City of Hamilton 2015 Annual Energy Report

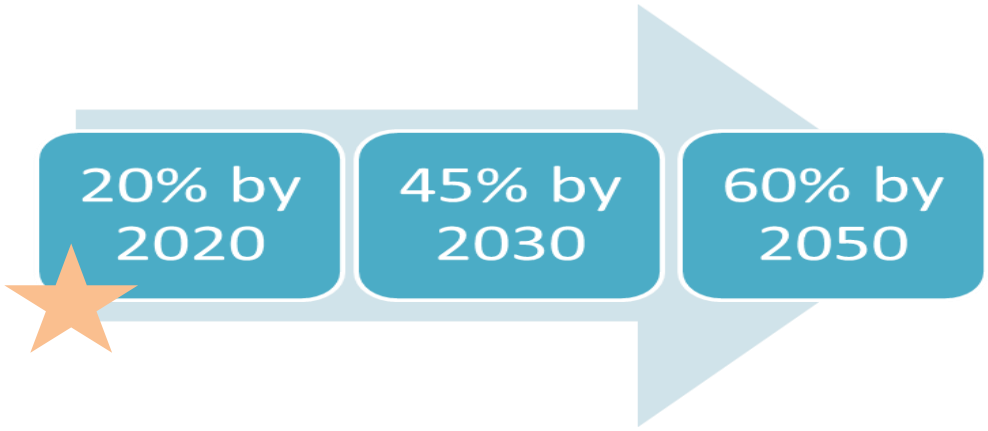
Introduction

The City of Hamilton continues to demonstrate municipal leadership in managing its corporate energy costs by reducing its energy use and thereby reducing its carbon foot print. This is achieved through several energy related initiatives such as; energy conservation, demand management and renewable energy generation. The City's management and mitigation of rising energy costs is further assisted by effective management and monitoring of energy commodities, utility rate and billing review, energy controls and energy data capture.

In 2014, City Council approved the City's second version of the Corporate Energy Policy (PW14050)[1]. The new policy outlines specific targets for a variety of key performance measures and the guidelines to achieve them. Changes in the 2014 Energy Policy were designed to:

- Facilitate the achievement of City-wide energy and emission reduction targets;
- Address the legislated reporting requirements e.g. Green Energy Act;
- Define policies for capital investment related to energy;
- Define policies related to energy procurement; and
- Address regulations concerning greenhouse gases (GHG) emissions.

The policy itself calls for an energy intensity reduction target of 45% by 2030 and 60% by 2050 in corporate buildings. The initial target of 20% reduction by 2020 was achieved in 2013. Achieving the 2030 target alone is anticipated to deliver an additional $50 million in revenue from direct savings and avoided costs.



[1]For more information: https://www.hamilton.ca/city-initiatives/strategies-actions/office-energy-initiatives

In 2015, the City introduced the software tool, Energy & Sustainability Module (ESM) to track energy data (e.g. consumption and cost) for City facilities, Operations, Hamilton Water, Traffic and Street Lighting. The module allows energy staff and user groups (e.g. Facilities and Hamilton Water), to manage energy data and utilize a variety of reporting options to assist in management of facility portfolios.

The 2015 Annual Energy Report details the 2015 energy usage, costs, energy performance, procurement efforts, conservation, savings and avoided costs as well as cumulative results dating back to 2006.

Energy Savings and Avoided Costs

Efforts to reduce energy consumption and to mitigate and control associated energy costs are represented in three key areas:

Utility Rates and Cost Avoidance

Savings under this category are classified as the avoidance of costs that would have been incurred had no action been initiated. Such actions include procurement plans and strategies, including commodity hedging, and optimizing utility rates. The 2015 savings in this category totaled $4.3 Million.

Cost Recovery

Savings under this category are classified as costs recovered due to the City's continuous efforts to monitor and analyze all utility accounts. It is the recovery of costs stemming from adjustments made to billing errors, billing anomalies or rate corrections. The 2015 savings in this category totaled $222, 000.

Energy Conservation and Incentive Programs

This category is classified by the savings achieved from the implementation of energy efficient measures and equipment that leads to lower energy consumption and any financial incentives associated with the projects. In addition to capturing the energy cost and consumption savings, many of the City's energy efficiency projects are eligible for a variety of financial incentives from our utility providers (Horizon Utilities, Hydro One and Union Gas). The 2015 savings generated in this category was $2.9 Million.

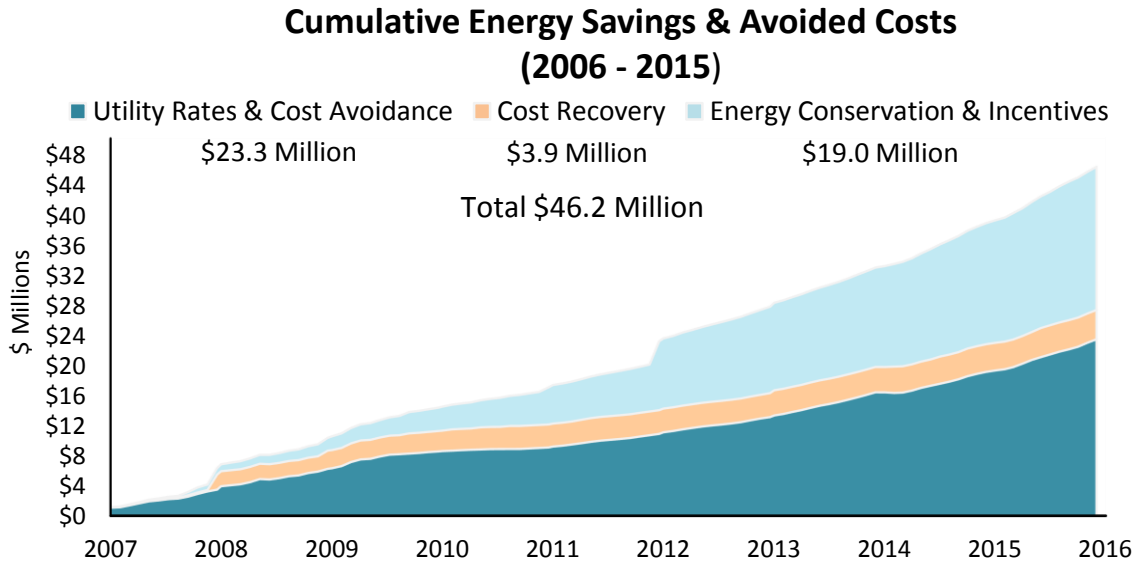
Historical energy savings are tracked for Levy (tax base) and Rate (water rates).

Table 1: Total Energy Savings and Avoided Costs

Total Energy Savings and Avoided Costs	Levy	Rate	Corporate Total
2015 Only	$3,982,304	$3,489,077	$7,471,381
Cumulative (2006-2015)	$31,307,493	$14,934,298	$46,241,791

Graph 1 below illustrates the cumulative total for energy savings and avoided costs achieved by the City of Hamilton from 2006 to year end 2015 amounts to $46.2 Million.

Graph 1: Cumulative Energy Savings and Avoided Costs



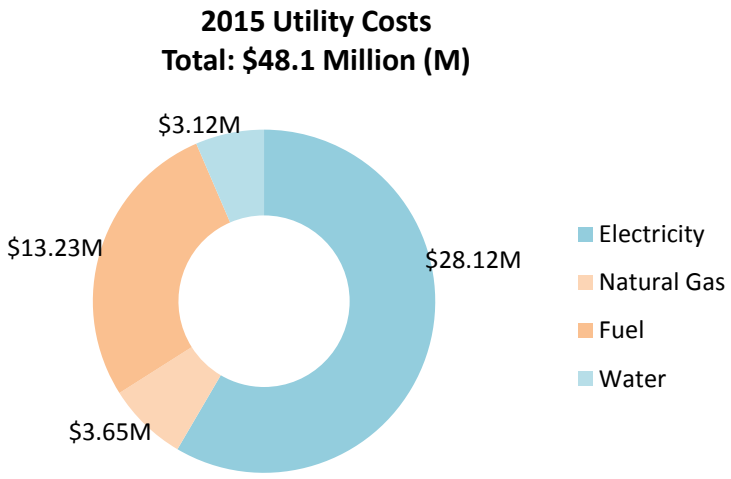
Additional tables and graphs providing more detailed information on Energy Savings and Avoided cost can be found on pages 20 and 21.

Overall Utility Cost

The City tracks and measures the costs and consumption for electricity, natural gas and fuel against the previous year and to the baseline year of 2005. Changes in costs and consumption can be attributed to several factors, such as changes in utility rates, weather, efficiency projects, occupancy and process changes. Comparing cost, consumption, unit pricing and energy intensity can give a clearer picture on the utilities within the City.

The City's expenditure on utilities included in this report (electricity, natural gas, water and fuel) for 2015 was $48.1 million. This is a slight cost decrease of 1% compared to 2014. Graph 2 below outlines the individualized costs for each of the categories.

Graph 2: 2015 Utility Costs for Electricity Natural Gas, Fuel and Water



The costs are incurred by all City-owned facilities, Hamilton Water, Public Works Operations, Street and Traffic lighting, and exclude City Housing Hamilton. The fuel information reported includes all Fleet, Operations and Transit vehicles but does not include Hamilton Police Services, GO Transit or Darts. Fuel costs include those for diesel, unleaded gasoline and compressed natural gas (CNG).

Sites that have only a partial year of utility data for 2015 were not included as part of this year's report. Those sites will be included once a full year data set becomes available. For example, Tim Horton's Field is not included in 2015 because it did not have a full year of operation under City control, but will be included in next year's report.

Energy Performance (Electricity and Natural Gas)

Energy costs and consumption for electricity and natural gas are tracked for all City-owned sites, excluding City Housing Hamilton. Consumption patterns for electricity and natural gas can vary and are impacted by weather and temperature. Increases or decreases in costs are reflected by the consumption changes, and are further impacted by regulatory and market activity. Therefore, it is not unusual to see higher costs even when consumption is lower, particularly with electricity.

The combined cost and consumption results for electricity and natural gas are measured in equivalent kilowatt-hours (ekWh) as shown table 2 below:

Table 2: Combined Cost and Consumption for Electricity and Natural Gas

				Comparisons	
Total Energy Overview	Base Year 2005	2014	2015	2015 vs 2005	2015 vs 2014
Total Energy (ekWh)	400,722,256	379,883,020	359,460,344	-10%	-5%
Total Energy Cost ($)	$27,177,303	$30,348,080	$31,766,870	17%	5%
Total Energy ($/kWh)	$0.068	$0.080	$0.088	30%	11%

Electricity

Electricity is the largest utility expenditure for the City. This includes costs for the commodity (discussed in greater detail in the "Energy Procurement" section, pages 9 to 13), and costs associated with distribution, transmission, regulatory and delivery. The City is serviced by two local distribution companies (Horizon Utilities and Hydro One). The City's cost and consumption are approximately 85% from Horizon Utilities and 15% from Hydro One. While the utility rates may vary between the utilities, both are regulated by the Ontario Energy Board (OEB) and must seek approvals for any rate or cost of service adjustments.

Costs for electricity have increased overall since the base year by 36%. This is due to increases in both regulated (e.g. Global Adjustment (GA)) and commodity costs in general.

Below is the comparison for year over year and to the base year for cost and consumption of electricity.

Table 3: Electricity Cost and Consumption Comparison

				Comparisons	
Electricity Overview	Base Year 2005	2014	2015	2015 vs 2005	2015 vs 2014
Total Electricity (kWh)	236,362,045	231,858,694	223,881,250	-5%	-3%
Total Electricity ($)	$20,657,050	$26,442,767	$28,121,815	36%	6%
Total Electricity ($/kWh)	$0.087	$0.114	$0.126	44%	10%

KWh = kilowatt hour

Natural Gas

Natural gas costs include commodity (discussed in greater detail in the "Energy Procurement" section, pages 9 to 13) and regulated costs for storage and delivery from Union Gas. Regulated costs for natural gas are also approved by the OEB. Natural Gas consumption is particularly impacted by cold winter weather. Prices for natural gas are typically higher during the peak-consuming times. However, because the City can purchase (hedge) natural gas on the wholesale market, the City is able to mitigate the fluctuations in commodity cost. Overall, natural gas costs for the City have decreased significantly over the past decade, down 44% from 2005. This is due to both the City's procurement program, and an overall decline in commodity prices. Below is the comparison year over year and to the base year for cost and consumption of natural gas.

Table 4: Natural Gas Cost and Consumption Comparison

				Comparisons	
Natural Gas Overview	Base Year 2005	2014	2015	2015 vs 2005	2015 vs 2014
Total Natural Gas (m^3)	15,403,956	14,137,949	12,949,293	-16%	-8%
Total Natural Gas ($)	$6,520,253	$3,905,313	$3,645,054	-44%	-7%
Total Natural Gas ($/$m^3$)	$0.423	$0.276	$0.281	-33%	2%

m^3 = cubic meter

District Energy

Hamilton has a long standing history with district energy in the downtown core of buildings that includes City Hall, Hamilton Convention Centre, Hamilton Place, Central Library, Lister Block and FirstOntario Centre. The supply of electricity, heating and cooling from a central source allows for greater efficiencies and lower operating costs. In 2015 a total of 32.2 million kWh of electricity, cooling and heating supply came from the district energy system. For reporting purposes the usage and costs for the City-owned properties are accounted for within their respective portfolios and included in the total electricity and/or natural gas tables above.

District heating and electricity are supplied by HCE Energy Inc. The City is also in the process of finalizing the sale of its district cooling assets to HCE Energy Inc.

Energy Intensity (City-Owned Facilities)

Energy intensity is the measure of usage in equivalent kilowatt-hours per square foot (ekWh/sqft). The ekWh figures are a combination of electricity and natural gas consumption. It is the key performance indicator for the City's Corporate Energy Policy reduction targets compared to base year. The energy intensity reduction for 2015 over 2005 was 19%. Corporately, looking at energy intensity per Department/Division allows for a better understanding of where the City could concentrate efforts to reduce usage.

Table 5: Energy Intensity City Wide Total Comparison for City Owned Facilities

				Comparisons	
Energy Intensity	Base Year 2005	2014	2015	2015 vs 2005	2015 vs 2014
City Total (ekWh/sqft)	45.69	38.37	36.79	-19%	-4%
City Total ($/sqft)	$2.67	$2.39	$2.56	-4%	7%
Reported Square Footage (sqft)	5,138,852	5,247,455	5,206,155	1%	-1%

ekWh/sqft= equivalent kilowatt-hours per square foot

The energy intensity (ekWh/sqft) decreased by 4% compared to 2014. However, the cost per square foot increased. This can be attributed to increases in overall electricity costs and a slight decrease in reported square footage for 2015 when compared to 2014.

Table 6 below outlines the energy intensity totals by site category (type) with a comparison to base year (2005) and to the previous year. Categories that have an "n/a" are not included in the energy intensity calculation as they are operations (e.g. street lighting, Hamilton Water pumping operations) and do not have relevant square footage information.

Table 6: Energy Intensity by Site Category Comparison

Energy Intensity By Grouping					
ekWh/sqft	2005	2014	2015	2015 # of Sites	2015 vs 2005
City/Town Halls	39.6	23.0	22.3	7	-44%
Corporate Facilities	44.6	22.1	20.1	13	-55%
Street Lighting	n/a	n/a	n/a	n/a	n/a
Traffic Lighting	n/a	n/a	n/a	n/a	n/a
Other City Operations	n/a	n/a	n/a	n/a	n/a
Hamilton Water	n/a	n/a	n/a	n/a	n/a
Yards	38.1	36.0	32.7	32	-14%
Arenas	51.3	46.9	46.3	19	-10%
Community/Senior Centers	31.1	24.8	22.2	19	-29%
Rec Centres/Pools	78.6	78.6	76.2	22	-3%
Rec Parks/Stadiums/Golf	36.5	47.5	40.6	49	11%
Lodges (Macassa Lodge, Wentworth Lodge)	113.6	48.2	47.4	2	-58%
Culture	35.5	40.2	38.2	15	8%
Fire/ EMS	45.2	41.8	39.6	30	-12%
Hamilton Public Libraries	25.2	26.7	26.6	21	6%
First Ontario Centre	22.5	22.2	23.0	1	2%
Hamilton Convention Centre	49.2	46.9	33.4	1	-32%
Hamilton Place	43.7	43.6	52.4	1	20%
Hamilton Police Services	59.8	39.8	38.9	7	-35%
City Wide Total	**45.69**	**38.37**	**36.79**	**239**	-19%

ekWh/sqft= equivalent kilowatt-hours per square foot

Additional tables and graphs on Energy Performance (electricity and natural gas) are shown on pages 21 to 32 including detailed breakdowns of energy intensity by individual category (group).

Energy Performance (Fuel)

Corporate Average Fuel Economy (CAFE)

Corporate Average Fuel Economy is the traditional method for measurement of the fuel consumed per 100 kilometers (km) of a vehicle and is used to monitor performance in fuel consumption, efficiency and fuel management activity. The long term target is a 20% reduction

in fuel economy by 2030 as compared to base year 2005. Reaching this level of improvement can be achieved through emerging technologies, fit-for-purpose fleet vehicles, acquiring new vehicles with better engine/drive technology, and reductions in horsepower requirement for fleet needs over time. Reduced idling time can assist in improving fuel economy as well.

As of 2015, there was a 7% reduction as compared to base year of 2005, shown in the table below.

Table 7: Corporate Average Fuel Economy 2015 to 2005 Comparison

DLE/100KM	2005	2015
Unleaded	24.4	22.2
Diesel	56.8	55.2
CNG	72.5	67.8
Total	50.7	47.4
% Change in DLE/100 KM Base Year		-7%

DLE/100KM = Diesel Litre Equivalent per 100 kilometers

Energy Procurement - Commodities

Strategic management of commodity procurement is a key factor in managing utility costs. Governed by the Corporate Energy Policy, the purchase of natural gas, electricity and fuel for the City's facilities and its fleets are completed in an informed and disciplined way.

There are various methods the City uses to facilitate its procurement plan, including hedging programs, rate optimization programs and consultant guidance.

Of the $48.1 million the City spent on utilities in 2015, electricity, natural gas and fuel amounted to $45 million of the total. The procurement plan helped to control those costs across departments.

Natural Gas

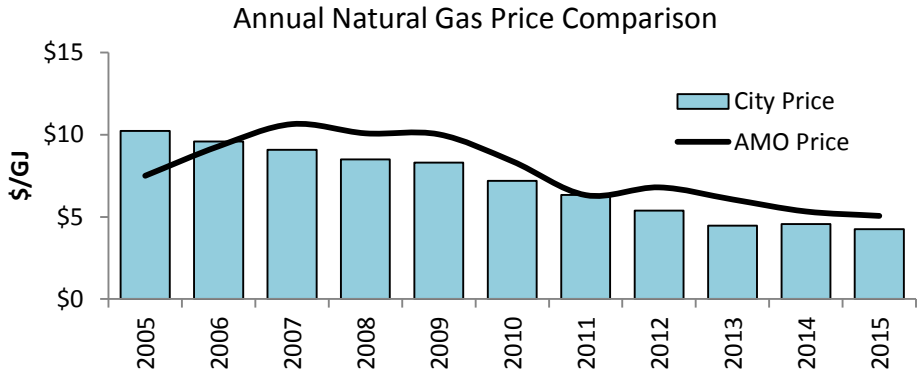
The City has supply agreements in place which allows for the City to purchase commodities at wholesale market prices and hedge for forward terms. Typically, the City purchases approximately 70% to 80% of its natural gas supply requirements on a forward basis when market conditions are deemed favourable. A portion of natural gas supply is purchased as much as 2 years in advance to protect against market volatility while other portions are purchased just a month or two in advance. Fixing the price on a portion of the City's natural gas

volumes has allowed for better budget predictability and protection against spot market fluctuations which is particularly important during periods of tight supply, such as extremely cold winter weather or unpredictable market events.

The ability to buy for forward terms allows the City to partially control natural gas prices for current and upcoming years. Natural gas is purchased under wholesale agreements for the City's facilities and for compressed natural gas (CNG) used to fuel transit vehicles. The 2015 price for natural gas commodity averaged $4.25 per gigajoule (GJ) ($0.16/$m^3$) including both hedged and unhedged volumes. The price fluctuated throughout the year as the daily prices changed. Although the market can be price volatile, the current hedged portfolio and forecasted price environment in the near future support no increase to budget for 2016.

The City benchmarks the performance of its natural gas hedging activities against the procurement program offered by the Association of Municipalities of Ontario/Local Authority Services (AMO/LAS). The City has enough volume to allow for direct purchases of natural gas with wholesale suppliers. However, smaller municipalities may not have the volume or expertise to manage their own programs; therefore, they benefit from and highly value the AMO/LAS program and its consolidated volumes and centralized purchasing programs. The City and AMO program are shown in the graph below.

Graph 3: Annual Natural Gas Commodity Price Comparison to AMO



$/GJ = dollars per gigajoule

While steps can be taken to manage natural gas prices through hedging activity, controlling consumption also plays a large role in managing the overall costs. Consumption reduction helps

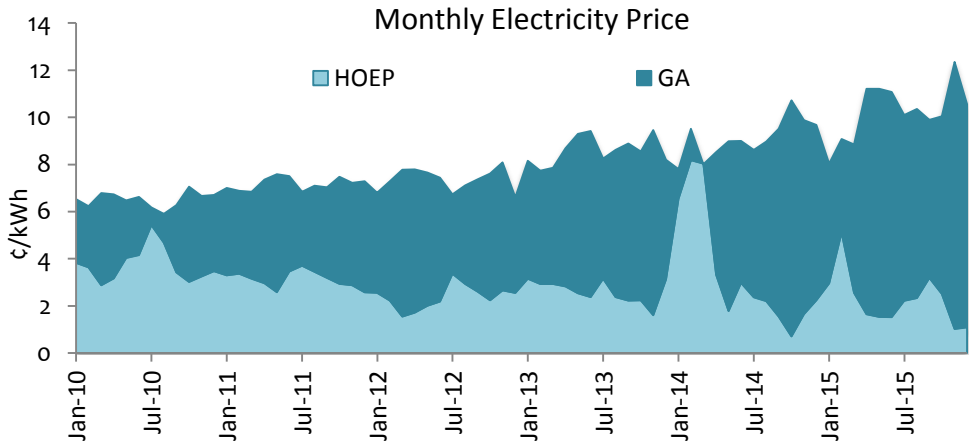
to mitigate the potential for increased costs of natural gas on the utility rate side, while further reducing the footprint of the City's facilities by reducing carbon emissions.

Electricity

The electricity market in Ontario is complex, volatile, and only partially de-regulated. While market conditions do play a role in monthly rate setting for the cost of electricity, the rates are heavily influenced by long-term generation contracts. Consumer electricity bills contain both commodity (cost of electricity) and the OEB-regulated costs. Ontario's cost of electricity is comprised of the Hourly Ontario Electricity Price (HOEP) and the Global Adjustment (GA). When the HOEP is low, the GA increases in order to cover the costs of generation in the province. The monthly costs vary depending on consumer demand, the generation mix, how often each type of generation is offered into the market, and weather.

The graph below shows how HOEP and GA make up the overall market price for the past five years.

Graph 4: Monthly Electricity Prices (HOEP & GA)



¢/kWh = cents per kilowatt-hour

Unlike natural gas, fixing for forward terms on the price of electricity is less appealing. Since HOEP has a diminishing overall impact, fixing the HOEP does little to protect against the greater fluctuations in the GA. However, since the HOEP and GA move in conjunction with one another, at this time the City sees little benefit in hedging the HOEP for forward terms.

The best methods to control electricity costs are by rate optimization and consumption reduction. Rate optimization ensures that each account is on the correct rate for their size and consumption patterns.

The City has had success with moving some of its large user accounts from a general service Class B to Class A rate. The sites at 900 Woodward Avenue (Hamilton Water), the Municipal Recycling Facility, FirstOntario Centre, Central Utilities Plant (CUP), and the Hamilton Water pump station at Greenhill Avenue were able to convert to Class A. The rate class change resulted in avoided costs of $3.9 million in 2015 in GA charges alone.

Class A customers have more control over their GA costs due to the methodology used by the Independent Electricity Service Operator (IESO) to calculate their GA costs. By limiting consumption use during peak demand times, Class A consumers can reduce the costs on the GA rates during the following year.

Electricity peak tracking is an internal process used by staff to track demand forecasts on a daily basis and communicate out to City sites when a peak demand day is expected. Facilities, in particular, Class A sites, can then take steps to reduce their usage (demand) during peak times. It has the potential to lower the site's calculated portion of the GA and to decrease costs as hourly prices tend to also peak during high demand times.

Consumption reduction is valuable in controlling costs across all rate classes. Reduction helps to mitigate increases on the utility rate side.

The average price for electricity commodity (HOEP + GA) in 2015 was $0.101/kWh. Electricity commodity prices in 2015 were extremely volatile, and that is likely to continue in 2016.

Fuel

The City of Hamilton purchases bulk fuel for its fleet of vehicles that include Transit (Hamilton Street Railway (HSR)) buses, waste collection vehicles, snow removal trucks, street sweepers, roads and parks vehicles, as well as Fire and Emergency Medical Services (EMS) vehicles. The volumes reported exclude GO Transit, DARTS and Police. The majority of these vehicles use traditional petroleum based fuel products (diesel and unleaded gasoline) while a small volume of dyed diesel is purchased for small equipment.

In an effort to control costs, the City purchases it's fuel directly from large suppliers, and secures discounts through wholesale contracts. In 2015, the City departments used

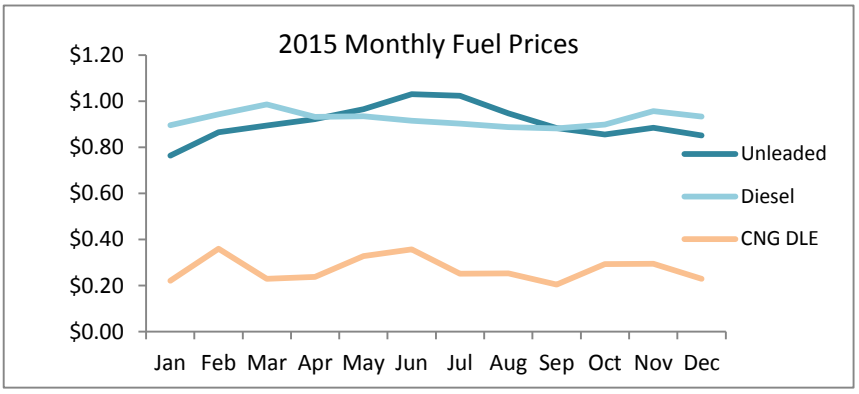
approximately 11.9 million litres of diesel fuel, a 1% reduction over 2014 purchases. The city also used 2 million litres of gasoline, a 4% increase over 2014.

In late 2014, the City completed its first hedging program for diesel for the 2015 calendar year. Throughout 2015, additional hedges were transacted for periods to the end of 2016. The hedging of fuel differs from the City's natural gas hedging program in that it is a financial product only. The pricing is settled monthly and then applied to the costs of diesel.

Natural gas is purchased for the City's facilities, but also for the growing natural gas-fuelled fleet of HSR transit buses. In partnership with Union Gas, the City completed a new Compressed Natural Gas (CNG) station at the Mountain Transit Centre to service the fleet of existing and new natural gas buses. In September 2015, 18 new CNG-fuelled buses were added, bringing the fleet of CNG buses to 48. An additional 80-100 CNG buses are expected to be added over the next 3 years. The station now operates under a natural gas storage contract and is managed daily to accommodate the growing fleet. Natural gas has a lower cost compared to diesel and a favourable impact on GHG emissions of up to 25% fewer emissions.

The City's monthly fuel price including Transit's compressed natural gas price (converted to diesel equivalent) are shown in the graph 5 below.

Graph 5: 2015 Monthly Fuel Prices for Unleaded, Diesel and CNG



CNG DLE = Compressed Natural Gas Diesel Litre Equivalent

Additional tables and graphs on Energy Procurement are shown on pages 33 to 35.

Renewable Energy

When it comes to renewable energy, The City of Hamilton continues to be a leader among Ontario municipalities. Technologies and systems that capture emissions (previously released into the atmosphere) are today utilizing more energy from waste and lowered the City's overall emissions.

Hamilton Renewable Power Inc. (HRPI)

The City is the sole shareholder of the private company, Hamilton Renewable Power Inc. (HRPI) that owns, operates and maintains three 1.6 Megawatt (MW) renewable gas fueled generators. Two are located at the Glanbrook landfill site and the third unit is located at the Hamilton Water wastewater treatment plant. The units use methane as a renewable fuel source to produce electricity that is secured through long term contracts with the province. The net benefit from all HRPI operations in 2015 was approximately $1,549,800 for the City, with a cumulative total of $13,873,000 for the period from 2006 to 2015.

HRPI also contributes over 100,000 tonnes Co_2 of annual emission reduction by producing electricity from renewable gas-fired units that would have otherwise been provided by the electricity grid. This reduction is not included in any City of Hamilton emission reporting.

Biogas Purification Unit (BPU)

The BPU is located within Hamilton Water's Woodward plant. The BPU captures excess methane gas from the anaerobic digestion process of waste water. The raw gas is purified, treated and conditioned to yield utility grade natural gas that is injected into the Union Gas distribution system. In 2015, the BPU operated for 193 days, and yielded 15,631 gigajoules of natural gas. The gas was used for the City's own requirements throughout the year, and was valued at $60,000.

Solar Energy

Currently, there is a 250kW rooftop photovoltaic solar installation at the City-owned site, 330 Wentworth St North. Additional installations at Harry Howell and Morgan Firestone arenas had applications submitted to the regulator. The installations are funded under the Feed-In-Tariff (FIT-version 4) program. In these rooftop solar installations, the City elected to lease the roof space to Horizon Energy Services whom act as owner and operator of renewable energy projects. Further assessment of ground mount solar installations is continuing for additional renewable energy potential.

Energy Conservation

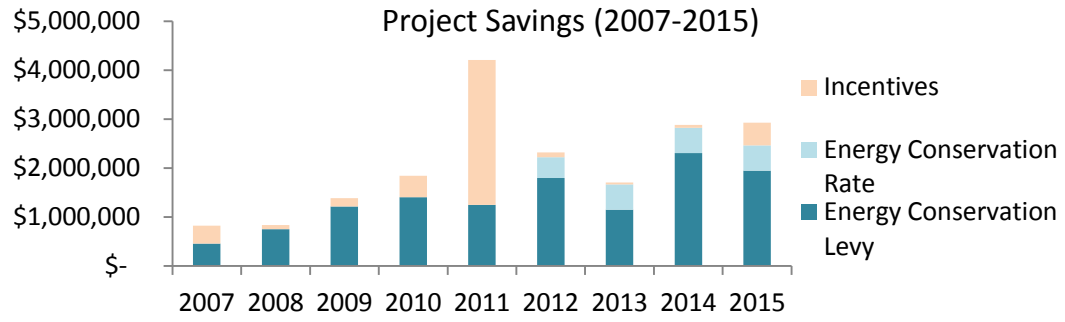
2015 Project Updates

Conservation projects continue to be an integral part in achieving success in energy reduction goals. Not only do the projects often increase efficiencies and embrace emerging technologies, but the City can continue to track the savings achieved even after a project is complete. The approved International Protocol for Monitoring and Verification (IPMV) is used to consistently track savings and avoided costs.

Project teams work in conjunction with consultants, engineers, utility personnel and other industry experts to maximize savings as well as ensure incentive applications are completed with appropriate Monitoring and Verification (M&V) plans as required.

The 2015 energy savings contribution from projects is $2.46 million, plus $465,000 in incentives, for a total of $2.9 million. The cumulative value since the 2005 baseline year is $14.2 million.

Graph 6: Project Savings (Energy Conservation and Incentives)



LED Street Lighting Replacement

LED replacement has been ongoing throughout City for the past few years. In 2015, Corridor Management undertook the largest LED replacement project to date. Over 10,300 High Pressure Sodium (HPS) luminaires were replaced with high efficient LEDs. Not only is the

estimated annual energy reduction expected in the range of 10.5 million kilowatt-hours (kWh) per year, but the City has been approved to receive an incentive from the IESO under the SaveONenergy retrofit program valued at over $3.4 million. The incentive dollars will be reflected in the 2016 reporting year (year received).

Central Police Station – LED Lighting Retrofit Project

This lighting retrofit project at the Central Police Station involved changing exterior wall packs and parking pole lights from HPS and interior metal halide luminaires in the basement to energy efficient LED luminaires. The combined impact of the LED lighting upgrades is a reduction of approximately 70% in lighting specific electrical consumption. The project qualified for approximately $8,000 of incentives.

Aquatics Centres - Energy Efficient Lighting Project

This project was initiated after a lighting audit process of the Aquatic Centres. The project involved installing new lighting designs in lobbies, hallways, change rooms, meeting rooms, gymnasiums and pool areas. LED lighting systems were incorporated where appropriate, including pool enclosures. LED lamp life far exceeds that of traditional fluorescent or high intensity discharge (HID) light sources and as such will reduce future relamping maintenance costs at the Aquatics Centres over the long term. The energy savings is expected to be a 700,000 kWh reduction annually. The project qualified for $46,600 in incentives.

Hamilton Place and Hamilton Convention Center - Heating Recommissioning Project

The goal of this project was to primarily address heating comfort and control issues through a building recommissioning process at both Hamilton Place and the Hamilton Convention Center.

The project converted the building's hydronic heating systems from constant flow to variable flow through the replacement of existing 3-way valves on heating coil connections with 2-way valves, and the reconfiguration of the pumping control. Heating control valves were replaced on various HVAC units at the Hamilton Convention Centre and Hamilton Place. Modifications to the Central Utility Plant's connection to Hamilton Place were also completed. The project provided better heating system control while making building more energy efficient and reducing utility costs. The energy savings is expected to be a 27,600 kWh reduction annually. The project qualified for $5,900 in incentives.

Hamilton Convention Centre - LED Lighting Retrofit Project

The lighting systems at the Hamilton Convention Centre needed to be replaced as they were at end of life cycle. The project involved replacing lighting systems with LED. The replacement included lighting in foyers, hallways, stairways, kitchens, lobbies and ballrooms areas. The Ballroom dimming systems were replaced to include the use of LED technology. Not only was the look of the lighting greatly improved but with the greater LED lamp life, future maintenance costs will be greatly reduced. The energy savings is expected to be a 657,000 kWh reduction annually. The project qualified for $38,800 in incentives.

Small Business Lighting Program

One of the many initiatives pursued by the City of Hamilton to reduce energy and utilize utility funded programs was the Small Business Commercial lighting program sponsored by Horizon Utilities and Hydro One. The program's objective was to reduce energy at smaller facilities by offering fully funded retrofits for lighting systems and controls. Through this program, 56 City of Hamilton facilities received a total of $84,000 in retrofit work which resulted in a savings of 248,790 kilowatt-hours.

2016 Project Highlights

Several projects have already been approved by Council for the calendar year 2016. Among them are:

- Hamilton Water – Miscellaneous Lighting Upgrades
- Mountain Transit Centre Lighting Upgrades
- LED Replacement in Parking Garages
- Stoney Creek Town Hall BAS System
- Low Emissivity Ceilings at Harry Howell Arena
- Pilot Project to Optimize Arena Ice Refrigeration Systems

Environmental Reporting

Green Energy Act Reporting

The City is required to report to the provincial government on its energy use as part of adherence to the Green Energy Act (GEA). The most recent data set submission was for the 2013 calendar year. The 2014 data will be submitted in summer of 2016 as mandated by the GEA. According to the GEA's reporting formula, the City-owned corporate facilities are responsible for emitting 34,466 tonnes of CO_2e, which is comparable to having 7255 cars on the road each day. It should be noted that the GEA facility type categories do vary from those reported by the City in this energy report, as they are pre-set categories which do not necessarily follow the same naming convention as the City.

Greenhouse Gas (GHG) Emissions

GHG emissions related to Corporate operations have been inventoried and reported annually since adoption of the Corporate Air Quality and Climate Change Strategic Plan (PED06336(a)) in 2008. The plan established Hamilton's Corporate emission targets 20% reduction of 2005 GHG's levels by 2020. The City achieved the 2020 target in 2012, eight years ahead of schedule. New GHG emission targets have been established and aligned with the Council approved Corporate Energy Policy (CEP) (PW14050) and the Board of Health Climate Change Actions 2012 report (BOH13024). Both have established an 80% reduction in Greenhouse Gas Emissions by 2050 from a base year of 2005. An interim emission reduction target has been set through the CEP at 50% by 2030.

In the 2014 reporting year, the GHG emissions inventory was 98,319 tonnes CO2e (Carbon Dioxide equivalence). This represents a 22% reduction from the base reporting year of 2005 which had 126,567 tonnes CO2e generated.

Cap and Trade

The recently announced Cap and Trade program will not have a material impact on the City's budget until 2017. As the rules and regulations are developed by the province, the City will be budgeting higher energy costs with fuels and natural gas. None of the City's sites meet the minimum threshold that would require establishing an emission Cap. However there may be an option to voluntarily participate should there be a business case to do so. For instance, the City does create renewable natural gas that may be capitalized on through the emerging Cap and

Trade market. Assessment will occur after the program details are made available and come into effect in 2017.

Additional graphs on Environmental Reporting are shown on page 37.

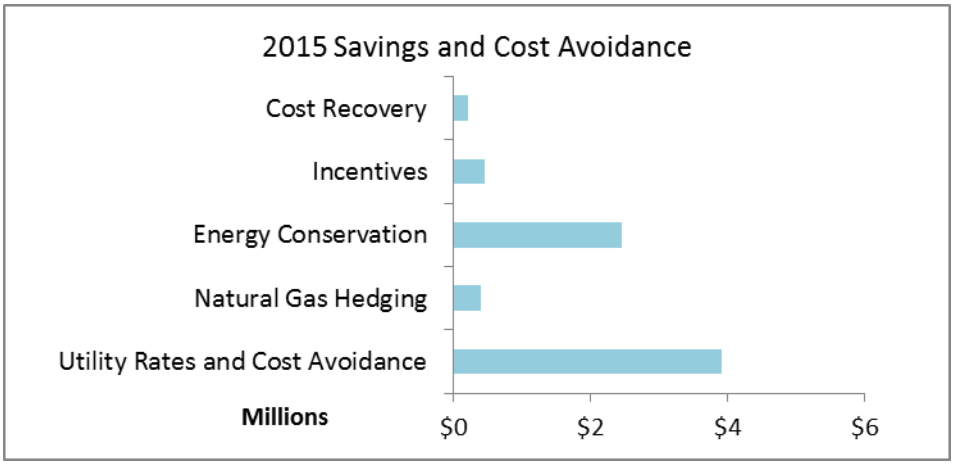
Supplemental Energy Data

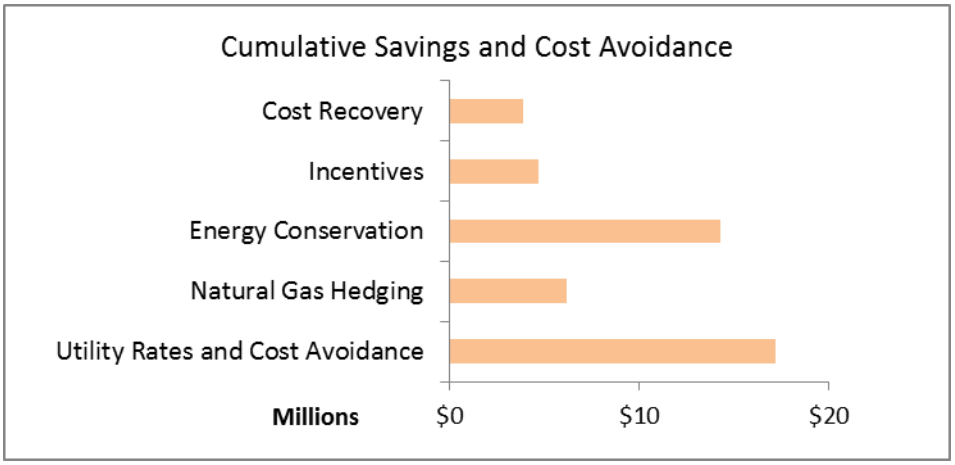
Find in the following section more charts, graphs and tables that further breaks down the data.

Energy Savings and Avoided Costs

Savings and Avoided Cost Overall

Savings and Cost Avoidance	2015	Cumulative
Utility Rates and Cost Avoidance	$3,911,299	$17,191,080
Natural Gas Hedging	$411,642	$6,190,504
Energy Conservation	$2,461,084	$14,252,428
Incentives	$465,362	$4,720,305
Cost Recovery	$221,993	$3,887,475
Total	$7,471,381	$46,241,791





3 Year History by Rate/Levy Category

Category Savings/Avoided Costs	Past 3 Years			2006-2015
	2013	2014	2015	Cumulative
Levy RPP/Interval Change	$0	$0	$0	$2,886,651
Rate RPP/Interval Change	$0	$0	$0	$2,873,163
Levy Global Adjustment	$945,464	$276,053	$994,677	$2,514,502
Rate Global Adjustment	$1,652,757	$2,072,524	$2,916,622	$8,916,764
Levy Natural Gas	$563,312	$290,146	$352,603	$5,247,953
Rate Natural Gas	$126,581	$67,054	$59,040	$942,551
Energy Conservation Levy	$1,152,996	$2,308,250	$1,947,669	$12,285,982
Energy Conservation Rate	$513,415	$513,415	$513,415	$1,966,446
Incentives	$40,515	$62,197	$465,362	$4,720,305
Cash Recovery Levy	$179,975	$302,615	$221,993	$3,652,100
Cash Recovery Rate	$0	$0	$0	$235,375
Totals	$5,175,016	$5,892,255	$7,471,381	$46,241,791

*Rate Protection Plan (RPP) savings/avoided costs were recorded to 2009. After that date the City elected to go to spot market pricing and this category is no longer relevant.

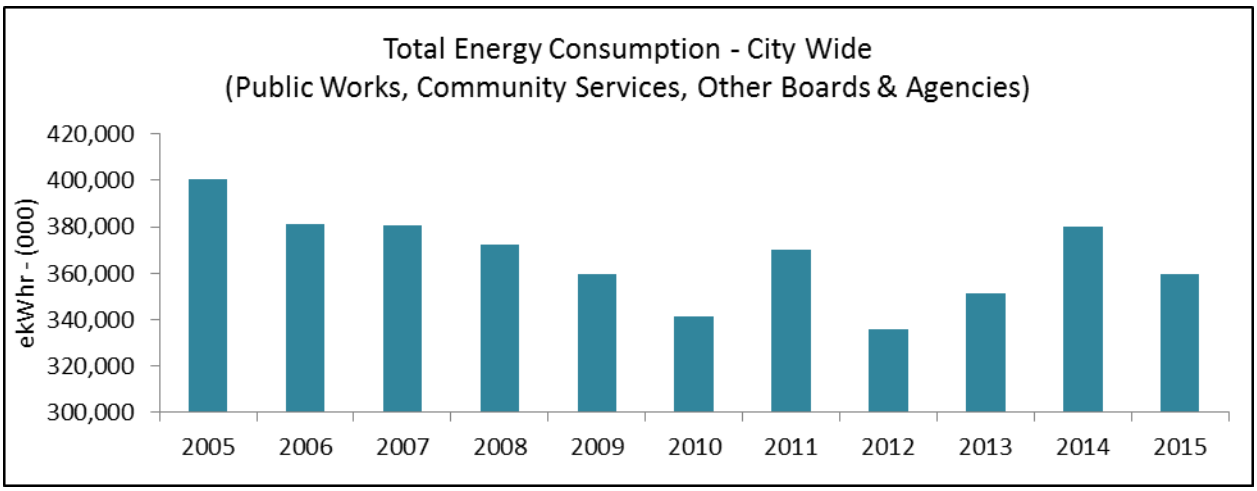
Rate/ Levy Cumulative Savings Breakdown

Energy Savings Thru 2015	Levy Total	Rate Total	City Total
Energy Conservation	$12,285,982	$1,966,446	$14,252,428
Incentives/Funding	$4,720,305		$4,720,305
Billing Recoveries	$3,652,100	$235,375	$3,887,475
Natural Gas Hedging	$5,247,953	$942,551	$6,190,504
Electricity Rate Savings	$5,401,153	$11,789,927	$17,191,080
2006-15 Avoided Costs Total	$19,021,511	$12,967,853	$31,989,363
2006-15 Savings Totals	$12,285,982	$1,966,446	$14,252,428

Energy Performance

Annual Consumption and Cost and Energy Intensity are shown in ekWh and include all City-owned sites, excluding City Housing Hamilton for electricity and natural gas.

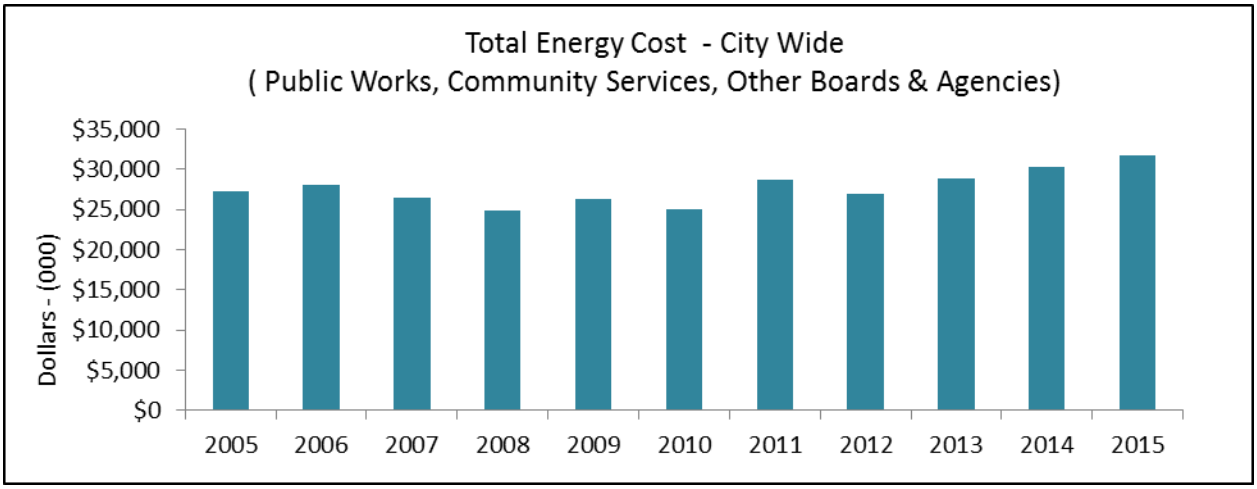
Total Energy Consumption (ekWh)



Total Energy (ekWh) Consumption Comparison by Category

Total Energy	**in 000's of ekWh**			**Comparisons**	
Consumption	**2005**	**2014**	**2015**	**2015 vs 2005**	**2015 vs 2014**
City/Town Halls	13,775	7,672	7,451	-46%	-3%
Corporate Facilities	17,188	11,000	9,568	-44%	-13%
Street Lighting	33,603	34,941	30,922	-8%	-12%
Traffic Lighting	5,688	2,132	1,965	-65%	-8%
Other City Operations	5,618	6,260	6,096	9%	-3%
Hamilton Water	121,040	135,206	128,919	7%	-5%
Yards	39,589	29,973	27,323	-31%	-9%
Arenas	39,904	38,106	36,641	-8%	-4%
Community/Senior Centers	3,834	4,025	3,607	-6%	-10%
Rec Centres/Pools	26,789	29,098	28,200	5%	-3%
Rec Parks/Stadiums/Golf	8,332	5,291	4,519	-46%	-15%
Lodges (Macassa Lodge, Wentworth Lodge)	24,938	16,739	16,444	-34%	-2%
Culture	5,383	5,027	4,777	-11%	-5%
Fire/ EMS	10,698	13,932	13,203	23%	-5%
Hamilton Public Libraries	9,343	10,830	10,806	16%	0%
First Ontario Centre	10,122	9,966	10,315	2%	4%
Hamilton Convention Centre	4,656	4,402	4,182	-10%	-5%
Hamilton Place	5,466	5,453	4,914	-10%	-10%
Hamilton Police Services	14,757	9,830	9,608	-35%	-2%
City Wide Total	**400,722**	**379,883**	**359,460**	-10%	-5%

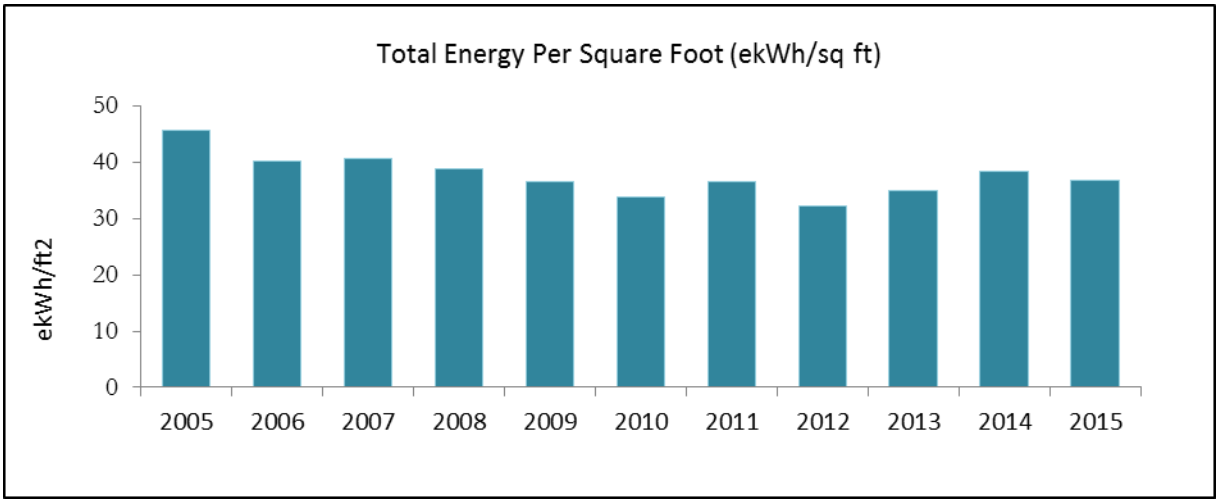
Total Energy Cost



Total Cost Comparison by Category

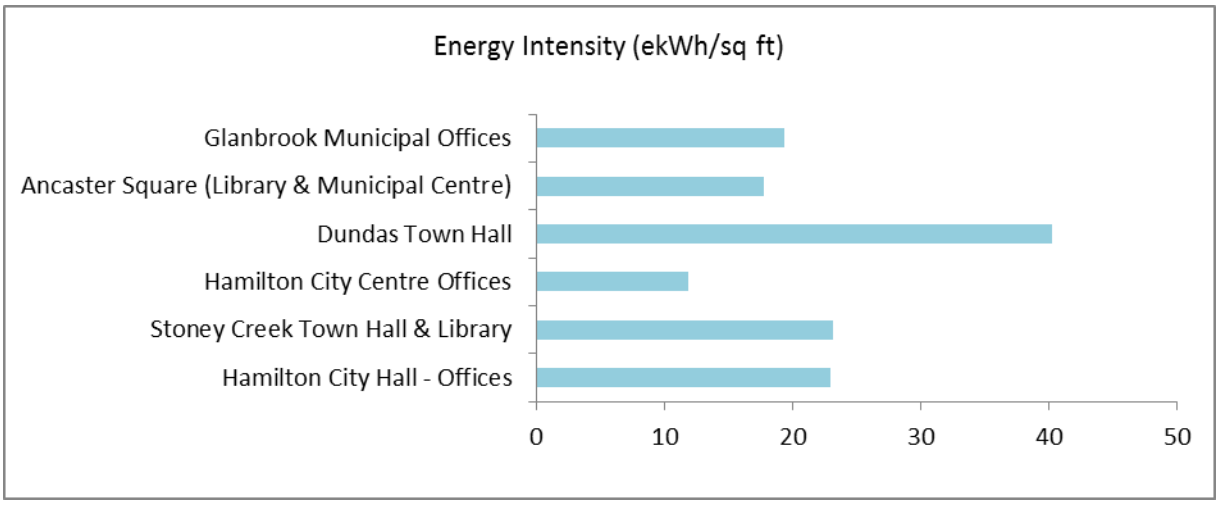
Total Energy-$	**in 000's of $**			**Comparisons**	
Cost	**2005**	**2014**	**2015**	**2015 vs 2005**	**2015 vs 2014**
City/Town Halls	$860	$652	$651	-24%	0%
Corporate Facilities	$866	$776	$756	-13%	-3%
Street Lighting	$2,895	$5,407	$5,689	97%	5%
Traffic Lighting	$462	$370	$347	-25%	-6%
Other City Operations	$534	$827	$895	68%	8%
Hamilton Water	$9,590	$11,186	$11,483	20%	3%
Yards	$2,205	$1,509	$1,673	-24%	11%
Arenas	$2,455	$2,576	$2,877	17%	12%
Community/Senior Centers	$224	$235	$247	10%	5%
Rec Centres/Pools	$1,192	$1,243	$1,337	12%	8%
Rec Parks/Stadiums/Golf	$564	$350	$340	-40%	-3%
Lodges (Macassa Lodge, Wentworth Lodge)	$1,087	$858	$968	-11%	13%
Culture	$338	$260	$275	-19%	6%
Fire/ EMS	$614	$837	$896	46%	7%
Hamilton Public Libraries	$827	$956	$961	16%	1%
First Ontario Centre	$840	$822	$911	8%	11%
Hamilton Convention Centre	$387	$366	$330	-15%	-10%
Hamilton Place	$454	$447	$377	-17%	-16%
Hamilton Police Services	$783	$672	$753	-4%	12%
City Wide Total	**$27,177**	**$30,348**	**$31,767**	17%	5%

Total Annual Energy Intensity

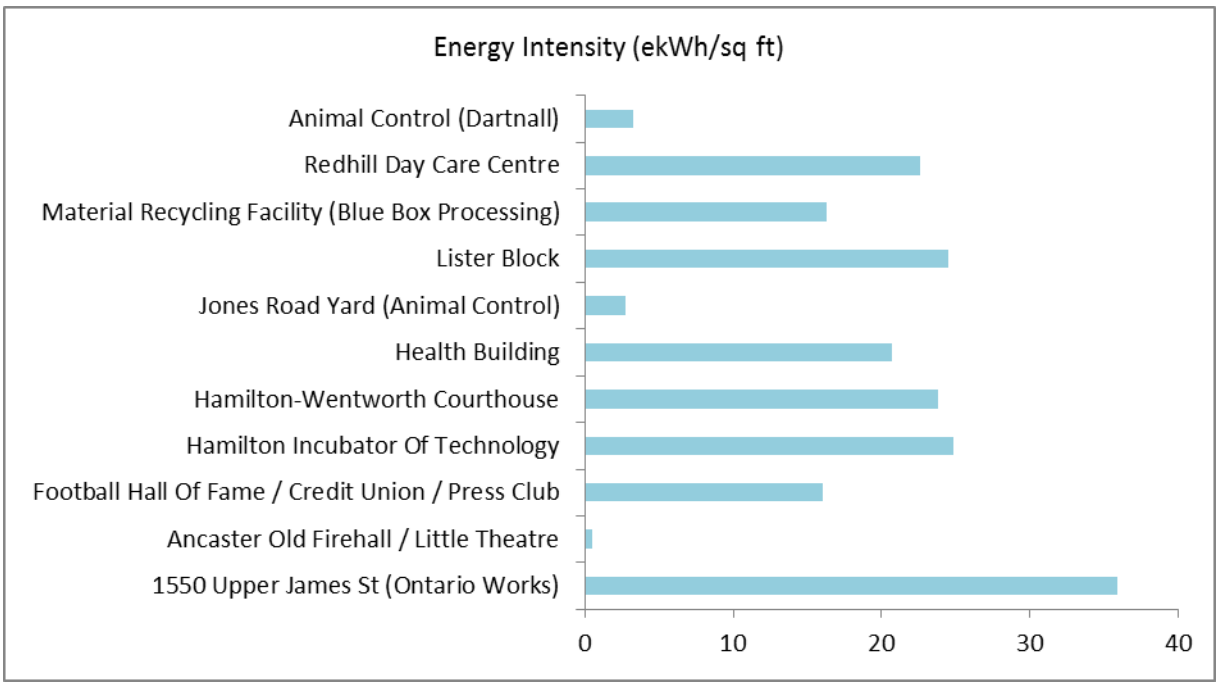


The following series of graphs break down the energy intensity levels per site for 2015 within their specific reporting category (group). Energy Intensity is calculated by using the equivalent kilowatt-hours (ekWh) divided by the reported square footage for the site. Sites that do not have recorded square footage may show as a zero value on the energy intensity graphs below.

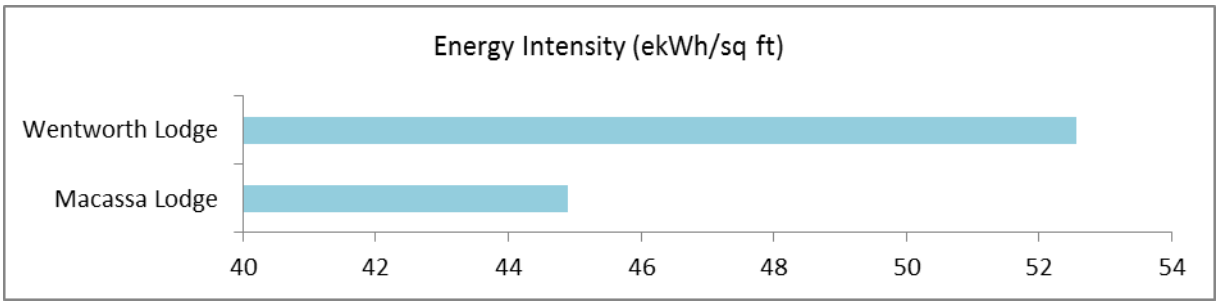
City/Town Halls:



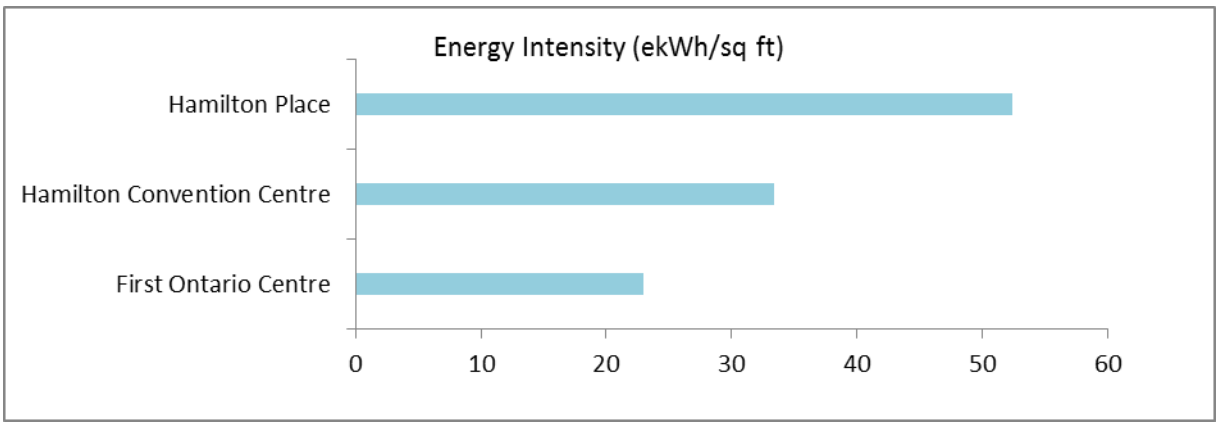
Corporate Facilities:



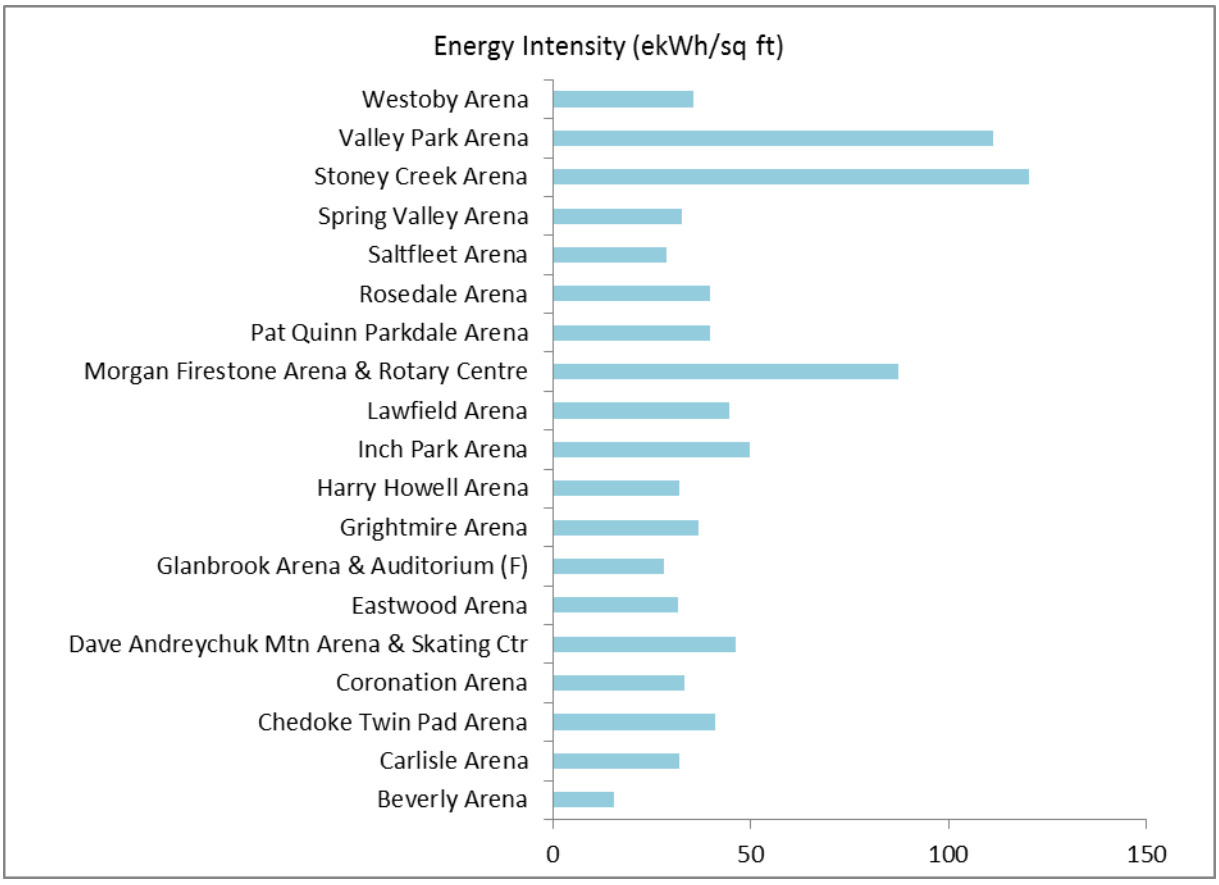
Lodges:



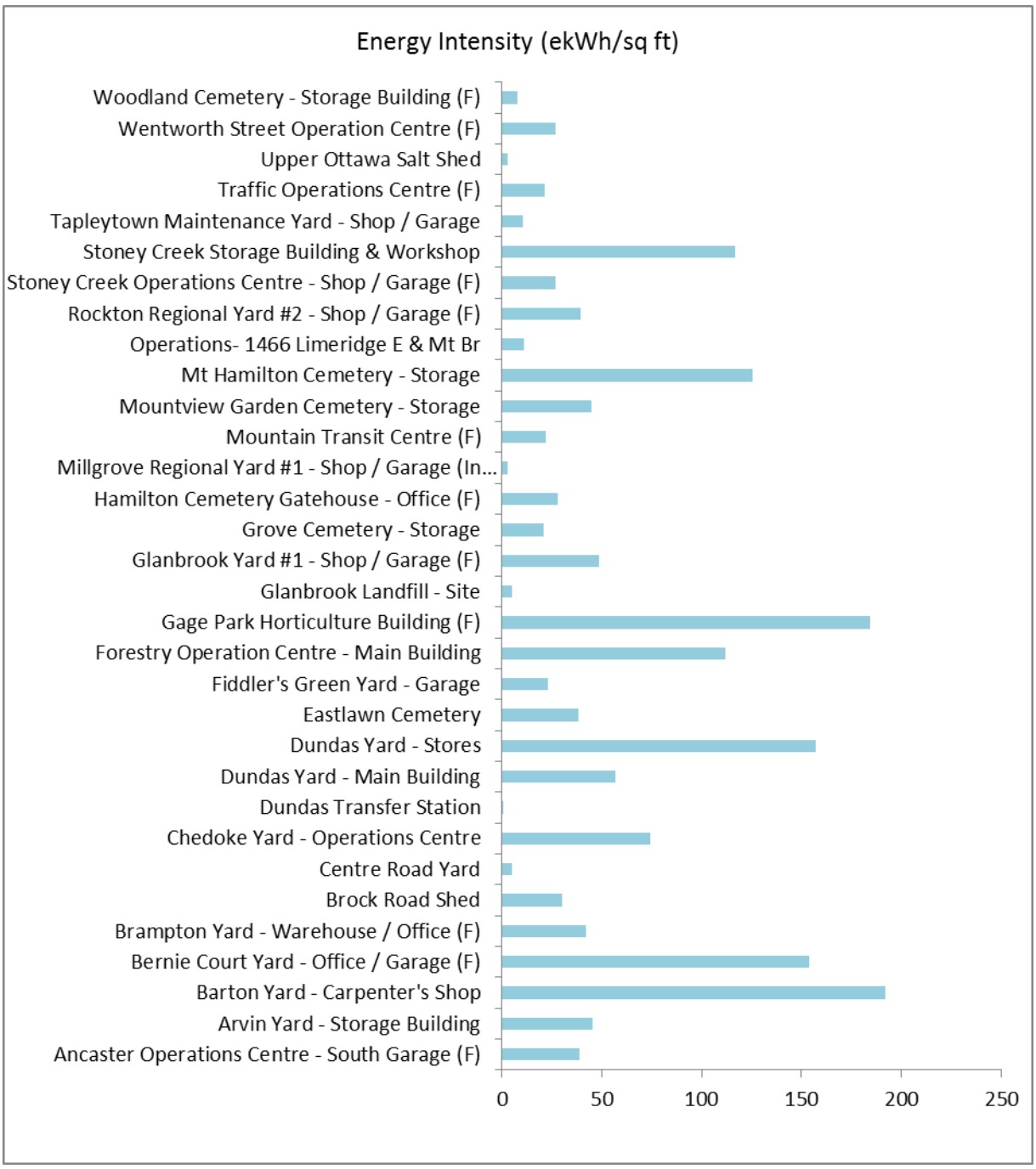
Entertainment Venues (formally HECFI):



Arenas:

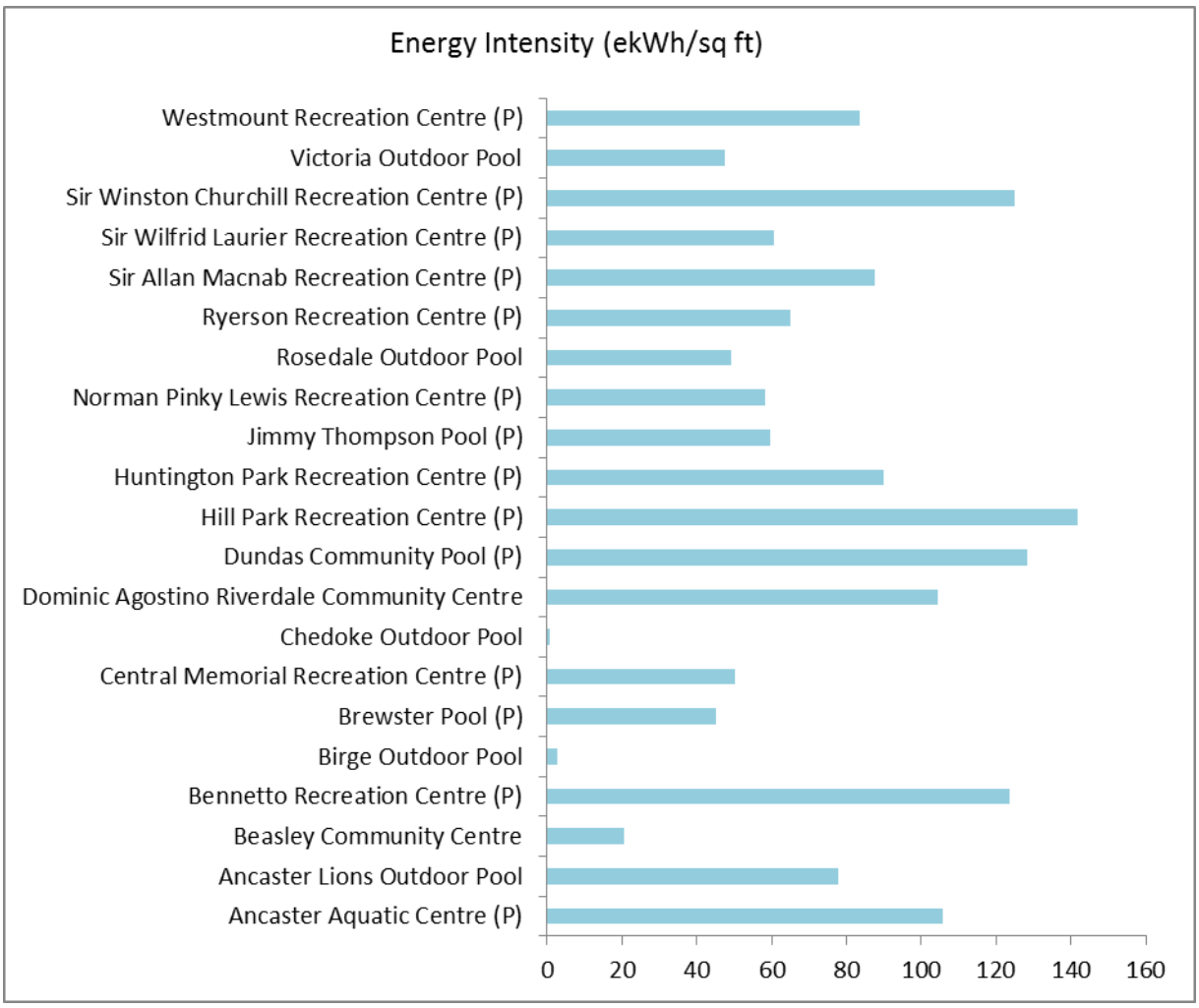


City Yards:



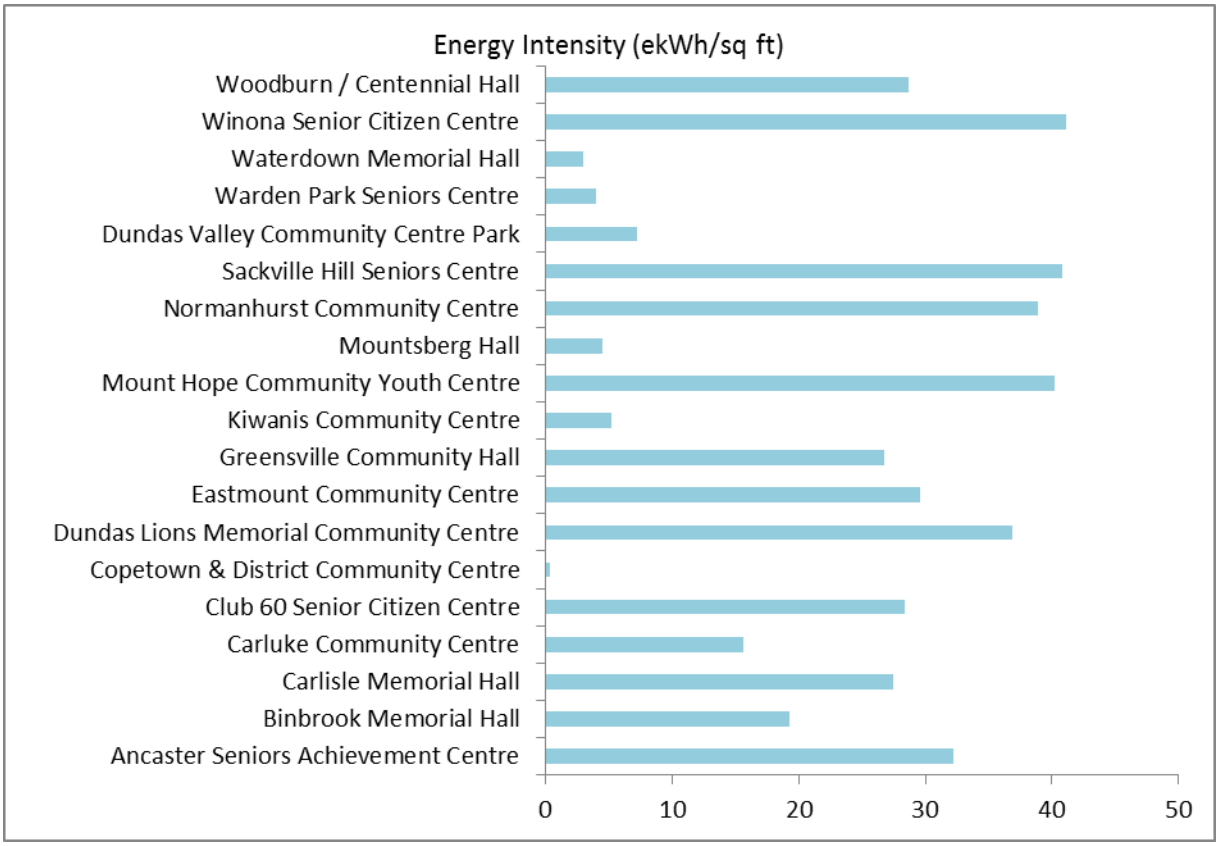
(F) = Fuel site

Recreation Centres/Pools:

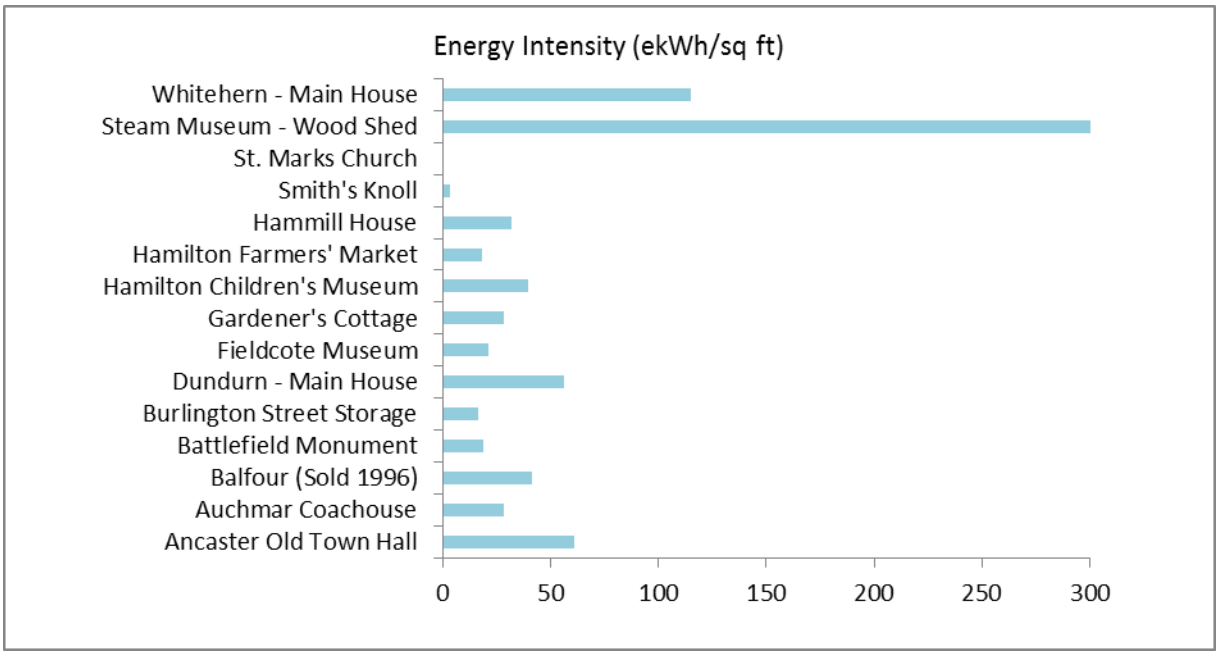


(P) = Pool

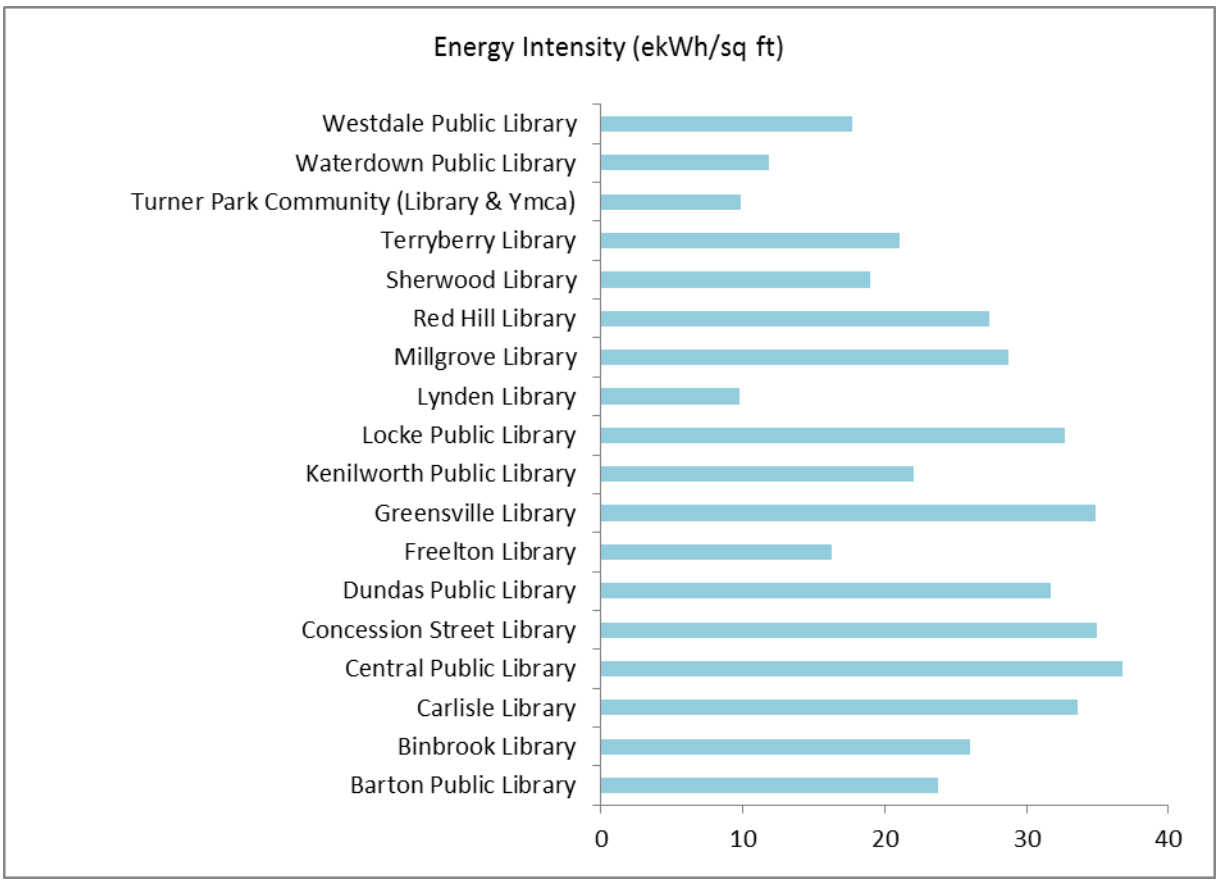
Community Centres:



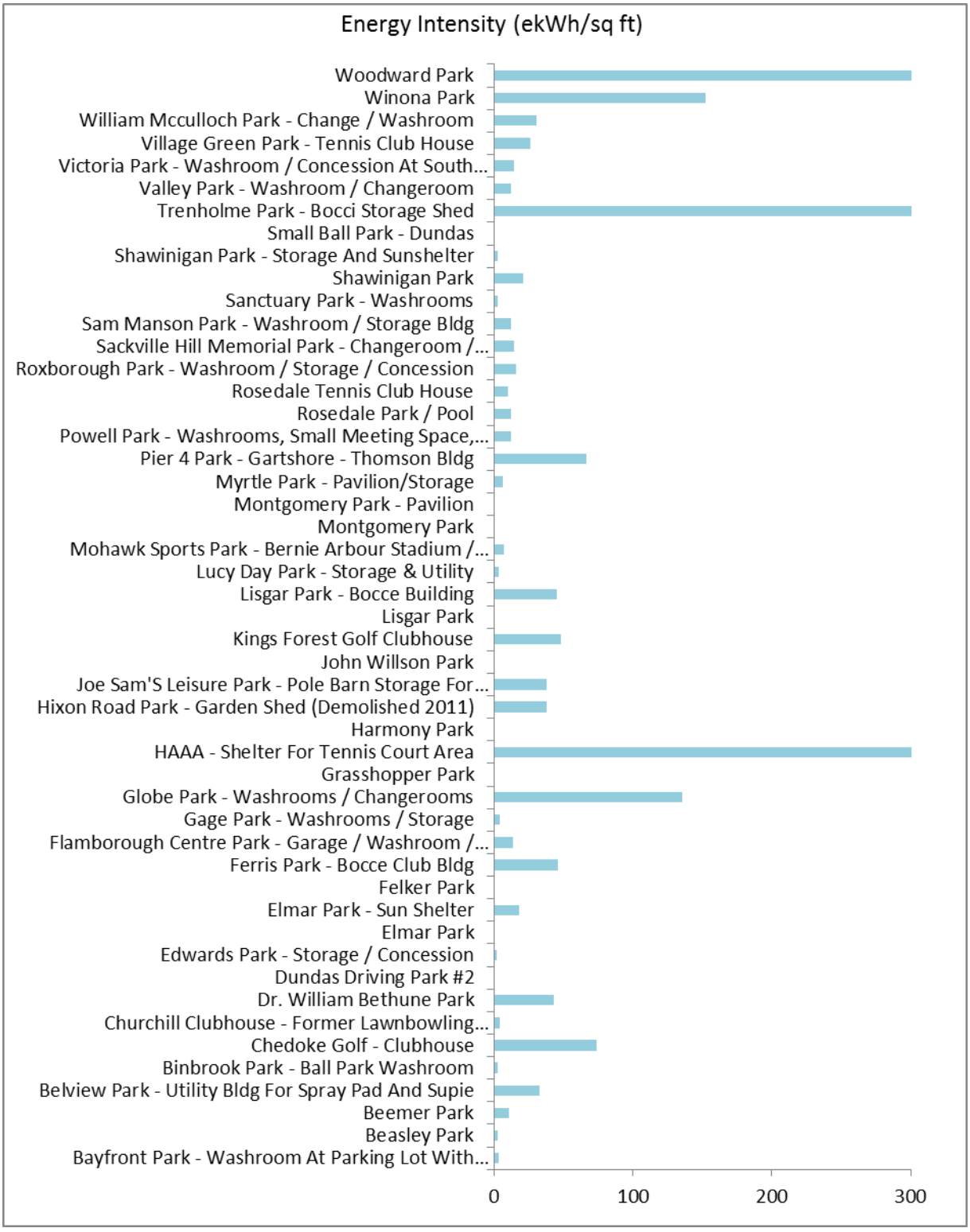
Culture:



Libraries:

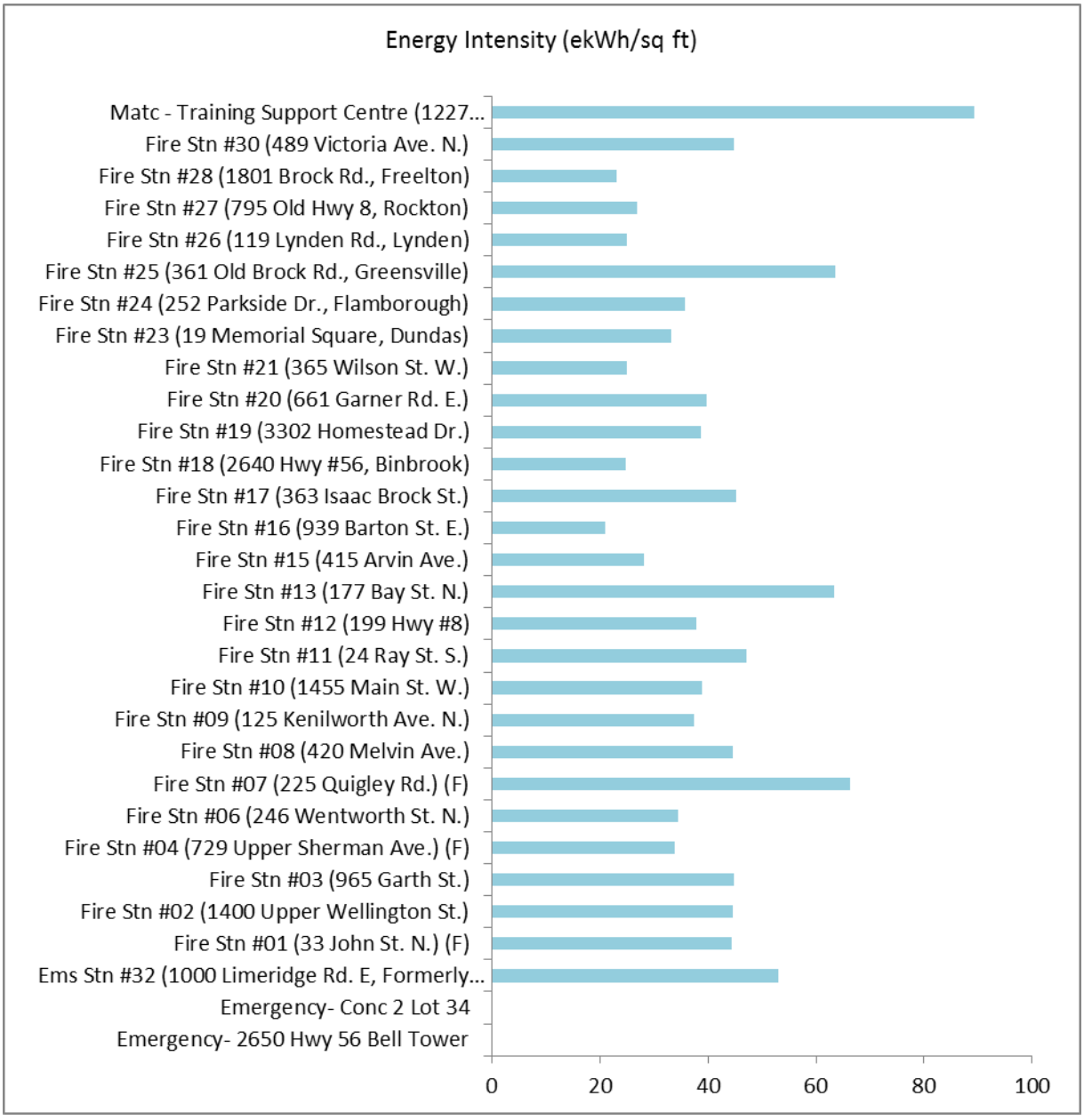

Energy Intensity (ekWh/sq ft)
Westdale Public Library
Waterdown Public Library
Turner Park Community (Library & Ymca)
Terryberry Library
Sherwood Library
Red Hill Library
Millgrove Library
Lynden Library
Locke Public Library
Kenilworth Public Library
Greensville Library
Freelton Library
Dundas Public Library
Concession Street Library
Central Public Library
Carlisle Library
Binbrook Library
Barton Public Library
0
10
20
30
40

Parks/Stadiums & Golf Courses:



Note – 300 ekWh/sqft was set as the maximum value for this grouping, some may exceed.

Fire/EMS:

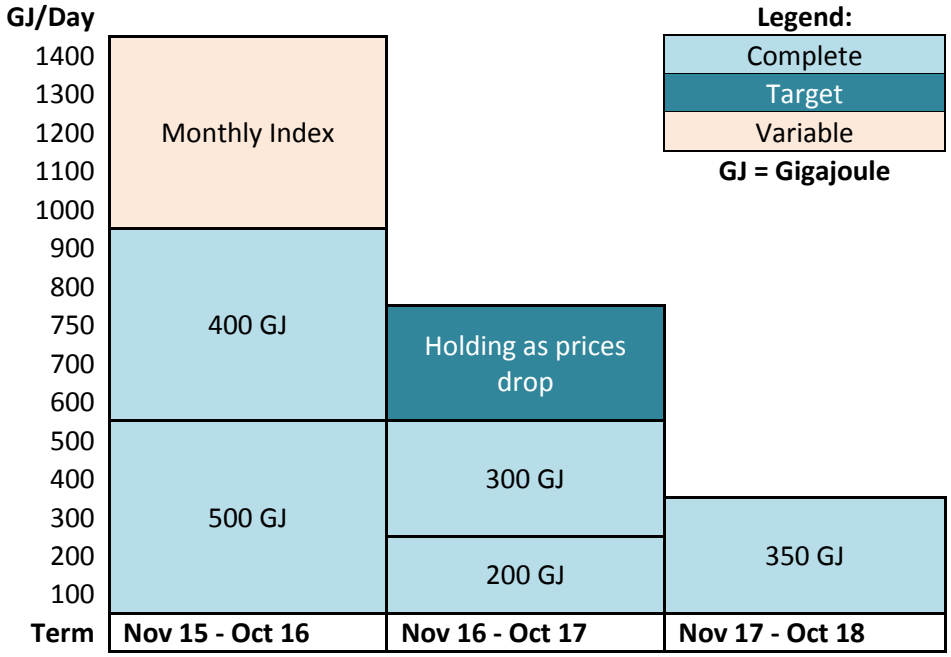

Energy Intensity (ekWh/sq ft)
Matc - Training Support Centre (1227...
Fire Stn #30 (489 Victoria Ave. N.)
Fire Stn #28 (1801 Brock Rd., Freelton)
Fire Stn #27 (795 Old Hwy 8, Rockton)
Fire Stn #26 (119 Lynden Rd., Lynden)
Fire Stn #25 (361 Old Brock Rd., Greensville)
Fire Stn #24 (252 Parkside Dr., Flamborough)
Fire Stn #23 (19 Memorial Square, Dundas)
Fire Stn #21 (365 Wilson St. W.)
Fire Stn #20 (661 Garner Rd. E.)
Fire Stn #19 (3302 Homestead Dr.)
Fire Stn #18 (2640 Hwy #56, Binbrook)
Fire Stn #17 (363 Isaac Brock St.)
Fire Stn #16 (939 Barton St. E.)
Fire Stn #15 (415 Arvin Ave.)
Fire Stn #13 (177 Bay St. N.)
Fire Stn #12 (199 Hwy #8)
Fire Stn #11 (24 Ray St. S.)
Fire Stn #10 (1455 Main St. W.)
Fire Stn #09 (125 Kenilworth Ave. N.)
Fire Stn #08 (420 Melvin Ave.)
Fire Stn #07 (225 Quigley Rd.) (F)
Fire Stn #06 (246 Wentworth St. N.)
Fire Stn #04 (729 Upper Sherman Ave.) (F)
Fire Stn #03 (965 Garth St.)
Fire Stn #02 (1400 Upper Wellington St.)
Fire Stn #01 (33 John St. N.) (F)
Ems Stn #32 (1000 Limeridge Rd. E, Formerly...
Emergency- Conc 2 Lot 34
Emergency- 2650 Hwy 56 Bell Tower
0
20
40
60
80
100

Procurement

Additional charts and graphs related to natural gas, electricity and fuel procurement activity is shown below.

Natural Gas

City of Hamilton Current Hedge Profile for Natural Gas



Total GJs purchased for Natural Gas Contract Obligations – Commodity

Year	Annual GJs Purchased	Total Cost	Average $/GJ	Average $/m3
2006	627,290	$7,399,073	$9.59	$0.37
2007	624,415	$6,018,104	$9.09	$0.35
2008	631,394	$5,663,439	$8.50	$0.33
2009	652,391	$5,391,145	$8.30	$0.32
2010	531,895	$5,411,613	$7.19	$0.28
2011	615,312	$3,824,180	$6.33	$0.24
2012	505,397	$2,722,385	$5.39	$0.21
2013	454,339	$2,028,150	$4.46	$0.17
2014	516,614	$2,333,650	$4.56	$0.18
2015	550,112	$2,380,926	$4.25	$0.16

GJs purchased are not equal to GJs consumed or total price paid. Purchases are made to meet contractual obligations for commodity only.

Electricity

Global Adjustment Avoided Costs for 2015 for Class A sites

2015	kWh Consumption	GA Charges from HUC Invoice	IESO Posted GA Rate $/kWh	Calculated GA	Differential
Jan	8,753,819	$290,427	$0.05068	$443,644	-$153,217
Feb	7,960,719	$212,127	$0.03961	$315,324	-$103,197
Mar	9,168,424	$326,816	$0.06290	$576,694	-$249,877
Apr	8,983,186	$429,389	$0.09559	$858,703	-$429,314
May	9,228,960	$434,239	$0.09668	$892,256	-$458,017
Jun	8,003,379	$436,055	$0.09540	$763,522	-$327,467
Jul	8,260,557	$319,098	$0.07880	$650,932	-$331,834
Aug	8,207,753	$310,307	$0.08010	$657,441	-$347,134
Sep	7,849,526	$251,793	$0.06703	$526,154	-$274,361
Oct	7,687,886	$262,101	$0.07544	$579,974	-$317,873
Nov	7,867,747	$395,050	$0.11320	$890,629	-$495,578
Dec	8,195,883	$352,804	$0.09471	$776,232	-$423,428
Total	100,167,838	$4,020,207		$7,931,504	**-$3,911,297**

Class A Sites: 900 Woodward Ave, 850 Greenhill, 1579 Burlington St, FirstOntario Place, CUP Operations

Fuel

Fuel Cost and Consumption for Diesel and Unleaded Gasoline as Compared to Budget.

2015	Diesel Cost ($)	Diesel Consumption (L)	Gasoline Cost ($)	Gasoline Consumption (L)
Budget	$12,365,360	12,490,264	$2,163,610	2,185,466
Actual	$10,993,512	11,961,168	$1,888,488	2,084,181
Variance	-$1,371,848	-529,096	-$275,122	-101,285
% of Budget	89%	96%	87%	95%
Average Price Per Litre	$0.92		$0.91	

Fuel Usage By User Group

User Group	Diesel Usage Litres	Unleaded Usage Litres	Total Usage Litres
Corporate Assets and Strategic Planning	126,008	164,643	290,651
Public Works Engineering	-	38,265	38,265
Public Works Environmental Services	429,311	349,504	778,815
Hamilton Water	163,690	217,742	381,432
Public Works Operations	2,100,527	356,511	2,457,038
Other	358,205	873,434	1,231,640
Transit (Excluding DARTS and Go Transit)	8,783,426	84,082	8,867,508

*Transit includes Transit Operations, Route Planning and Transit Yard Support. Operations includes Waste Management, Landfill, Roads and Support Services. The "Other" group includes Public Health, Recreation, Tourism and Culture, Library, By-Law Services, Mayor's Office, City Clerk, Digital Technology, and Information Services.

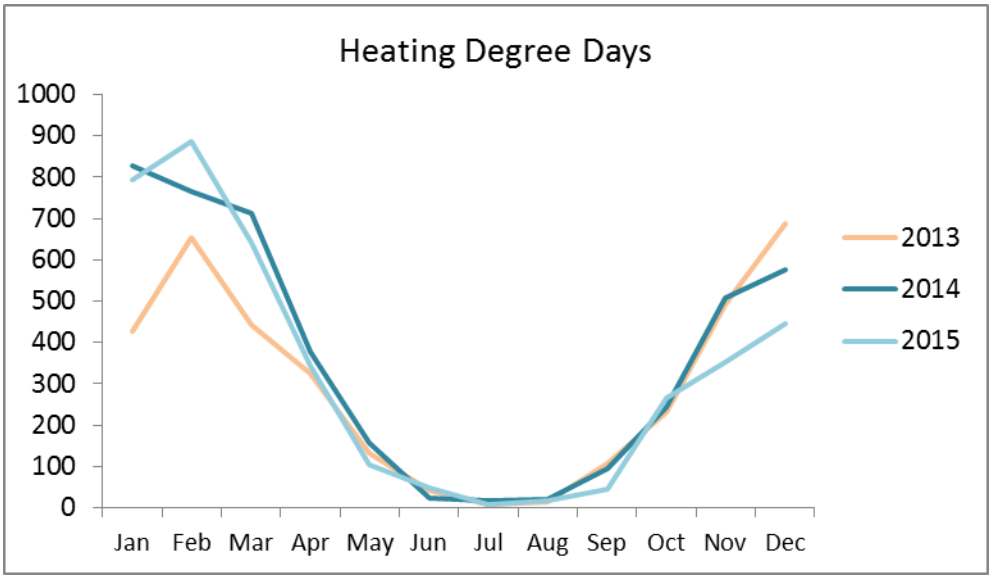
Weather Data

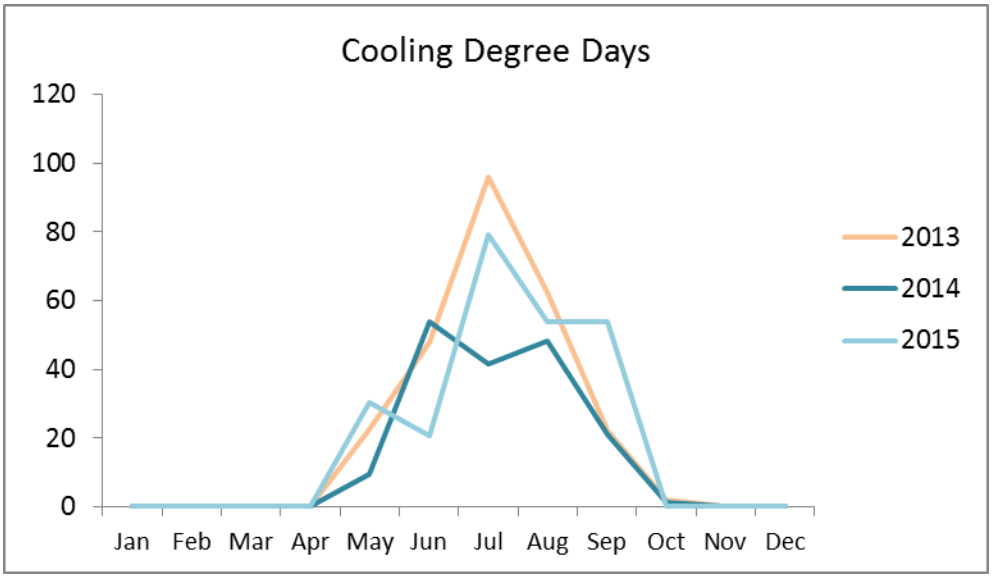
2015 Heating and Cooling Degree Days

Weather Data from Environment Canada (weather station: YHM)

Month	Avg Max Temp (◦C)	Avg Min Temp (◦C)	Avg Mean Temp (◦C)	HDD	CDD	2015 vs 2014 HDD	2015 vs 2014 CDD
Jan-15	-3.6	-13.1	-8.5	794.4	0	-4%	
Feb-15	-8.5	-18.7	-13.6	885.8	0	16%	
Mar-15	2	-7.3	-2.7	640.5	0	-10%	
Apr-15	12.1	1	6.6	342.1	0	-9%	
May-15	22.6	8.6	15.6	103.8	30.5	-33%	218%
Jun-15	22.1	12	17	49.4	20.7	127%	-62%
Jul-15	26.4	14.1	20.3	8.9	79.3	-48%	90%
Aug-15	24.7	13.6	19.2	17.1	53.8	-16%	11%
Sep-15	23.7	12.7	18.3	46.3	53.8	-51%	154%
Oct-15	14.3	4.5	9.4	266.4	0	10%	-100%
Nov-15	11.1	1.1	6.3	351.2	0	-31%	
Dec-15	7.1	0.2	3.6	445.2	0	-23%	
2015 Annual Total				**3951.1**	**238.1**	**-9%**	**35%**

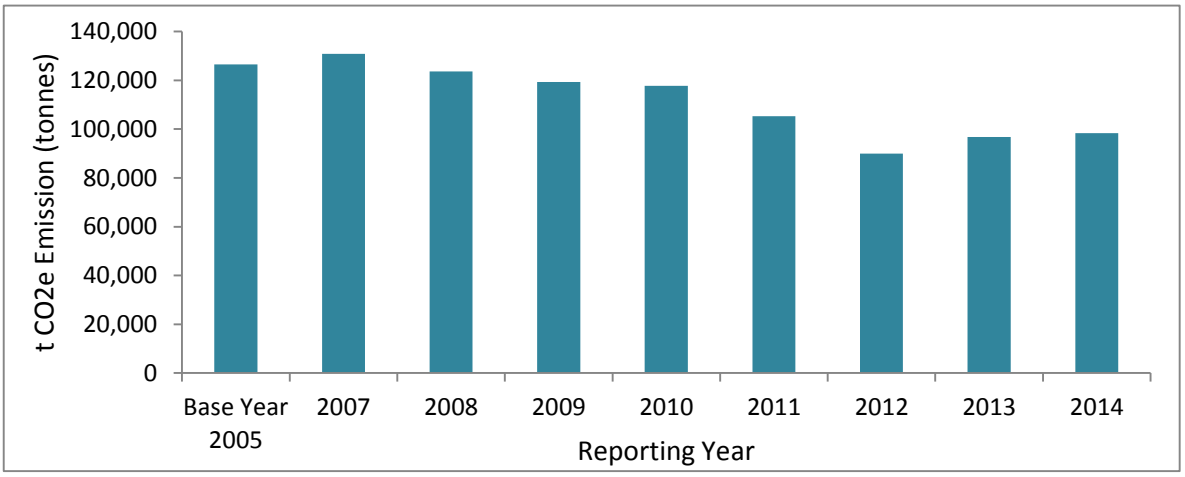
Heating and Cooling Degree Days for the Past Three Years



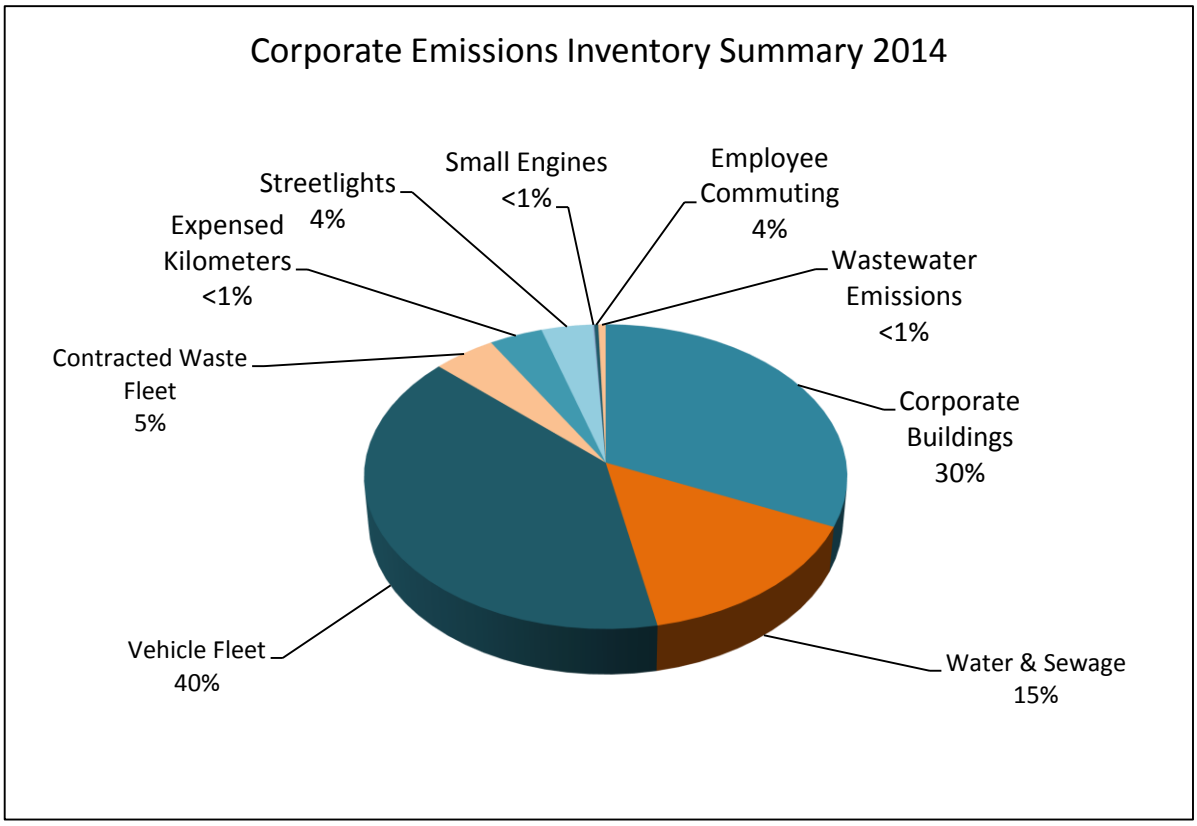


Environmental Reporting

City of Hamilton Corporate GHG Emissions 2005 – 2014



2014 Percent Tonnes CO2e of GHG Emissions Total by Sector



For further information on City of Hamilton energy policies and the relevant reports referenced herein, see: https://www.hamilton.ca/city-initiatives/strategies-actions/office-energy-initiatives