



2013-2015 Corporate Energy Management Activities City of London

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1 Corporate Energy Management – Update

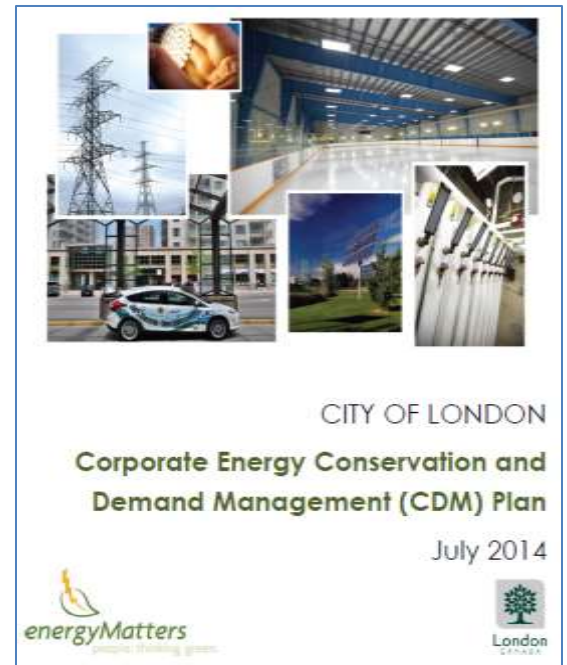
Energy management is a key component in managing facilities and infrastructure in today's economy. The City of London has been a leader in energy conservation and sustainable energy for more than 15 years and as part of its commitment to sustainable development, City of London has been actively involved in conservation projects in every operational area of the City.

In 2013, the City published "Past and Current Energy Management Activities" report which provides an overview of all the energy management measures undertaken by the City from the early 1990's until 2012. This report also illustrated City of London's position in energy conservation and sustainable energy, and created a benchmark that assisted in preparation of the City of London's Corporate Energy Conservation and Demand Management (CDM) Plan.

1.1 CDM Plan Update

The introduction of CDM Plan provided the City of London with an opportunity to review its energy program initiatives and proposed energy targets. The Plan was developed according to Ministry of Energy's direction to provide the City's annual energy consumption information to the public and set goals and actions for conserving energy and reduce GHG emissions from 2014 to 2020.

A series of past energy activities, programs, utility consumption and documents were analyzed to understand the City's standing in energy management and to set a CDM target. The approach was to set a target achievable by continuing to implement short term initiatives, adopt energy conservation resources into existing capital investments already assigned, explore incentive opportunities towards energy project initiatives and review long term initiatives that have significant impacts on energy consumption and GHG emissions.



The City of London's proposed CDM goal is to achieve a 10 percent reduction in overall annual energy use over the duration of the CDM Plan to the end of calendar year in 2020. The baseline year is 2014. Tied to this goal are:

- A projected total energy use reduction of 30 million ekWh by 2020.
- A projected 15 percent improvement (76 ekWh/person) in energy efficiency annually based on the projected population in 2020.
- A projected total GHG emission reduction of 3,900 tonnes annually by 2020.
- A projected energy cost avoidance of about \$4 million by 2020.

In order to achieve this goal of a 10 percent reduction by 2020, 35 technical and non-technical actions were prioritized to contribute to overall reductions. All actions were identified under four prescribed categories as follows:

- Tracking and Monitoring Measures
- Technical Measures
- Organizational Measures
- Behavioral Measures

Overall, the City of London's performance in 2015 is on track with the CDM goal. A complete update of all actions (complete or in progress) will be provided as part of a comprehensive 2017 CDM Update report (see 2015 Corporate Energy Consumption Report).

2 2013-2015 Energy Management Activities

The Corporation of City of London leads by example when it comes to sustainable energy investments and initiatives. London's future sustainability depends on the implementation of best practices in energy management today.

The purpose of the current report is to provide an update to the Past and Current Energy Management Activities report published in 2013. The current report summarizes a selection of the significant energy management projects and supporting initiatives completed in recent years which has resulted in efficient municipal building and infrastructure stock.

2.1 Funding and Incentive Sources

Incentives offered for energy conservation projects from Union Gas and London Hydro and the Federation of Canadian Municipalities have encouraged various City of London operations to undertake energy conservation projects. The incentive programs offer funding for controlling and reducing energy demand by replacing energy-wasting equipment, or to pursue new construction(s) that exceed provincial building codes and standards which in turn assist the City of London in achieving targets to reduce annual energy costs and associated greenhouse gas (GHG) emissions. Additionally, these incentives support in developing stronger business cases to help save money and energy. The table below shows the total amount of incentives received for projects undertaken from 2013 to 2015.

Organization	Total Incentives received between 2013 - 2015
Union Gas	\$206,000
London Hydro	\$530,000

2.2 Current Activities

Updates on Current Activities in this report are identified according to the six key focus areas of the City's Corporate Energy Management Program:

- Tracking & monitoring energy consumption
- Renewable energy and feasibility projects

- Leadership in Energy and Environmental Design (LEED) buildings and new energy efficient buildings
- Energy conservation and demand management projects
- Energy procurement
- Creating a corporate “Culture of Conservation”

3 Tracking & Monitoring Energy Consumption



Tracking energy usage is an important first step to understanding how an organization uses energy which is necessary before any efforts to reduce energy costs and usage can be made. The City of London realized the importance of energy tracking and procured EnergyCAP software for utility analysis in 2005. All the functions performed by EnergyCAP are listed in Past and Current activities report published in September 2013.

Since its procurement, EnergyCAP has been continuously updated to accommodate various reporting requirements. From 2013 over 400 utility consumption anomalies were detected via EnergyCAP and investigated. Some of these anomalies would have otherwise been noticed and/or expected due to known operational changes such as an arena or pool being shut-down for maintenance. However, the majority of the anomalies were identified only due to the automatic auditing that the EnergyCAP software provides.

The EnergyCAP developers are working on software updates that will enable it to automatically receive utility data made available in the ‘Green Button’ format.

The City of London paired with the City of Toronto and had EnergyCAP Canada develop a custom report to expedite the generation of the annual energy consumption reporting requirements for Ontario Regulation 397/11.

3.1 London Hydro

London Hydro continues to be an active partner in the City’s energy management efforts. They recently upgraded its online data access portal to make it more user friendly and powerful. Some of the improvements that have provided the City with immediate benefits are the ability to add delegates to accounts for set periods of time, the ability to add annotations onto metering charts and the ability to overlay local weather onto metering charts.

London Hydro is also an early adopter and implementer of the Green Button program in Canada. The Green Button program defines a particular data format and secure mechanism whereby the data can be accessed by third party applications for analysis, dashboard population, and other purposes with the data owner’s approval.



4 Renewable Energy Projects

In terms of an overall approach for supporting renewable energy, City staff continue to recommend making direct investment in renewable energy projects at municipal facilities rather than the procurement of “green energy” from energy retailers (e.g., purchase offset credits).

The following are updates to renewable energy projects since 2013.

4.1 Landfill Gas as a Potential Resource

The City's efforts to explore landfill gas utilization for power generation continued to be hampered by external factors. In 2014, the former Ontario Power Authority (OPA) did release its new Large Renewables Procurement competitive pricing process. This process entailed two steps, a Request for Qualifications (LRP1 RFQ) Process that would then be followed by a Request for Proposals (LRP1 RFP) from the pre-qualified applicants.



The LRP 1 RFQ qualification requirements process prohibited the City of London being a project proponent. Therefore, the City of London had to undertake its own Request for Qualifications process to select a project developer to which the City would sell rights for landfill gas utilization. Integrated Gas Recovery Systems (IGRS) was selected as our preferred developer. However, on November 4, 2014, the OPA published its list of Qualified Applicants from the LRP1 RFQ process, and it was noted that there were no Qualified Applicants in Ontario for landfill gas power plants identified by the LRP1 process. The OPA did not divulge information at that time as to why IGRS and Toromont – Ontario's leading landfill gas power plant developers – both failed to qualify for the LRP1 program.

Since that time, City staff have explored other options such as direct utilization in proposed agricultural greenhouses, other power generation options outside of the LRP1 process, and a renewed look at renewable natural gas.

In June 2016, Ontario released its new Climate Change Action Plan that has proposed a new renewable natural gas content requirement for the province's natural gas supply from sources such as landfills and municipal green bin collection. This provides new opportunities for the utilization of landfill gas from the W12A Landfill and the potential for utilization of biogas from a future organics management program in London.

In July 2016, in the lead up to the second round of Large Renewables Procurement (LRP2), the Independent Electricity System Operator (IESO) released new transmission capacity technical

information that now shows that the Wonderland Transformer Station no longer has capacity to support power generation above 500 kilowatts.

Given this information, City staff are re-examining that renewable natural gas as part of landfill gas utilization efforts. The landfill is capable of providing an estimated 8 million cubic metres per year of renewable natural gas. This is sufficient to heat about 3,600 homes in London, and represents 1.2 percent of London's entire annual natural gas demand.

4.2 Waste Heat Recovery from Sludge Incineration

Greenway Wastewater Treatment Plant (WWTP), the City's largest wastewater treatment plant, presents an opportunity to conserve energy by installing an Organic Rankine Cycle (ORC) engine to recover waste heat from its Fluidized Bed Combustor (FBC) unit. Greenway WWTP's FBC unit is used to incinerate cake sludge produced after wastewater treatment. Currently only a portion of energy generated and exhausted in this process is captured and used to pre-heat intake air to the FBC unit.



In April 2016, Greenway WWTP completed a preliminary study with a consultant, GHD Limited, to determine the feasibility of implementing energy recovery from the FBC unit. The GHD study concluded that energy recovery using an ORC power-generating engine is a viable option for the plant. The ORC system has two main components: The Turboden ORC unit and a thermal fluid heat exchanger. The low temperature heat can be transformed into electricity.

The results from the preliminary study have shown that the ORC engine has the potential to almost completely offset the

electricity requirements of the solids handling process unit at current solids handling rates. This would reduce the Greenway WWTP's annual electricity load by 26 percent and a 6 percent annual reduction in City corporate-wide electricity load. The ORC engine is expected to produce 6,043 megawatt-hours (MWh) annually running at 24 hours and 330 days per year. The study also showed a co-generation of 3.9 Million BTU of reusable heat from this system.

Energy recovery using the ORC unit also contributes to the City of London's Community Energy Action Plan which has "Making use of free heat and free light" & "Use of Renewable Energy" as key guiding principles. This project would also be eligible for \$1.2 million in incentives offered under the Industrial Accelerator Program (IAP) from London Hydro and the IESO.

The table below shows annual GHG emissions saved by using the electricity generated by the ORC system. There are two ways to quantify the GHG reduction benefits – using the Ontario grid-average emission factor and using the Ontario fossil-on-margin emissions factor. The first method assumed that the electricity savings are allocated evenly across all power generating sources such as nuclear, hydro, wind, and natural gas. The second method assumes that electricity savings are allocated to the natural gas power plants that operate on the margins of demand, ramping up and down in response to power demands. The GHG savings from this project typically contribute towards the second method (electricity generated by fossil fuels) as it directly reduces demand on the grid.

Estimation Method	Annual GHG emissions (tonnes)
Electricity GHG savings using the grid-average emissions factor	360
Electricity GHG savings using the fossil-on-margin emissions factor	3,400

Based on the economic and environmental benefits identified in the feasibility study, the City has decided to go ahead with implementation of the ORC system as a capital project for the Greenway WWTP plant. A report to Civic Works Committee and Council was submitted in July 2016. Next steps involve commencement of Preliminary Engineering Design in August 2016 followed by a Detailed Design in October 2016. The total timeline for the project implementation is estimated to be from fall 2016 to spring 2018.

4.3 Bioenergy

London Waste to Resource Innovation Centre

In February 2015, London Municipal Council approved a concept referred to as the London Waste to Resources Innovation Centre. The primary goal of the Centre is to create a location(s) in or near London for the ongoing examination of innovative solutions for waste reduction, resource recovery, energy recovery, and/or waste conversion.

In 2016, a number of small projects have been initiated under this banner, including significant discussion with Western University and a number of private companies. One Memorandum of Understanding (MoU) has been signed with Green Shields Energy for further examination of a waste conversion technology known as Gas Phase Reduction.

Canadian Biogas Association Preliminary Feasibility Study

Prior to the announcement of Ontario's Climate Change Action Plan, City staff started to work with the Canadian Biogas Association and Union Gas to research the potential for resource recovery from organic materials discarded by London residents by producing renewable natural gas that could be used in compressed natural gas (CNG) vehicles. It has been estimated that the cost to fuel a vehicle with RNG is on par with the current market price of diesel fuel, and this study will provide estimates specific for London. The Federation of Canadian Municipalities (FCM) provided funds to assist the City in this research.

The City of London undertook this work as part of its investigation of various options for the management of the organic portion of its residential waste. This work will provide the City with information on using residential organics to produce RNG including performance, costs, and GHG reductions. This includes options such as biogas from “green bin” source-separated organics and “whole bag” facility-separated organics, as well as landfill gas. This information will assist the City in evaluating and assessing options for London for managing residential organics, and the final report is expected by September 2016.

Given the proposed RNG measures outlined in the Ontario Climate Change Action Plan, it is more likely that incentives will be provided for RNG injection directly in to the pipeline rather than wheeling the gas for use in CNG vehicles.

4.4 Solar Roof Top Sections

Solar photovoltaic generating systems (PV systems) were to be mounted on the rooftops of City of London facilities' rooftops under the former OPA Feed-in Tariff (FIT) Program. The City of London participated as a system host through roof leases for the proposed rooftop PV system project applications submitted in the FIT 1.0 and FIT 2.1 program window to be undertaken by a joint venture between London Hydro and the London District Renewable Energy Cooperative, referred to as the London Renewable Energy Initiative (LREI). However, LREI was not successful in its application to the FIT program. Since that time, there has been no action undertaken to install rooftop solar PV systems.



However, new City buildings are being designed so that flat roof components of these buildings are “solar ready” for future installations, through design loads for both snow load and solar PV systems. The South Community Centre expansion area has been built with a “solar ready” roof substructure as will the South West Community Centre. The new East Community Center which is currently in the design phase will include solar readiness as well for appropriately sized flat roof sections.

4.5 Solar Trackers

In 2015, London Hydro installed three ground mounted solar tracking array units, with a total capacity of 30 kilowatts, at the Manning Drive Material Recovery Facility (MRF). City staff have established an environmental education area at the MRF, and London Hydro's solar trackers will be an asset to this area.



5 LEED Buildings and New Energy Efficient Buildings

The City of London makes use of the Canada Green Building Council's Leadership in Energy and Environmental Design (LEED) program to advance green building and sustainable community practices.

As part of its Corporate CDM plan strategy, the City continues to pursue LEED design principles, which are incorporated within the scope of all new City facilities and infrastructure upgrade projects. This does not mean that every single building will seek formal LEED certification, as the cost and effort for obtaining certification would not make sense for smaller projects.

5.1 Southeast Reservoir Pumping Station

The new Southeast Reservoir Pumping Station was designed to meet the LEED Silver certification standard in early 2013 and was registered with the Canada Green Building Council. However, before completion of this building, an updated LEED program was released that rendered the Southeast Reservoir site ineligible for certification. This building has been designed to consume at least 25 percent less energy than a similar building designed to the Building Code.



The energy efficient highlights of this building include:

- A green roof to reduce storm runoff,
- Lighting that doesn't contribute to light pollution,
- Water use reduction measures in plumbing fixtures for water,
- Use of building materials – certified woods, paints and carpets free of volatile organic compounds (VOCs),
- Public access to the site –walking trails, and
- The use of renewable materials made from agricultural products, and the use of regionally manufactured materials.

5.2 New East Community Centre

Facilities has taken up LEED initiative for construction of New East Community Centre. This building is currently in design phase and the goal is to complete this project with LEED Silver design standards.

6 Energy Conservation and Demand Management Projects

The City of London, as part of its Strategic Plan (Strategic Area of Focus - Building a Sustainable City), continues to explore energy management within every project. Energy conservation and demand management consists of corporate initiatives and projects that result in the reduction of energy consumption by proposing more efficient methods and technologies and/or technologies that shift power demand to off-peak periods.

The strengthening of our corporate energy management team has brought forward a number of conservation projects, and energy management staff also having the opportunity to weigh in and encourage energy-saving measures on upcoming designs and proposals throughout the Corporation has proven to be beneficial.

6.1 Roads and Transportation

6.1.1 LED Street Lights

With the successful pilot projects completed between 2010 and 2012 to evaluate LED street light effectiveness, the City of London has decided to expand its use all across the City. Results of the 2012 pilot project concluded that the installations of all fixtures appear to be operating as expected, with reduced maintenance and utility costs.



There are about 35,000 street lights in London. In an effort to convert all street lights to LEDs, the project scope was divided into three phases. In the first phase, completed between November 2015 and May 2016, 9,276 existing cobra style High Pressure Sodium (HPS) fixtures were converted to LEDs. All the major arterial road street lights of the City were covered in this phase. A total of

2,285,000 watts of HPS lighting were replaced with 997,000 watts of CREE LED fixtures for a 56 percent reduction in energy. The approximate cost avoidance to be expected in 2016 from this project is around \$690,000. This project was also accepted for incentive dollars of \$1.3 million from London Hydro.

Phase one will be closely followed by phase two street light replacement project, where all the remaining city streets with cobra style lights will be replaced with LEDs. Phase three of the project will be looking at secondary roads with non-cobra style fixtures for which a reliable LED technology is still under review.

6.2 Wastewater Treatment

The City of London operates six Wastewater Treatment Plants (WWTPs) and 36 pumping stations to assist wastewater flow to plants from gravity sewers or force mains. Wastewater Operations' primary focus is the treatment of incoming sewage to meet legislative requirements set out by the Ministry of Environment and Climate Change. As operating costs, energy demands and commodity costs continue to climb, the evaluation of operating efficiencies, energy conservation methods, and demand management projects and initiatives play a vital role in maintaining successful wastewater and treatment facilities.

Between 2013 and 2015, Wastewater Operations implemented a number of projects that fit within best practices of energy conservation and demand management initiatives. Some of these projects are identified in the next five sections:

6.2.1 Treatment Plants – Aeration Blower Upgrade

Blower power consumption represents the largest electrical energy consumption in the wastewater treatment process, sometimes up to 50 percent of total consumption. Older centrifugal blower installations throughout the city, while running effectively, are not as efficient as newer technology. The City replaced existing blowers at Adelaide WWTP (Section 2), Vauxhall WWTP (Sections 1 and 2) and Oxford WWTP (Section 2) with new turbo blowers.

Turbo blowers are typically 20-30 percent more efficient than standard centrifugal blowers, and utilize variable-frequency drive (VFD) control rather than throttling the pumps to better match actual process demands. Given the success of these installations, the City is currently pursuing the replacement of the Section 3 blowers at Greenway WWTP with new turbo blowers as well.

Implementing these measures at Adelaide, Vauxhall, Oxford and Greenway results in:

- 6,340 MWhs per annum in electrical consumption or \$760,800 in utility cost avoidance
- 6% towards the City of London's electricity reduction
- \$1.24 million incentive from London Hydro

6.2.2 Greenway – Sludge Dewatering System Modifications

In the secondary stage of water treatment at Greenway WWTP sludge is dewatered and pumped to the Fluidized Bed Combustor (FBC) unit for incineration. The sludge from the other five wastewater treatment plants across the city is hauled by tankers to Greenway WWTP for incineration. Historically the City's FBC has required a supplementary heat source (natural gas) in order to ensure full combustion of the dewatered solids fed from the Belt Filter Presses (BFPs) because of the water content in the dewatered cake. By replacing these BFPs with new centrifugal system in 2013, the City was able to achieve a drier cake, and the FBC was able to run autogenously (i.e., self-producing energy), with no gas required except for start-up. Total savings from the new centrifugal system include:

- 1.18 million cubic meters (m³) of natural gas savings per annum which equals to approximately \$240,000 per year of cost avoidance to the plant
- \$60,000 incentive received from Union Gas

6.2.3 Greenway – Slurry Heat Recovery

A by-product of the FBC process at Greenway WWTP is a hot slurry containing waste ash from the incinerator, plus water added following combustion. This hot slurry is piped to a separate area of the plant for dewatering. In 2014, in order to reduce electrical and gas consumption in the plant, a heat exchanger was added to the discharge line to allow for recovery of this previously wasted heat for use as a domestic heating supply for staff facilities around the Greenway plant. Total savings from this project:

- 300,000 m³ of natural gas savings per annum or \$60,000 in cost avoidance
- \$30,000 incentive received from Union Gas

6.2.4 Adelaide – Ventilation Optimization – Pilot Project

Various buildings at City's wastewater treatment plant require a minimum number of air exchanges for employee safety. However, during the winter months these air changes incur higher heating costs, due to the supply of cold fresh air from outside. In 2015, the heating, ventilation and air-conditioning (HVAC) system in the main inlet pumping station at Adelaide WWTP was upgraded to allow for a pre-heating of inlet air using the exhausted air. In addition, restrictions on air exchanges when unoccupied and when outside temperatures are low further reduced the energy consumption relating to building heating. Total savings from this project:



- 125,300 m³ of natural gas savings per annum or \$25,000 in cost avoidance
- \$12,500 incentive received from Union Gas

6.2.5 Adelaide – ZeeLung Technology – Pilot Project

After upgrading aeration blowers to newer efficient turbo blowers, Adelaide WWTP is looking to further improve its process efficiency by piloting ZeeLung Membrane Aerated Biofilm Reactor (MABR) technology. ZeeLung MABR is trademark of General Electrical (GE) Company. This process enables simple, low-energy nutrient removal in a smaller footprint.

ZeeLung membranes can be installed directly into existing bioreactor tanks, minimizing the impact on equipment hydraulics and operations. Oxygen is delivered at an efficiency four times greater than fine bubble aeration. The system increases biomass inventory by supplementing a suspended growth system with attached growth enabling nutrient removal. The nutrient removal along with increased capacity in existing bio-reactor volumes avoids the need to construct new bio-reactor tanks and this contains the process to smaller footprint.

Depending on the outcome of ZeeLung technology pilot project at Adelaide wastewater treatment plant and the lessons learned, this will be expanded across all the water treatment plants in the City.

6.3 Water Engineering and Operations

6.3.1 Elgin Middlesex Pumping Station (EMPS)

Currently, Water Engineering is undertaking upgrades at EMPS for the replacement of Pumps 4 and 5 with more efficient water pumps that are better sized for the new pumping requirements. This will result in substantial reductions of energy consumption at this site. The anticipated



replacement will change the two 600 horsepower (hp) pumps and motors with two 450 hp pumps and motors. Preliminary projections indicate an annual energy savings of 850,000kWh/year (over \$100,000/year). Further savings will be realized by operating these pumps at off peak times vs peak times. A custom retrofit application was submitted to the IESO for possible incentive funding in 2014 and an incentive amount of \$370,000 was approved.

6.3.2 Arva Pumping Station

In October 2013, the Arva Pumping Station undertook a process upgrade project to optimize its utility efficiency and meet the new pumping requirements for the plant. The impeller on one of the 700hp pumps at the Arva Pumping Station was trimmed from 23.8" to 20" to reduce power consumption and to better meet the new pumping needs. Total project savings are identified to be 1,125 MWhs per annum in electricity and the project has also been approved for \$18,000 in incentives by IESO.

6.4 Facilities (Design & Construction)

The Facilities Division is responsible for the design, construction, energy management/life cycle renewal works and maintenance of facilities operated by City of London with the exception of streetlighting, wastewater treatment and water supply operations. The City of London maintains and operates over 95 sites, 279 buildings, 750 acres (304 hectares) of property and approximately 3,400,000 square feet (315,870 square meters) of owned and leased space.

Facilities is often invited to manage capital development projects for municipal organizations such as London Fire Services, London Police Service, London Public Library and Museum London.

In Appendix A, a list of all 2013 to 2015 Facilities projects is included among all other projects that had an energy conservation component associated with them. The projects identified from 2013 to 2015 were not necessarily large stand-alone energy conservation projects, but rather contribute incrementally to the corporate energy conservation and demand management results.

The following are highlights of a number of recently completed projects by Facilities that contribute to energy conservation initiatives.

6.4.1 Centennial Hall Building Automation System

Historically, HVAC equipment at Centennial Hall was controlled by building occupants manually and manually adjusting the temperature set points on the pneumatic control system. As a result of the manual nature of the operation, equipment was turned on and set points were changed well in advance of an upcoming event leading to longer equipment runtimes than necessary. Being a large assembly facility, the systems are designed for high occupancy and are sized to handle the large occupancy loads. However, this creates unnecessary energy consumption.

Modern building automation solutions are sophisticated systems that allow for precise feedback based control and allow for reliable scheduling and deploy complex sequences of operation to the equipment under their control. A direct digital control building automation system has been installed at Centennial Hall to control the HVAC equipment. There are now particular occupancy level operating modes that are designed to suit the various event types that occur at the facility – including light occupancy for when it is staff only who are present preparing for or disassembling after a show. The equipment is operating for the minimum necessary time required to meet the desired indoor conditions in the lead-up to any one of the occupancy types, otherwise the systems are operated automatically only to maintain pre-determined set-back and set-up

temperatures. The use of the new building automation system also allows for remote monitoring of the facilities HVAC equipment for anomalies, set point adjustments, and trend logging.

This project uncovered a secondary energy measure that provided additional savings. Centennial Hall had designated smoking area that had dedicated exhaust that operated continuously for cigarette smoke removal. Rather than add these fans to the building automation system, the unneeded fans were removed from service. Due to this, their motor electricity draw was eliminated and the fresh air heating/cooling system for the building became more efficient.

6.4.2 Farquharson Arena Brine Pump Variable Speed Drive

Historically, the brine pump that moves the cooling fluid through the pipe network under the ice pad floors has operated continuously once the ice was installed each season. A significant water pressure flow issue relating to the operation of the brine pump was identified and three solutions were considered: change the physical pipe layout, install a soft star on the motor or install a variable speed drive to slowly start the motor.

The variable speed drive offered the best combination of benefits and was selected. Upon the installation of the variable speed drive, the pump operation was modified such that the pump operates to meet the demand of the ice pad and turns off if there is no call for cooling. This change has resulted in a correction of a maintenance issue while providing significant energy savings relative to the historical usage associated with the brine pump.

6.4.3 Canadian Games Aquatic Centre (CGAC)

The scope of the CGAC project began to form through the City's lifecycle renewal program based upon the combination of known maintenance needs, life expectancy of major systems, availability increasingly efficient replacement systems coming to market and the availability of incentives and third party funding sources associated with energy efficiency projects.

In 2012, the City commissioned its energy service partner, Ameresco Canada, to complete an Energy Reduction and Facility Renewal Study report. All the energy savings measures from the study were approved by Council in February 2013. Ameresco Canada was also approved to design and complete the CGAC project based on the measures identified in the study and timeline from inception to completion of the project went from April 2012 to November 2014. Some of the project highlights are listed the below:

- Replace existing metal halide fixtures near the pool area and high pressure sodium fixtures in parking lot area with new efficient LEDs
- Installation of VFDs on circulation pumps
- Replace existing makeup air unit with new efficient one
- Retrofit, expand and optimize the building automation system for increased efficiency
- Installation of a 53 kW co-generation unit
- Upgrade existing air handling units in Natatorium area



Pool area building with original lighting, acoustic treatment



Pool area building with new lighting, bulkheads, acoustic treatments

Incentive applications for all the energy projects executed at CGAC were approved by both London Hydro and Union Gas. Total incentive dollars of \$154,000 from London Hydro and \$35,000 from Union Gas are expected.

Implementing these energy measures resulted in:

- Total energy reduction at the facility 20%
- Peak energy demand reduction 5%

The analysis of the natural gas usage continues to be under observation, as usage reduction was based upon a baseline correction to account for the fact that the post project ventilation strategy was corrected to meet standards for natatoriums.

In addition to environmental and energy benefits, this project also resulted in socio-economic benefits to the city:

- Increased return on investment - In addition to high usage of this facility, returning users have noticed and reported air quality improvements and have commented on the water quality – including such comments from the national swim team on a post-project visit to the facility.
- Increased public education or awareness - The project provided an opportunity for the City to lead by example in areas such as facility lifecycle renewal activities and energy conservation and demand management activities. The recent renewal project is an example of components of the City's Strategic Plan in action.

The measures completed during this project would also contribute significantly in improving comfort for staff and patrons, reducing operating costs, and providing London residents with a reliable and highly efficient facility for another 20 years.



New Combined heat and Power System

The Facilities Division continues to develop lifecycle renewal project scopes based upon renewal needs and energy efficiency opportunities. The CGAC Project represented Phase IV of a multiphase series of energy projects that Ameresco Canada has completed for the City. There is currently a Phase V project underway that includes a series of smaller projects at various locations and scope is being developed for possible further phases of work. The City is also considering CHP systems at other facilities in its portfolio which have appropriate base loads and is investigating the feasibility of further new technologies such as biomass hot water heating and passive fresh air pre-conditioning.

6.4.3.1 Awards & Recognition

2016 Clean50 Top 15 Project

Canada's Clean50 Award series was initiated in 2011 by Delta Management Group. The award series' purpose is to bolster the many sustainability related activities in Canada by recognizing and connecting leaders in the field. After its renovations CGAC was awarded 2016 Clean50 Top 15 Project.

Media

The local newspaper, The London Free Press ran various articles in 2014 before the shutdown occurred for construction, which included quotations from affected swim clubs commenting in support of the planned renewal despite the disruption that the project would cause to their normal operation. The London Free Press, CTV London and Metro land media also ran stories after the project's completion which noted that a portion of the funding was from the Federal Gas Tax Fund. Rogers TV featured the CGAC in series titled "Inside London" which included a tour through the whole facility including the mechanical spaces.

Relevant Links

Rogers TV – [Inside London](#), CTV News London – [Post Project, Clean50](#)

6.4.4 High Efficiency Lighting

In past two years, the City of London continued to explore LED technology for parking lots and for municipally owned facilities. With the help of incentive dollars offered by London Hydro for efficient lighting technologies, these projects have proven to be cost effective projects with quick return of investments.

Arena facilities and corporate buildings owned and operated by the City of London continued to be subject to lighting retrofit projects with the new high efficiency LED lighting systems installed – replacing the existing, inefficient metal halide lighting. Between 2013 and 2015, the City has upgraded eight corporate buildings to LED to provide better and efficient lighting. Most of the office fixtures are fixed with motion sensors which contribute to added energy savings. The total energy savings resulted in 400 MWh per



year which is approximately \$50,000 per year in utility cost avoidance for the City.

In addition to achieving energy consumption savings, the City stands to benefit from a maintenance burden perspective due to the reliability and longevity and comparatively long warranty period associated with LED light fixtures. The City continues to develop business cases for high efficiency interior lighting and lighting controls in various municipal facilities and include lighting measures that comply with the saveONenergy incentive program for additional grants and funding. All the

lighting upgrades completed in the past two years are shown in Appendix A.

The continued quick payback and return on investment associated with lighting retrofit projects proves their effectiveness as energy conservation projects. The City of London continues to review capital assets to identify opportunities where lighting upgrades can be completed which will make the building inventory more efficient operationally.

6.5 Fleet Services

6.5.1 Green Fleet Initiatives

The City's Fleet Services Division is responsible for over \$49 million in municipal fleet and equipment assets. Services include vehicle and equipment purchases and disposals, maintenance and service, asset management/administration and fuel management including refuelling stations. Fleet Services' vehicles and equipment support over 30 City of London service areas including Water, Sewer, Wastewater, Transportation, Solid Waste and Parks & Recreation. Fleet Services also provides various services to agencies, boards, and commissions including London Public Library, Tourism London, Fire and Police. The City equipment and fleet consists of over 1,300 units ranging from hand held equipment like string trimmers, to light passenger vehicles, to heavy off-road equipment like graders and backhoes. City of London services are a large consumer of fuel, and Fleet Services continues to research technology that helps end users reduce both energy consumption and their environmental impacts.



Fleet Services strives to help their end users understand and implement fuel savings opportunities and how to reduce their environmental impacts. Fleet Analysts electronically track and report fuel use in vehicles and equipment through an automated system called Petrovend. Additionally, they continue to invest in telematics systems that closely monitor usage patterns (utilization), idling, driver performance (speeding, rapid starts, harsh cornering) and route optimization (trip maps, Global Positioning System (GPS)).

The "Green Fleet" initiatives currently underway include:

- Continued use and replacement of gas-electric hybrid vehicles where model types are available and add value
- Move away from hybrid vehicles if suitable high-efficiency right-sized solutions provide better value without significant additional environmental impact.
- Replacement of full-size work vans with more-efficient Ford Transit vans and in some cases downsized even further to high efficiency Ford Transit Connects.
- Continue to expand cab heating technology, where effective, to reduce the idle time necessary for warm up, engine controls and cab heat in the winter months.
- All gasoline used is ethanol blended to E10 (10% ethanol content).

- 35 medium and heavy units now include DEF (diesel exhaust fluid) selective catalytic reduction systems.
- 50+ units GPS AVL systems installed with plans for an additional 50 units by year end.

Today, the current City of London “Green Fleet” Roster consists of:

City of London “Green Fleet” Roster Vehicles / Equipment Type	Number of units in service
Hybrid SUVs	20
Hybrid Cars – C-Max	8
Full Electric Vehicle (EV)	1
Selective Catalytic Reduction (SCR) Systems using Diesel Exhaust Fluid (DEF)	30
Vehicles using Ethanol blended Gasoline	221
Units using B5 biodiesel blend	50
Total Green Fleet (in rolling stock)	330 (55% of 600 rolling stock)

6.5.2 Electric Vehicle Charging Stations

In March 2013, the Charging London pilot project was launched. City of London partnered as a host with London Hydro for this pilot project. As part of this pilot project three EV charging stations were installed in three publicly-accessible parking lots in the City of London:

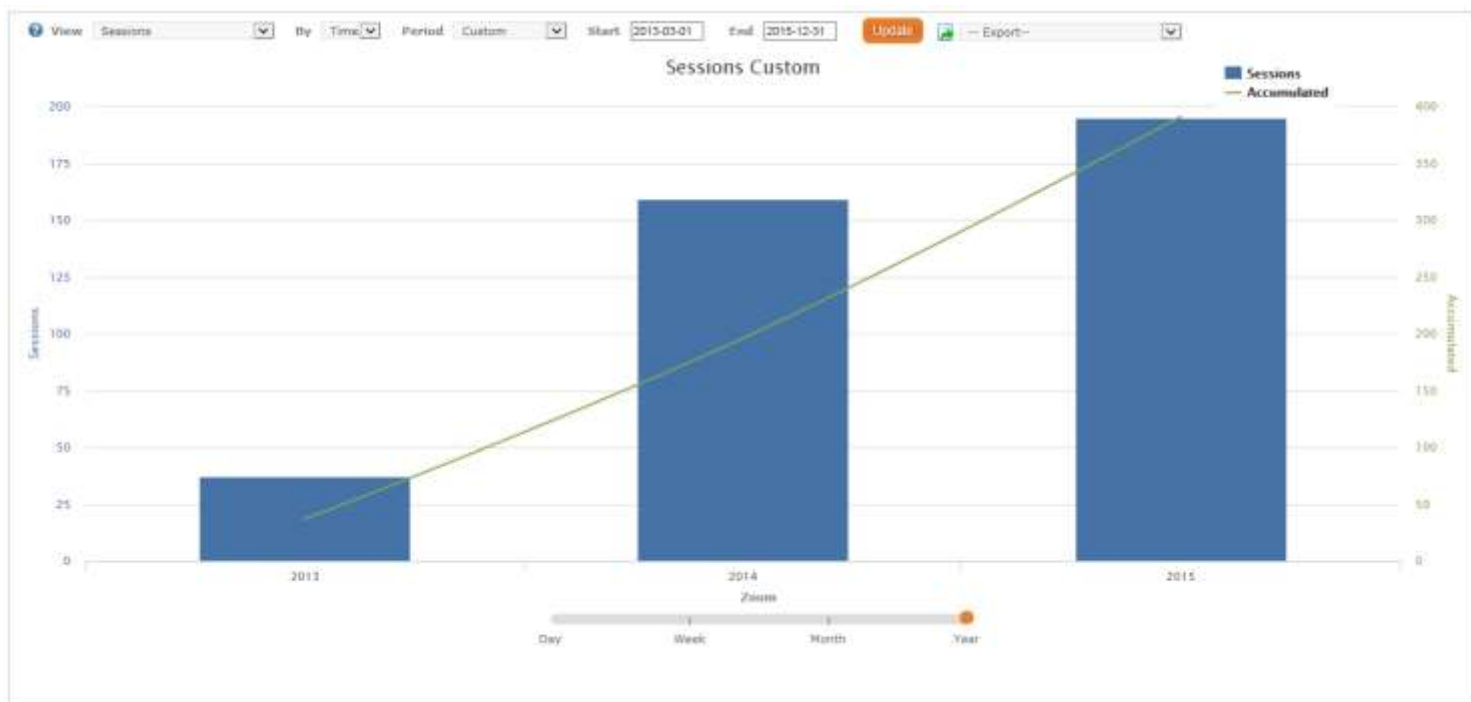
- The City Hall Lower Level Parking garage provides Level 1 charging for the City of London’s Ford Focus EV fleet EV as well as a Level 2 charging port for the public. The ChargePoint EV Charging Station was selected for trial in this parking lot due to its ability to provide this dual service.
- Budweiser Gardens was selected as the trial for the Sun Country Highway EV Charging Station. This lot serves the public attending Budweiser Gardens during entertainment and sports venues and hourly parking for visitors to downtown local businesses.
- The Covent Garden Market Parking Garage was selected to trial the General Electric EV charging station in this parking lot due to its availability to the public and proximity to popular destinations.



Since that time, Covent Garden Market requested in 2014 that their charging station be removed and replaced with a Community CarShare location due to low demand at that time.

There are no statistics for the Budweiser Gardens charging station, but anecdotal evidence indicates that this location is popular. However, during major events, this location does tend to get gas-powered vehicles looking for a parking spot.

The ChargePoint EV Charging Station at City Hall does provide statistics on utilization, and these statistics have shown an increase in the number of charging session's year-over-year. From its installation in 2013 the utilization rate has increased by 80 percent in 2014 compared to 2013 and 20 percent in 2015 compared to 2014.



Number of Charging Station Sessions Per Year at City hall

Upon completion of the Canada Games Aquatic Centre (CGAC) lifecycle Renewal and Energy Efficiency project, and due to the energy emphasis of the project, local distribution company, London Hydro, expressed interest in installing a combined electric vehicle charging station with battery storage in the facility's parking lot. The City and London Hydro entered into an occupancy agreement and when installed the unit and battery storage was to be used for public awareness and education. However, as of late July 2016 London Hydro advised that the Ministry of Energy is in the process of terminating the project as the charging station design being changed by the manufacturer which resulted in cost increase for the units on a scale that was not acceptable to the program participants.

City of London continues to work with London Hydro in identifying new programs to encourage and support the use of Electrical Vehicles.

7 Energy Procurement

The City of London uses energy procurement strategies in an effort to mitigate the cost of energy. Since 2005, summaries of our accounts indicate that our electrical procurement strategy has helped to avoid over \$6.5 million in accumulated electricity costs versus the use of the Provincial Government's Regulated Price Plan (RPP).

In the late 2000s, the significance of the amount of avoided costs obtained by the City of London as measured against the RPP resulted in many other Ontario municipalities joining with London's energy procurement advisor (Wattsworth Analysis Inc.) and creating a larger buying pool of municipalities. Also of interest is that Local Authority Services (LAS), operated under the Association of Municipalities of Ontario (AMO), began operating a comparable program for generally smaller municipalities based, in part, on the success of the program that London had enlisted back in 2005.

However, in past couple of years, part of the rate class shifting based cost avoidance realized by the City of London could no longer be credited to the existing procurement strategy as Streetlighting was reclassified into its own rate class by the Ontario Energy Board (OEB). This made Streetlighting costs mirror those which were credit to the previously enacted strategy of shifting Streetlighting to spot market prices and away from RPP tiered pricing structure. Also the new market rule changes mandated that all large use accounts consuming greater than 250 MWh's per year be automatically billed via spot market pricing whereas they may have previously fell under RPP tiered price structure.

Applying the most economical rate class allowable to the City's varied electrical accounts is one of the near term strategies on increasing and maintaining cost efficiencies in electricity procurement and will be a focus of upcoming discussions and market assessments.

In addition to procurement strategies, Wattsworth provides projections in commodity price forecasts for electricity and natural gas. This assists the City of London to project long term budgetary considerations in preparation for budget projections. Currently, projections indicate rate change increases for the next five years for electricity and natural gas contracts. These projections in market forecasts give the City of London the opportunity to prepare for increased operating costs and to develop additional measures to mitigate some of these financial impacts.

Annual Commodity Price Adjustments			
Year	Electricity	Nat Gas	% Hedged (based on consistent quantity of 411GJ's/day)
2016			72.5%
2017	6.8%	5.8%	68.9%
2018	6.7%	9.0%	51.1%
2019	6.7%	10.6%	42.6%
2020	6.6%	20.7%	0.0%

8 Culture of Conservation

Engaging City of London staff and stakeholders in energy conservation initiatives is a challenging, rewarding and proven method of achieving conservation targets. With energy costs on the rise, Londoners expect their government to lead the way.



In the past, there have been many programs that the City of London participated in to focus on energy conservation. The City of London developed a corporate energy program to embrace a culture of conservation called **energyMatters, people. thinking. green.** In 2013, the *energyMatters* program was updated to improve staff engagement in conserving energy with energy saving tips and overviews on what roles employees can take to save energy. The program was accepted and promoted.

The following activities were undertaken to develop the updated plan and represent actions for the Culture of Conservation programs between 2013 and 2014:

- Solicit input from employees to assist in the re-development of the program.
- Development of motivational themes, messages and slogans.
- Obtain upper management support for the program.

This program was launched in various city facilities including office spaces, operation centres and WWTP's between 2013 and 2015. Some of the simple and "quick win" deliverable actions that City of London employees have taken part to provide assistance in a broader education and awareness approach to conservation included:

Motion Sensor Power Bar Pilot Project – The Pilot project included purchase of energy-efficient motion sensor power bars in bulk and exchange internally to city employees for old inefficient bar users. This was a simple approach to those who forgot to turn off their desktops.



Space Heater Pilot Project

– The project focused on replacement of personal portable space heater units with more efficient technology by introducing radiant heat pads or motion sensor space heaters as opposed to traditional space heaters. To recognize participation of the motion sensor space heater pilot project, a "green certified" participation placard was issued to the employee to post at their workstation.

City of London Arenas Energy Challenge – Parks and Recreation have developed an energy challenge to raise the awareness of saving energy in City of London Arenas. The challenge encouraged staff at each Arena to try and save energy, while staying within operational guidelines. The *energyMatters* campaign was used to assist Parks and Recreation in this challenge to promote encourage and look for additional opportunities to expand this energy challenge to other key areas within Corporation.

Arena Challenge Results:

The City of London won a 2014 Community Conservation Award which was presented by the IESO (former Ontario Power Authority) and the Association of Municipalities of Ontario (AMO) at the AMO's Annual General Meeting. The award was for the Arena Energy Challenge which saw the staff responsible for the various arena's competing with each other to save the most energy over the previous year's usage. Parks and Recreation Management staff created an incentive as part of the competition which was awarded to the winning team.

<http://www.powerauthority.on.ca/opa-conservation/community-conservation-awards>

The *energyMatters* program was successfully launched and expanded across many City facilities, however, this program was stalled in 2015 due to fewer available resources. With full complement by mid-2016, City of London is planning to re-launch an updated version of “*Culture of Conservation*” program to inspire employee behavior that reduces corporate energy consumption that aids in meeting City's CDM plan target, increase employee awareness of corporate conservation activities and strengthen employee commitment to energy conservation.

9 Agencies Boards and Commissions

Many Boards and Commissions have also undertaken sustainable energy initiatives; however, this report outlines only City of London activities.

The City of London will continue with the process of updating Corporate Energy Conservation and Demand Management Plan in coming years to meet the regulations set out by the Green Energy Act and Ontario Regulation 397/11.

Overall, the City of London is on track with its commitments on energy initiatives stated in the CDM Plan. The Corporation continues to search for innovative and collective ways to reduce its greenhouse gas emissions.

10 Appendix A

2013 – 2015 Energy Conservation Projects

Location	Project Title	Estimated / Actual Electricity Savings (MWh)	Anticipated Completion Date	Completion Date
Convention Centre	Parking Garage Lights to LED	228 MWh	31/08/2013	31/08/2013
London Museum	T12 Lighting Retrofit - Museum LDN	25 MWh	20/12/2013	20/12/2013
AJ Tylor building	Replace old gas fired RTU with new custom RTU.	6 MWh	07/06/2013	19/06/2013
Arva Pumping Station	Trim and balance the existing impeller on a 700HP pump to more closely match the required flow rate.	375 MWh	09/30/2013	09/30/2013
Farquharson Arena	Re-clad double pad arena with insulated panels.	2 MWh	01/10/2013	30/01/2014
Centennial Hall	Replace the existing inefficient RTU with a new energy efficient RTU.	3 MWh	31/01/2014	
Argyle Arena	Unheated water, mechanically treated to remove dissolved air used for flooding.	26 MWh	07/02/2014	20/01/2014
Carling Arena	Cold Water Flood	32 MWh	07/02/2014	20/01/2014
Firehalls	Implement a preventative maintenance program at the municipality's fire halls.	136 MWh	01/06/2014	27/06/2014
City Hall	Implement a preventative maintenance program at the municipality's fire halls.	203 MWh	01/06/2014	27/06/2014
City Hall	Culture of Conservation implementation	107 MWh	01/07/2014	09/05/2014
CGM 130 King Street	Medium Bay Lights replacement with LEDs	243 MWh	30/05/2014	12/08/2014
City Hall	Lobby Retrofit	28 MWh	30/05/2014	29/08/2014
W12A Landfill	T12 Retrofit	1 MWh	06/06/2014	27/06/2014
Junior Achievement	Lighting Retrofit	7 MWh	30/04/2014	15/06/2014
Centennial Hall	LED Exterior/Pots	7 MWh	31/01/2014	31/01/2014
Carling Arena	Interior/Exterior Lighting	54 MWh	22/10/2013	22/10/2013
Stronach Arena	Interior Lighting Retrofit	2 MWh	23/05/2013	23/05/2013
Southdale Road	LED Roadway Lighting	40 MWh	17/12/2013	17/12/2013
Richmond Street	LED Roadway Lighting	3 MWh	10/01/2014	10/01/2014
Royal York Road	LED Roadway Lighting	27 MWh	12/12/2013	12/12/2013
Labatt Park	Interior Lighting Retrofit	5 MWh	31/05/2014	9/7/2014

AJT	Lighting	47 MWh	30/06/2016	
Centennial Hall	Building Automation	25 MWh	31/12/2015	
South London	Community Pool Lights	21 MWh	30/06/2016	
Carling Heights	CC Pool Lights	20 MWh	30/06/2016	
AJT	2nd Floor Office Lighting	23 MWh	30/06/2014	
EMPS	Replace the two existing 600HP pumps with two new 450HP pumps which will meet the revised operational needs of the water system.	850 MWh	31/12/2016	
Lambeth Arena & CC	Lighting retrofit to LED	20 MWh	30/06/2013	
652 Elizabeth Street	T12 Lighting Retrofit - T Block	18 MWh	31/12/2014	
Vauxhall WWTP	Aeration Upgrades	1,190 MWh	31/07/2014	19/01/2015
Oxford WWTP	Aeration Upgrades	MWh	29/08/2014	
Adelaide WWTP	Aeration Upgrades	819 MWh	26/09/3014	23/01/2015
Arva Pumping Station	Optimize the utility and efficiency of the 700HP pumps in the station by completing a combination of impeller trimmings and impeller replacements.	1,125 MWh	31/12/2016	
CGAC	Make up Air upgrade	30 MWh	31/10/2014	31/10/2014
CGAC	Spectator RTU	6 MWh	31/10/2014	31/10/2014
CGAC	Admin/Office RTU	2 MWh	31/10/2014	31/10/2014
CGAC	Building Automation System	10 MWh	31/10/2014	31/10/2015
CGAC	Pool Lighting	363 MWh	31/10/2014	07/10/2014
CGAC	Pump VFDs	115 MWh	31/10/2014	07/10/2014
CGAC	Parking Lot Lights	21 MWh	31/10/2014	31/10/2015
CGAC	Natatorium AHUs	MWh	31/10/2014	31/10/2015
AJ Tylor	Culture of Conservation	89 MWh	30/06/2015	01/5/2015

AOC	Culture of Conservation	38 MWh	30/06/2015	01/5/2015
404 Exeter Road	Culture of Conservation - EROC	64 MWh	30/06/2015	01/5/2015
Cafeteria	Lighting Retrofit	19 MWh	08/08/2014	08/08/2014
130 King Street	Rooftop Unit Replacement	2 MWh	30/06/2014	30/06/2014
2115 River Road	Lighting Retrofit	5 MWh	22/08/2014	
Stronach Gym	Lighting Retrofit	36 MWh	26/12/2014	02/04/2015
663 Bathurst Street	Victoria Park Christmas Lights	151 MWh	15/12/2014	18/02/2015
481 Ridout Street	Eldon House Lighting Upgrade	9 MWh	30/10/2014	
Wilton Grove Yard	Salt Storage Lighting	3 MWh	30/10/2014	30/10/2014
Centennial Hall	Pot Lights	13 MWh	31/10/2014	
Centennial Hall	Interior Lighting Upgrades	20 MWh	02/20/2014	13/03/2015
AJT	Direct Install Lighting Program	127 MWh	31/12/2014	31/12/2014
CGAC	Cogeneration project	465 MWh	17/06/2015	
Centennial Hall	Exhaust Air Correction	44 MWh	31/03/2015	31/03/2015
710 Southdale Road East	Replace existing dryers with new efficient dryers	4 MWh	18/12/2013	18/12/2013
799 Homeview Road - Arena	Desiccant Dehumidification	86 MWh	30/06/2016	
799 Homeview Road- Arena	Exterior Lighting Upgrades	41 MWh	31/12/2015	31/12/2015
AJT	Garage - high bay lighting	32 MWh	30/06/2016	
AJT	Exterior Lighting Upgrades	49 MWh	31/12/2015	
AJT	HVAC upgrades	4 MWh	30/06/2016	
825 Valetta Street	Exterior Lighting Upgrades	9 MWh	30/06/2016	31/12/2015
825 Valetta Street- Arena	Arena Desiccant Dehumidification	17 MWh	30/06/2016	
656 Elizabeth Street	General Lighting Upgrades	2 MWh	26/02/2016	
656 Elizabeth Street	Exterior Lighting Upgrades	18 MWh	11/12/2015	31/12/2015
400 Horton Street	Exterior Lighting Upgrades	11 MWh	22/12/2015	31/12/2015
411 Tecumseh Avenue East	Exterior Lighting Upgrades	8 MWh	11/12/2015	31/12/2015
130 King Street	Rooftop Unit Replacement	5 MWh	04/05/2015	29/05/2015
Dearness Home	Pot Light Retrofit Phase I	65 MWh	16/07/2015	31/08/2015
1153 Adelaide Street North	Exterior Lighting Upgrades	8 MWh	20/04/2015	27/04/2015
300 Dufferin Avenue	Phase 1 of the LED Streetlight Upgrade Program	5,669 MWh	10/08/2015	
7112 Beattie Street	Interior Lighting Upgrades	6 MWh	30/06/2016	
7112 Beattie Street	Exterior Lighting Upgrades	26 MWh	31/12/2015	31/12/2015

1345 Cheapside Street	Replace 4 pad mounted HVAC units	4 MWh	31/12/2015	
411 Tecumseh Avenue East	On-demand Glycol pump control via soft start VFD	202 MWh	31/10/2015	15/10/2015
1045 Wonderland Road North	General Lighting Upgrades	14 MWh	04/09/2015	11/09/2015
78 Riverside Drive	General Lighting Upgrades	9 MWh	15/01/2016	22/01/2016
300 Dufferin Avenue	Executive Parking Garage Lighting	29 MWh	22/09/2015	22/09/2015
Greenway WWTP	Replace the existing aeration blowers with new energy efficient turbo blowers at the pollution control plant.	4,334 MWh	01/03/2017	

11 Appendix B

Incentive Funding Chart

Organization	Program	Year	Funding Amount	Comments	Status
		2013			
London Hydro	Retrofit Program	2013	\$795	POA - Parking Lot Light Upgrades	Received
London Hydro	Retrofit Program	2013	\$3,675	Carling	Received
London Hydro	Retrofit Program	2013	\$21		Received
London Hydro	Retrofit Program	2013	\$5,187	Argyle Arena RTUs	Received
London Hydro	Retrofit Program	2013	\$620	Fire Hall # 12 - Parking Lot Light Upgrades	Received
London Hydro	Retrofit Program	2013	\$516	Lambeth Arena - Lighting Upgrades	Received
London Hydro	Retrofit Program	2013	\$20,137	Arena Lighting Upgrades	Received
London Hydro	Retrofit Program	2013	\$403	Stronach Arena Lighting	Received
London Hydro	Retrofit Program	2013	\$1,037	Medway Arena Lighting	Received
London Hydro	Retrofit Program	2013	\$1,946	Tourism London Lighting	Received
London Hydro	Retrofit Program	2013	\$956	Centennial House - Lighting Upgrades	Received
London Hydro	Retrofit Program	2013	\$3,255	Centennial Hall - Lighting Upgrades	Complete
London Hydro	Retrofit Program	2013	\$3,221	Kinsmen Arena -RTU	Complete
London Hydro	Retrofit Program	2013	\$1,680	East Lions - Lighting Upgrades	Complete
Union Gas	Enersmart - prescriptive Retrofit	2013	\$300	Fire Station # 6 - Infrared Heaters	Received
London Hydro	Retrofit Program	2013	\$699	Fire Station #2	Received
London Hydro	Retrofit Program	2013	\$3,676	Unknown	Received
Union Gas	Enersmart - prescriptive	2013	\$800	AJ Tyler Operations - WaS Bldg Boilers & ERV	Received
Union Gas	Enersmart - prescriptive	2013	\$6,400	Westminster Pool Boiler	Received
Union Gas	Enersmart - prescriptive	2013	\$300	Carling Arena Infrared Heaters	Received
London Hydro	PSUI Program	2013	\$2,543	EEM Program - CEM Course	Received
London Hydro	PSUI Program	2013	\$18,742	EEM Program - FTE Burden Recovery	Received

London Hydro	PSUI Program	2013	\$39,934	EEM Program - FTE Burden Recovery	Received
London Hydro	PSUI Program	2013	\$20,743	EEM Program - FTE Burden Recovery	Received
enernoc	Demand Response	2013	\$2,204	Earl Nichols Arena	Received
enernoc	Demand Response	2013	\$2,204	Earl Nichols Arena	Received
enernoc	Demand Response	2013	\$2,204	Earl Nichols Arena	Received
enernoc	Demand Response	2013	\$1,469	Earl Nichols Arena 12/2/2013	Received
Union Gas	Enersmart - prescriptive Retrofit Program	2013	\$900	Vauxhall PCP Energy Audit - Covent Garden Market	Application
London Hydro	Retrofit Program	2013	\$9,888	Convention Centre Parking Garage	Received
London Hydro	Retrofit Program	2013	\$12,897	Boathouse - Lighting Upgrades	Received
London Hydro	Retrofit Program	2013	\$920	Boathouse - Lighting Upgrades	In Process
			\$169,349	Total Received	Received
			\$920	Total in Process	In Process
			\$170,269	Total for 2013	Total
		2014			
London Hydro	Retrofit Program	2014	\$6,571	Museum London T12 Lighting Retrofit	Received
enernoc	Demand Response	2014	\$2,204	Earl Nichols Arena Oct/Nov/Dec 2013	Received
London Hydro	PSUI Program	2014	\$19,833	EEM Program - FTE Burden Recovery Y2/Q1	Received
Union Gas	Enersmart - Custom	2014	\$60,000	Greenway PCP - Sludge Dewatering Project	Received
London Hydro	PSUI Program	2014	\$43,688	EEM Program - FTE Burden Recovery Y2/Q2	Received
enernoc	Demand Response	2014	\$2,204	Earl Nichols Arena Jan/Feb/Mar 2014	Received
London Hydro	Retrofit Program	2014	\$2,266	Southdale LED Streetlight Upgrades	Received
London Hydro	Retrofit Program	2014	\$1,497	Royal York and Oxford LED Streetlight Upgrades	Received
London Hydro	Retrofit Program	2014	\$184	West Brough LED Lights	Received
enernoc	Demand Response	2014	\$2,204	Earl Nichols Arena Apr/May/June 2014	Received
London Hydro	Retrofit Program	2014	\$4,059	City Hall Lobby and Exterior Lighting	Received
London Hydro	Retrofit Program	2014	\$1,113	Labatt Park T12 Lighting Retrofit	Received
London Hydro	Retrofit Program	2014	\$3,110	City Hall Cafeteria Pot Light	Received

London Hydro	PSUI Program	2014	\$22,642	EEM Program - FTE Burden Recovery Y2/Q4	Received
London Hydro	Demand Response	2014	\$2,204	Earl Nichols Arena Jul/Aug/Sept 2014	Received
Union Gas	Enersmart - prescriptive	2014	\$750	CGAC - Condensing DHW heater	Received
Union Gas	Enersmart - prescriptive	2014	\$9,000	CGAC - Condensing Boilers	Received
London Hydro	PSUI Program	2014	\$21,784	EEM Program - FTE Burden Recovery Y3/Q1	Received
London Hydro	Retrofit Program	2014	\$18,000	Arva Pumping Station	Received
London Hydro	Retrofit Program	2014	\$198	W12A T12 Lighting Retrofit	Received
London Hydro	Small Business	2014	\$37,500	Various Facilities	Received
Hydro One	Retrofit Program	2014	\$369,600	EMPS Pump Replacement	Pre-Approval
London Hydro	Retrofit Program	2014	\$0	Sarnia Road Widening	Pre-Approval
London Hydro	Retrofit Program	2014	\$0	Hyde Park Road	Design
London Hydro	Retrofit Program	2014	\$0	Dufferin Ave (Wellington to Waterloo) LED	Design
London Hydro	Retrofit Program	2014	\$0	Wellington St. (Dufferin to Central)	Design
London Hydro	Retrofit Program	2014	\$0	Queens Ave/Richmond St LED	Design
London Hydro	Retrofit Program	2014	\$0	Dundas/Ontario LED	Design
London Hydro	Retrofit Program	2014	\$0	Emery/Wharncliffe LED	Design
London Hydro	Retrofit Program	2014	\$0	Power bar Pilot Project at City Hall	Pre-Approval
London Hydro	Retrofit Program	2014	\$0	Space Heater Pilot Project	Pre-Approval
London Hydro	Retrofit Program?	2014	\$0	Greenway PCP - Ancillary Building Heating	Design
London Hydro	Retrofit Program?	2014	\$0	Greenway PCP - Flushing Water System Upgrades	Design
Union Gas	Enersmart-Custom	2014	\$0	Adelaide PCP Natural Gas Consumption Reduction	Pre-Approval
London Hydro	PSUI Program	2014	\$334,000	Vauxhall Aeration Optimization	M&V
London Hydro	PSUI Program	2014	\$163,800	Adelaide Blower Upgrade	M&V
London Hydro	Retrofit	2014	\$163,800	Oxford Blower Upgrade	M&V
London Hydro	Smart Grid	2014	\$20,000	Incentive is in Asset form. EV Charger and Smart	Pre-Approval
			\$261,009	Total Received	Received
			\$1,031,200	Total in Process	In Process
			\$1,292,209	Total for 2014	Total

		2015			
London Hydro	Retrofit Program	2015	\$25,061	CGAC - New Pool lighting and Lighting Controls	Received
London Hydro	Retrofit Program	2015	\$12,946	CGAC -Pool Pump VFDs	Received
London Hydro	Retrofit Program	2015	\$5,786	CGAC - Packaged RTUs serving admin	Received
London Hydro	Retrofit Program	2015	\$11,210	CGAC - Roof Mount AHU for spectator area	Received
London Hydro	Retrofit Program	2015	\$2,254	CGAC - BAS Upgrade	Received
London Hydro	Retrofit Program	2015	\$3,818	CGAC - Parking Lot Lights	Received
London Hydro	Retrofit Program	2015	\$904	CGAC - Natatorium Dehumidification (HVAC)	Received
London Hydro	Retrofit Program	2015	\$4,972	CGAC - Makeup Air Unit	Received
London Hydro	Retrofit Program	2015	\$8,528	Victoria Park Christmas Lights	Received
London Hydro	Retrofit Program	2015	\$4,520	Stronach Gym Lighting Upgrade	Received
enernoc	Demand Response	2015	\$2,204	Earl Nichols Arena Oct/Nov/Dec 2014	Received
London Hydro	Retrofit Program	2015	\$403	Wilton Grove Yard Lighting	Received
London Hydro	Retrofit Program	2015	\$712	River Road GC Lighting	Received
London Hydro	PSUI Program	2015	\$48,326	EEM Program - FTE Burden Recovery Y3/Q2&3	Received
London Hydro	Retrofit Program	2015	\$3,188	Centennial Hall Lighting Upgrades	Received
London Hydro	Retrofit Program	2015	\$1,856	Earl Nichols Arena Jan/Feb/Mar 2015	Received
London Hydro	Retrofit Program	2015	\$46,620	Energy Audits of 17 Facilities	Received
London Hydro	Retrofit Program	2015	\$1,338	Adelaide Operations Centre - Exterior Lights	Received
Union Gas	Enersmart - Prescriptive Demand	2015	\$10,264	CGAC - CHP (Natural Gas incentive) Earl Nichols Arena	Received
enernoc	Response Retrofit	2015	\$2,204	Earl Nichols Arena Apr/May/June 2015	Received
London Hydro	Program	2015	\$933	Eldon House Lighting Retrofit	Received
London Hydro	PSUI Program	2015	\$28,865	EEM Program - FTE Burden Recovery Y3/Q4	Received
London Hydro	Retrofit Program	2015	\$550	Tourism Information Centre Lighting	Received
enernoc	Demand Response	2015	\$2,204	Earl Nichols Arena Jul/Aug/Sep 2015	Received
Union Gas	Enersmart - Prescriptive	2015	\$14,415	CGAC - Dectron Units	Received

Union Gas	Enersmart - Prescriptive Retrofit Program	2015	\$300	EROC - Infrared Heaters	Received
London Hydro	Program Retrofit	2015	\$2,912	Argyle Arena - SmartICE System	Received
London Hydro	Program Retrofit	2015	\$3,707	Nichols Arena - SmartICE System	Received
London Hydro	Program Retrofit	2015	\$3,585	Carling Arena - SmartICE System	Received
London Hydro	Program Retrofit	2015	\$1,997	CGAC - Lower Level Corridor LED Lighting	Received
London Hydro	Program Retrofit	2015	\$1,633	City Hall Executive Parking LED Lighting	Received
enernoc	Demand Response	2015	\$2,204	Earl Nichols Arena Oct/Nov/Dec 2015	Received
London Hydro	PSUI Program	2015	\$93,000	CGAC - CHP	Pre-Approval
			\$260,416	Total Received	Received
			\$93,000	Total in Process	In Process
			\$353,416	Total for 2015	Total

\$745,088	Total Received
\$1,125,120	Total In Process
\$1,870,208	Total in Incentives

*Enernoc – Demand response aggregator.