

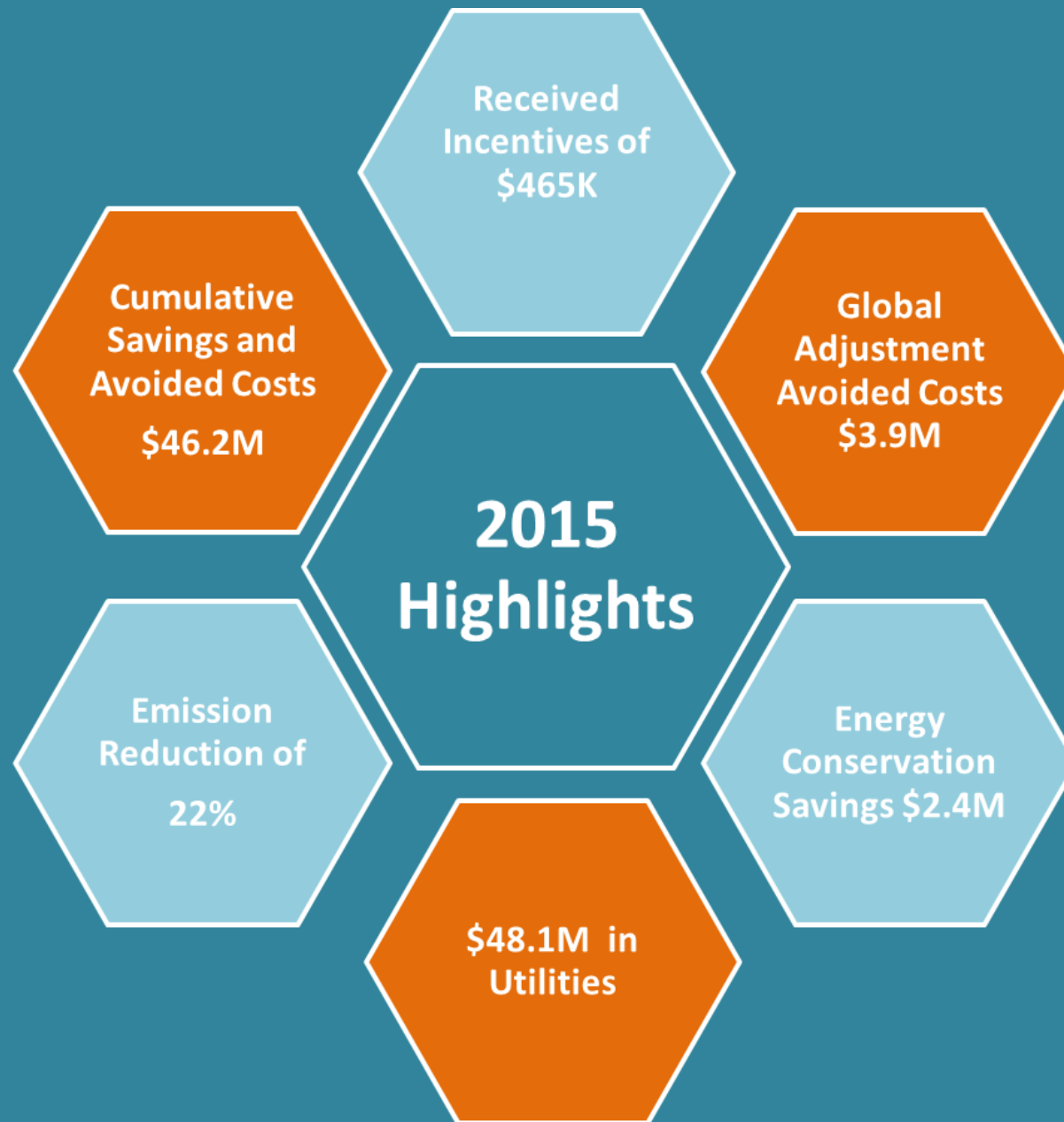
City of Hamilton 2015 Annual Energy Report

Cover Photo: Sherman Falls

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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.

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. The total cumulative avoided costs, energy efficiency savings and incentives are \$46.2 million dollars since 2006. \$7.4 million was achieved for the calendar year 2015.

Energy reduction is an ongoing process. There is still much work to be done and the City continues to make it a priority by looking at new

and exciting green and renewable energy opportunities, promoting energy efficient projects and increasing awareness.



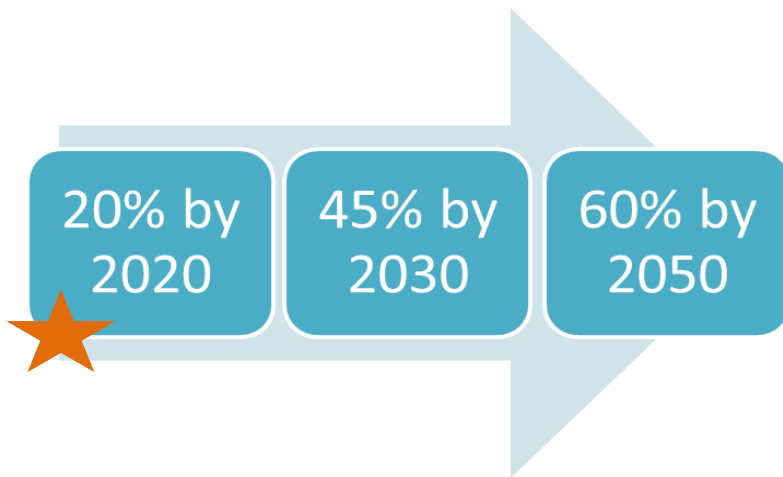
Visit:

www.hamilton.ca/energy for further links to policies and reports referenced in this report.

Corporate Energy Policy

City of Hamilton's Corporate Energy Policy outlines specific energy reduction targets and acts as the guideline to achieve them.

The policy calls for an energy intensity reduction target of 45% by 2030 and 60% by 2050. 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 in direct savings and avoided costs.



Facilitate the achievement of City-wide energy and emission reduction targets

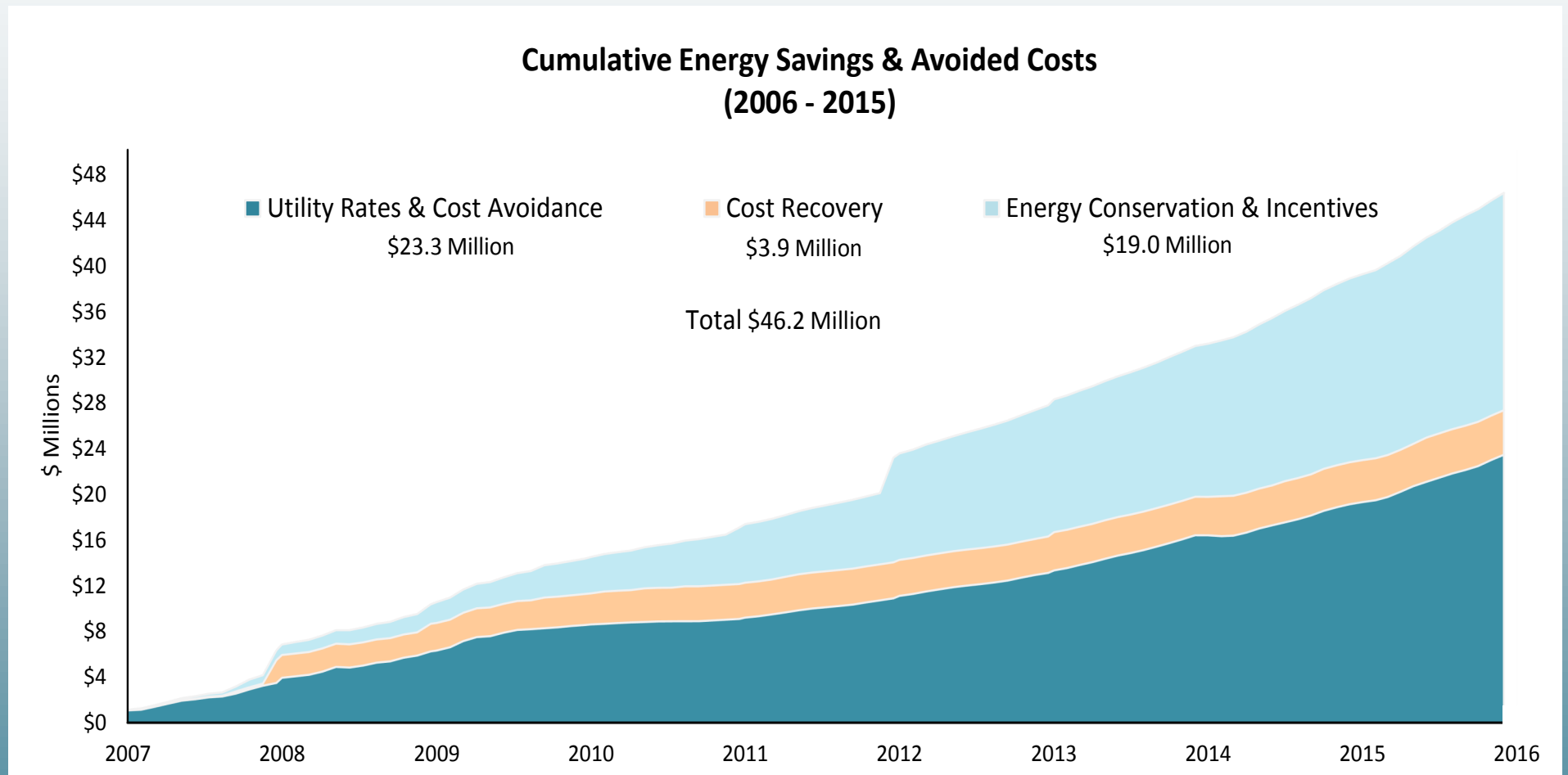
Address the legislated reporting requirements e.g. Green Energy Act

Address regulations concerning greenhouse gas (GHG) emissions

Define policies for capital investment related to energy

Define policies related to energy procurement

Cumulative Savings and Avoided Costs



Savings and Avoided Cost

The total savings and avoided costs for 2015 amounted to \$7.4 Million in three categories:

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.

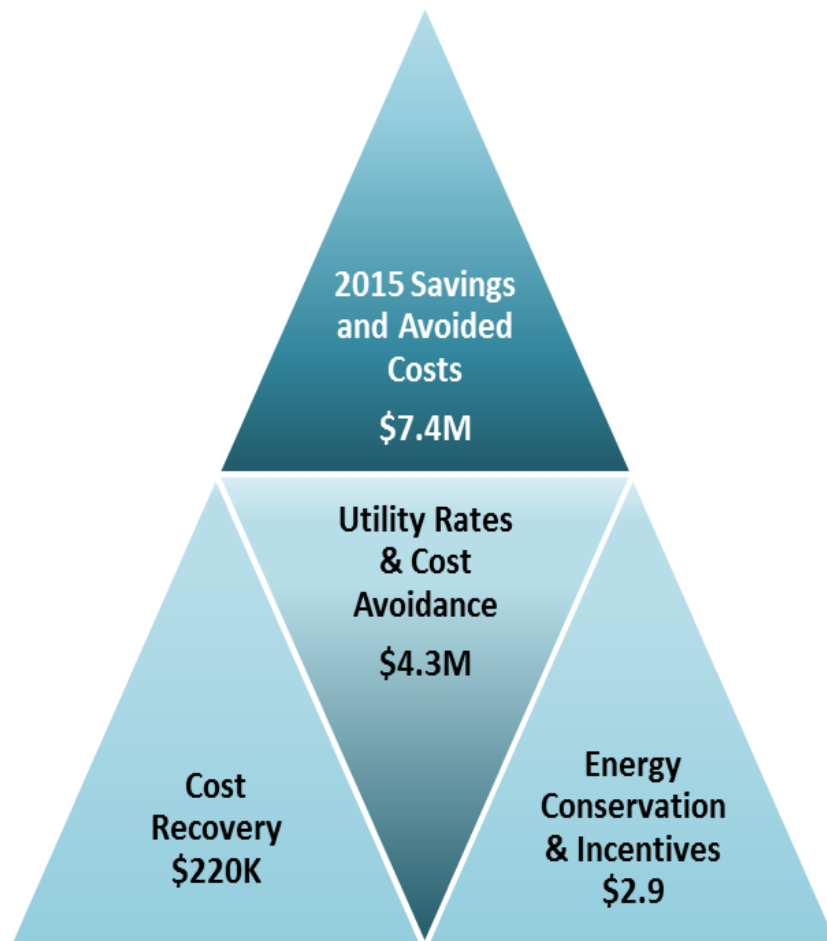
Such actions include procurement plans and strategies, including commodity hedging, and optimizing utility rates. The 2015 savings in this category totaled \$4.3 Million.

Cost Recovery

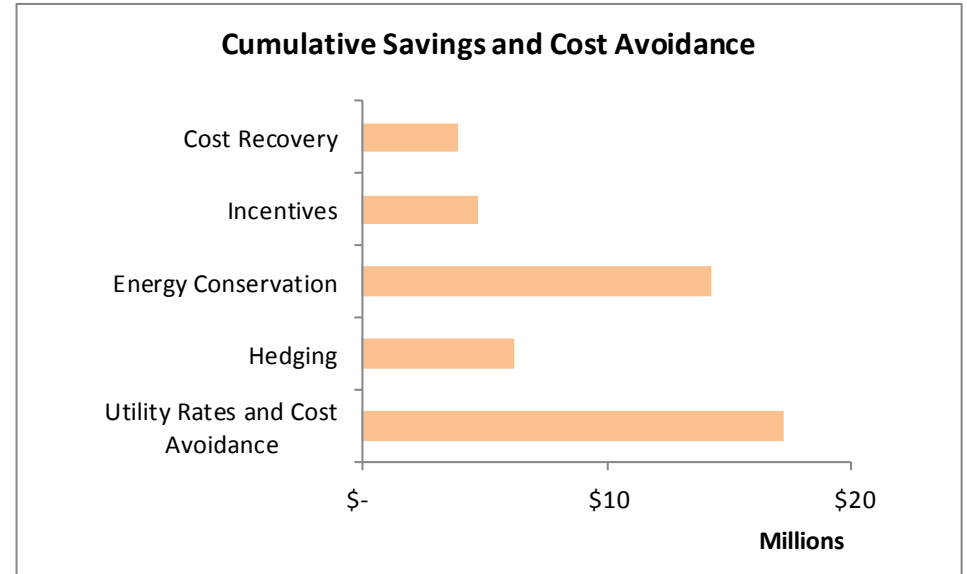
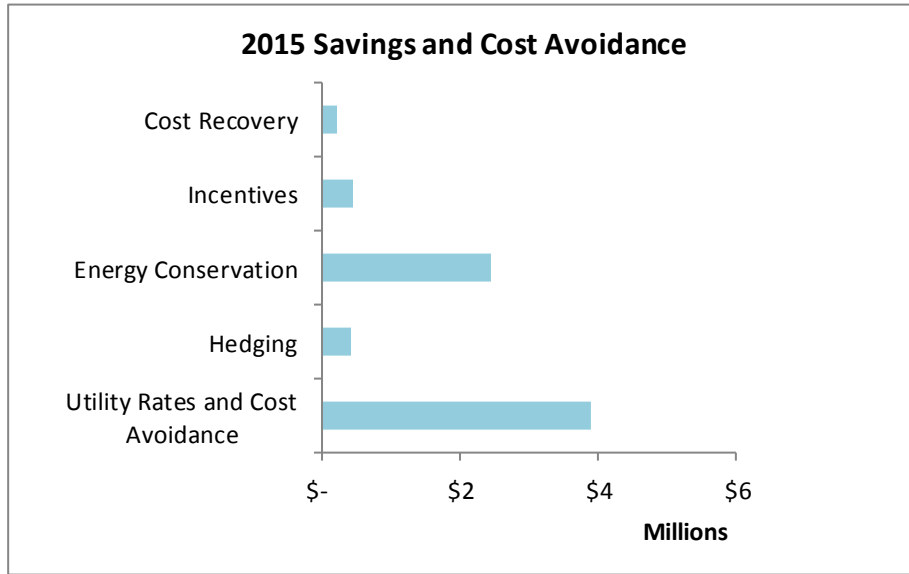
Savings under this category are classified as costs recovered due to the City's continuous efforts to monitor and analyze all utility accounts. This is the recovery of costs stemming from adjustments made to billing errors, billing anomalies or rate corrections. The 2015 savings in this category totaled \$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 capital projects are eligible for a variety of financial incentives from our utility providers (Horizon Utilities, Hydro One and Union Gas). The 2015 savings in this category totaled \$2.9 Million.



Savings and Avoided Cost



\$46.2M

Savings since 2005

Overall 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 total expenditures for utilities (electricity, natural gas, water and fuel) for the City was \$48.1 million in 2015. That was a slight decrease of 1% compared to 2014.



Overall costs down 1% from 2014:

Electricity increased 6%

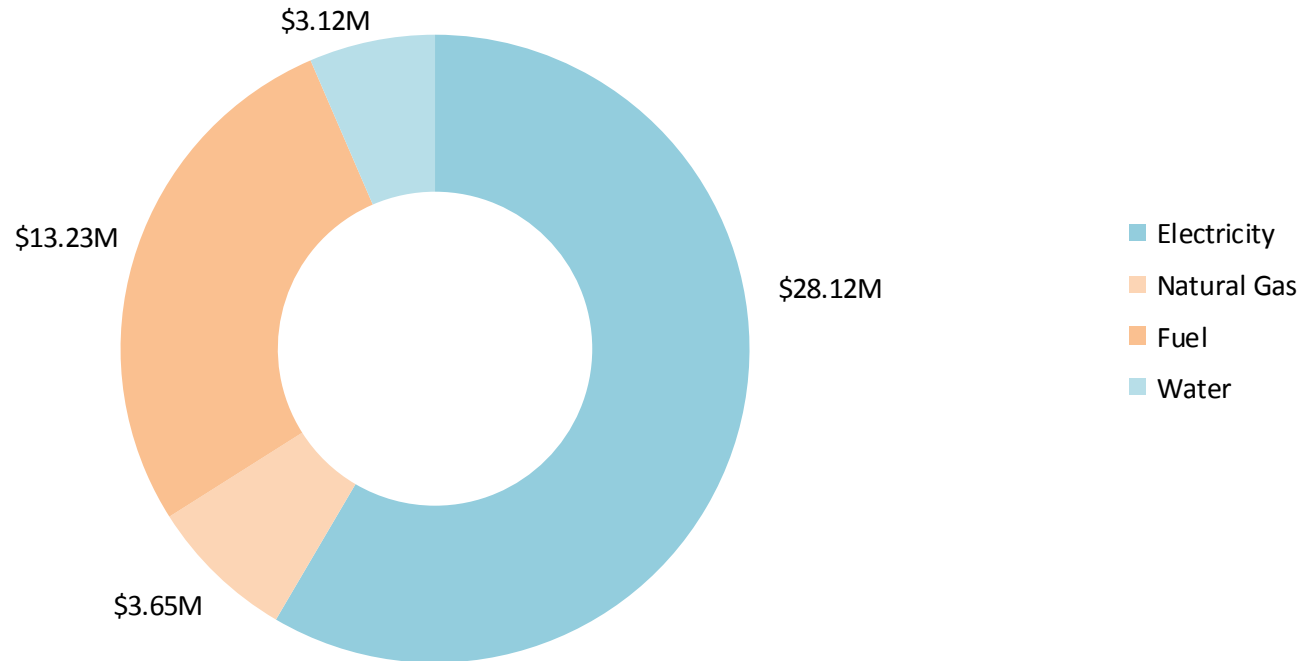
Natural Gas decreased 7%

Fuel decreased 15%

Water increased 9%

Overall Cost

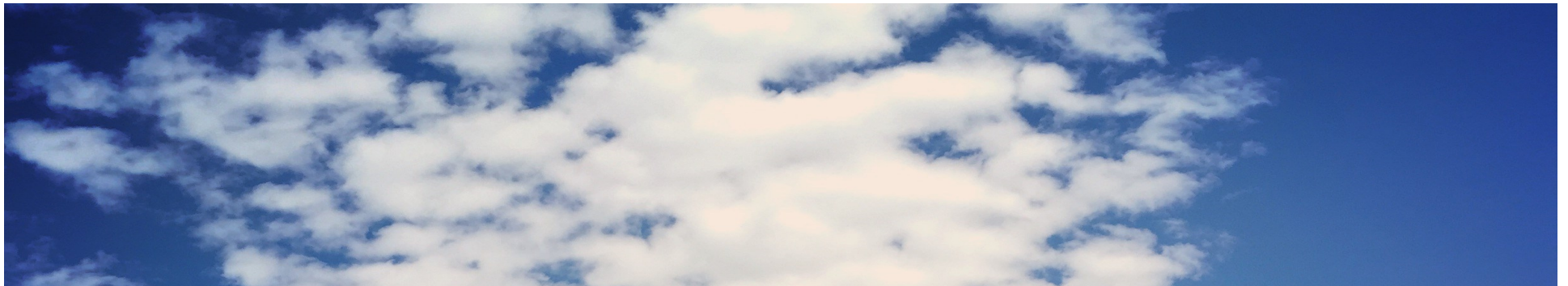
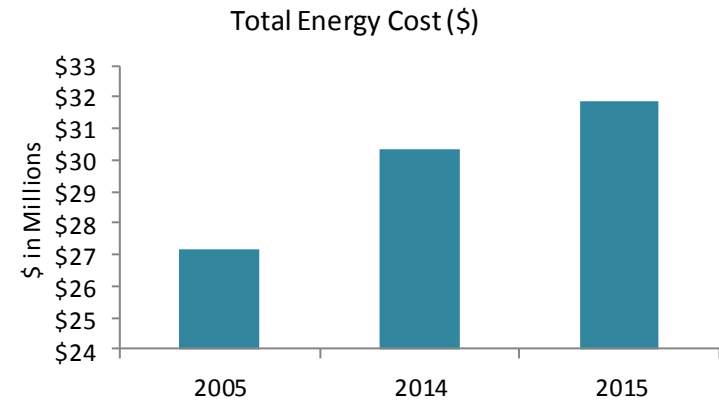
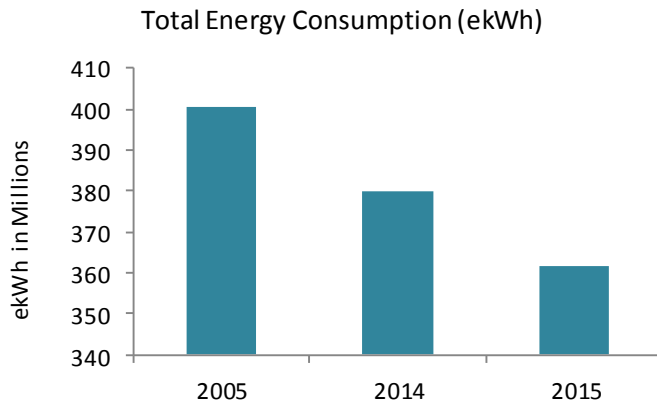
2015 Utility Costs
Total: \$48.1 Million (M)



* The costs are incurred from all City-owned facilities, Hamilton Water, Public Works Operations, Street and Traffic lighting, excluding City Housing Hamilton. Sites with partial year data are not included (e.g. Tim Horton's Field) . The fuel information reported includes all fleet, operations and transit vehicles but does not include Police, GO Transit or Darts. Fuel costs include those for diesel, unleaded gasoline and compressed natural gas (CNG).

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 for electricity and natural gas can be heavily impacted by weather and temperature. Increases or decreases in costs are reflected by the changes in consumption, and are further influenced by regulatory activity, market activity and cost of service. Therefore it is not unusual to see higher costs even when consumption is lower. The graphs below show the consumption in equivalent kilowatt-hours (ekWh), and costs for electricity and natural gas .

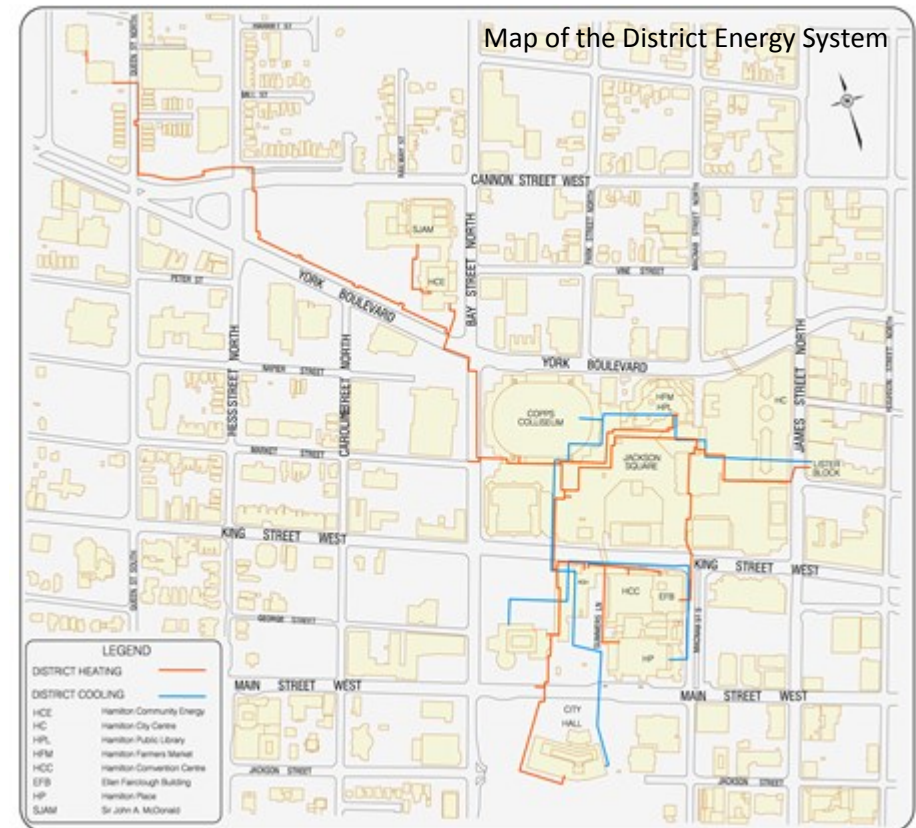


Energy Performance (Electricity and Natural Gas)

District Energy

Hamilton has a long standing history with district energy in the downtown core 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.

District Heating and electricity are supplied by HCE Energy Inc.



Energy Performance (Electricity and Natural Gas)



Energy Intensity for City-owned sites

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.

Energy Intensity

↓ 4%

From 2014 level

Energy Performance (Electricity and Natural Gas)

Energy Intensity	ekWh/sqft			2015 # of Sites	2015 vs 2005
	2005	2014	2015		
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%

The City reports on energy intensity values for City-owned sites. The table to the left shows a breakdown of the energy intensity levels per site category and comparisons to base year 2005 and last year.

Energy intensity is calculated by using the equivalent kilowatt-hours (ekWh) divided by the reported square footage (sqft) for the site. Sites that do not have recorded square footage may show as an n/a or zero value. For example, Street Lighting, Traffic Lighting, Other City Operations and Hamilton Water are groups not included in the energy intensity calculation. Those groups may have associated energy costs, but no reported square footage.



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. 2015 resulted in a reduction of 7% reduction from 2005 CAFE levels.

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%



Energy Procurement



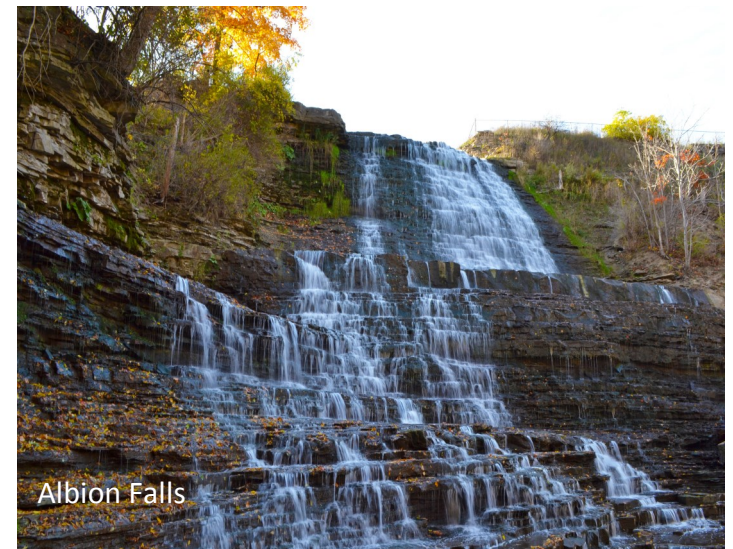
Strategic management of commodity procurement is a key factor in managing utility costs throughout the City. Governed by the policies within the Corporate Energy Policy, the purchase of natural gas, electricity and fuel for the City's facilities and fleet are completed in an informed and disciplined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

There are various methods the City uses to facilitate its procurement plan, including: hedging programs, which fix the price for commodities for forward terms; rate optimization programs which ensures that each account is on the correct rate for their size and consumption patterns; and consultant guidance which has City staff seeking advice from a variety of industry experts.

The City spent \$45 million on commodities last year (excludes Water), and the procurement plan helped to control those costs across departments.

\$45M

Spent on commodities (excl.
Water) in 2015



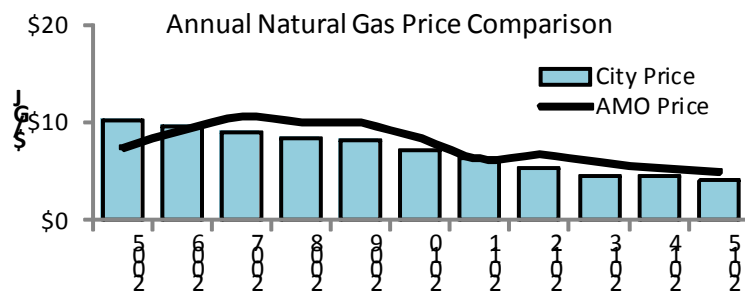
Albion Falls

Energy Procurement

Natural Gas

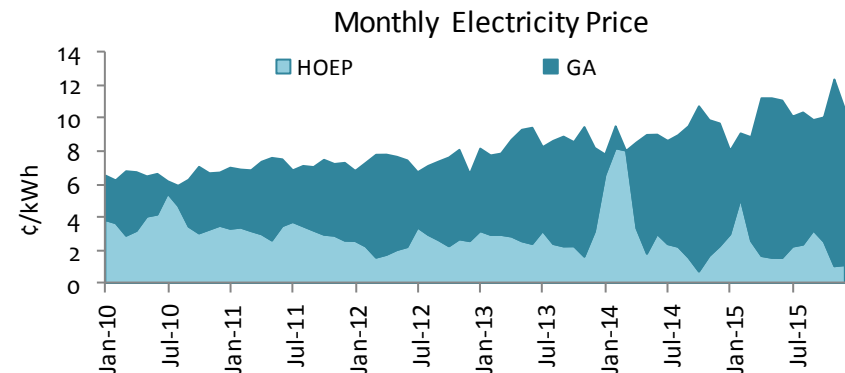
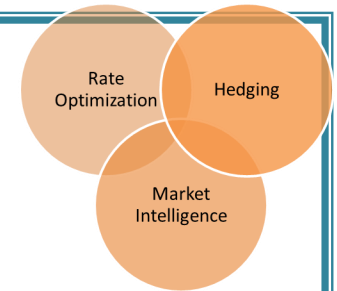
Typically, the City purchases approximately 70% to 80% of its natural gas supply requirements on a forward basis when market conditions are deemed favourable. Fixing the price on a portion of the City's natural gas volumes has allowed for improved budget predictability and protection against spot market fluctuations which is particularly important during periods of tight supply, such as extremely cold winters or unpredictable weather events. The 2015 price for natural gas commodity averaged \$4.25 per gigajoule (GJ) or (\$0.16/m³) including both hedged and unhedged volumes.

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).



Electricity

Ontario's cost of electricity (commodity) is comprised of the Hourly Ontario Electricity Price (HOEP) and the Global Adjustment (GA). The HOEP and GA move in conjunction with one another. When the HOEP is low, the GA increases in order to cover the costs of generation in the province.



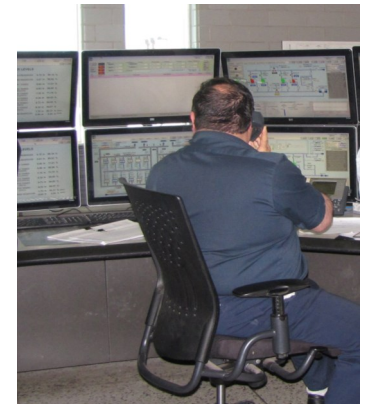
The above graph shows how the HOEP and GA make up the overall market price. The average price for electricity (HOEP + GA) in 2015 was \$0.101/kWh. Electricity prices in 2015 were extremely volatile, and that is likely to continue in 2016.

Energy Procurement

Electricity Peak Tracking

One of the best methods to control electricity costs is by rate optimization and consumption reduction. The City has had success with moving some large users from a general service Class B to Class A. 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. City Staff track forecasted provincial demand and pricing on a daily basis to communicate out to various departments when peak demand events are expected. By limiting consumption use during peak demand times, Class A consumers can reduce the costs on the GA rates during the following year. Even Class B customers can reduce costs during peak times.

By reducing consumption, overall costs (which are typically higher during high demand) can be reduced.



Public Works staff work together to reduce costs and consumption. OEI track the demand and price forecasts daily and communicate out to operators at Hamilton Water, who can take steps to shift operations to off peak times.



Pricing and Demand forecasts from Independent Electricity Service Operator (IESO) at: www.ieso.ca

Global Adjustment

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 are Class A sites. The rate class change resulted in avoided costs of \$3.9 million in 2015 in GA charges alone.

2015	GA Charges from HUC Invoice	Calculated GA (Posted)	Differential (Avoided Costs)
Total	\$4,020,207	\$7,931,504	-\$3,911,297

Energy Procurement

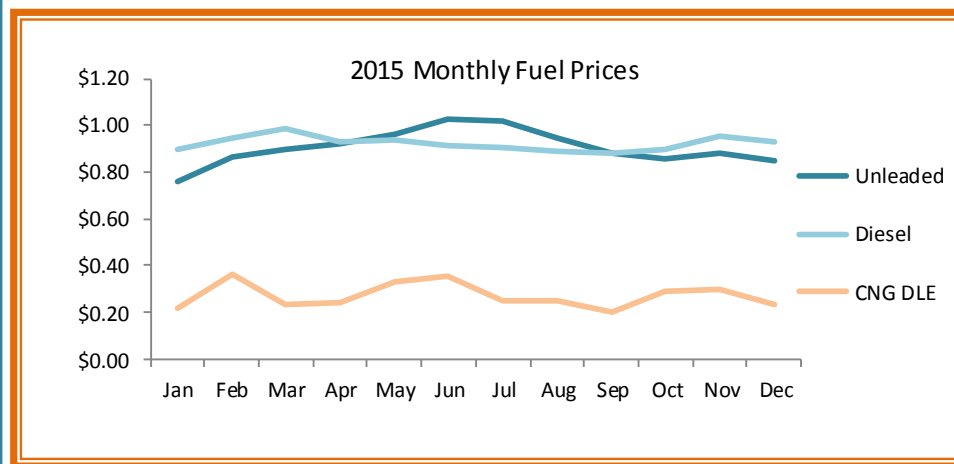
Fuel (Diesel, Gasoline and CNG)

The City of Hamilton purchases bulk fuel for its fleet of vehicles that include 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.

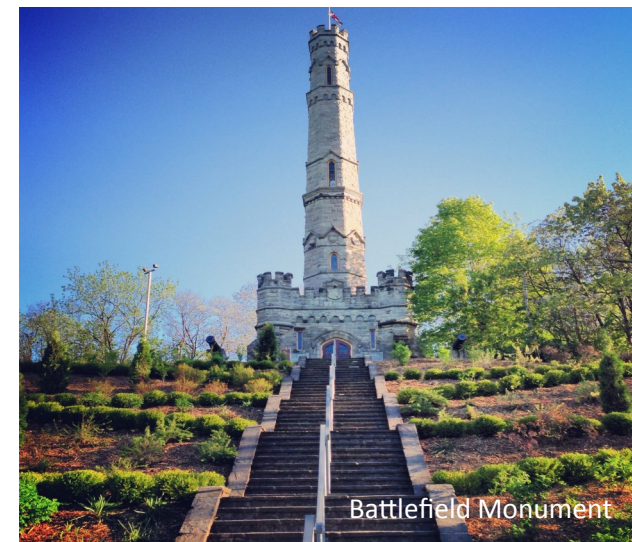
In an effort to control costs, the City purchases its fuel directly from large suppliers, and secures discounts through wholesale contracts.

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 cost of diesel.



*CNG DLE = Compressed Natural Gas Diesel Litre Equivalent



Battlefield Monument

Energy Procurement

Natural gas is purchased for the City's facilities, and the growing natural gas-fuelled fleet of 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 Hamilton Street Railway (HSR) 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.

The new CNG station at Mountain Transit
was commissioned in September 2015

Photo of Mayor Fred Eisenberger (L) and Steve Baker (President, Union Gas)
fueling one of the new natural gas buses in the Transit Fleet



Renewable Energy

Hamilton Renewable Power Inc. (HRPI)

The City is the sole shareholder of HRPI which owns and operates three 1.6 Megawatt (MW) renewable gas fueled generators. 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, with a cumulative total of \$13,873,000 for the period from 2006 to 2015. HRPI also contributes over 100,000 tonnes of carbon dioxide (CO₂) of annual emission reduction by producing electricity from renewable gas-fired units that would have otherwise been provided by the electricity grid.

Biogas Purification Unit (BPU)

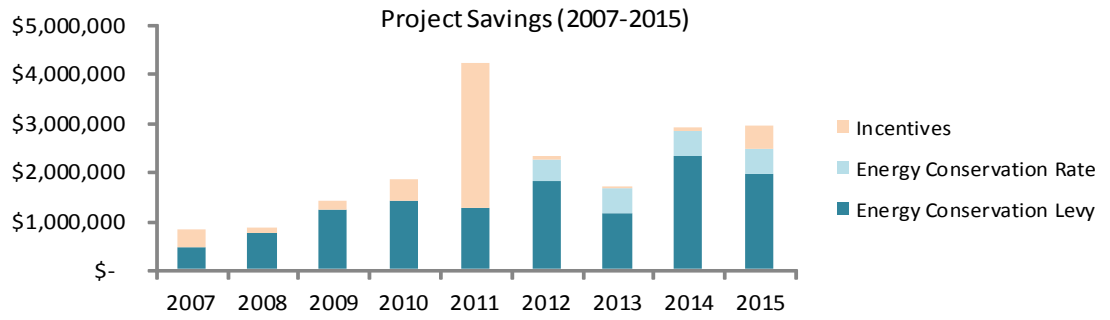
The BPU captures excess methane gas from the anaerobic digestion process of waste water. The raw gas is purified, treated and conditioned to yield utility grade natural gas that is injected into the Union Gas distribution system. In 2015, the BPU produced 15,631 GJs of natural gas and was valued at \$60,000. The Gas was used to heat City facilities and run CNG buses.

Solar Energy

Currently, there is a 250kW rooftop photovoltaic solar installation at the City-owned site at 330 Wentworth Street North. The City leases the roof space to Horizon Energy Services whom act as owner and operator of the solar installation. Additional installations at Harry Howell Arena and Morgan Firestone arenas await approval to be funded under the Feed-In-Tariff (FIT-version 4) program. Further assessment of ground mount solar installations is continuing for additional renewable energy potential.



Energy Conservation



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.

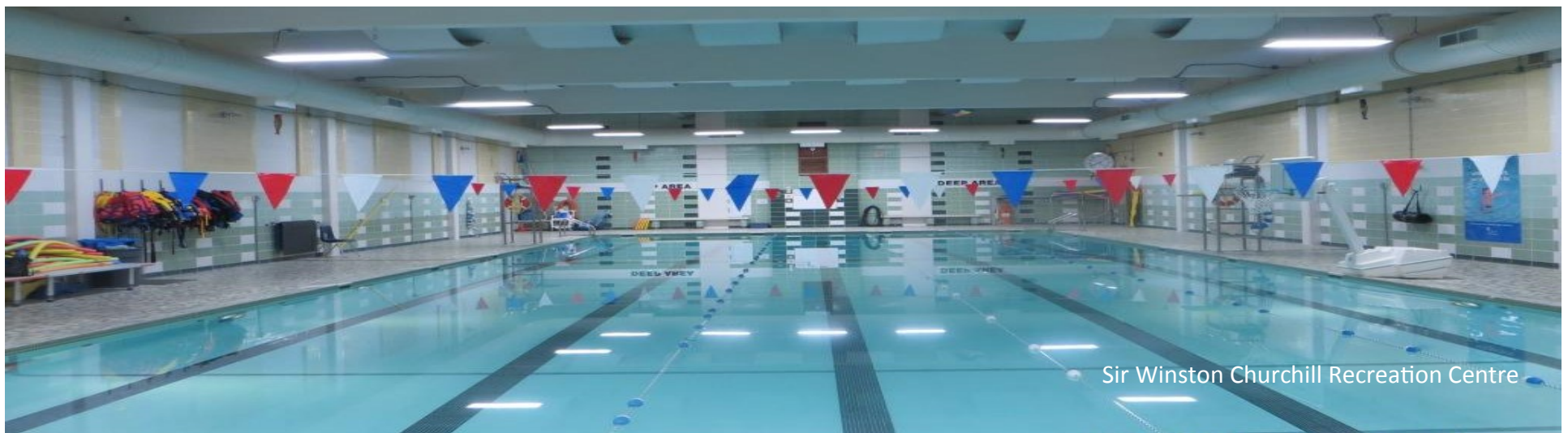


Energy Conservation—2015 Projects

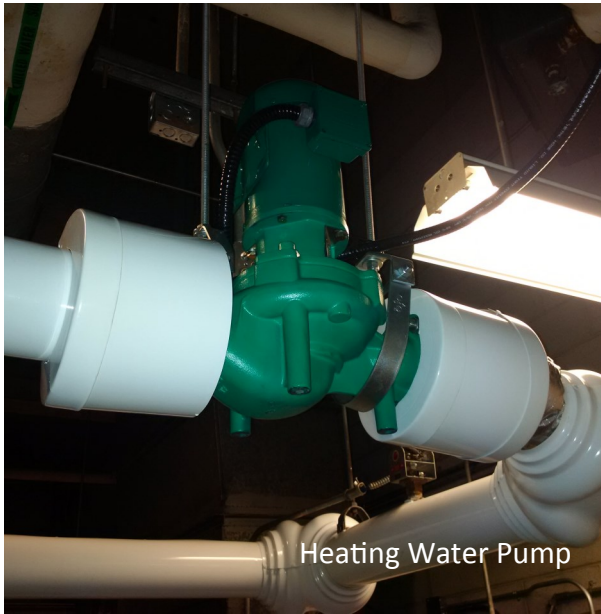


Aquatic Centres

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. Light Emitting Diode (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 from the IESO SaveONenergy Retrofit Program.



Energy Conservation—2015 Projects



Heating Water Pump

Hamilton Place and Hamilton Convention Center - Heating Recommissioning Project

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. 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 from the IESO SaveONenergy Retrofit Program.

Hamilton Convention Centre - LED Lighting Retrofit Project

The project involved replacing lighting systems with LED, including 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 from the IESO SaveONenergy Retrofit Program.



Hamilton Convention Centre

Energy Conservation—2015 Projects

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 High Pressure Sodium (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 from the IESO SaveONenergy Retrofit Program.



LED Street Lighting Replacements

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 HPS cobra head luminaires were replaced with high efficient LEDs. The estimated annual energy reduction is expected in the range of 10.5 million kilowatt-hours (kWh). As well, it qualified for \$3.4 million in incentives from the IESO SaveONenergy Retrofit Program.

Note: The incentive dollars will be reflected in the 2016 reporting year (year received).

Energy Conservation—Looking Forward

2016 Projects

Energy efficiency projects are always ongoing. Here is a look ahead to some Council-approved projects for 2016:

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



Environmental Reporting

Cumulative GHG Reductions from Energy Conservation Initiatives (Tonnes)



This is the resulting cumulative GHG reduction from energy efficiency projects undertaken at City-owned sites.

Green Energy Act Reporting

In addition to its internal reporting requirements, 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. According to the GEA's reporting formula, the City-owned corporate facilities are responsible for emitting 34,466 tonnes of Carbon Dioxide equivalent (CO₂e), which is comparable to having 7,255 cars on the road each day.

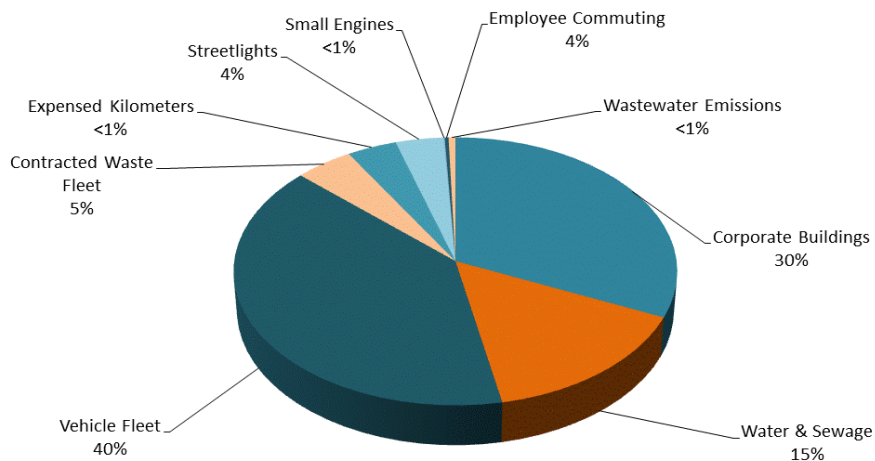
Environmental Reporting

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 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. New GHG emission targets have been established and aligned with the Corporate Energy Policy and the Board of Health Climate Change Actions 2012 report. 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. This represents a 22% reduction from the base reporting year of 2005 which had 126,567 tonnes CO₂e generated.

Corporate Emissions Inventory Summary 2014



GHG Emissions

↓ 22%

From 2005





Hamilton

Corporate Culture Pillars

Collective Ownership

Looks like:
We build relationships across departments/divisions to achieve our objectives and bring the ideas of others forward.

Sounds like:
We raise good ideas with ease and have an eagerness to discuss and generate new ideas.

Feels like:
Each and all of us understand how what we do affects the work of others and the results we achieve.

Steadfast Integrity

Looks like:
We are not afraid to take action when necessary.

Sounds like:
We are direct and truthful individuals working in a respectful manner.

Feels like:
We are trusted to perform.

Courageous Change

Looks like:
We support and discuss innovative ideas and actions to improve how we do what we do.

Sounds like:
We hear acceptance and willingness to proceed with new ideas.

Feels like:
We handle risk and uncertainty with ease.

Sensational Service

Looks like:
We take a citizen-centred approach to providing exceptional service in a timely and responsive manner.

Sounds like:
We communicate in an open and transparent manner, especially when mistakes inevitably occur.

Feels like:
We feel pride in being a public servant and serving the community.

Engaged Empowered Employees

Looks like:
We treat employees equitably in a climate where people are rewarded and recognized and want to do their best.

Sounds like:
We invite input from people regularly, spending more time with our teams and less time in meetings.

Feels like:
We feel motivated and go the extra mile.



Prepared By City of Hamilton, Public Works Department

2016