles are fueled by diesel and unleaded gasoline. However, Transit continues to expand its fleet of CNG-fueled buses as direct replacements for diesel-fueled buses, so requirements of diesel have reduced year over year and CNG purchases have increased.

In 2019, the City used 8.6 million litres of diesel fuel, a 6% reduction from 2018. The City used 2.4 million litres of gasoline, a 5% increase over 2018. However, average per litre cost for both diesel and gasoline decreased by 7% and 6% respectively.

CNG usage increased by 25% overall, with a total of 6.4 million diesel litre equivalent.

Figure 11: Fuel Consumption and Costs 2019

Fuel Type	Consumption Litres	Cost	Average \$/L
Diesel	8,595,617	\$8,478,640	\$0.99
Unleaded Gasoline	2,364,574	\$2,357,059	\$1.00
CNG (DLE)	6,388,918	\$1,366,874	\$0.21
Total	17,349,109	\$12,202,573	

CNG is a lower cost fuel for buses compared to diesel and gasoline, but they do operate at approximately 75% efficiency per DLE when compared to diesel fueled buses. However, despite a lower fuel efficiency, when converted to diesel equivalent dollars and adjusted for efficiency, Transit spent \$3.29 million less running their fleet of CNG buses than they would have only using diesel buses. In addition, the lower GHG emissions from using CNG fuel versus diesel is of benefit to the City overall and positively impacts the City’s GHG emissions inventory.

Energy Conservation

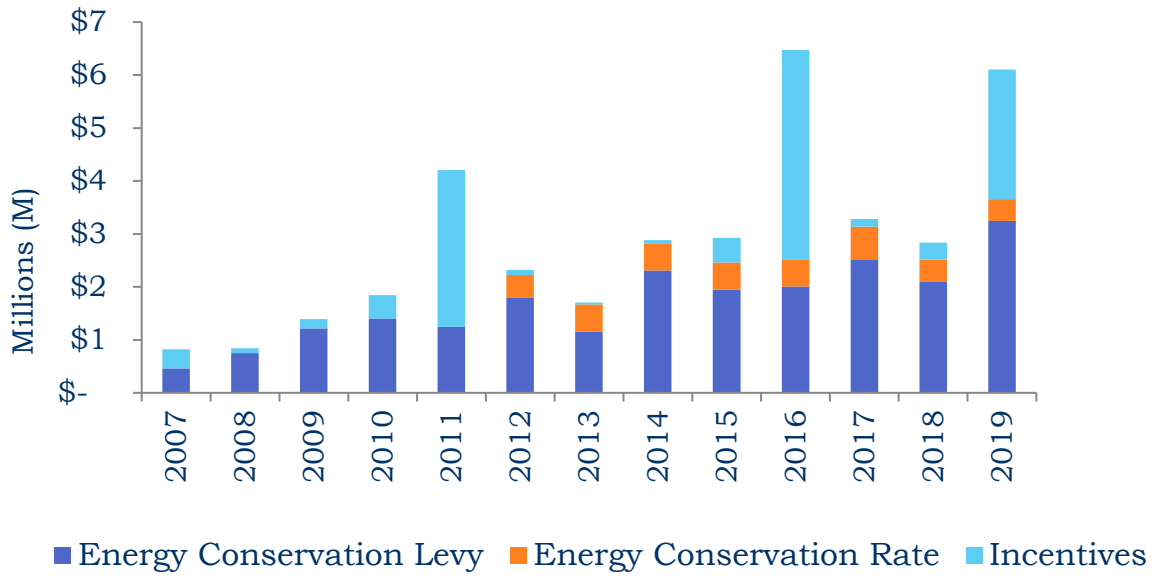
One of the energy reduction and energy intensity improvement strategies the City employs is the completion of energy conservation projects. Upgrades to existing corporate buildings by installing energy efficient lighting and equipment or utilizing new technologies can help to improve operational efficiencies, cost effectiveness and help meet corporate targets for energy intensity and GHG reductions.

With global attention on climate change, greener public buildings are an expectation by staff and communities and will help move Hamilton toward meeting its strategic and corporate goals.

The City’s project teams work closely with consultants, engineers, utility personnel and industry experts to retrofit existing buildings, construct new buildings, and upgrade equipment and processes. An important part of the process also involves securing incentives and funding opportunities and post project monitoring and verification of savings.

The City tracks the energy savings achieved from projects once they are complete. The 2019 contribution from project savings was \$3.7M and \$2.4M from incentives received. Cumulatively, a total result is \$37.4M since 2005 for projects and incentives.

Figure 12: Annual Project Savings and Incentives in Millions (\$M)



2019 Project Highlights



Valley Park Aquatic Centre - LED Lighting Upgrades

- Installation of new LED lighting in pool & change room areas, gym, common areas and parking lot lighting.
- Benefits include improved lighting conditions, safety, a reduction in electrical consumption, GHG's & lighting maintenance costs.
- \$21,000 in incentives received from IESO SaveOnEnergy program.



Lister Block - Interior LED Lighting Upgrades

- Retrofit of interior lighting.
- Benefits include improved lighting conditions and a reduction in lamp maintenance costs.
- \$7,984 in incentives pre-approved under the IESO SaveOnEnergy program.



Traffic Operations - Interior & Exterior LED Lighting Upgrades

- Installation of new interior and exterior LED lighting.
- Benefits include improved lighting conditions and a reduction lamp maintenance costs.
- \$5,754 in incentives pre-approved under the IESO SaveOnEnergy program.



Woodward Plant - Interior & Exterior Lighting Upgrade

- Installation of new interior and exterior LED lighting.
- Benefits include improved lighting conditions and a reduction lamp maintenance costs.
- \$44,000 in incentives pre-approved under the IESO SaveOnEnergy program.

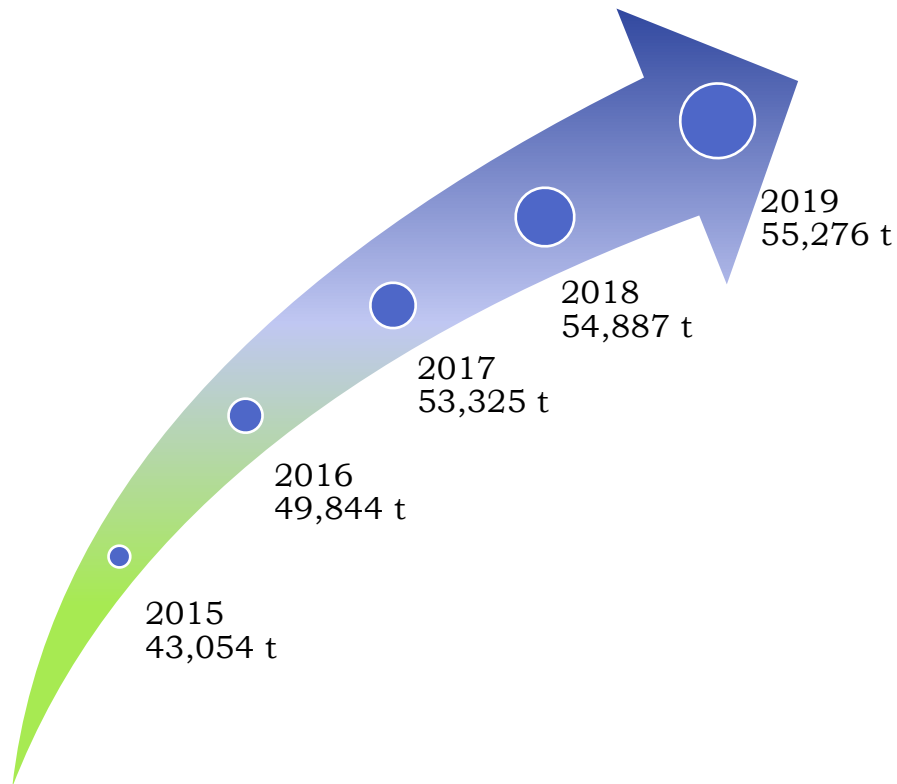
Listing of Upcoming Projects for 2020

- Wentworth Operations Centre Interior LED Lighting Retrofit.
- Wentworth Lodge – HVAC and BAS Upgrades.
- Library Branches LED Lighting Retrofit.
- Central Public Library LED Lighting Retrofit.
- Central Public Library's IT Room Data Center Environmental Control Units (ECUs) Replacement.

- Hamilton City Hall LED Lighting Retrofit.
- Material Recycling Facility – LED Lighting Retrofit.
- Westmount DHW Solar Thermal & Controls.
- Pinky Lewis Aquatic Centre – Solar Wall.
- Arenas - Ice Plant, Floating Head Pressure Control.
- Various Recreation Facilities – LED Lighting Retrofit.

Energy efficiency projects that reduce energy use also have the added benefit of reducing greenhouse gas (GHG) emissions that would have been otherwise emitted. The GHG savings from projects in 2019 was 653 tonnes (t) of CO₂e, for a cumulative GHG reduction of 55,276 tCO₂e.

Figure 13: Cumulative GHG Reductions from Energy Conservation Projects (in tCO₂e)



Energy reduction continues to be a driving force for energy conservation. However, with the increased focus on climate change, resiliency, and meeting corporate targets for greater reductions in GHG emissions, business cases for projects, programs, investment in new technology or infrastructure will prioritize actions within this lens as well.

Renewable Energy

Existing renewable generation operations for the City are managed through Hamilton Renewable Power Inc. (HRPI). HRPI owns and operates three 1.6 MW renewable gas fueled units. Two of the units are located at the Glanbrook landfill site. The third unit, a cogeneration unit, producing electricity and heat, is located at the Hamilton Water site at Woodward Avenue.

The three units use raw biogas as a renewable fuel sources to produce electricity for the power grid through a long-term contract with the province. Using renewable fuel contributes to a more efficient and sustainable process, and further offsets GHG emissions. The systems produce 28,000,000 kWh of renewable energy annually, with a reduction of 100,000 tonnes CO₂e. In 2019 the net benefit from all HRPI operations was approximately \$1.2 million, with a cumulative total of \$18.7 million from 2006.

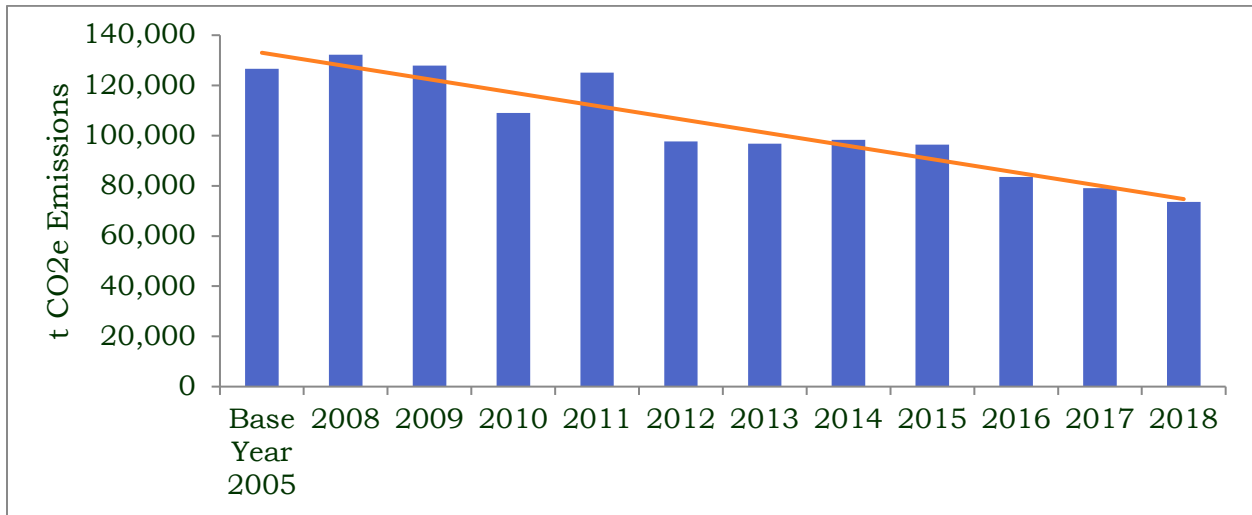
Renewable natural gas is also produced at Woodward Avenue using a Biogas Purification Unit (BPU). The BPU captures excess methane gas from the anaerobic digestion process of the waste water process. The raw biogas is purified, treated and conditioned to yield the utility grade renewable natural gas that can be injected into Enbridge Gas distribution system.

Greenhouse Gas Emissions Inventory 2018 Report

GHG emissions related to corporate operations have been inventoried and reported annually since the adoption of the Corporate Air Quality and Climate Change Strategic Plan (PED06336(a)) in 2008. Original targets of a 20% reduction by 2020 were then updated and aligned with the Corporate Energy Policy and the Board of Health Climate Change Actions 2012 report (BOH13024), calling for an 80% reduction in GHG emissions by 2050 from the base year 2005.

Reporting data for the GHG emissions report is one year behind the annual energy report. Therefore, the data presented here is for the 2018 calendar year. In 2018, the GHG emissions inventory was 73,638 tonnes of CO₂e (carbon dioxide equivalent). This represents a 42% reduction from the base year and 7% reduction from 2017. The inventory does not include HRPI operations.

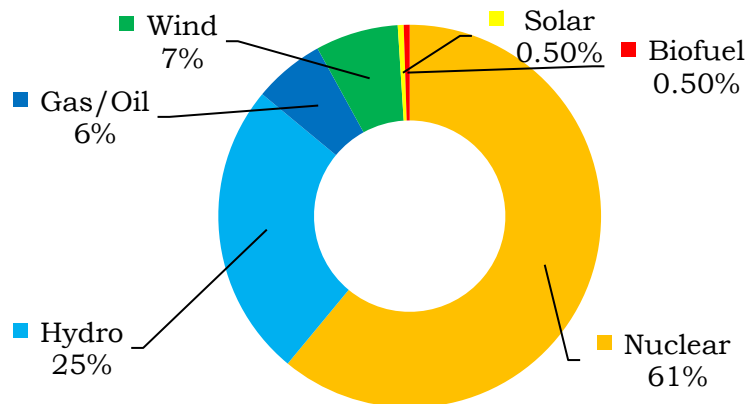
Figure 14: City of Hamilton Corporate GHG Emissions Annual Trends



Since 2005 the inventoried emissions have been on a downward trend. Several factors have contributed to this trend including energy efficiency projects that reduce overall energy usage and fuel conversion in Transit from diesel buses to CNG buses. However, the Ontario electricity emission factor, which is the measurement of the CO₂e intensity of the electricity generation, has had a significant impact on GHGs. As the Ontario electricity supply mix moves towards increasing its cleaner power sources, the lower the City’s use of electricity impacts the emissions inventory.

Below, the diagram shows the energy output by fuel type for 2018 as reported at the Independent Electricity System Operator (IESO) for transmission-connected generation. The mix varies annually, depending on what fuel sources are being dispatched. This data does not include embedded generation.

Figure 15: 2018 Ontario Energy Output by Fuel Type



Source: Transmission-Connected Generation - IESO Mix 2018 Output

Our corporate GHG emissions are generated by the following energy sources: electricity, natural gas, diesel and gasoline.

Figure 16: 2018 Percentage of tCO2e Emissions by Fuel Source

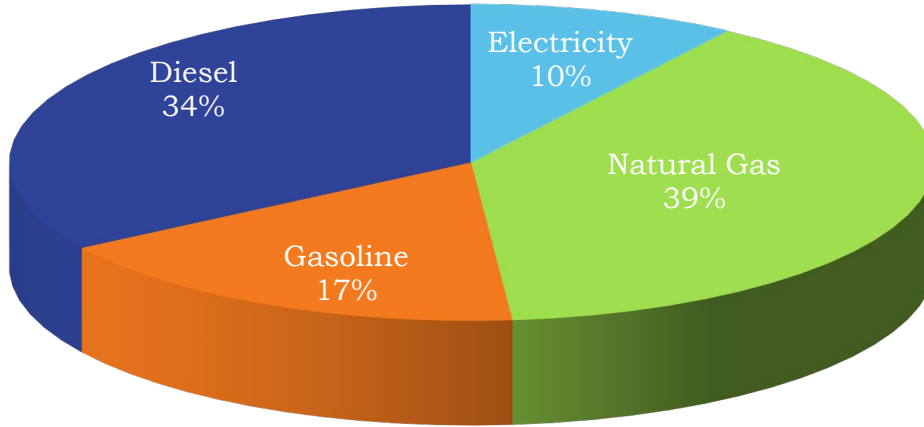
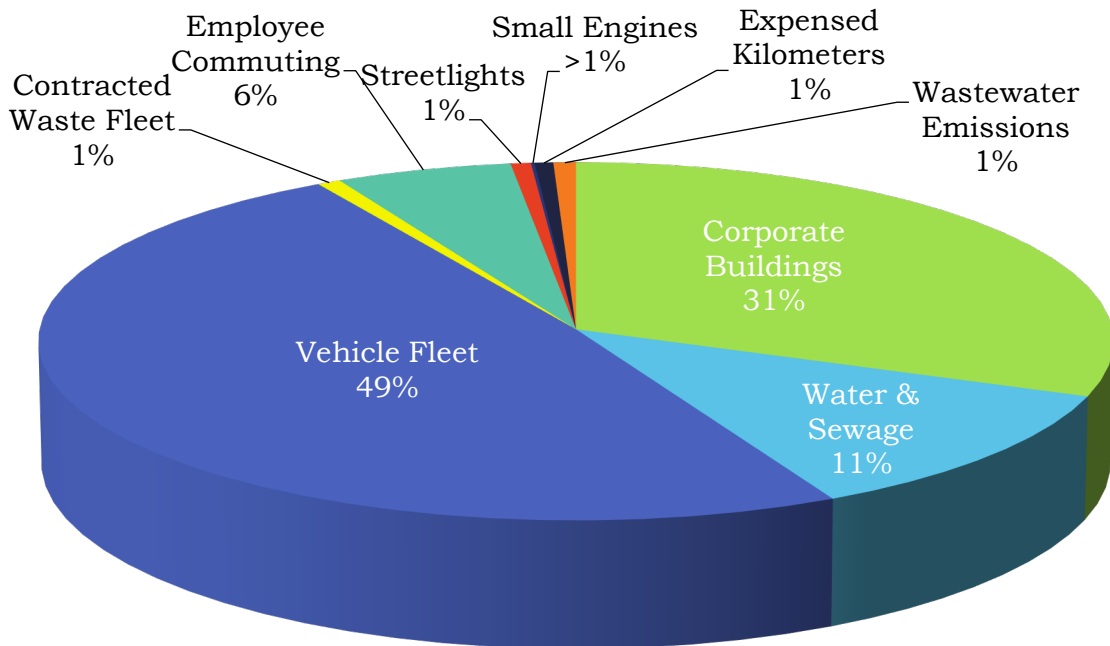


Figure 17: 2018 Percent Tonnes CO2e of Total by Sector



Of the above reported sectors, the largest emitter is Vehicle Fleet (36,039 t CO2e) at 49%. For 2018, this is less than a 1% decrease to the base year. Of

note, emissions for vehicles have varied over the years. While vehicles may have become more efficient and many of the buses have been switched to CNG, which has lower emissions than diesel, the vehicle fleet size has increased. In addition, year over year usage can be impacted by weather conditions. An example would be the varying demand for large winter-related vehicles (snow-removal, salters and sanders).

Contracted Fleet has been amended for 2018 to better reflect the average distance that the contract fleet vehicles are travelling on a daily and annual basis. Therefore, the GHG emissions attributed to contract fleet vehicles has been reduced.

Corporate buildings (22,817 t CO₂e) makes up 31% of the total inventory for 2018 which is 51% less than the base year and 5% lower than 2017. A large part of this reduction is the completion of energy efficiency initiatives at many corporate sites over the past several years. Some examples include LED lighting installations, BAS controls systems and equipment upgrades. However, like fleet, the inventory of corporate buildings can increase or decrease year over year as assets are acquired or removed and can have broader changes in usage and GHG emissions due to large scale renovation projects and program or operational changes.

Water and Sewage, which includes the Woodward Water and Wastewater plant, pump stations, wells and reservoirs throughout the City make up the third largest emission sector (8,532 t CO₂e), with 11% of the total inventory for 2018. It is a 66% decrease from 2005, and on par with 2017. Process efficiencies have had a large impact on this reduction. The Water and Sewage sector is the largest user of electricity in the City.

Street lighting, although not a large overall emitter, has had an impressive reduction of 94% when compared to the base year. The LAMP program (Lighting Asset Modernization Project) has made a large impact to both reducing electrical usage but also in reducing its GHG emissions over the past 3 years.

A greater emphasis has been placed on addressing climate change and resiliency within the City. Continued efforts must be made to further reduce the City's corporate emissions to meet the targets laid out in the Corporate Energy Policy and as a response to the climate change emergency. Investments in renewable energy, retrofit projects that reduce both usage and emissions, greener vehicles and behavioral changes will be necessary to achieve the long-range targets established in the Corporate Energy Policy which are updated approximately every 5 years.

Final Comments

2019 saw a large shift in focus from making decisions based on the reduction of electricity usage to decision-making with a climate change lens, particularly as it related to projects and funding opportunities for projects.

As the federal government mandated provinces implement carbon reduction plans and highlighted the aggressive global shift in addressing climate change, municipalities responded in kind. The City of Hamilton declared a climate emergency to focus its future development, infrastructure, corporate energy planning and community engagement to improve the City's resiliency plans and favorable climate change outcomes.

The City will always require energy to run its facilities, vehicles and operations, but strategic management of energy usage, emissions, investment in renewable technologies and a keen focus on climate change can help them use less, become carbon neutral and greener overall.

Appendix A

This appendix provides additional tables, charts and graphs as it relates to the information presented throughout the report.

Energy Strategies and Program KPIs

Figure A-1: Cumulative Results of Energy Programs and Strategies KPIs (2006-2019)

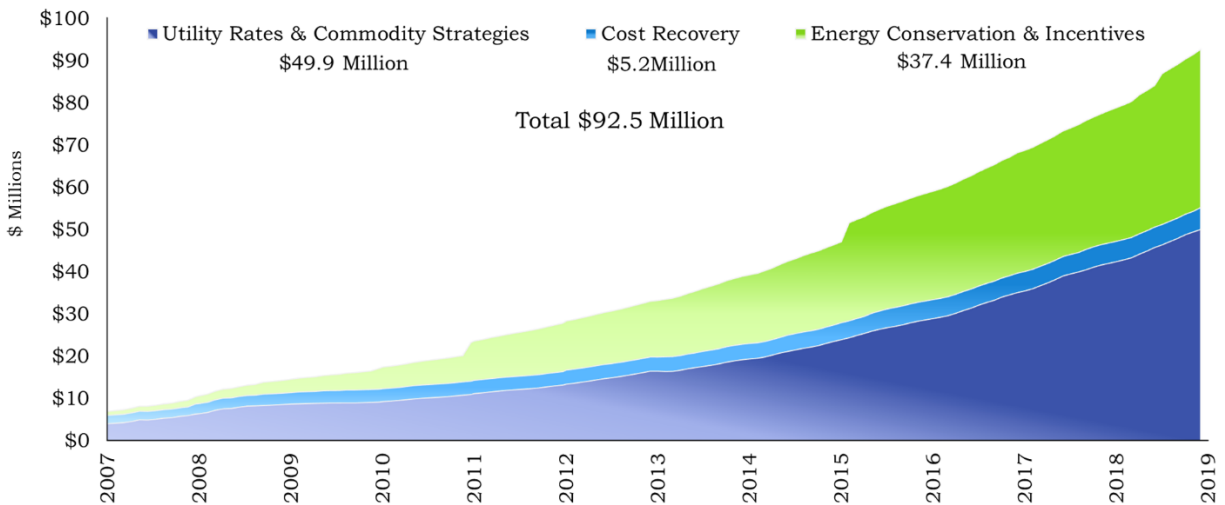


Figure A-2: Three Year Comparison of Energy Programs and Strategies

Category	Past 3 Years			2006-2019 Cumulative
	2017	2018	2019	
Levy RPP/Interval Change	\$ -	\$ -	\$ -	\$ 2,886,651
Rate RPP/Interval Change	\$ -	\$ -	\$ -	\$ 2,873,163
Levy Global Adjustment	\$ 1,344,340	\$ 1,953,610	\$ 1,310,581	\$ 8,402,655
Rate Global Adjustment	\$ 4,631,762	\$ 4,450,962	\$ 5,937,456	\$ 27,339,531
Levy Natural Gas	\$ 446,304	\$ 465,571	\$ 693,429	\$ 7,184,883
Rate Natural Gas	\$ 66,946	\$ 64,126	\$ 77,155	\$ 1,208,251
Energy Conservation Levy	\$ 2,286,392	\$ 2,101,419	\$ 3,246,246	\$ 21,928,204
Energy Conservation Rate	\$ 616,098	\$ 410,732	\$ 410,732	\$ 3,917,423
Incentives	\$ 147,841	\$ 323,354	\$ 2,447,863	\$ 11,587,402
Cash Recovery Levy	\$ 118,099	\$ 220,046	\$ 358,928	\$ 4,943,004
Cash Recovery Rate	\$ -	\$ -	\$ -	\$ 235,375
Totals	\$ 9,657,782	\$ 9,989,820	\$ 14,482,390	\$ 92,506,542

Overall Costs, Consumption and Performance (Electricity & Natural Gas)

Figure A-3: Total Annual Consumption Electricity & Natural Gas (Facilities)

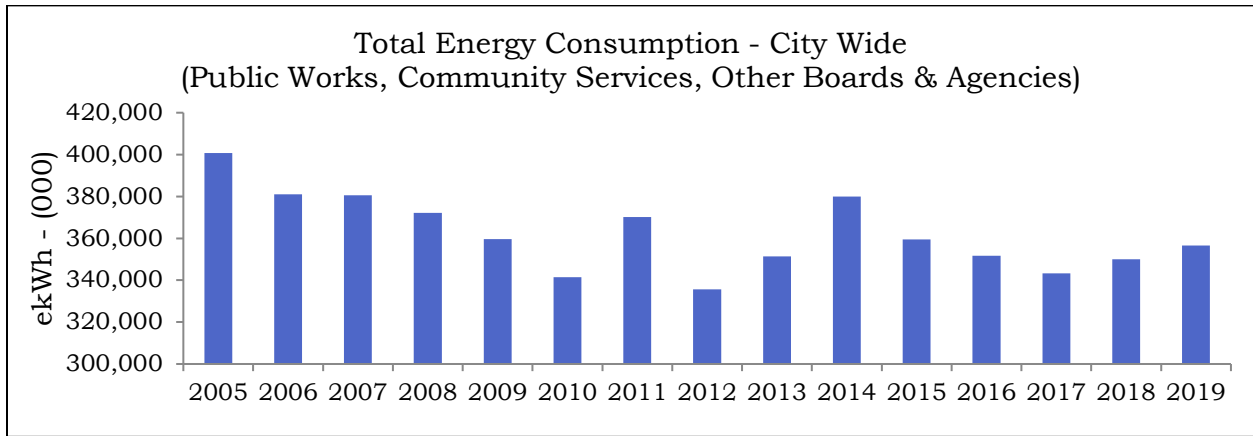


Figure A-4: Total Annual Reported Costs Electricity & Natural Gas (Facilities)

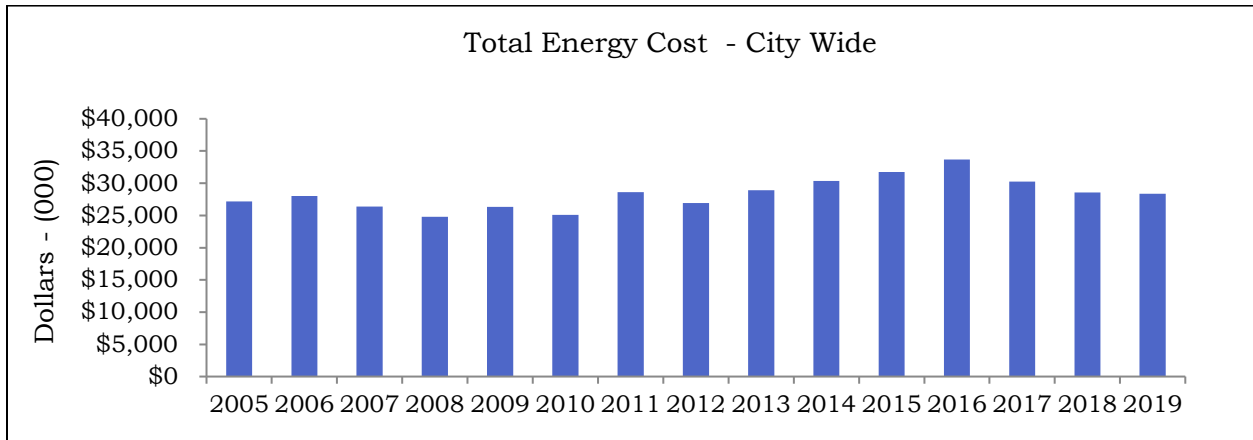


Figure A-5: Total Consumption Comparison by Portfolio Category

Total Energy Consumption	in 000's of ekWhs			Comparisons	
	2005	2018	2019	2019 vs 2005	2019 vs 2018
City/Town Halls	13,775	8,706	8,899	-35%	2%
Corporate Facilities	17,188	9,404	12,256	-29%	30%
Street Lighting	33,602	20,050	17,808	-47%	-11%
Traffic Lighting	5,688	2,069	2,112	-63%	2%
Other City Operations	5,618	6,349	6,355	13%	0%
Hamilton Water	121,040	126,764	126,788	5%	0%
Yards	39,589	28,503	27,869	-30%	-2%
Arenas	39,904	36,345	35,094	-12%	-3%
Community/Senior Centers	3,834	3,536	3,601	-6%	2%
Rec Centres/Pools	26,789	25,130	30,073	12%	20%
Tim Horton's Field	0	6,995	9,267	0%	32%
Rec Parks/Stadiums/Golf	8,332	5,063	4,997	-40%	-1%
Lodges (Macassa, Wentworth)	24,938	15,113	15,774	-37%	4%
Culture	5,383	4,932	5,278	-2%	7%
Fire/ EMS	10,698	12,814	12,803	20%	0%
Hamilton Public Libraries	9,343	11,211	11,726	26%	5%
First Ontario Centre	10,122	9,904	9,214	-9%	-7%
First Ontario Concert Hall	5,466	4,517	4,571	-16%	1%
Hamilton Convention Centre	4,656	4,068	3,780	-19%	-7%
Hamilton Police Services	14,757	8,573	8,303	-44%	-3%
City Wide Total	400,722	350,050	356,568	-11%	2%

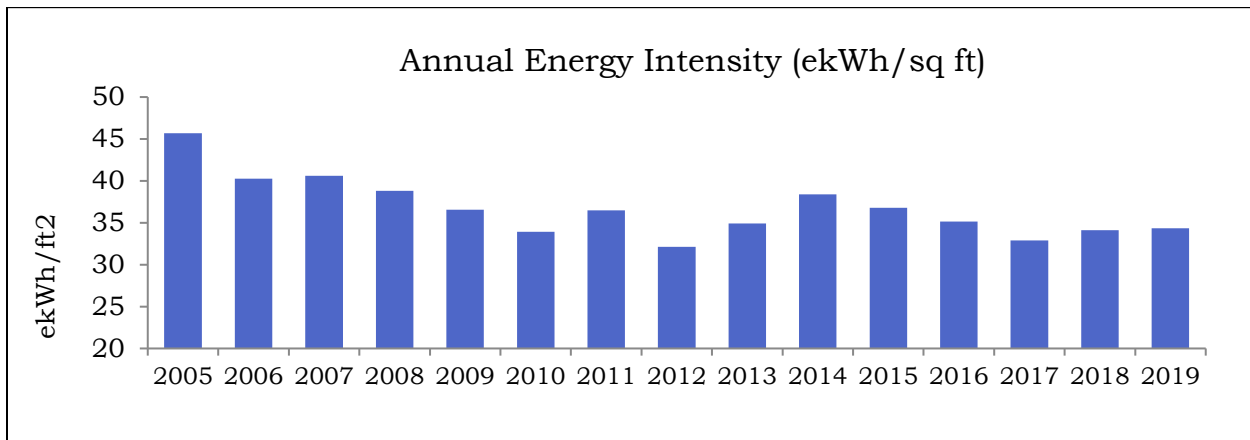
*values are shown in 000's, does include full values in calculations

Figure A-6: Total Reported Cost Comparison by Portfolio Category

Total Energy-\$ Cost	in 000's of \$			Comparisons	
	2005	2018	2019	2019 vs 2005	2019 vs 2018
City/Town Halls	\$860	\$653	\$700	-19%	7%
Corporate Facilities	\$866	\$790	\$980	13%	24%
Street Lighting	\$2,895	\$3,728	\$3,510	21%	-6%
Traffic Lighting	\$462	\$323	\$299	-35%	-7%
Other City Operations	\$534	\$813	\$802	50%	-1%
Hamilton Water	\$9,590	\$10,436	\$9,739	2%	-7%
Yards	\$2,205	\$1,686	\$1,658	-25%	-2%
Arenas	\$2,455	\$2,718	\$2,682	9%	-1%
Community/Senior Centers	\$224	\$246	\$241	8%	-2%
Rec Centres/ Pools	\$1,192	\$1,405	\$1,657	39%	18%
Tim Horton's Field	\$0	\$661	\$712	0%	8%
Rec Parks/Stadiums/Golf	\$564	\$434	\$407	-28%	-6%
Lodges (Macassa, Wentworth)	\$1,087	\$695	\$700	-36%	1%
Culture	\$338	\$257	\$268	-21%	4%
Fire/ EMS	\$614	\$819	\$798	30%	-3%
Hamilton Public Libraries	\$827	\$734	\$856	3%	17%
First Ontario Centre	\$840	\$961	\$1,087	29%	13%
First Ontario Concert Hall	\$454	\$257	\$296	-35%	15%
Hamilton Convention Centre	\$387	\$243	\$257	-33%	6%
Hamilton Police Services	\$783	\$723	\$727	-7%	1%
City Wide Total	\$27,177	\$28,581	\$28,376	4%	-1%

*values are shown in 000's, does include full values in calculations

Figure A-7: Total Annual Energy Intensity City-wide (ekWh/sqft)



The following series of graphs represent the energy intensity results per site for 2019 within the specific portfolio category. Sites that did not have square footage were removed but were included in the overall consumption and costs data sets. Sites were only included if there were full data sets for the year. There is no energy intensity data for Hamilton Water and Operational (O&M) sites. Also note that the energy intensity axis value may be adjusted depending on grouping.

Figure A-8: Corporate Facilities 2019 Energy Intensity

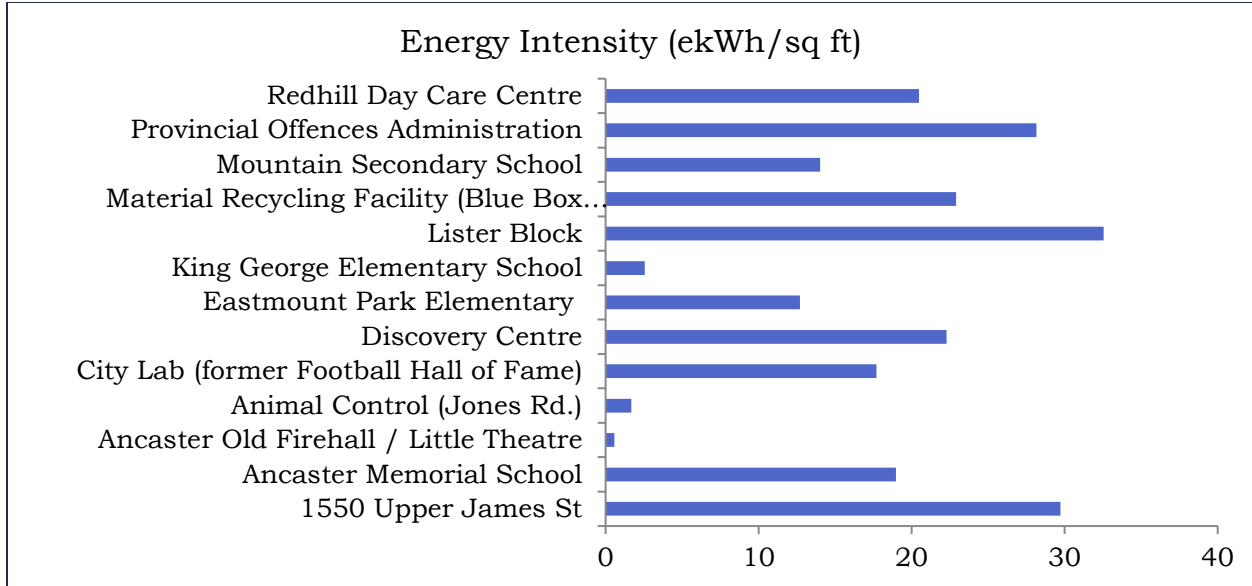


Figure A-9: City and Town Halls 2019 Energy Intensity

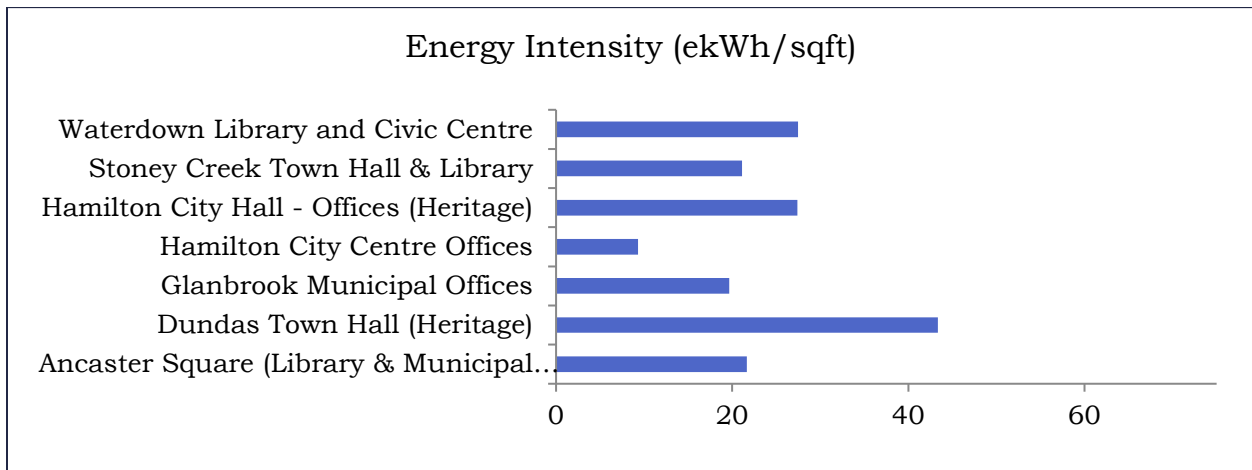


Figure A-10: Arenas 2019 Energy Intensity

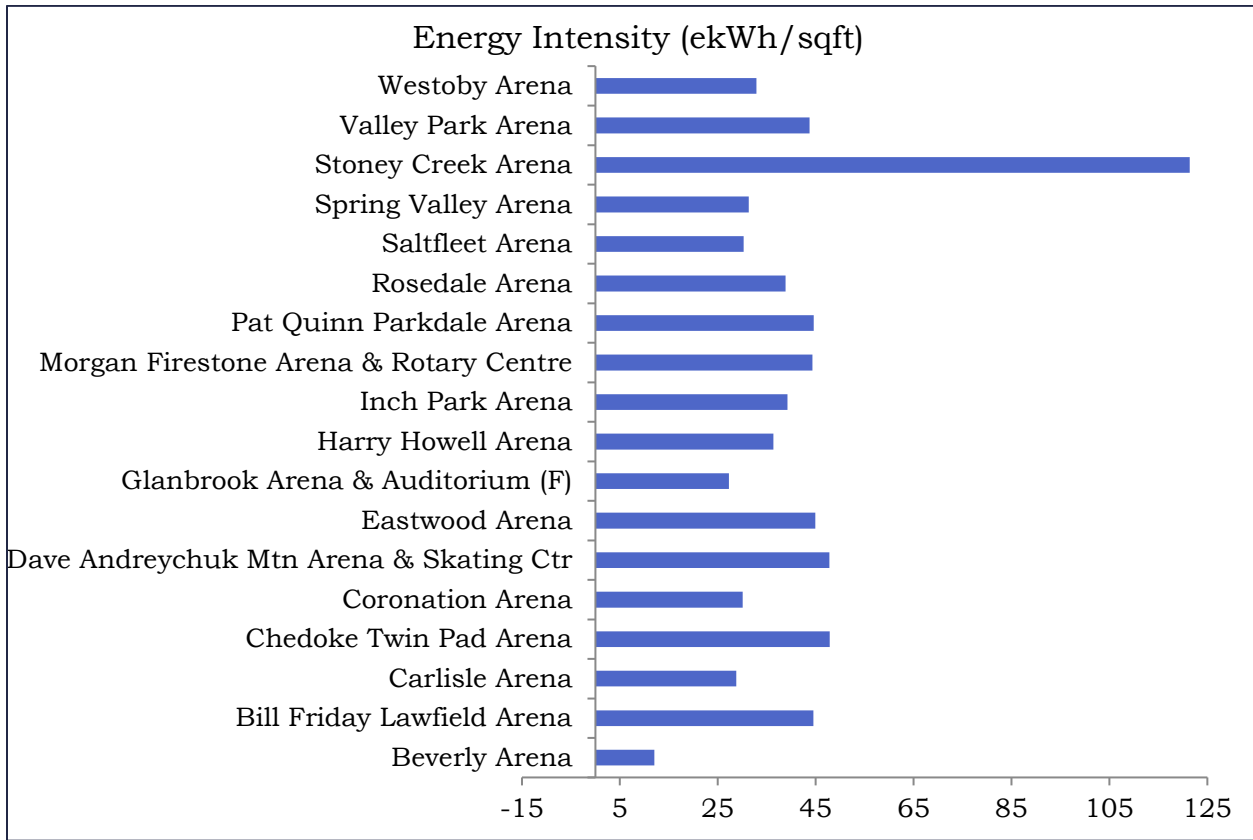


Figure A-11: Lodges 2019 Energy Intensity

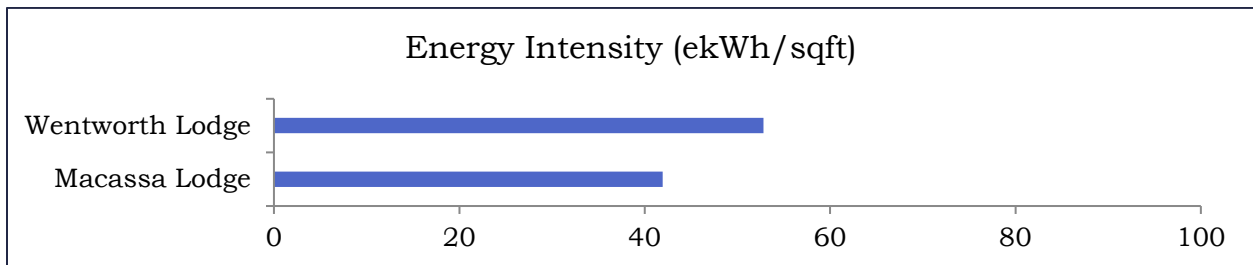


Figure A-12: Yards 2019 Energy Intensity

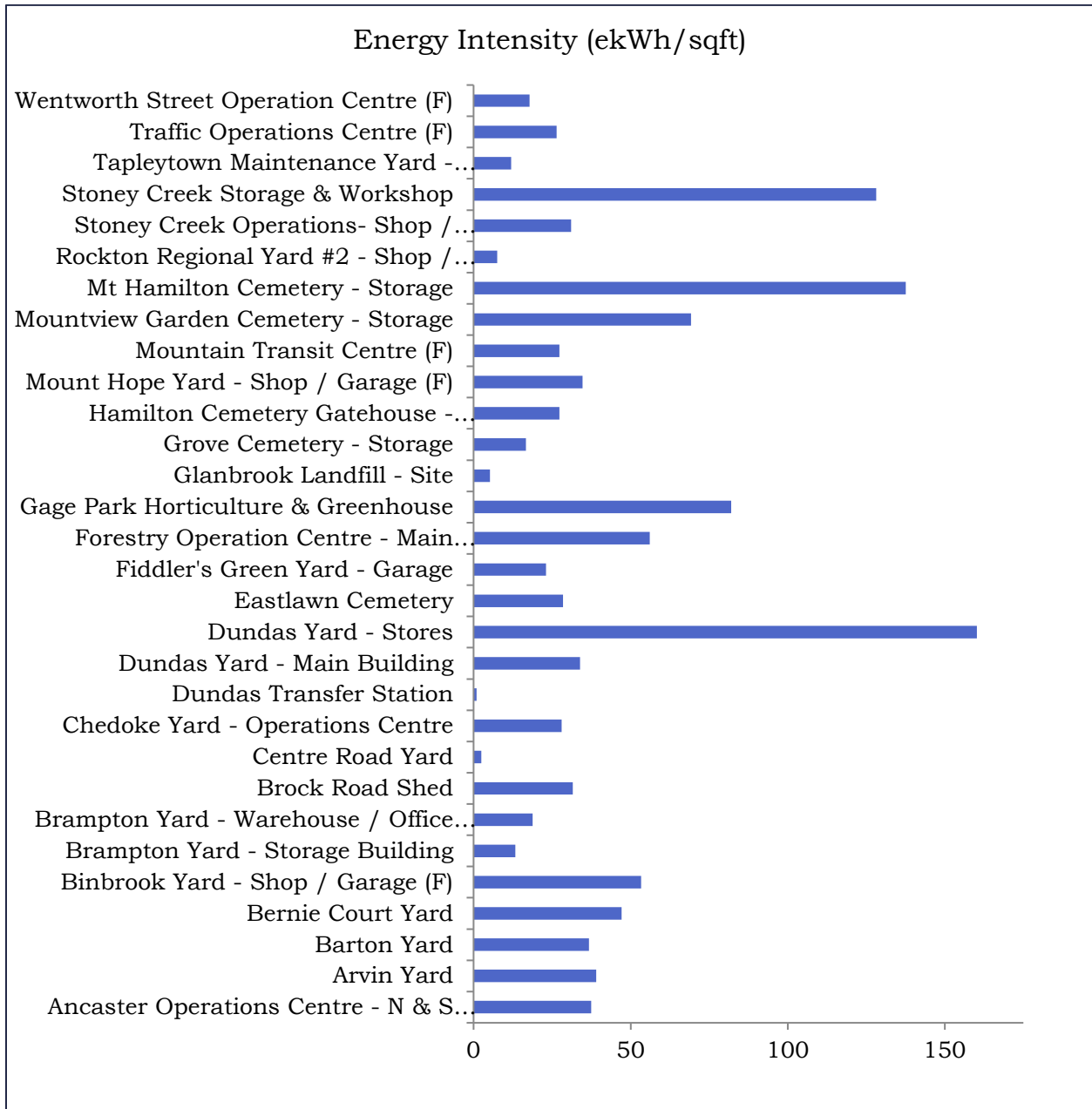


Figure A-13: Community Centres 2019 Energy Intensity

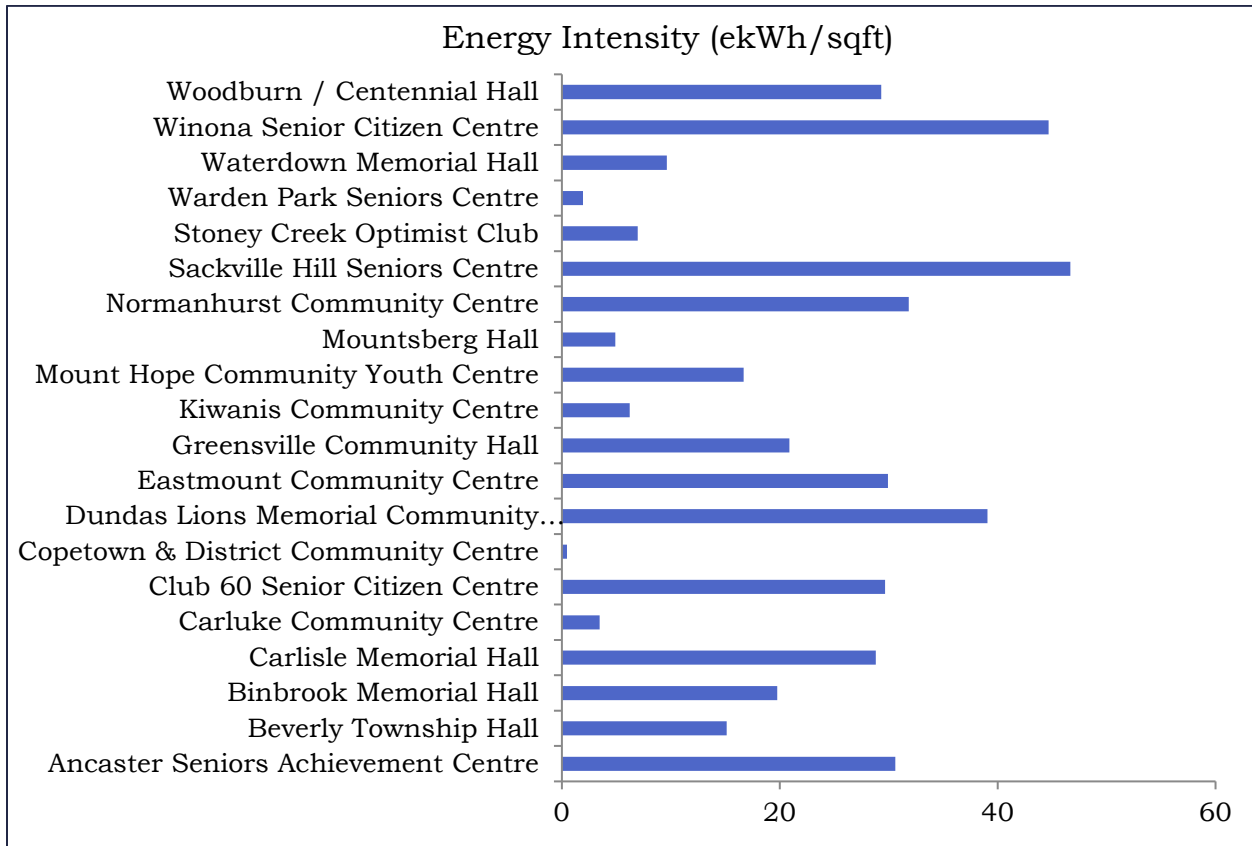


Figure A-14: Culture & Museums 2019 Energy Intensity

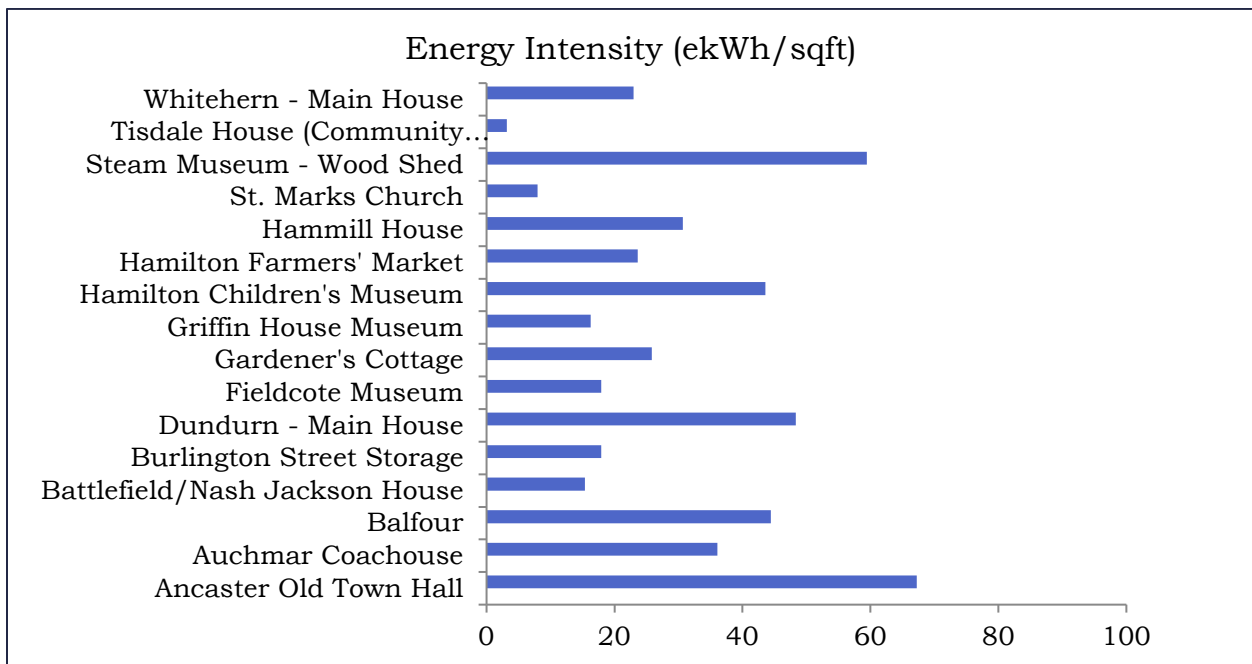
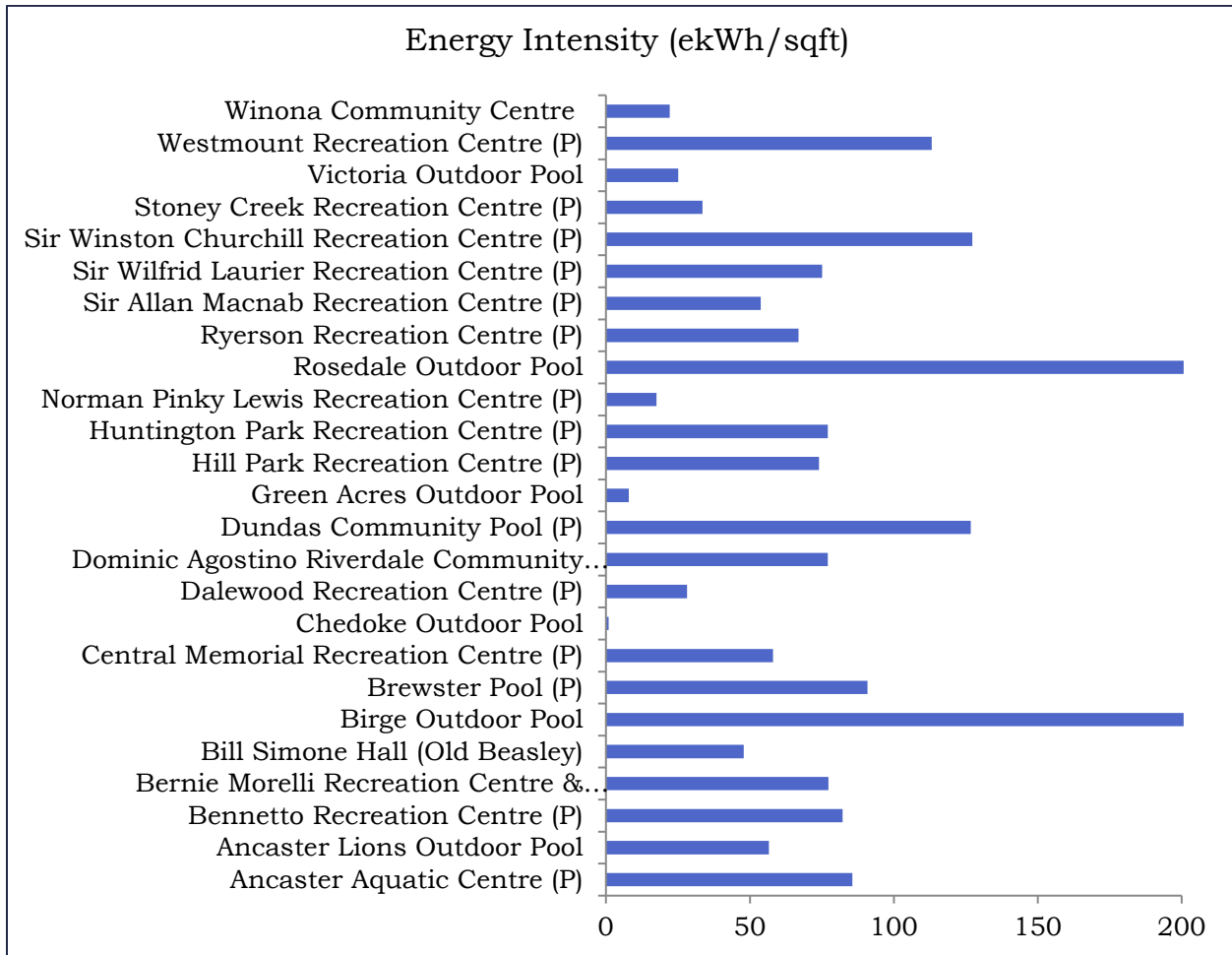


Figure A-15: Recreation Centres and Pools 2019 Energy Intensity



*Birge Outdoor Pool has an energy intensity of 354, Rosedale Outdoor Pool has an energy intensity of 225

Figure A-16: Stadium, Recreation Park Buildings & Golf 2019 Energy Intensity

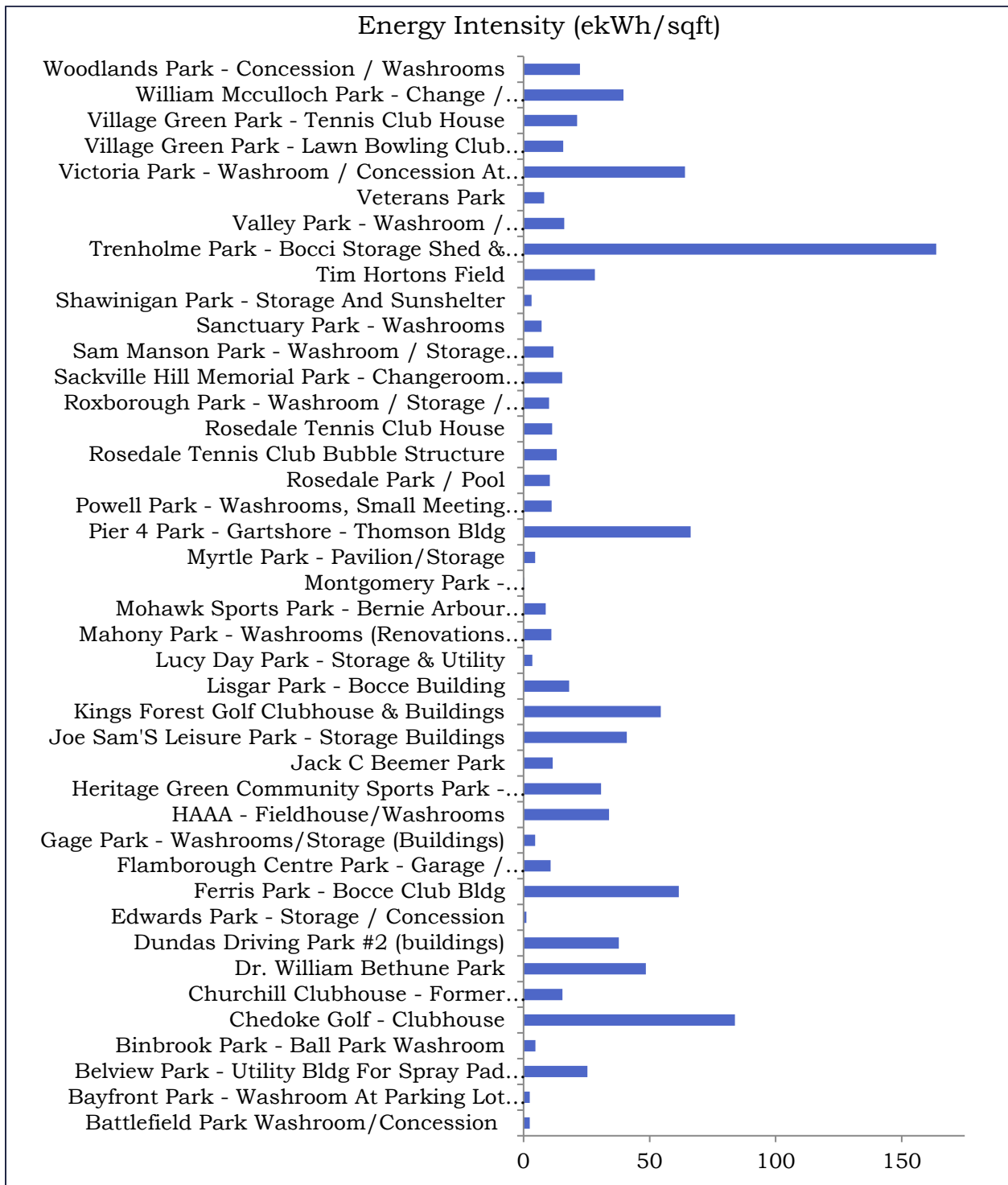


Figure A-17: Libraries 2019 Energy Intensity

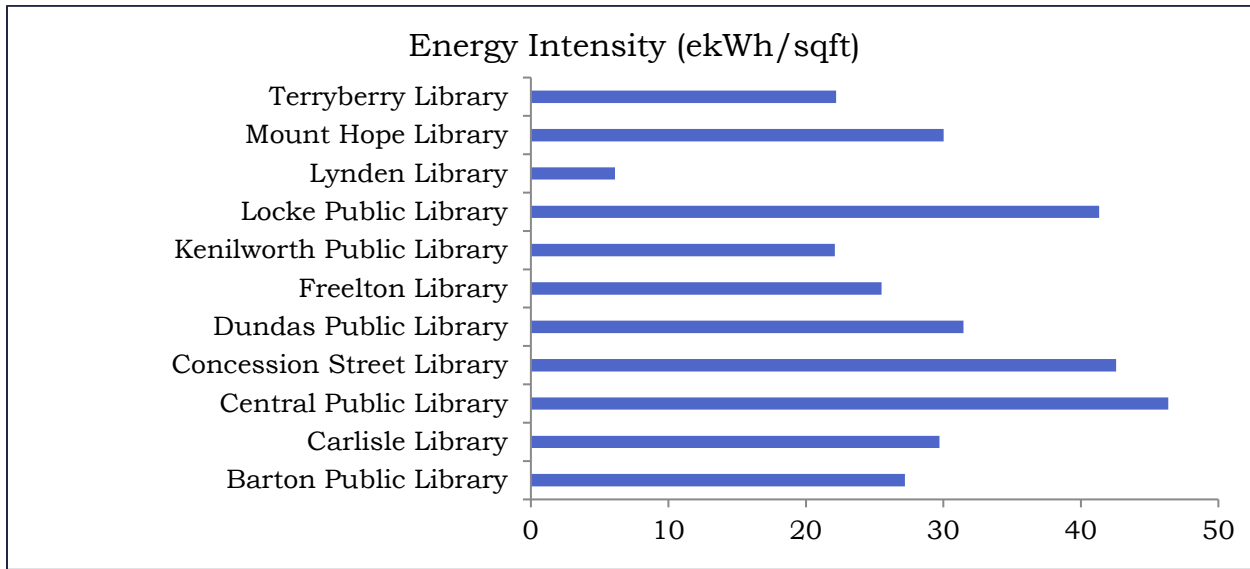


Figure A-18: Entertainment 2019 Energy Intensity

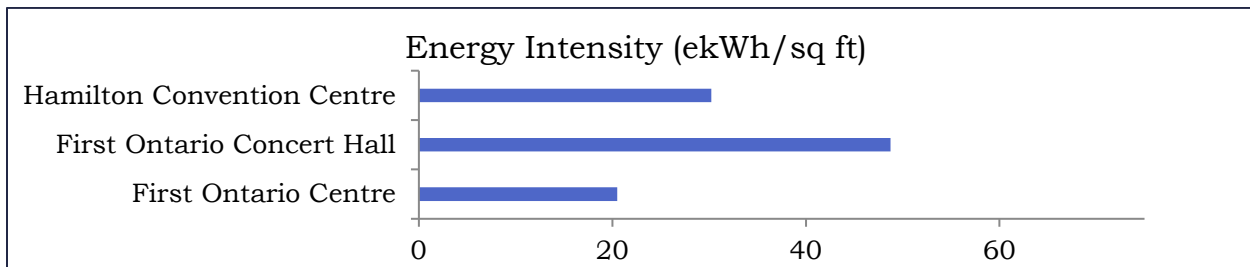


Figure A-19: Police 2019 Energy Intensity

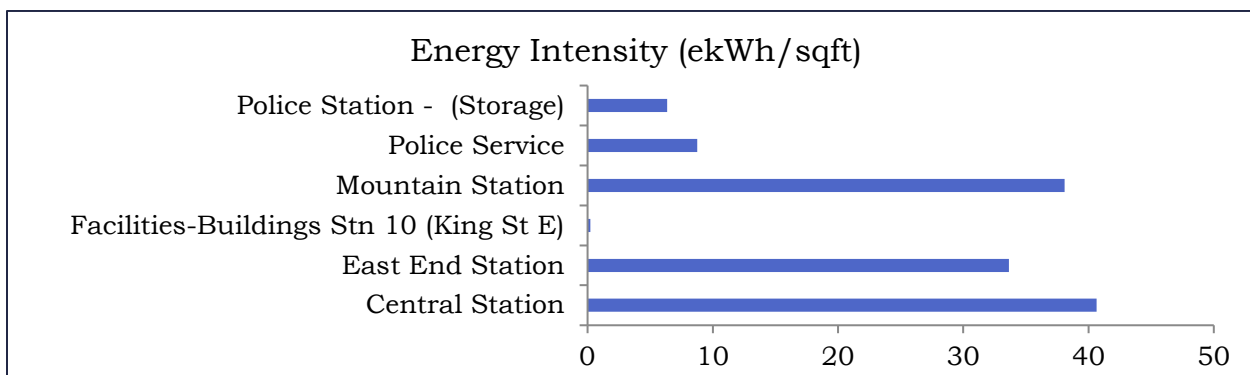
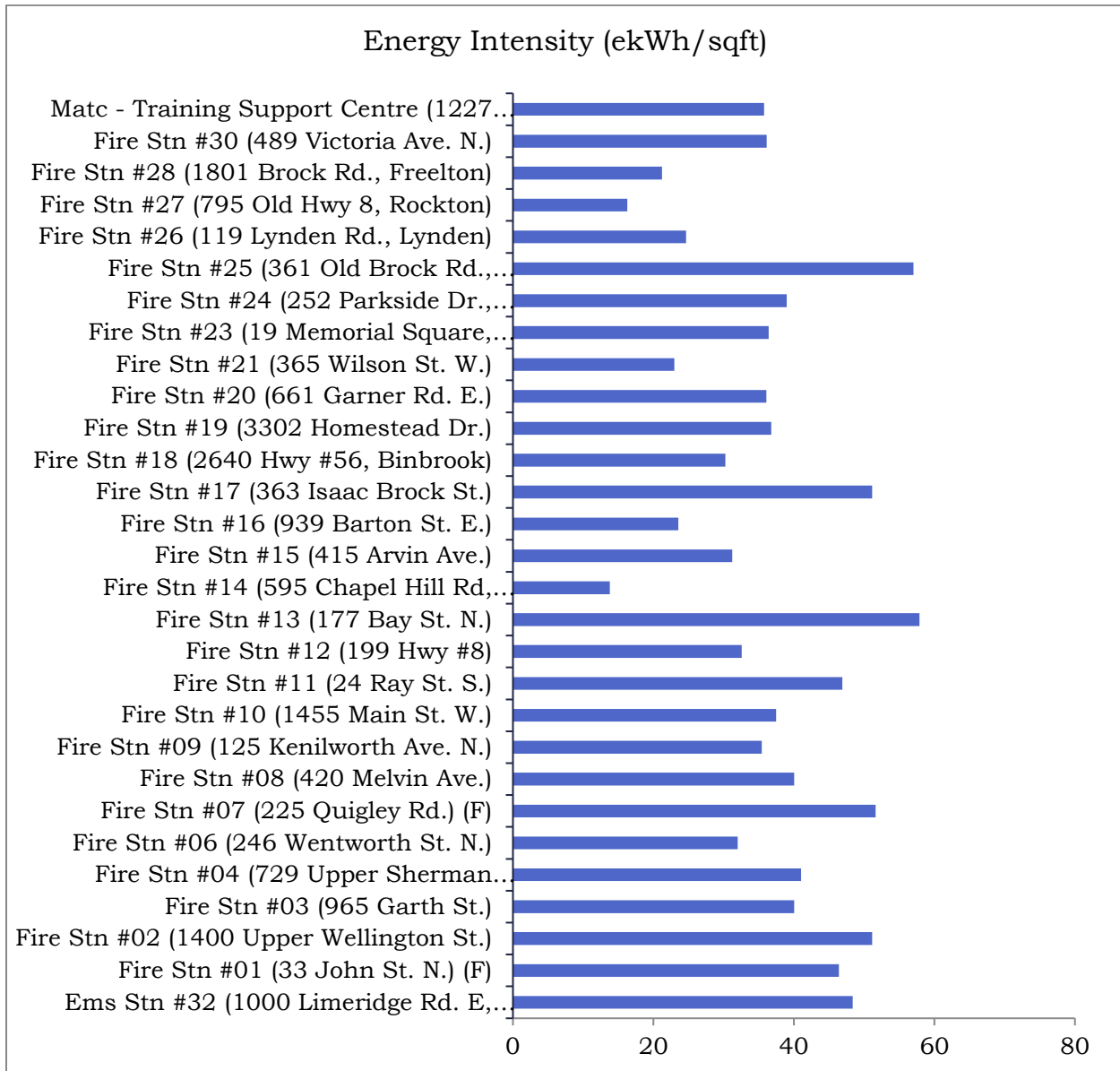


Figure A-20: Fire & EMS 2019 Energy Intensity



Weather Data

Weather and temperatures can impact energy consumption for electricity, natural gas and fuel. Referencing cooling degree days (CDD) and heating degree days (HDD) can help identify one reason why consumption could be higher or lower year over year. CDD is a measure of how much (in degrees) and for how long, the outside air temperature was higher than a specific base temperature. HDD is a measure of how much and for how long the outside temperature was lower than a specific base temperature. The base temperature for this reporting

is 18 degrees Celsius. The City tracks degree day data from Environment Canada.

Figure A-21: Weather Data for Hamilton (Environment Canada – station YHM)

Month	Mean Temp (°C)	HDD	CDD	2019 vs 2018 HDD	2019 vs 2018 CDD
Jan-19	-6.9	745.7	0	-1%	0%
Feb-19	-4.4	627.5	0	10%	0%
Mar-19	-1.3	579.9	0	-1%	0%
Apr-19	5.5	361.5	0	-20%	0%
May-19	11.5	194	0.2	118%	-99%
Jun-19	17.7	37.2	27.9	9%	-35%
Jul-19	22.1	0.6	124.1	100%	0%
Aug-19	20	7.6	66.3	69%	-45%
Sep-19	17	45.8	16.9	-29%	-73%
Oct-19	10	243.2	4	-17%	-47%
Nov-19	0.4	528.6	0	3%	0%
Dec-19	-1.2	594	0	3%	0%
2019 Annual Total		3965.6	239.4	1%	-37%

*HDD = Heating Degree Days/CDD = Cooling Degree Days

Figure A-22: 5 Year Average Compared to 2019 HDD & CDD

Month	HDD		CDD	
	5 YR AVG	2019 vs 5 Yr Average	CDD 5 YR AVG	2019 vs 5 Yr Average
JAN	722	3%	0	0%
FEB	637	-2%	0	0%
MAR	573	1%	0	0%
APR	371	-3%	0	0%
MAY	149	30%	18	-99%
JUN	38	-2%	39	-28%
JUL	2	-75%	106	17%
AUG	10	-26%	85	-22%
SEP	53	-14%	44	-62%
OCT	238	2%	4	-7%
NOV	435	22%	0	0%
DEC	588	1%	0	0%
Average	3816	4%	296	-19%

Figure A-23: Heating Degree Days (HDD)

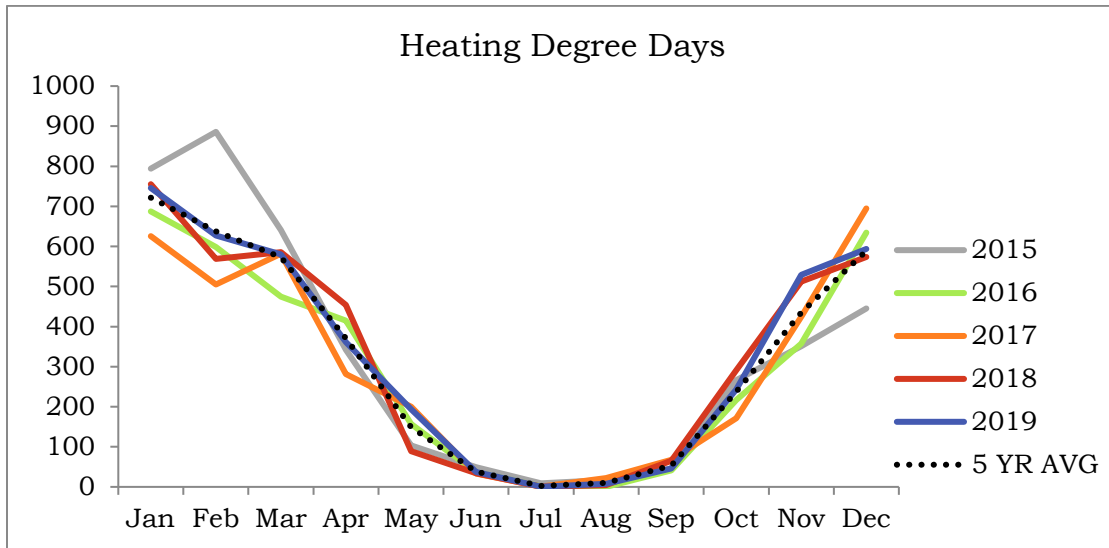
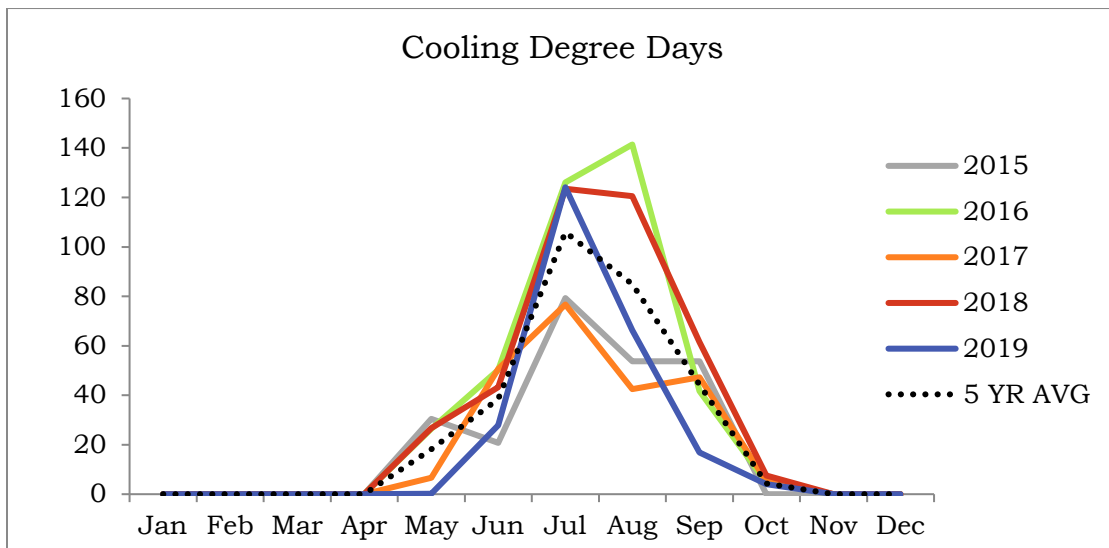


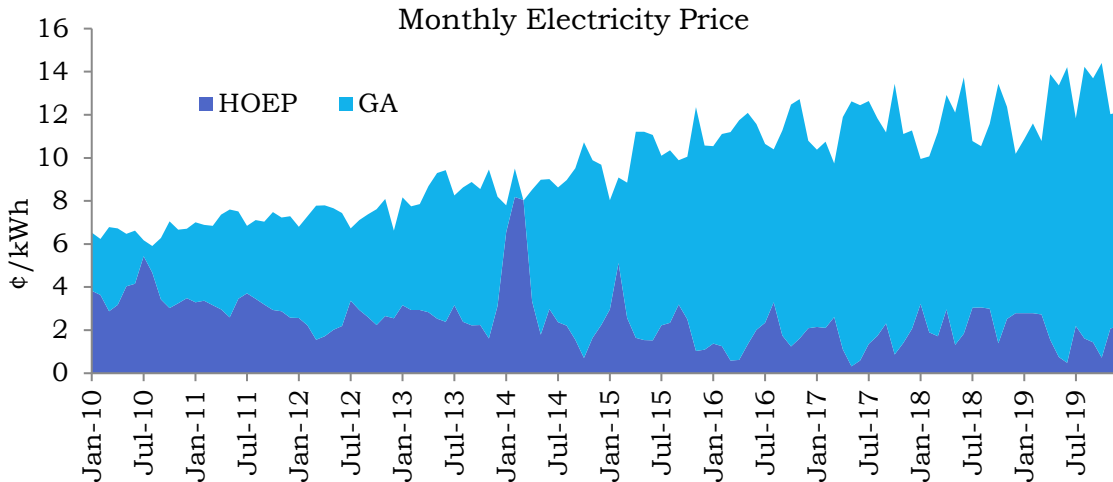
Figure A-24: Cooling Degree Days (CDD)



Global Adjustment

Electricity commodity in Ontario comprises two components; the Hourly Ontario Energy Price (HOEP) and the Global Adjustment (GA).

Figure A-25: Electricity Monthly Commodity Price (2014-2019)



For the Global Adjustment, consumers are divided into two rate classes. Most commercial consumers are Class B. Class B consumers pay the regulated GA rate set monthly. Eligible, high demand consumers can opt for a Class A rate. The Class A rate consumers pay their GA rate based on a percentage contribution to the total provincial monthly GA costs, calculated during a peak setting period. The benefit to a Class A consumer is that they can impact their costs by reducing demand during peak periods. The City tracks these benefits and they are included in this report in the Energy Strategies and Programs under “Utility Rate and Commodity Strategies”. The City has the following Class A sites: 900 Woodward Ave., 850 Greenhill Ave., 78 Kenilworth Ave., FirstOntario Centre, the CUP Operations, and Tim Horton’s Field.

Figure A-26: Cumulative Class A Global Adjustment Results

Year	Standard Global Adjustment Charge	Actual Global Adjustment Charge	Cost Benefit
2011	\$2,703,065	\$1,640,102	\$1,062,963
2012	\$3,852,903	\$2,354,335	\$1,498,568
2013	\$5,720,669	\$3,220,565	\$2,500,104
2014	\$5,574,562	\$3,127,867	\$2,446,695
2015	\$7,931,504	\$4,020,207	\$3,911,297
2016	\$9,132,962	\$4,450,757	\$4,682,206
2017	\$10,218,507	\$4,242,405	\$5,976,103
2018	\$10,417,523	\$4,012,950	\$6,404,572
2019	\$11,613,062	\$4,365,025	\$7,248,037
Total	\$67,164,757	\$31,434,212	\$35,730,546

Figure A-27: 2019 Class A Global Adjustment Results by Month

2019	Standard Global Adjustment Charge	Actual Global Adjustment Charge	Cost Benefit
Jan	\$724,936	\$353,623	\$371,312
Feb	\$749,544	\$335,825	\$413,718
Mar	\$730,958	\$317,146	\$413,812
Apr	\$1,099,653	\$345,064	\$754,589
May	\$1,182,253	\$503,875	\$678,378
Jun	\$1,262,165	\$466,411	\$795,753
Jul	\$893,712	\$348,008	\$545,704
Aug	\$1,104,075	\$401,921	\$702,154
Sep	\$995,470	\$327,825	\$667,644
Oct	\$1,148,410	\$366,179	\$782,232
Nov	\$887,905	\$296,362	\$591,543
Dec	\$833,983	\$302,785	\$531,198
Total	\$11,613,062	\$4,365,025	\$7,248,037

Peak Days

The GA charges for Class A are calculated based on a percentage of demand during the peak setting period. The peak setting period runs from May to April annually, and the top 5 demand hours are used to calculate each Class A site's demand factor, which is used to calculate the GA charges each month. Public Works personnel work collaboratively to manage peak events and reduce demand during these periods. The Office of Energy Initiatives (OEI) use tools to predict peaks and notify key frontline staff. Staff, such as operators in Hamilton Water and Corporate Facilities may shift processes to off peak times and/or minimize usage during a potential peak event.

Figure A-28: Top 10 Ontario Verified Peak Demand Days (May 1, 2019 – April 30, 2020)

Rank	Date	Hour Ending (EST)	Adjusted AQEW (MW)
1	05-Jul-19	17	21,275
2	20-Jul-19	17	21,147
3	29-Jul-19	17	21,068
4	19-Jul-19	12	21,006
5	04-Jul-19	18	20,956
6	21-Aug-19	17	20,848
7	10-Jul-19	17	20,600
8	17-Jul-19	17	20,542
9	13-Aug-19	17	20,536
10	20-Aug-19	17	20,533

*AQEW= Adjusted Allocated Quantity of Energy Withdrawn: Source [IESO/Settlements/Global Adjustment Class A](#)

Fuels

Figure A-29: 2019 Fuel Usage by User Group

Group	Diesel Litres	Unleaded Litres	CNG DLE	Total (DLE)
Energy, Fleet & Facilities	18,973	103,959	-	122,932
Engineering Services	-	41,848	-	41,848
Environmental Services	1,082,573	402,982	-	1,485,555
Hamilton Water	166,228	189,656	-	355,885
Operations	1,369,077	444,978	-	1,814,055
Transportation	87,882	46,377	-	134,259
Other	391,492	1,046,850	-	1,438,342
Transit	5,479,391	87,925	6,388,918	11,956,234
Totals	8,595,617	2,364,574	6,388,918	17,349,109

Notes for Clarification on the above fuel usage data:

- 1) Transit includes Transit Operations, Route Planning and Transit Yard Support.
- 2) Operations includes Waste Management, Landfill, Roads and Support Services.
- 3) "Other" includes Public Health, Recreation, Tourism and Culture, Library, Bi-Law Services, Mayor's Office, City Clerk's Office and Information Services.

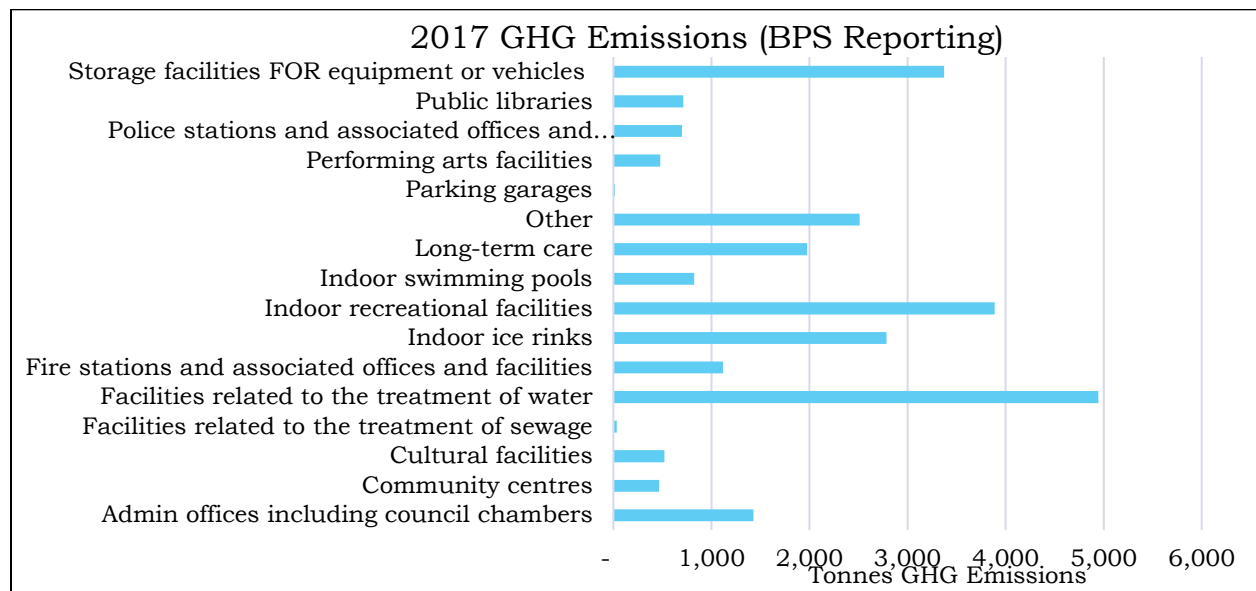
Broader Public Sector Reporting (BPS)

The City submits the annual reporting data for GHG emissions as part of the adherence to Ontario Regulation 507/18. Annual reporting will continue as required.

The latest submission, July 2019 was for the calendar year 2017. According to the reporting formula City-owned corporate facilities (building only) were responsible for emitting 25,779 tonnes of CO₂e. The categories for this reporting requirement are pre-set and do vary from the City's internal reporting and are limited to buildings only. However, they do continue to represent corporately-owned assets only. In addition to reporting on an annual basis, the City is also required to submit a five-year Conservation and Demand Management (CDM) Plan, submitted in July 2019. Both the annual data submission and the CDM Plan are found on the City website:

<https://www.hamilton.ca/office-energy-initiatives>.

Figure A-30: 2017 GHG Emissions Results O.Reg 507/18



Glossary

Common Acronyms used throughout the report

BPS = Broader Public Sector

CAFE = Corporate Average Fuel Economy

CDD = Cooling Degree Days

CDM – Conservation and Demand Management

CEP = Corporate Energy Policy

CNG = Compressed Natural Gas

CO₂ = Carbon Dioxide

CO₂e = Carbon Dioxide equivalent

DLE = Diesel Litre Equivalent

ekWh = equivalent kilowatt hours

GA = Global Adjustment

GHG = Greenhouse Gas

GJ = Gigajoule

HDD = Heating Degree Days

HOEP = Hourly Ontario Electricity Price

HRPI = Hamilton Renewable Power Inc.

IESO = Independent Electricity System Operator

KPI = Key Performance Indicator

kW = Kilowatt

kWh = Kilowatt-hour

LED = Light Emitting Diode

m³ = Cubic Metres

OEB = Ontario Energy Board

tCO₂e = Tonnes Carbon Dioxide equivalent

Definitions: Common concepts used throughout the report

Energy Performance is the collection of performance measurements including consumption, cost and energy intensity as compared against baseline and year over year.

Energy Intensity is the measurement of energy used per square foot of facility space.

Avoided Cost/Cost Avoidance refers to the costs not incurred as a result of some action taken which is outside of status quo.

Utility Rates refers to the rate classes identified by utility providers.

Rate Optimization refers to ensuring that utility accounts are assigned to the appropriate rate class to result in best cost benefit.

Cost Recovery is the value collected by identifying billing errors, billing anomalies or rates corrections that result in a financial adjustment to costs.

Incentives are monies received from a recognized program including from utility providers, the IESO, Federal or Provincial grant programs where incentives are tied to energy conservation measures.

Energy Conservation is the collection of energy efficient measures, equipment or processes that lead to lower consumption.

Commodity Hedging is the process of fixing prices for specific terms for natural gas, fuels or electricity (commodities).

Unit Cost is the total price of variable and fixed costs per unit. In this report it refers to unit costs of electricity, natural gas and fuels.