

2022 ANNUAL ENERGY REPORT



**CITY OF
HAMILTON**



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MISSION STATEMENT

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

INTRODUCTION

2022 saw most of North America begin to return to normal, or rather the “new normal”. While the impacts of COVID-19 continue to affect business operations and building occupancy, The City did see most of its services return to pre-pandemic levels within the 2022 year. Community and recreational services increased programming and capacity levels at their facilities and many work spaces were opened again. Varying work models emerged for City staff, from complete return to site work, to hybrid and remote work models. Overall, by the end of 2022, City-owned sites were occupied to some level with staff.

From an energy perspective, the annual results of 2022 energy usage would be closer to pre-pandemic levels than the previous two years. Although there were some lingering impacts in the start of 2022, usage was on par with expectations of a typical year.

The annual energy report provides data for the City’s corporate energy and fleet usage, utility and fuel costs, energy intensity results and a variety of key performance indicators. These include savings and avoided costs for different reduction programs, strategies and benchmarks.

Also included in this report is the Corporate GHG Emissions Inventory Report for 2021. The data for GHG reporting is currently one year behind the reporting of the energy data. Council approved the creation of the Climate Change Office which is focused on moving the City to net zero emissions by 2050 and creating emissions reductions policy actions. While the Climate Change Office is focused on moving Hamilton toward this goal, current Energy and Sustainability policies are also in place with requirements to report on annual GHG emissions for Corporate assets. The inventory shows a 43% reduction in GHG emissions in 2021 when compared to base year¹. Corporate facilities energy and emissions data is also submitted annually as part of the Broader Public Sector reporting requirements of Ontario Regulation 507/18 and is included in Appendix A of this report.

As in previous years, consumption and cost data has been collected for corporate assets, specifically City-owned and operated facilities and vehicle fleet. Additionally, cost savings data related to conservation projects, cost recovery and rate-related decisions have been calculated for the year. Overall, the actions in 2022 from key metrics result in an energy intensity reduction of 27% when compared to the base year of 2005.



Hamilton City Hall

¹ Correction made due to an error discovered on the GHG calculation tool. Further details in section on Corporate GHG: 2021 Inventory (page 18 of this report).

2022 HIGHLIGHTS



Overall Energy Spend of \$47.6M on Utilities for Electricity, Natural Gas and Fuels.



Usage of Electricity decreased by 2%, and Natural Gas Usage increased by 6% compared to 2021.



Energy Intensity decreased by 27% when compared to base year 2005.



Fuel Costs Increased 51% and Fuel Usage increased by 8% compared to 2021.



Conservation Savings of \$4.3M and Incentives received of \$215K.



Project Emissions Savings of 1,148 tonnes CO_{2e} in 2022.



Net Zero Pathways for facilities under development to meet the City's Net Zero targets by 2050.



GHG Corporate Emissions Inventory (2021) decreased by 43% when compared to base year.

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](#)². 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 GHG emissions reduction targets to achieve 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

The City is committed to tracking and reporting on a variety of the key performance indicators (KPI) to measure the City's successes and identify areas for improvement. These metrics have been a principal in evaluation of 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 the 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 energy costs for the City.

Overall, the total results from implementing the various energy strategies and programs in 2022 has resulted in a savings and avoided costs of \$8.5M.

² Corporate Energy & Sustainability Policy is available: <https://www.hamilton.ca/home-neighbourhood/environmental-stewardship/environmental-plans-strategies/office-energy>

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 amounted to a cost of \$127K for 2022 when compared to its benchmark. As we discuss later in the report, natural gas prices did increase overall for 2022. GA strategies resulted in an avoided cost of \$3.5M for 2022. The total avoided costs under this category is \$3.4M in 2022.

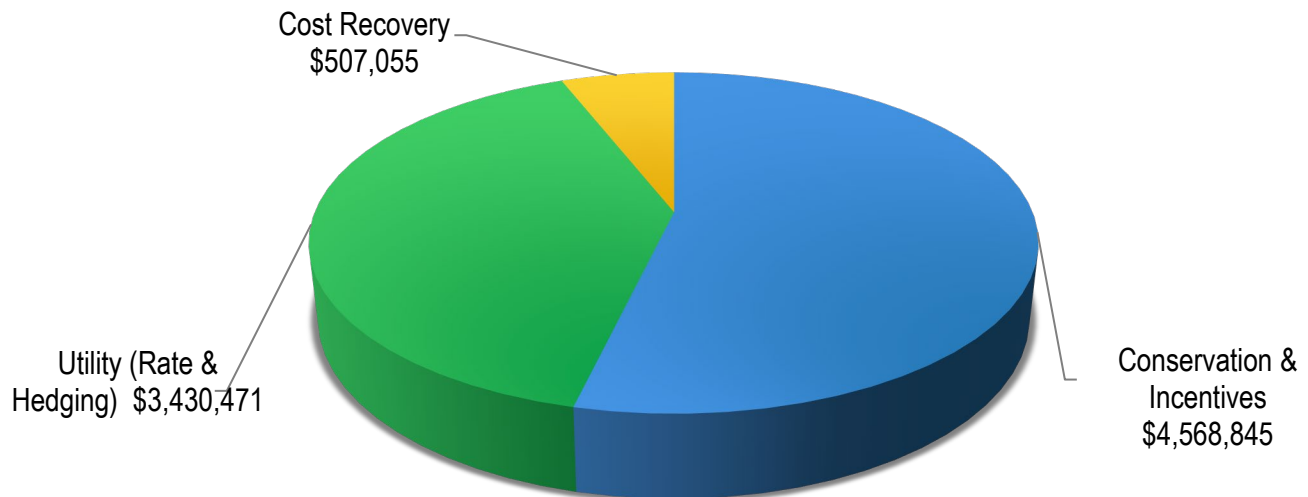
COST RECOVERY

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 2022, the consistent review of the City's accounts and of corrected estimated billings resulted in \$436K of savings in this area. Fuel tax credit recovery for the years 2020 and 2021 was collected during 2022 was \$71K. The total overall for this category was \$507K in 2022.

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 2022 was \$4.3M, with incentives received of \$215K, for a total of \$4.6M 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: 2022 Breakdown of Savings and Avoided Costs



OVERALL UTILITY COSTS 2022

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 2022 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 cost mitigation actions from 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.

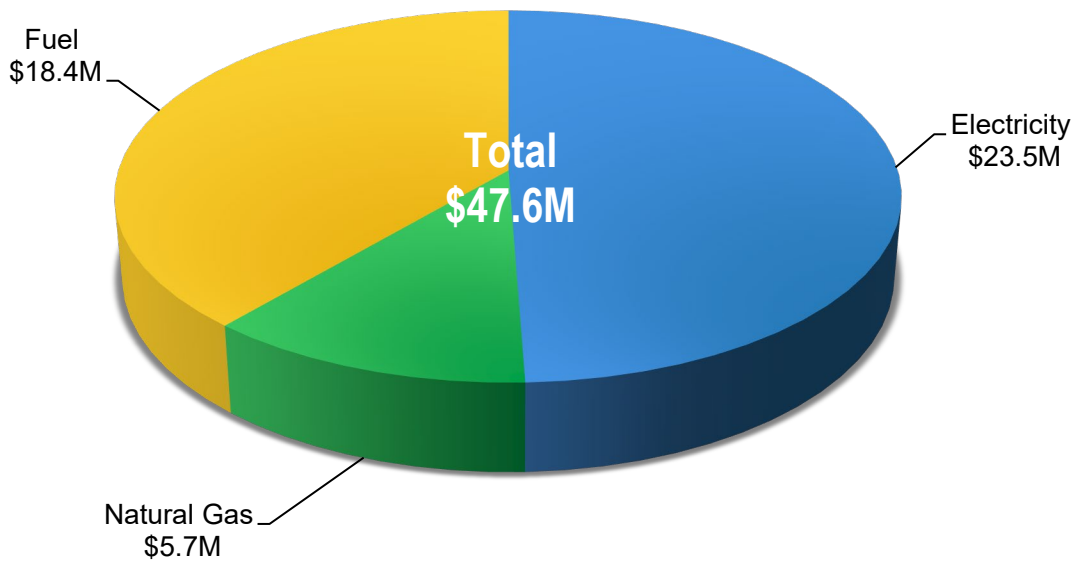
Costs determined in this report are incurred by City-owned and operated buildings/sites and exclude City Housing Hamilton. Utilities include Alectra Utilities, Hydro One Utilities and Enbridge Gas Inc. Sites linked to the district energy system with utility costs provided from HCE are included in electricity and natural gas respectively. Fuels include diesel, unleaded gasoline and compressed natural gas (CNG) for all Transit and Fleet operations (excluding 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 is adjusted annually to include only reported sites.

2022 saw the return of more typical building and fleet usage in the city. Coupled with rise in global inflation, increases to utility and fuel costs were impacted. There were periods of market volatility in 2022 due economic recovery as well as geo-political events with Russia and Ukraine that put pressure on prices overall. The federal carbon charge for natural gas increased as scheduled in April 2022. Fuel costs were particularly vulnerable to global market changes, resulting in a total fuels cost increase of 51% compared to 2021.

Additional information on the impacts will be discussed in upcoming sections of this report. In 2022, the total spend for consumption of electricity, natural gas and vehicle fuels (diesel, unleaded gasoline and compressed natural gas (CNG)) was \$47.6, an increase of 12% overall compared to 2021.

Figure 3: 2022 Total Utility Costs for Electricity, Natural Gas and Fuels³



ENERGY PERFORMANCE KPI RESULTS

Gathering and reviewing data on energy usage and cost is instrumental in understanding trends and decision making for program and project activities. This section reviews the comparison results of electricity, natural gas and energy intensity to the prior year (2021) and to the base year (2005). The last previous typical year in consumption was 2019, therefore some of the KPIs in this section are also compared to 2019 year. This helps to view changes through a lens not primarily affected by the impacts of the COVID-19 pandemic and is perhaps a more accurate reflection of the City's efforts to reduce consumption year over year.

One major change to the data set was the removal of the "Entertainment" category in 2022 reporting. This category included First Ontario Centre, First Ontario Concert Hall and Hamilton Convention Centre. Those properties are not operated by the City, and therefore any changes to operational activities that impact consumption and cost are not directed by City staff.

The energy consumption and costs reported here are period normalized for 2022 and are calculated as usage and cost during that period and may or may not coincide with a billing period for any given account. In addition, the data reported here is for full year data set. If a property is added or removed mid-year it is not included on the reporting. Additional charts on the results presented in this section are in Appendix A of this report.

ELECTRICITY CONSUMPTION AND COST



The table below shows the results for Electricity in 2022. Electricity Consumption in 2022 was down 2% from 2021 and 15% down from the base year of 2005. The costs and unit price were also lower in 2022 when compared to the previous year.

³ Total Costs rounded for graph, total amount = \$47,597,098. Includes City-owned and operated buildings/sites, excluding leased properties, City Housing Hamilton and is period normalized. Entertainment portfolio removed in 2022. Fuels include diesel, gasoline, compressed natural gas. Excludes data for Hamilton Police and DARTS.

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.

Figure 4: Electricity Consumption and Cost Comparison Summary

Electricity Overview					Comparisons		
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
Total Electricity (kWh)	236,362,045	216,929,517	204,698,978	201,298,489	-15%	-7%	-2%
Total Electricity (\$)	\$20,657,050	\$24,575,215	\$25,029,589	\$23,501,278	14%	-4%	-6%
Total Electricity (\$/kWh)	\$0.087	\$0.113	\$0.122	\$0.117	34%	3%	-5%

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 accounts (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. The cooling degree days in 2022 were 6% lower than in 2021, and 9% below the 5-year average. It was not a particularly hot or prolonged summer and likely it took slightly less electricity to reduce the temperatures during the 2022 summer period than it did in 2021.

NATURAL GAS CONSUMPTION AND COST



Natural gas results for 2022 are shown in the table below. Natural Gas consumption for buildings in 2022 was a 6% increase over 2021 and on par with consumption in the base year of 2005. Costs for natural gas were 10% higher in 2022 as compared to 2021, and the unit cost was 4% increase from 2021. Compared to 2019, there are large increases in consumption and costs due to additions in volume for the biosolids production program at the Hamilton Water Woodward site.

Figure 5: Natural Gas Consumption and Cost Comparison Summary

Natural Gas Overview					Comparisons		
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
Total Natural Gas (m³)	15,403,956	13,478,604	14,573,707	15,480,459	0%	15%	6%
Total Natural Gas (\$)	\$6,520,253	\$3,800,296	\$5,131,213	\$5,664,625	-13%	49%	10%
Total Natural Gas (\$/m³)	\$0.423	\$0.282	\$0.352	\$0.366	-14%	30%	4%

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 7.83 cents per m³ to 9.79 cents per m³ at April 1, 2022, an increase of 25% for the FCC component on the regulated costs alone. The FCC is anticipated to increase annually with the expected increase in carbon value. In addition, Enbridge delivery and administrative rates did increase slightly 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 plant 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 2022 increased in the short term as domestic and global industrial and commercial demand rose steadily fueled by European supply shortages from political unrest. This does impact unhedged volumes of the City's natural gas requirements and contributed to the overall higher costs.

The heating degree days (HDD) in 2022 for Hamilton were 8% higher than in 2021. There were considerably higher HDD during January of 2022, indicating a cold start to the year. There were also higher HDD during the later part of Sept and Oct, which is earlier in the season than expected. Overall, 2022 was 1% higher than the 5-year average for HDD.

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 2% increase over 2021 and a 1% increase over 2019. There is a 10% decrease in consumption when compared to the base year of 2005. Overall, the cost for electricity and natural gas combined decreased by 3% over 2021 and increased by 7% compared to the base year.

Figure 6: 2022 Combined Consumption and Cost Comparison Summary

Total Combined Energy Overview	Comparisons						
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
Total Energy (ekWh)	400,722,256	356,567,857	355,682,587	361,676,039	-10%	1%	2%
Total Energy Cost (\$)	\$27,177,303	\$28,375,511	\$30,160,802	\$29,165,903	7%	3%	-3%
Total Energy (\$/ekWh)	\$0.068	\$0.080	\$0.085	\$0.081	19%	1%	-5%

Collectively, the total numbers show some increases in consumption which we would expect as 2022 had increased activity at buildings, particularly those that host community programs like arenas and community centres or house staff. However, had the Entertainment Group not been removed from reporting in 2022, the increase in consumption would have been higher.

In the chart below, the combined consumption information is shown by facility grouping, which may be a better reflection of the 2022 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: 2022 Combined Electricity and Natural Gas Consumption by Facility Grouping (000's of ekWh)

Total Energy Consumption	in 000's of ekWhs				Comparisons		
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
City/Town Halls	13,775	8,899	6,623	8,662	-37%	-3%	31%
Corporate Facilities	17,188	12,256	9,381	10,936	-36%	-11%	17%
Street Lighting and Traffic Lighting	39,290	19,920	19,198	18,682	-52%	-6%	-3%
Other City Operations	5,618	6,355	3,986	4,275	-24%	-33%	7%
Hamilton Water	121,040	126,788	156,362	162,930	35%	29%	4%
Yards	39,589	27,869	26,016	27,935	-29%	0%	7%
Arenas	39,904	35,094	23,673	28,967	-27%	-17%	22%
Community/Senior Centers	3,834	3,601	2,681	3,622	-6%	1%	35%
Rec Centres/ Pools	26,789	30,073	27,000	30,043	12%	0%	11%
Tim Horton's Field	N/A	9,267	7,737	8,880	N/A	-4%	15%
Rec Parks/Stadiums/Golf	8,332	4,997	5,134	5,301	-36%	6%	3%
Lodges (Macassa, Wentworth)	24,938	15,774	15,018	13,699	-45%	-13%	-9%
Culture	5,383	5,278	3,222	3,975	-26%	-25%	23%
Fire/ EMS	10,698	12,803	11,203	12,181	14%	-5%	9%
Hamilton Public Libraries	9,343	11,726	10,235	10,351	11%	-12%	1%
Entertainment	20,244	17,565	16,877	N/A			
Hamilton Police Services	14,757	8,303	11,338	11,238	-24%	35%	-1%
City Wide Total	400,722	356,568	355,683	361,676	-10%	1%	2%

ENERGY INTENSITY RESULTS

Energy intensity is one of the key metrics for the City, and it measures usage in equivalent kilowatt hours per square foot (ekWh/sqft) of operated space. Each year, the city reviews the electrical and natural usage and updates the square footage of occupied space to reflect changes in building portfolios. 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 2022, the energy intensity represents a reduction of 27% as compared to the base year.

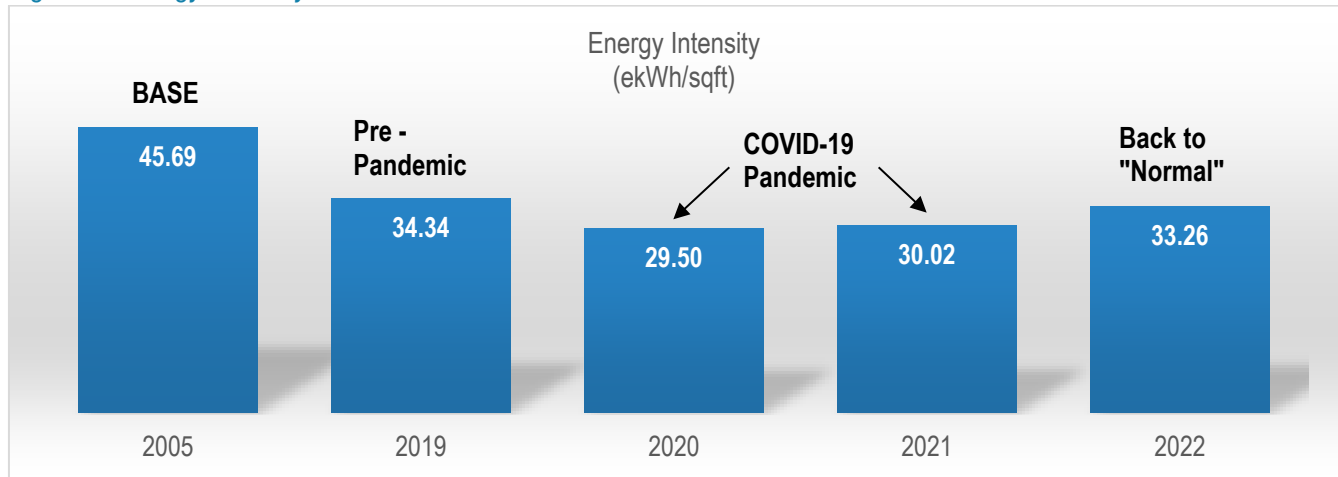
Figure 8: 2022 Energy Intensity Comparison Summary (ekWh/sqft)

Energy Intensity					Comparisons		
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
City Total (ekWh/sqft)	45.69	34.34	30.02	33.26	-27%	-3%	11%
City Total (\$/sqft)	\$2.67	\$2.37	\$2.31	\$2.44	-8%	3%	6%
Reported Square Footage	5,138,852	5,926,831	5,866,611	5,286,082			

Notable exception to this data is the categories of O&M (Operational and Maintenance) and Hamilton Water. The O&M category includes such things as usage related to street lighting, traffic lighting, parking structures/lots, and park or path lighting. Hamilton Water includes usage related to pump stations, reservoirs, wells or water towers. Both categories may have significant usage, but do not represent occupiable space or "building" usage. As noted, the Entertainment Group was removed for 2022 and the square footage was also adjusted to accommodate that change.

Energy intensity results need to be viewed with some caution over the past couple of years, as consumption patterns in 2020 and 2021 were irregular. Although there was an increase of 11% in 2022 when compared to 2021, it is more realistic to compare results to 2019, which was the last "typical" year regarding consumption and operations. Compared to 2019, there was a decrease of 3% in energy intensity.

Figure 9: Energy Intensity



The following chart shows the energy intensity results for specific groupings.

Figure 10: 2022 Energy Intensity Comparison by Portfolio⁵

Energy Intensity	ekWh/sqft				Comparisons		
	2005	2019	2021	2022	2022 vs 2005	2022 vs 2019	2022 vs 2021
City/Town Halls	39.6	24.9	20.3	26.5	-33%	7%	31%
Corporate Facilities	44.6	22.3	19.8	23.1	-48%	3%	17%
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	25.7	27.7	-27%	-4%	8%
Arenas	51.3	41.9	29.4	35.9	-30%	-14%	22%
Community/Senior Centers	31.1	24.3	20.8	23.0	-26%	-6%	10%
Rec Centres/ Pools	78.6	64.6	57.5	59.0	-25%	-9%	2%
Tim Horton's Field	0.0	28.3	23.6	27.1		-4%	15%
Rec Parks/Stadiums/Golf	36.5	30.9	27.0	26.3	-28%	-15%	-3%
Lodges (Macassa, Wentworth)	113.6	45.4	43.2	39.4	-65%	-13%	-9%
Culture	35.5	33.3	24.5	30.2	-15%	-9%	23%
Fire/ EMS	45.2	37.3	32.4	34.2	-24%	-8%	6%
Hamilton Public Libraries	25.2	33.0	28.1	28.7	14%	-13%	2%
Entertainment	30.3	26.3	25.3		Removed		
Hamilton Police Services	59.8	35.1	41.0	40.5	-32%	15%	-1%
City Wide Total	45.69	34.34	30.02	33.26	-27%	-3%	11%

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. Square footage is adjusted for any building not included in the calculation of energy intensity.

VEHICLE FUELS

FUELS CONSUMPTION AND COST



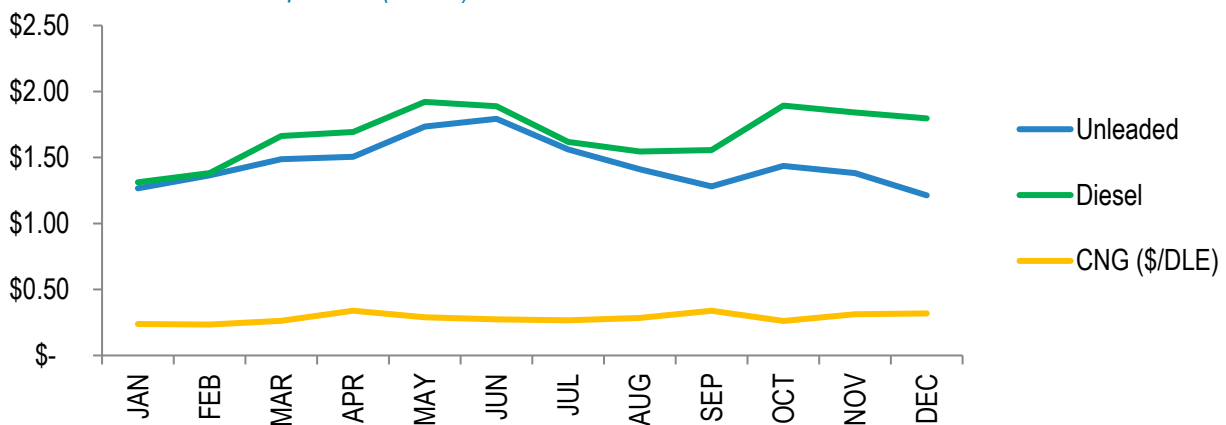
Fuel for the City’s fleet of vehicles is purchased on the wholesale market for all of the City’s own fleet vehicles, including, but not limited to heavy vehicles for Roads, Waste, Hamilton Water, Fire and EMS and Transit, as well as smaller departmental vehicles, like small trucks and SUVs for Building and By-law vehicles. Fuels include diesel, unleaded gasoline and compressed natural gas (CNG).

2022 Results in consumption for diesel and gasoline were as expected, with a modest increase of 3% each, likely due to increased operational activities. There was an increase of 17% of CNG compared to the prior year. This was expected due to an increase in the number of natural gas-powered buses operating in Transit. By the end of 2022, the number of CNG-powered buses represented about 65% of the bus fleet. An increase in CNG usage is expected to continue as Transit replaces all its Diesel bus fleet to CNG over the next few years. An estimated 80% of the bus fleet will be CNG by the end of 2023.

Figure 11: 2022 Fuel Consumption and Costs

Fuel Type	Consumption Litres	Cost	Average \$/L	Comparison 2022 vs 2021	
				Consumption	Average Price
Diesel	7,664,103	\$12,754,304	\$1.66	3%	55%
Unleaded Gasoline	2,541,761	\$3,703,290	\$1.46	3%	28%
CNG (DLE)	6,891,128	\$1,973,601	\$0.29	17%	17%
Total	17,096,992	\$18,431,195	\$1.08	8%	39%

Figure 12: 2022 Fuel Costs Comparison (\$/DLE)



Although CNG is a lower cost fuel compared to diesel and gasoline, the buses do operate at approximately 74% efficiency per diesel litre equivalent (DLE) when compared to diesel fueled buses. However, despite a lower fuel efficiency, when converted to diesel equivalent dollars and adjusted for efficiency, Transit avoided spending \$6.5M with their fleet of CNG buses than they would have using only 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 corporate GHG emissions inventory.

Additionally, the City continued its partnership with Enbridge Gas to operate a fully carbon-negative bus through 2022. The goal of the original one-year pilot in 2021 was to demonstrate reduced emissions from the City’s public

transit operations. The pilot was a success and its extension for the further year continued help to displace approximately 36,000 liters of diesel. RNG is a practical option that enables Transit to reduce emissions without compromising performance or reliability while using its existing fleet.

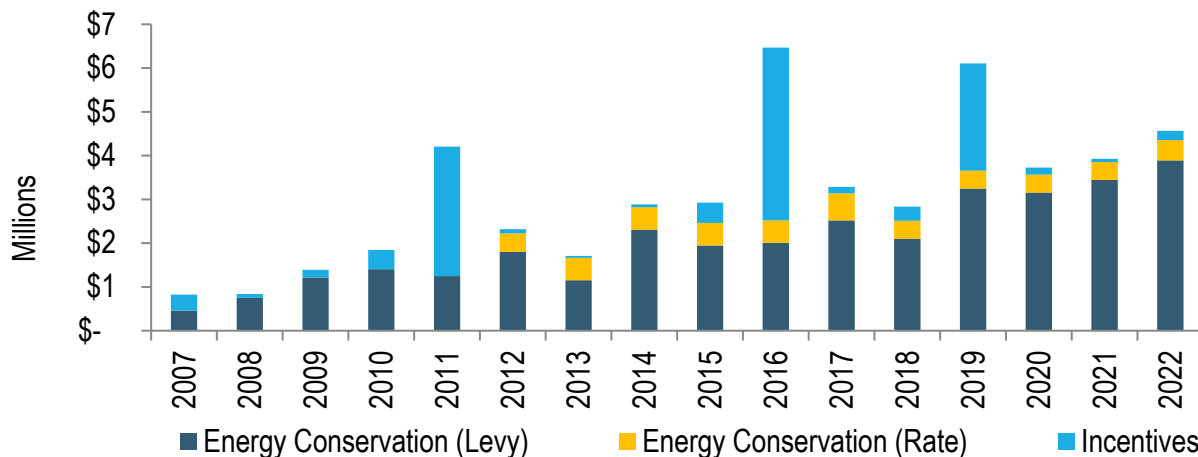
ENERGY CONSERVATION

Project activities at the City play an important role toward meeting the energy reduction and emissions targets and improving efficiencies within City buildings. Every year, these 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 in reporting and tracking the efforts.

The City tracks the energy savings achieved from projects once they are complete. Project activity in 2022 contributed \$4.3M in annual project savings. There was \$215K in incentives received in 2022. Cumulatively, a total result of \$49.6M since 2005 has been achieved for projects and incentives.

Figure 13: Annual Project Savings (Rate & Levy) and Incentives



ENERGY EFFICIENCY PROJECTS

A variety of projects are undertaken annually with the intentions of reducing both energy usage and GHG emissions to help achieve the targets in place. Some highlights on energy efficiency projects that have been completed in 2022 are:

Stoney Creek Recreation Centre - Pool Waste Heat Recovery Project



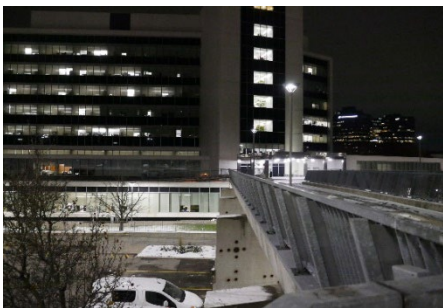
- Installation of Thermal Heat Recovery Systems including efficient make-up water controls. Measures also include low flow shower heads and a slight reduction in pool water temperature.
 - Benefits include: a reduction in electrical, gas & water consumption, reduced GHG emissions & reduced maintenance costs.
 - Annual energy savings for electricity are estimated at 34,969kWh including natural gas savings estimated at 17,929 cubic meters per year. Water savings are estimated at approximately 3,559 m³ per year.
 - GHG emission reduction is estimated at 39 tonnes of CO_{2e} per year.
- Overall operational savings are estimated at \$21,906 annually.
 - Natural gas incentives are estimated at \$1,452.

Ice Plant Optimization Project

- Installation of Floating Head Pressure controls at 6 Arenas
- Benefits include: better ice plant control/optimization for reduced energy consumption and equipment wear & tear.
- Annual energy savings are estimated at 531,065 kWh per year
- IESO SaveOnEnergy incentives are estimated at \$53,107



Hamilton City Hall: LED Lighting Retrofit



- Retrofit of existing indoor light fixture's lamps and ballasts with their equivalent LEDs along with exterior lighting post tops, wall packs, and flood light fixtures upgrade to their equivalent LED models.
 - Benefits included improved energy efficiency, reduced GHG emissions, minimized maintenance cost, and improved Health & Safety aspects of the building.
 - This project yielded an electrical consumption reduction of 446,750 kWh related to lighting load of City Hall along with operational cost reduction of \$40,207 annually.
- These energy saving translated into an annual GHG emissions reduction of 12.5 tonnes of CO_{2e}.
 - Total one-time incentives from the IESO's SaveOnEnergy program was \$26,806.

Macassa Lodge: BAS Controllers Upgrade

- Replace existing BAS controllers excluding field devices to address life cycle replacement.
- Benefits included reduced maintenance, better reliability, and enhanced occupant comfort with improved automation.
- In-addition to above benefits, this project also yielded an annual electrical consumption reduction of 30,000 kWh and 6,500 m³ of natural gas respectively which works out to be an annual operational cost reduction of \$5,000 annually.
- These energy saving translated into an annual GHG emissions reduction of 14 tonnes CO_{2e}.
- Total one-time incentives from the Enbridge's gas program was \$1,320.



Wentworth Lodge: Air Circulation and Perimeter Heating Controls

- Improve air circulation in Dishwashing, Gym and Physio, and Salon areas of the Lodge along with perimeter heating controls in various sections of the Lodge by installing new control valves and VFDs on primary heating pumps and motors.
- Benefits included improved energy savings, reduced GHG emissions, better residents' comfort with improved automation.
- This project yielded an electrical consumption reduction of 71,000 kWh and 22,000 m³ of natural gas respectively with operational cost reduction of \$13,000 annually. These energy saving translated into an annual GHG emissions reduction of 53 Tonnes of CO₂e.
- Total one-time incentives from the IESO and Enbridge Gas programs were \$5,000 combined.

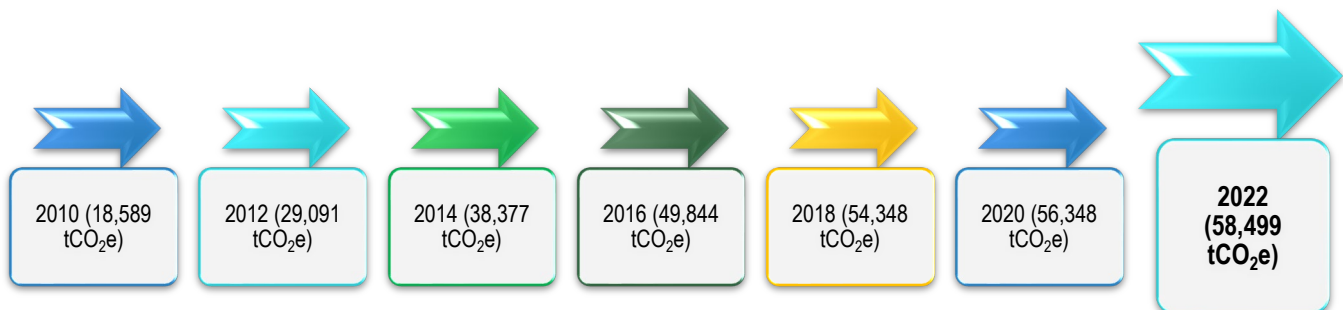


The development of future projects is always ongoing, with emphasis on energy use and GHG emissions reduction. Some of the projects that are underway or expected in 2023 and 2024 include:

- Dundas Town Hall: Lighting Upgrade to LEDs;
- Fire Complex 5: LED Upgrade (remaining indoor CFLs);
- Wentworth Operations Center: LED Lighting Upgrade;
- Wentworth Operations Center: Boiler and Condensers Upgrade;
- Central Public Library: ECUs Replacement;
- Roof Top Units Replacement at Fire Station Admin building and Fire Station;
- Bennetto Recreation Centre Pool Waste Heat Recovery Project;
- Jimmy Thompson Pool Filter Pumps VFD Project;
- Ryerson Pool Waste Heat Recovery Project & VFD Project;
- Stoney Creek Municipal Centre – Cooling Tower Replacement Project;
- Glanbrook Town Hall – Heating/Cooling replacement/conversion to Air Source Heat Pump Systems;
- Arena's Solar PV Project.

The goal of energy efficiency projects is not only 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 efficiency measures completed on projects in 2022 resulted in 1,033 tCO₂e, with a cumulative total of 58,499 tCO₂e reduction from project activities since 2005. This is the equivalent of removing approximately 12,700 cars from the road.

Figure 15: Cumulative GHG Savings from Project Activities



RENEWABLE ENERGY GENERATION

The City's renewable generation operations are owned and managed through Hamilton Renewable Power Inc. (HRP Inc.). 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.

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, renewable 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 through expansion of generation capacity as well as implementing additional renewable energy options. Staff will be working on new plan to explore renewable energy generation opportunities in all corporate facilities including Hamilton Water and its waste processing facilities.

NET ZERO INITIATIVE

In 2019, City council declared a climate change emergency. As a response to this declaration, the City committed to becoming a net zero emissions city by 2050. This target was solidified in the five-year review of the Corporate Energy and Sustainability Policy document in 2020 which supports corporate goals. Additionally, the City created a Climate Change Office to help achieve these long-term targets by guiding overall City policy (community and corporate). There is no one clear route to achieving net zero emissions. It requires a broad combination of various projects and programs, operational changes, renewable energy generation and electrification. In order to facilitate all that must be accomplished, a forward-looking plan or "pathway" is required.

PATHWAY TO NET ZERO

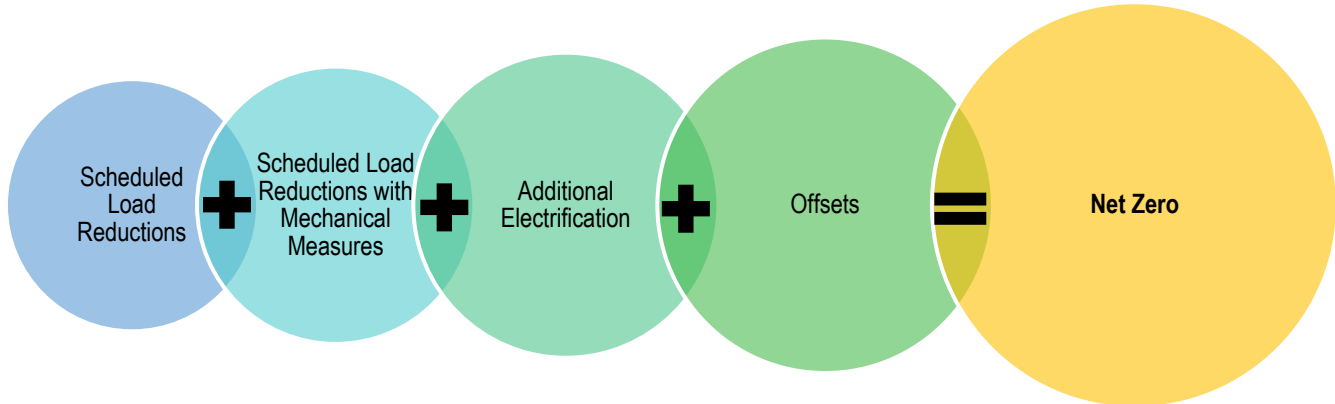
As part of the City declaration, city staff looked toward its corporate assets. Energy Initiatives engaged a consultant to review City facility energy usage data and existing asset/equipment replacement schedules and prepare an overall strategy that would create a pathway toward net zero carbon emissions (operational) for the entire Corporate building portfolio.

The strategy was developed through site walkthroughs and staff interviews, facility program data and analysis of the utility data. The study provided an overview for different carbon reduction scenarios including a tiered pathway approach. Ultimately, the pathway to net zero scenario is intended to allow for achievement of net zero carbon by 2050 by taking a practical approach that aligns but moves beyond the existing asset replacement plans while still incorporating important elements of those plans. For example, when replacing building components, instead of like-for-like replacements, buildings should be upgraded with more energy efficient equipment and components, with a

focus on phasing out natural gas equipment in favor of electric where viable. Lastly, considering renewable energy options wherever possible, solar thermal, ground source heat pumps, and waste gas capture.

This pathway incorporates several tiers that together demonstrates a series of cumulative efforts to pursue net-zero carbon energy consumption for Corporate buildings:

Figure 14: Pathway to Net Zero for Facilities



The pathway estimates the following:

- Scheduled load reductions – will decrease the GHG emissions by 20%;
- Scheduled load reductions and mechanical measures will decrease the GHG emissions by 72%;
- Additional electrification combined with the previous two measures will decrease the GHG emissions by 88%; and
- Offsets will be the final gap and reduce the emissions to 100%.

In short, combined efforts with a focus on GHG emissions-reducing project work (energy efficient equipment replacements), coupled with renewable energy generation and electrification, is key to meeting the corporate goals.

The study and overall strategy were a critical first step in developing the long-term plans needed to achieve these targets. As a result, specific pathways to net zero reports (PNZ reports) have been developed initially for 10 facilities to outline the actions required to achieve the net zero goals. The facilities chosen were a cross section of the corporate facilities portfolio including arenas, recreation centres, a fire station, a town hall and a few city public works yards. While the PNZ reports are specific to the facility, many of the activities included in these pathways can be extrapolated for use in other similar buildings.

- Harry Howell Arena
- Morgan Firestone Arena
- Chedoke Arena
- Jimmy Thompson Pool
- Ryerson Recreation Centre
- 330 Wentworth Operations Centre
- Traffic Operations Yard
- Dundas Town Hall
- Fire Station 5 complex
- Mountain Transit Centre

The strategy and the PNZ reports serve as guidelines and are shared with the Facilities Operations & Maintenance and Strategic Planning, Capital and Compliance groups, so these documents can add support to feasibility studies for overall facility upgrades. Moving forward, Energy Initiatives is continuing to communicate effective actions and recommendations for more efficient equipment, electrification options and/or alternate fuel sources, and funding opportunities to target the facilities and portfolios that have the highest emissions. It is a collaborative endeavor and requires input and expertise throughout the corporation.

City staff will continue to deploy resources across departments to meet these targets and monitor successes and adjust the pathway along the way.

CORPORATE GREENHOUSE GAS (GHG) REPORT: 2021 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 were 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.

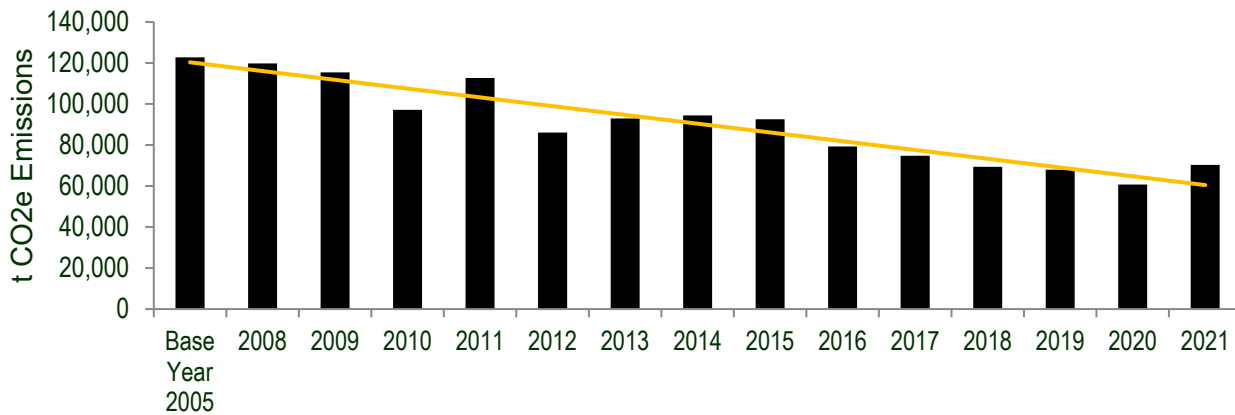
The GHG reporting is a year behind the energy reporting, and therefore the following results are for the 2021 annual inventory. As a reminder from the 2020 report, the base year 2005 was revised in 2020 to accommodate two changes; the removal of employee commuting; and the move of small vehicles category into the vehicle fleet category.

2021 INVENTORY RESULTS

Considering that the data presented here is for the 2021 calendar year, the effects from pandemic responses were still impacting overall usage in the City and some services were reduced, particularly notable in buildings. However, efforts to reduce emissions through energy efficiency continued to be a priority during this period as well. Additionally, an emissions calculation error was corrected in 2021 related to the vehicle fleet and contracted fleet sectors which showed emissions had been previously under-reported.

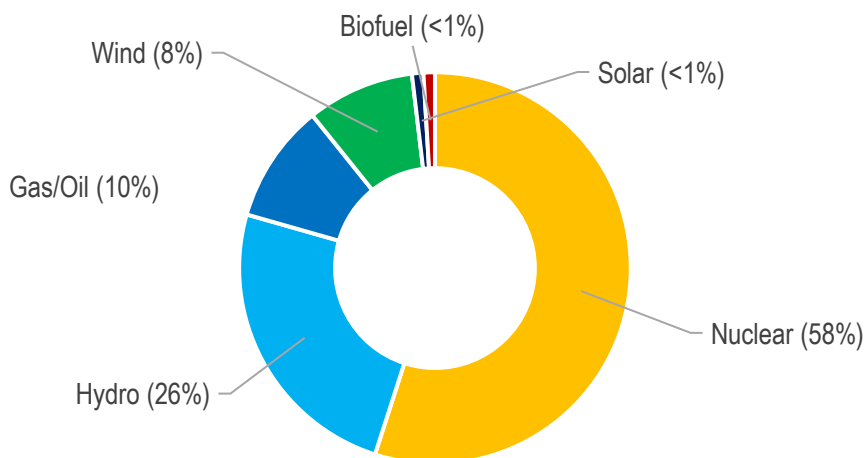
In 2021, the GHG corporate emissions inventory was 70,271 tonnes of CO₂e (carbon dioxide equivalent). This represents a 43% reduction from the 2005 base year (122,699 tonnes CO₂e/) and 16% increase compared to 2020. The inventory does not include HRPI operations.

Figure 16: City of Hamilton Corporate GHG Emissions Year Trends 2005-2021



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 2021. 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: 2021 Ontario Energy Output by Fuel Type⁶

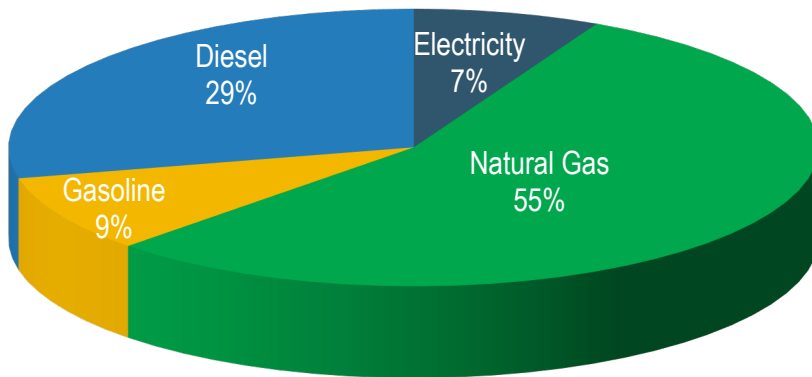


In addition to electricity emission factors, other impacts to the City's inventory include completion of energy efficiency projects, reductions in usage from operational improvements and fuel switching, such as Transit's ongoing conversion from diesel buses to CNG-powered buses. Future developments around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

⁶ IESO source: <https://ieso.ca/en/Power-Data/Supply-Overview/Transmission-Connected-Generation>

significantly impact GHG emissions for the City. In 2021, Transit, in partnership with Enbridge Gas, announced Ontario's first carbon-negative bus fueled by renewable natural gas. The goal of the one-year RNG pilot was to demonstrate reduced emissions from the City's public transit operations. The pilot also extended into 2022.

Figure 18: 2021 Percentage of tCO_{2e} 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. Of note, the natural gas is used in both buildings and to power 65% of the City's bus fleet.

The emissions from all related fuel sources by sector; buildings, vehicles and processes are shown in Figures 19 and 20 below. Of the reported sectors, vehicle fleet remains the largest emitter with 51% of corporate emissions for 2021. Corporate buildings represent 29% and Water and Sewage operations with 17% round out the top 3. The other sectors account for the remaining 3% of emissions in 2021.

Figure 19: 2021 Percent tCO_{2e} of Total by Reporting Sector

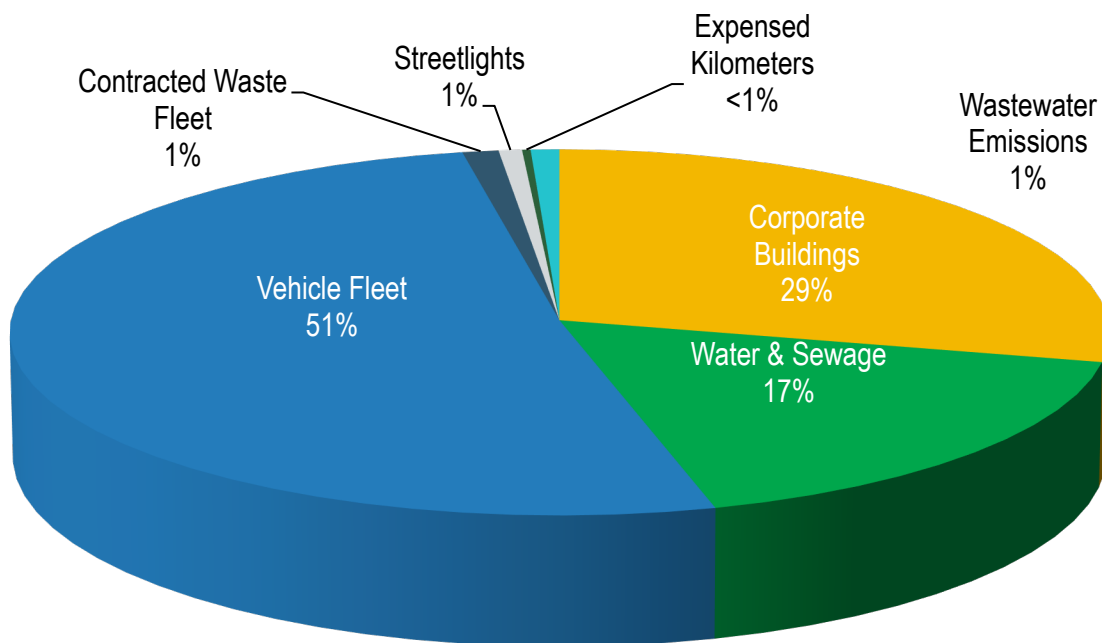


Figure 20: 2021 Breakdown of tCO_{2e} by Sector

Sector	2021 Total CO_{2e}	2021 Vs Base	2021 Vs 2020
Corporate Buildings	20,126	-57%	-4%
Vehicle Fleet	36,025	0%	35%
Water and Sewage Buildings	11,997	-52%	10%
Street lights	513	-94%	-17%
Contracted Waste Fleet	795	-85%	44%
Expensed Kilometers	186	-62%	-14%
Wastewater Emissions	629	20%	-1%
TOTAL	70,271	-43%	16%

Corporate buildings show a significant reduction in emissions of 57% 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 2021 reductions were compounded by lower usage from varying degrees of building closure or shifts in operational hours due to the COVID-19 safety plans.

Vehicle fleet includes emissions from diesel, gasoline and natural gas. The 2021 emissions show no overall reduction when compared to the 2005 base year. In calculating the emissions for the 2021 year, an error was discovered in the calculation model that revealed that the emissions inventory for compressed natural gas (CNG) had been under-reported for several years in the Vehicle Fleet and Contracted Waste Fleet sectors. As a result, the correction has been made to the calculation formula and is now accurately reported for 2021. It is important to note that the base year was not impacted because there were not any natural gas fueled vehicles at that time, so no adjustments have been made to the base year in either of the impacted sectors. Additionally, Transit is the primary user of natural gas vehicles, for City buses, therefore it should also be noted that Transit has also increased its fleet size. Although it is accurate that fuel switching from diesel buses to CNG fueled buses have lowered emissions comparatively, the inventory (composition of fleet vehicles) has also changed. However, the emissions were positively impacted by an RNG-fueled pilot bus which utilized RNG that was carbon negative and reduced the emissions by ~222 tCO_{2e} in 2021.

The 2021 emissions from Water and Sewage buildings has increased compared to 2020, with the addition of a natural-gas fueled biosolids processing operation at the Woodward site. However, this sector still shows a reduction of 52% when compared to 2005 base year.

It is important to re-iterate that a majority of the GHG emissions here are directly tied to usage and is an inventory of calculated emissions, and therefore with the overall fluctuations in usage during 2021, corrections to the calculation model and some increases in assets, 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. As the City moves forward to achieve net -zero corporate emissions, a combination of energy efficiency and an increase in renewable fuel sources will be required to meet ambitious targets.

2022 ENERGY REPORTING FINAL COMMENTS

In 2022, the City was largely “back to normal”. That is, City operations were tracking at pre-pandemic levels. Public services and sites were open for business, and transit operations were running full schedules. Even if facilities were operating with reduced in-person staffing levels at some sites, the buildings continued to be heated and cooled.

The data for 2022 showed an increase in energy intensity when comparing to the impacted pandemic years in 2020 and 2021, but a small decrease in energy intensity when compared to the last pre-pandemic year of 2019. Overall, energy intensity is trending downward. Energy efficient project activity did continue to deliver some energy usage reductions and GHG reductions.

However, maintaining just a downward trend is not enough. Hamilton has long-term goals to reduce its energy intensity by 50% and to become a net-zero city by 2050. Both of those goals are ambitious and will require all City departments to implement actionable plans and policies to actively reduce energy usage and GHG emissions. Many divisions have begun to address the targets by:

- Improving operational efficiencies with equipment and lifecycle replacements;
- Creating green policies for procurement of new equipment;
- Creating resiliency policies around climate change;
- Forming Pathway to Net Zero plans; and
- Utilizing low or carbon neutral fuels;

Implementing new innovative technology, investing in renewable energy generation and carbon-reducing/carbon-neutral projects and prioritizing climate action is imperative across the City if we hope to meet the 2050 targets.

Additionally, the creation of the Office of Climate Change Initiatives will play a large part in establishing policies and programs toward achieving the net zero goals for the City as a whole. The Energy Management office will continue to support Climate Change Initiatives through identification, recommendation and implementation of key energy and emission reduction projects including low carbon fuel generation and resiliency projects.

As always, 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 the ever-changing energy landscape. Additional details on specific reporting items can be found in the Appendix A.

The City of Hamilton’s commitment to energy conservation and environmental sustainability plays an important role in supporting the City’s Strategic Plan by contributing to a prosperous and healthy community; providing valued and sustainable services; and demonstrating innovation and leadership. Ongoing success of the energy program requires engagement of all Five Values of Our Culture - Collective Ownership; Steadfast Integrity; Sensational Service; Engaged, Empowered Employees; and Courageous Change.

APPENDIX A

This appendix provides additional information, charts and graphs for more specific details on KPI results and impacts to various KPIs for 2022 as presented in the report.

Energy Strategies and Programs KPIs

The following charts outline some of the results from the Energy Strategies and Programs, including the cumulative results in 2022.

Figure A-1: Cumulative Savings and Avoided Costs 2005-2022

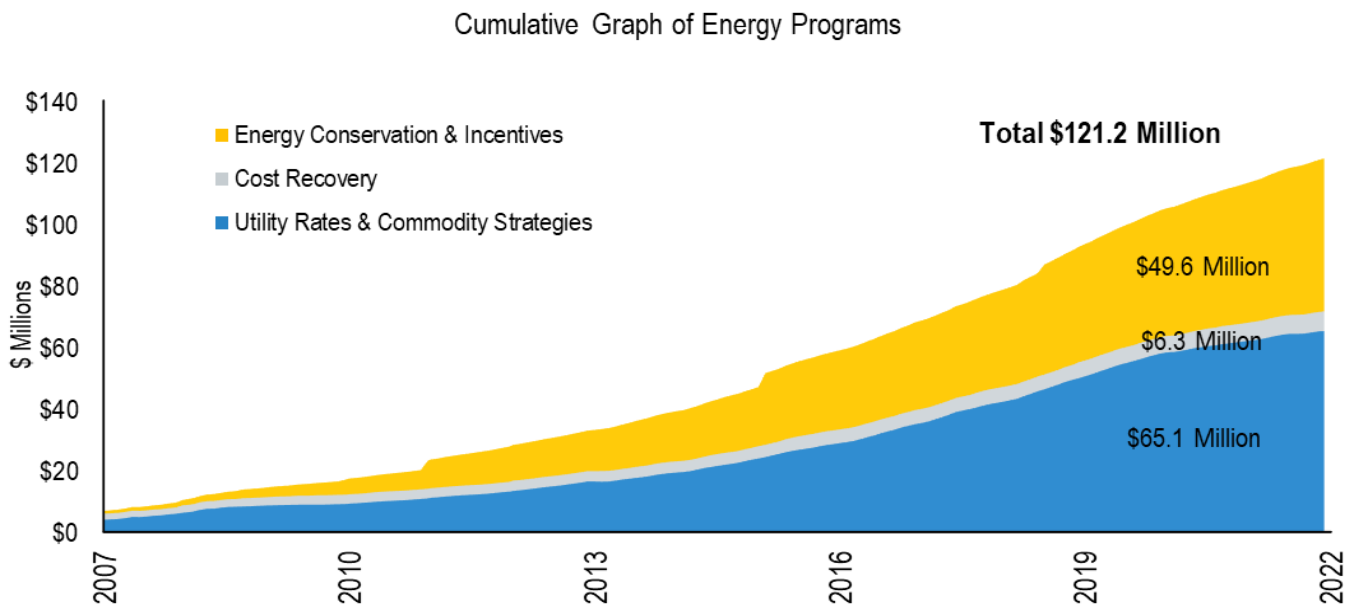
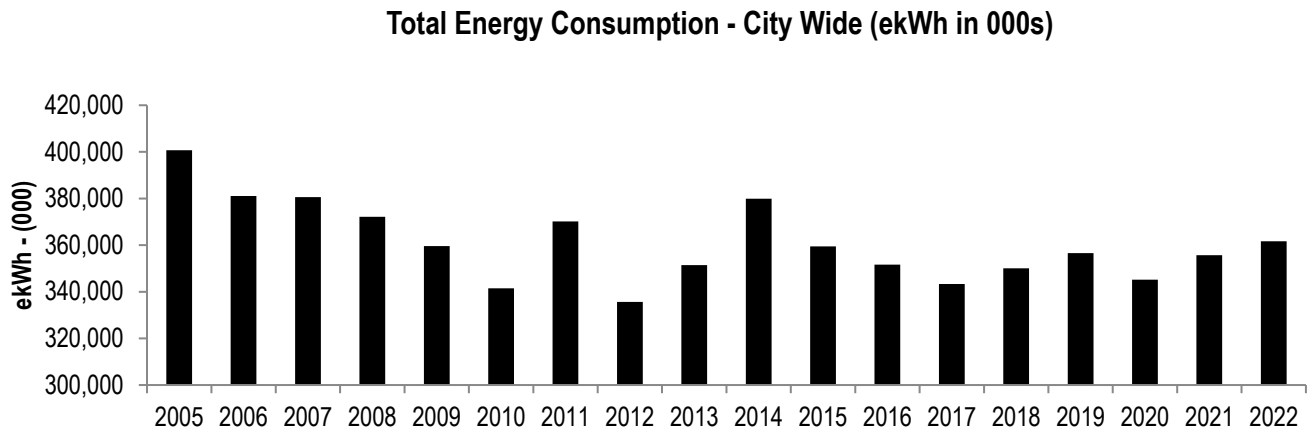


Figure A-2: Three Year Comparison of Energy Programs and Strategies

Category	Past 3 Years			2006-2022 Cumulative
	2020	2021	2022	
Levy RPP/Interval Change	\$0	\$0	\$0	\$2,886,651
Rate RPP/Interval Change	\$0	\$0	\$0	\$2,873,163
Levy Global Adjustment	\$1,687,244	\$1,125,127	\$929,594	\$12,144,620
Rate Global Adjustment	\$5,709,856	\$2,511,526	\$2,628,391	\$38,189,304
Levy Natural Gas	\$489,742	\$146,558	-\$86,195	\$7,720,686
Rate Natural Gas	\$134,580	\$79,586	-\$41,320	\$1,379,759
Energy Conservation Levy	\$3,154,851	\$3,443,080	\$3,891,267	\$32,417,402
Energy Conservation Rate	\$410,732	\$410,732	\$462,074	\$5,200,961
Incentives	\$160,138	\$73,292	\$215,504	\$12,036,336
Cash Recovery Levy	\$173,608	\$471,291	\$468,376	\$6,056,279
Cash Recovery Rate	\$0	\$47,684	\$38,679	\$321,738
Totals	\$11,920,752	\$8,308,876	\$8,506,370	\$121,226,901

Overall Costs, Consumption and Performance - Electricity and Natural Gas

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



The following two charts show the consumption of electricity and natural gas individually by portfolio.

Figure A-4: Electricity Consumption Comparison by Portfolio Category

Electricity Consumption	in 000's of kWhs		
	2005	2021	2022
City/Town Halls	4,736	3,271	4,042
Corporate Facilities	4,669	4,195	5,097
Street Lighting	33,603	17,770	17,465
Traffic Lighting	5,688	1,428	1,216
Other O&M	5,248	3,939	4,205
Hamilton Water	106,561	104,634	104,684
Yards	11,982	9,020	9,170
Arenas	17,834	11,251	12,534
Community/Senior Centers	1,258	850	1,329
Rec Centres/Pools	4,124	7,243	7,575
Tim Hortons Field	N/A	4,713	6,046
Rec Parks/Stadiums/Golf	3,885	2,453	2,912
Lodges	4,673	5,216	5,276
Culture	2,254	1,539	1,957
Fire/ EMS	3,766	4,500	4,677
Libraries	7,314	7,464	7,212
First Ontario Centre	6,578	5,689	Removed
First Ontario Concert Hall	3,552	1,870	Removed
Hamilton Convention Centre	3,026	1,608	Removed
Police	5,613	6,046	5,899
Total Electrical Consumption	236,362	204,699	201,298

Figure A-5: Natural Gas Consumption by Portfolio Category

Natural Gas Consumption	in 000's of M3s		
	2005	2021	2022
City/Town Halls	847	324	446
Corporate Facilities	1,173	501	564
Street Lighting	0	0	0
Traffic Lighting	0	0	0
Other O&M	35	5	7
Hamilton Water	1,357	4,993	5,622
Yards	2,587	1,640	1,811
Arenas	2,068	1,199	1,586
Community/Senior Centers	241	177	221
Rec Centres/ Pools	2,124	1,907	2,169
Tim Hortons Field	N/A	292	274
Rec Parks/Stadiums/Golf	417	259	231
Lodges	1,899	946	813
Culture	293	162	195
Fire/ EMS	650	647	724
Libraries	190	267	303
First Ontario Centre	332	348	Removed
First Ontario Concert Hall	179	213	Removed
Hamilton Convention Centre	153	183	Removed
Police	857	511	515
Total NG Consumption	15,404	14,574	15,480

Figure A-6: Total Combined Consumption by Portfolio Category (ekWh)

Total Energy Consumption	in 000's of ekWhs		
	2005	2021	2022
City/Town Halls	13,775	6,623	8,662
Corporate Facilities	17,188	9,381	10,936
Street Lighting	33,602	17,770	17,465
Traffic Lighting	5,688	1,428	1,216
Other City Operations	5,618	3,986	4,275
Hamilton Water	121,040	156,362	162,930
Yards	39,589	26,016	27,935
Arenas	39,904	23,673	28,967
Community/Senior Centers	3,834	2,681	3,622
Rec Centres/ Pools	26,789	27,000	30,043
Tim Horton's Field	0	7,737	8,880
Rec Parks/Stadiums/Golf	8,332	5,134	5,301
Lodges (Macassa, Wentworth)	24,938	15,018	13,699
Culture	5,383	3,222	3,975
Fire/ EMS	10,698	11,203	12,181
Hamilton Public Libraries	9,343	10,235	10,351
First Ontario Centre	10,122	9,292	Removed
First Ontario Concert Hall	5,466	4,077	Removed
Hamilton Convention Centre	4,656	3,508	Removed
Hamilton Police Services	14,757	11,338	11,238
City Wide Total	400,722	355,683	361,676

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

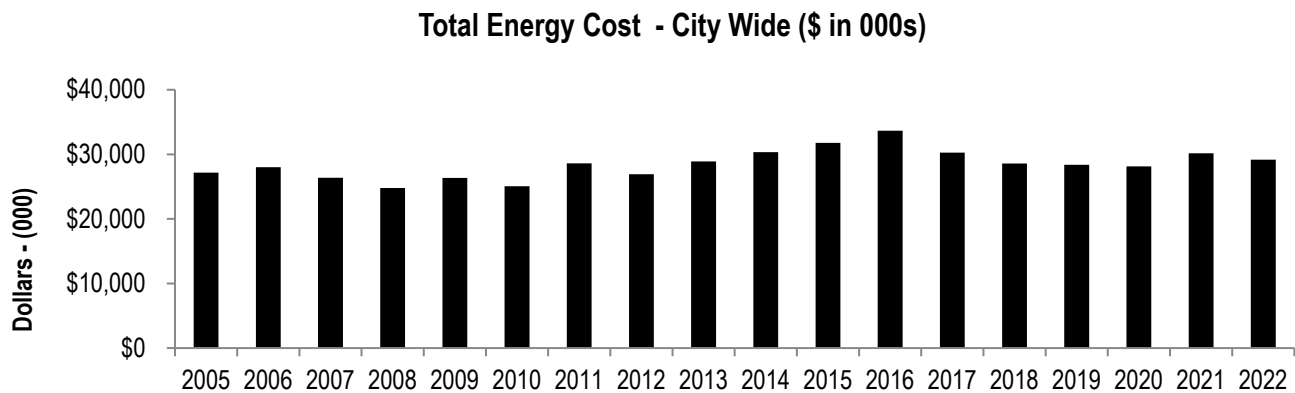
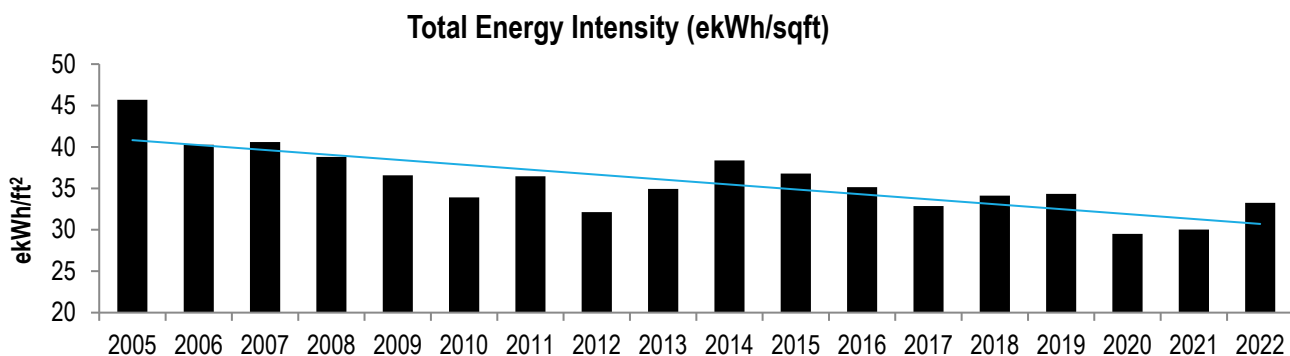


Figure A-8: Total Reported Cost Comparison by Portfolio Category

Total Energy- Cost	in 000's of \$				Comparisons	
	2005	2020	2021	2022	2022 vs 2005	2022 vs 2021
City/Town Halls	\$860	\$673	\$599	\$826	-4%	38%
Corporate Facilities	\$866	\$940	\$749	\$851	-2%	14%
Street Lighting	\$2,895	\$3,504	\$3,462	\$3,266	13%	-6%
Traffic Lighting	\$462	\$222	\$222	\$206	-55%	-7%
Other City Operations	\$534	\$628	\$497	\$551	3%	11%
Hamilton Water	\$9,590	\$10,507	\$12,427	\$12,245	28%	-1%
Yards	\$2,205	\$1,635	\$1,718	\$1,797	-18%	5%
Arenas	\$2,455	\$2,098	\$2,015	\$2,204	-10%	9%
Community/Senior Centers	\$224	\$212	\$190	\$270	21%	42%
Rec Centres/ Pools	\$1,192	\$1,555	\$1,554	\$1,673	40%	8%
Tim Horton's Field	\$0	\$686	\$775	\$836	#DIV/0!	8%
Rec Parks/Stadiums/Golf	\$564	\$374	\$451	\$495	-12%	10%
Lodges (Macassa, Wentworth)	\$1,087	\$756	\$831	\$800	-26%	-4%
Culture	\$338	\$218	\$215	\$283	-16%	32%
Fire/ EMS	\$614	\$795	\$775	\$826	35%	7%
Hamilton Public Libraries	\$827	\$920	\$865	\$873	6%	1%
First Ontario Centre	\$840	\$1,116	\$1,062	Removed		
First Ontario Concert Hall	\$454	\$285	\$307	Removed		
Hamilton Convention Centre	\$387	\$254	\$274	Removed		
Hamilton Police Services	\$783	\$746	\$1,173	\$1,163	49%	-1%
City Wide Total	\$27,177	\$28,125	\$30,161	\$29,166	7%	-3%

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



The following series of graphs represent the energy intensity results per site for 2022 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.

Figure A-10: 2021 Energy Intensity Corporate Facilities⁷

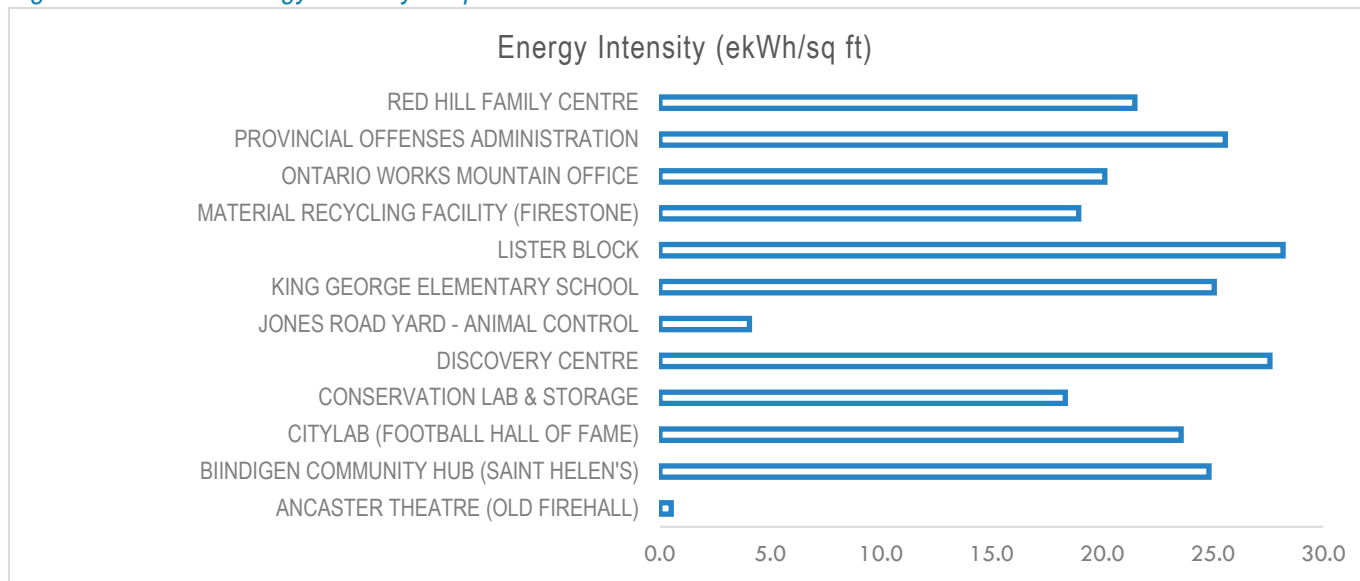
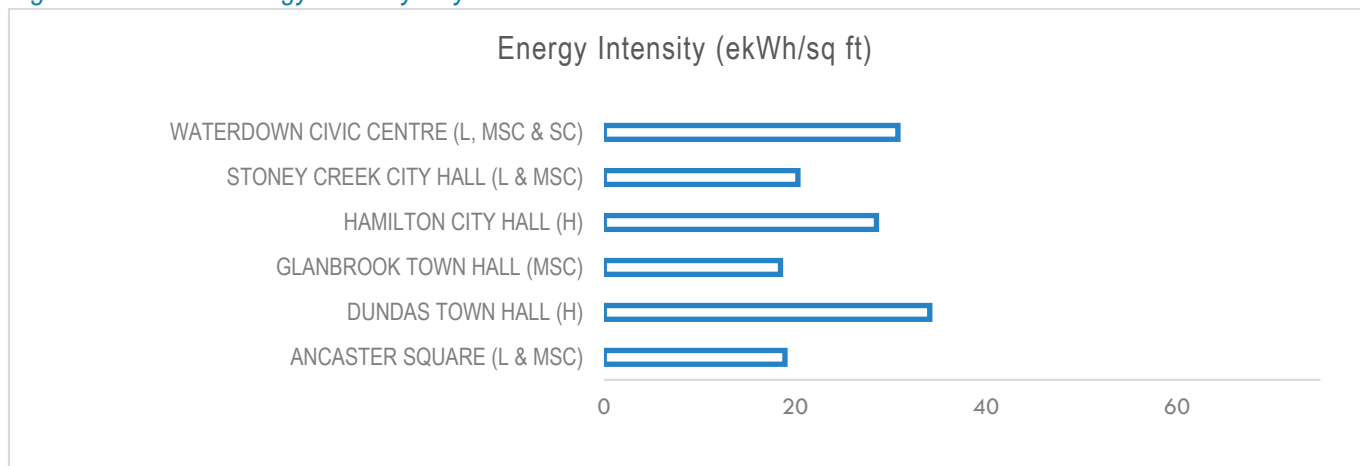


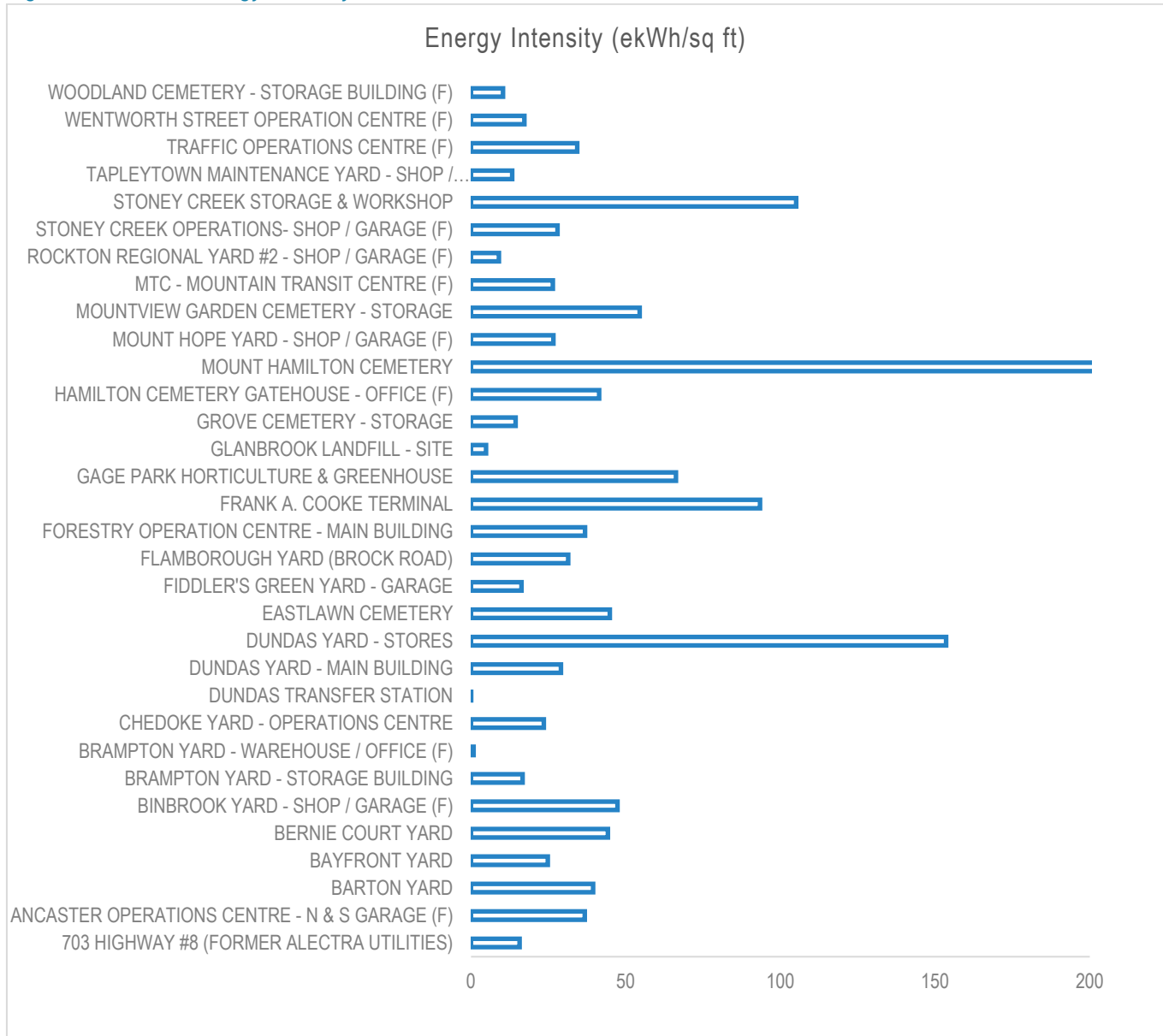
Figure A-11: 2021 Energy Intensity City & Town Hall Facilities⁸



⁷ Material Recycling Facility does not include consumption related to Composting facility operations – metered separately and operated by a third party.

⁸Operation site notes: L = Library; MSC = Municipal Service Centre; SC=Senior Centre; H= Heritage.

Figure A-12: 2021 Energy Intensity Yards Facilities⁹



⁹ (F) = Fueling site on premises

Figure A-13: 2021 Energy Intensity Community Centres Facilities¹⁰

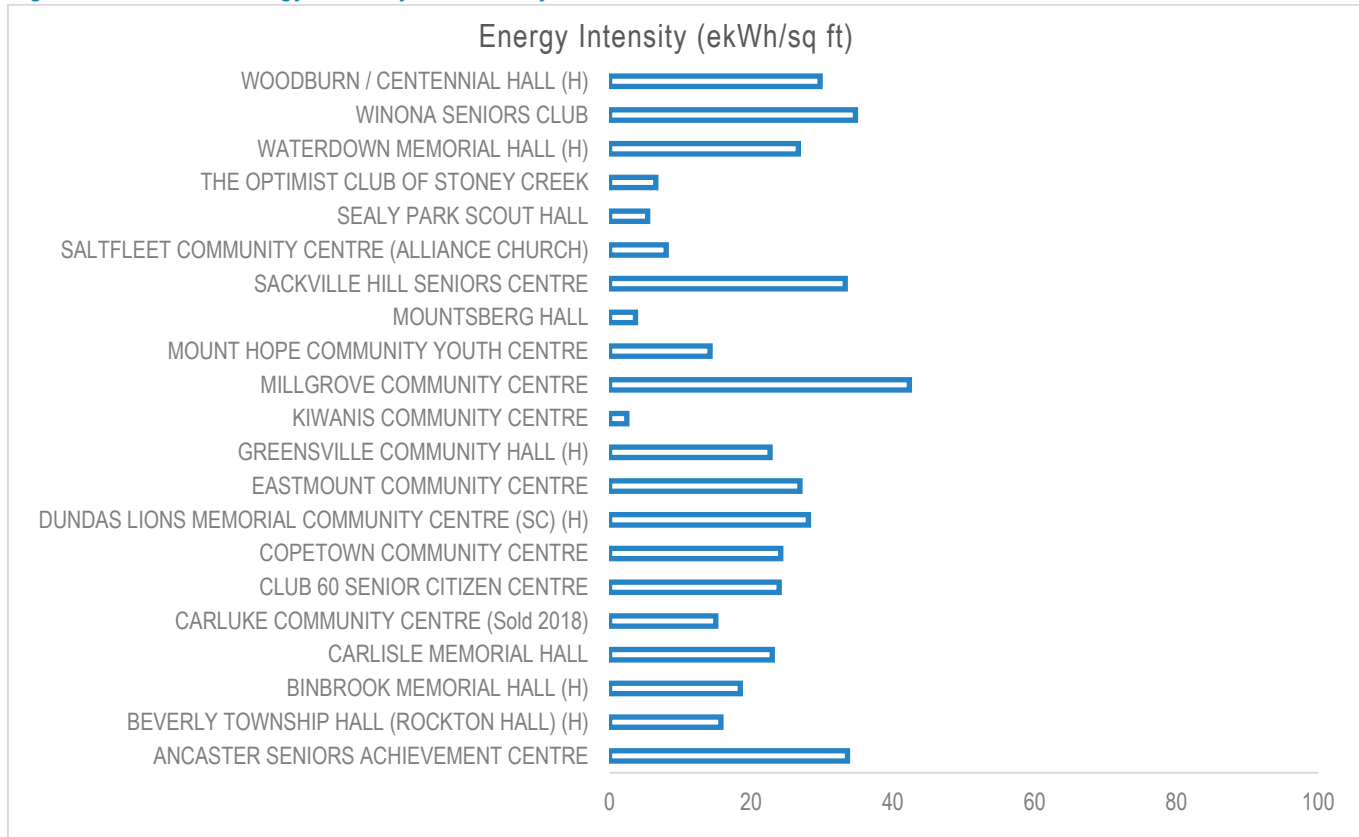
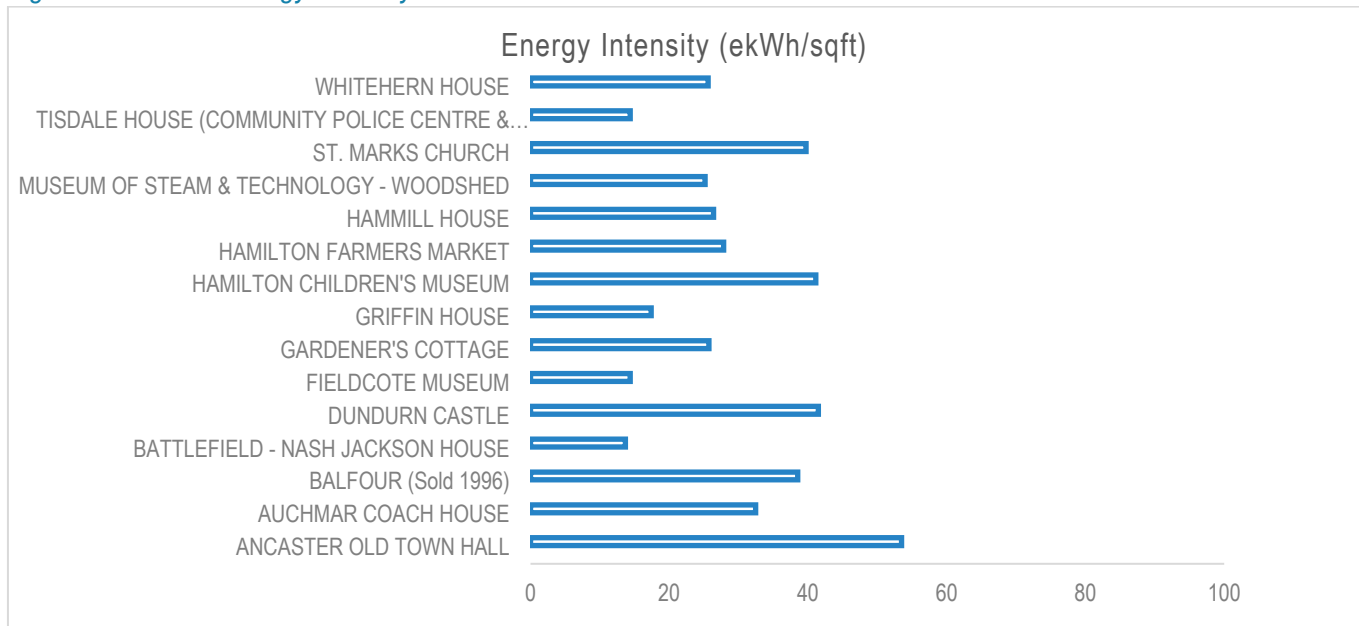
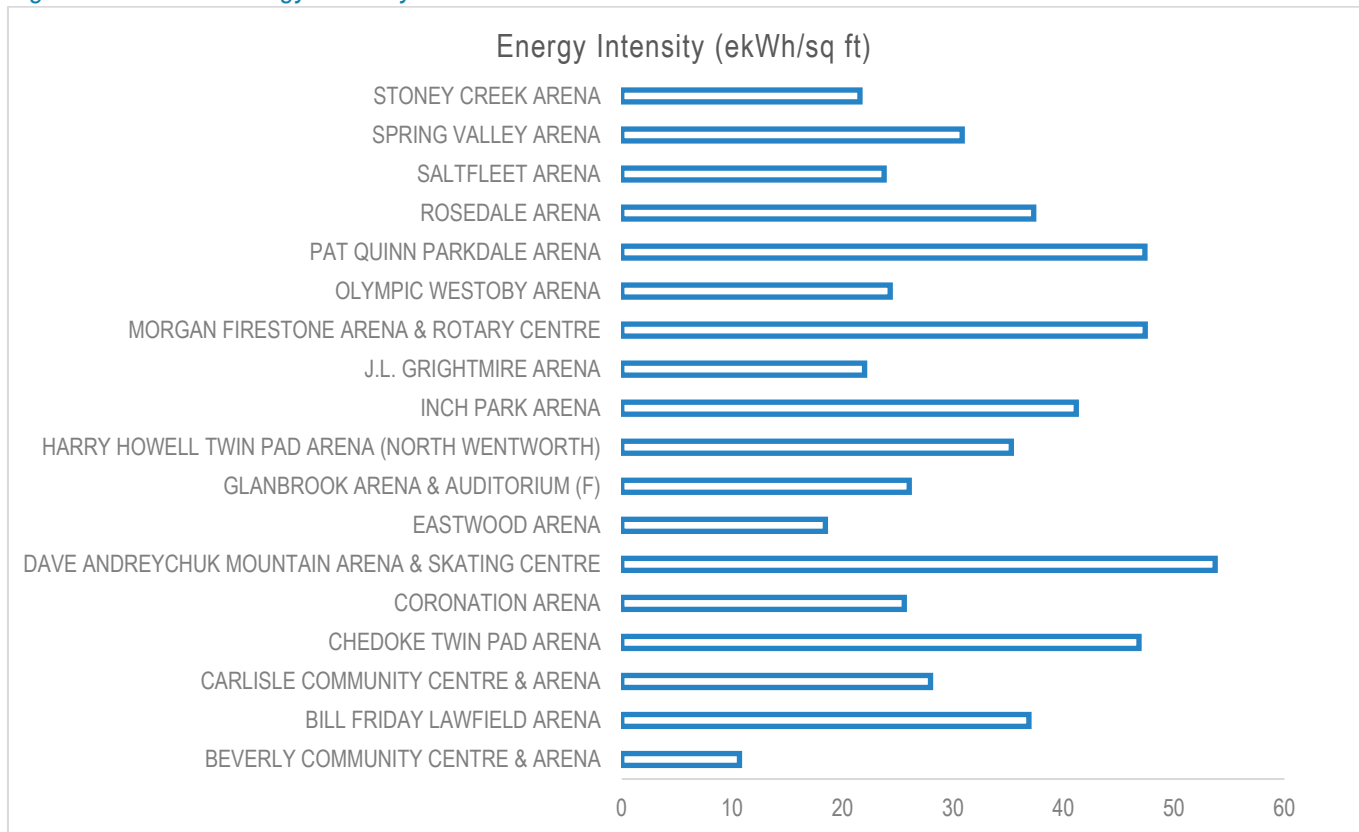


Figure A-14: 2021 Energy Intensity Culture and Museum Facilities



¹⁰ Operation site notes: (SC)=Senior Centre; (H)= Heritage.

Figure A-15: 2021 Energy Intensity Arena Facilities¹¹



¹¹ Valley Park Arena removed for 2021 and 2022 reporting year (includes data for arena, aquatic centre, community centre) due to major construction to several service areas. Completed mid-2022 and will be re-added to 2023 reporting.

Figure A-16: 2021 Energy Intensity Recreation Centres and Pools¹²

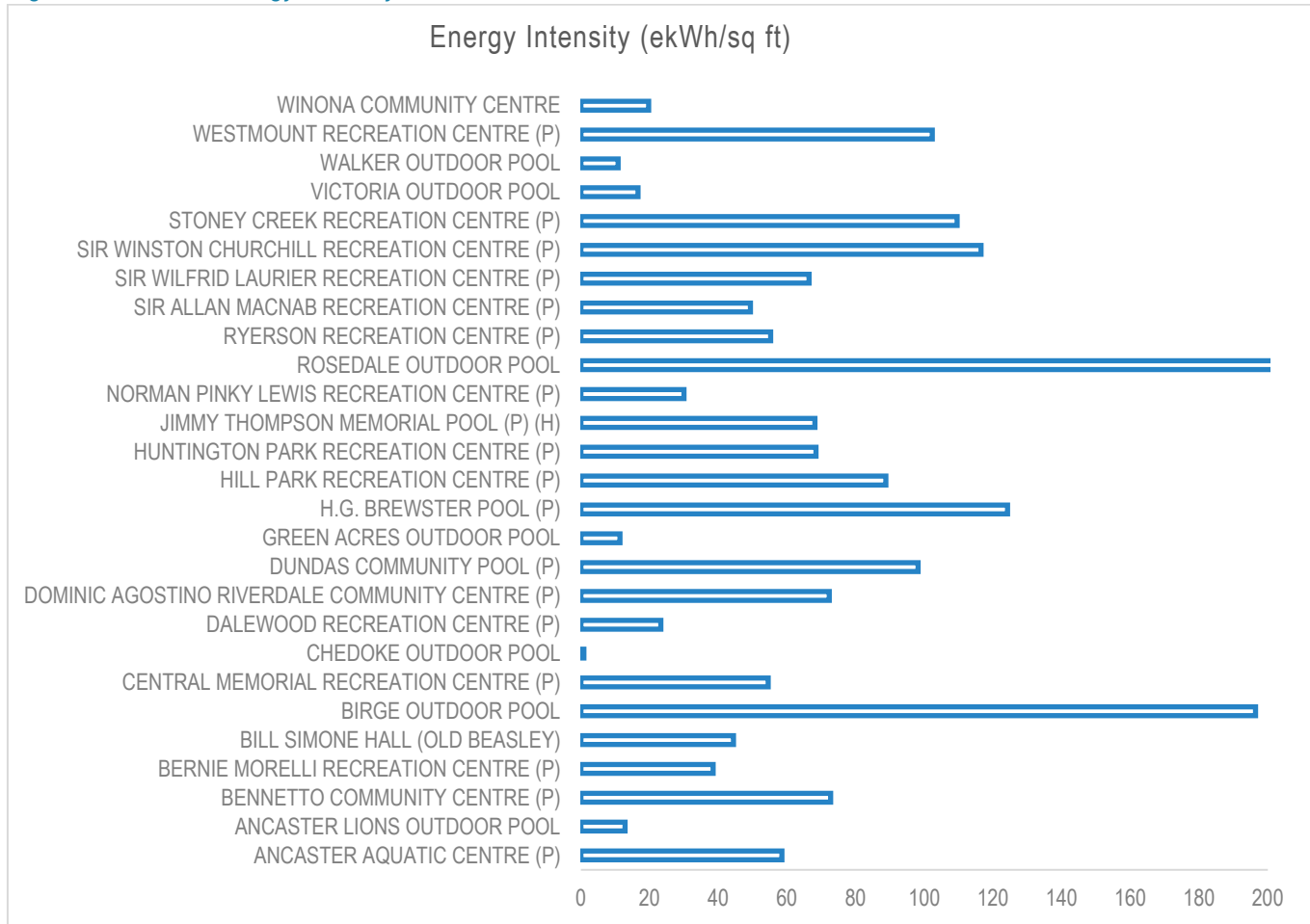
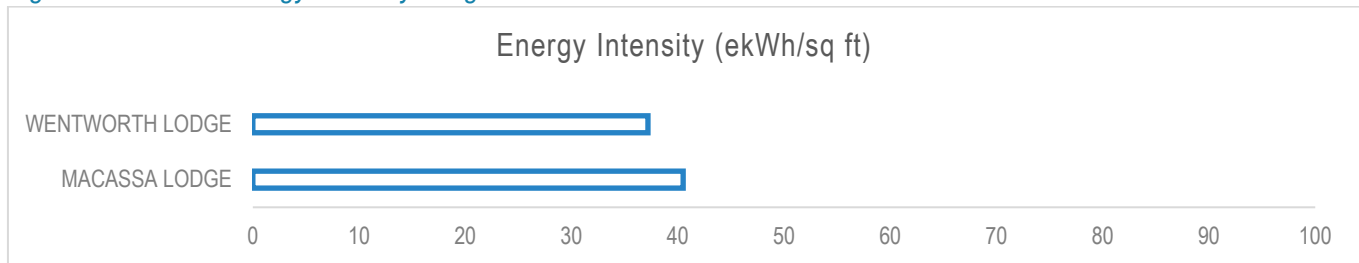


Figure A-17: 2021 Energy Intensity Lodges



¹² (P) = Pool on premises

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

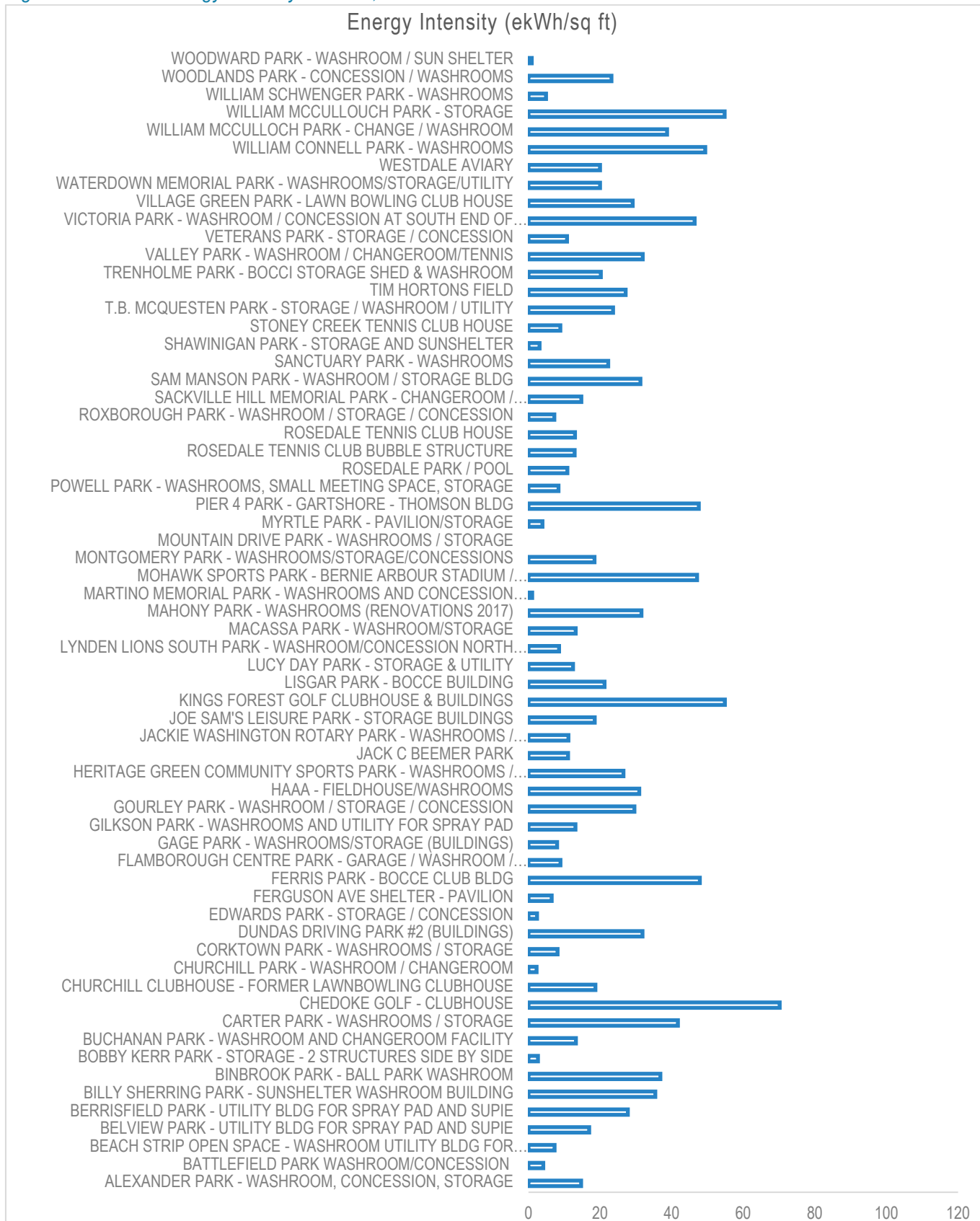


Figure A-19: 2021 Energy Intensity Fire and EMS Facilities¹³

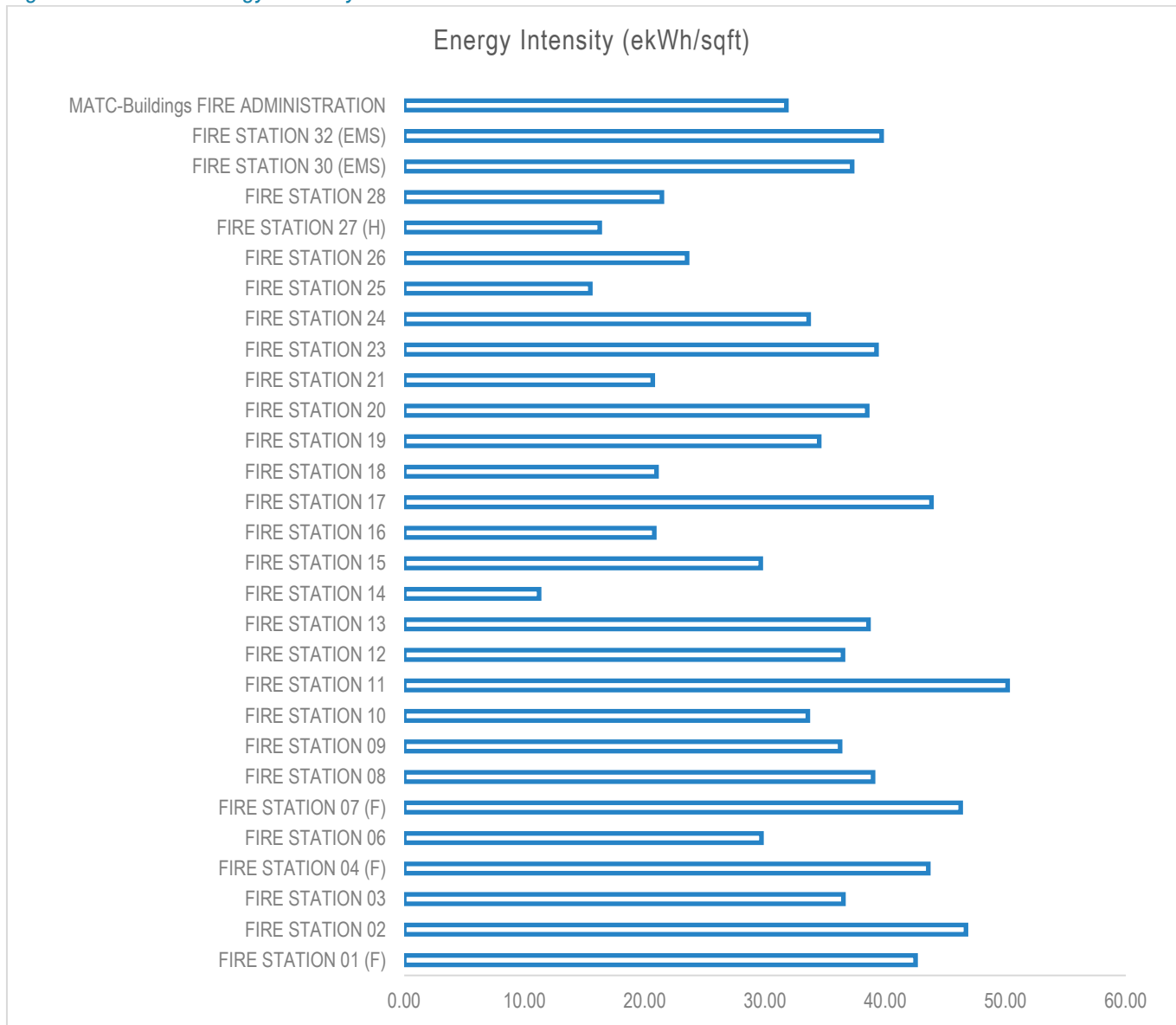
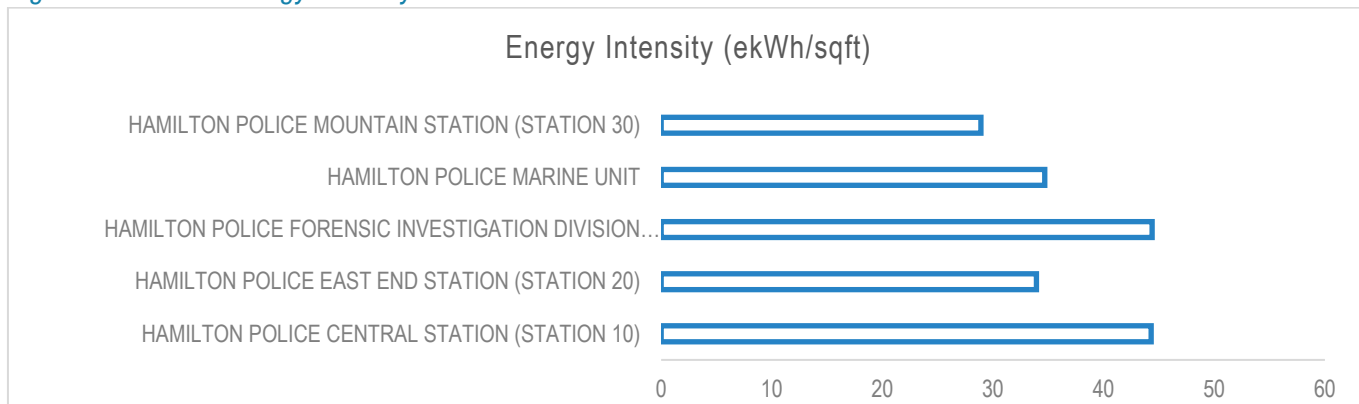


Figure A-20: 2021 Energy Intensity Hamilton Police Services Facilities



¹³ (F) = Fueling on premises; MATC site includes several buildings.

Figure A-21: 2021 Energy Intensity Libraries Facilities¹⁴

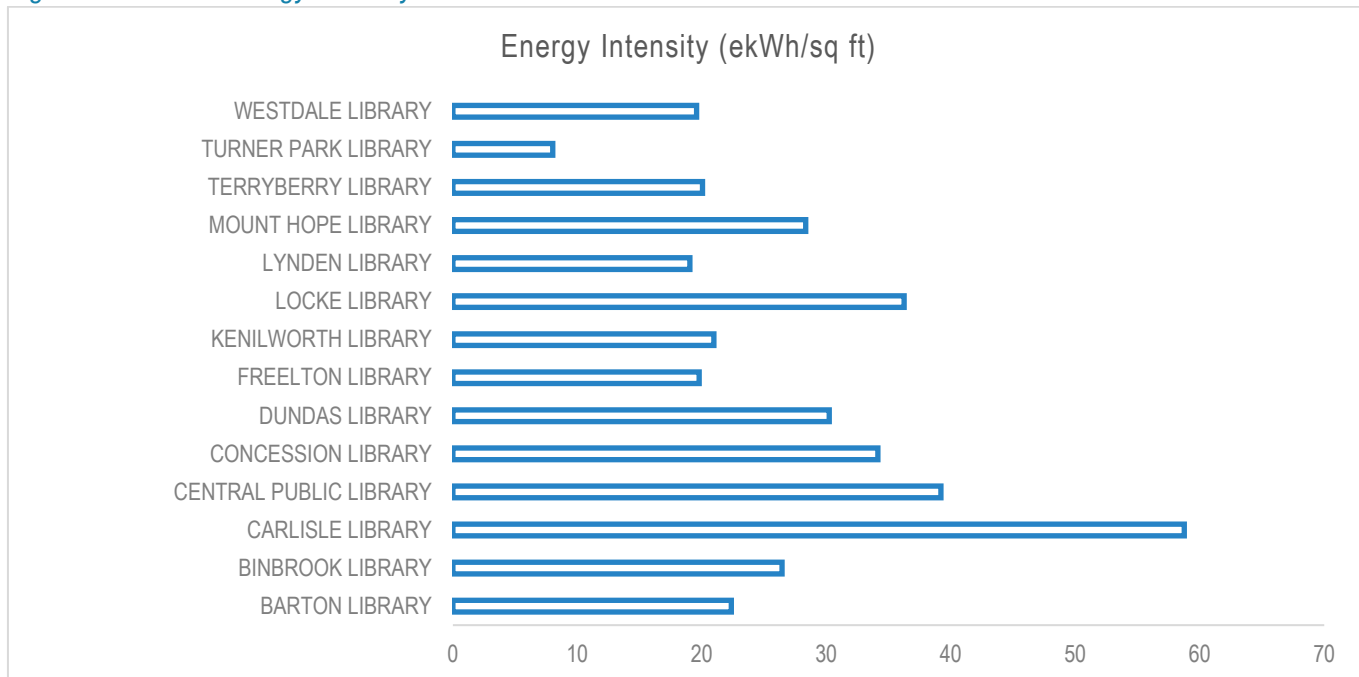
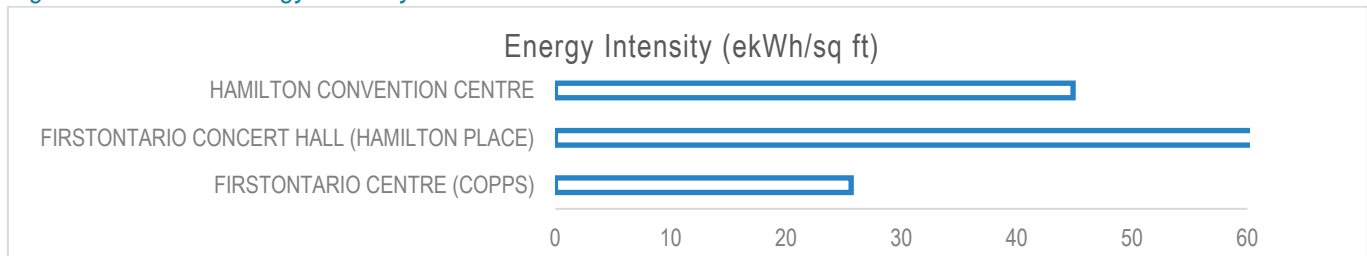


Figure A-22: 2021 Energy Intensity Entertainment Facilities¹⁵



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 2022 was 291. The total heating degree days in 2022 was 3729. Details are in the charts below.

¹⁴ Bookmobiles included in library facility usage and cost reporting, but not included in Energy Intensity calculation; Libraries located in Ancaster Square, Stoney Creek Town Hall & Library, Waterdown Library and Civic Centre included in City and Town Hall reporting category (shared utility meters).

¹⁵ Entertainment portfolio removed from reporting. Data is not included in Energy Intensity or included in consumption and cost. Operated by Third party.

Figure A-23: Weather Data for Hamilton (Environment Canada – Station YHM)¹⁶

MONTH	MEAN TEMP (°C)	HDD	CDD	2022 VS 2021 HDD	2022 VS 2021 CDD
JAN-22	-8.6	826	0	31%	
FEB-22	-4.9	642	0	-7%	
MAR-22	0.9	513	0	18%	
APR-22	5.9	362	0	11%	
MAY-22	15.2	109	26	-40%	46%
JUN-22	18.4	37	48	95%	-43%
JUL-22	21	0	93	-98%	49%
AUG-22	21.2	1	101	-77%	-21%
SEP-22	16.2	73	22	42%	99%
OCT-22	9.4	267	0	67%	-100%
NOV-22	4.6	376	1	-8%	
DEC-22	-0.7	525	0	-1%	
2022 ANNUAL TOTAL		3729	291	8%	-6%

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

MONTH	HDD		CDD	
	5 YR AVG	2022 vs 5 Yr Average	CDD 5 YR AVG	2022 vs 5 Yr Average
JAN	713	16%	0	
FEB	594	8%	0	
MAR	517	-1%	0	
APR	377	-4%	0	
MAY	159	-32%	21	22%
JUN	31	16%	54	-12%
JUL	1	-93%	115	-19%
AUG	4	-86%	99	2%
SEP	62	17%	26	-16%
OCT	249	7%	3	-100%
NOV	435	-14%	0	400%
DEC	559	-6%	0	
AVERAGE	3703	1%	319	-9%

¹⁶ 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)

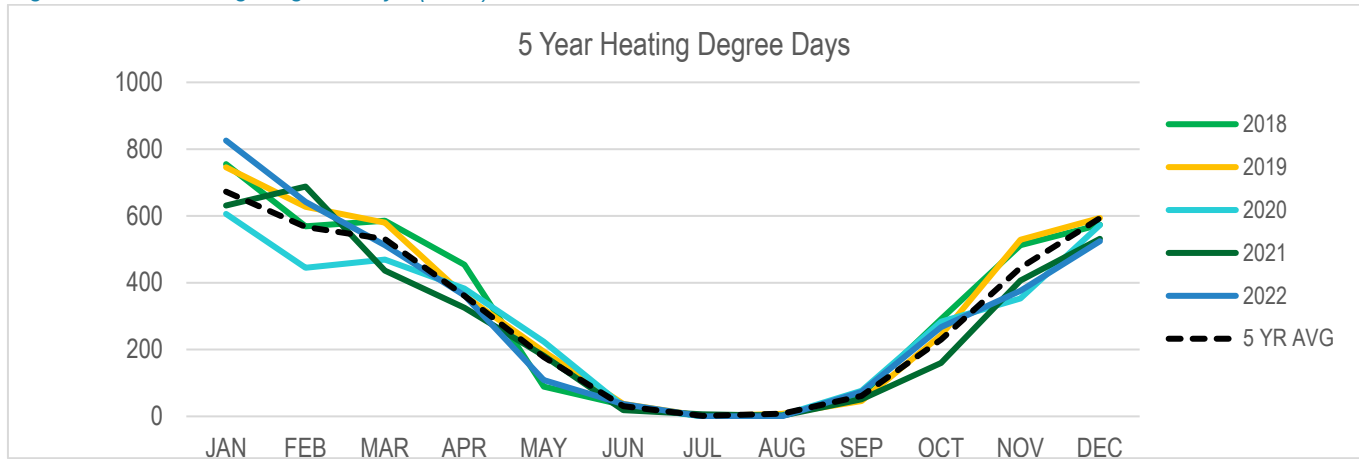
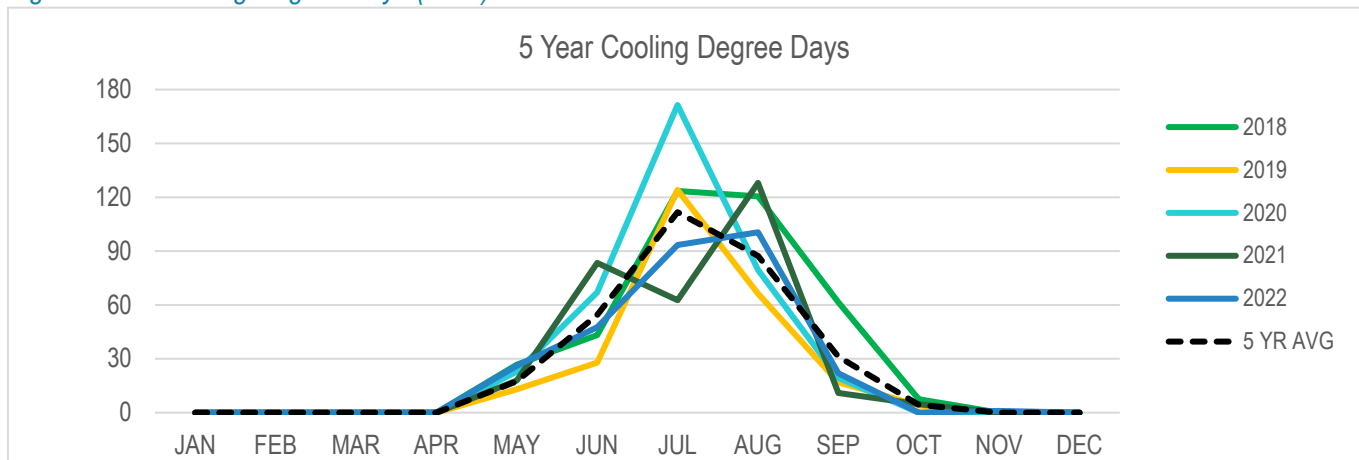


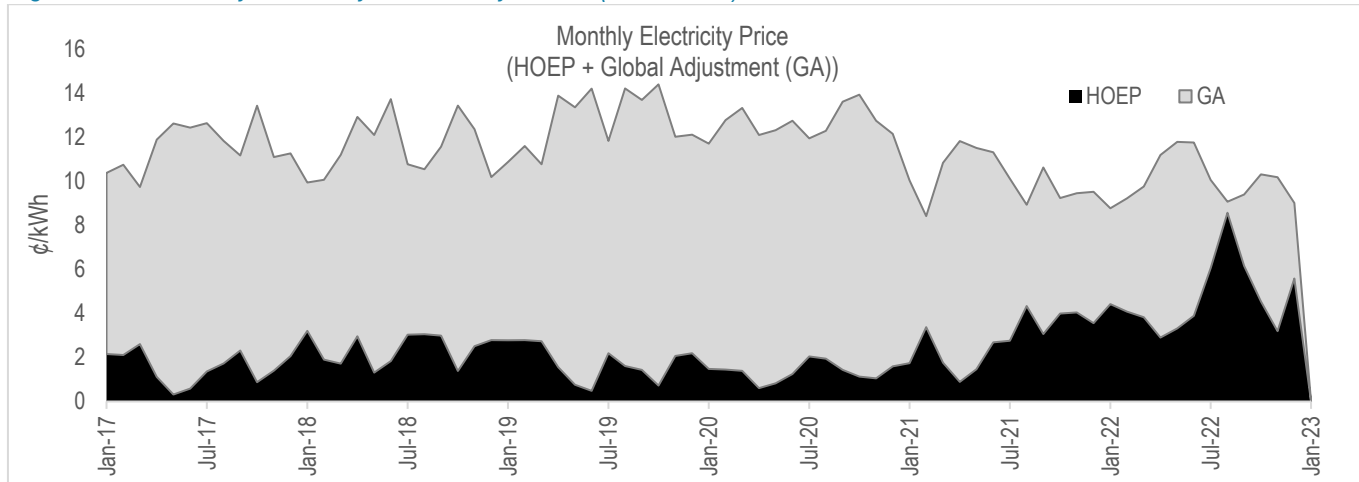
Figure A-26: Cooling Degree Days (CDD)



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 (2017-2022)



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 program¹⁷. 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 Woodward, 850 Greenhill Ave., 78 Kenilworth Ave., Tim Horton's Field¹⁸ and CUP Operations.

The following graph shows the City's cumulative benefits and 2022 benefits from the rate optimization under the ICI program.

Figure A-28:2022 and Cumulative Class A Global Adjustment Results

2022	Standard Global Adjustment Charge	Actual Global Adjustment Charge	Cost Benefit		Year	Annual Benefit
Jan	\$381,633	\$158,202	\$223,431		2011	\$1,061,230
Feb	\$428,758	\$166,622	\$262,136		2012	\$1,511,939
Mar	\$536,189	\$194,436	\$341,753		2013	\$2,598,221
Apr	\$707,716	\$229,760	\$477,956		2014	\$2,348,577
May	\$738,477	\$243,680	\$494,796		2015	\$3,911,299
Jun	\$664,185	\$240,635	\$423,550		2016	\$4,682,209
Jul	\$384,969	\$143,674	\$241,295		2017	\$5,976,102
Aug	\$47,088	\$18,319	\$28,769		2018	\$6,404,572
Sep	\$286,139	\$97,342	\$188,797		2019	\$7,248,037
Oct	\$496,356	\$169,969	\$326,386		2020	\$7,397,100
Nov	\$575,978	\$215,554	\$360,424		2021	\$3,636,653
Dec	\$311,411	\$122,720	\$188,690		2022	\$3,557,985
Total	\$5,558,899	\$2,000,914	\$3,557,985		CUMULATIVE	\$50,333,924

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.

¹⁷ ICI Program = Industrial Conservation Initiative by IESO: <https://ieso.ca/en/Sector-Participants/Settlements/Global-Adjustment-Class-A-Eligibility>

¹⁸ Tim Horton's Field added effective July 1, 2022.

Figure A-29: Top 10 Ontario Verified Peak Demand Days (May 1, 2022-April 30, 2023)¹⁹

Rank	Date	Hour Ending	ICI Ontario Demand (MW)	Coincident Adjusted AQEW (MWh)	Status (Initial, Prelim, Final)
1	19-Jul-22	18	22,607	22,127	Final
2	22-Jun-22	17	21,954	21,340	Final
3	29-Aug-22	17	21,871	21,170	Final
4	20-Jul-22	16	21,850	21,394	Final
5	07-Aug-22	17	21,778	21,073	Final
6	06-Aug-22	18	21,761	21,153	Final
7	08-Aug-22	15	21,560	20,901	Final
8	16-Jun-22	17	21,500	20,778	Final
9	23-Jul-22	17	21,423	20,691	Final
10	03-Feb-23	19	21,388	20,711	Final

Fuels

The following chart breaks down the fuel usage by user group category. For further clarification:

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

Figure A-30: 2021 Fuel Usage by User Group

Group	Diesel Litres	Unleaded Litres	CNG DLE	Total (DLE)
Energy, Fleet & Facilities	9,304	82,407	-	91,711
Engineering Services	-	33,318	-	33,318
Environmental Services	340,588	352,507	-	693,094
Waste Management	626,448	36,621	-	663,069
Hamilton Water	125,395	219,882	-	345,277
Operations	999,265	497,140	-	1,496,405
Transportation	85,761	32,356	-	118,117
Other	335,035	1,235,826	-	1,570,861
Transit	5,142,308	51,705	6,891,128	12,085,140
Totals	7,664,103	2,541,761	6,891,128	17,096,992

¹⁹ Source Data: <https://ieso.ca/en/Sector-Participants/Settlements/Peak-Tracker>

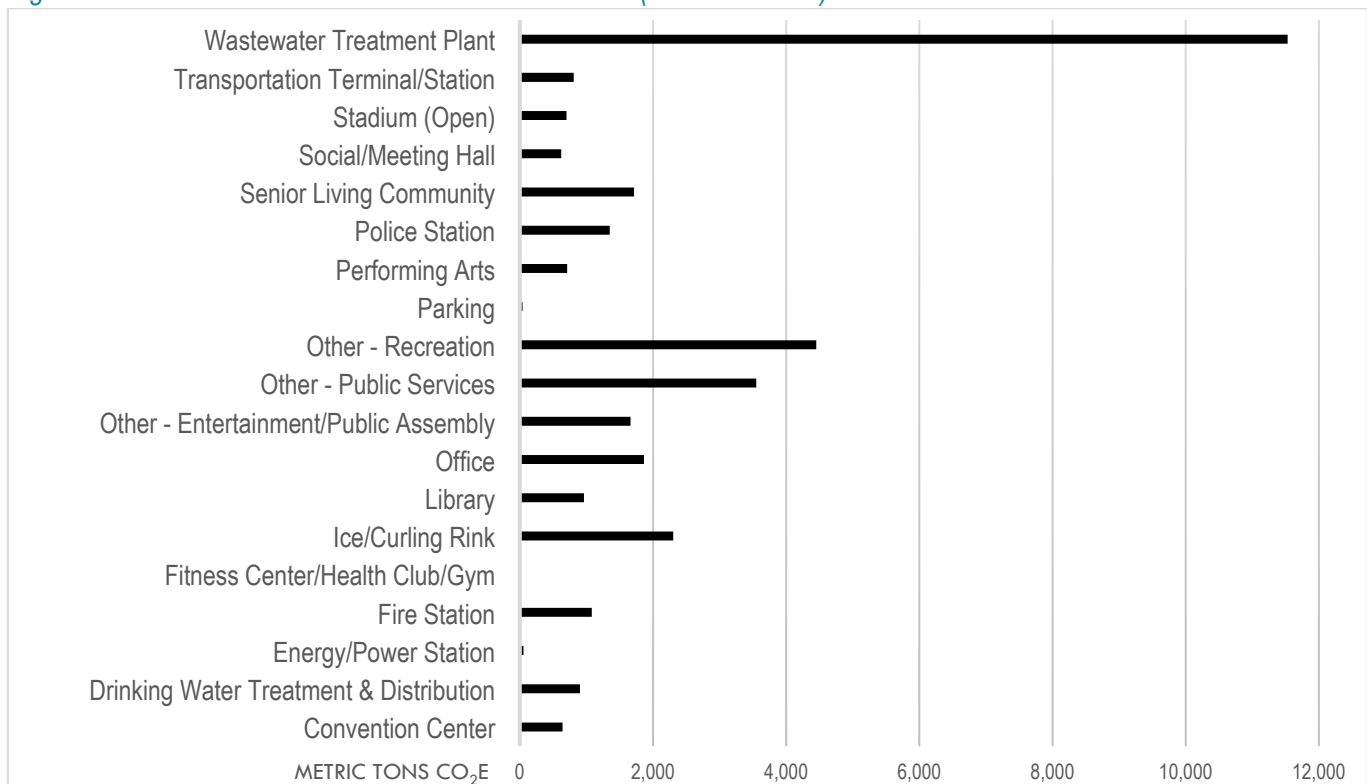
Broader Public Sector Reporting (BPS)

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 2023 was for the calendar year 2021. According to the reporting formula City-owned corporate facilities (building assets only) were responsible for emitting 34,965.2 metric 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. The report format was changed in 2021, and some of the reporting categories have changed from prior submissions. 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-31: 2021 GHG Emissions Results Submitted (O.REG 507/18)²⁰



²⁰ Broader Public Sector Report is pre-templated using Portfolio Manager (new in 2023) platform where specific data is required to be reported as per provincial O.Reg 507/18. Next submission is due in 2024.

GLOSSARY

COMMON ACRONYMS 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 TERMS 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.