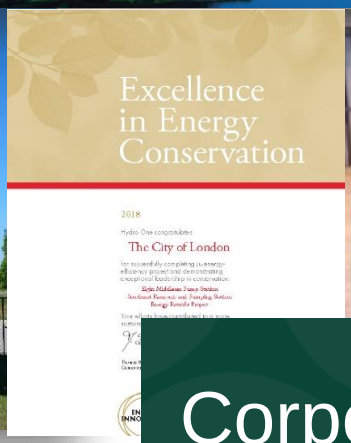

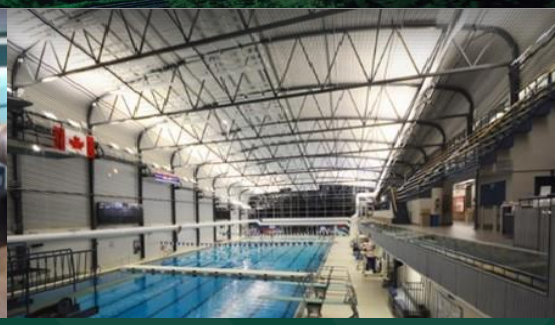

Corporate Energy Conservation and Demand Management Plan (CDM) 2019-2023

October 2019

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Executive Summary

The City of London (the City) has been committed to corporate energy management since the 1990s.

On July 1st 2014, the City submitted its first Corporate Energy Conservation and Demand Management (CDM) Plan to the Ontario Ministry of Energy in compliance with the former Ontario Regulation 397/11 Green Energy Act (now O.Reg 507/18 Electricity Act 1998 – Section 6). The regulation also mandates municipalities to document and report on the results of their CDM plans and update their CDM Plans every five years. The development of the CDM Plan in 2014 was also vital to curb the increasing utility costs to the City.

This report meets the regulatory requirements by providing:

- The results from the 2014-2018 Corporate Energy CDM Plan, documenting energy management initiatives implemented between 2014 and 2018 within various Service Areas, and

- The 2019-2023 Corporate Energy CDM Plan, which outlines the goals and energy management initiatives to be undertaken by the City over the next five years.

2014-2018 CDM Plan

The 2014-2018 CDM Plan covered the City's plan to reduce energy use and GHG (GHG) emissions across its corporate service areas, including:

- Facilities and buildings owned and operated by the City of London
- Wastewater treatment and pumping facilities and operations
- Water distribution and storage facilities and operations
- Street lighting
- Fleet vehicles and equipment

The 2014-2018 CDM 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 reducing GHG emissions from 2014 to 2020. However, the 2014-2018 CDM Plan went above and beyond regulatory requirements with the inclusion of vehicle fleet energy use within the scope of the plan.

The primary goal for the 2014-2018 CDM Plan was to achieve a ten percent reduction in total annual corporate energy use by 2020, using 2014 as the baseline year. Tied to this primary goal were three secondary goals:

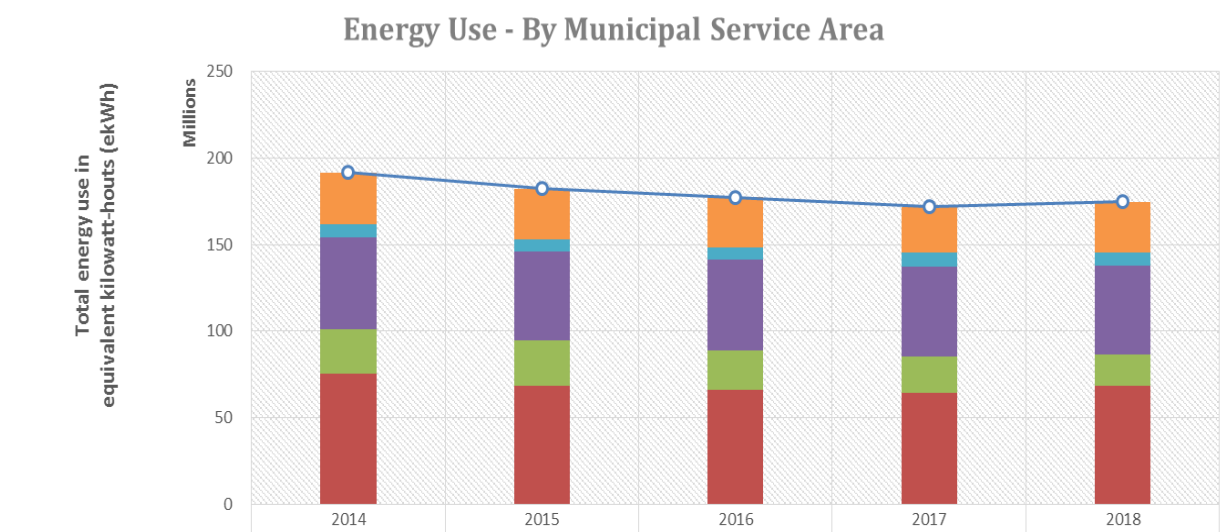
- 15 percent reduction in corporate energy per capita (i.e., energy efficiency for service delivery),
- 15 percent reduction in corporate energy-related GHG emissions (i.e., excluding landfill gas methane emissions and sewage incineration nitrous oxide emission), and

- Control utility costs below $22.7 million by 2020

In order to achieve these targets by 2020, technical and non-technical actions were prioritized. Some of the highlights of results include:

- **The City achieved a 9% reduction in total annual energy use as of 2018.** With current energy reduction measures in place, the City is confident that it will meet and possibly exceed the 10% goal by 2020.
- **Energy related GHG emissions have been reduced by 13%** since 2014.
- **Energy use per capita have been reduced by 15%** since 2014
- **Energy costs have been reduced by 5%.** The fluctuations in energy prices are not entirely under City's control, but energy consumption is.
- **$12.5 million in total energy cost avoidance** over the last five years.

Since 2015, the City has been providing annual reports on corporate energy consumption and activities. These annual reports help track progress towards the City's Strategic Plan and 2014-2018 CDM plan goals. Figure i below shows total energy reduction in the last five years.



	2014	2015	2016	2017	2018
Vehicle Fleet	29,750,000	29,139,000	28,666,000	26,583,000	29,083,000
Water Pumping	7,600,000	7,399,000	7,176,000	7,702,000	8,081,000
Wastewater & Treatment	52,831,000	51,228,000	52,539,000	52,041,000	50,823,000
Traffic Signals & Streetlights	26,101,000	26,257,000	22,668,000	21,182,000	18,421,000
Buildings	75,238,000	68,341,000	66,139,000	64,264,000	68,343,000
Total	191,514,000	182,368,000	177,188,000	171,772,000	174,751,000

Figure i – Total energy use by municipal service area between 2014 and 2018

2019-2023 CDM Plan

The 2019-2023 CDM Plan is built upon the successful foundation laid by the 2014-2018 CDM Plan. The 2019-2023 CDM Plan supports the City's 2019-2023 Strategic Plan and its "Building a Sustainable City" Strategic Area of Focus. Goals developed in the 2019-2023 CDM Plan also supports London's Community Energy Action Plan (CEAP).

The energy savings initiatives and goals outlined in the 2019-2023 CDM Plan were developed by conducting inter-departmental consultations, reviewing those actions undertaken as part of the 2014-2018 CDM Plan implementation, and analysing energy use and cost in the last five years. The key initiatives developed for each service area are categorised as Planned, Proposed, and Behavioural initiatives that can be implemented in the next five years.

Using 2018 as the baseline year for the new 2019-2023 CDM Plan, the proposed new primary goals includes:

1. Total energy reduction target of 5% by 2023, tied to this goal are:
    - 10% decrease in energy use per capita, and
    - 900 tonnes of avoided GHG emissions by 2023
2. Keep total energy cost increases within 5% from 2018 baseline year.

The 2019-2023 CDM Plan has also identified long term secondary goals as below:

1. Monitor and track City of London's corporate water consumption starting 2018, and
2. Investigate possible pathways for achieving net zero emissions by 2050 or sooner (2030, 2040).

The 2019-2023 CDM Plan identifies key initiatives, energy standards, achievable measures and commitments towards:

- Improving energy efficiency within City facilities,
- Reducing GHG emissions and energy consumption in day-to-day operations,
- Extending the lifecycle of the City's assets, where possible
- Maximizing fiscal resources through direct and indirect energy cost avoidance
- Monitoring energy consumption and utility usage
- Demonstrating leadership and awareness within City employees by creating a Culture of Conservation
- Achieving greater budget control towards energy consumption
- Achieving measures to reach set targets

The 2019-2023 CDM Plan will be a live document that provides a roadmap to build internal energy management knowledge and awareness. This will provide the groundwork for successful energy management decisions and actions within all corporate operations for the next five years and beyond, particularly those that begin to take the actions needed to respond to the City of London's Climate Emergency Declaration.

City of London Climate Emergency Declaration

"Whereas climate change is currently contributing to billions of dollars in property and infrastructure damage worldwide, stressing local and international economies;

Whereas climate change is currently jeopardizing the health and survival of many species and other natural environments worldwide, stressing local and international eco systems;

Whereas climate change is currently harming human populations through rising sea levels and other extraordinary phenomena like intense wildfires worldwide, stressing local and international communities;

Whereas recent international research has indicated a need for massive reduction in carbon emissions in the next 11 years to avoid further and devastating economic, ecological, and societal loss;

Whereas the climate in Canada is warming at twice the rate of the rest of the world, as per Canada's Changing Climate report;

Whereas current initiatives such as City's green fleet plans and energy reduction initiatives are not sufficient to meet the targets as defined by the IPCC scientists,

Whereas an emergency can be defined as "an often dangerous situation requiring immediate action";

Whereas municipalities such as Kingston, Vancouver and Hamilton have already declared climate emergencies;

Therefore, a climate emergency BE DECLARED by the City of London for the purposes of naming, framing, and deepening our commitment to protecting our economy, our eco systems, and our community from climate change."

1. Introduction

With increasing effects of climate change and global warming, it is important for governments to take actions to mitigate its effects on environment. Development of the 2019-2023 CDM Plan is a step towards addressing climate change for activities managed for the City. The 2019-2023 CDM Plan is built upon the successful foundation laid by the City's previous 2014-2018 CDM Plan.

The 2019-2023 Plan supports the City's Strategic Plan 2019-2023 with area of focus on "Building a Sustainable City" with a planned action of developing and implementing a Corporate Energy Management Plan. Goals developed in the 2019 Plan support London's Community Energy Action Plan (CEAP) and the City's recent *Climate Emergency Declaration*.

The 2019-2023 CDM Plan helps strengthen corporate energy management practices and gives direction to all service areas on energy management. The 2019-2023 CDM Plan also meets the new requirements of the Ontario Regulation 507/18 under the Electricity Act, 1998.

The 2019-2023 CDM Plan identifies key initiatives, energy standards, achievable measures and commitments towards:

- Improving energy efficiency within City facilities,
- Reducing GHG emissions and energy consumption in day-to-day operations,
- Extending the lifecycle of the City's assets where possible
- Maximizing fiscal resources through direct and indirect energy cost avoidance
- Monitoring energy consumption and utility usage
- Demonstrating leadership and awareness within City employees by creating a Culture of Conservation
- Providing greater budget control towards energy consumption
- Beginning to control water consumption in City buildings, and
- Establishing measures to reach set targets

All the key initiative required to implement the 2019-2023 CDM Plan and to achieve set goals are categorised by corporate service areas as below:

- Facilities and buildings owned and operated by the City of London
- Wastewater treatment and pumping facilities and operations
- Water distribution and storage facilities and operations
- Street lighting
- Fleet vehicles and equipment

1.1 City of London Strategic Plan

The City of London's Strategic Plan outlines the mission, values and the five areas of focus.

The five areas of focus of the strategic plan have significant ties to the CDM Plan for corporate energy, and the strategic area of focus "Building a Sustainable City" specifically reference the development and implementation of the 2019-2023 CDM Plan.

2. Background

On July 1st 2014, the City introduced its first Corporate Energy and Demand Management (CDM) Plan for 2014-2018 in compliance with the former Green Energy Act, Ontario Regulation 397/11 (now the O.Reg. 507/18, Electricity Act 1998). It proposed technical and non-technical measures that the City would undertake to reduce energy use and GHG reductions from its operations. In order to develop energy reduction targets and initiatives for the 2014-2018 CDM Plan, it was necessary to understand where the City's current performance was compared to previous energy management activities that go as far back as the 1990s. In September 2013, the City published a series of documents to capture the past achievements and management activities for all of the Corporation's energy needs. All of the previous energy management reports can be found on the Corporate Energy Management page on the City's website.

2.1 Ontario Regulation 397/11

In August 2011, the provincial government introduced Ontario Regulation 397/11 under the Green Energy Act, 2009. This regulation required certain public agencies – Municipalities, Municipal Service Boards, Schools Boards, Universities, Colleges and Hospitals – to report on their energy consumption and GHG emissions annually beginning in 2013. The affected public agencies were also required to develop and implement five-year energy conservation and demand management (CDM) Plans starting in 2014. The intent of the regulation was to help the broader public sector organizations better understand their energy consumption, to help them benchmark energy use, and to encourage energy conservation and demand management activities within them.

In order to comply with the minimum requirements of the Green Energy Act and the Ontario Regulation 397/11, the City was required to submit annual energy consumption and GHG emissions for each calendar year in buildings or facilities the public agency owns or leases that,

a) Are heated or cooled and in respect of which the public agency is issued the invoices and is responsible for making the payments for the energy consumptions; or

b) Are related to the treatment or pumping of water or sewage and in respect of which the public agency is issued the invoices and is responsible for making the payments for the energy consumptions.

On July 1st, 2013, the City prepared and submitted the first Annual Energy Consumption and GHG emissions report to the Ministry of Energy to support the province's reporting requirements and has been doing so annually since. These submissions can be found on the City's open data catalogue.

3. 2014-2018 CDM Plan Results

The introduction of the 2014-2018 CDM Plan provided the City with an opportunity to review its energy management program initiatives and proposed energy targets. The approach was:

- To set an achievable target by adopting energy conservation resources into existing capital investments already assigned.
- Explore incentive opportunities towards energy project initiatives.
- Review long term initiatives that have significant impacts on energy consumption and GHG emissions and
- Deepen the culture of conservation within the Corporation's operations.

The primary goal of the 2014-2018 CDM Plan was set to achieve a ten percent reduction in overall annual energy by 2020, using 2014 as the baseline year.

Tied to this primary goal were three secondary goals:

- 15% reduction in corporate energy per capita (i.e., energy efficiency for service delivery),
- 15% reduction in corporate energy-related GHG emissions (i.e., excluding landfill gas methane emissions and sewage incineration nitrous oxide emission), and
- Control the energy cost increase below $22.7 million

The progress towards these goals, as of 2018, is shown below:

Total Energy Use (170 million ekWh)

- **2018-** 174 million equivalent kilowatt-hours (ekWh), 9% reduction. The City achieved 170 million ekWh in 2017, three years ahead of 2020, but overall comsumption in 2018 increased by 1% due to cold weather
- Trends are in line for 10% reduction by 2020

Energy Performance (432 ekWh per person)

- **2018** - 436 ekWh per person, 14.7% reduction
- Trends are in line for 15% reduction by 2020

GHG Emissions (18,500 tonnes)

- **2018** - 18,700 tonnes, 14% reduction
- Trends are in line for 15% reduction by 2020

Energy Cost ($22.7 million)

- **2018** - $17.9 million in energy cost, City of London performed $4.8 million below projected target.
- Energy efficiency projects and provincial acts to reduce electricity rates in 2017 and 2018 helped the City to lower its energy costs.

3.1 Success Stories

A complete update of all the technical measures identified in the 2014-2018 CDM Plan (complete or in progress) are listed in Appendix A. The non-technical measures implemented in the last five years are carried forward and updated as necessary in the 2019-2023 CDM Plan.

The following is a summary of a few of the key energy initiatives from the last five years which contributed to energy savings. This section also highlights the GHG emission reductions achieved by avoiding fossil fuel use as a result of these initiatives.

There are two ways of quantifying the GHG reduction benefits associated with electricity conservation and demand management activities:

- using the Ontario grid-average emission factor, a method that assumes that the electricity savings are allocated evenly across all generating sources such as nuclear, hydro, wind, and natural gas; and

- using the Ontario fossil-on-margin emission factor, a method assumes that the 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.

Both methods are equally valid as they each serve a different purpose. If the purpose is to inventory overall emissions from electricity use, the grid-average emissions factor is used. If the purpose is to quantify impact of an electricity-related action, the fossil-on-margin emissions factor is used. City staff used the electricity-related emissions factors provided by The Atmospheric Fund in their June 2019 report, "A Clearer View on Ontario's Emissions".

3.1.1 Canada Games Aquatic Centre

Project

Lifecycle renewal project to reduce energy usage, reduce maintenance costs and improve indoor air quality.

Action

- Replace existing metal halide fixtures near the pool area and high pressure sodium fixtures in parking lot with new efficient LEDs.

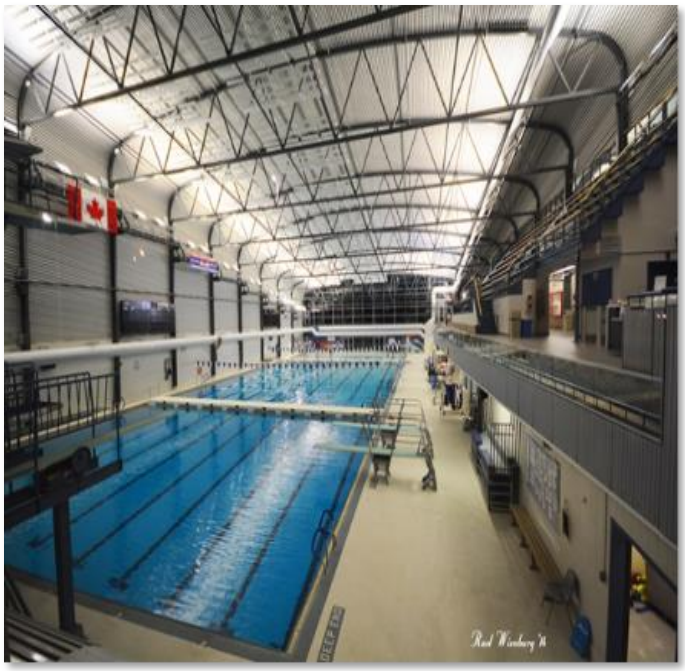
- Installation of variable-frequency drive (VFD) motors on circulation pumps.

- Replace existing makeup air unit with new efficient one.

- Retrofit, expand and optimize the building automation system for increased efficiency

- Installation of a 53 kilowatt (kW) co-generation unit to provide pool heat as well as power

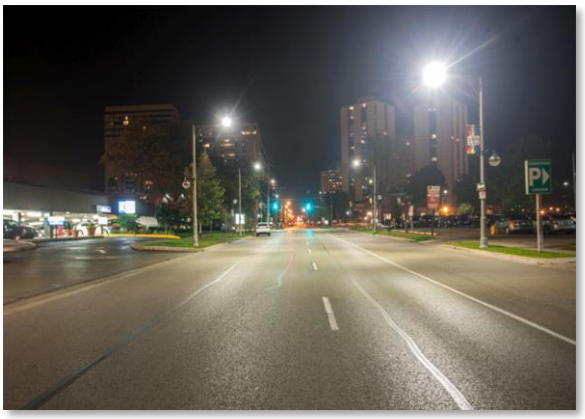
- Upgrade existing air handling units in Natatorium area



Results

- 20% total energy reduction
- 5% peak electricity use reduction
- Annual electricity-related GHG emission reduction
  - 30 tonnes based on the grid-average emission factor
  - 135 tonnes based on the fossil-on-margin emission factor
- $154,000 in incentives from London Hydro and $35,000 from Union Gas
- Co-generation system cost avoidance - $20,000 annually
- Received $3 million loan from Federation of Canadian Municipalities (FCM) and $154,000 in incentives from London Hydro and $35,000 from Union Gas
- Recognition – 2016 QUEST Smart Energy Communities Award – Real Estate Sector, 2016 Clean30 Top 15 Project
- Media Coverage – Rogers TV link, CTV link, Clean 50

3.1.2 Streetlights Conversion to LEDs



Project

Conversion of High Pressure Sodium (HPS) streetlight fixtures to LEDs.

Action

To date, 20,000 of the existing 35,000 streetlights have converted to LEDs in Phase 1 and Phase 2 of the street lighting project between 2015 and 2017.

Result

- Phase 1 – 56% reduction in electricity use, $690,000 in electricity cost avoidance, and $1.3 million in incentives from London Hydro.

- Phase 2 – 64% percent reduction in electricity use, $620,000 in electricity cost avoidance, and $500,000 in incentives received from London Hydro.

- Annual GHG reduction of 940 tonnes based on the off-peak fossil-on-margin emission factor.

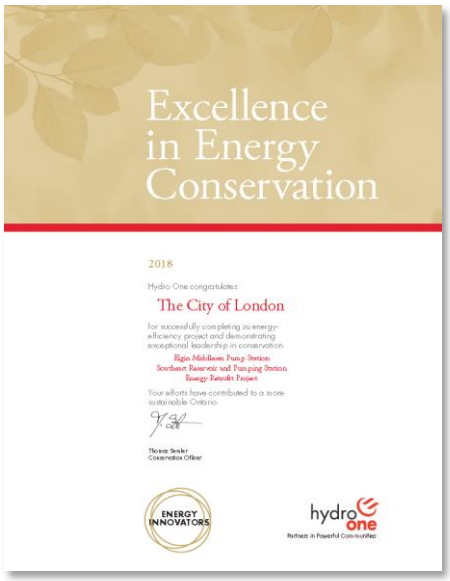
3.1.3 Aeration Blowers Upgrade

Project
Upgrading existing centrifugal blowers to turbo blowers.

Action
City upgraded aeration blowers in all the treatment plants between 2016 and 2018.

Results
- 6,340 megawatt-hours per year in electrical savings and over $760,000 per year in electricity cost avoidance.
- Annual electricity-related GHG emission reduction
  - 200 tonnes based on the grid-average emission factor
  - 850 tonnes based on the fossil-on-margin emission factor
- 6% reduction towards the City's total electricity use
- Received 100% funding from the Canadian Water and Wastewater Fund (CWWF) in 2017 to complete the project and $2.1 million incentive from London Hydro.

3.1.4 Elgin-Middlesex Pump Station


Excellence in Energy Conservation

2018

Hydro One congratulates

The City of London

for successfully completing an energy-efficiency project and demonstrating exceptional leadership in conservation.

Elgin Middlesex Pump Station
Southeast Reservoir and Pumping Station
Energy Retrofit Project

Your efforts have contributed to a more sustainable Ontario.

Thomas Sesler
Conservation Officer

ENERGY INNOVATORS

hydro one
Refresh in Powerful Communities

Project

Reducing the size of Pump 1 and Pump 2 at the Elgin Middlesex Pump Station in conjunction with commissioning the South East Reservoir and Pump Station (SERPS).

Action

Replaced the two 600 horsepower (hp) pumps with 450 hp pumps and motors which were sized for pumping to SERPS. These pumps are operated off-peak.

Results

- 850,000 kWh savings annually ($100,000/year).
- $420,000 in incentives in 2018 by Hydro One.
- Annual electricity-related GHG emission reduction
  - 25 tonnes based on the grid-average emission factor
  - 110 tonnes based on the fossil-on-margin emission factor
- City of London has also received "*Excellence in Energy Conservation"* plaque from Hydro one in March 2019 for completion of this project.

3.1.5 South East Reservoir and Pump Station (SERPS)

Project

Construction of the SERPS building to the LEED Silver standard.

Action
SERPS was designed to meet the LEED Silver standard in 2013. However before the completion of the building in 2017, the updated LEED program was released which rendered SEPRS ineligible for certification.

Results
- Consumes 25% less energy compared to a similar building
- A green roof to reduce storm runoff,
- Lighting that does not contribute to light pollution
- Water use reduction measures in plumbing fixtures,
- 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.

3.1.6 Other Facility Energy Retrofits

Project
Implementation of various energy efficiency upgrade projects by the Facilities Division.

Action
More than 50 individual energy efficiency driven and lifecycle renewal with energy efficiency benefits (including those associated with the Canada Games Aquatic Centre project) were complete by Facilities over the term of the 2014-2018 CDM Plan.

Results

All the projects completed by facilities in the last five years are listed in Appendix A.

- Savings over the last five years:
  - 10,300,000 kWh electricity savings
  - 52,000 m^3 natural gas savings
- Annual electricity-related GHG emission reduction
  - 320 tonnes based on the grid-average emission factor
  - 1,200 tonnes based on the fossil-on-margin emission factor
- Annual natural gas-related GHG emissions reductions of 100 tonnes

3.2 Renewable Energy

In terms of 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).

3.2.1 Landfill Gas as a Potential Resource

The City has been collecting and flaring landfill gas since 2004, and has attempted to undertake a number of landfill gas utilization projects such as use as a fuel for power generation and upgrading this landfill gas to pipeline quality renewable natural gas (RNG). In all cases, these projects did not proceed due to external factors.

2017 - The City was awarded a FIT5 contract from the Independent Electricity System Operator (IESO) in mid-October 2017 for the development of a 500 kW landfill gas power plant at the W12A Landfill. The City's FIT5 application was the only one submitted using landfill gas as the renewable energy source, out of 1,120 applications submitted.

2018 - The City was in the process of securing a Renewable Energy Approval from the province for the 500 kW power plant. However, in July 2018, the new Provincial Government cancelled the FIT5 contract. The City had also submitted a proposal to Union Gas in April 2018 for their RNG Request for Proposals (RFP). However, the new Provincial Government also cancelled the Cap & Trade program which was the basis of Union Gas RFP. This project is currently on hold by Union Gas (now Enbridge).

As of October 2019, the City is in discussions with FortisBC Inc., an electricity and gas distribution company in British Columbia (BC), to potentially supply RNG to FortisBC in response to their Request for Expression of Interest (REOI). The City is awaiting further direction from FortisBC regarding their energy regulator's approval to import RNG from outside of British Columbia.

3.2.2 New Construction Solar Rooftop Sections

Roof sections capable of supporting solar photovoltaic generating system (PV systems) continue to be included in new construction design criteria for flat roof areas that are suitably sized and oriented to host a PV System.

In addition to having a PV system-ready flat roof area at the Bostwick Community Centre, the soon-to-be-completed Southeast Community Centre project will include a 10 kilowatt net-metered solar PV system that will offset a portion of the facility's electrical load. This measure was part of the Facility Energy Management Budget Amendment (Case # 19) which was approved by Council in the fall of 2016.

3.2.3 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.

3.3 Fleet Measures

3.3.1 Green Fleet

Fleet GHG emissions from fuel use are the second largest source of energy-related emissions from City operations. Fleet services continue to monitor practices and bring forward methods and technologies to their customers to help reduce both energy consumption and their environmental impacts.

Highlights of the "Green Fleet" initiatives in the last five years include:

- Started the process to replace diesel-fuelled waste collection trucks with compressed natural gas (CNG) trucks over the 2019-2025 timeframe, including facility upgrades to accommodate CNG vehicle maintenance and shared use of the Clean Energy CNG fast-fill station at the Flying "J" Truck Stop.

- Electronically tracking and reporting fuel use patterns and utilization in vehicles and equipment through the Petrovend automated fuel software system.

- AVL Telematics and GPS systems are used in more than 50% of the fleet to monitor and track utilization, idling, engine faults, driver performance (speeding, rapid starts, harsh cornering) and route optimization (trip maps). Specialized telematics systems are used for winter maintenance equipment to manage and/salt distribution and service levels.

- Continued use of gas-electric hybrid vehicles where model types are the "right fit". Successful units in the fleet include the Ford Escape Hybrid and Ford C-Max hybrid.

- Continue to investigate additional hybrid vehicle options as part of every light vehicle replacement process.

- Replacement of full-size work vans with more efficient transit vans;

- Engaged in a pilot project using the “GRIP” idle management system that has lower idling on test vehicle by up to 30 percent. GRIP is a smart customizable idle management solution that identifies and controls voluntary idling by automatically shutting off and restarting the vehicle based on the demands and uses of the vehicle;

- All gasoline used is ethanol blended to E10 (10% ethanol content);

- 59 medium and heavy duty units now include diesel exhaust fluid selective catalytic reduction systems;

- The City is a member in good standing with the E3 Fleet (Energy, Environment and Excellence) program. E3 membership has included several municipal fleet reviews, best practices sharing, certification and continuous improvement programs and initiatives.

- Utilizing approximately 500,000 litres of B5 (5% biodiesel) at the Exeter Road Operations Facility on an annual basis.

- First Full Electric vehicle has been added to the fleet with business plans to add an additional 5-7 full electric vehicles by 2020.

- Business case proposal to transition to full electric ice-resurfacers by 2021.

In the last five years, total green fleet in the rolling stock increased from 55 percent to 57 percent. Fleet GHG emissions have also been reduced by two percent as of 2018 compared to 2014.

3.3.2 Electric Vehicle Charging Stations at City Facilities

Since ChargePoint’s Level 1 & 2 combination EV charger was installed in 2013 as part of a pilot project, the utilization rate has more than doubled by 2018, and is often at 100 percent utilization during weekday business hours. Recognizing the need for more EV chargers, the City conducted a survey of City employees in January 2017 to identify the demand for employee EV charging at various City buildings. Based on the results of this survey, the City has purchased five new dual port Level 2 ChargePoint chargers in December 2018 and currently working on plans to install these at City Hall and AJ Tyler locations with “pay-per-use” access for City employees and public use. These chargers can also be activated via RFID for Fleet vehicle use.

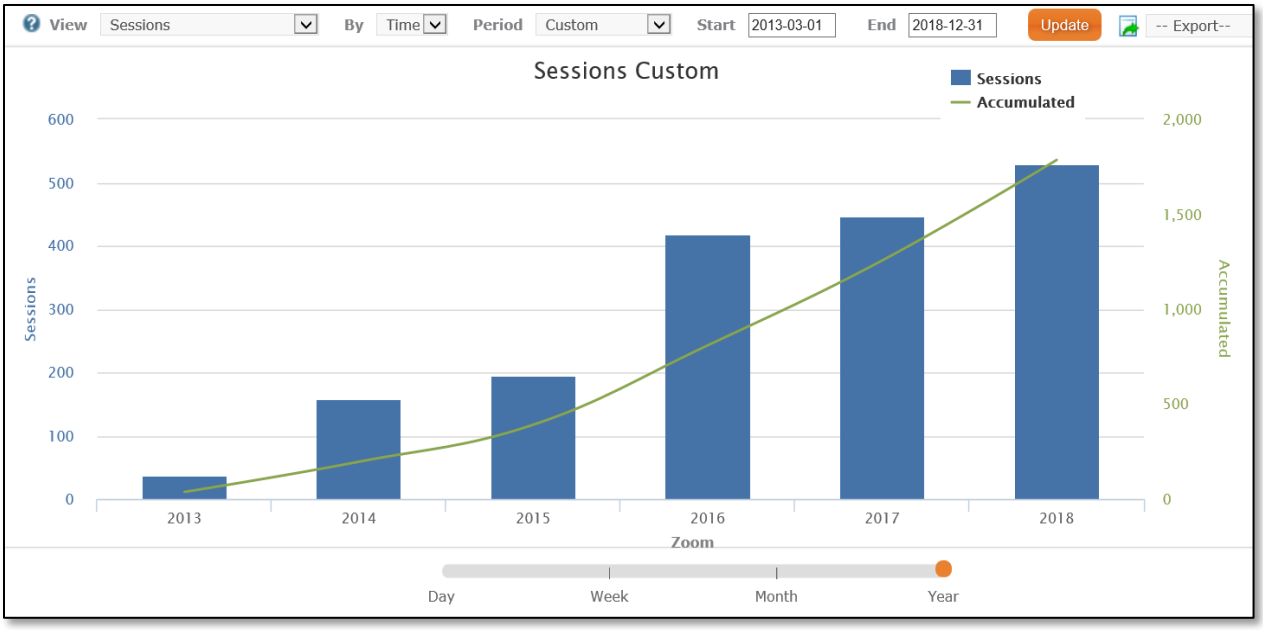


Figure 1 - Number of charging station sessions per year at City Hall

3.4 Culture of Conservation

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

3.4.1 Employee Engagement Event

For example, the 2016 employee engagement event presented an excellent occasion to meet staff in person and answer questions on corporate energy consumption. This event also presented an opportunity to get input from employees to assist in the development of the program. Feedback received from this event helped the Energy Management team develop a series of employee engagement activities that the City can undertake for the coming years.

3.4.2 Re-launching the Energy Mascot

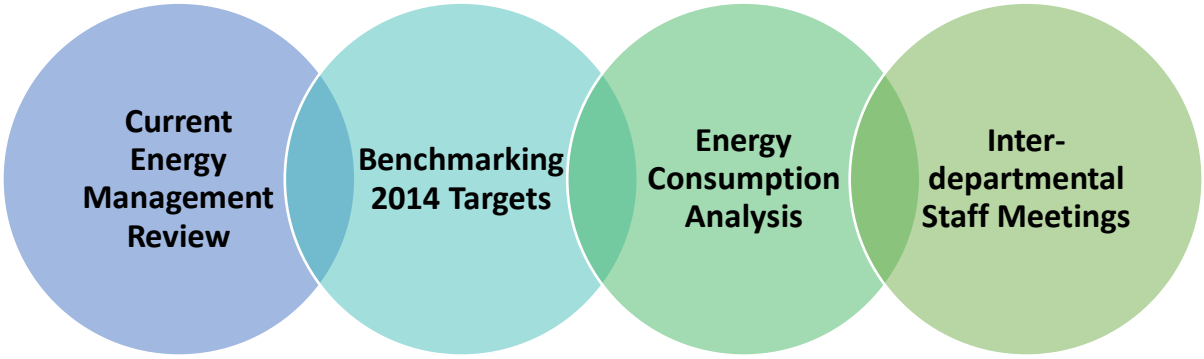
Resurrecting the City's energy mascot was crucial to re-launching *energyMatters* program. Harry the Leopard Frog, native to the Thames River, has been the City's energy mascot since 2013. In 2016, with the help of the City's Communications division, Harry's image has been designed to suit various energy messages for employees.

3.4.3 Building Operator Certification

In Fall 2016, the City had six facility staff members complete the “Building Operator Certification” course for which the City recovered its costs through incentives from the IESO, Union Gas and London Hydro.

4. The 2019-2023 CDM Plan Development Strategy

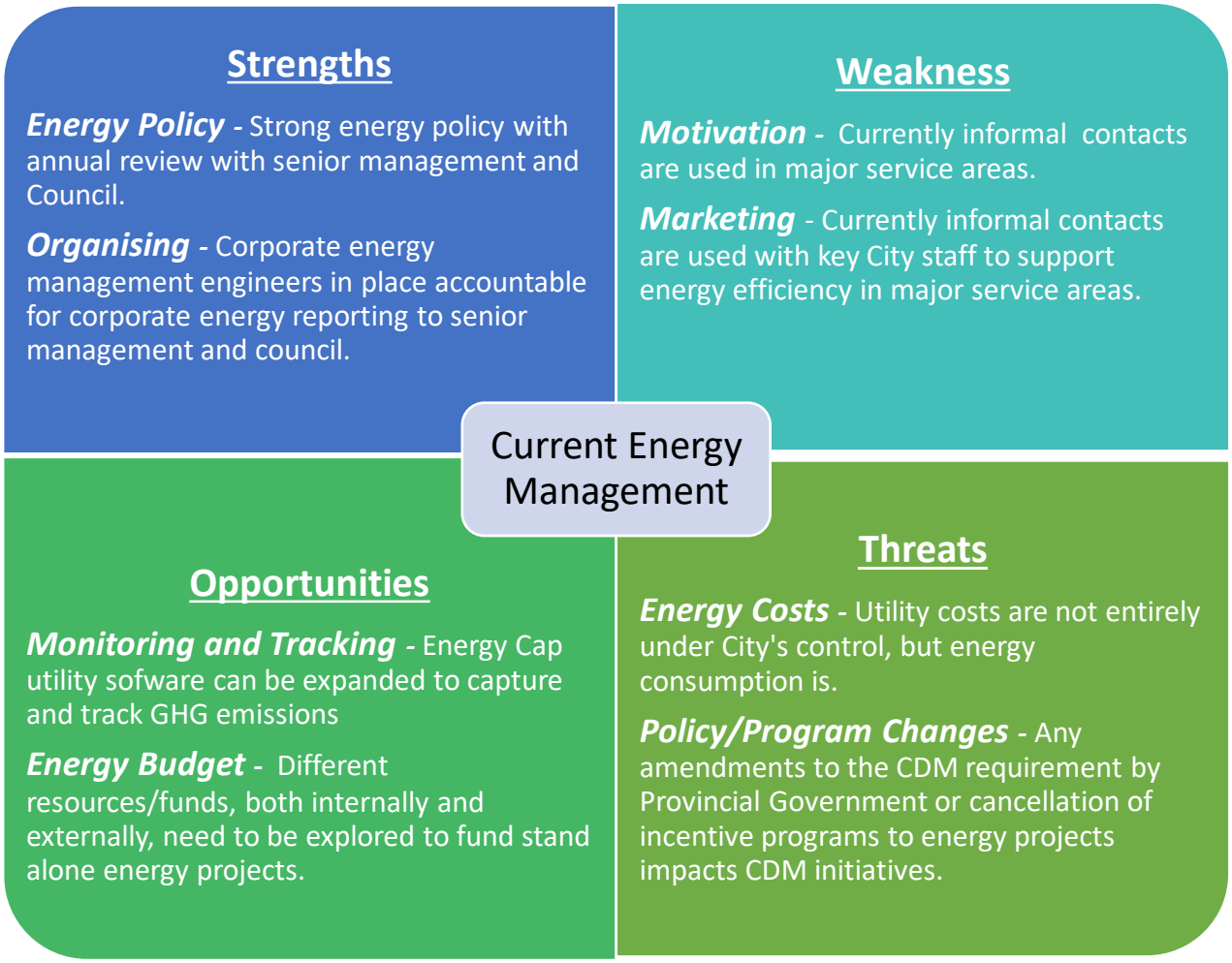
The City’s Environmental Programs division initiated the 2019-2023 CDM Plan development as an interdepartmental exercise that included a review of the City’s current approach to energy management, review of the City’s 2014-2018 CDM plan with other municipalities in southern Ontario, the City’s energy consumption and GHG emissions over the 2014-2018 period, and series of staff meetings with major service areas. This resulted in a list of energy projects, initiatives and activities that can be undertaken in the next five years.



2019-2023 CDM Plan Development Strategy

4.1 Current Corporate Energy Management Review

Environmental programs staff implemented a high level S.W.O.T (Strengths, Weaknesses, Opportunities, and Threats) analysis review of its current approach to energy management. Highlights from this review are below:



Overview of S.W.O.T analysis shows that, moving forward, there are opportunities to improve in areas of employee engagement and exploring different sources of funding for standalone energy projects.

Threats such as fluctuations in utility cost and changes to energy policy by Federal or Provincial governments is not entirely under City's control.

4.2 Benchmarking London's Plan with Other Ontario Municipalities

This process included benchmarking the City's 2014-2018 CDM Plan with other municipalities in southern Ontario. It compared energy goals, initiatives, and action items with those taken in London. The results of this work are summarized below:

Highlights of the City's 2014-2018 Plan:
• The City's 2014-2018 CDM targets were on par with other municipalities. • Setting a total energy target rather than focusing just on per capita energy reduction was an aggressive approach to reducing emissions. • The City of London was one of the few municipalities that included fleet emissions as part of its CDM plan. • The City of London was also one of the few municipalities which captured not only technical measures but listed action items on non-technical and behavioural measures and progress of renewable energy adoption within City operations.
Lessons Learned:
• Develop realistic short-term target that contributes to a longer-term goal. • Include water conservation in the plan (second-highest utility cost to the City). • Have service area specific goals and initiatives to increase accountability. • Develop networking with other municipal energy managers to adopt and share best practices and success stories.

4.3 Energy Consumption Analysis

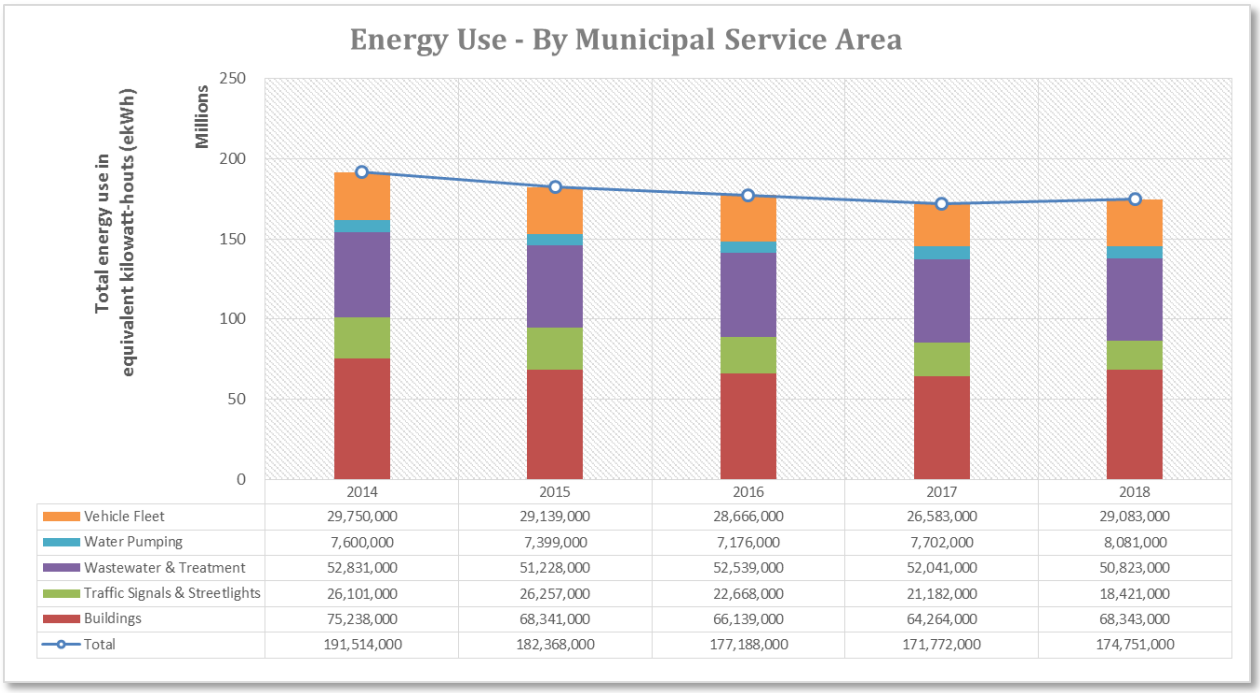
In order to develop targets for the 2019-2023 CDM Plan, it was necessary to do a deep dive in to total energy consumption, emissions and cost trends for the previous five years.

4.3.1 Energy Use

As Figure 2 illustrates, there has been a steady decrease in total energy consumption year over year with an overall nine percent reduction from 2014 to 2018.

The conversion of streetlights to LEDs contributed to the majority of savings by reducing electricity consumption by 30 percent, followed by corporate Buildings and Wastewater Operations at nine percent and four percent. In Water Operations, the new SERPS facility was commissioned in September 2017, which increased water supply energy usage as reflected in Figure 2.

The energy use analysis illustrates that there needs to be increased energy conservation focus and opportunities for energy efficiency in Water Operations and Fleet in the coming five years.



	2014	2015	2016	2017	2018
Vehicle Fleet	29,750,000	29,139,000	28,666,000	26,583,000	29,083,000
Water Pumping	7,600,000	7,399,000	7,176,000	7,702,000	8,081,000
Wastewater & Treatment	52,831,000	51,228,000	52,539,000	52,041,000	50,823,000
Traffic Signals & Streetlights	26,101,000	26,257,000	22,668,000	21,182,000	18,421,000
Buildings	75,238,000	68,341,000	66,139,000	64,264,000	68,343,000
Total	191,514,000	182,368,000	177,188,000	171,772,000	174,751,000

Figure 2 - Total energy use by municipal service area between 2014 and 2018

4.3.2 Greenhouse Gas Emissions (GHG)

The GHG emissions from energy use were 25 percent lower (5,400 tonnes) between 2014 and 2017 due to increased conservation efforts and cleaner sources of energy used to generate electricity in Ontario.

However, due to colder weather in 2018, there was increase in natural gas consumption in buildings and increase in fleet fuel consumption led to 11 percent increase in 2018 (see Figure 3). GHG emissions reduction in fleet fuel use and in City building heating will be areas of focus for the next five years.

Since 2007 though, total GHG emissions have reduced by 58 percent as shown in Figure 4. The majority of the emission reductions are due to increased conservation efforts and cleaner sources of energy used to generate electricity in Ontario:

- 90% reduction in electricity-related emissions
- 34% reduction in steam-related emissions, due solely to corporate actions
- 27% reduction in natural gas related emissions, due solely to corporate actions

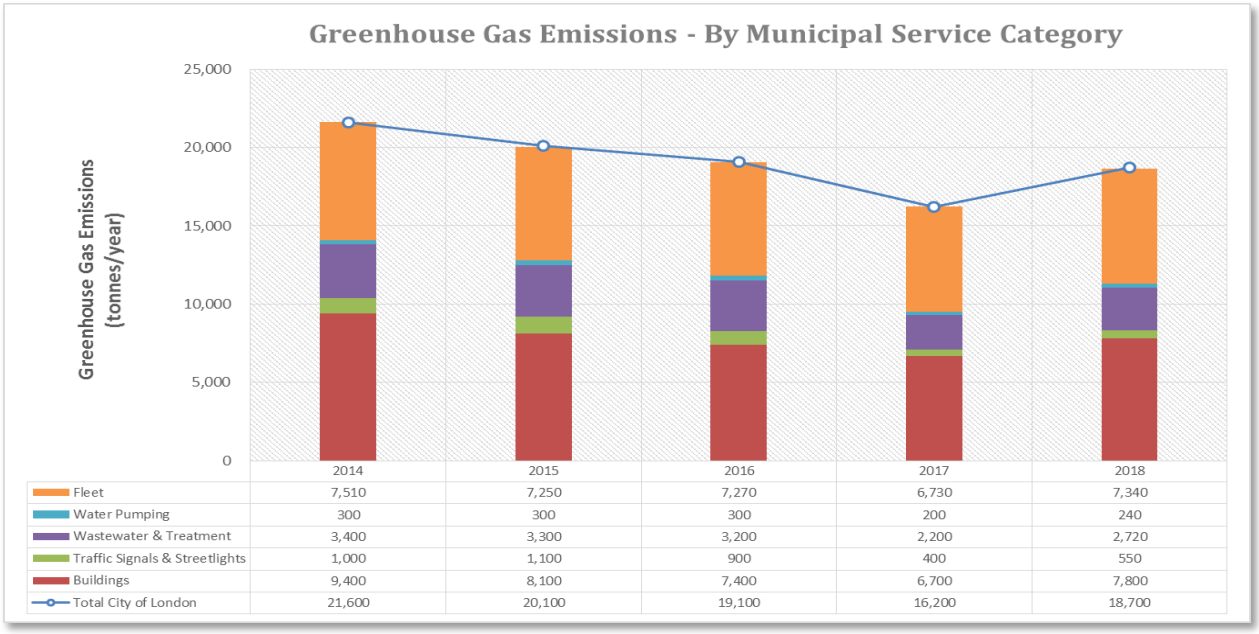


Figure 3 - GHG emissions by municipal service area from 2014 to 2018

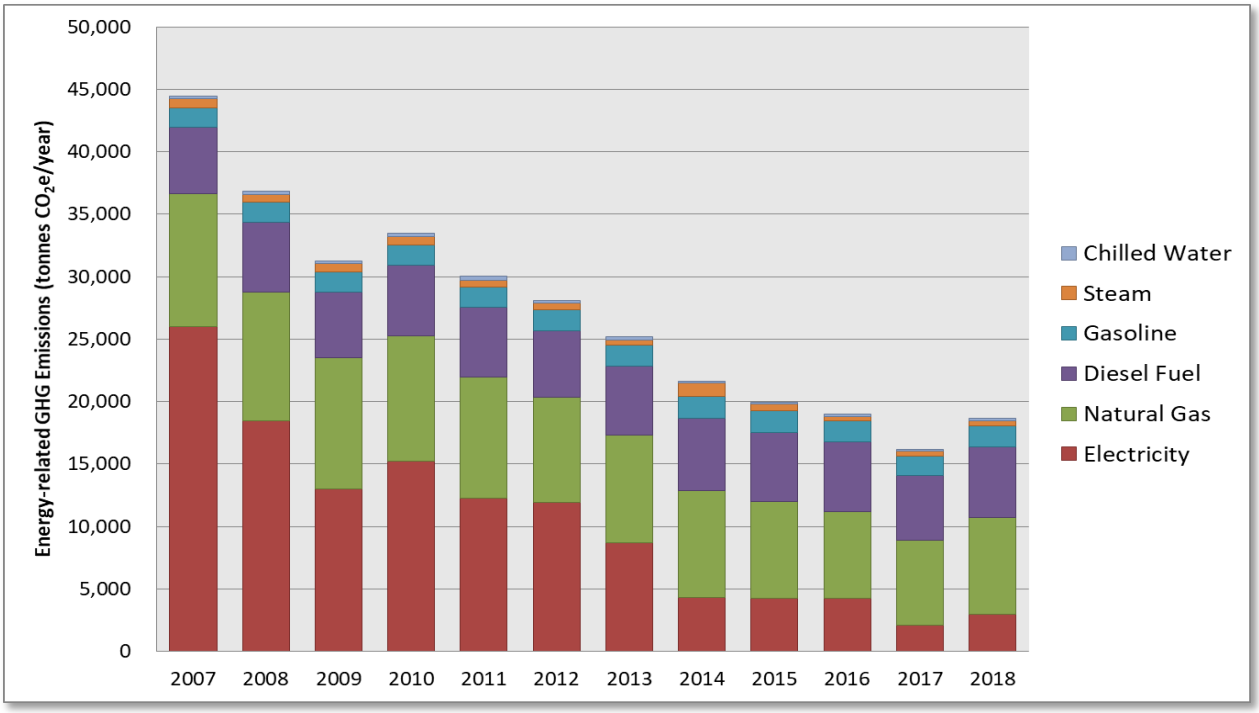


Figure 4 – Trends in Corporate Greenhouse Gas Emissions by Commodity

4.3.2 Energy Costs

The City decreased its energy costs by five percent over the last five years (see Figure 5). There had been a ten percent increase in energy costs between 2014 and 2016 even though energy consumption reduced by seven percent in the same period. Most of this cost increase was due to the increase in electricity and fuel prices.

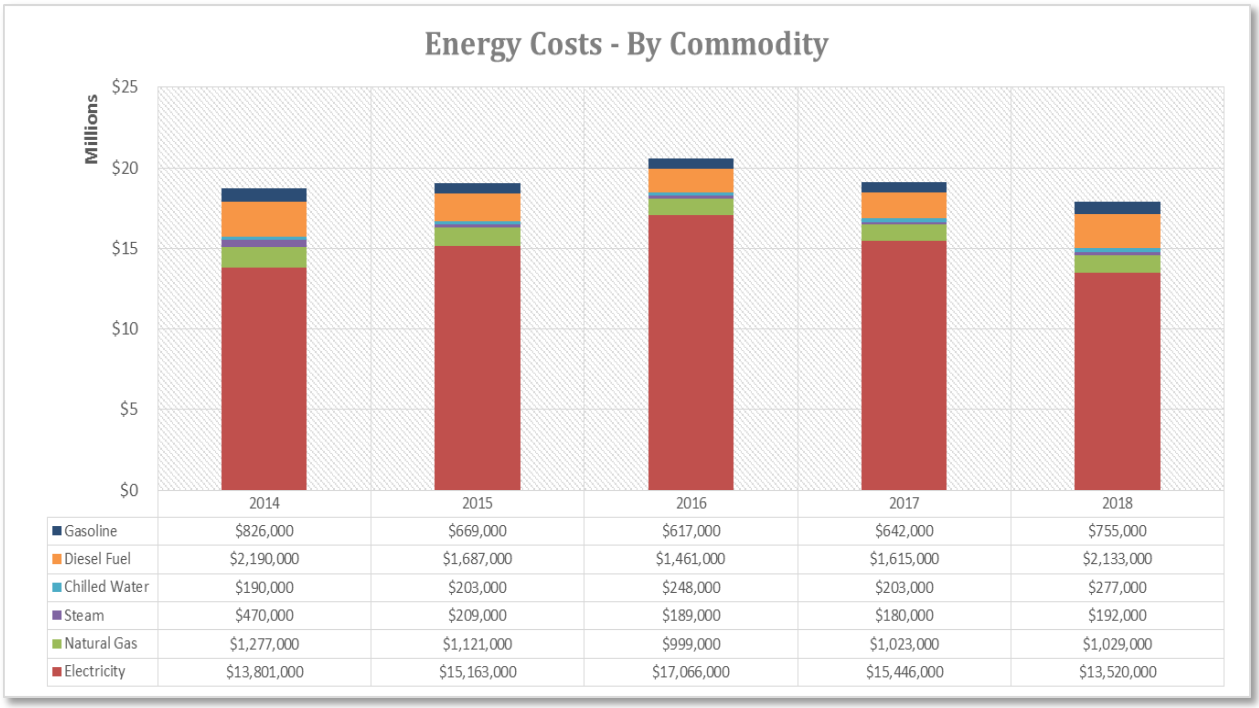
The subsequent drop in electricity unit rates in particular were the result of Provincial policy changes in the latter part of the term. Utility rates fluctuated in the last five years according to various influences including market pressures and governmental policies. A summary of some of the primary rate drivers are as follows:

Electricity - The Ontario electricity market was subject to a number of policy changes that affected the various rate classes in different ways. The significant policy changes were as follows: the expiration of the 10 percent *Ontario Clean Energy Benefit*, the introduction of the 8 percent *Provincial Rebate*, the expiration of the debt retirement charges, the introduction of the *Ontario Fair Hydro Plan* and the successive reduction of the Class A eligibility threshold. One of the significant cost electricity drivers was the "Global Adjustment" (GA) component of the blended electricity rate. For much of the term, the GA fluctuated significantly month-to-month and consistently trended upward.

Water - The water rates are largely tracked and targets set forth in the *Water Service Area Financial Plan*. There were three successive notable annual increases to the storm water component of the water rates associated with the new formula that includes an emphasis on fixed rate factors associated with property surface area.

Natural Gas - The majority of the City of London natural gas accounts are grouped to enable the bulk purchase of natural gas. This strategy allows for increased price certainty via a series of multi-year bulk natural gas purchase contracts that hedge against market fluctuations and the ability to monitor market prices and respond accordingly. In 2014, a combination of the North American natural gas storage levels falling to record lows and demand reaching a dramatic high due to the polar vortex effect in the winter resulted in a temporary spike in rates. For the remainder of the term, the natural gas rates experienced normal seasonal and market fluctuations, generally trended down as supply levels increased and anticipated exports to offshore markets did not materialize as quickly as expected.

Cost fluctuations are not entirely under City's control, but the City aims to keep the energy cost increase below five percent by conserving energy use. Further details on energy cost forecast and initiatives to mitigate the costs are discussed in section 7.3 of this report.



	2014	2015	2016	2017	2018
Gasoline	$826,000	$669,000	$617,000	$642,000	$755,000
Diesel Fuel	$2,190,000	$1,687,000	$1,461,000	$1,615,000	$2,133,000
Chilled Water	$190,000	$203,000	$248,000	$203,000	$277,000
Steam	$470,000	$209,000	$189,000	$180,000	$192,000
Natural Gas	$1,277,000	$1,121,000	$999,000	$1,023,000	$1,029,000
Electricity	$13,801,000	$15,163,000	$17,066,000	$15,446,000	$13,520,000

Figure 5 - Energy costs by commodity from 2014 to 2018

4.3.3 Cost Avoidance

Approximately $2.9 million in energy costs were avoided in 2018 compared to business-as-usual projections (based on 2014 levels of energy efficiency) and $12.5 million in avoided energy costs have been accumulated since 2007 (based on 2007 levels of energy efficiency), as shown in Figure 6.

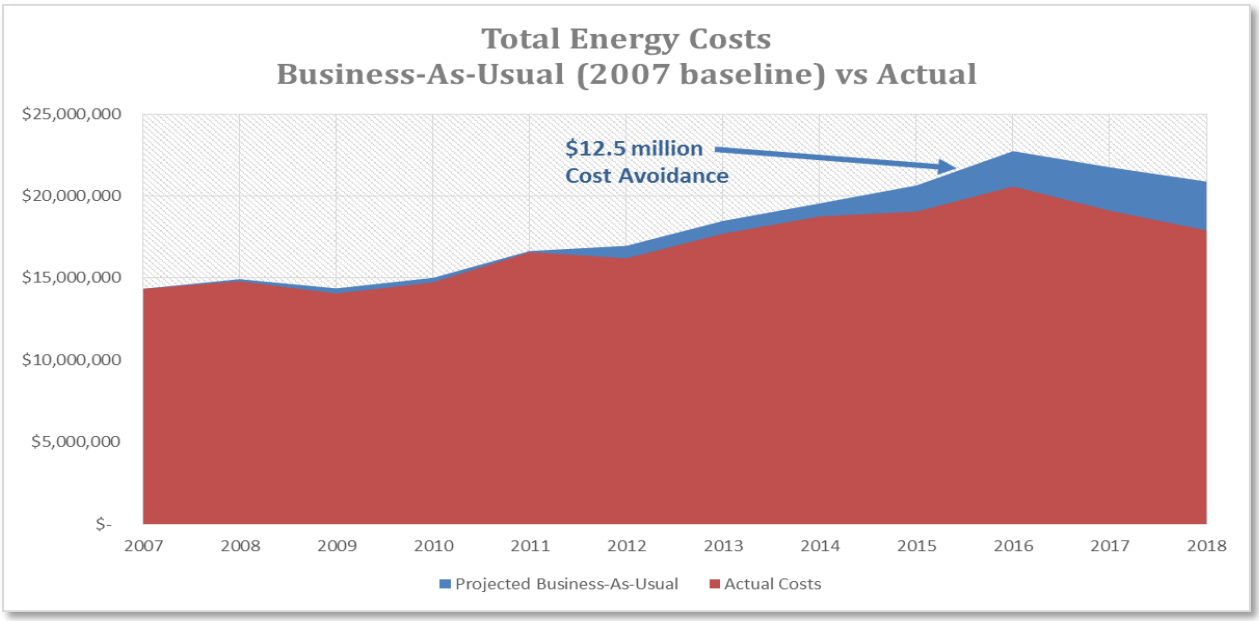


Figure 6 - A comparison of actual energy costs to date versus business-as-usual

4.4 Staff Meetings

A series of staff meetings have been held for Service Areas whose operations have direct control over energy use and GHG emissions. A review of current energy consumption, proposed purpose of the 2019-2023 CDM Plan, direction, and ingredients for future success were discussed in these meetings. A collaborative process to implement the key initiatives in the 2019-2023 CDM Plan was introduced.

These focused meetings facilitated sharing of best practices and identification of key initiatives that will work towards achieving the overall 2019-2023 CDM plan goal. The key initiatives identified by staff in each service area are divided into Planned, Proposed, and Behavioural measure.

Planned measures lists all the projects that have funding assigned in the current multi-year budget. Proposed measures lists all the projects that are currently at the investigation stage, but not currently included within the multi-year budget. Behavioral measures lists actions that can be undertaken by City staff as part of the *Culture of Conservation Program* or other non-technical measures such as developing energy policies or standards. These measures are elaborated further in section 6 of this report.

The measures and initiatives identified in the staff meetings provided specific guidance and direction to set new targets that were realistic and achievable. A final meeting with each service area on proposed 2019-2023 CDM Plan activities provided staff with an opportunity to confirm, review, and refine the preliminary energy initiatives and targets.

5. Targets for the 2019-2023 CDM Plan

In order to safeguard the success of the 2019-2023 CDM Plan, there are a number of goals and objectives that align with its development and implementation. The City's approach for the 2019-2023 CDM Plan is to set achievable targets by continuing to implement short term planned and proposed measures, adopt energy conservation resources into current capital investments already assigned, and review long term initiatives that have significant impacts on energy consumption and GHG emissions.

The 2019-2023 CDM Targets are categorised into Primary and Secondary targets with 2018 as the baseline year. Primary targets will be the main focus and will help achieve Secondary targets. Secondary targets are long term goals and initiatives that have significant impact on GHG and total utility consumption. These targets support the City's Strategic Plan outlined in section 1.1 of this report.

5.1 Primary Targets

The primary targets were developed by capturing all the planned, behavioral, and proposed initiatives that leads to measurable savings.

1. Total annual energy (ekWh) use reduction of 5% by 2023, tied to this goal are;
   - Total energy per capita (ekWh/pp) reduction of 10 percent
   - Avoided GHG emissions of 900 tonnes by 2023

2. Control energy cost increase within 5% of 2018 total costs over the 2019-2023 CDM plan

The recommended key initiatives (planned and behavioral) by various Service Areas are presented later in this document (Section 6) are expected to result in 8,100,000 ekWh reduction in total energy use, over 900 tonnes fewer GHG emissions, and 42 ekWh per person improvement in energy efficiency by 2023 (from the baseline year - 2018). Additionally, if all the proposed initiatives are implemented by the City, an additional three percent reduction can be achieved. If none of the energy efficiency measures are implemented for 2019 to 2023, the Business-As-Usual (BAU) forecasts overall energy consumption to increase by two point eight percent from 2018 baseline year as illustrated in Figure 7.

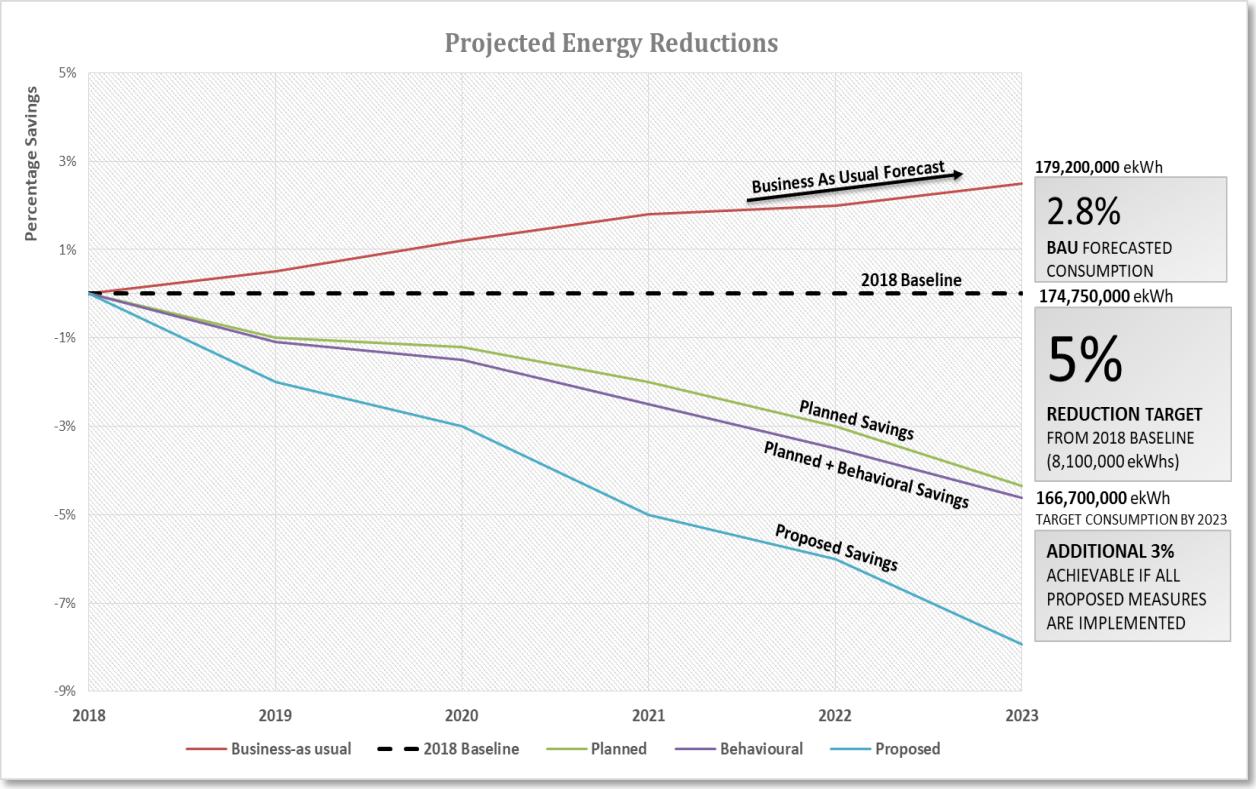


Figure 7 - Forecasts for business-as-usual energy use and planned, behavioral, and proposed savings

5.2 Secondary Goals

1. City staff will monitor and track water consumption and develop corporate water conservation initiatives for its administrative buildings starting 2019.
2. City staff will investigate different options for achieving net zero emissions from corporate activities by 2050, or possibly sooner.

5.2.1 Water Consumption

Water consumption contributes to second highest utility cost to the City, hence, it is important to track. Figure 8 illustrates that water cost is increasing year over year regardless consumption.

Implementing water efficiency at corporate level starts with understanding a facility's water-using processes. City's water consumption on a high level is broken down into two usages:

- 70 percent of the water consumption by the City is used for public pools, arenas, splash pad and for parks and recreation maintenance. It has been observed that this consumption closely follows cooling degree days.

- The rest 30 percent is consumed by City staff needs and for City operations (wastewater operations, vehicle wash, building cooling, etc.)

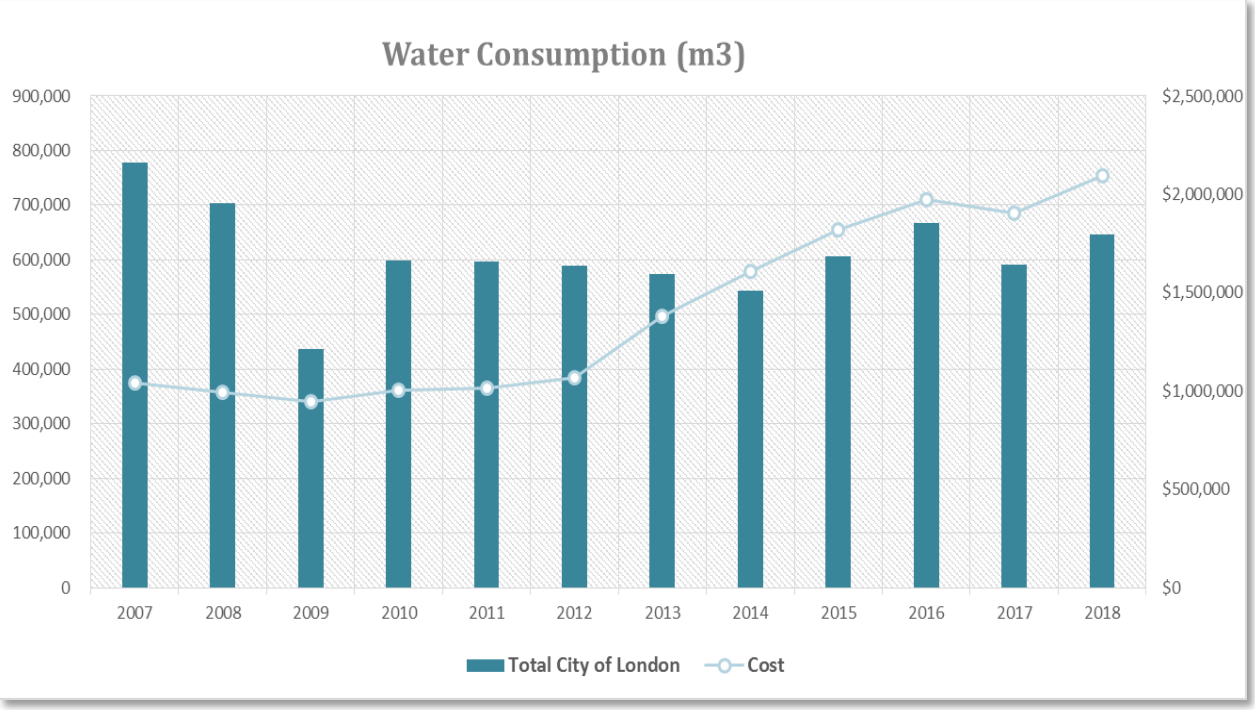


Figure 8 – City of London total water consumption (m3) from 2007 to 2018

As part of water monitoring and tracking initiative, going forward, facilities will conduct a water assessment which helps managers and owners understand how much their facilities use and which processes require the most water. This also helps identify potential water-saving opportunities.

Currently as part of a pilot project, Facilities service area is monitoring water usage in a number of facilities at a granular level via a specialized meter sensor for a combination of leak detection and usage anomalies. Facilities has also partnered with the Water Demand Management staff filed testing a number of waterless urinals.

5.2.2 Net Zero Emissions by 2050 or Sooner

The 2019-2023 CDM Plan aspires to set City operations on the path to net zero GHG emissions by 2050, or possibly sooner. Current corporate GHG emission trends and the primary targets listed in this report are on track and build momentum towards achieving net zero emissions by 2050.

The Ontario electricity grid has seen a reduction in emissions by almost 90 percent in the last decade alone, from 240 grams per kilowatt-hour (g CO_2e/kWh) in 2007 to 30 g CO_2e/kWh in 2018. As of 2018, over 90 percent of Ontario's electricity was generated by emissions-free facilities (nuclear, large hydro, and renewables). This enables the electrification of the City's light-duty fleet vehicles and building space heating as one pathway towards net zero emissions.

However, based on power supply forecasts provided by Ontario's Independent Electricity System Operator (IESO), The Atmospheric Fund estimates that GHG emission factors for Ontario's electricity grid will increase between 2018 and 2035, from 30 to 86 g CO_2e/kWh. This is due to an expected greater reliance on the use of natural gas to meet peak power generation as a result of the planned closure of the Pickering Nuclear Generating Station after 2024 and the Provincial Government's cancellation of the last round of renewable power generation procurement in 2018.

This could result in corporate energy-related GHG emissions increasing over the 2019-2023 timeframe even with the planned energy savings, given that electricity represents about 60 percent of corporate energy needs.

However, after 2035, it is assumed that Ontario's electricity grid will become emissions free by 2050 as these natural gas power plants, designed to meet peak demand needs, are replaced by renewable power generation combined with power storage systems.

Values, Forecasted Emissions Factors

	Emissions Factors (gCO_2eq/kWh)			
Year	**AEF**	**MEF**	**Peak MEF**	**Off-Peak MEF**
2019	34	118	133	106
2020	40	136	154	122
2021	41	140	158	125
2022	45	156	176	140
2023	63	219	247	197
2024	53	184	208	165
2025	82	284	321	255
2026	75	259	293	232
2027	72	247	279	221
2028	67	232	261	208
2029	73	251	283	225
2030	71	246	278	221
2031	84	292	329	262
2032	76	261	295	234
2033	78	270	304	242
2034	82	285	321	255
2035	86	296	335	266

Source: TAF, A Clearer View on Ontario's Emissions (June 2019)

City staff sees the following preliminary ideas as a pathways to net-zero emissions:

- The potential use of renewable natural gas (RNG) from the W12A landfill in heavy-duty fleet vehicles and building space heating. The City has enough potential RNG production capacity from its W12A landfill gas collection system to fuel all the City's heavy-duty vehicles as well as heat every City facility, and still have large quantities remaining to sell to other interested parties.

- City facilities is investigating adoption of carbon-neutral and passive house standards for new constructions. Facilities is also planning to pilot solar thermal and solar wall technologies to reduce natural gas consumption for building heating.

It is important to note that changes to federal and provincial legislation and regulations, as well as technological advances, are anticipated over the next decade that will impact the long-range energy initiatives.

The pathway to net zero emissions for City operations including the forecast for 2023 is illustrated in Figure 9.

Reaching net-zero GHG emission by 2050 or sooner is possible but will require increased changes in energy use, introduction of new technologies, investment in renewable energy, and fuel switching away from fossil fuels. During the next four years, City staff will continue to monitor best practices in other jurisdictions and prepare different scenarios for reaching net zero GHG emissions by 2030, by 2040, and by 2050.

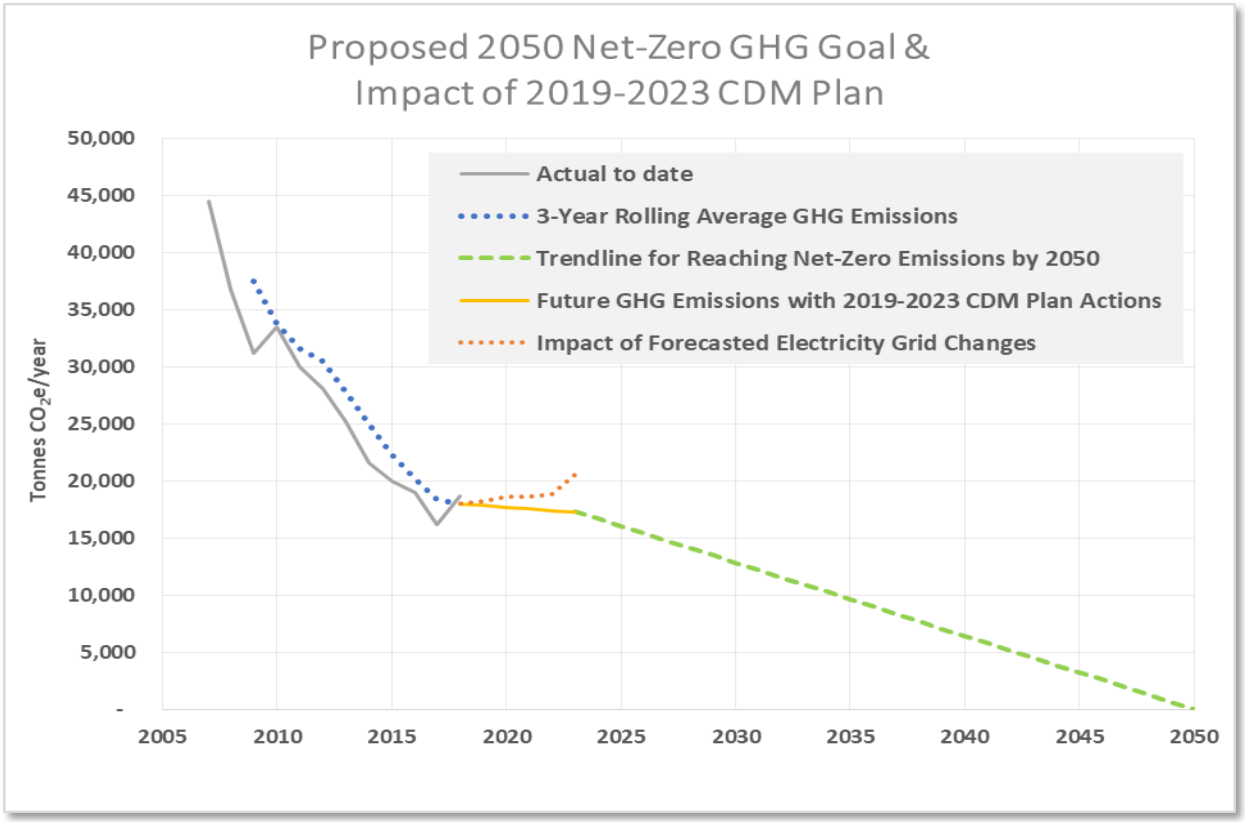


Figure 9 - Historical GHG emissions, emission forecast for 2023, and trend line for achieving net-zero emissions by 2050

6. Key Initiatives by Service Area

With the development of the 2019-2023 CDM Plan targets, a concept of integrated approach to energy management was essential. To accomplish the successful implementation of the 2019-2023 CDM plan, it is imperative that all the service areas be involved in the process. By reviewing the energy consumption and costs, key initiatives have been developed within each service area of the City as every area has a responsibility in energy management.

All the key initiatives listed in this section reflect a review and input from staff meetings and meet the unique needs of the City of London. As changes to the policies, legislation, technology, and climate occur, this list of initiatives will evolve. The initiatives listed below align with the 2023 targets and are within the control of the City.

Key initiatives have been classified into three categories:

Planned initiatives are those that have already been identified by service areas and are approved by the Council. These measures are largely included in existing capital and operating forecasts. All of these initiatives are near-term actions within each area and support the 2023 targets proposed in section 5 of this report. By 2023, these initiatives are expected to account for 4.3 percent of corporate energy use reduction and GHG reductions from 2018 levels.

Behavioural initiatives are “low cost” or “no cost” initiatives for the City. They are the center of the overall strategy to reduce energy use and associated GHG emissions within City buildings. It has been noted that “careless energy consumption in office buildings can add one-third to a building’s design performance, while conservation behavior can save (an additional) third” (source - Nguyen, T. & Aiello, M. (2013) Energy intelligent buildings based on user activity: A survey. Energy and Buildings. 56, 244.)

Behavioral initiatives in the current report lists employee engagement activities which have an impact on energy consumption. These initiatives are expected to contribute to 0.5 percent reduction in corporate energy use and GHG reductions by 2023.

Proposed initiatives are built upon the planned measures and initiatives, and required operational or policy changes. Business cases will be required to justify the project funding. Capital budgets will be impacted by the addition of qualified and approved projects. These initiatives will rely heavily on staff time and additional capital investment and will account for additional three percent of corporate energy use reductions.

As part of the 2020-2023 Multi-Year Budget deliberations, Business Cases has been identified for the following proposed actions to be undertaken by Environmental Programs alone:

- Feasibility studies that identifying and assess new projects for carbon curtailment
- Culture of Conservation employee engagement activities
- Improving energy efficiency performance measurement & reporting
- Electric vehicle charging stations, with cost recovery for the operations, maintenance and lifecycle replacement costs of these chargers

The current five percent reduction target is achievable even if the above Business Cases are altered or not approved due to other City of London priorities.

It is important to note that for a success of the 2019-2023 CDM Plan, service areas need to adopt and implement initiatives identified in this plan. The service areas that include planned, proposed and behavioral initiatives are categorised into Facilities, Water and Wastewater operations, Traffic and Streetlights Operations and Corporate Fleet.

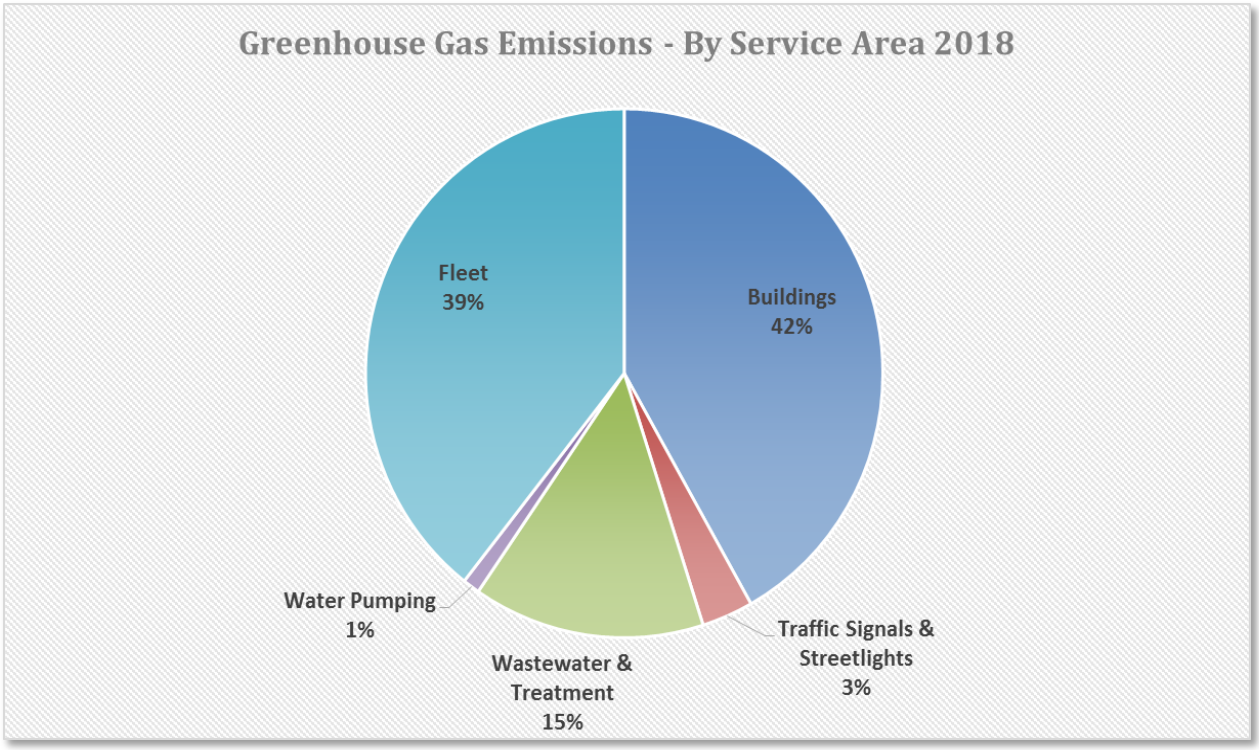


Figure 10 - Breakdown of GHG emissions by service area

6.1 Facilities

According to the Intergovernmental Panel on Climate Change (IPCC), "over the whole building stock, the largest portion of carbon savings by 2030 is in retrofitting existing buildings and replacing energy using equipment." This statement holds true when we analyse the City's total GHG emissions, where buildings contribute to the largest (42%) share of GHG emissions, followed by fleet vehicles (39%). The majority of building GHG emissions comes from natural gas consumption. See Figure 10 above.

- Facilities maintains and operates over 95 sites, 279 buildings, 304 hectares (750 acres) of property and approximately 315,870 square metres (3,400,000 square feet) of owned and leased space.
- Facilities Buildings account to 39% of the total corporate energy consumption.
- The proposed projects and initiatives under facilities buildings will contribute to 5% reductions in facilities total energy consumption and GHG emissions by 2023.

The Facilities service area is responsible for the design, construction, energy management, life cycle renewal works, and maintenance of facilities operated by the City with the exception of streetlights, wastewater treatment, sewer operations, and

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

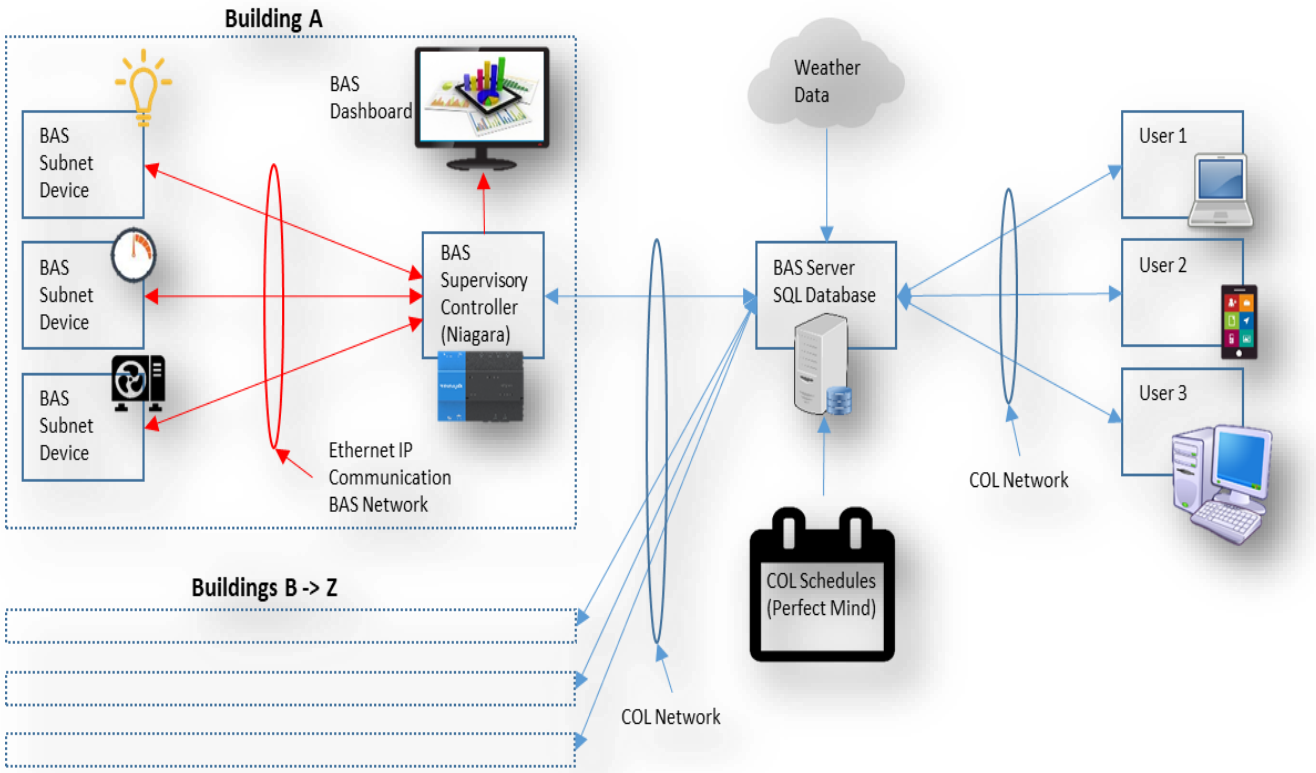
6.1.1 Planned Initiatives

Facilities is currently undertaking Phase Six of energy and lifecycle renewal audits with its energy service partner Ameresco Canada. Audits so far listed a series of energy projects that focused on:

- Energy management control system upgrades (EMS)
- Heating ventilation and air conditioning (HVAC) upgrades
- Lighting upgrades
- Installation of solar PV and
- Deep building energy retrofits

A few highlights of the planned initiatives are detailed below:

EMS Upgrades An energy management system (EMS) is a system of computer-aided tools used by operators to monitor, control, and optimize the performance of their systems. When applied to buildings, energy management systems are typically referred to as building automation systems (BAS).



Building automation is the centralized control of a building's mechanical and electrical subsystems, leveraging an interconnected network of sensors and meters to improve occupant comfort, optimize building efficiency and prolong equipment life through monitoring, alarming and reporting protocols. Such subsystems include, but are not limited to, HVAC, lighting, refrigeration and pumping with integration into scheduling, security and fire safety systems.

In Canada, using energy to heat and cool buildings accounted for 17 percent of the country's GHG emissions (*Senate Report posted 2018-11-19:* https://sencanada.ca/content/sen/committee/421/ENEV/reports/ENEV_Buildings_FINAL_e.pdf). Through a renewal of the City's building automation systems and leveraging on existing controls infrastructure, we plan to reduce each identified site's energy consumption (pools, community centers, arenas, etc.) by at least five percent.

Solar PV at East Community Centre

The installation and utilization of a solar photovoltaic (PV) array is an efficient and cost effective strategy to generate clean and renewable power.

As a demonstration project, the City invested funds to design and construct a 10kW PV array, placed on the roof of the East Community Centre, scheduled to open fall 2019. When installed, the PV array is estimated to generate 12,500 kWh annually.

6.1.2 Behavioral Initiatives:

Highlighted below are the behavioral initiatives that Facilities will be focused on;

1. Assign energy champions within City buildings to promote energy engagement events and promotional materials
2. Establish written operating procedures to control equipment systems operations so as to optimize energy efficiency and eliminate waste energy
3. Publish energy conservation posters where appropriate (light reminder posters, conservation messages, dashboards etc.)
4. Develop user friendly and "easy to understand" energy dashboard for Corporate facilities
5. Undertake building operator training workshops
6. Implement temperature optimization standard

6.1.3 Proposed Initiatives

To further the City's energy efficiency, Facilities will work on the following proposed initiatives to integrate energy management into daily operation processes and facility-based infrastructure decisions to support the 2019-2023 CDM Plan implementation.

1. Identify and implement natural gas savings projects
2. Phase out florescent and other traditional lighting technologies and adopt LEDs in all City Owned and operated buildings.
3. Develop a policy that all major renovations and new construction of city owned facilities include provisions to include a central Energy Management Controls System.
4. Continue to develop and review opportunities towards the development of renewable power generation projects
5. Development of a policy that all new City of London owned buildings and major renovations to the existing buildings be designed to Passive House or similar net-zero energy sustainable design guidelines/ standards

A list of all the planned and proposed energy savings projects are listed in Appendix B of this report.

Table 1 - Facilities Target

Target	Energy Consumption (ekWh)
2018	68,343,000
CDM target reduction	4,162,000
2023	64,180,000
Percentage reduction	6%

6.2 Water Operations

Water Operations provides continuing maintenance of the water storage, pumping and distribution system in the City of London to ensure that water can be conveyed to the residents of London. The City receives its treated water from both the Lake Huron Water Supply System (approximately 85 percent of the daily consumption) and the Elgin Area Water Supply System. A network of well fields, which remain inactive, have been maintained historically in case an emergency situation arises.

Water is delivered from Lake Huron to the Arva Pumping Station, where the City of London's water distribution system begins. Similarly, Lake Erie water is also delivered to the Elgin-Middlesex Pumping Station, from which the City assumes responsibility. Water Operations maintain, operate and control drinking water infrastructure, fire hydrants, water meters, and standby emergency well supplies through both operator-controlled and automated processes.

Water Operations is continuously monitored for energy efficiency opportunities as each litre of water delivered by the city requires energy for pumping which results in GHG emissions associated with the use of electricity and natural gas.

6.2.1 Planned and Proposed Initiatives

Water Operations is currently reviewing energy savings opportunities proposed by AECOM in a optimization study conducted in 2017 and 2018, and does not have any planned projects with capital budget assigned. However, there are a few proposed initiatives identified which support the 2019-2023 CDM Plan targets and listed as follows:

1. Develop on-going water conservation initiatives
2. Review participation in Global Adjustment Class A program for ARVA pumping station
3. Investigate and invest into on-site energy generation/renewable energy projects
4. Investment in future energy audits towards identifying new energy savings measures and opportunities on water operations infrastructure
5. Right-sizing equipment
6. Identify and implement pump optimization projects from the AECOM study recommendations
7. Complete the formal decommissioning and demolition of all wells and former Water facilities no longer in service
8. Downsize the Pond Mills Pumping Station service area, recognizing the capabilities of the Southeast Pumping station to provide service.
9. Review opportunities for revised operational procedures to lessen energy demands during periods of high market energy consumption

Highlights of the proposed initiatives include the following:

Water Conservation - Water Engineering team administers annual water conservation initiatives across the City. These initiatives include:

- Conducting water audits in partnership with facilities
- Designing and implementing a proactive leak detection and monitoring program throughout the City's distribution network.
- Improving the tracking of water used for construction, firefighting and maintenance through the use of reporting protocols and monitoring hardware.
- Funding and piloting water efficient fixtures in City facilities.
- Interval Water Data delivered through the MyLondonHydro online portal, which allows for hourly consumption data to be tracked and viewed.
- Working with Green Economy London to share conservation projects and opportunities with industrial, commercial and institutional customers.
- Upgrades to the MyLondonHydro portal to provide quicker notifications when high bills and leaks are detected.
- Implementation of the Growing Naturally Home Audit Program for members of the public, where user-specific data is generated and a water use report card is provided.
- Improved outreach material for teachers regarding the value of water, and made it more engaging and interesting for students.

- Attained portable water bottle filling stations to allow further participation in community events, allowing for the dissemination of communications materials to a larger variety of groups.

Energy Efficiency and Pump Optimization Study (Arva Pumping Station) - In 2017, City commissioned AECOM to complete energy efficiency and pump optimization study at Arva pumping station. AECOM partnered with VIP Energy to conduct the study. This was completed in 2018 and currently the City is reviewing the recommendations and developing a plan to implement identified projects. A few of the projects that the City is working in regards to energy efficiency include:

- Further detailed analysis of current process pumping operations, with opportunities to replace pumping units (including right-sizing) enhancing control equipment, and developing operational optimization;
- Review the current HVAC system, and replace aged AHU equipment with premium efficiency units;
- Install LED wall-pack fixtures and upgrading interior lighting, including occupancy sensors.

6.2.2 Behavioral Initiatives

1. Assign energy champions within major operational facilities to promote energy engagement events and promotional materials.
2. Undertake operator training workshops

Table 3 – Water Operations Target

Target	Energy consumption (ekWh)
2018	8,081,000
CDM target reduction	760,000
2023	7,321,000
Percentage reduction	9%

6.3 Wastewater Operations

- City of London Corporation owns operates five Wastewater Treatment Plants (WWTPs) and 36 pumping stations to assist wastewater flow to plants from gravity sewers or force mains.
- Wastewater operations are the second highest (29%) in utility consumption among corporate service areas.
- The initiatives identified in this section are planned to improve the energy efficiency of our wastewater operations by 9% in the next five years.

Wastewater Operations' primary focus is the treatment of incoming sewage to meet legislative requirements set out by the Ministry of the Environment, Conservation & Parks. The wastewater operations initiatives aim to optimize energy consumption while maintaining the required treatment standards and capitalize upon on-site energy generation and recovery. The initiatives presented in this plan are built upon the success of the opportunities identified and projects undertaken in the last five years (the 2014-2018 CDM Plan) and support the current primary and secondary targets of this report.

6.3.1 Planned Initiatives

Waste Heat Recovery from Sewage Sludge Incineration - The 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 utilize waste heat from its Fluidized Bed Combustor (FBC) unit to generate electricity for plant operations. Sludge, a by-product of the treatment process, is produced at each of our five WWTPs and is incinerated via Greenway's FBC. Greenway WWTP's FBC unit is used to incinerate cake (the product remaining after sludge is dewatered). 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, the 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 utilized by the ORC engine to generate 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 within the WWTP at current solids handling rates. This would reduce the Greenway WWTP's annual electricity load by 16 percent, which translates to a four percent annual reduction in City corporate-wide electricity load. The ORC engine is expected to produce 3,675 megawatt-hours (MWh) annually running at 24 hours and 330 days per year. The study also showed a co-generation of almost 9,300 equivalent megawatt-hours of reusable heat energy from this system.

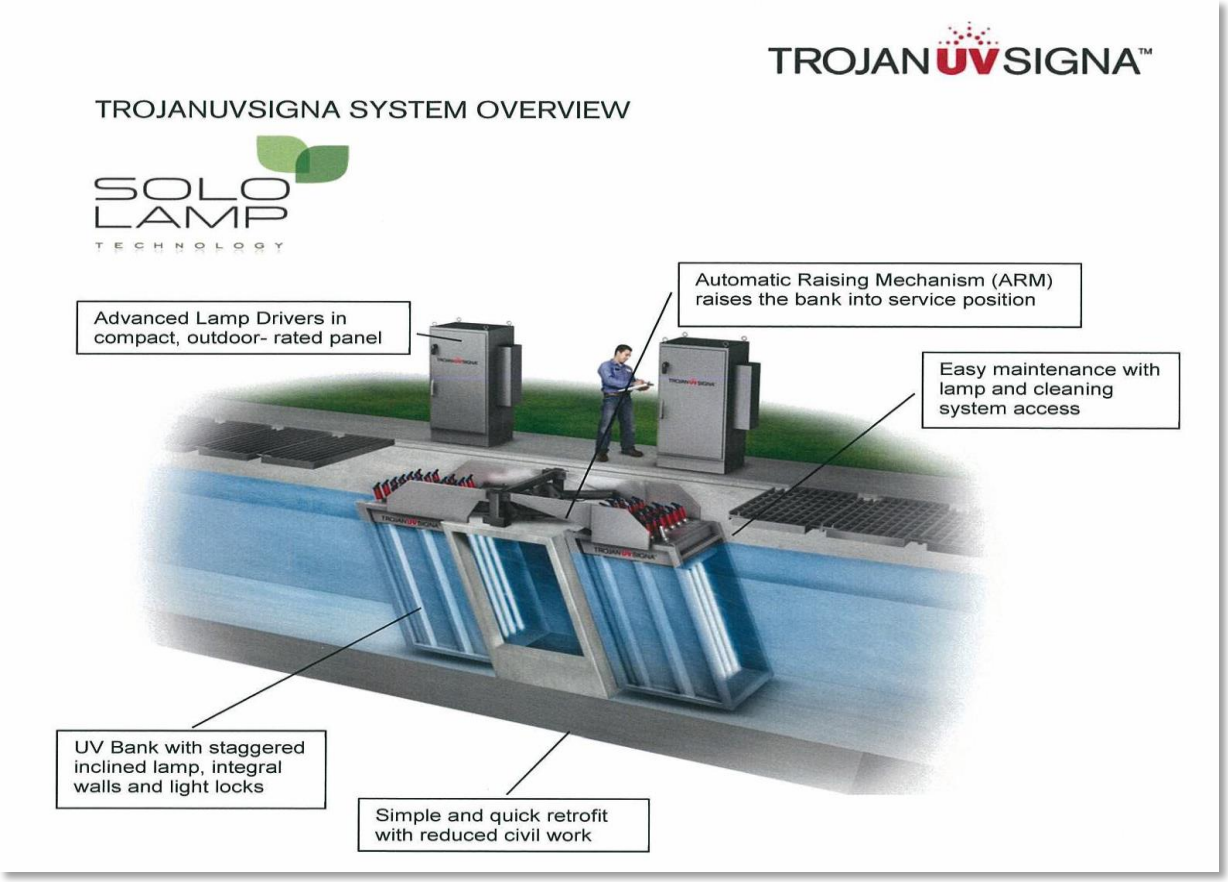
Energy recovery using the ORC unit is the largest energy savings project for the City. It also contributes to the London's Community Energy Action Plan which has "Making use of free heat and free light" & "Use of renewable energy" as key guiding principles. This project has been approved for $750,000 in incentives under the Industrial Accelerator Program (IAP) from London Hydro and the IESO.

The below table shows annual GHG emissions saved by using the electricity generated by the ORC system in lieu of electricity from the grid.

Estimated Method	**Annual GHG Emissions Reduction (tonnes)**
Electricity GHG savings using the grid-average emissions factor	110
Electricity GHG savings using fossil-on-margin emissions factor	580

Based on the economic and environmental benefits identified in the feasibility study, the City is currently working towards implementing the ORC system as a capital project for the Greenway WWTP. The timeline for project completion is estimated to be December 2020.

Ultraviolet (UV) Disinfection System Upgrade - As part of efficiency upgrade at Greenway and Adelaide WWTPs, the City is planning to replace the existing UV disinfection system, which is approaching the end of its asset life, with more current technology. UV is the most effective, safe and environmentally friendly way to disinfect wastewater. It provides broad spectrum protection against a wide range of pathogens, including bacteria, viruses and chlorine-resistant protozoa. However, these systems are energy intensive and accounts for seven percent and four percent of Adelaide and Greenway WWTPs total electrical energy use.



The planned system to be implemented is a Trojan UV Signa™ system that is proven to reduce energy consumption, costs and drastically simplify operation and maintenance of the system. Currently, the City is in the planning stages for this project and it will likely be implemented as part of a larger capital project at the Adelaide and Greenway treatment plants. These projects are expected to be completed and in operation by 2021.

Wastewater Treatment plant	**Expected energy savings from UV disinfection upgrade project**
Adelaide WWTP	153,000 kWh/year
Greenway WWTP	532,000 kWh/year

6.3.2 Behavioral Initiatives

1. Undertake operator training workshops.
2. Continue to build upon "Culture of Conservation" program to encourage employee engagement towards energy conservation in the workplace
3. Assign environmental champion to promote "Culture of Conservation" activities within WWTPs.
4. Develop and adopt energy dashboard for WWTPs.

6.3.3 Proposed Initiatives

1. Investigate solar PV installation opportunity at the five treatment facilities
2. Replace all the outdoor/indoor light (high pressure sodium/fluorescent) fixtures with LEDs.
3. Review and implement measures recommended in the Chemically Enhanced Primary Treatment Study by Western University on Adelaide treatment plant.
4. Utilize FOG cup generated waste as an additional fuel source for the ORC.
5. Review and implement measures recommended in monitoring and tracking study by UWO on Adelaide treatment plant.
6. Investigate and participate in battery storage technology for Class A Ontario peak days and Demand Response periods.
7. Investment in future energy audits towards identifying new energy savings measures including renewable projects and opportunities on WWTPs infrastructure.

Wastewater Operations Targets: Wastewater treatment is a highly energy intensive process which is required to provide a safe level of treatment in a compact footprint. Based on current planning estimates, it is expected that wastewater flows treated at the City's WWTPs will increase by approximately 18 percent over the next five years, largely as a result of new industrial contributions. As a result, energy consumption at our wastewater facilities is forecasted to increase by seven percent by 2023. These increases relate to processes necessary for treatment and therefore cannot be avoided. However, projects outlined in sections above improve the efficiency of wastewater related processes to ensure that energy used is done so in the most efficient manner possible. To reflect this, energy targets have been presented in terms of energy consumed (ekWh) per 1,000,000 L (Mega Litre –ML). The targets provided for 2023 demonstrate the City's continued path towards optimizing how we use energy.

Table 4 – Wastewater Operations Target

Target	Energy Efficiency (ekWh/Mega Liter)
2018	738
CDM target reduction	67
2023	671
Percentage reduction	9%

6.4 Traffic Signals and Streetlights

City of London has already completed LED conversion of 20,000 out of 35,000 streetlight fixtures from high pressure sodium fixtures in Phase One and Phase Two projects. This resulted in a 30 percent reduction of electricity consumption and a 14 percent reduction in utility cost to the City. Currently City is investigating conversion of the remaining 15,000 streetlights to LED as part of Phase Three, which covers all the remaining streetlights which are located along local streets or walkways connecting streets. Phase Three also covers 150 streetlight wall pack fixtures which are located at pedestrian tunnels. Savings associated with the proposed Phase Three project are shown in the below table.

Table 5 – Streetlights Target

Target	Energy consumption (ekWh)
2018	18,421,000
CDM target reduction	3,285,000
2023	15,136,000
Percentage reduction	18%

6.5 Fleet Services and Equipment

Fleet 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 program 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, London Animal Care Centre, EMS, Fire and Police Services.

- The Corporation's Fleet Services Division is responsible for over $54 million in municipal fleet and equipment assets.
- The Corporation's equipment and fleet consists of over 1,310 units ranging from hand held equipment like string trimmers, to light passenger vehicles, to a whole range of commercial vehicles like dump trucks, waste collection vehicles and heavy off-road and speciality equipment like graders, hydro-excavators and backhoes.
- Fleet contributes to 17% of the total energy consumption by the Corporation and is second highest in GHG emissions (39 percent).
- The fleet initiatives listed in this report contribute to 2% reduction in fleet fuel consumption and reduce 250 tonnes per year of GHGs by 2023.

6.5.1 Planned Initiative

CNG Transition of Solid Waste Trucks - In an effort to reduce its GHG emissions, Fleet Services and Solid Waste Operations have partnered in a plan to convert all of its solid waste collection trucks from diesel to compressed natural gas (CNG) by 2025. Council approved this project in early 2018 and the first phase of CNG trucks have been ordered. Six out of 37 trucks will be CNG by the first quarter of 2020. By end of 2023, 24 trucks will be converted into CNG. This contributes to 150 tonnes GHG emission reductions by 2023. A full transition of 37 trucks is scheduled by end of 2025.

Simultaneously, the City is investigating the use of renewable natural gas (RNG) from its W12A landfill to be used in solid waste collection trucks instead of CNG. If this initiative is successful and implemented before 2023 it would mean that the waste collection fleet would be powered 100 percent with the waste they collect. This in turn will increase the GHG emission reductions by three fold.

6.5.2 Behavioural Initiatives

1. Expansion and better use of idling data from Telematics systems
2. "Green Fleet" campaigns with end users around responsible green decisions (right sizing, fleet optimization, increased utilization, vehicle sharing, fuel savings and efficiency, idle management, changing behaviour)
3. Car share to reduce fleet size and limit underutilization

6.5.3 Proposed initiatives

Fleet Services' operations are built upon success achieved and lessons learned in the past five years. These key initiatives contribute to 2019-2023 CDM targets and are as follows:

1. Expansion of GRIP Idle Management technology
2. Expansion and better use of idling data from Telematics systems
3. Addition of electric vehicle chargers and vehicles at City Hall and AJ Tyler operations
4. Explore further expansion of CNG vehicles
5. Monitor and track Green Fleet performance through CDM targets and annual update reports.

Fleet Target **–** unlike other service areas of the City, Fleet Services' performance is measured to GHG emission reductions. This supports City's long term goals and Fleet Services' green initiatives.

Table 6 – Fleet Target

Target	GHG Emissions (tonnes)
2018	7,340
CDM target reduction	250
2023	7,090
Percentage reduction	3.5%

6.6 Other Area Measures

Other service areas of City of London listed below contribute indirectly to the 2019-2023 CDM goals.

Service Area	Goal	Proposed initiative
Purchasing and Supply	Source and identify energy efficient products during the procurement of equipment	Build upon the existing sustainable purchasing policy. Adopt Green procurement standards.
Purchasing and Supply	Energy procurement strategy for energy commodity	Continue to evaluate utility rates on behalf of the City's commodity supply arrangements to optimize rates favourable to the City
Asset Management (Facilities)	Adopt climate change impacts in financial planning	Assign funds to climate change mitigation actions such as reduce energy consumption and emissions reductions which are significant decision drivers when planning new assets or renovating existing assets.
Transportation Demand Management – Environmental Programs	Bikes and electrically-assisted bikes (e-bikes) in the Fleet, bike share corporate membership, car share corporate membership, full corporate participation in Commute Ontario, full bicycle facilities at all City facilities, carpool parking spaces at all City facilities.	Conduct survey to review the potential use for bikes and e-bikes in City fleet. Conduct annual surveys to assess City staff commute modal split. Add bicycle facilities to all City facilities. Add carpool parking spots to all City facilities. Explore feasibility of joining a car share and/or bike share program as a corporate member.

Service Area	Goal	Proposed initiative
Planning – Environmental and Parks Planning	Reduce energy consumption in City of London parks	Review lighting standards for parks to assess the needs and to adjust lighting requirements to suit time of use. Expand the use of solar-powered lighting and LED technology.
All Service Areas – Corporate Buildings and Facilities	All renovations to the existing buildings and assets to include an energy efficiency review to ensure targets and efficiencies are being considered	Develop a policy that all retrofits to infrastructure consisting of energy measures be reviewed by Energy Management Conservation Committee (EMCT) for comment.

All the *Planned, Proposed and Behavioural* initiatives listed in section 4 contribute to 8,250,000 ekWh of total energy savings which is equivalent to 1,030 tonnes of GHG reductions by 2023. Meeting 2019-2023 CDM targets will help in moving towards net zero emissions by 2050 (City of London's long term goal).

7. Implementation Structure

The intent of 2019-2023 CDM Plan is to prepare a document that is going to be used by the City to better manage energy use, reduce energy consumption and to demonstrate leadership in the community. For a successful implementation of the CDM Plan, City of London has identified the following areas of improvement: Organizing & Commitment, Motivation, Budget and Monitoring & Marketing.

7.1 Organizing & Commitment

The 2019-2023 CDM Plan is to be reviewed and updated annually to the council. The successful implementation of the 2019-2023 CDM Plan comes from commitment and collaboration from inter departmental staff. The level of commitment towards the CDM plan depends on the level of commitment by Council, senior management and staff at the City.

For stronger adoption of the 2019-2023 CDM Plan and its initiatives by various service areas, it is recommended that:

1. The City create and maintain *Energy Focused Service Area Groups* which meet weekly or bi-monthly to discuss on-going initiatives and best practices. Water and Wastewater Operations, Facilities and Fleet operations need to act on these initiative closely as they contribute to 80 percent of the emissions and energy consumption for the City.

2. Corporate energy management engineers need to be responsible for these energy committees representing all users and participate on as needed basis to discuss CDM initiatives, track progress and share region-wide initiatives.

7.2 Motivation

Education and awareness programs on energy conservation play an integral role in achieving and sustaining reductions in energy use. While efforts to adopt energy efficient equipment, maintenance and operational practices can be challenging, it is a much more difficult challenge to establish energy efficiency as a fundamental value. People tend to take energy for granted, and many are unaware of the opportunities they have to reduce energy use.

GHG emission reduction needs to be integrated into the everyday practices and thinking of more City of London staff. Increasing staff awareness towards energy use is therefore important to ensure the success of the energy efficiency initiatives.

Currently, corporate energy staff works with informal contacts in various service areas and with Human Resources (HR) staff to promote employee engagement events and messages. To leverage on existing mechanisms for employee engagement and motivation, corporate energy staff will:

1. Will contact major users through *Energy-Focused Service Area groups* chaired by an "*Environmental Champion*"
2. Continue to develop and improve upon the employee engagement program to solicit energy saving ideas from City of London staff
3. Take a holistic approach for promoting energy and environmental activities for City staff under the "Culture of Conservation" banner.
4. Develop and promote user friendly and "easy-to-understand" energy dashboard.

7.3 Energy Budget

The City has actively committed to many measures towards energy management in the past that have positioned us. Since the expansion of the Corporate Energy Management program in 2007, the City of London has assigned an annual budget of between $300,000 to $600,000 towards the program and the associated costs for energy management staff, feasibility studies, and other consulting costs. The City has also invested between $250,000 and $1 million per year in capital expenditures related to energy efficiency projects. The City has also spent approximately $14.5 million on energy efficiency motivated projects and lifecycle renewal projects with energy benefits in the last five years. To implement all the identified Planned and Behavioral measures of 2019-2023 CDM Plan, City is investing $6 to $8 million in the coming five years.

Additionally to implement standalone energy projects and initiatives with no budget constraints, it is recommended that:

1. The current Energy Revolving Fund which exists in Facilities be adopted by other major service areas as well to implement energy initiatives or standalone energy projects
2. It is recommended to tap into City's Efficiency, Effectiveness & Economy (EEE) Reserve to implement energy projects and green initiatives which contribute to the Strategic Plan's Building a Sustainable City goals.
3. Utilization of incentive opportunities from governmental and distribution companies towards energy projects.

Energy procurement strategy - The City will continue to seek and pursue energy procurement strategies to achieve cost certainty and best value. There is currently few options for electricity procurement in the marketplace, however, opportunities in the natural gas market continue to be available.

7.4 Monitoring and Marketing

Monitoring - The City currently monitors energy performance (natural gas, electricity and water) through the utilization of a billing analysis and accounting software suite, EnergyCAP. Furthermore, the City uses London Hydro's Interval Data Center to analyse minute-resolution electrical consumption and demand profiles to diagnose operational issues and perpetuate conservation efforts.

Moving forwards, the City will utilize RETScreen to develop and improve energy monitoring performance. RETScreen is an energy accounting software used to identify, assess and optimize the technical and financial viability of conservation projects, as well as ongoing energy performance analysis.

Reporting - In compliance with the Energy Conservation and Demand Management Plans Regulation (O.Reg. 507/18), the City will continue to report its annual energy use and GHG emissions using the Ministry's template on an annual basis. The City will submit its 2019-2023 CDM Plan Update report on November 1st, 2019. This update will serve as a report to document results of the initiatives identified the 2014-2018 CDM Plan and will be updated again in five years as per regulatory requirements.

Apart from the five year CDM plan reporting to the Ministry, Environmental Programs staff will be producing annual energy reports that will include:

- Impacts of energy projects/initiatives implemented by individual service areas.
- Progress towards the 2019-2023 CDM Targets
- Annual energy consumption compared with City's Strategic Plan baseline year of 2007 and CDM Plan updated baseline year of 2018.
- A revised forecast of Planned, Proposed and Behavioural measures.
- A description of any proposed changes to be made to assist the City in achieving established 2019-2023 CDM targets and forecasts.
- A report on the actual results achieved based on the energy initiatives of the 2019-2023 CDM Plan.

Celebrating Success - Previously energy management was promoted through informal contacts. The key focus in the development of 2019-2023 CDM Plan is to market the value of energy efficiency and performance of energy initiatives both within the organisation and outside it. The implemented energy measures and the results will be promoted internally via Environmental Champions under *Culture of Conservation* program. The success from staff and service area that make significant strides towards emission reductions will be recognised through employee recognition awards (BRAVO award, etc.), staff celebration, Team London forums and employee engagement or Community events.

The success of the 2019-2023 CDM Plan relies on adoption of the Plan by various service areas and City staff. Through the City's *Culture of Conservation* program, staff are further encouraged to participate in increasing corporate energy efficiency through behavioural-based ways (e.g., turn energy using infrastructure off or down when not needed).

The City is committed to following the direction of this plan, and will take the necessary steps to ensure its implementation and success. The CDM Plan is a living document that will provide a roadmap and build internal energy management knowledge and awareness that will provide the groundwork for successful energy management decisions and actions within all corporate operations for the next five years and beyond.

Appendix A

2014-2018 Completed Energy Projects:

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
Richmond Street	LED Roadway Lighting	3 MWh	10-01-14
EMPS	EMPS Pumps	850 MWh	31-01-18
Centennial Hall	Centennial Hall LED Exterior/Pots	7 MWh	31-01-14
Argyle Arena	Argyle Arena Cold Water Flood	26 MWh	07-02-14
Carling Arena	Carling Arena Cold Water Flood	32 MWh	07-02-14
Junior Achievement	Junior Achievement Lighting Retrofit	7 MWh	30-04-14
W12A Landfill	W12A Landfill T12 Retrofit	1 MWh	06-06-14
City Hall	City Hall Lobby Retrofit	28 MWh	30-05-14
Labatt Park	Labatt Park Interior Lighting Retrofit	5 MWh	31-05-14
Covent Garden Market	CGM Medium Bay Lights	243 MWh	30-05-14
City Hall	Cafeteria Lighting Retrofit	19 MWh	08-08-14
Oxford PCP	Aeration Upgrades - Oxford PCP	897 MWh	29-08-14
River Road Golf Course	Ligthing Retrofit	5 MWh	22-08-14
CGAC	CGAC Spectator RTU	6 MWh	31-10-14
CGAC	CGAC Pool Lighting	363 MWh	31-10-14
CGAC	CGAC Admin/Office RTU	2 MWh	31-10-14
CGAC	CGAC Pump VFDs	115 MWh	31-10-14
CGAC	CGAC Natatorium AHUs	MWh	31-10-14
CGAC	CGAC Make up Air	30 MWh	31-10-14
CGAC	CGAC Parking Lot Lights	21 MWh	31-10-14
CGAC	CGAC Building Automation System	10 MWh	31-10-14
Centennial Hall	Centennial Hall Pot Lights	13 MWh	31-10-14
Covent Garden Market	Rooftop Unit Replacement	2 MWh	30-06-14
Wilton Grove Yard Salt Storage	Wilton Grove Yard Salt Storage Lighting	3 MWh	30-10-14

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
Eldon House	Eldon House Lighting Upgrade	9 MWh	30-10-14
Stronach Arena	Stronach Gym - Lighting Retrofit	36 MWh	26-12-14
AJT Operations Centre	Victoria Park Christmas Lights	151 MWh	15-12-14
Streetlights	Phase 1 of the LED StreetLight Upgrade Program	4,958 MWh	10-08-15
Centennial Hall	Centennial Hall Interior Lighting Upgrades	20 MWh	20-02-14
Adelaide Operations Centre	Exterior Lighting Upgrades	8 MWh	20-04-15
Covent Garden Market	Rooftop Unit Replacement	5 MWh	04-05-15
Dearness Home	Dearness Home - Pot Light Retrofit Phase I	65 MWh	16-07-15
CGAC	General Lighting Upgrades	14 MWh	04-09-15
City Hall	Executive Parking Garage Lighting	29 MWh	22-09-15
Fire Department London	Exterior Lighting Upgrades	11 MWh	31-12-15
Oakridge Arena	Exterior Lighting Upgrades	9 MWh	30-06-16
Lambeth Community Centre	Exterior Lighting Upgrades	26 MWh	31-12-15
Farquharson Arena	Exterior Lighting Upgrades	8 MWh	11-12-15
Earl Nicols Recreation Centre	Arena Exterior Lighing Upgrades	41 MWh	31-12-15
Carling Heights	Exterior Lighting Upgrades	18 MWh	11-12-15
AJT Operations Centre	Exterior Lighting Upgrades	49 MWh	31-03-17
Kiwanis Senior's CC	General Lighting Upgrades	9 MWh	15-01-16
Carling Heights	General Lighting Upgrades	2 MWh	03-03-17

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
Adelaide PCP	Aeration Upgrades - Adelaide PCP	819 MWh	26-09-14
Vauxhall PCP	Aeration Upgrades - Vauxhall PCP	1,190 MWh	31-07-14
CGAC	CGAC Cogeneration project	465 MWh	31-03-17
Farquharson Arena	Farquharson Arena Insulate Walls	2 MWh	01-10-13
City Hall	Preventative Maintenance - Firehalls	136 MWh	01-06-14
City Hall	Preventative Maintenance - City Hall	203 MWh	01-06-14
City Hall	Culture of Conservation - City Hall	107 MWh	01-07-14
AJT Operations Centre	Culture of Conservation - AJT OC	89 MWh	30-06-15
Adelaide Operations Centre	Culture of Conservation - AOC	38 MWh	30-06-15
Exeter Road Operations Centre	Culture of Conservation - EROC	64 MWh	30-06-15
AJT Operations Centre	Direct Install Lighting Program	127 MWh	31-12-14
Centennial Hall	Centennial Hall Exhaust Air Correction	44 MWh	31-03-15
Farquharson Arena	On-demand Glycol pump control via soft start VFD	202 MWh	31-10-15
Centennial Hall	Centennial Hall Rooftop Unit	3 MWh	31-01-14
AJT Operations Centre	AJT 2nd Floor Office Lighting	13 MWh	31-03-17
Earl Nicols Recreation Centre	Arena Desiccant Dehumidification	86 MWh	30-06-18
AJT Operations Centre	Garage high bay and Main Building Interior Lighting Retrofit	92 MWh	30-11-17
AJT Operations Centre	HVAC upgrades	4 MWh	31-12-17

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
Oakridge Arena	Arena Desiccant Dehumidification	17 MWh	30-06-18
North London Optimist CC	Replace 4 pad mounted HVAC units	4 MWh	31-01-16
Earl Nicols Recreation Centre	Nichols Arena - Lighting Upgrades	3 MWh	31-03-17
City Hall	City Hall Executive Parking Garage Lighting Upgrade	29 MWh	22-09-15
City Hall	Arena Programming Consolidation	116 MWh	31-12-16
Argyle Arena	Argyle Arena - Equipment Summer Schedule	25 MWh	06-01-16
Adelaide PCP	Adelaide PCP Lighting Retrofit	25 MWh	30-06-18
Adelaide Operations Centre	Phase 6 - Adelaide OC Lighting	64 MWh	31-12-18
Argyle Arena	Phase 6 - Argyle Arena Level Ice Control	54 MWh	31-12-18
Carling Heights	Phase 6 - Pool Lighting Retrofit	69 MWh	31-12-18
Stronach Arena	Phase 5 - Arena Desiccant Dehumidification	31 MWh	28-02-17
Carling Arena	Floating Head Pressure Control	185 MWh	10-10-14
Kinsmen Arena	Phase 6 - Level Ice System	54 MWh	31-12-18
Stronach Arena	Phase 6 - Level Ice System	54 MWh	31-12-18
City Hall	Phase 2 of the LED StreetLight Upgrade Program	6,200 MWh	31-12-17
AJT Operations Centre	IPLC Smart Power Receptacle Reprogramming	251 MWh	01-02-17
Adelaide Operations Centre	IPLC Smart Power Receptacle Reprogramming	158 MWh	01-02-17
Exeter Road Operations Centre	IPLC Smart Power Receptacle Reprogramming	366 MWh	01-02-17
Oxford OC	IPLC Smart Power Receptacle Reprogramming	50 MWh	01-02-17

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
Citi Plaza	Lighting Retrofit - Citi Plaza	9 MWh	31-07-17
Oakridge Arena	Phase 6 - Floating Head Pressure Control	152 MWh	14-12-18
Labatt Park	Exterior Lighting Upgrades	12 MWh	07-06-18
City Hall	Exterior Lighting Upgrades	204 MWh	31-12-18
Dearness Home	Direct Digital Control System Upgrade Phase I	400 MWh	31-12-18
Stronach Arena	Floating Head Pressure Control	184 MWh	31-01-18
Argyle Arena	Argyle - Increase Humidity Setpoint	144 MWh	13-12-18
Carling Arena	Level Ice	54 MWh	30-11-18
Covent Garden Market	Ice Plant Upgrades	13 MWh	01-01-18
South London Community Center	LED Retrofit - Hallway Lighitng	20 MWh	31-12-18
Streetlights	Phase 2 LED streetlights	4,410 MWh	31-12-17
London Museum	Replace the existing building automation system chiller controllers with new controllers with optimized sequences.	25 MWh	20-05-18
Greenway WWTP	Replace the existing aeration blowers with new energy efficient turbo blowers at the pollution control plant	4,334 MWh	01-03-17
Arva Pumping Station	Optimize the utility and efficiency of the 700 horsepower (HP) pumps in the station by completing a combination of impeller trimmings and impeller replacements.	1,125 MWh	31-12-16

Appendix B

Planned Initiatives for 2019-2023

Facility Name	Project Name	Estimated/ Actual Electricity Savings (MWh)	Completion Date
AJ Tyler Operations Centre	Energy Management Control System Upgrades and Expansion	27,640	10-01-20
AJ Tyler Operations Centre	Rooftop HVAC Replacement	12,000	31-01-19
Adelaide Operations Centre	Energy Management Control System Upgrades and Expansion	25,524	31-01-20
Argyle Arena	Energy Management Control System Upgrades and Expansion	40,975	07-02-19
Argyle Arena	LED Ice Pad Lighting Upgrades	50,000	07-02-19
Blackburn Fountain	Energy Management Control System Upgrades and Expansion	3,750	30-04-20
Canada Games Aquatic Centre	Energy Management Control System Upgrades and Expansion	65,560	06-06-20
Carling Arena	Energy Management Control System Upgrades and Expansion	38,475	30-05-20
Carling Heights Optimist Community Centre	Energy Management Control System Upgrades and Expansion	38,475	30-05-20
Civic Garden Complex	Energy Management Control System Upgrades and Expansion	19,725	30-06-20
Dearness Home	Energy Management Program	423,044	30-05-21
Eldon House	HVAC Upgrades	10,350	30-04-20
Fire Hall 1	Energy Management Control System Upgrades and Expansion	14,390	30-10-19
Fire Hall 2	Energy Management Control System Upgrades and Expansion	17,987	30-12-19

Fire Hall 5	Energy Management Control System Upgrades and Expansion	3,917	30-06-20
Fire Hall 8	Energy Management Control System Upgrades and Expansion	3,317	30-12-19
Fire Hall 11	Energy Management Control System Upgrades and Expansion	5,695	30-12-19
Fire Hall 12	Energy Management Control System Upgrades and Expansion	11,292	30-05-20
J Allyn Taylor	Energy Management Control System Upgrades and Expansion	8,896	30-04-20
Kinsmen Arena	Energy Management Control System Upgrades and Expansion	47,572	30-09-20
Kinsmen Arena	LED Ice Pad Lighting Upgrades	50,000	30-08-20
Kiwanis Senior Centre	Energy Management Control System Upgrades and Expansion	9,195	30-05-20
Lambeth Arena and Community Centre	Energy Management Control System Upgrades and Expansion	26,682	30-04-21
North London Optimist Community Centre	Energy Management Control System Upgrades and Expansion	24,585	30-06-21
North London Optimist Community Centre	HVAC Upgrades	6,860	30-06-21
Earl Nichols Arena and Community Centre	Energy Management Control System Upgrades and Expansion	67,572	30-06-21
Earl Nichols Arena and Community Centre	LED Ice Pad Lighting Upgrades	75,000	30-06-21
Provincial Offences Act	Energy Management Control System Upgrades and Expansion	11,744	31-07-20

South London Community Centre	Energy Management Control System Upgrades and Expansion	15,987	25-02-20
South London Community Pool	Energy Management Control System Upgrades and Expansion	36,475	25-02-20
South London Community Pool	LED Natatorium Lighting Upgrades	12,500	30-03-20
Adelaide WWTP	UV disinfection technology upgrade –utilizing the Trojan UV Signa™ system	154 MWh	01-12-21
Greenway WWTP	UV disinfection technology upgrade –utilizing the Trojan UV Signa™ system	533 MWh	01-12-21
Greenway PCP	Installation of ORC engine to utilize waste heat and generate electricity	3,960	01-12-21
LED Streetlights	Phase 3 streetlights – convert remaing 15,000 fixtures to LEDs	3,300 MWh	01-12-23
Fleet	Convert Solid Waste Trucks to CNG	150 GHG tonnes	31-12-23