
2021 Annual Energy Report

**City of Hamilton
Public Works**

Our Mission



***“To provide
high quality
cost
conscious
public
services that
contribute to
a healthy, safe
and
prosperous
community, in
a sustainable
manner.”***



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Introduction

The Coronavirus pandemic continues to impact communities around the world. As we moved from 2020 and through 2021, the response to the complicated pandemic situation continued its effects on operational activities and community programs. While there was some recovery of services within 2021, there were also periods of shut-down, building closures and other measures designed to slow the spread of the virus and reduce its impact on the provincial health care system. The introduction of different mutated variants accelerated the spread and resulted in additional measures both provincially and federally, such as travel restrictions, vaccine mandates, contact tracing, and masking.

From an energy perspective, evaluating the annual energy results for 2021 is comparable to 2020 wherein results were greatly impacted by changes to social and public services. It is important to remember that City buildings still required heating, cooling and lighting even with lower capacity or closures. In some cases, buildings were re-purposed or modified to accommodate new health measures and staff re-deployed to administer required City amenities to the public. Fleet and transit vehicles still required fuel in order to maintain essential City services.

Overall, the results for 2021 need to be viewed through the lens of the continued atypical global experience associated with pandemic response.

The reporting contained herein provides data for the City's energy and fleet usage, utility and fuel costs, energy intensity in addition to the savings and avoided costs for a variety of energy reduction programs, strategies and benchmarks. Overall, the key metrics result in an energy intensity reduction of 34% when compared to the base year of 2005.

The GHG emissions inventory for 2020 is also presented within this report. For 2020 it shows a GHG inventory reduction of 51% when compared to base year.



2021 Highlights



Energy Utility Spend of \$42.4M¹ in 2021 (electricity, natural gas, fuels)



Energy Intensity Reduction of 34% from base year



Corporate GHG Emissions Inventory 2020 Reduction of 51% from base year



\$518,976 in Cost Recovery from Utility reviews



Energy Strategies and Programs Savings & Avoided Costs \$8.3M



Combined (Electricity & Natural Gas) usage up 3% in 2021 over 2020



1118 tCO₂e (GHG Emissions) saved as a result of Efficiency Projects in 2021



Approval of the City's Fleet Services Green Fleet Strategy June 2021



1% increase in Fuels consumption (diesel, gasoline and CNG) over 2020

¹ See Overall Energy Costs section on pages 8-9 for inclusions and exclusions of utility costs.

At A Glance

Despite another unusual year of activity, energy reduction, conservation, operational improvements along with policy and plan development remained key priorities. The following items are discussed in greater detail throughout the report.

STRATEGIC HIGHLIGHTS

Energy Intensity, which is the energy use per measured area is one of the key performance indicators (KPI) for the City. Typically, it can show results of energy efficiency actions on City buildings. Projects, operational improvements and behavioral improvements can reduce energy intensity resulting in the achievements of broad corporate targets. 2021 continued to be an interesting year as it pertained to energy usage and KPIs for the City.

Like 2020, there were several public health guidelines initiated that resulted in closures of buildings, or shifting operations, which did reduce energy use overall when compared to pre-COVID use.

2021 Energy Intensity Reduction is 34% when compared to 2005 base year, and a 13% reduction to Pre-COVID 19 numbers (2019) and a 2% increase over 2020.

FINANCIAL HIGHLIGHTS

The overall annual cost of utilities (electricity, natural gas and fuels) for City-owned buildings and vehicles² amounted to \$42.4 million (M), which was an increase of 12% from last year. A lot of this can be attributed to increases in consumption and per unit costs from commodity or rate increases.

In addition, although Provincial COVID-19 rate relief programs continued throughout 2021,

some of the deferred costs from 2020 were further recovered by utilities in the later part of 2021, specifically with electricity rates.

Energy strategies and programs (cost recovery, hedging, rates activities and conservation efforts) continued throughout 2021, and the annual results of savings and avoided costs were \$8.3 million.

OPERATING HIGHLIGHTS

Pandemic response throughout 2021 resulted in temporary building closures or modified hours and services at varying points throughout the year. Installation of several health and safety measures occurred to accommodate for a return to in-person services. It is important to note that buildings, while many are still operating at reduced capacity, require heating, cooling and staffing to ensure continued building integrity and adherence to maintenance schedules. Some of the buildings were also temporarily repurposed for public health use.

Compared to 2020, Electricity usage was 3% higher, natural gas was 3% higher and fuel used (by fleet and transit) was also 1% higher.

Combined Energy Use (electricity and natural gas) was 3% higher than 2020 and 11% lower compared to 2005 base year.

Fuel used was 1% higher than 2020.

² See Overall Energy Costs section on pages 8-9 for inclusions and exclusions of utility costs.

Corporate Energy & Sustainability Policy

One of the tools used to guide decision making around energy use reduction, sustainability, emissions and reporting for corporate assets and operations is the Corporate Energy and Sustainability Policy. The policy was revised in 2020 to further re-iterate the importance of considering energy and sustainability decisions in capital planning, and to align it with other City-wide initiatives including other corporate and community-based plans, such as addressing climate change, renewable energy and Fleet and Transit policies.

The revisions re-committed to existing energy intensity targets and included an update to targets for GHG emissions reduction to achieving Net Zero emissions by 2050. In addition, further actionable items were defined in the areas of building efficiency, sustainable building, and operational set points and improvement measures.

The targets confirmed in the 2020 revision to the policy include:

Figure 1: Corporate Energy Intensity and Emissions Reduction Targets

Year	Energy Intensity Reduction Targets	Emissions Reduction Targets
2020	20%	20%
2030	45%	50%
2050	60%	100%*

*Net zero emissions

The revised policy was accepted by Council in February 2021. The policy document is revised every five years to ensure that it remains relevant to the existing regulatory environment and to other City-endorsed policies or initiatives on energy reduction and sustainability.

Energy Strategies & Programs KPI Results

Reporting on various metrics related to energy and utilities, the “key performance indicators” have been a principal measure for evaluating the City’s performance and results from different decisions made, or strategies developed to meet different City goals and targets.

Although costs may be impacted by many outside factors, cost reduction and the avoidance of costs are a result of energy strategies and programs implemented by the City. Energy conservation projects, utilizing incentive programs, bill recovery from reviewing utility invoices or tax rebate programs, and utility rate optimization are a few of the methods used to contribute to annual cost savings or mitigation of costs for the City.

Overall, the total results from implementing the various energy strategies and programs in 2021 has resulted in a savings and avoided costs of \$8.3M.

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 plans, natural gas hedging strategies and optimizing utility rates including switching rate class to increase benefits from

Global Adjustment (GA) savings opportunities. Natural gas hedging strategies resulted in an avoided cost of \$226,143 for 2021. GA strategies resulted in an avoided cost of \$3.6M for 2021. The total avoided costs under this category is \$3.8 M in 2021.

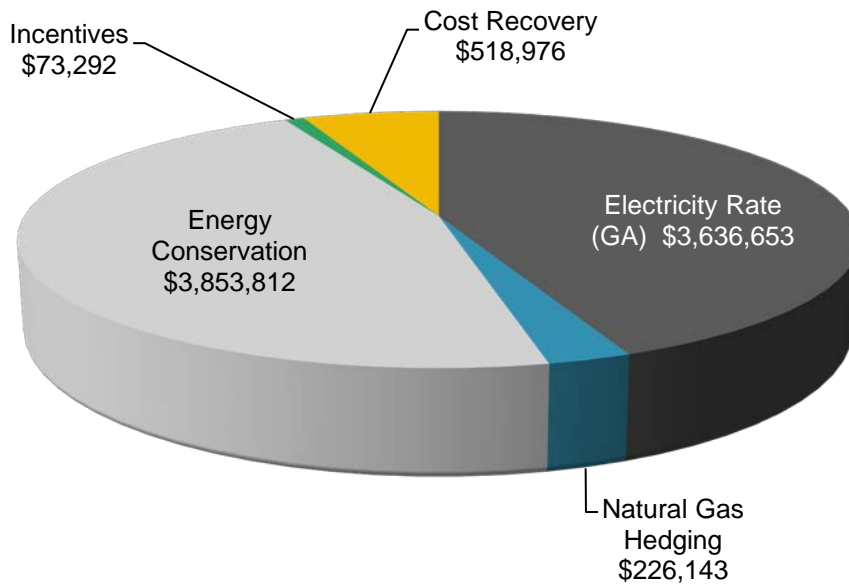
COST RECOVERY

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 fuel tax recovery programs. In 2021, the consistent review of the City's accounts and of corrected estimated billings resulted in \$518,976 of savings in this area.

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. The project savings for 2021 was \$3.8M, with incentives received of \$73,292, for a total of \$3.9M in this category. Any incentives applied for, but not confirmed or received by the City, will be reported in the following year's report.

Figure 2: 2021 Breakdown of Energy Strategies and Programs KPI Results



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. The costs are period normalized for usage in the 2021 year. In addition, for the purposes of 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.

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 much 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.

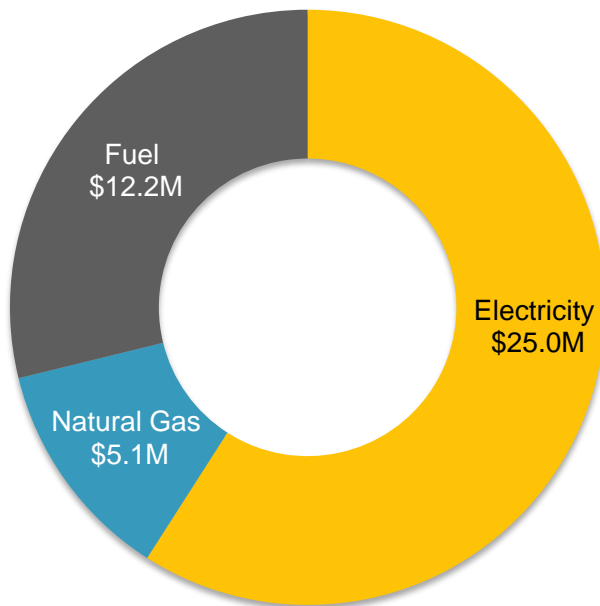
Costs determined in this report are incurred by City-owned buildings/sites and exclude City Housing Hamilton. Utilities include Alectra Utilities, Hydro One Utilities and Enbridge Gas Inc. Sites linked to the district energy system with utility costs provided from HCE are included in electricity and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

The inclusion of buildings/sites 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.

Despite a slight increase of combined usage of electricity and natural gas for buildings (3%) in 2021, the costs were 7% higher overall. There are several contributing reasons for this: Some of the costs for electric utilities to implement temporary rate relief programs in 2020 were then recovered in 2021. The federal carbon charge for natural gas increased as scheduled in April 2021, and there were periods of commodity market volatility in 2021 due to the push for economic recovery both domestically and globally that put pressure on prices overall. Fuel usage increased by 1%, but costs were 28% higher in 2021 when compared to 2020.

Additional information on the impacts will be discussed in upcoming sections of this report. In 2021, the total spend for consumption of electricity, natural gas and vehicle fuels (diesel, unleaded gasoline and compressed natural gas (CNG)) was \$42.4M, an increase of 12% overall than in 2020.

Figure 3: 2021 Energy Utilities Costs for Electricity, Natural Gas and Fuels³



³ Total Costs rounded for graph, total amount = \$42,375,909. Includes City-owned buildings/sites, excluding City Housing Hamilton and is period normalized. Fuels include diesel, gasoline, compressed natural gas. Excludes data for Hamilton Police and DARTS.

Energy Performance KPI Results

This section reviews the comparison results of electricity, natural gas and energy intensity to the prior year (2020) and to the base year (2005). For some of the KPIs noted in this section, we also included additional comparison points to determine how 2021 compared to pre-pandemic (2019) results. The added point is to demonstrate the results in 2021 as compared to a more “typical” year. However, as noted, the impacts of the pandemic response and varying closures of City buildings and services, did continue throughout 2021 so isolating specific reasons for results is still difficult to quantify.

The energy consumption and costs reported here are period normalized for 2021 and are calculated as usage and cost during that period and may or may not coincide with a billing period for any given account. Additional charts on the results presented in this section are in Appendix A of this report.

ELECTRICITY CONSUMPTION AND COST

Electricity consumption in 2021 was a slight increase of 3% when compared to 2020, and a 6% decrease when compared to 2019. Costs were a 6% increase over 2020 and 2% when compared to 2019. The figure below shows the consumption and costs comparisons.

Figure 4: 2021 Electricity Consumption and Cost Comparison

Electricity Overview	2005	2019	2020	2021	Comparisons		
					2021 vs 2005	2021 vs 2019	2021 vs 2020
Total Electricity (kWh)	236,362,045	216,929,517	199,136,278	204,698,978	-13%	-6%	3%
Total Electricity (\$)	\$20,657,050	\$24,575,215	\$23,619,728	\$25,029,589	21%	2%	6%
Total Electricity (\$/kWh)	\$0.087	\$0.113	\$0.119	\$0.122	40%	8%	3%

Costs for electricity comprises commodity, delivery, transmission and other regulatory charges. Commodity includes the Hourly Ontario Energy Price (HOEP) and the Global Adjustment (GA). Both portions of the commodity are determined by market-based factors and are administered by Ontario’s Independent Electricity System Operator (IESO). The other charges, delivery, transmission and regulatory are regulated by the Ontario Energy Board (OEB), and any requests by a local utility (also called a local distribution company), to change such rates requires OEB approval. The City of Hamilton operates within two local distribution companies, Alectra Utilities and Hydro One.

The City has a variety of rate classes due to the different sizes and needs of power across the City. There are small commercial (or residential) accounts, unmetered or static accountss (i.e. streetlights), large commercial or demand-based rate accounts, and a few high demand (Class A) accounts. The unit cost is a blend of the varying rates and therefore is not necessarily reflective of a specific account.

The impacts to consumption (and cost) are varying, but typically relate to weather conditions, building capacity, operations and energy efficiency. In 2021, COVID-19 continued to impact building capacity and operations as many of the city buildings had periods of shutdown to both staff and the public. However, most buildings did continue to require base cooling and heating throughout 2021. Additionally, the largest user of electricity for the City is Hamilton Water which operates its systems as required for the needs and safety of the public and is not necessarily impacted by lockdowns the same way public buildings are.

In 2020, as a response to the COVID-19 pandemic, electric utilities offered temporary rate relief plans, including price caps on peak electricity prices and global adjustment, and deferred some pre-approved rate plans and increases into 2021. Additional programs were implemented to offer financial stability for small business and residents with deferred payment or payment plans. In 2021, the costs from many of these programs were recovered, and many of these programs ended in early 2021. However, as a result

of continued hardship on residents and small businesses, short term plans were re-introduced in the later part of 2021. Any costs for those programs would be deferred into 2022.

For the large commercial and industrial sector, modifications were made to the IESO's ICI program (GA – Class A) to allow for those sectors to focus on financial recovery and stimulating the economy by eliminating the requirements that they respond to peak electricity demand events during the 2020-2021 peak setting period (May 2020 – April 2021). However, the peak setting period that began May 2021 will impact the Class A peak demand factor (PDF) taking effect July 2022. That is, the actions customers take to reduce demand during peak periods of provincial demand will impact their portion of GA costs and overall cost benefit.

Weather can also play a role in usage across the City. The cooling degree days in 2021 were 15% lower than in 2020, and on par with the 5-year average. Likely it took slightly less electricity to reduce the temperatures during the summer period than it did in 2020. However, coupled with the reduced capacity in buildings, it is difficult to say how much the cooling demand was an impact on consumption overall.

NATURAL GAS CONSUMPTION AND COST

Natural Gas consumption for buildings in 2021 was a 3% increase over 2020, and down 5% from 2005. Costs for natural gas were 14% higher in 2021 as compared to 2020, and the unit cost was 10% increase from 2020. The overall increase in consumption and costs in 2021 compared to 2019 was due to the addition of volume for the biosolids production at the Hamilton Water Woodward site.

Figure 5: 2021 Natural Gas Consumption and Cost Comparison

Natural Gas Overview				Comparisons			
	2005	2019	2020	2021	2021 vs 2005	2021 vs 2019	2021 vs 2020
Total Natural Gas (m ³)	15,403,956	13,478,604	14,100,215	14,573,707	-5%	8%	3%
Total Natural Gas (\$)	\$6,520,253	\$3,800,296	\$4,505,011	\$5,131,213	-21%	35%	14%
Total Natural Gas (\$/m ³)	\$0.423	\$0.282	\$0.319	\$0.352	-17%	25%	10%

Costs for natural gas include the commodity charges, which the City purchases on the wholesale market via purchasing agreements, and distribution and transportation charges, which are provided by Enbridge Gas. The gas is delivered to the end user by Enbridge Gas regardless of where the commodity is purchased.

There are a few factors that led to an increase in the cost per m³, which is the best indication of changes in the costs. The largest impact to costs was the annual increase in the Federal Carbon charge, which increased from 5.87 cents per m³ to 7.83 cents per m³ at April 1, 2021. In addition, Enbridge delivery and administrative rates did increase as well.

Natural gas accounts do also vary in their rate classes and the unit cost is a blend of these rates. For natural gas, most of the City's accounts are residential (small commercial) or mid to large commercial rates. The City does also have two high volume industrial accounts, one of which is for Transit's compressed natural gas (CNG) bus fueling and is not included in the usage or costs shown above. It is included in the fuels section. The second account is for the biosolids production activity at the Woodward campus.

While the City does hedge the price on a large portion of natural gas, the commodity market prices for natural gas in the later part of 2021 did begin to increase as domestic and global industrial and commercial demand rose steadily. This does have some impact on any unhedged volumes of the City's natural gas requirements.

The heating degree days (HDD) in 2021 were on par with 2020, and overall 7% lower than the 5-year average. In 2021, there was higher HDD during January and February than in 2020 which is also typically the higher demand period for building heat. However, Ontario was also experiencing some building lockdowns and limited capacity during that time which may have limited some of the impacts of incremental heating needs during that time.

COMBINED CONSUMPTION AND COST (ELECTRICITY AND NATURAL GAS)

The combined consumption of electricity and natural gas converted to equivalent kilo-watt hours (ekWh)⁴ represents a 3% increase over 2020, and slightly less than 2019. It is a 11% decrease in consumption when compared to the base year of 2005. Overall, the cost for electricity and natural gas combined increased by 7% over 2020 and by 11% to the base year.

Figure 6: 2021 Combined Consumption and Cost Comparison (Electricity and Natural Gas)

Total Combined Energy Overview				Comparisons			
	2005	2019	2020	2021	2021 vs 2005	2021 vs 2019	2021 vs 2020
Total Energy (ekWh)	400,722,256	356,567,857	345,214,509	355,682,587	-11%	0%	3%
Total Energy Cost (\$)	\$27,177,303	\$28,375,511	\$28,124,739	\$30,160,802	11%	6%	7%
Total Energy (\$/ekWh)	\$0.068	\$0.080	\$0.081	\$0.085	25%	7%	4%

Collectively, the total numbers show some increase in consumption which we would expect as there were periods of increased activity at buildings. However, much of the increase was due to the Hamilton Water Biosolids production for natural gas and the increased activity at the Woodward site overall with the upgrades occurring there. Police services also showed consumption increases with the addition of their large Investigative Services Facility which was added for the 2021 reporting period. However, many facility groups continued to see decreases in the combined electricity and natural gas.

In the chart below, the combined consumption information is shown by facility grouping, which may be a better reflection of the 2021 results on the various facility and operational groups.



⁴ Combined usage is electricity in kWh plus natural Gas in m³ (converted to ekWh).

Figure 7: 2021 Combined Electricity and Natural Gas Consumption by Facility Grouping (000's of ekWh)

Total Energy Consumption	in 000's of ekWhs				Comparisons		
	2005	2019	2020	2021	2021 vs 2005	2021 vs 2019	2021 vs 2020
City/Town Halls	13,775	8,899	7,528	6,623	-52%	-26%	-12%
Corporate Facilities	17,188	12,256	11,702	9,381	-45%	-23%	-20%
Street Lighting and Traffic Lighting	39,290	19,920	19,328	19,198	-51%	-4%	-1%
Other City Operations	5,618	6,355	4,866	3,986	-29%	-37%	-18%
Hamilton Water	121,040	126,788	145,802	156,362	29%	23%	7%
Yards	39,589	27,869	25,517	26,016	-34%	-7%	2%
Arenas	39,904	35,094	24,505	23,673	-41%	-33%	-3%
Community/Senior Centers	3,834	3,601	3,122	2,681	-30%	-26%	-14%
Rec Centres/Pools	26,789	30,073	27,230	27,000	1%	-10%	-1%
Tim Horton's Field	0	9,267	6,652	7,737	0%	-17%	16%
Rec Parks/Stadiums/Golf	8,332	4,997	4,661	5,134	-38%	3%	10%
Lodges (Macassa, Wentworth)	24,938	15,774	14,756	15,018	-40%	-5%	2%
Culture	5,383	5,278	3,368	3,222	-40%	-39%	-4%
Fire/ EMS	10,698	12,803	11,639	11,203	5%	-12%	-4%
Hamilton Public Libraries	9,343	11,726	10,654	10,235	10%	-13%	-4%
First Ontario Centre	10,122	9,214	8,654	9,292	-8%	1%	7%
First Ontario Concert Hall	5,466	4,571	3,735	4,077	-25%	-11%	9%
Hamilton Convention Centre	4,656	3,780	3,175	3,508	-25%	-7%	11%
Hamilton Police Services	14,757	8,303	8,323	11,338	-23%	37%	36%
City Wide Total	400,722	356,568	345,215	355,683	-11%	0%	3%

ENERGY INTENSITY (CITY-OWNED SITES)

Energy intensity is the measurement of usage in equivalent kilo-watt hours per square foot (ekWh/sqft). The forward targets outlined in the Corporate Energy & Sustainability Policy are a reduction in energy intensity of 45% by 2030 and 60% by 2050 as compared to the base year of 2005. In 2021, the energy intensity represents a reduction of 34% as compared to the base year.

Figure 8: 2021 Energy Intensity Comparison (ekWh/sqft)

Energy Intensity					Comparisons		
	2005	2019	2020	2021	2021 vs 2005	2021 vs 2019	2021 vs 2020
City Total (ekWh/sqft)	45.69	34.34	29.50	30.02	-34%	-13%	2%
City Total (\$/sqft)	\$2.67	\$2.37	\$2.23	\$2.31	-13%	-2%	3%
Reported Square Footage	5,138,852	5,926,831	5,940,090	5,866,611	14%	-1%	-1%

Energy intensity results need to be viewed with some caution as consumption patterns in 2021 were irregular. Although consumption reductions are always a goal, and various policies are in place to support reductions in consumption, such as building temperature set points, reduction of demand during peak days and installation of energy efficient equipment, the 2021 results were heavily impacted by the pandemic response to close buildings and/or limit capacity throughout 2020 and 2021. There was an

increase in energy intensity of 2% over 2020. Compared to 2019 (a pre-pandemic year), the 2021 results in a 13% decrease.

Costs per sqft showed an increase of 3% over last year which is in line with the increases in overall costs of electricity and natural gas. There was a slight decrease in sqft reported in 2021, due largely to some large project work and some closures or sales of corporate properties.

Operational sites, such as street lighting, traffic lighting and park lighting (without buildings) and Hamilton Water sites are not included in the calculation of energy intensity. This is important to note, because for intensity, the additional natural gas volumes for the biosolids production operation at Hamilton Water would not impact the energy intensity results.

In the following chart, the energy intensity results for specific groupings shows where the impacts were more greatly felt as compared to the base year (2005) and to 2019.

Figure 9: 2021 Energy Intensity Comparison by Portfolio⁵

Energy Intensity	ekWh/sqft				Comparisons		
	2005	2019	2020	2021	2021 vs 2005	2021 vs 2019	2021 vs 2020
City/Town Halls	39.6	24.9	21.0	20.3	-49%	-19%	-4%
Corporate Facilities	44.6	22.3	20.3	19.8	-56%	-11%	-2%
Street Lighting & Traffic Lighting	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other City Operations	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hamilton Water	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Yards	38.1	28.7	26.3	25.7	-32%	-10%	-2%
Arenas	51.3	41.9	29.1	29.4	-43%	-30%	1%
Community/Senior Centers	31.1	24.3	24.3	20.8	-33%	-14%	-14%
Rec Centres/ Pools	78.6	64.6	59.0	57.5	-27%	-11%	-2%
Tim Horton's Field	0.0	28.3	20.3	23.6	0%	-17%	16%
Rec Parks/Stadiums/Golf	36.5	30.9	25.9	27.0	-26%	-13%	4%
Lodges (Macassa, Wentworth)	113.6	45.4	42.5	43.2	-62%	-5%	2%
Culture	35.5	33.3	25.6	24.5	-31%	-27%	-4%
Fire/ EMS	45.2	37.3	33.4	32.4	-28%	-13%	-3%
Hamilton Public Libraries	25.2	33.0	29.3	28.1	12%	-15%	-4%
First Ontario Centre	22.5	20.5	19.3	20.7	-8%	1%	7%
First Ontario Concert Hall	57.8	48.7	39.8	43.5	-25%	-11%	9%
Hamilton Convention Centre	37.2	30.2	25.4	28.0	-25%	-7%	11%
Hamilton Police Services	59.8	35.1	35.2	41.0	-31%	17%	16%
City Wide Total	45.7	34.3	29.5	30.0	-34%	-13%	2%

Additional details on energy intensity within the portfolios is shown in Appendix A.

⁵ Operational Accounts are not included in the calculation of Energy Intensity, these include street lighting, traffic lighting, park lighting or streetscape and Hamilton Water.

Vehicle Fuels

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. Transit continues to expand its fleet of compressed natural gas (CNG)-fueled buses as direct replacements for diesel-fueled buses.

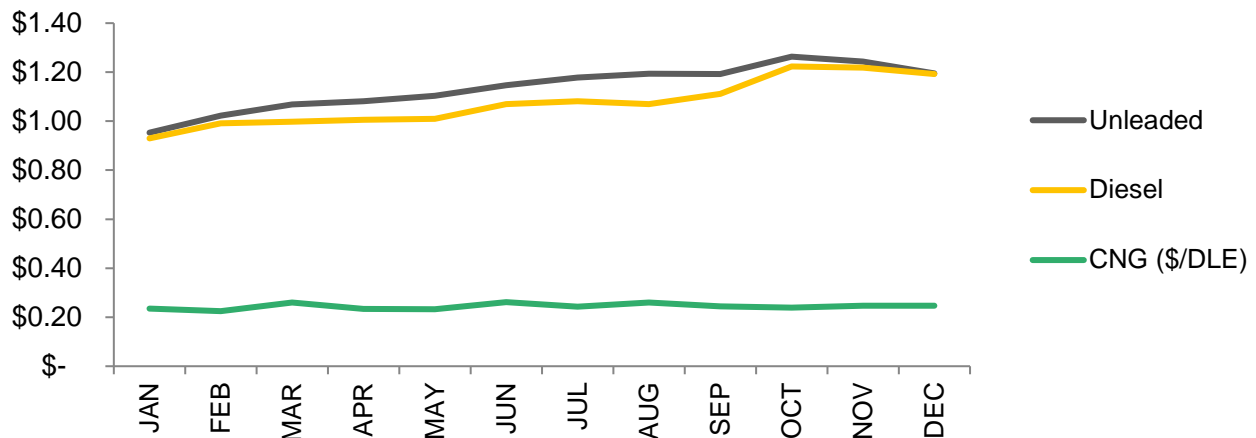
In 2021, the City used 7.4 million litres of diesel fuel, a 2% reduction from 2020. The City used 2.5 million litres of gasoline, an 8% increase over 2020. The average per litre cost for both diesel and gasoline increased by 29% and 32% respectively. Pricing increased steadily through 2021 as demand increased both domestically and globally amidst different pandemic re-opening plans and geo political events.

CNG usage increased slightly in 2021 by 2%, with a total of 5.9 million diesel litre equivalent (DLE) used. The cost of CNG increased by 12% over 2020.

Figure 10: 2021 Fuel Consumption and Costs

Fuel Type	Consumption Litres	Cost	Average \$/L
Diesel	7,410,520	\$7,964,845	\$1.07
Unleaded Gasoline	2,465,253	\$2,808,382	\$1.14
CNG (DLE)	5,902,159	\$1,441,880	\$0.24
Total	15,777,932	\$12,215,107	\$0.77

Figure 11: 2021 Fuel Costs Comparison



Overall the combined fuel usage in DLE is in line with 2020 usage, at a slight increase overall of 1%. Operationally, the vehicle fleet in 2021 was not fueling at pre-pandemic levels. However, average prices overall are higher as a reflection of market conditions on all fuel sources as compared to 2020 (27% higher) and 2019 (10% higher).

Figure 12: Fuel Consumption and Average Price Comparison in Diesel Litre Equivalent

Fuels	Diesel Litre Equivalent (DLE)			Comparisons	
	2019	2020	2021	2021 vs 2019	2021 vs 2020
Consumption	17,349,109	15,668,985	15,777,932	-9%	1%
Average Cost	\$0.70	\$0.61	\$0.77	10%	27%

Although CNG is a lower cost fuel compared to diesel and gasoline, the buses do operate at approximately 75% efficiency per diesel litre equivalent when compared to diesel fueled buses. However, despite a lower fuel efficiency, when converted to diesel equivalent dollars and adjusted for efficiency, Transit spent \$3.25M 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.

CORPORATE AVERAGE FUEL ECONOMY (CAFE)

One of the KPI measurements for fleet is to achieve greater fuel efficiency. That is, to reduce the amount of fuel consumed in diesel litre equivalent (DLE) per 100 kilometers of distance travelled. The long-term target is to reduce the CAFE by 20% by 2030 compared to the base year of 2012. 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 idling bylaws. Overall results in 2021 were in line with 2020, as shown below. There was an increase of 1% as compared to the base year of 2012.

Figure 13: Corporate Average Fuel Economy 2021 Comparison

Diesel Litre Equivalent (DLE) per 100 KM	BASE (2012)	2020	2021
Unleaded Gasoline	20.7	21.5	21.6
Diesel	54.5	54.6	57.0
CNG	66.2	67.0	65.0
Total	46.2	46.7	46.7
% Change in DLE/100 KM Base Year		1%	1%
% Change in DLE/100 KM Year to Year			0%

Data provided for the purpose of reporting on fuel analytics, such as mileage and usage for CAFE is collected by Fleet. With fueling stations throughout the City, managing the data continues to be an identified area of concern. Staff take extra time with the existing system to ensure the results are accurately interpreted.

In June of 2021 Council approved the City's Green Fleet Strategy. Recommendations identified for implementation by Fleet Services through the 2021-2024 Green Fleet Action Plan includes:

- 3 year forecast of vehicles that can be replaced with Battery Electric Vehicles (BEV's) and replace as scheduled;
- Coordinate the supply and installation of electric charging infrastructure requirements, for which bid solicitation is expected to commence in 2022;
- Pilot program on the optimal use of Biodiesel to identify highest blend possible;
- Eco Driving and Anti-Idling training module for all fleet operators to increase awareness on safety and fuel efficiency and;
- Anti-Idling awareness campaign expected for roll out in 2022.

The above actions will continue through to 2024 and are expected to have favorable impacts on GHG reductions and improvements to fuel efficiency that was recommended in the overall Green Fleet Strategy. Additional details and progress of these initiatives will be provided by Fleet Services directly through an Information Update expected in Summer of 2022.

HSR'S RNG PILOT PROJECT

Hamilton Street Railway (HSR) has a proud legacy of having one of the greenest fleets in Canada and was an early adopter of natural compressed gas (CNG) in the mid-1980s. Today, approximately half (49%) of its fleet operates on CNG and by the end of 2022, that number will increase to roughly 70%, as HSR continues to replace diesel-fueled buses with lower-emission CNG-fueled buses.

Building on this legacy, the City of Hamilton, in partnership with Enbridge Gas, announced Ontario's first carbon-negative bus fueled by renewable natural gas in 2021.



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The goal of the one-year RNG pilot was to demonstrate reduced emissions from the City's public transit operations. RNG is a practical option that enables transit to reduce emissions without compromising performance or reliability while using its existing fleet. During this time, the RNG pilot aimed to use and divert 450 tonnes of organic waste from the landfill and displace emissions from 36,000 liters of diesel. The pilot was a great success and has been extended through 2022 while we explore expanding the use of renewable natural gas as we continue our path to net zero.

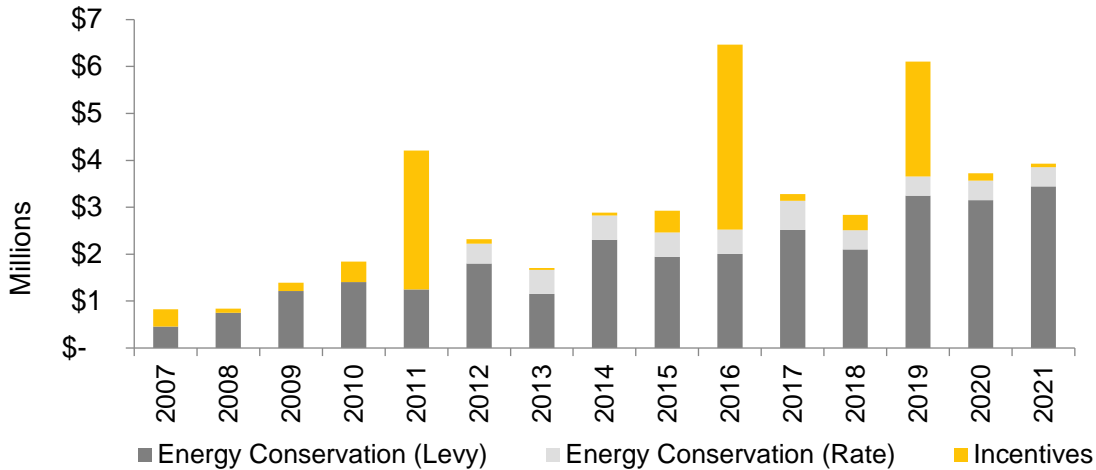
Energy Conservation

Project activities at the City are an important part of meeting the energy reduction and emissions targets and improving efficiencies within City buildings. Every year, projects are evaluated using specific criteria to identify energy and emissions savings. 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, including the goal of net zero emissions by 2050.

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. In addition, securing funding and incentives for efficiency and GHG-reducing projects and the post project monitoring and verification of savings is an important process for reporting and tracking the efforts.

The City tracks the energy savings achieved from projects once they are complete. Project activity in 2021 contributed \$3.8M in annual project savings. There was \$73,292 in incentives received in 2021. Cumulatively, a total result is \$45M since 2005 for projects and incentives.

Figure 14: Annual Project Savings (Rate & Levy) and Incentives



Some highlights on energy efficiency projects that have been completed in 2021 are:

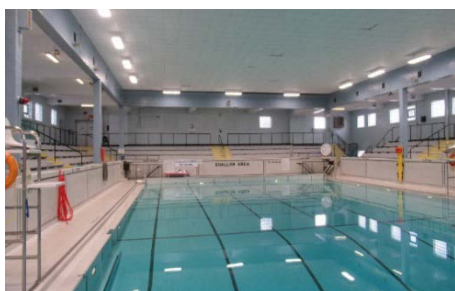
Wentworth Lodge – HVAC and BAS Upgrade Project

- Retrofit of HVAC and Building Automation System (BAS) in Rose and Oak and Administrative areas of the Lodge;
- Benefits include improved indoor air quality, better operational efficiency by converting old pneumatics controls to Direct Digital Control (DDC), and maintenance costs. As well there are expected reductions in energy use and reduction in GHG emissions;
- Verified annual energy savings of 41,699 kWh of electricity and 3,746 m3 of natural gas resulting in an estimated annual operational savings of \$6,000;
- Total incentives of \$4,918 from the IESO/SaveONenergy and Enbridge Gas programs.



Recreation Facilities LED Lighting Project

- Installation of new LED lighting & controls at 35 various Recreation facilities including Senior Centres, Recreation Centres, Golf Facilities, Arenas & Outdoor pools. Upgrades included indoor and exterior LED lighting;
- Benefits include: much improved lighting conditions, health & safety, a reduction in electrical consumption and GHG emissions & reduced maintenance costs;
- Annual Energy savings are estimated at 637,906 kWh, with annual operational savings estimated at \$97,313;
- IESO SaveONenergy incentives are estimated at \$50,566.



Westmount Solar Thermal & Pool Waste Heat Recovery Project

- Installation of new Solar Thermal & Heat Recovery Systems including efficient make-up water controls. Measures also include low flow shower heads and a slight reduction in pool water temperature;
- Benefits include a reduction in electrical, gas & water consumption, reduced GHG emissions & reduced maintenance costs;
- Annual energy savings for electricity are estimated at 25,929 kWh, and natural gas savings estimated at 41,803 cubic meters per year. Water savings are estimated at approximately 3969 cubic meters per year. GHG emission reduction is estimated at 80 tCO_{2e} per year. Overall operational savings are estimated at \$27,000 annually;
- Natural gas incentives are estimated at \$5,691.



Central Public Library and Library Branches LED Lighting Retrofit Project



- Retrofit of indoor light fixtures to energy efficient LED technology;
- Benefits include improved lighting conditions, reductions in energy use and GHG emissions and a reduction in lamp maintenance costs;
- Verified annual energy savings of 484,498 kWh resulting in an estimated annual operational savings of \$55,177;
- An estimated \$39,055 in incentives from the IESO SaveOnEnergy program.

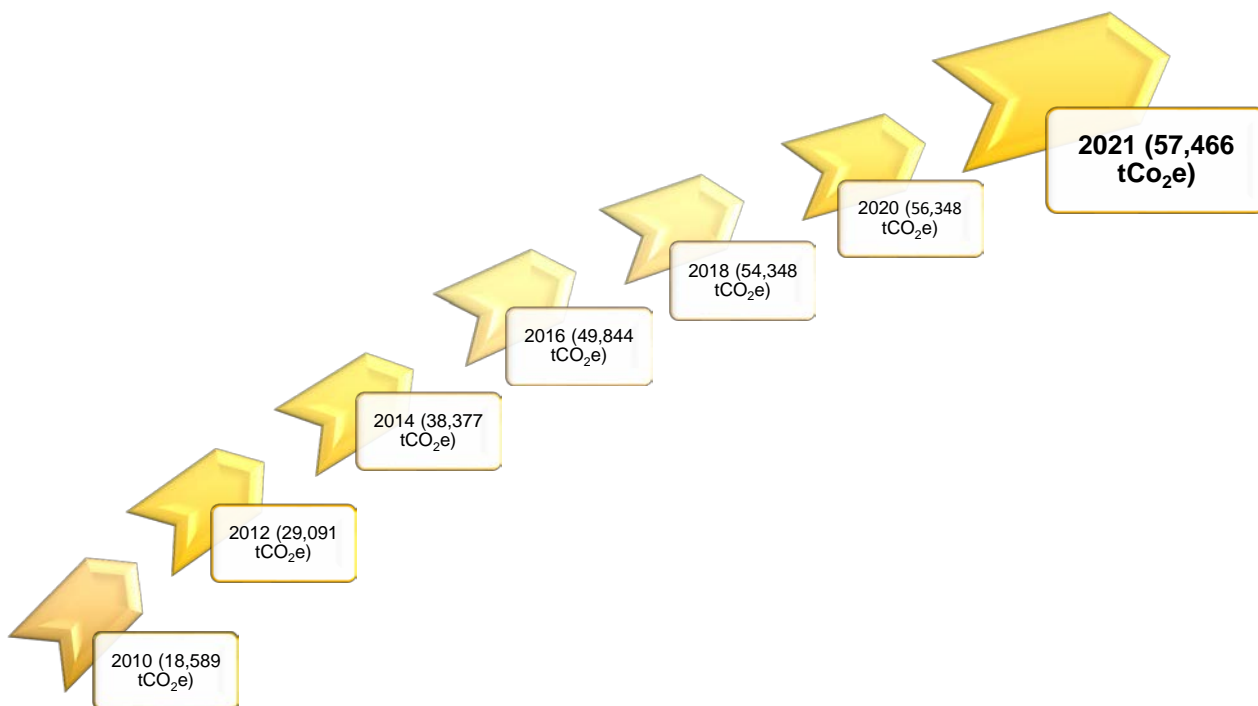
The development of future projects is always ongoing, with emphasis on energy use and GHG emissions reduction. Some of the projects that are underway or expected in 2022 and 2023 include:

- Hamilton City Hall: LED Lighting Retrofit;
- Macassa Lodge: BAS Controllers Upgrade;

- Wentworth Lodge: Air circulation and Perimeter Heating Control;
- Bennetto Recreation Centre: Pool Waste Heat Recovery;
- Chedoke Arena: Variable Speed HRV & Exterior Lighting;
- Jimmy Thompson Pool: Filter Pumps VFD Project;
- Ryerson Pool: Waste Heat Recovery & VFD;
- Stoney Creek Recreation Centre: Pool Waste Heat Recovery;
- Dundas Town Hall: Demand Control Ventilation and Lighting Upgrade to LEDs;
- Fire Complex 5: LED Upgrade (remaining indoors CFLs).

Completion of energy efficiency projects do not just hope to achieve energy use reductions and save money, they are also key instruments in reducing GHG emissions that would have otherwise been emitted into the atmosphere. The various measures completed on projects in 2021 resulted in 1,118 tCO₂e, with a cumulative total of 57,466 tCO₂e reduction from project activities since 2005.

Figure 15: Cumulative GHG Savings from Project Activities



Renewable Energy

The City's renewable generation operations are owned and managed through Hamilton Renewable Power Inc. (HRPI). There are three 1.6 MW biogas-fueled systems. 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. HPRI operations are not included in the Corporate GHG inventory which is reported in the next section.

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 in 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.

As the City moves forward to achieve its goals of net zero by 2050, renewal energy will need to play a key role in achieving those targets. A variety of feasibility studies are underway to propose the best way forward in utilizing the City's existing renewable assets as well as implementing additional renewable energy options.

Corporate Greenhouse Gas (GHG) Report: 2020 Inventory

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 and the Board of Health Climate Change Actions 2012 report (BOH13024). The original targets set were for a 20% reduction by 2020, a 50% reduction by 2030 and an 80% reduction in GHG emissions by 2050 from the base year 2005. With the update to the Corporate Energy and Sustainability Policy, the long-term target was updated to net zero emissions by 2050 when compared to the base year 2005.

The GHG reporting is a year behind the energy reporting, and therefore the following results are for the 2020 annual inventory.

2020 INVENTORY RESULTS

Considering that the data presented here is for the 2020 calendar year, the effects of pandemic-related responses is evident in the usage reductions from varying building closures, fleet reductions, and operational changes. In addition, there were two further changes were made relating to the reporting categories. It is important to evaluate available data sources periodically and as they become more robust, make necessary adjustments to data points to accurately reflect the City's inventory.

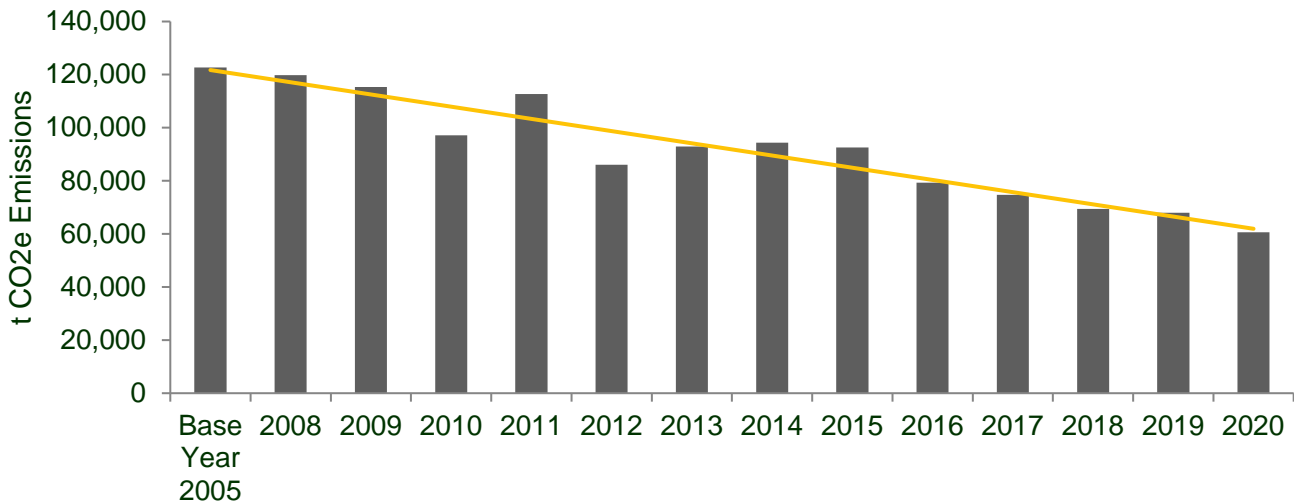
The first adjustment made to the inventory was to move small engines under the vehicle fleet output category for GHG emissions. Previously, small engines were reported as its own category and was found to be based on an outdated inventory estimate. As fleet tracks fuel usage for all vehicles and small engines, including it under vehicle fleet is a more accurate representation of the GHG emissions resulting in vehicle and engine use.

Secondly, the data for employee commuting was removed as a reporting category. Collecting data for this category was problematic and relied on unchanged or difficult to obtain employee statistics. In addition, it is outside of corporate control, and is further captured in overall community emissions, reported elsewhere. The shift in employee work patterns and commuting in 2020 would have also rendered any former assumptions around this category unusable. The 2005 baseline was adjusted down by 3% to account for the removal of this category. ⁶

In 2020, the GHG corporate emissions inventory was 60,674 tonnes of CO₂e (carbon dioxide equivalent). This represents a 51% reduction from the revised 2005 base year (122,699 tonnes CO₂e/) and 11% reduction compared to 2019. The inventory does not include HRPI operations.

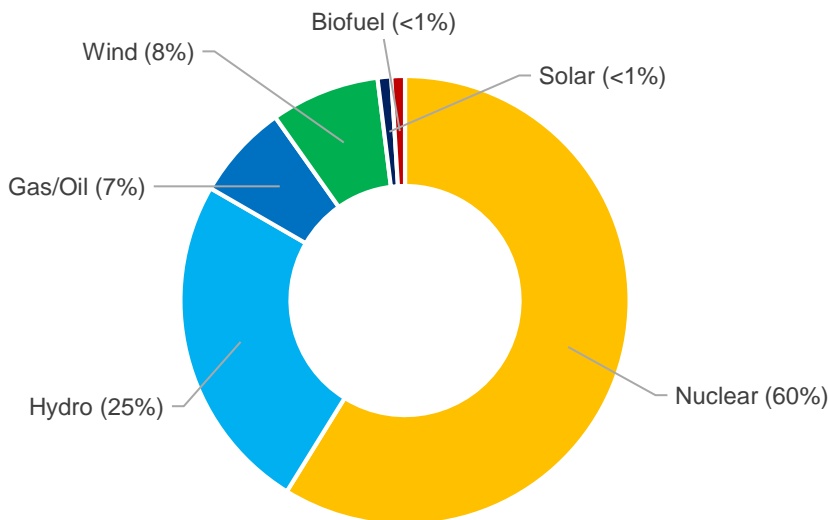
⁶ Prior 2005 base GHG inventory reported as 126,567 tCO₂e

Figure 16: City of Hamilton Corporate GHG Emissions Year Trends 2005-2020



The inventoried emissions have been on a downward trend since 2005, and several factors have contributed to this trend over the years. Regulatory impacts such as the removal of coal-fired generation as part of the generation supply mix, was significant. Overall, as Ontario increases its use of cleaner energy sources for its electrical generation supply, the lower the City's use of electricity impacts the emissions inventory. The following diagram depicts the energy output by fuel type for 2020. This is reported by the Independent Electricity System Operator (IESO) for transmission-connected generation. It does not include embedded generation but shows what makes up the supply mix which can vary year to year depending on availability. The provincial emissions factors are impacted by changes to the generation mix.

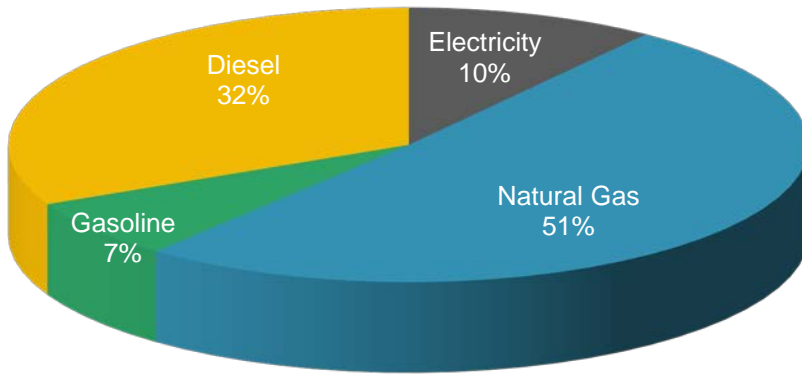
Figure 17: 2020 Ontario Energy Output by Fuel Type⁷



⁷ IESO source: <https://ieso.ca/en/Power-Data/Supply-Overview/Transmission-Connected-Generation>

In addition to electricity emission factors, other impacts to the City's inventory include completion of energy efficiency projects, reductions in usage from operational improvements and fuel switching, such as Transit's ongoing conversion from diesel buses to CNG-powered buses. Future developments around this area, particularly the utilization of renewable natural gas and electric-power transportation for City's fleet and transit vehicles should significantly impact GHG emissions for the City.

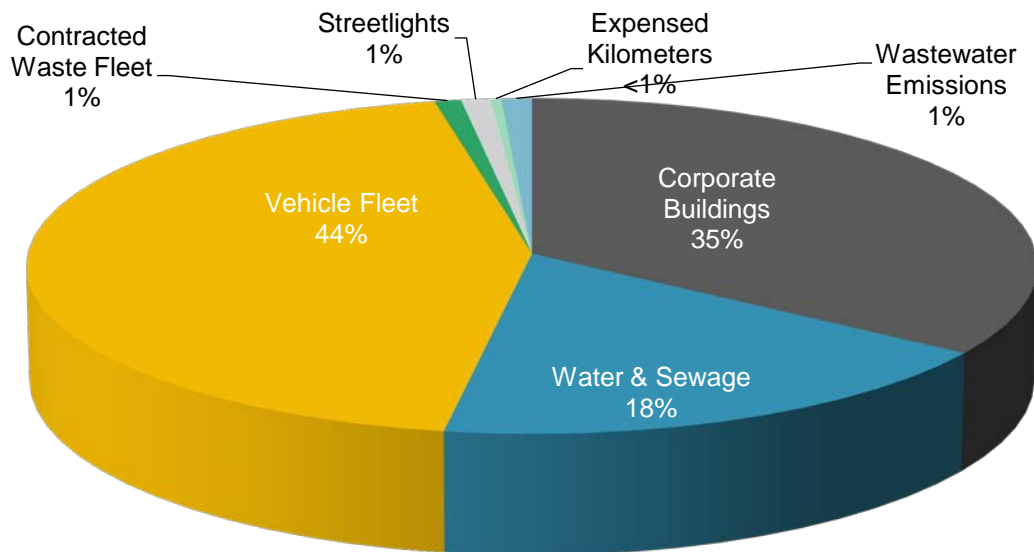
Figure 18: 2020 Percentage of tCO₂e Emissions by Fuel Source



Corporately, the generation mix for the City's inventoried emissions is as follows: electricity, natural gas, diesel and gasoline. Ideally, renewable energy sources would be used to offset the higher emissions fuel sources such as diesel, gasoline and natural gas.

The emissions from all related fuel sources by sector; buildings, vehicles and processes are shown in the chart below. Of the reported sectors, vehicle fleet remains the largest emitter at 26,742 tCO₂e (44%) for 2020. Corporate buildings with 21,039 tCO₂e (35%) and Water and Sewage operations with 10,870 tCO₂e (18%) round out the top 3. The other sectors account for the remaining 3% of emissions in 2020.

Figure 19: 2020 Percent tCO₂e of Total by Reporting Sector



Vehicle fleet includes emissions from diesel, gasoline and natural gas. The 2020 emissions show a reduction of 26% compared to the 2005 base year. Some of that reduction in emissions can be attributed to the fuel switching from diesel buses to compressed natural gas (CNG)-fueled buses. However, the

composition of fleet vehicles, the number of fleet vehicles and pandemic-related closures or reduction in usage have also been contributing factors in the overall emissions of the City's fleet.

Corporate buildings also show a significant reduction in emissions of 55% compared to 2005. The reductions here are mainly attributed to lower usage from energy efficiency work and lower Ontario emissions factors from changes in the province's energy supply mix. For 2020 reductions were compounded by lower usage from varying degrees of building closure or shifts in operational hours due to the COVID-19 safety plans.

Unlike the emissions for vehicles and buildings, the 2020 emissions from Water and Sewage increased over the prior year, with the addition of a natural-gas fueled biosolids processing operation. However, this sector still shows a reduction of 57% when compared to 2005 base year.

It is important to re-iterate that GHG emissions here are directly tied to usage and is an inventory of calculated emissions, and therefore with the overall lower usage in buildings and fleet vehicles in 2020, the resulting GHG emissions may not be an accurate reflection of a "typical" year. Further reduction plans would be required to maintain this downward trend regardless of an increased usage from pandemic recovery.

LOOKING FORWARD – GHG REPORTING

Climate change has become an important topic of focus for municipalities across the nation and globally. The City of Hamilton declared a Climate Emergency in 2019 and further updated its GHG emissions reductions to target Net Zero emissions by 2050 in the Corporate Energy and Sustainability Policy. There is increased pressure community-wide (including for corporately managed assets) to develop plans around meeting the aggressive targets and considering maximizing emissions reduction as a criterion for decision-making. The City is reviewing this report and evaluating future Corporate GHG inventory reporting formats, with a goal to provide more robust emissions reporting and align it with other City climate action initiatives such as the Community Energy and Emissions Plan. One potential option is to remove this section from the Annual Energy Report where it has been included since 2016 and present it as a stand-alone annual inventory report.

Although many aspects of the inventory reporting would remain the same, including the reporting categories shown in the current inventory, the overall goal is to better highlight and further identify areas of focus and offer more insight into the development of future GHG reduction opportunities within the City.

2021 Energy Reporting Final Comments

The hopes there would be a resolution to the COVID-19 pandemic and global economic recovery in 2021 were soon replaced with the realization that it would be another unprecedented year with further lockdowns, new virus variants, higher caseloads and varying global responses. The added complexity of balancing City services within federal, provincial and community guidelines and policies saw the City pivot its reopening strategies several times throughout the year.

There were periods in 2021 where many public buildings were re-opened, only to be closed again under provincial or federal mandates. Like in 2020, quantifying the impacts of these periods of shutdown to energy usage and other similar metrics is difficult because many buildings were still operational for staff and/or re-purposed (i.e. for vaccine roll-out and clinics) and vehicles were still fueled and used. All over the City, buildings and divisions were impacted differently. Therefore, it is important to view the data with some caution, as it is not necessarily reflective of a "normal" year.

Despite the challenging environment, the City continued to deliver key public services. As well, staff continued to efficiently operate and maintain facilities, complete efficiency projects and develop policies and future actionable plans around reducing energy usage and GHG emissions. Continued exploration

of more sustainable products and methods will be necessary to meet the aggressive targets around energy and sustainability.

Hamilton has long-term goals to reduce its energy intensity by 50% and to become a net-zero city by 2050. Although the pandemic may have shifted some of the momentum toward these targets, we are making progress. In June 2021 Council approved a Green Fleet Strategy which outlines recommendations on various actionable plans to reduce GHGs and improve efficiencies. Overall, implementing new technology, investing in renewable energy and carbon-reducing/carbon-neutral projects and prioritizing climate action is imperative across the City. The City is committed to focusing efforts in these areas.

Continued measurement and reporting on results help to identify where the City falls in line with its goals and allows for more targeted decision-making as we move through 2022 and to the future.



Appendix A

This appendix provides additional information, charts and graphs for more specific details on KPI results and impacts to various KPIs for 2021 as presented in the report.

Energy Strategies and Programs KPIs

Figure A-1: Cumulative Savings and Avoided Costs 2005-2021

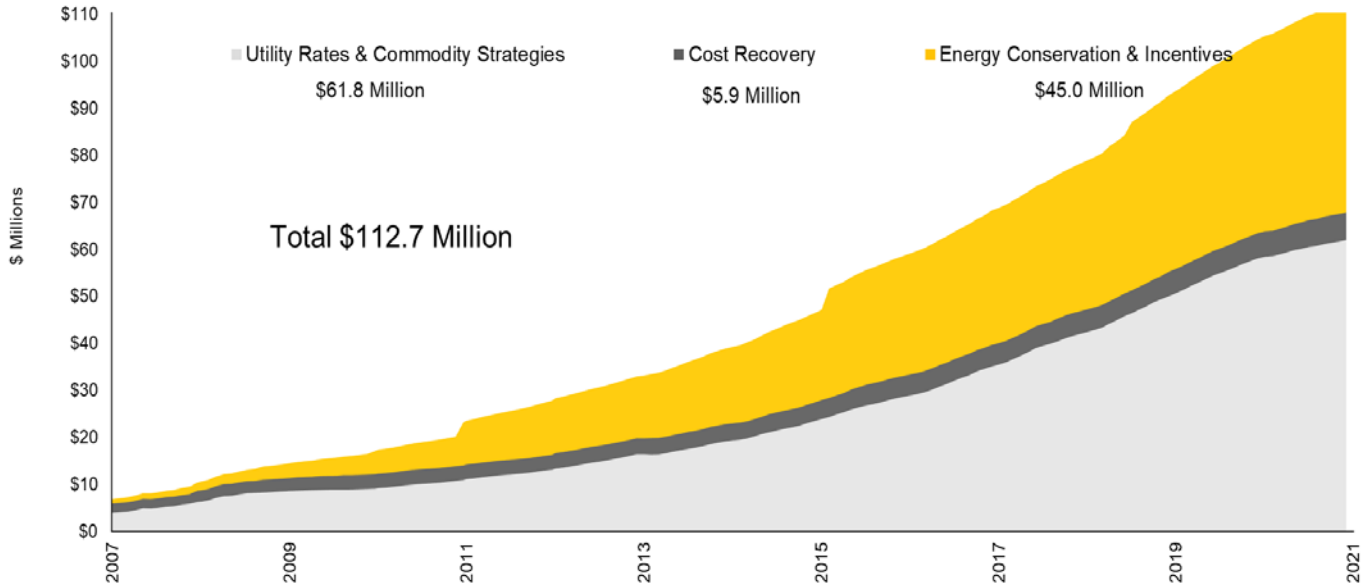


Figure A-2: Three Year Comparison of Energy Programs and Strategies

Category	Past 3 Years			2006-2021 Cumulative
	2019	2020	2021	
Levy RPP/Interval Change	\$ -	\$ -	\$ -	\$ 2,886,651
Rate RPP/Interval Change	\$ -	\$ -	\$ -	\$ 2,873,163
Levy Global Adjustment	\$ 1,310,581	\$ 1,687,244	\$ 1,125,127	\$ 11,215,026
Rate Global Adjustment	\$ 5,937,456	\$ 5,709,856	\$ 2,511,526	\$ 35,560,913
Levy Natural Gas	\$ 693,429	\$ 489,742	\$ 146,558	\$ 7,821,182
Rate Natural Gas	\$ 77,155	\$ 134,580	\$ 79,586	\$ 1,422,416
Energy Conservation Levy	\$ 3,246,246	\$ 3,154,851	\$ 3,443,080	\$ 28,526,135
Energy Conservation Rate	\$ 410,732	\$ 410,732	\$ 410,732	\$ 4,738,888
Incentives	\$ 2,447,863	\$ 160,138	\$ 73,292	\$ 11,820,833
Cash Recovery Levy	\$ 358,928	\$ 173,608	\$ 471,291	\$ 5,587,904
Cash Recovery Rate	\$ -	\$ -	\$ 47,684	\$ 283,059
Totals	\$ 14,482,390	\$ 11,920,752	\$ 8,308,876	\$ 112,736,170

Overall Costs, Consumption and Performance - Electricity and Natural Gas

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

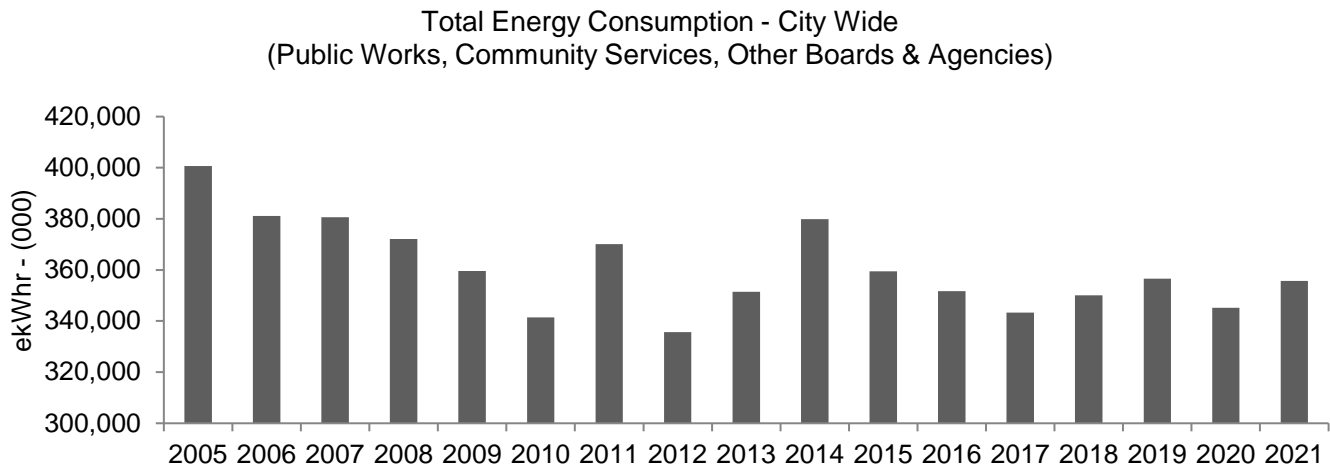


Figure A-4: Electricity Consumption Comparison by Portfolio Category

Electricity Consumption	in 000's of kWhs		
	2005	2020	2021
City/Town Halls	4,736	3,461	3,271
Corporate Facilities	4,669	5,156	4,195
Street Lighting	33,603	17,757	17,770
Traffic Lighting	5,688	1,571	1,428
Other O&M	5,248	4,396	3,939
Hamilton Water	106,561	102,880	104,634
Yards	11,982	8,459	9,020
Arenas	17,834	10,633	11,251
Community/Senior Centers	1,258	933	850
Rec Centres/Pools	4,124	6,800	7,243
Tim Hortons Field		3,587	4,713
Rec Parks/Stadiums/Golf	3,885	2,007	2,453
Lodges (Macassa, Wentworth)	4,673	5,089	5,216
Culture	2,254	1,546	1,539
Fire/ EMS	3,766	4,550	4,500
Libraries	7,314	7,634	7,464
First Ontario Centre	6,578	5,113	5,689
First Ontario Concert Hall	3,552	1,686	1,870
Hamilton Convention Centre	3,026	1,445	1,608
Hamilton Police Services	5,613	4,434	6,046
Total Electrical Consumption	236,362	199,136	204,699

Figure A-5: Natural Gas Consumption by Portfolio Category

Natural Gas Consumption	in 000's of M3s		
	2005	2020	2021
City/Town Halls	847	393	324
Corporate Facilities	1,173	632	501
Street Lighting	0	0	0
Traffic Lighting	0	0	0
Other O&M	35	45	5
Hamilton Water	1,357	4,143	4,993
Yards	2,587	1,647	1,640
Arenas	2,068	1,339	1,199
Community/Senior Centers	241	211	177
Rec Centres/Pools	2,124	1,972	1,907
Tim Hortons Field		296	292
Rec Parks/Stadiums/Golf	417	256	259
Lodges (Macassa, Wentworth)	1,899	933	946
Culture	293	176	162
Fire/ EMS	650	684	647
Libraries	190	291	267
First Ontario Centre	332	342	348
First Ontario Concert Hall	179	198	213
Hamilton Convention Centre	153	167	183
Hamilton Police Services	857	375	511
Total NG Consumption	15,404	14,100	14,574

Figure A-6: Total Consumption Comparison by Portfolio Category

Total Energy Consumption	in 000's of ekWhs			Comparisons	
	2005	2020	2021	2021 vs 2005	2021 vs 2020
City/Town Halls	13,775	7,528	6,623	-52%	-12%
Corporate Facilities	17,188	11,702	9,381	-45%	-20%
Street Lighting	33,602	17,757	17,770	-47%	0%
Traffic Lighting	5,688	1,571	1,428	-75%	-9%
Other City Operations	5,618	4,866	3,986	-29%	-18%
Hamilton Water	121,040	145,802	156,362	29%	7%
Yards	39,589	25,517	26,016	-34%	2%
Arenas	39,904	24,505	23,673	-41%	-3%
Community/Senior Centers	3,834	3,122	2,681	-30%	-14%
Rec Centres/ Pools	26,789	27,230	27,000	1%	-1%
Tim Horton's Field	0	6,652	7,737	0%	16%
Rec Parks/Stadiums/Golf	8,332	4,661	5,134	-38%	10%
Lodges (Macassa, Wentworth)	24,938	14,756	15,018	-40%	2%
Culture	5,383	3,368	3,222	-40%	-4%
Fire/ EMS	10,698	11,639	11,203	5%	-4%
Hamilton Public Libraries	9,343	10,654	10,235	10%	-4%
First Ontario Centre	10,122	8,654	9,292	-8%	7%
First Ontario Concert Hall	5,466	3,735	4,077	-25%	9%
Hamilton Convention Centre	4,656	3,175	3,508	-25%	11%
Hamilton Police Services	14,757	8,323	11,338	-23%	36%
City Wide Total	400,722	345,215	355,683	-11%	3%

Figure A-7: Total Annual Reported Costs Electricity & Natural Gas (Facilities)

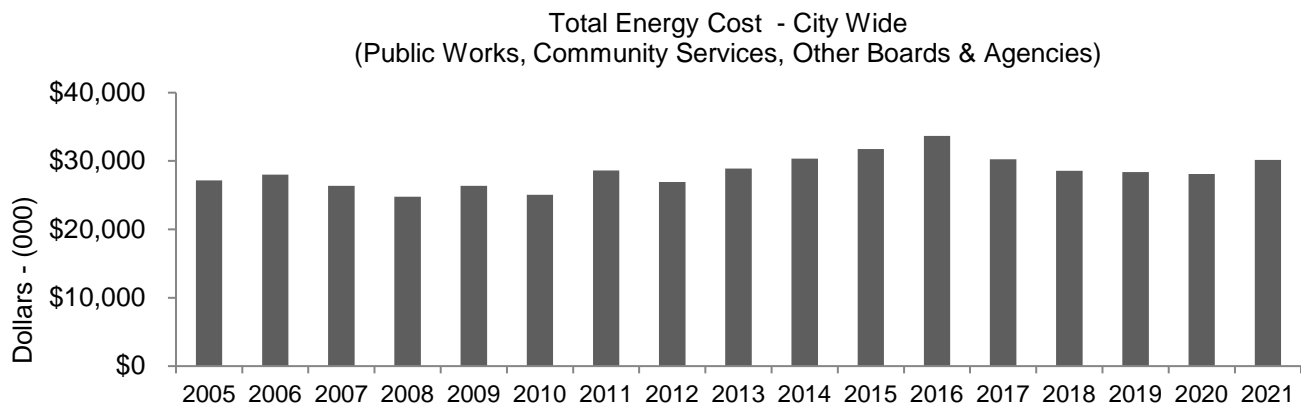
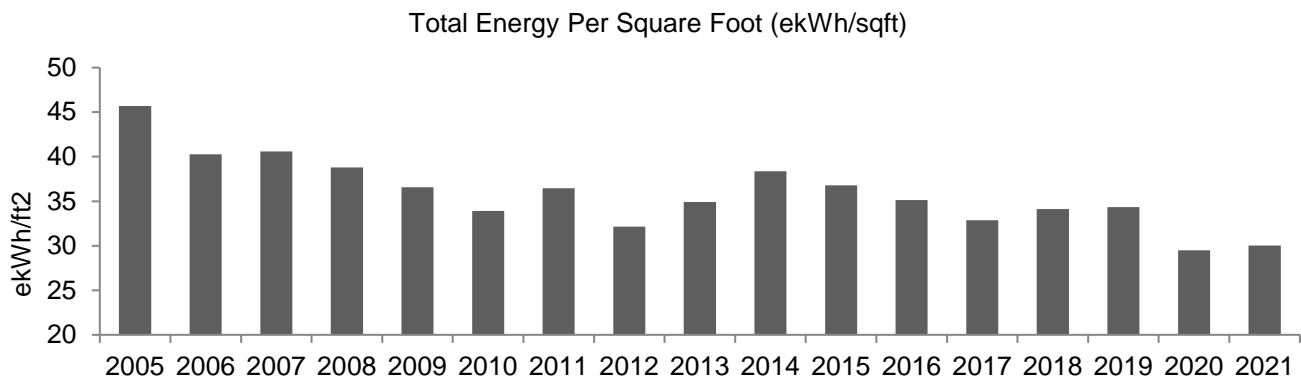


Figure A-8: Total Reported Cost Comparison by Portfolio Category

Total Energy-\$	in 000's of \$			Comparisons	
	2005	2020	2021	2021 vs 2005	2021 vs 2020
City/Town Halls	\$860	\$673	\$599	-30%	-11%
Corporate Facilities	\$866	\$940	\$749	-14%	-20%
Street Lighting	\$2,895	\$3,504	\$3,462	20%	-1%
Traffic Lighting	\$462	\$222	\$222	-52%	0%
Other City Operations	\$534	\$628	\$497	-7%	-21%
Hamilton Water	\$9,590	\$10,507	\$12,427	30%	18%
Yards	\$2,205	\$1,635	\$1,718	-22%	5%
Arenas	\$2,455	\$2,098	\$2,015	-18%	-4%
Community/Senior Centers	\$224	\$212	\$190	-15%	-11%
Rec Centres/Pools	\$1,192	\$1,555	\$1,554	30%	0%
Tim Horton's Field	\$0	\$686	\$775	0%	13%
Rec Parks/Stadiums/Golf	\$564	\$374	\$451	-20%	20%
Lodges (Macassa, Wentworth)	\$1,087	\$756	\$831	-24%	10%
Culture	\$338	\$218	\$215	-36%	-1%
Fire/ EMS	\$614	\$795	\$775	26%	-3%
Hamilton Public Libraries	\$827	\$920	\$865	5%	-6%
First Ontario Centre	\$840	\$1,116	\$1,062	26%	-5%
First Ontario Concert Hall	\$454	\$285	\$307	-32%	8%
Hamilton Convention Centre	\$387	\$254	\$274	-29%	8%
Hamilton Police Services	\$783	\$746	\$1,173	50%	57%
City Wide Total	\$27,177	\$28,125	\$30,161	11%	7%

Figure A-9: Total Annual Energy Intensity City-wide (ekWh/sqft)



The following series of graphs represent the energy intensity results per site for 2021 within the specific portfolio categories. 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.

As indicated in the body of the report, energy intensity results for 2021 could be considered anomalous due to the reductions in consumption due to operational reactions to COVID-19.

Figure A-10: 2021 Energy Intensity Corporate Facilities

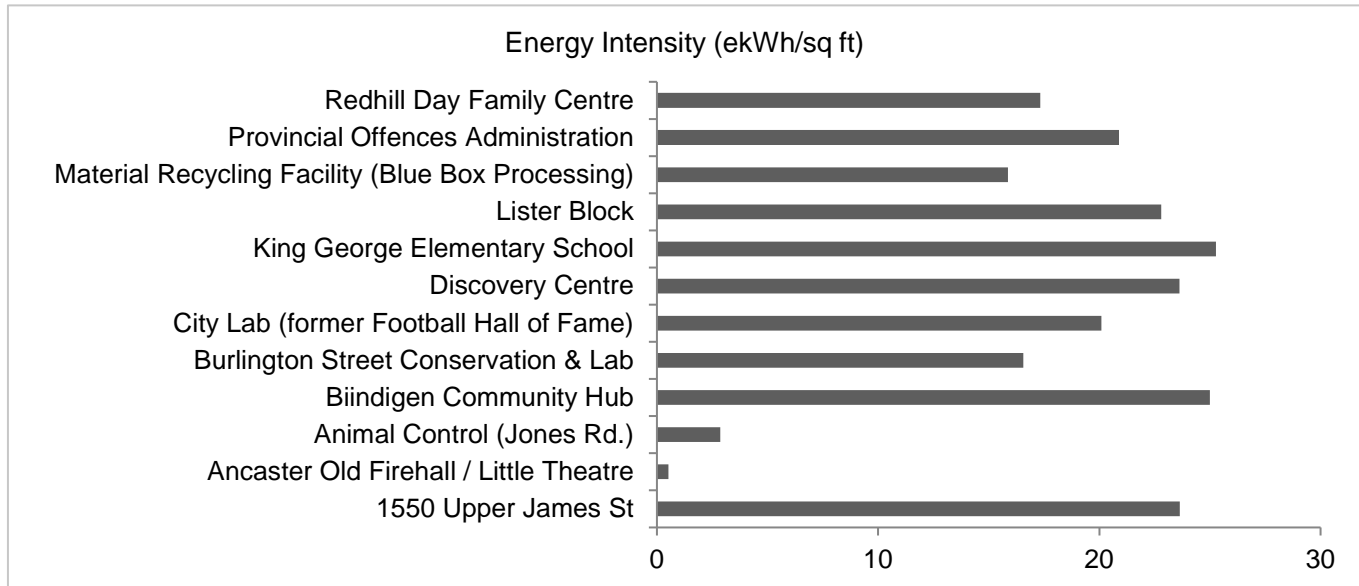


Figure A-11: 2021 Energy Intensity City & Town Hall Facilities

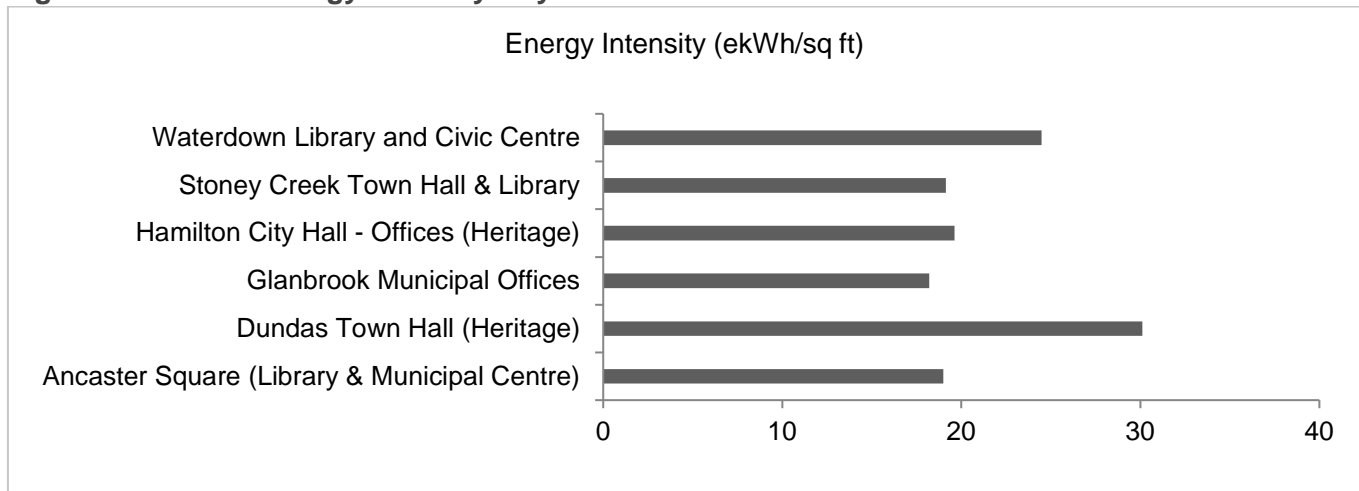
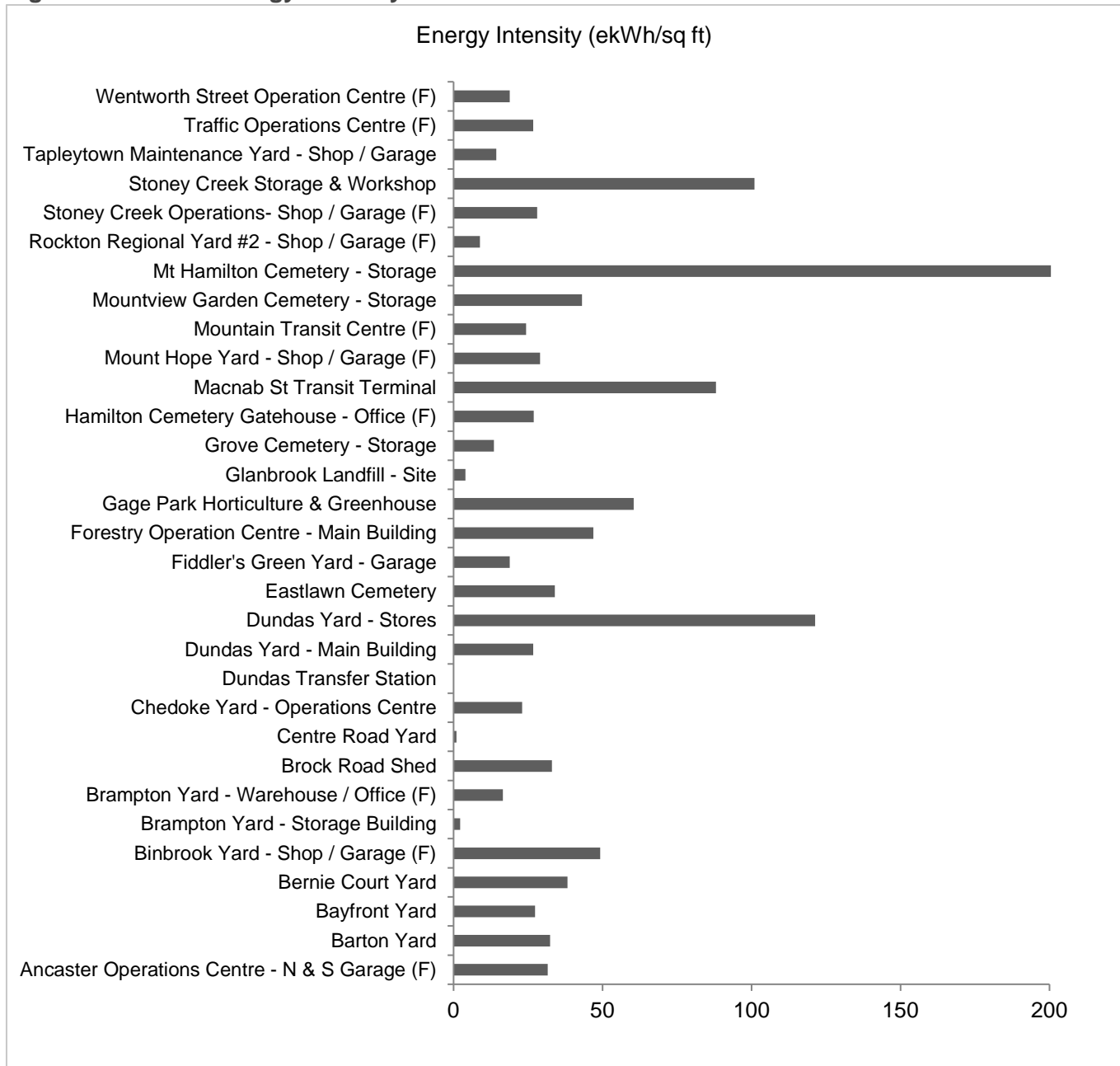


Figure A-12: 2021 Energy Intensity Yards Facilities⁸



⁸ (F) = Fueling site located on the Yard premises

Figure A-13: 2021 Energy Intensity Community Centres Facilities

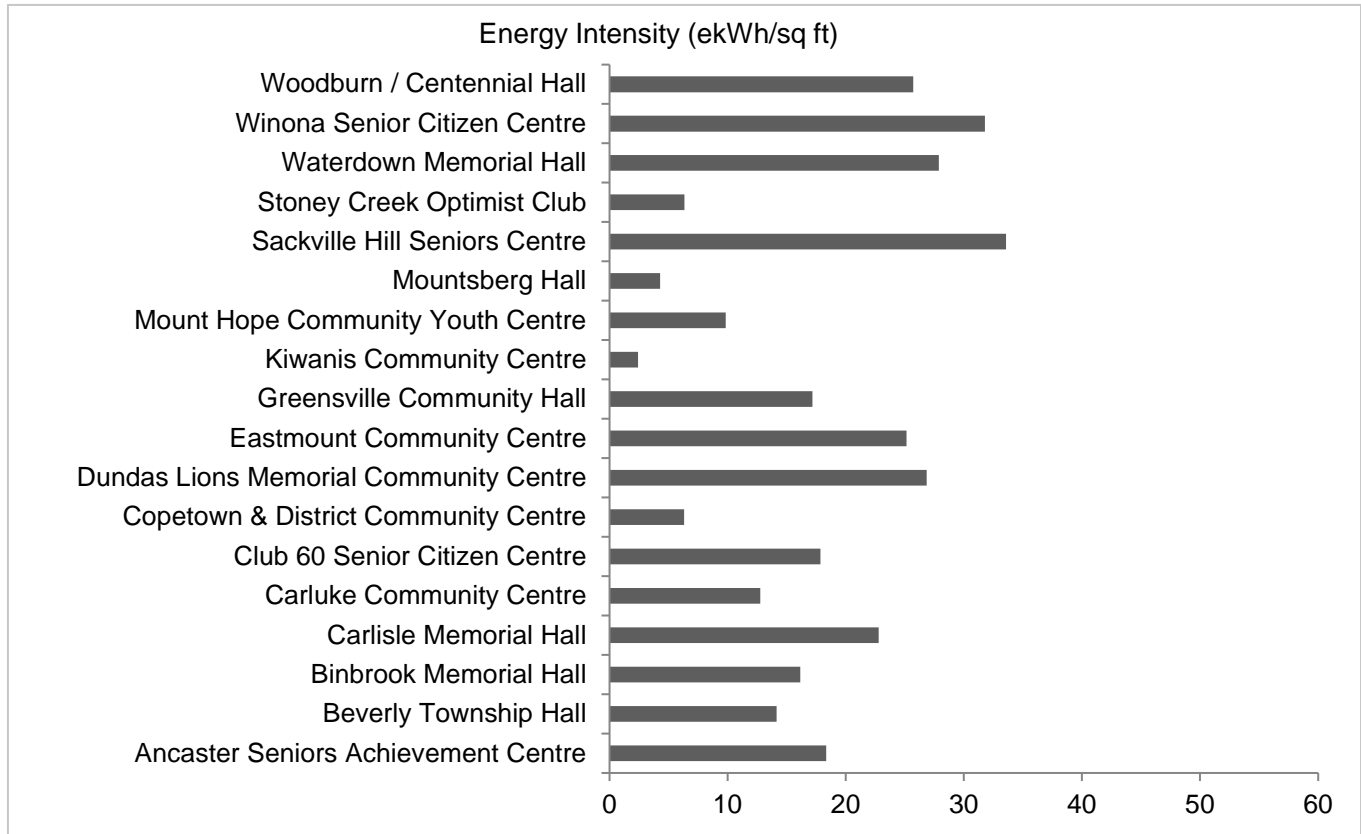


Figure A-14: 2021 Energy Intensity Culture and Museum Facilities

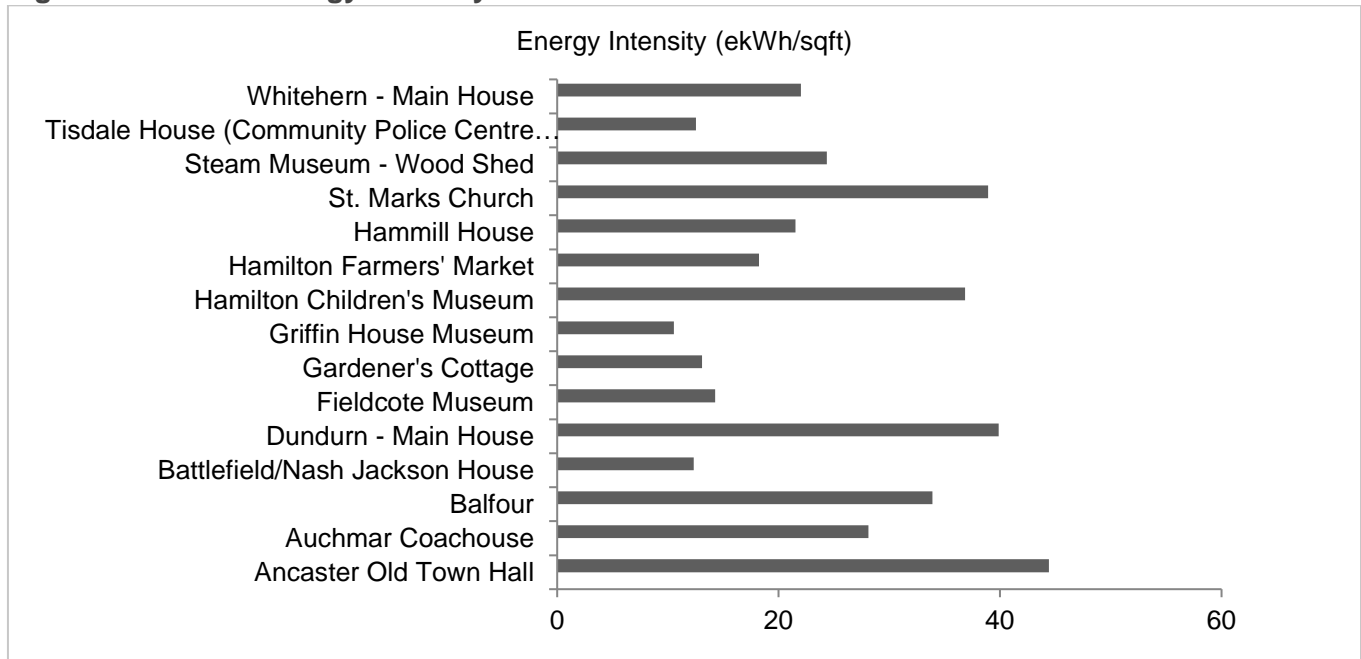
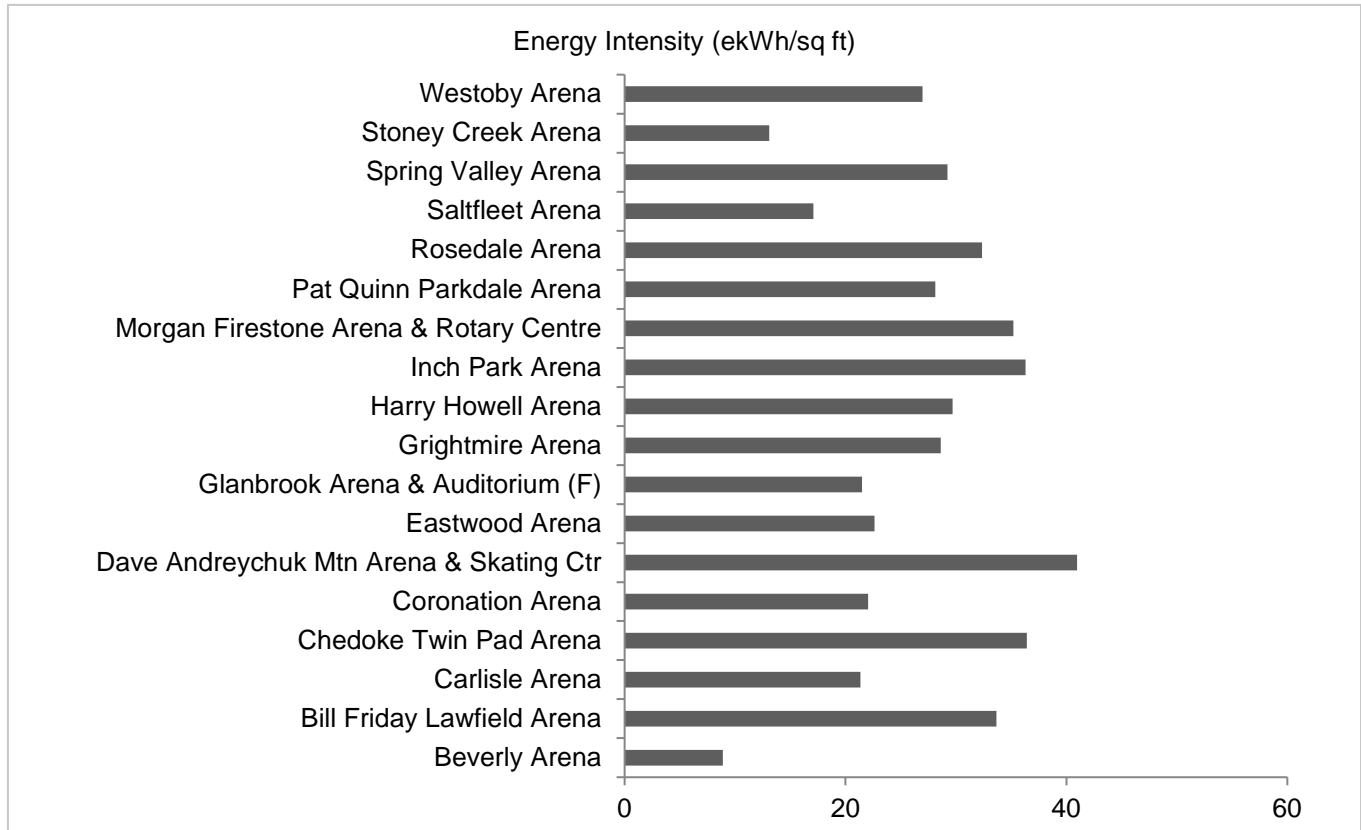


Figure A-15: 2021 Energy Intensity Arena Facilities⁹



⁹ Valley Park Arena removed for 2021 reporting year (includes data for arena, aquatic centre, community centre)

Figure A-16: 2021 Energy Intensity Recreation Centres and Pools¹⁰

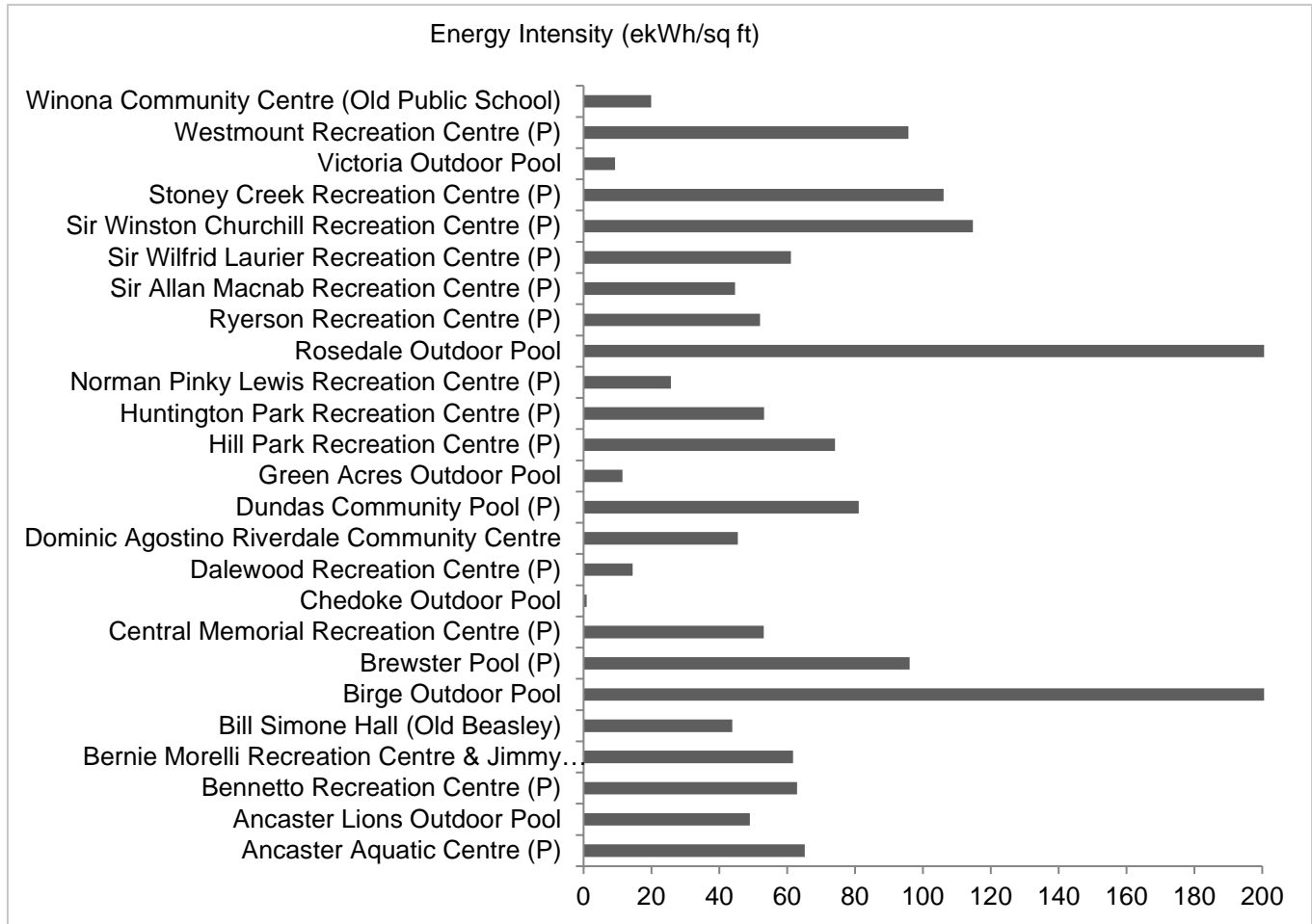
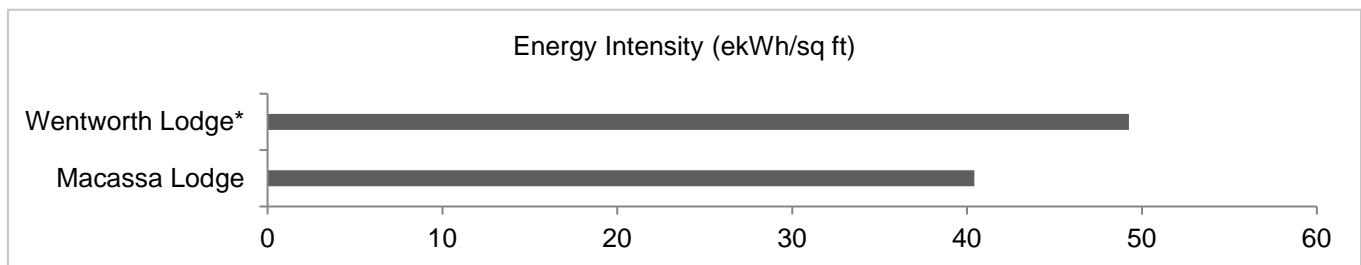


Figure A-17: 2021 Energy Intensity Lodges¹¹



¹⁰ (P) = Pool on premises

¹¹ Wentworth Lodge has estimated natural gas consumption using prior 5 yr. average usage due to utility underbilling starting June 2021 to be corrected in 2022.

Figure A-18: 2021 Energy Intensity Stadium, Golf Course Facilities and Recreation Parks Facilities

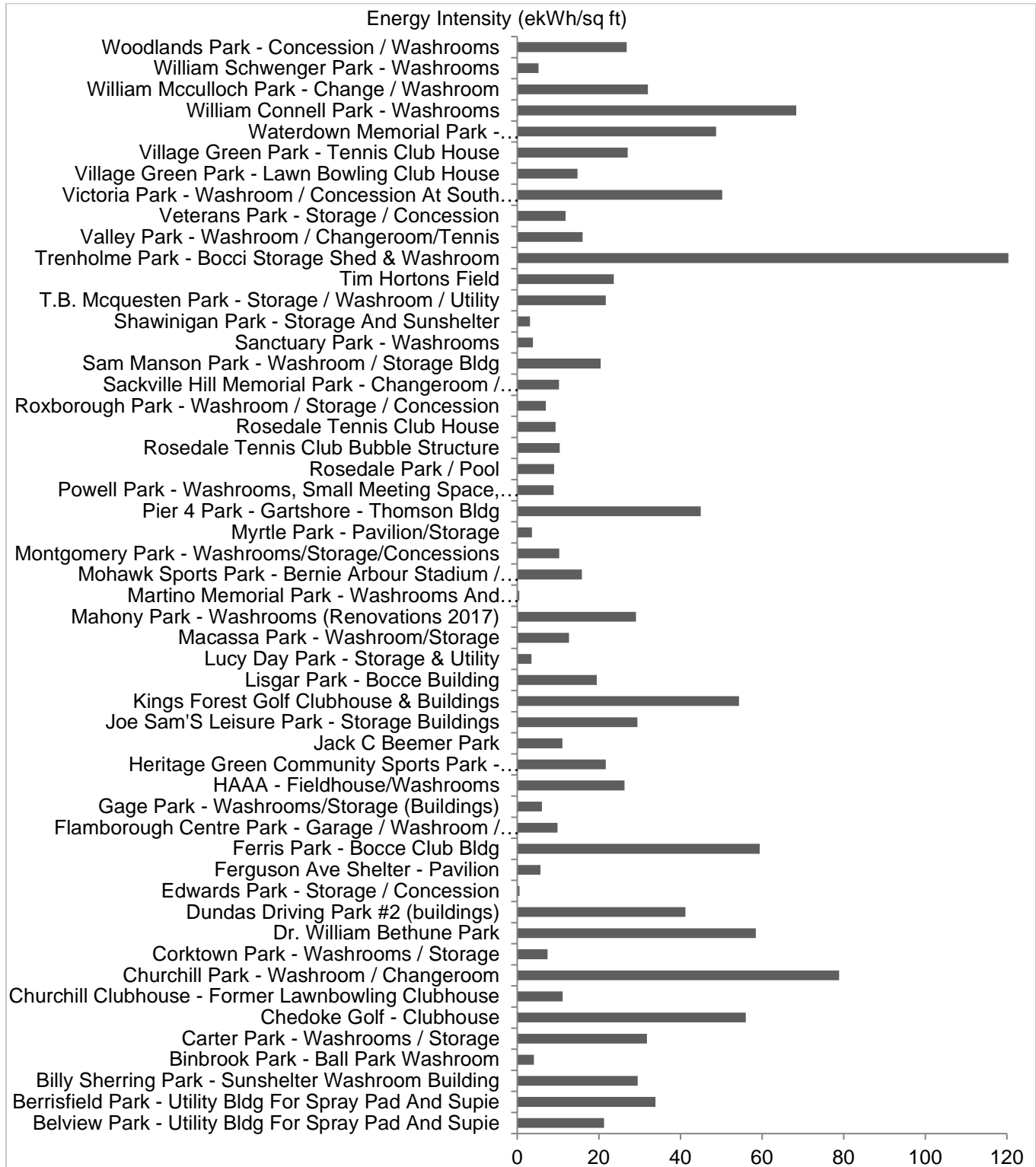


Figure A-19: 2021 Energy Intensity Fire and EMS Facilities

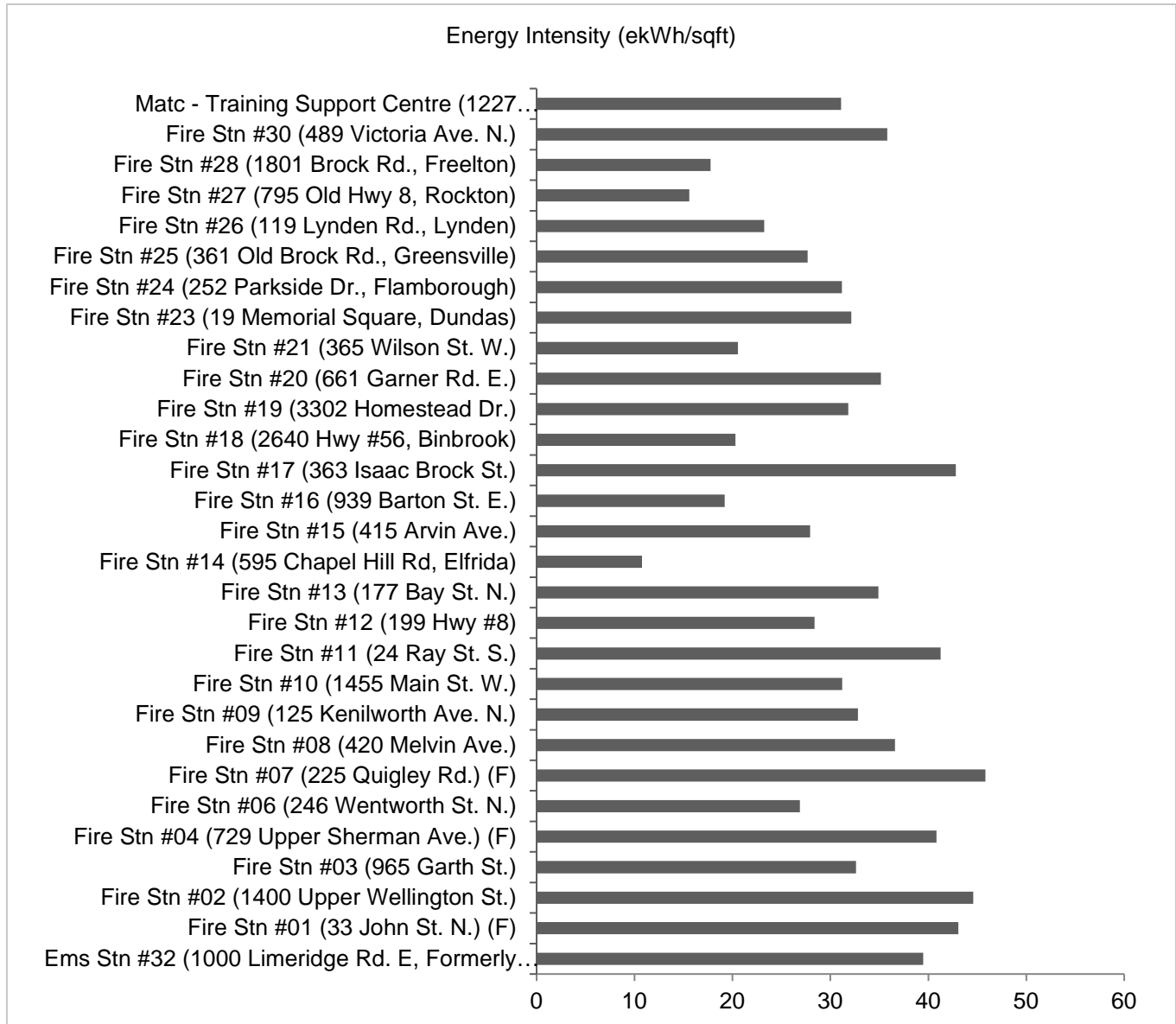


Figure A-20: 2021 Energy Intensity Hamilton Police Services Facilities

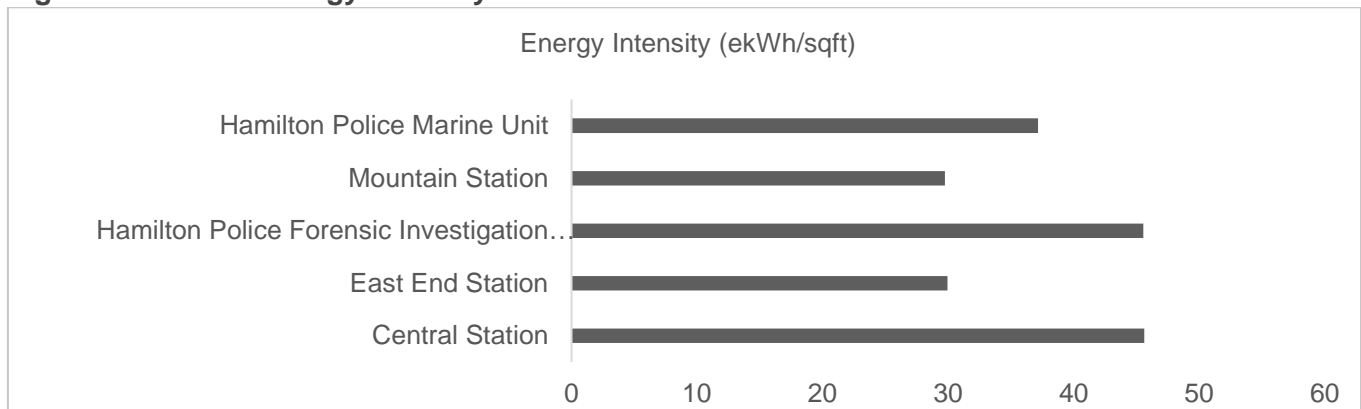


Figure A-21: 2021 Energy Intensity Libraries Facilities¹²

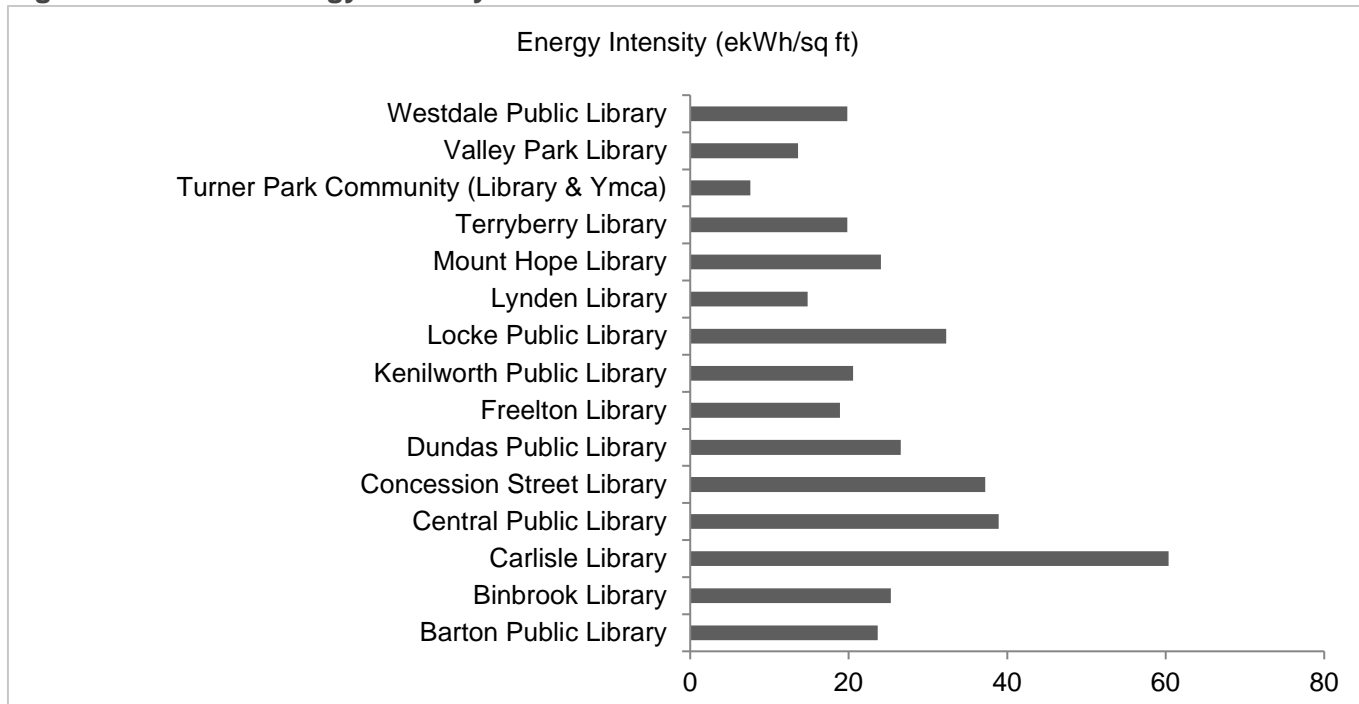
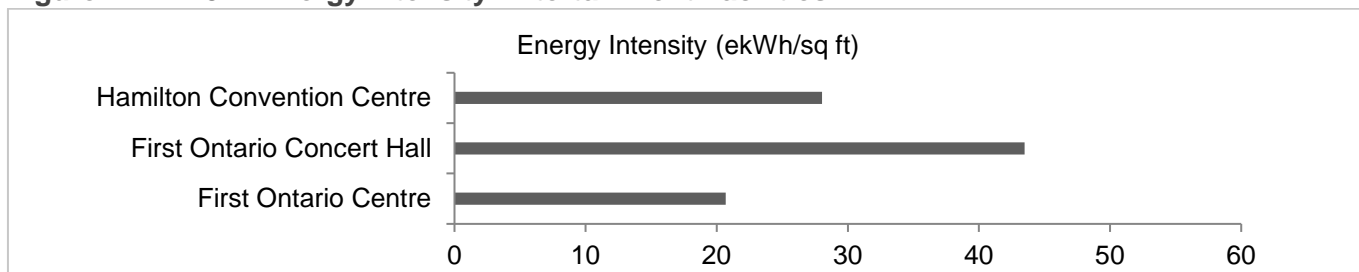


Figure A-22: 2021 Energy Intensity Entertainment Facilities



Weather Data

Weather and temperatures can impact energy consumption for electricity, natural gas and fuel. Reviewing 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 and is sourced from Environment Canada.

According data for Hamilton weather station YHM, the annual Total cooling degree days in 2021 was 308. The total heating degree days in 2021 was 3439. Details are in the charts below.

¹² Bookmobiles included in library facility usage and cost reporting, but not included in Energy Intensity calculation. Ancaster Square, Stoney Creek Town Hall & Library, Waterdown Library and Civic Centre included in City and Town Hall reporting category (shared utility meters).

Figure A-23: Weather Data for Hamilton (Environment Canada – Station YHM)¹³

Month	Mean Temp (°C)	HDD	CDD	2021 vs 2020 HDD	2021 vs 2020 CDD
Jan-21	-3.0	631.2	0	4%	-
Feb-21	-6.6	688.0	0	55%	-
Mar-21	3.5	436.3	0	-7%	-
Apr-21	7.2	325.1	0	-15%	-
May-21	12.6	181.5	17.9	-19%	-22%
Jun-21	20.2	18.8	83.4	-39%	24%
Jul-21	19.9	6.2	62.7	-	-63%
Aug-21	22.1	2.2	128	-37%	61%
Sep-21	16.6	51.4	11	-33%	-43%
Oct-21	13	160.1	4.7	-44%	-
Nov-21	3	406.4	0	15%	-
Dec-21	0.9	531.8	0	-7%	-
2021 Annual Total		3439	308	0%	-15%

Figure A-24: 2021 Comparison to 5 Year Average HDD & CDD

Month	HDD		CDD	
	5 YR AVG	2021 vs 5 Year Average	CDD 5 YR AVG	2021 vs 5 Year Average
JAN	673	-6%	0	-
FEB	567	21%	0	-
MAR	531	-18%	0	-
APR	361	-10%	0	-
MAY	178	2%	17	3%
JUN	31	-39%	54	53%
JUL	2	297%	112	-44%
AUG	8	-73%	87	47%
SEP	61	-16%	31	-65%
OCT	230	-30%	4	9%
NOV	445	-9%	0	-
DEC	593	-10%	0	-
Average	3679	-7%	306	0%

¹³ Source for weather data for HDD and CDD: https://climate.weather.gc.ca/historical_data/search_historic_data_e.html

Figure A-25: Heating Degree Days (HDD)

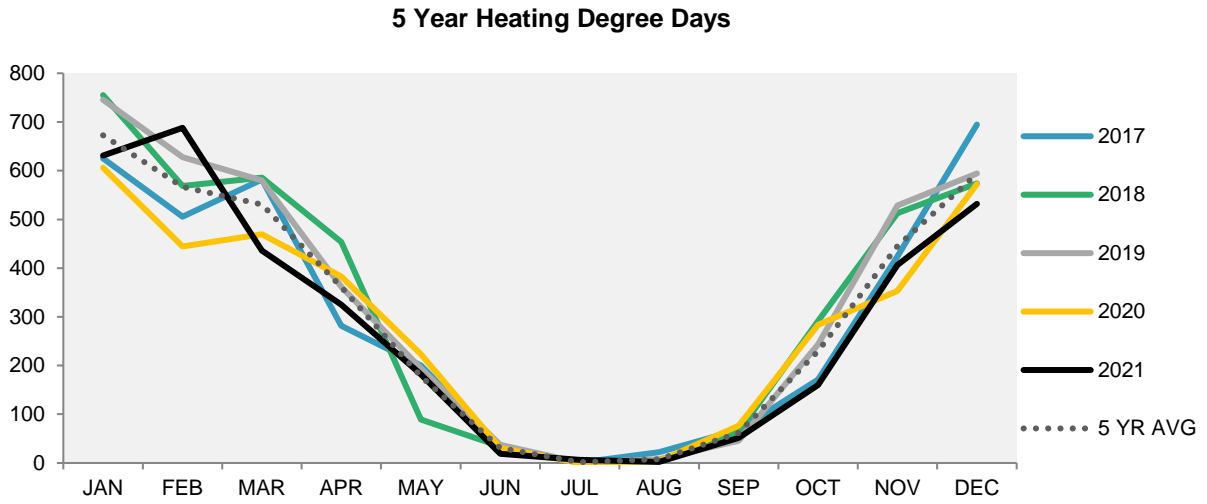
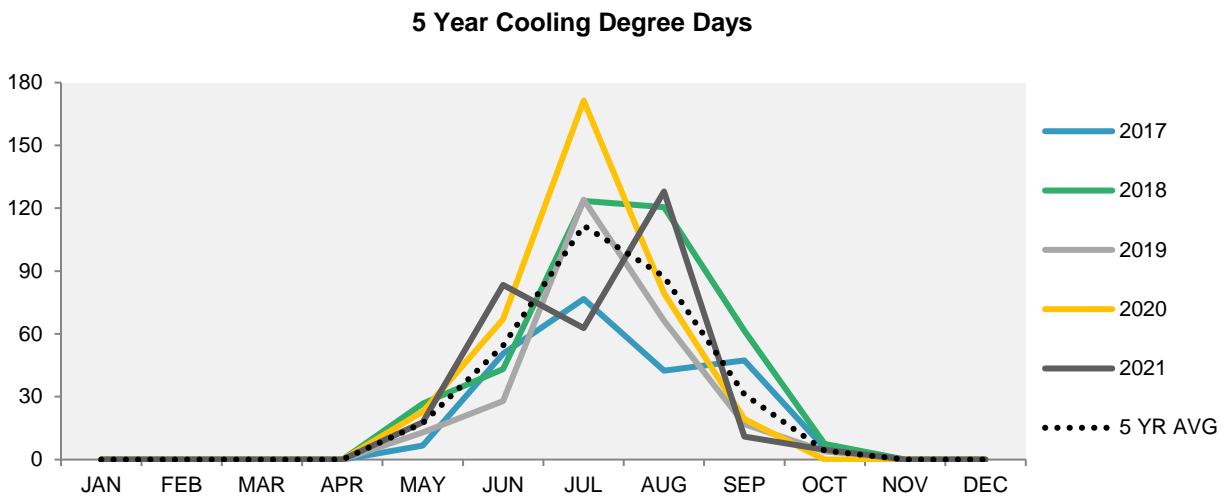


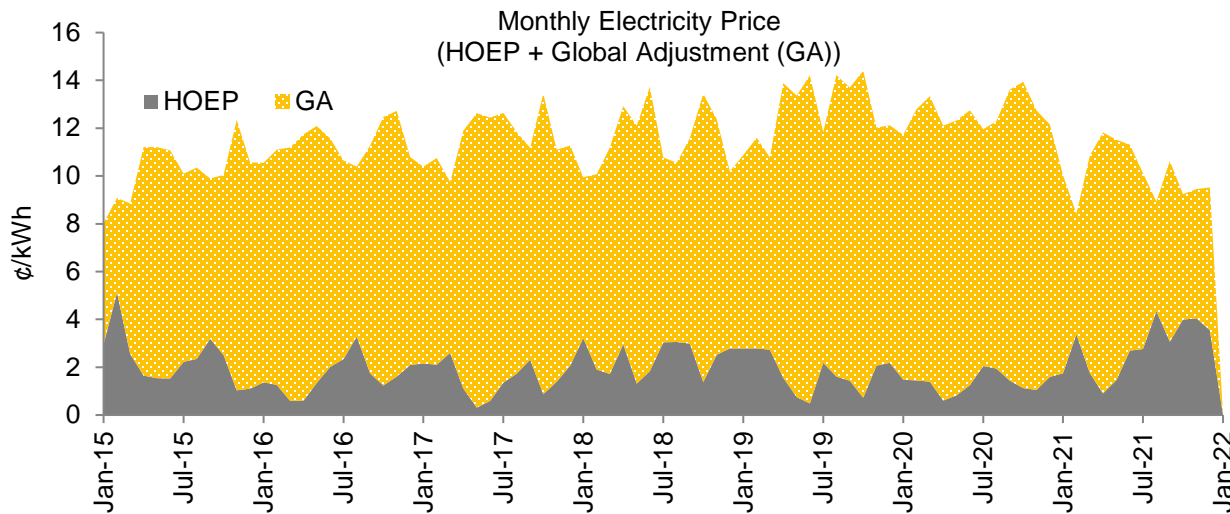
Figure A-26: Cooling Degree Days (CDD)



Electricity and Global Adjustment

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

Figure A-27: Monthly Electricity Commodity Prices (2015-2021)



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 into a Class A rate under the IESO’s ICI program¹⁴. 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., 700 Woodward¹⁵, 850 Greenhill Ave., 78 Kenilworth Ave., 1579 Burlington Street (Materials Recycling Facility)¹⁶ and CUP Operations.

Government intervention to increase economic recovery of large commercial and industrial customers impacted the program rules for the 2021-22 period. Some Class A customers continued to benefit under the Class A rate, whereas others were impacted by reduced demand, such as Tim Horton’s Field and FirstOntario Centre. Overall however, the City has continued to benefit from rate optimization.

The following two graphs show the City’s cumulative benefits and 2021 benefits from the rate optimization under the ICI program.

¹⁴ ICI Program = Industrial Conservation Initiative by IESO: <https://ieso.ca/en/Sector-Participants/Settlements/Global-Adjustment-Class-A-Eligibility>

¹⁵ 700 Woodward added to Class A rate as of July 1, 2021. This was a new account at the Hamilton Water Woodward campus.

¹⁶ 1579 Burlington Street removed from Class A rate as of July 1, 2021

Figure A-28: Cumulative Class A Global Adjustment Results

Year	Global Adjustment Cost Benefit
2011	\$1,061,230
2012	\$1,511,939
2013	\$2,598,221
2014	\$2,348,577
2015	\$3,911,299
2016	\$4,682,209
2017	\$5,976,102
2018	\$6,404,572
2019	\$7,248,037
2020	\$7,397,100
2021	\$3,636,653
CUMULATIVE	\$46,775,939

Figure A-29: 2021 Class A Global Adjustment Results by Month

2021	Standard Global Adjustment Charge	Actual Global Adjustment Charge	Cost Benefit
Jan	\$716,020	\$368,357	\$347,663
Feb	\$286,141	\$179,352	\$106,788
Mar	\$716,632	\$410,011	\$306,622
Apr	\$787,903	\$384,907	\$402,996
May	\$809,822	\$368,709	\$441,114
Jun	\$627,091	\$368,074	\$259,017
Jul	\$628,525	\$266,614	\$361,911
Aug	\$383,164	\$190,834	\$192,330
Sep	\$621,663	\$229,421	\$392,242
Oct	\$442,630	\$165,371	\$277,259
Nov	\$435,846	\$181,905	\$253,941
Dec	\$514,990	\$220,219	\$294,771
Total	\$6,970,427	\$3,333,774	\$3,636,653

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. The GA term begins July 1 annually. 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-30: Top 10 Ontario Verified Peak Demand Days (May 1, 2021-April 30, 2022)¹⁷

Rank	Date	Hour Ending	Ontario Demand (MW)*	AQEW (MW)	AQEW Status
1	24-Aug-21	17	22,986	22,428	Final
2	26-Aug-21	15	22,740	22,358	Final
3	09-Aug-21	17	22,428	21,813	Final
4	25-Aug-21	17	22,360	21,719	Final
5	23-Aug-21	17	22,309	22,055	Final
6	28-Jun-21	18	22,258	21,678	Final
7	11-Aug-21	17	22,042	21,516	Final
8	29-Aug-21	17	21,930	21,415	Final
9	19-Aug-21	17	21,788	21,382	Final
10	12-Aug-21	18	21,734	21,240	Final

Fuels

The following chart breaks down the fuel usage by user group.

Figure A-31: 2021 Fuel Usage by User Group

Group	Diesel Litres	Unleaded Litres	CNG DLE	Total (DLE)
Energy, Fleet & Facilities	7,677	77,195	0	84,871
Engineering Services	0	39,213	0	39,213
Environmental Services	382,440	341,374	0	723,814
Waste Management	653,388	35,830	0	689,218
Hamilton Water	131,801	227,386	0	359,186
Operations	1,023,694	475,332	0	1,499,026
Transportation	94,231	44,525	0	138,756
Other	305,120	1,172,610	0	1,477,731
Transit	4,812,169	51,789	5,902,159	10,766,117
Totals	7,410,520	2,465,253	5,902,159	15,777,932

For further clarification:

1. Transit includes Transit Operations, Route Planning and Transit Yard Support;
2. Operations includes Waste Management (non-contracted), Landfill, Roads and Support Services; and
3. "Other" includes Public Health, Recreation, Tourism, Library, Bi-Law Services, Clerks, Information Services and Fire and EMS.

¹⁷ Source Data: <https://ieso.ca/en/Sector-Participants/Settlements/Peak-Tracker>

Broader Public Sector Reporting (BPS)

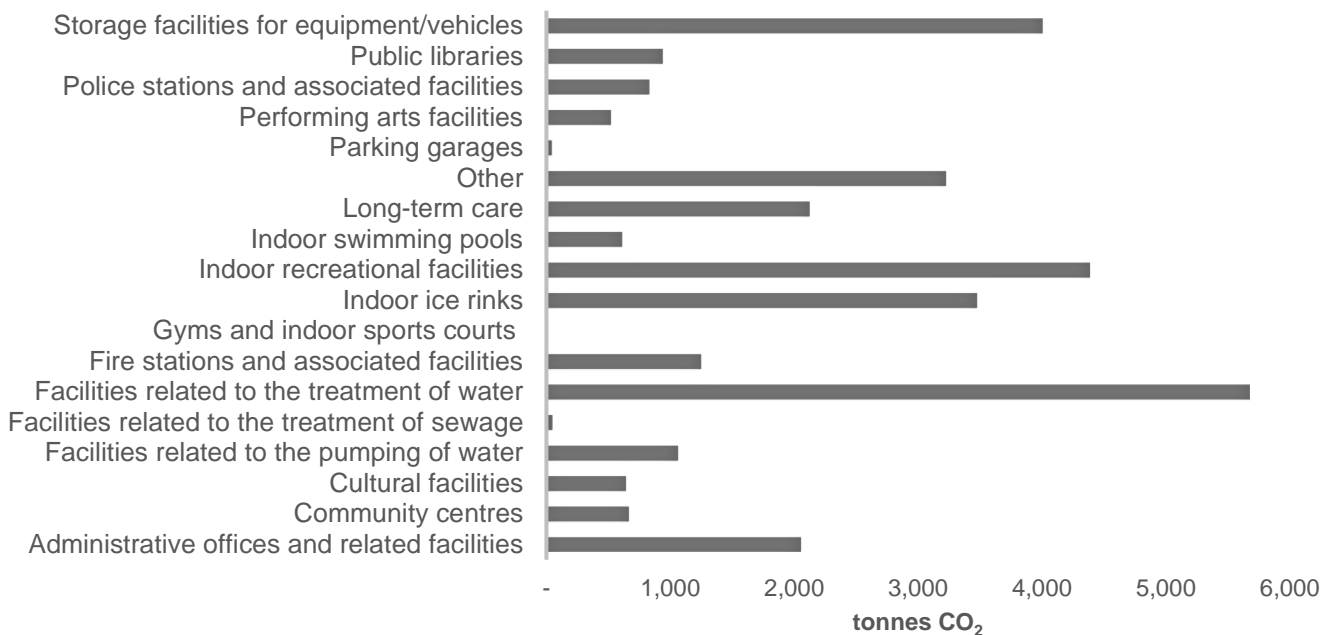
The City submits the annual reporting data for GHG emissions as part of the adherence to Ontario Regulation 507/18. Annual reporting will continue as required under any existing or future legislation.

The latest submission, July 2021 was for the calendar year 2019. According to the reporting formula City-owned corporate facilities (building only) were responsible for emitting 31,565 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, the latest of which was 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-32: 2019 GHG Emissions Results Submitted (O.REG 507/18)¹⁸



¹⁸ Broader Public Sector Report is a pre-templated platform where specific data is required to be reported as per provincial O.Reg 507/18. Next submission for year 2020 is July 2022.

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.
ICI = Industrial Conservation Initiative
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

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

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

Corporate Energy & Sustainability Policy is the revised and renamed corporate policy (previously the Corporate Energy Policy) governing energy-related decisions for corporately run assets.

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

Demand Reduction referenced in the report is action taken to reduce electrical demand during forecasted provincial peak events (high demand period) for optimizing Class A customers.

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

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

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

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.

Net Zero means achieving overall, zero greenhouse gas emissions by balancing any emissions from energy use with carbon removal via a combination of reducing usage, changing to low or zero energy sources (i.e. renewable energy sources) changing processes and carbon offsetting.

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

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.

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