Agenda Including Addeds
Advisory Committee on the Environment

9th Meeting of the Advisory Committee on the Environment

November 3, 2021, 12:15 PM

Advisory Committee Virtual Meeting - during the COVID-19 Emergency

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NET-ZERO READY BUILDING CODES

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ABSTRACT

This paper provides an overview of current legislation and regulatory frameworks or proposals of three levels of government to achieve "net-zero energy ready" new construction over the next decade. The paper defines the performance standard, highlights policy drivers, and compares and contrasts the approach of three levels of government from the perspectives of technical performance of buildings, consistency, compliance and enforcement, and opportunities for transformative market change. While the scope of the paper is limited to current building code objectives, namely energy efficiency, it provides a foundation for future research on decarbonization and resiliency of buildings.

INTRODUCTION

This paper provides an overview of current legislation and regulatory frameworks or proposals of three levels of government to achieve "net-zero energy ready" new construction over the next decade. The three levels of government include the federal government publishing of the National Building Code of Canada (NBC), the Province of BC's Energy Step Code within the BC Building Code (BCBC) and the City of Vancouver's Building Bylaw and rezoning policy.

Codes Canada publishes the NBC and the National Energy Code for Buildings (NECB) approximately every five years, with the 2020 edition anticipated by the end of 2021. While the federal government publishes the NBC, it is the provinces, territories and charter cities such as Vancouver that adopt it in regulation, along with its various performance standards.

A key federal policy driver is the Pan Canadian Framework on Clean Growth and Climate Change. It states, "The Government of Canada will work with the provinces and territories to … develop a "net-zero energy ready" model building code, with the goal that provinces and territories adopt it by 2030" [ECCC 2016]. This precipitated amendments to the NBC and NECB that were posted for public review in early 2020.

The BCBC is adopted in regulation under the *Building Act*, applying to owners and developers of buildings. The *Local Government Act* and *Community Charter* enable local governments to implement the BCBC and enforce it through local government bylaws and building permits. Local governments are unable to enforce technical standards that are "matters" referenced in the BCBC unless the Building Act General Regulation [Queen Printer 2020-1] explicitly makes a matter "unrestricted" such as the form, exterior design, or finish of buildings relating to wildfire hazard (a topic of resiliency). In the case of the conservation of energy and the resultant reduction of greenhouse gas emissions, a local government can reference any step of the BC Energy Step Code in policy or bylaw.

A key policy driver is the 2018 CleanBC Plan that includes a commitment to "Improve the BC Building Code in phases leading up to 'net-zero energy ready' by 2032". This includes making homes and buildings 20 per cent more energy efficient by 2022, 40 per cent more energy efficient by 2027, and 80 per cent more energy efficient by 2032 – the net-zero energy ready standard" [BCECCS 2018].

The BCBC objectives include "Energy Efficiency and Water Use" to "limit the probability that, as a result of the design, construction or renovation of the building, the use of energy will be inefficient or the use of water will be excessive." [Queens Printer 2020-2]. Energy security, carbon intensity and resiliency are beyond the scope of this paper, but conclusions are drawn to inform future research on those topics.

The regulatory jurisdiction of the City of Vancouver is governed by the *Vancouver Charter*, and that includes authority to publish its own building bylaw with unique technical standards, including regulations for the reductions of greenhouse gas emissions [Queens Printer 2020-3]. In practice, the Vancouver Building Bylaw standards are harmonized with the BCBC, but in some areas adopt different standards. Vancouver's "rezoning policy" has very stringent energy efficiency and emission management standards which is only triggered when changes in density, height or use is sought.

Definition of Net-Zero Energy Ready

There are several definitions on 'Net-Zero Energy' (NZE) vs. 'Net-Zero Energy Ready' (NZER) buildings/houses. The following established definitions are frequently referenced:

- The Canada Mortgage and Housing Corporation [CMHC 2018] defines a NZE house as:

A house that is designed and built to reduce household energy needs to a minimum and includes on-site renewable energy systems, so that the house may produce as much energy as it consumes on a yearly basis.

- Natural Resources Canada [NRCan 2020] defines:

A Net-Zero Energy (NZE) house is a house that produces as much energy from on-site renewable energy sources as it consumes each year, and

A Net-Zero Energy Ready (NZER) house is a variant of the NZE house in which the builders have not installed the renewable energy generation system.

- BC Energy Step Council [ESC 2020] defines:

Net-zero energy buildings produce as much clean energy as they consume. They are up to 80 percent more energy efficient than a typical new building, and use on-site (or near-site) renewable energy systems to produce the remaining energy they need, and

A net-zero energy ready building is one that has been designed and built to a level of performance such that it could, with the addition of solar panels or other renewable energy technologies, achieve net-zero energy performance.

DISCUSSION AND RESULT ANALYSIS

The current and proposed codes and standards to achieve net-zero energy ready construction are highlighted below.

BC Energy Step Code

The BC Energy Step Code (ESC) was included as an optional compliance path into the BC Building Code (BCBC) in April 2017. The fourth and most recent amendment was included in the BCBC 2018 mid-cycle revision that took effect on December 12, 2019 [MAH 2019]. The BC ESC provides a technical "roadmap" to net-zero energy ready construction. It includes between three and five tiers for the following building types in all climate zones within the province:

- Part 9 residential;
- Part 3 hotels and motels;
- Part 3 residential;
- Part 3 office; and,
- Part 3 business and personal services or mercantile.

The tiers have increasingly stringent energy efficiency requirements for whole-building or mechanical end-use intensity, building envelope thermal performance, and in some cases airtightness. The BC ESC does not include prescriptive solutions; rather is exclusively a performance-based code. All buildings are required to undertake energy modelling and conduct a whole building airtightness test.

Tier 1 is always equivalent to the performance of the BCBC Division B acceptable solutions set out in section 9.36 or section 10.2. The BCBC s9.36 is based substantially on the NBC 2015 and s10.2 references both ASHRAE 90.1 2016 and NECB 2015 as acceptable solutions. The BC ESC energy modelling is primarily based on the performance paths of BCBC/NBC s.9.36.5 or NECB 2015 Part 8. It also references the City of Vancouver Energy Modelling Guidelines.

The most recent amendment to the BC ESC included a first tier (with no performance requirements) for Part 3 public sector archetypes, including schools, libraries, colleges, recreation centres, hospitals and care centres, effectively requiring energy modelling and air tightness testing for those buildings [MAH 2019].

The BC ESC top tier is designed to be equivalent to "net-zero energy ready" construction. For houses, Step 5 requires a mechanical end-use intensity (MEUI) as low as 25 $kWh/m^2/yr$, excluding plug load and lighting, a thermal energy demand intensity (TEDI) of 15 $kWh/m^2/yr$, and an airtightness of 1 air change per hour at 50Pa pressure differential (ACH_{50}). Passive House certified houses are deemed compliant with Step 5. An alternative Step 5 compliance path for TEDI includes a 50% improvement compared to an EnerGuide Rating system reference house. Alternative compliance paths for both TEDI and MEUI apply to Steps 2 through 4 based on EnerGuide; up to 40% for MEUI and 20% for TEDI, aligned with the NBC 2020. MEUI for all steps depend on climate zone, size of house, and use of cooling energy. TEDI requirements can be adjusted to reflect the specific heating degree days in the community where the house is located.

For multi-family residential buildings, Step 4 is the highest tier, with total energy use intensity (TEUI) as low as 100 $kWh/m^2/yr$ in Climate Zone 4, including plug load and lighting, and a TEDI of 15 $kWh/m^2/yr$. These figures increase to TEUI $\leq$ 140 and TEDI $\leq$ 60 in Climate Zone 8.

For hotels and motels Step 4 is the highest tier, with TEUI as low as 120 $kWh/m^2/yr$ and TEDI $\leq$ 15 in Climate Zone 4.

For other Part 3 buildings, the top tier is Step 3, with TEUI as low as 100 $kWh/m^2/yr$ and TEDI $\leq$ 20 in Climate Zone 4 for offices, and TEUI as low as 120 for business and personal service and mercantile occupancies with TEDI ≤ 20.

National Building Code 2020

Codes Canada conducted the final public review of the next edition of the national codes from January to March 2020. Two proposed tiered performance requirements were introduced: one for the NBC Section 9.36. (Part 9 Residential Buildings) and one for the NECB (Part 3 Buildings). The tiers represent voluntary standards that have been codified. This provides increased flexibility to authorities having jurisdiction (AHJ). It is up to the AHJ to decide whether to adopt a tier or not, and at which level. The publication of these voluntary tiers in the code should help industry and the public prepare for potential upcoming code changes, essentially ‘priming’ the market for upcoming code cycles.

Tiered Performance (NBC Section 9.36.)

The Proposed Code Change Form (PCF) 1617 [Codes Canada 2020-1] introduces a new Subsection that establishes tiered performance requirements by defining five tiers in terms of overall energy performance improvement, improvement in building envelope performance, and airtightness level. The tiers are based on a reference case of the 2015 NBC and represent percentage improvements in energy performance of 10%, 20%, 40% and 70% for Tiers 2 through 5 respectively. For the envelope, the improvements are 5%, 10%, 20% and 50% compared to the reference case.

For airtightness, there are two target levels, albeit the PCF 1610 [Codes Canada 2020-2] includes 6 possible levels that span from 3 air changes per hour (at 50Pa) to 0.6 ACH_{50}. Two additional airtightness methodologies using the Normalized Leakage Area (NLA) or the Normalized Leakage Rate (NLR) approach are included – the NLA@10 and the NLR@50.

To supplement this tiered approach, it adds a new Subsection on prescriptive requirements for compliance with Tier 2 above (i.e., 10% improvement compared to reference case, 5% improvement in building envelope, level 1 airtightness) based on a points system that links to dozens of performance improvement technologies and designs. This is documented in PCF 1611 [Codes Canada 2020-3].

Tiered Performance Requirements (NECB)

Similar tiered performance requirements were introduced for the NECB through PCF 1527 [Codes Canada 2020-4].

As Tier 1 requirements are the same as the balance of the NECB there is no cost impact or energy savings attributed to this Tier.

Table 1. *NBC 2020 Tiered Performance.*

Tier	Performance vs. Target	% Improvement of Envelope	Airtightness Level [1]
1	≥0%	n/a	Test only
2	≥10%	≥5%	1
3	≥20%	≥10%	1
4	≥40%	≥20%	3
5	≥70%	≥50%	3

Note (1): Airtightness Levels are defined in Table 3.

Table 2. *NBC 2020 Airtightness.*

Airtightness Level	ACH_{50}	NLA_{10}		NLR_{50}	
		cm^2	$in^2/100\,ft^2$	$L/s/m^2$	cfm_{50}/ft^2
1	3.0	1.92	2.76	1.17	0.23
2	2.5	1.60	2.3	0.98	0.19
3	2.0	1.28	1.84	0.78	0.15
4	1.5	0.96	1.38	0.59	0.12
5	1.0	0.64	0.92	0.39	0.077
6	0.6	0.38	0.55	0.23	0.046

Table 3. *NECB 2020 Tiered Performance.*

Energy Performance Tier	Performance of Proposed Building Relative to Performance of Reference Building (% building energy target)
1	≤ 100%
2	≤ 75%
3	≤ 50%
4	≤ 40%

Progressive Tiers were selected to improve efficiency levels, leading to a fourth tier which is equivalent to net zero energy ready performance. Based on Codes Canada committee work Tier 4 was originally set at 25% of the reference building energy target, or a 75% reduction in energy use, the modelling rules, non-regulated loads, and fixed loads, made this target near impossible to achieve for several building typologies [Personal communications between author and committee]. As a result, the Tier was increased to 40%, for the proposed NECB-2020, to enable progressive designs to achieve Tier 4 irrespective of building type.

The four tiers for the NECB are shown in Table 3.

Vancouver Building Bylaw (VBBL)

In July 2016, Vancouver City Council approved the Zero Emissions Building Plan, aimed at reducing emissions from new buildings by 90% in 2025 [Vancouver 2016]. The Plan also adopted a target of reducing emissions from all newly permitted building to zero by 2030. To achieve this, the City is setting limits on emissions and energy use in new buildings through several policy levers. As noted earlier, the Vancouver Building Bylaw closely matches the BC Building Code, with the exception of significantly more stringent standards for one- and two-family houses, not documented in this paper.

The Green Building Policy for Rezonings applies when a development falls outside of the "Community Plan" for the particular neighborhood with respect to height, density, occupancy and other factors. This represents a sizable proportion of construction activity in the city [Personal communication with City of Vancouver]. It includes two alternative compliance paths based on the carbon intensity of the fuels used for the building. Table 4 illustrates that energy efficiency requirements are less stringent for buildings with lower carbon fuels, resulting in an equivalent greenhouse gas intensity (GHGI) under both compliance paths.

Table 4. *VBBL Rezoning Requirements.*

Performance Limits Buildings Not Connected to a City-recognized Low Carbon Energy System			
Building Type	TEUI (kWh/m^2)	TEDI (kWh/m^2)	GHGI ($kgCO_2/m^2$)
Residential Low-Rise (< 7 storeys)	100	15	5
Residential High-Rise (7+ storeys)	120	30	6
Office	100	27	3
Retail	170	21	3
Hotel	170	25	8
All Other Buildings	EUI 35% better than Building By-law energy efficiency requirements, Section 10.2, in effect at the time of rezoning application		

Performance Limits Buildings Connected to a City-recognized Low Carbon Energy System			
Building Type	TEUI (kWh/m^2)	TEDI (kWh/m^2)	GHGI ($kgCO_2/m^2$)
Residential Low-Rise (< 7 storeys)	110	25	5
Residential High-Rise (7+ storeys)	130	40	6
Office	110	27	3
Retail	170	21	3
Hotel	170	25	8
All Other Buildings	EUI 35% better than Building By-law energy efficiency requirements, Section 10.2, in effect at the time of rezoning application		

TEUI: Total Energy Use Intensity
TEDI: Thermal Energy Demand Intensity
GHGI: Greenhouse Gas Intensity

Comparison and Analysis

The following highlight the differences between the four profiled "net-zero energy ready" codes – the BC Energy Step Code (BC ESC), the proposed National Building Code (NBC) 2020, National Energy Code for Buildings (NECB) 2020, and the City of Vancouver Green Buildings Policy for Re-zoning (COV).

All four codes include a performance path, leaving it to the developer/builder to ensure the building meets targeted performance outcomes. Up to four specific performance outcomes are required: (i) airtightness; (ii) energy use intensity (EUI), (iii) thermal energy demand intensity (TEDI), and (iv) greenhouse gas intensity (GHGI). Only the first requirement is measured, whereas the remaining three are modelled. The modelled values can be later verified through measured energy consumption and sub-metering; however, this falls outside of the timeframe that a building permit applies.

The primary driver for the BC ESC, NBC and NECB is energy efficiency. Up to three energy performance indicators are included – whole-building, building-envelope and airtightness. The NECB does not include TEDI. By having airtightness, TEDI, and/or a percentage envelope improvement to the reference building, the codes adopt an "building envelope first" framework, which prevents a designer from meeting the whole-building efficiency with mechanical solutions alone.

The COV drivers include both energy efficiency and greenhouse gas reductions, adding a limit to modelled emissions from the building, both direct from the combustion of fuels and indirect from the production of electricity. However, the approach allows for reduced energy efficiency for lower carbon fuels. This is misaligned with economic optimization given that low-carbon fuels are often higher cost to consumers and therefore there is rationale for increased levels of energy efficiency. This could compromise consumer affordability due to both lower energy efficiency and higher cost fuels. It would be appropriate to retain the TEDI between the two fuel choices for resiential, as Vancouver has done for office, retail and hotel (albeit not for residential), thereby reducing heat loss and protecting affordability.

Based on the author's experience the performance tiers of the BC ESC and COV are based on best practices of previously constructed buildings within generalized archetypes that represent a large proportion of construction. The reference case is based on a fixed EUI, TEDI and (for Part 9 Buildings only) airtightness level. In contrast the NBC and NECB are based on the building-specific reference case, a hypothetical building that aligns with the design and meets the prescriptive requirements of NBC and NECB. In all four codes, the design must have an energy performance that is better than the reference building.

In three of the codes (excluding COV), the lower tiers are aligned with financially optimized design solutions with a positive net-present value (NPV) of energy bill reductions versus incremental capital costs based on [BC Housing 2018]. The upper tiers are based on technical best practices and best-available technologies, which in some cases have a positive NPV and in other cases are not strictly "cost-effective", depending on the architectural design of the building. However, the financial assessment overlooks the fact that current carbon pricing is unlikely to address the necessary costs to mitigate emissions, and henceforther market failures exist, a topic for future research.

With their fixed reference cases, the BC ESC and COV approaches allow for greater consistency, verifiability and enforcement. In contrast, the NBC and NECB with hypothetical reference cases can vary for each individual designer and energy modeller, thereby reducing consistency across the marketplace. The local autorities having jurisdiction will be unlikely able to verify the reference case due to the complexity of modelling. Several BC urban municipalities have concerns with the reference case for thermal performance in lieu of TEDI, suggesting this will undermine the "building envelope first" design approach. Absent a formal evaluation, measurement and verification system with calibrated energy modelling, it will be difficult to identify the differences between designers. Furthermore, the BC ESC and COV use energy modelling guidelines to enhance consistency, and the Engineers and Geoscientists of BC and Architectural Institute of BC have published professional practice guidelines for energy modelling services.

There are some differences in the number of tiers and their stringency, depending on the particular code. For Part 9 Buildings, both the BC ESC and NBC have the same number of steps and similar expectations of performance improvements of 10%, 20%, 40% and 50+% based on BC Housing [2018]. However, the airtightness requirements for the equivalent tier of the NBC are less stringent. For example, the Step/Tier 3 airtightness is 3ACH50 and 2.5ACH50 for NBC and BC ESC respectively. For Step/Tier 5, those compare at 2ACH50 and 1ACH50.

For Part 3 buildings, the BC ESC and NECB have the same number of steps, but slightly different expectations of performance improvements based on BC Housing [2018]. BC ESC steps 2, 3 and 4 are estimated to achieve improvements up to 40%, 50% and 60% [BC Housing 2018]. The percentage improvements in NECB-2020 are 25%, 50%, and 60% for tiers 2,3,4 respectively, as compared the prescriptive standards in NECB. To allow for comparison, separate research pegs NECB-2017 as about 5-9% improvement compared to NECB-2015 in British Columbia [EnerSys 2018], similar to the anticipated performance of NECB-2020. Thus, expected BC ESC Step 4 savings are 51-55% compared to NECB-2020, potentially less stringent than the 60% improvement of Tier 4 in NECB-2020.

COV standards are comparable to BC ESC Step 3 for buildings over 7 storeys, and Step 4 for lower buildings. The Higher Building Policy is aligned with BC ESC Step 4, the equivalent to net-zero energy ready construction.

CONCLUSION

This paper has summarized four alternative "technical roadmaps" to net-zero energy ready construction, including the BC Energy Step Code, the proposed changes to the National Building Code and National Energy Code for Buildings and the Vancouver Rezoning Policy. The two significant differences were:

(1) The national codes are based on a hypothetical reference building of the same configuration being designed with prescriptive standards. Whereas, the BC ESC and COV have fixed energy performance references associated with a generic archetype building.

(2) The COV policy emphasizes greenhouse gas reduction, whereas the national codes and BC ESC emphasize energy efficiency.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the comments provided by Norm Connolly, City of Richmond during the preparation of this paper.

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Codes Canada. 2020-2. Public Review - National Building Code of Canada 2015 (Proposed Changes): PCF 1610-Measured Airtightness 9.36.

Codes Canada. 2020-3. Public Review – National Building Code of Canada 2015 (Proposed Changes): PCF 1611-Prescriptive Requirements for Energy Performance Improvement.

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Natural Resources Canada (NRCan). Net Zero Energy (NZE) Housing webpage. Accessed March 2, 2020.

Queens Printer BC-1. Building Act General Regulation. Accessed March 2, 2020.

Queens Printer BC-2. British Columbia Building Code 2018. Accessed July 31, 2020.

Queens Printer BC-3. Vancouver Charter. Accessed July 31, 2020.

Advisory Committee on the Environment

Report

7th Meeting of the Advisory Committee on the Environment
September 1, 2021
Advisory Committee Virtual Meeting - during the COVID-19 Emergency

Attendance PRESENT: M.T. Ross (Chair), N. Beauregard, M. Bloxam, J. Howell, K. May, M.D. Ross, J. Santarelli, D. Szoller, A. Tipping and B. Vogel and J. Bunn (Committee Clerk)

ALSO PRESENT: T. Arnos, J. Stanford and B. Westlake-Power

The meeting was called to order at 12:15 PM.

1. Call to Order

1.1 Disclosures of Pecuniary Interest

That it BE NOTED that no pecuniary interests were disclosed.

1.2 Election of Chair for the Remainder of the Current Term

That it BE NOTED that the Advisory Committee on the Environment elected M.T. Ross and J. Santarelli as Chair and Vice Chair, respectively, until the end of the current term.

2. Consent

2.1 5th and 6th Reports of the Advisory Committee on the Environment

That it BE NOTED that the 5th and 6th Reports of the Advisory Committee on the Environment, from the meetings held on June 2, 2021 and August 4, 2021, respectively, were received.

2.2 Municipal Council Resolution - 4th Report of the Advisory Committee on the Environment

That it BE NOTED that the Municipal Council resolution, from its meeting held on June 15, 2021, with respect to the 4th Report of the Advisory Committee on the Environment, was received.

2.3 Municipal Council Resolution - 5th Report of the Advisory Committee on the Environment

That it BE NOTED that the Municipal Council resolution, from its meeting held on July 6, 2021, with respect to the 5th Report of the Advisory Committee on the Environment, was received.

2.4 Notice of Study Completion - Pottersburg Creek Sanitary Trunk Sewer

That it BE NOTED that the Notice of Study Completion, from A. Corpodean, Technologist II, with respect to the Pottersburg Creek Sanitary Trunk Sewer, was received.

2.5 Climate Emergency Action Plan (CEAP) - London Hydro Questions and Answers

That it BE NOTED that the communication, dated July 27, 2021, from T. Arnos, London Hydro, with respect to the Climate Emergency Action Plan (CEAP) and London Hydro Questions, was received.

2.6 2022 Mayor's New Year's Honour List - Call for Nominations

That it BE NOTED that the communication, dated July 9, 2021, from C. Saunders, City Clerk and B. Westlake-Power, Deputy City Clerk, with respect to the 2022 Mayor's New Year's Honour List Call for Nominations, was received.

3. Items for Discussion

None.

4. Confidential

4.1 Personal Matters / Identifiable Individual

The Advisory Committee on the Environment convened in closed session from 12:44 PM to 12:51 PM after having passed a motion to do so, with respect to a personal matter pertaining to identifiable individuals, including municipal employees, with respect to the 2022 Mayor’s New Year’s Honour List.

5. Adjournment

The meeting adjourned at 1:00 PM.

Advisory Committee on the Environment
Report

8th Meeting of the Advisory Committee on the Environment
October 6, 2021
Advisory Committee Virtual Meeting - during the COVID-19 Emergency

Attendance

PRESENT: M.T. Ross (Chair), M. Bloxam, J. Howell, K. May and B. Vogel and J. Bunn (Committee Clerk)

ABSENT: N. Beauregard, M.D. Ross, J. Santarelli, D. Szoller and A. Tipping

ALSO PRESENT: T. Arnos, M. Fabro, J. Skimming, J. Stanford and B. Westlake-Power

The meeting stood adjourned at 12:45 PM due to lack of quorum.

Report to Civic Works Committee

To: Chair and Members
Civic Works Committee
From: Kelly Scherr, P.Eng., MBA, FEC
Deputy City Manager, Environment & Infrastructure
Subject: 2020 Community Energy Use and Greenhouse Gas Emissions Inventory
Date: August 31, 2021

Recommendation

That, on the recommendation of the Deputy City Manager, Environment & Infrastructure and City Engineer, the following actions **BE TAKEN:**

a) this report on the 2020 Community Energy Use and Greenhouse Gas Emissions Inventory **BE RECEIVED** for information; and,

b) this report **BE CIRCULATED** to the Advisory Committee on the Environment (ACE), Transportation Advisory Committee (TAC), Cycling Advisory Committee (CAC), Trees and Forestry Advisory Committee (TFAC), Agricultural Advisory Committee (AAG) and Environmental & Ecological Planning Advisory Committee (EEPAC) for their information.

Executive Summary

The 2020 Community Energy Use and Greenhouse Gas Emissions Inventory provides an overview of the energy used in the London community. This report covers all significant energy sources used in London: natural gas, gasoline, electricity, diesel, fuel oil, and propane. Energy-using sectors covered by the inventory include transportation, residential, industrial, commercial, and institutional. It also includes an estimate of the total cost associated with these energy needs and the greenhouse gas emissions associated with these energy sources. The COVID pandemic has had a major influence of energy use and greenhouse gas emissions.

2020 Community Energy Use

The impact of the COVID pandemic on transportation energy use was significant, which was 20 percent lower than 2019 overall. In particular:

- the amount of gasoline and diesel sold at London's gas stations dropped by 21%;
- Londoners used the opportunity provided by quieter roads to ride their bikes, with the estimated total distance of trips taken by bike increasing by 20% in 2020; and,
- The number of vehicles registered in London in 2020 decreased by 6%.

Energy used in London's single-family homes was down by four percent overall. Electricity use in homes did increase due in part to shifting to work from home as well as warmer summer temperatures increasing the demand for air conditioning. However, natural gas use decreased due to warmer winter and autumn weather reducing the demand for interior heating.

Energy used by London's industrial, commercial, and institutional sector remained relatively unchanged in 2020.

It is estimated that Londoners spent about $1.35 billion on energy in 2020, a decrease of 11 percent from 2019. The improvements in energy efficiency seen since 2010, combined with the COVID-19 pandemic, are estimated to have saved Londoners $380 million in avoided energy costs in 2020. Added up year-over-year, London has avoided over $1.3 billion in energy costs due to improved efficiency since 2010. On average, every percentage that Londoners reduce their energy use results in around $13 million staying in London.

2020 Greenhouse Gas Emissions

London's current greenhouse gas emission reduction targets are:

- 15% reduction from 1990 levels by 2020;
- 37% reduction from 1990 levels by 2030; and,
- Net-zero emissions by 2050.

In April 2021, the federal government revised its 2030 target to aim for a 40 to 45 percent reduction in greenhouse gas emissions from 2005 levels as well as net-zero emissions by 2050. To date, the provincial government has not revised its 2030 target for a 30 percent reduction from 2005 levels and has not established an emission reduction target beyond 2030.

Total greenhouse gas emissions in 2020 were over 2.7 million tonnes of equivalent carbon dioxide, or 22 percent lower than the 1990 level. This is well below the 15 percent reduction target set for 2020. However, it is important to note the extraordinary impact of the COVID-19 pandemic on emissions.

The COVID-19 pandemic has shown the impact that transportation demand management activities such as working-from-home can have on reducing emissions. This highlights the importance of new City-led measures to be developed in the upcoming Mobility Master Plan. There is also the potential role that building energy retrofits can play as part of the London Community Recovery Network.

Annual reporting on community energy use and resulting greenhouse gas emissions has been underway since 2012 These details are part of the foundation for the development of the Climate Emergency Action Plan, a response to the climate emergency declaration. Complete details are found in Appendix A: 2020 Community Energy Use and Greenhouse Gas Emissions Inventory – Executive Summary and Appendix B: 2020 Community Energy Use and Greenhouse Gas Emissions Inventory – Report.

Linkage to the Corporate Strategic Plan

Municipal Council continues to recognize the importance of climate change mitigation, sustainable energy use, related environmental issues, and the need for a more sustainable and resilient city in its 2019-2023 - Strategic Plan for the City of London. Specifically, London's efforts in climate change mitigation address four of the five Areas of Focus, at one level or another:

- Strengthening Our Community
- Building a Sustainable City
- Growing our Economy
- Leading in Public Service

Analysis

1.0 Background Information

1.1 Previous Reports Related to this Matter

- Report to the October 22, 2019 Civic Works Committee (CWC) Meeting, 2018 Community Energy and Greenhouse Gas Inventory (Agenda Item #2.9)

1.2 Context

Addressing the Need for Action on Climate Change
On April 23, 2019, the following was approved by Municipal Council with respect to climate change:

> *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.*

The 2020 Community Energy Use and Greenhouse Gas Emissions Inventory report is the measurement tool to highlight London's progress towards meeting its community energy reduction and greenhouse gas reduction targets along with other targets and directions.

Background
The City of London does not have direct control over how much energy is used in London, but it does have influence. The control over energy use in London rests primarily with citizens, visitors, employers, and employees. Individual and collective action with respect to sustainable energy use, energy management, and energy conservation is critical for our future.

Continuing from London's previous 2014-2018 Community Energy Action Plan, the upcoming Climate Emergency Action Plan will continue to place a priority on providing Londoners with annual information on community energy use and greenhouse gas emissions. London's current greenhouse gas emission reduction targets are:

- 15% reduction from 1990 levels by 2020;
- 37% reduction from 1990 levels by 2030; and,
- Net-zero emissions by 2050.

In April 2021, the federal government revised its 2030 target to aim for a 40 to 45 percent reduction in greenhouse gas emissions from 2005 levels as well as net-zero emissions by 2050. To date, the provincial government has not revised its 2030 target for a 30 percent reduction from 2005 levels and has not established an emission reduction target beyond 2030.

The three most common benchmark dates used by City staff to report on overall progress are:

- 1990 – The first year that for which London's community-wide greenhouse gas emissions and energy use were determined, as well as Province of Ontario's previous baseline year;
- 2005 – the baseline year used for the Government of Canada's and the new Province of Ontario's greenhouse gas reduction targets; and,
- 2010 – the first year for which total energy cost data was determined in London.

The 2020 Community Energy Use and Greenhouse Gas Emissions Inventory provides an overview of the energy used in the London community. This report covers all significant energy sources used in London: natural gas, gasoline, electricity, diesel, fuel oil, and propane. Energy-using sectors covered by the inventory include transportation, residential, industrial, commercial, and institutional. It also includes an estimate of the total cost associated with these energy needs and the greenhouse gas emissions associated with these energy sources. In addition, this report also includes the greenhouse gas emissions associated with the City of London's W12A Landfill and closed landfill sites, as well as sewage sludge incineration at the Greenway Wastewater Treatment Plant.

The City of London also reports this information on an annual basis to CDP Cities and the Global Covenant of Mayors for Climate & Energy.

2.0 Discussion and Considerations

The 2020 Community Energy Use and Greenhouse Gas Emissions Inventory report can be found on the Get Involved London Climate Emergency Action Plan website. Highlights from the 2020 report are below in two categories:

1. Community energy use by product and sector including cost spent on energy
2. Greenhouse gas emissions and progress towards current targets

Energy use accounted for 95 percent of community greenhouse gas emissions. Not only does burning fossil fuels such as gasoline, diesel, and natural gas produce carbon dioxide – the most common greenhouse gas associated with human activity – but the use of electricity also contributes to greenhouse gas emissions. The remaining five percent of greenhouse gas emissions are methane emissions from landfills and nitrous oxide emissions from sewage sludge incineration.

2.1 2020 Community Energy Use

Energy use by sector in London was as follows:

- 44% from industrial, commercial, and institutional buildings and facilities;
- 31% from transportation, primarily cars and trucks on London's roads; and,
- 25% from single-family residential homes.

There are four major energy commodities used in London – natural gas, gasoline, electricity, and diesel. The following table summarizes the impact of these energy commodities in terms of total energy use, total cost, and greenhouse gas emissions.

Energy Commodity	Share of Total Energy Used (in terajoules)*	Share of Total Energy Costs	Share of Energy-related GHG Emissions
Natural gas	47%	21%	51%
Gasoline	20%	27%	29%
Electricity	21%	42%	4%
Diesel	8%	7%	11%
Other	4%	3%	5%

Table Note: * a terajoule (or, one trillion joules) is a metric unit for measuring energy and is approximately equivalent to the energy provided by burning 26,000 litres of gasoline (roughly the amount of gasoline in 500 cars).

The impact of the COVID-19 pandemic on transportation energy use was significant, which was 20 percent lower than 2019 overall. In particular:

- the amount of gasoline and diesel sold at London's gas stations dropped by 21% because of many London workplaces shifting to work-from-home as well as reduced non-work automobile trips associated with stay-at-home orders and similar restrictions;

- Londoners used the opportunity provided by quieter roads to ride their bikes, with Google's Environmental Insights Explorer estimating the total distance of trips taken by bike increasing by 20% in 2020; and,

- The number of vehicles registered in London in 2020 decreased by 6%.

Other highlights of recent community energy use progress and longer-term trends, include:

- **The total amount of energy used in London in 2020 was 55,100 terajoules.** This is an 8% decrease from 2019.

- **Londoners are using energy more efficiently** – on a per person basis, Londoners and London businesses used 21% less energy overall in 2020 than used in 1990.

- **London is producing more goods and services for every unit of energy used** – on a dollar gross domestic product (GDP adjusted for inflation) per unit energy basis, London's industrial, commercial, and institutional sector improved the value of goods and services produced per unit of energy used by 37% between 1990 and 2020.

- **$1.35 billion was spent by Londoners and London businesses on energy in 2020**. This is a decrease of 11% from 2019. As noted earlier, the response to the COVID Pandemic reduced the demand for gasoline, which also reduced the price for gasoline in 2020. In total, Londoners spent about $170 million less on gasoline in 2020 than they did in 2019. Almost 90% of the $1.35 billion leaves London. On average, every 1% reduction in energy use keeps about $13 million from leaving the local economy.

- **London is spending less money on energy** – The improvements in energy efficiency seen since 2010, combined with COVID, are estimated to have saved London $380 million in avoided energy costs in 2020. Added up year-over-year, London has avoided over $1.3 billion in energy costs due to improved efficiency since 2010.

In addition, since 1990, on an energy used per person basis:

- Transportation fuel use has decreased by 31%;
- Energy use to heat and power single-family residential homes has decreased by 21%; and,
- Energy use to heat and power industrial, commercial, and institutional buildings decreased by 12%.

Prior to COVID, vehicle ownership in London had grown by over four percent every year on average between 2010 and 2019, much faster than London's overall population growth. As of December 2020, the number of light-duty vehicles registered in London dropped by six percent to just over 273,000 vehicles. This works out to about 0.86 vehicles per person aged 20 to 84.

In terms of low-emission vehicles, the number of hybrid and/or electric vehicles in London is almost six times higher in 2020 compared to 2010. There are also now over 1,000 electric vehicles registered in London. Almost one percent of new 2020 model year vehicles registered were electric vehicles and four percent were hybrid vehicles.

On the negative side, high gas-consuming sport utility vehicles and large pick-ups continue to gain in popularity as the relative number of minivans and mid-sized sedans decline.

Figure 1 illustrates the trend in energy use for major energy-using sectors on a per person basis since 1990. Figure 2 illustrates the trend for energy costs by commodity since 2010.

Figure 1 – Change in Energy Use in London, Per Person, by Sector Since 1990

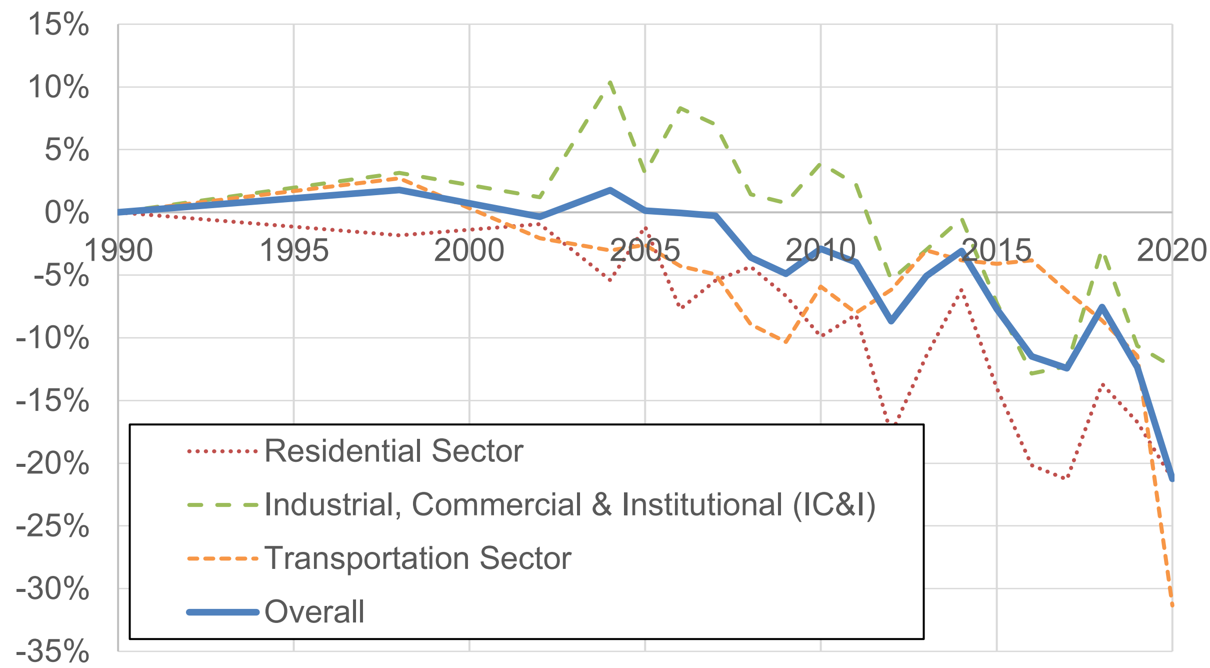
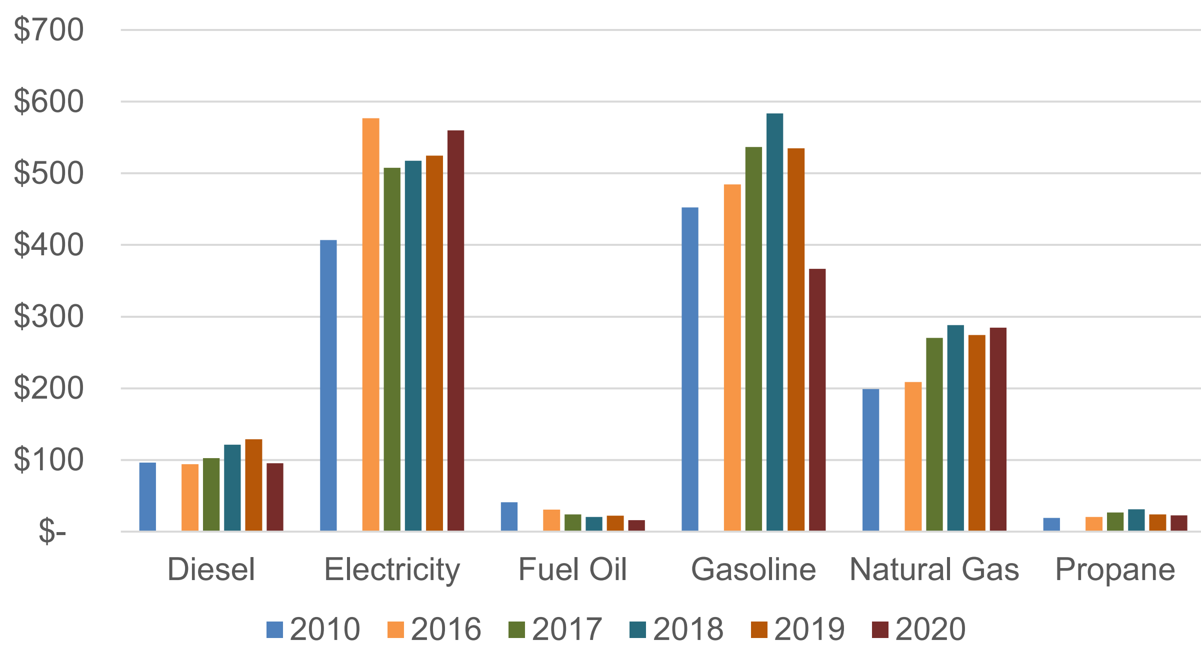


Figure 2 – Trends in Energy Costs ($ Millions) by Energy Commodity



2.2 2020 Greenhouse Gas Emissions and Progress Towards Targets

Total greenhouse gas emissions in 2020 were over 2.7 million tonnes of equivalent carbon dioxide. This is 22 percent lower than the 1990 level. This is well below the 15 percent reduction target set for 2020.

Compared to 2005, the baseline year used by the federal and provincial governments, total greenhouse gas emissions from London in 2020 have decreased by 30 percent.

As noted earlier, the COVID-19 pandemic had a significant impact on transportation fuel use, with an associated 20 percent drop in transportation greenhouse gas emissions between 2019 and 2020. Warmer weather in the winter and autumn also reduced the demand for natural gas used for heating, with an associated seven percent drop in residential greenhouse gas emissions between 2019 and 2020.

Over 90 percent of Ontario's electricity was generated from emissions-free sources in 2020, such as nuclear and hydro-electric generating stations as well as renewable sources (wind and solar). However, Ontario still relies on fossil fuels such as natural gas to generate almost seven percent of its electricity.

In summary:

- **Total greenhouse gas emissions in 2020 were over 2.7 million tonnes of equivalent carbon dioxide** – the top three sources in 2020 were personal vehicles (27%), single-family homes (20%), and commercial buildings (17%).

- **Londoners' per-person greenhouse gas emissions are significantly lower** – on a per person basis, Londoners and London businesses released 30% fewer greenhouse gas emissions in 2020 than they did in 1990.

Figure 3 illustrates the trends to date for greenhouse gas emissions compared to London's greenhouse gas emission reduction targets as well as targets set by senior levels of government.

Figure 3 – London's Greenhouse Gas Emissions Trend versus Reduction Targets

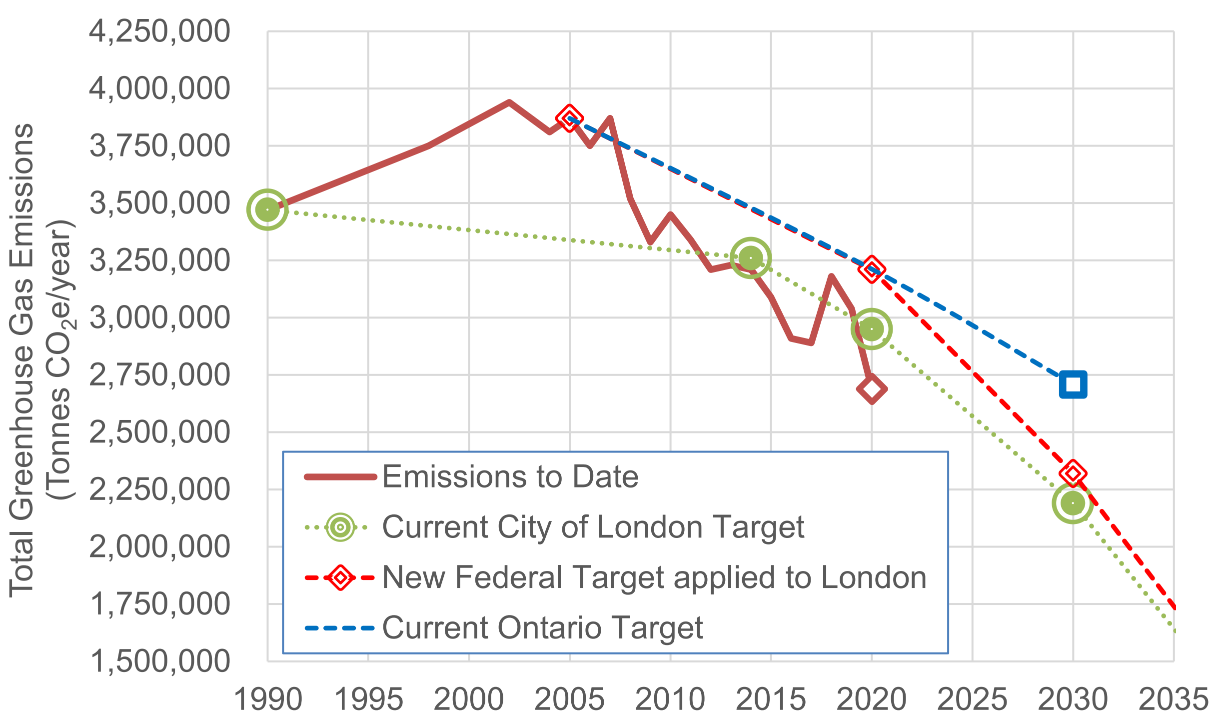


Chart Note:

- London's targets are for a 15% reduction from 1990 levels by 2020, 37% reduction from 1990 levels by 2030, and net-zero emissions by 2050.
- Federal targets are for a 40% to 45% reduction from 2005 levels as well as net-zero emissions by 2050. The 40% target is shown here.
- Provincial target is for a 30% reduction from 2005 levels by 2030. The province does not currently have any long-term targets.

Whether emissions continue to decrease depends upon the impact of energy and fuel conservation efforts, provincial and federal climate change policies, climate trends, economic growth, and consumer choices. It is also important to note that these actions also contribute to reductions in air pollution emissions (e.g., nitrogen oxides, volatile organic compounds) from fossil fuel use.

Household-Level Energy Use and Greenhouse Gas Emissions

It is estimated that the average household in London, living in a single-family home, spent over $380 every month on energy in 2020. Almost half of this, about $170 a month, was spent on gasoline. Note that this was $70 a month lower than 2019. Electricity accounted for around $120 per month, while natural gas was around $70 per month.

In terms of household greenhouse gas emissions, the average household emitted over nine tonnes per year. As with cost, almost half of this came from burning gasoline. Natural gas used for interior heating and water heating accounted for 42 percent of emissions. Organic waste in the landfill accounts for about seven percent. Given Ontario's clean electricity grid, using electricity in the home only accounts for under two percent of household GHG emissions.

It is important to recognize the fact that the production and transportation of the consumer goods purchased also have an environmental impact and that some types of goods (e.g., meat and dairy products) do have a larger impact than others. At this point in time, there is no easy-to-use methodology to estimate this at the community-wide scale. Therefore, municipalities across Canada currently do not include the energy use and greenhouse gas emissions from these activities in inventory reporting. These are often considered Scope 3 emissions (generated outside of the community). Establishing a consistent and acceptable measurement and reporting methodology will be important in the near future.

However, the Environmental Commissioner of Ontario report, *Climate Pollution: Reducing My Footprint (2019)*, provides estimates of consumption related GHG for Ontario residents. This report estimated that the average household's consumption related GHG emissions are about 18 tonnes per year. This is larger than the emissions from the direct use of energy and from waste. This highlights the climate change mitigation of several environmental initiatives such as:

- Food waste reduction;
- Buying durable products;
- Buying local products and local “staycations”;
- Recycling and the circular economy; and,
- Repurposing and renovating existing buildings.

2.3 Development of the Climate Emergency Action Plan

The development of a Climate Emergency Action Plan is a fundamental and required response to the City of London's climate emergency declaration. The goals are to improve London's resilience to climate change impacts, reduce London's greenhouse gas emissions by at least 37% below 1990 levels by 2030 and reach net-zero emissions by 2050.

A recent report to Council's Strategic Priorities and Policy Committee on April 27, 2021 provided an update on the plan's engagement and development to date. City staff are currently reviewing the ideas and feedback collected from residents and businesses submitted between October 2020 and April 2021 as part of the development of the plan. Opportunities for input continue and can found at https://getinvolved.london.ca/climate

The 2020 Community Energy Use and Greenhouse Gas Emissions Inventory Report Annual reporting on community energy use and resulting greenhouse gas emissions has been underway since 2012 These details are part of the foundation for the development of the Climate Emergency Action Plan (CEAP). The CEAP is currently scheduled to be submitted to the Strategic Priorities and Policy Committee (SPPC) in late fall 2021.

Conclusion

The results as demonstrated in the 2020 Community Energy Use and Greenhouse Gas Emissions Inventory Report continue to tell a positive story for London. Ontario's actions to replace coal-fired power plants with cleaner power generation have played a significant role in this reduction. Londoners have also taken action by reducing the amount of energy they use at home and at work.

Transportation fuel use remains an area where progress is needed. The COVID-19 pandemic has shown the impact that transportation demand management activities such as working-from-home can have on reducing emissions. This highlights the importance of City-led measures to be developed in the upcoming Mobility Master Plan.

Prepared by:	**James Skimming, P.Eng.** **Manager, Energy & Climate Change**
Prepared and Submitted by:	**Jay Stanford MA, MPA** **Director, Climate Change, Environment & Waste Management**
Recommended by:	**Kelly Scherr, P.Eng., MBA, FEC, Deputy City Manager, Environment & Infrastructure**

Appendix A 2020 Community Energy Use and Greenhouse Gas Emissions Inventory – Executive Summary

Appendix B 2020 Community Energy Use and Greenhouse Gas Emissions Inventory – Report

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Community Energy Use & Greenhouse Gas Emissions Inventory

Executive Summary

2020

London
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Introduction

The purpose of this document is to provide an overview on energy consumption in London and associated greenhouse gas emissions during the period from 1990 to 2020. The details in the document provide a useful source of information to strengthen existing projects/programs, or to help identify new business and academic opportunities for energy efficient products and technologies, energy conservation and demand management products and services, biofuels, and renewable energy generation.

There are many factors that influence how much energy a modern city uses to function and thrive:

- Land use and development
- Urban design
- Transportation
- Buildings
- Personal choices and actions
- Local climate & economy

Previous annual reports for 2012 through to 2018, as well as 2006 to 2008, 1998, and 1990 are available upon request.

Contents

Community energy use inventory

The three most common benchmark dates being used for reporting on overall progress are:

1990

The first year that for which London's community-wide GHG emissions and energy use were determined, as well as Ontario's previous baseline year.

2005

the baseline year used for the Government of Canada's and the Province of Ontario's greenhouse gas (GHG) reduction targets

2010

the first year for which total energy cost data has been determined in London

Previous annual reports for 2012 through to 2019, as well as 2006 to 2008, 1998, and 1990 are available upon request.

COVID's big impact on transportation in 2020

The impact of the COVID-19 pandemic on transportation energy use was significant, which was 20 percent lower than 2019 overall. In particular:

↓21% Gasoline and diesel sold

↑20% Distance travelled by bike

↓6% Vehicles registered

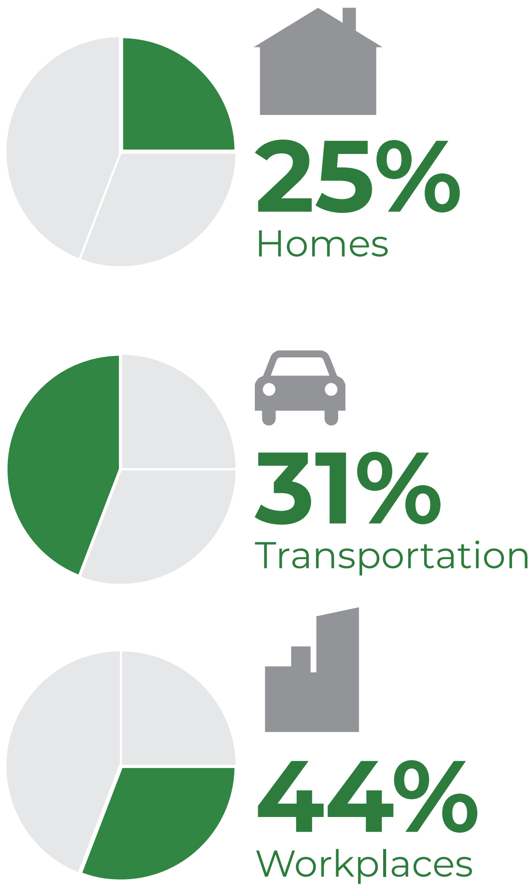
It is anticipated that the shift to working-from-home will remain in place at London's workplaces after the COVID-19 pandemic is over, although this is not likely to be a full-time shift for everybody. It is also anticipated that the interest in cycling for transportation will continue to grow.

Energy used in London's single-family homes was down by four percent overall. Electricity use in homes did increase due in part to shifting to work from home as well as warmer summer temperatures increasing the demand for air conditioning. However, natural gas use decreased due to warmer winter and autumn weather reducing the demand for space heating.

Energy used by London's industrial, commercial, and institutional sector remained relatively unchanged in 2020.

Total energy use in London in 2020 was 55,100 terajoules, an eight percent decrease from the previous year (2019).

Energy Use by Sector in 2020



Energy efficiency trends

In 2020, energy use per person in London was 21 percent below 1990 levels.

As noted earlier, COVID-19's impact on transportation in 2020 was dramatic. However, it is too early to consider this a long-term trend.

The biggest long-term trend seen since 1990 is in residential energy use per person, which was 21 percent lower in 2020 than 1990. This may be attributed to improvements in the energy efficiency of consumer appliances, space heating and cooling systems, home retrofits, and new home construction.

Reduction In Energy Use Per Person Since 1990

↓21% Homes

↓31% Transportation

↓12% Workplaces

Energy use per person in 2020 related to workplaces was 12 percent lower than 1990. However, London's energy productivity – dollars of real gross domestic product generated per unit energy used by London's employment sector – looks even more impressive with a 37 percent improvement between 1990 and 2020, even when adjusting for inflation.

Energy productivity, measured in terms of dollars of local Gross Domestic Product (GDP - adjusted for inflation)

1990 **$524**

2020 **$717**

of value /gigajoule of energy used

= 37%

more value for every gigajoule used!

Transportation fuel use is decreasing even as vehicle ownership increases

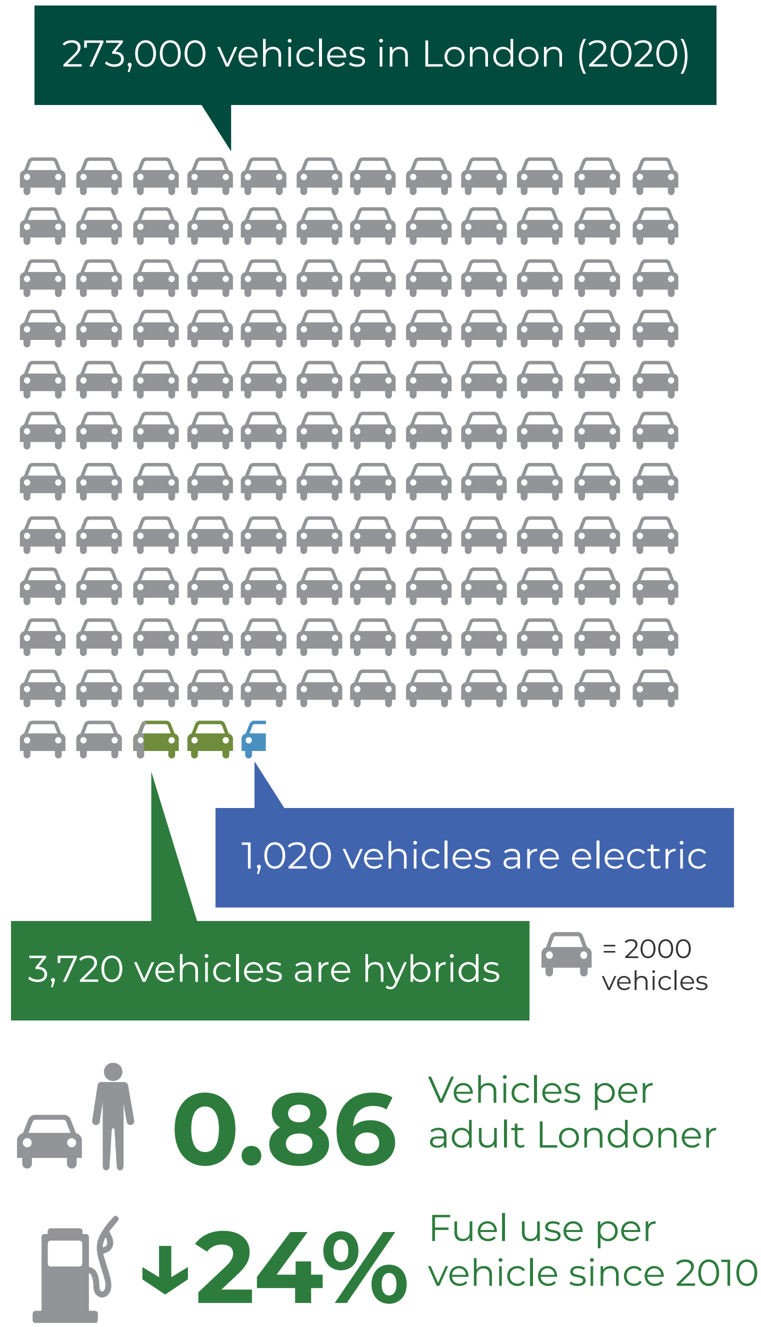
Prior to COVID-19, vehicle ownership in London had grown by over four percent every year on average between 2010 and 2019, much faster than London's overall population growth. As of December 2019, there were almost 292,000 light-duty vehicles registered in London – an increase of almost 89,000 since 2010. When compared to Census data on Londoners between the age of 20 and 84, vehicle registration increased from 0.75 per person in 2010 to an estimated 0.94 per person in 2019.

However, as of December 2020, the number of light-duty vehicles registered in London dropped by six percent down to just over 273,000 vehicles. This works out to about 0.86 vehicles per person aged 20 to 84.

The number of hybrid and/or electric vehicles in London are almost six times higher in 2020 compared to 2010. There are also now over 1,000 electric vehicles registered in London.

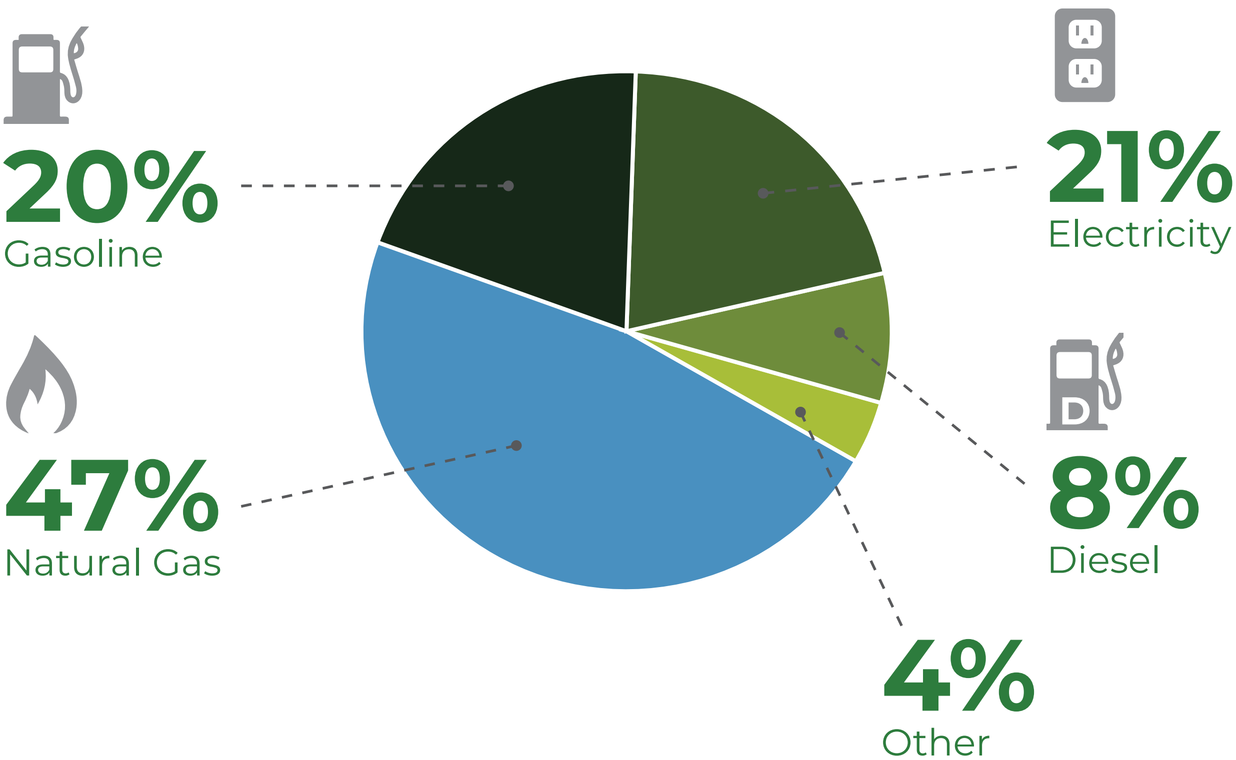
Almost one percent of new 2020 Model Year vehicles registered were electric vehicles and four percent were hybrid vehicles.

On the negative side, high gas consumption sport utility vehicles and large pick-ups continue to gain in popularity as the relative number of minivans and mid-sized sedans decline.



Sources of energy used in London

What sources of energy were used in London?



In terms of sources of energy, natural gas is the largest source of energy used in London, accounting for 47 percent of all energy used in 2020. Natural gas is used primarily for heating buildings, heating water, and providing heat for industrial processes.

Electricity was the second largest source of energy, accounting for 21 percent of London's energy use.

Gasoline accounted for 20 percent of all the energy used in London.

Electricity generation in London

London has almost 90 megawatts (MW) of local electricity generation capacity installed to date, an increase of about one megawatt from 2019. As of April 2021, there was 68.3 megawatts of gas-fired co-generation, 17.9 megawatts of solar photovoltaic (PV), 2.85 megawatts of biogas, and 0.675 megawatts of hydro-electric power generation in operation in London.

Most of London's local generating capacity is associated with natural gas combined heat and power cogeneration plants, used in four different applications:

- **District energy** - London District Energy (38.7 MW) provides power to the grid plus steam and chilled water to downtown buildings from its Colborne Street facility.
- **Industrial** - Ingredion (14.1 MW) and Labatt Brewery (4.2 MW) generate steam as well as electricity "behind-the-meter" for use in their operations.
- **Campus** – the London Health Sciences Centre (9.6 MW) Victoria Hospital campus generates both steam and electricity for hospital buildings.
- **Micro-scale** – small scale systems (under 100 kilowatts) are in use at the Canada Games Aquatic Centre and H.B. Beal Secondary School for pool heating as well as electricity "behind-the-meter" for use in their operations.

Translating energy use into economic and business development opportunities

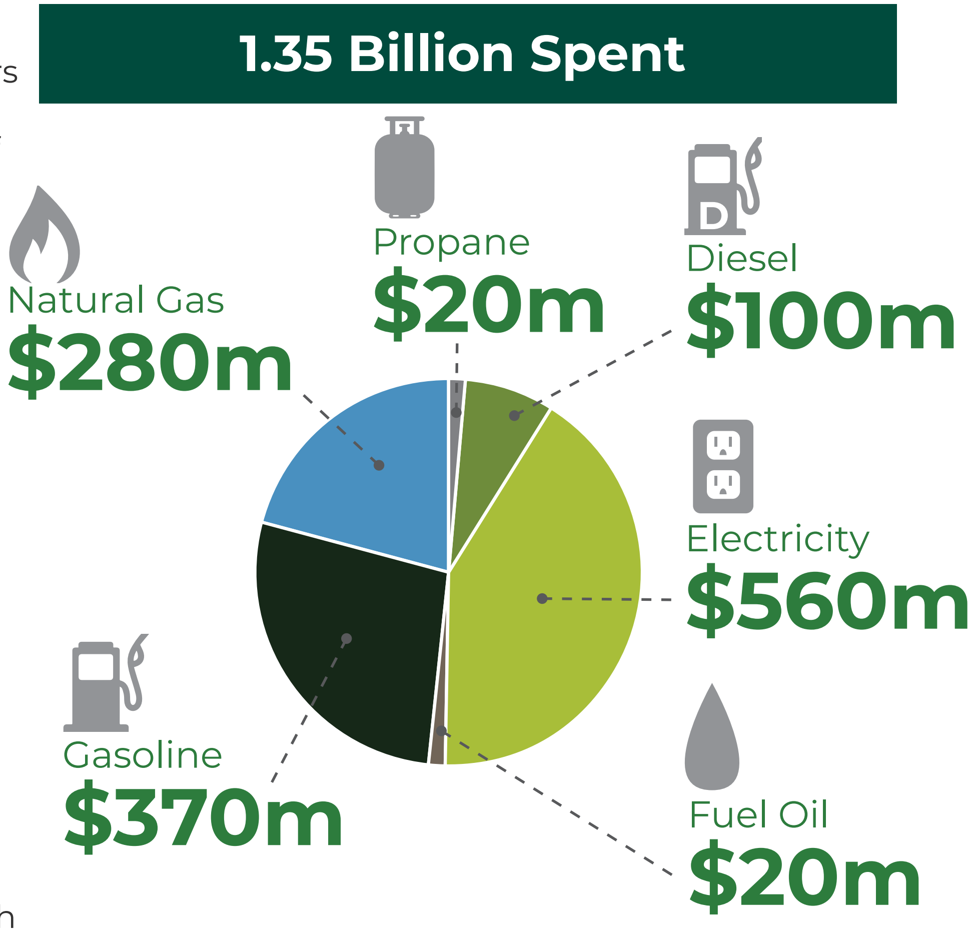
It is estimated that Londoners spent about $1.35 billion on energy in 2020, a decrease of 11 percent from 2019.

As noted earlier, COVID-19 reduced the demand for gasoline. As a result, the price for gasoline in 2020 decreased by 13 percent. In total, Londoners spent about $170 million less on gasoline in 2020 than they did in 2019.

Electricity accounts for 42 percent of total energy costs.

Natural gas use accounts for only 21 percent of energy costs, even though it is the largest source of energy we use. This is due to the low price of natural gas, even with the $30 per tonne carbon price in place during 2020.

On average, every percentage that Londoners reduce their energy use results in around $13 million staying in London.



The improvements in energy efficiency seen since 2010, combined with COVID-19, are estimated to have saved London $380 million in avoided energy costs in 2020. Added up year-over-year, London has avoided over $1.3 billion in energy costs due to improved efficiency since 2010.

Please note: due to rounding of numbers, individual numbers illustrated above may not add up to the rounded total.

London
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Translating energy use to greenhouse gas impact

Total greenhouse gas emissions in 2020 were about 2.7 million tonnes of equivalent carbon dioxide, or 22 percent lower than the 1990 level. This is well below the 15 percent reduction target set for 2020. However, it is important to note the extraordinary impact of the COVID-19 pandemic on emissions.

Energy use is responsible for 95 percent of all GHG emissions from human activity in London. Not only does burning fossil fuels such as gasoline, diesel, and natural gas produce carbon dioxide – the most common GHG associated with human activity – but the use of electricity also contributes to GHG emissions.

Over 90 percent of Ontario's electricity was generated from emissions-free sources in 2020, such as nuclear and hydro-electric generating stations as well as renewable sources (wind and solar). However, Ontario still relies on fossil fuels such as natural gas to generate almost seven percent of the electricity we use.

In summary, energy related GHG emissions are:

- 51 percent from natural gas
- 29 percent from gasoline
- 11 percent from diesel
- 4 percent from electricity
- 5 percent from other fuels

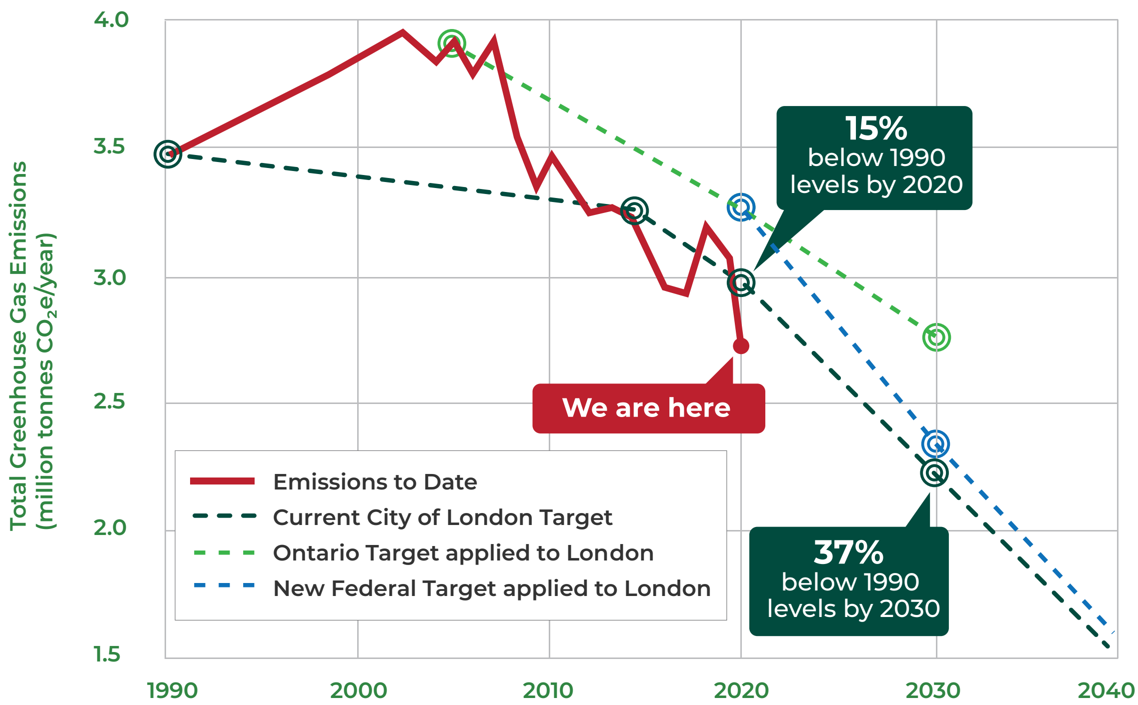
The remaining five percent of GHG emissions are methane emissions from the anaerobic decomposition of organic materials in the active and closed landfills located in London as well as commercial sector waste disposed in landfills outside London, and nitrous oxide emissions from sewage sludge incineration.

GHG emissions from energy sources

Electricity	Natural Gas	Gasoline	Diesel
8kg	**51kg**	**64kg**	**70kg**

Measured in kilograms (kg) of equivalent carbon dioxide CO_2E per unit of energy gigajoule

London's greenhouse gas emissions versus CEAP targets and Federal & Provincial reduction targets



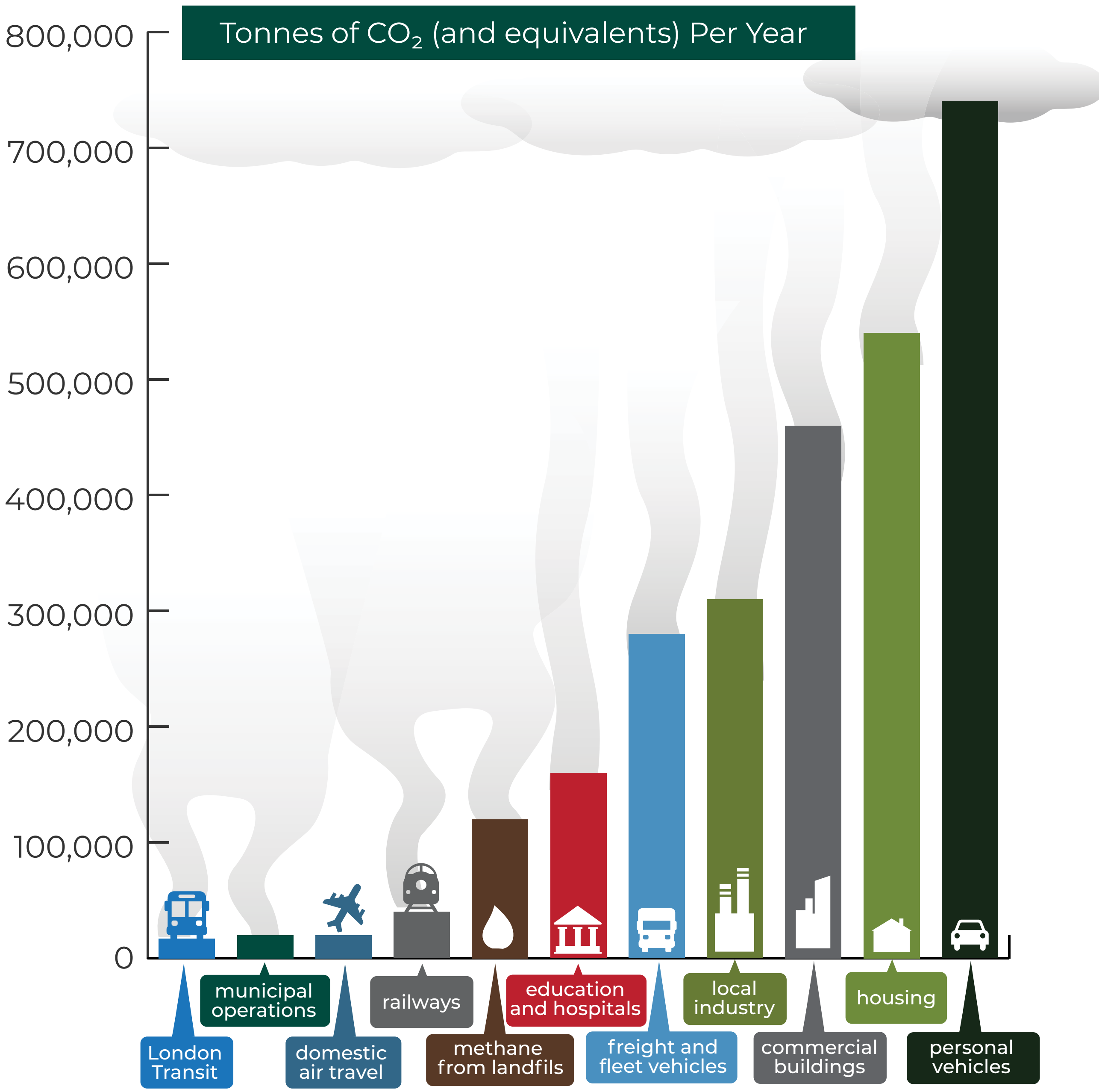
London's Climate Emergency Action Plan (CEAP) currently has the following greenhouse gas emission reduction goals:

- 15 percent reduction from 1990 levels by 2020
- 37 percent reduction by 2030, and
- Net-zero emissions by 2050.

In April 2021, the federal government revised its 2030 target to aim for a minimum 40 percent reduction in GHG emissions from 2005 levels as well as net-zero emissions by 2050. To date, the provincial government has not revised its 2030 target for a 30 percent reduction from 2005 levels and has not established an emission reduction target beyond 2030.

Compared to 2005, total greenhouse gas emissions from London in 2020 have decreased by 30 percent.

The following figure illustrates the estimated breakdown of greenhouse gas emissions in terms of human activity, with half of the emissions coming from personal transportation and energy use at home.



As mentioned earlier, the COVID-19 pandemic had a significant impact on transportation fuel use, with an associated 20 percent drop in transportation GHG emissions between 2019 and 2020. Warmer weather in the winter and autumn also reduced the demand for natural gas used for heating, with an associated seven percent drop in residential GHG emissions between 2019 and 2020.

Seasonal weather variations can affect energy use and associated emissions significantly on a year-by-year basis. However, over the last ten years, winter average temperatures and most summer average temperatures have been warmer than normal.

Since 2005 there has been a downward trend in community-wide emissions driven by a combination of cleaner electricity generation in Ontario and improved energy efficiency.

Reduction in GHG emissions per person since 1990

↓47%	↓37%	↓39%
Homes	Transportation	Workplaces

Whether emissions continue to decrease depends upon the impact of City-led actions as well as energy and fuel conservation efforts from Londoners, provincial and federal climate change policies, climate trends, economic growth, and consumer choices.

Household energy use and greenhouse gas emissions

It is estimated that the average household in London, living in a single-family home, spent over $380 every month on energy in 2020. Almost half of this, about $170 a month, was spent on gasoline. Note that this was $70 a month lower than 2019.

Electricity accounted for around $120 per month, while natural gas was around $70 per month.

In terms of household greenhouse gas emissions, the average household emitted over nine tonnes per year. As with cost, almost half of this came from burning gasoline. Natural gas used for space heating and water heating accounted for 42 percent of emissions. Organic waste in the landfill accounts for about seven percent. Given Ontario's clean electricity grid, using electricity in the home only accounts for under two percent of household GHG emissions.

It is important to recognize the fact that the production and transportation of the consumer goods purchased do have an environmental impact, and that some types of goods (e.g., meat and dairy products) do have a larger impact than others. At this point in time, there is no easy-to-use methodology to estimate this at the community-wide scale.

However, the Environmental Commissioner of Ontario report, *Climate Pollution: Reducing My Footprint*, provides estimates of consumption related GHG for Ontario residents. Using the information in this report, it is estimated that the average household's consumption related GHG emissions are about 18 tonnes per year. This is larger than the emissions from the direct use of energy and from waste.

This highlights the climate change mitigation of several environmental initiatives such as:

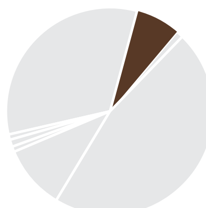
- Food waste reduction
- Buying durable products
- Buying local products and local "staycations"
- Recycling and the circular economy
- Repurposing and renovating existing buildings

Where do your greenhouse gas emissions come from?

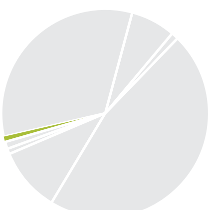
Vehicle Gasoline
47%

Natural Gas
Home Heating
33%

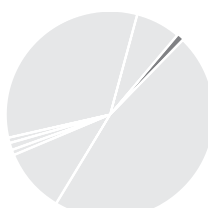
Natural Gas
Water Heating
10%



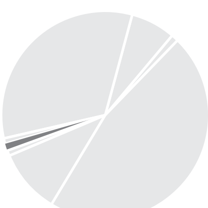
Methane From Food
& Organic Waste in
Garbage
7%



Propane BBQs etc.
1%



Electricity
Furnace & Air Conditioner
1%



Electricity
Appliances & Electronics
1%

Electricity Lighting
<1%

The average home in London emits
9.3
tonnes per year.

Based on 2020 average energy use for residential customers of London Hydro and Enbridge (formerly Union Gas), combined with retail sales of gasoline data.

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Glossary – what do these mean?

Gigajoule – (or, one billion joules) is a metric unit for measuring energy, and is approximately equivalent to energy provided by burning 26 litres of gasoline (roughly half a tank of gas in a car)

Terajoule – (or, one trillion joules) is equal to 1,000 gigjoules, or approximately 26,000 litres of gasoline (roughly the amount of gasoline in 500 cars).

Megawatt – (or, one million watts) is a metric unit for measuring power output, usually for electricity, and is approximately the amount of power needed to light 200,000 LED light bulbs (at 5 watts each).

Greenhouse gas - a gas that contributes to the greenhouse effect in our atmosphere by absorbing infrared radiation, similar to the glass in a greenhouse that traps heat. Carbon dioxide is the most common greenhouse gas produced by human activity, but methane from decomposing garbage and nitrous oxides from incinerating sewage sludge are also potent greenhouse gases. Emissions of greenhouse gases are reported in terms of "equivalent carbon dioxide."

Tonne – is the alternate metric unit of mass used to represent one megagram (one million grams or 1,000 kilograms), which is roughly the same (about 10% different) as a "ton" in the old Imperial system of measurement. Emissions of greenhouse gas emissions are reported in terms of "tonnes of equivalent carbon dioxide". Given that carbon dioxide is an invisible gas, the best way to picture what a tonne of carbon dioxide like is to imagine this as a balloon about ten metres wide.

2020 Community Energy Use & Greenhouse Gas Emissions Inventory

August 2021

london.ca

London
CANADA

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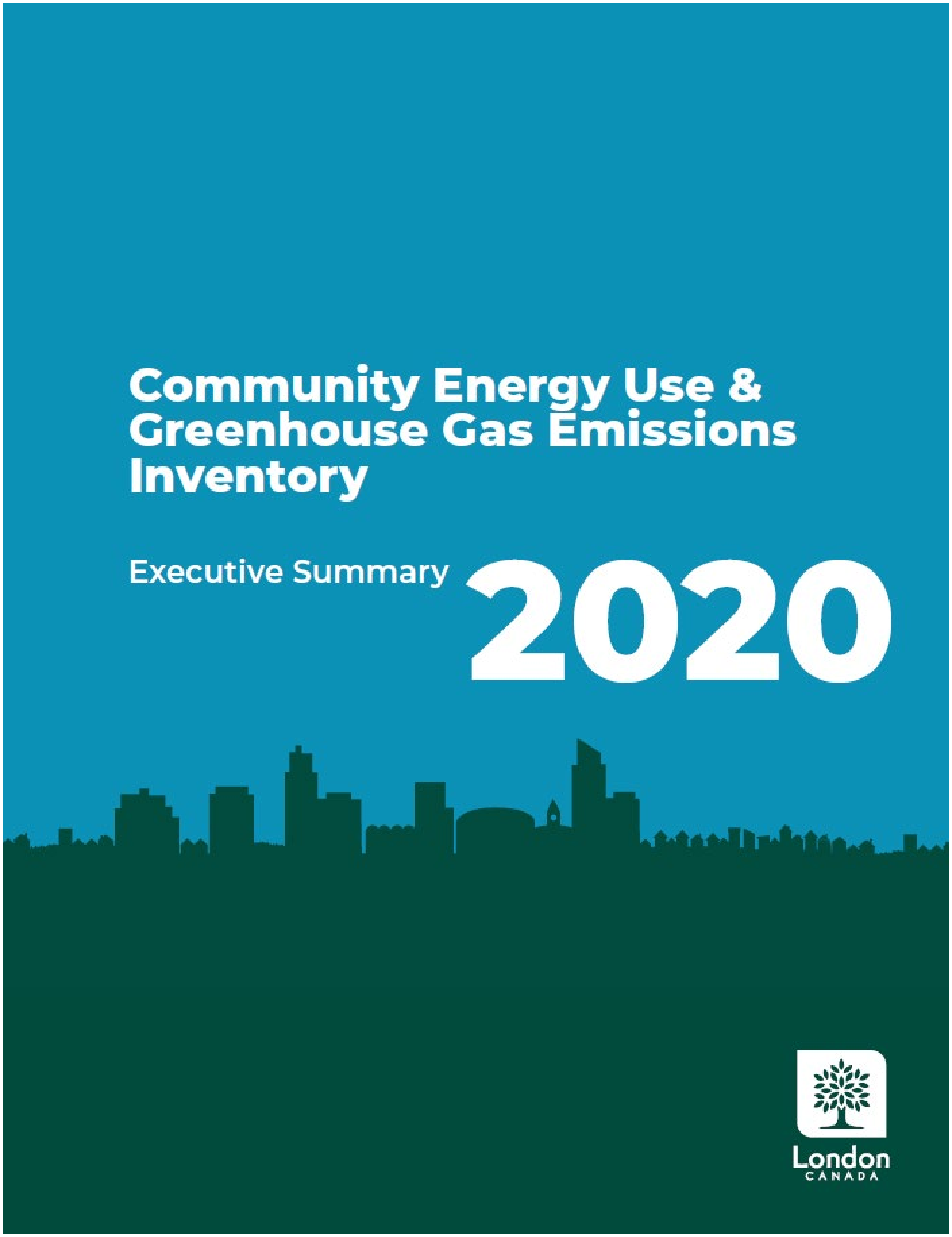
EXECUTIVE SUMMARY

The Executive Summary for the 2020 Community Energy Use & Greenhouse Gas Emissions Inventory is now a stand-alone document.



1 PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide an overview of:

- energy consumption in London (a high-level inventory of energy use) during the period 1990 to 2020;
- associated greenhouse gas (GHG) emissions; and
- energy expenditures in London.

On April 23, 2019, the following was approved by Municipal Council with respect to climate change:

> *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.*

This document is the measurement tool to highlight London's progress towards meeting its community energy reduction and GHG emission reduction targets along with other targets and directions.

Energy efficiency and conservation provides important opportunities to reduce costs. Most of the money spent on energy leaves London, but money spent on energy efficiency and conservation stays in London. It supports local businesses offering these products and services, while the resulting money saved from energy efficiency and conservation can then be used for more productive uses.

Many people benefit from the use of energy efficiency, renewable energy, and energy conservation products and services:

- Households can help the environment and typically save more money in the long run.

- Business owners and managers can reduce operating costs, become role models for corporate social responsibility, and position themselves with a competitive advantage.

- Students and teachers can benefit from learning about our current, unsustainable demand for energy and how energy conservation, energy efficiency and renewable energy technologies can help our environment and replace fossil fuels that are being depleted.

- Innovators can create new energy-efficient and renewable energy products and services, and become architects of change.

Many of these inventory reports have a similar look and feel by design. The data may change annually, but the rationale and dialogue remain similar. A complete listing of reports is found in Section 3.

The City of London also reports this information on an annual basis to CDP Cities and the Global Covenant of Mayors for Climate & Energy.

2 BACKGROUND

The City of London does not have direct control over how much energy is used in London, but it does have influence. The control over energy use in London rests primarily with citizens, visitors, employers, and employees. Individual and collective action with respect to sustainable energy use, energy management, and energy conservation is critical for our future.

London's 2014-2018 Community Energy Action Plan (CEAP) was approved by Council in July 2014. Within the 2014-2018 CEAP, listed under the subsection titled Reporting and Education about the Economic and Environmental Considerations of Energy Use, the highest priority actions for the City of London were to:

1. Provide Londoners with annual information on community energy use and GHG emissions.

2. Develop and report new energy-related performance indicators that highlight the total cost of energy and total money saved/generated from community energy actions.

3. Develop new tools to raise awareness on progress being made in London.

With the development of the new Climate Emergency Action Plan underway, the necessity to provide up-to-date information on London's progress towards its GHG emission reduction targets remains in place.

There are many factors that influence how much energy a city uses to function and thrive:

Land use and urban development – planning city growth sets the framework for how much energy is needed for a city to function. Mixed density balances the energy-efficiency of higher-density and social demand for living space. Mixed land use reduces the distance people and goods need to travel.

Urban design – urban design can either negate or enhance the energy efficiency benefits of good functional planning (mixed land use and mixed density). This includes design factors such as connectivity between city blocks, streetscape design, and street orientation.

Transportation – transportation planning accounts for the movement of people and goods. In an ideal world, you would minimize the interactions between the two. However, the reality is that a city's transportation network often must serve both needs at the same time. An energy-efficient transportation system is one that provides several competitive choices for the movement of people and goods.

Buildings – The design, construction, and maintenance of all building types (homes, office buildings, industrial buildings) has a significant impact on the energy consumed by that building. New buildings can be designed that approach net-zero energy use, but most London's buildings are old, inefficient designs that often have unseen problems with their insulation and draft-proofing. Building type can also affect energy use and associated emissions. Building energy modelling done for the London Energy Efficiency Partnership (LEEP) Project indicates the following:

- Single-family residential buildings (detached, semi-detached and row housing) require more energy for winter space (interior) heating than for summer space (interior) cooling;

- Conversely, commercial office buildings require more energy for summer space cooling than for winter space heating; and

- Multi-unit residential buildings generally have a balance between annual space heating and space cooling energy demand.

Personal choices and actions – Design and technology has its limits. For example, a programmable thermostat has no energy conservation benefit if its user does not program it. Social norms are a powerful influence on people's behaviour.

Local economy – the nature of the economic base will influence how much energy it will use. For some businesses, energy use is a minor cost. For others, energy bills can make the difference between profit and loss. For many local employers, there are opportunities for energy conservation, energy-efficiency, and renewable energy generation waiting to be developed.

Leadership – the words spoken, commitments made, and actions taken by leaders in the business, institutional, government and non-government sectors with respect to energy conservation, sustainable energy, reducing the use of fossil fuels, reducing GHG emissions and adapting to climate change.

Seasonal weather variations can affect energy use and associated emissions. London's climate is one that is dominated by the heating demand during cold weather months. On average, the heating season starts in late September and ends in May. With climate change, the energy demand for heating are expected to fall.

The energy demand for space cooling (i.e., air conditioning) in London is relatively small compared to space heating. However, on a hot summer day, a typical household's electricity demand will be three times greater than a cool summer day. This short term "peak demand" places strain on Ontario's electricity generation and supply system. With climate change, the energy demand for air conditioning is expected to increase.

3 PREVIOUS INVENTORY REPORTS

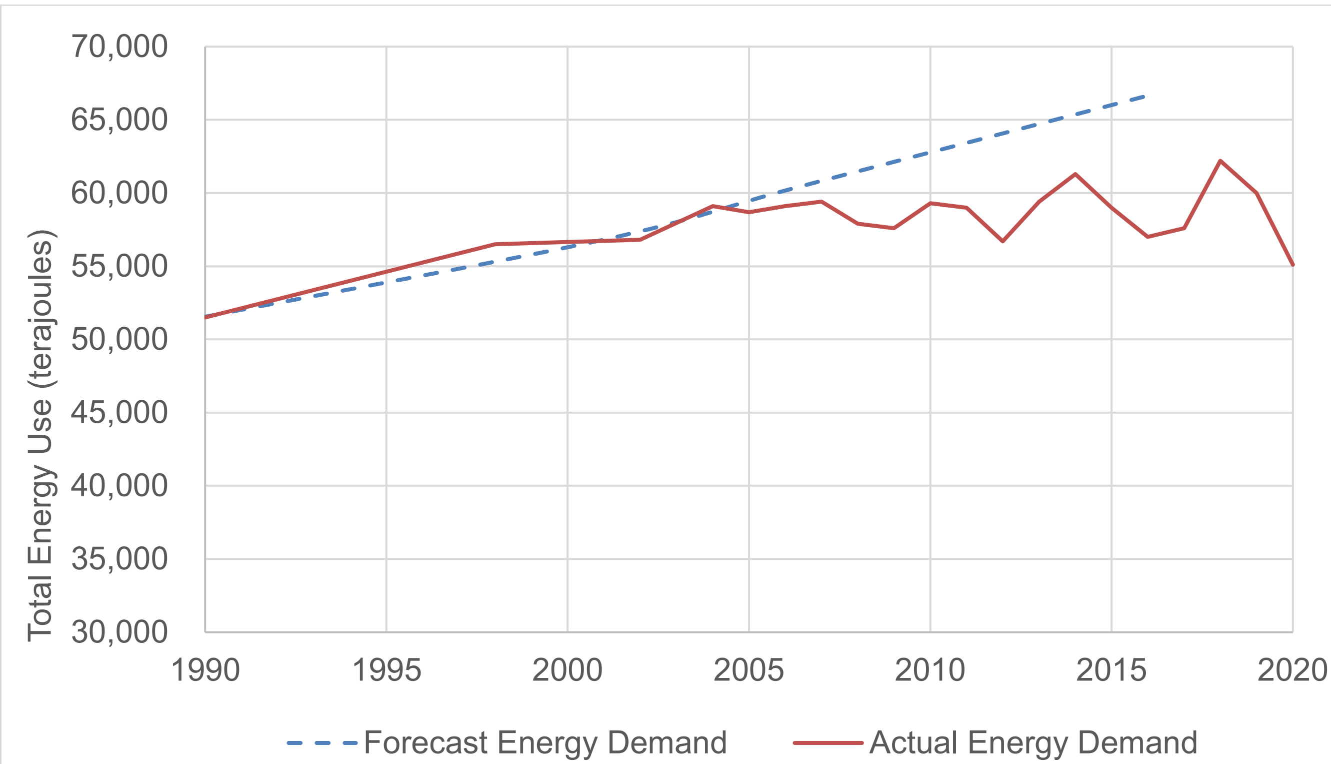
The following is a list of the previous energy inventory reports that have been prepared for London:

- *2019 Community Energy & Greenhouse Gas Inventory,* published on the City of London's Get Involved London website in December 2020.
- *2018 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in October 2019.
- *2017 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in August 2018.
- *2016 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in August 2017.
- *2015 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in June 2016.
- *2014 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in May 2015.
- *2013 Community Energy & Greenhouse Gas Inventory,* prepared by the City of London for the Civic Works Committee in July 2014.
- *2012 Community Energy & Greenhouse Gas Inventory: Challenges & Opportunities,* prepared by the City of London for the Civic Works Committee in October 2013.
- 2011 data was highlighted in the *Environmental Programs Update,* prepared for the Civic Works Committee meeting in May 2012.
- *2008 Energy Use Inventory Report,* prepared by the City of London for the Environment and Transportation Committee in July 2010.
- *2007 Energy Use Inventory Report,* prepared by the City of London for the Environment and Transportation Committee in May 2008.
- *2006 Energy Use Inventory Report,* prepared by the City of London for the Mayor's Sustainable Energy Council in November 2007.
- *1998 Air Emissions and Energy Use in the City of London*, prepared for the London Energy/Air Emissions Reduction Strategy Task Force in March 2000.
- *1990 City of London Air Emissions Study*, prepared by SENES Consultants in association with Proctor and Redfern Limited and Torrie Smith Associates for Vision '96 in September 1995.

4 COMMUNITY ENERGY USE INVENTORY

Total energy use in London in 2020 was 55,100 terajoules[1], seven per cent above 1990 levels, and six per cent below 2005 levels. As seen from Figure 1, since the mid 2000s, London's total energy use has dropped below the forecasted "business as usual" track forecasted in the 1990s. This illustrates the impact that energy conservation activities over the last 15 years have had decoupling energy use from growth.

Figure 1 - Comparison of Forecast vs. Actual Energy Demand for London



The COVID-19 pandemic had an impact on energy used in London, with overall total energy use in 2020 being eight per cent lower than 2019, as shown in Figure 1 above and Table 1 below.

The main impact was seen in transportation energy use, which was 20 per cent lower than 2019 overall. In particular, the local retail sales of gasoline and diesel at gas stations dropped by 21 per cent because of many London workplaces shifting to work from home as well as reduced discretionary trips associated with stay-at-home orders and similar restrictions.

Energy used by London's industrial, commercial, and institutional sector remained relatively unchanged in 2020. A six per cent decrease in electricity use was offset by a 14 increase in natural gas used in the industrial sector.

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[1] a terajoule (or, one trillion joules) is a metric unit for measuring energy, and is approximately equivalent to the energy provided by burning 26,000 litres of gasoline (roughly the amount of gasoline in 500 cars)

Energy used in London’s single-family homes was down by four per cent overall. Electricity use in homes did increase by six per cent, due in part to shifting to work from home as well as warmer summer temperatures increasing the demand for air conditioning. However, natural gas use decreased by eight per cent due to warmer winter and autumn weather reducing the demand for space heating.

Table 1 – 1990-2020 Total Community Energy Use by Sector (Terajoules per Year)

Sector	1990	2005	2019	2020
Transportation	18,200	20,200	21,200	17,000
Residential	13,100	14,800	14,600	14,000
Industrial, Commercial & Institutional (IC&I)	20,200	23,800	24,200	24,100
Total	**51,500**	**58,700**	**60,000**	**55,100**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

London’s industrial, commercial, and institutional buildings and facilities accounted for 44 per cent of all energy used in London (Table 2). London Hydro and Enbridge include multi-unit residential buildings (apartment buildings and condominiums) under the category of commercial buildings. Transportation accounted for 31 per cent of all energy used in London, most of which is associated with personal vehicle use. Single family residential homes accounted for 25 per cent of all the energy used in London.

Table 2 – 1990-2019 Share of Community Energy Use by Sector

Sector	1990	2005	2019	2020
Transportation	35%	34%	35%	31%
Residential	25%	25%	24%	25%
Industrial, Commercial & Institutional (IC&I)	40%	40%	40%	44%

The community energy model developed by the Canadian Urban Institute for the Integrated Energy Mapping for Ontario Communities project, combined with latest provincial Broader Public Sector (BPS) energy data (2018 data), was used to estimate a more-detailed breakdown of energy use by building type, as shown in Table 3.

Table 3 – 2020 Estimated Breakdown of Energy Use by Subsector (Terajoules per Year)

Sector	Sub-sector	Energy Use
Transportation	Fuel sold at gas stations	11,900
Transportation	Road freight transport	3,100
Transportation	Corporate fleets	1,000
Transportation	London Transit	200
Transportation	Railway freight transport	500
Transportation	Domestic aviation	300
Residential	Low-density homes	11,700
Residential	Medium-density townhomes	2,400
Industrial, Commercial & Institutional	High-density residential buildings	1,600
Industrial, Commercial & Institutional	Commercial – office buildings	3,700
Industrial, Commercial & Institutional	Commercial – retail (e.g., malls)	6,300
Industrial, Commercial & Institutional	Industrial	8,000
Industrial, Commercial & Institutional	Institutional - schools	700
Industrial, Commercial & Institutional	Institutional - hospitals	1,200
Industrial, Commercial & Institutional	Institutional - colleges & universities	2,100
Industrial, Commercial & Institutional	Institutional - municipal	400
Industrial, Commercial & Institutional	Other	200

Over the 1990-2020 period, London's population has increased by 36 per cent. Energy use per person in London was 132 gigajoules (GJ) per year in 2020, down 21 per cent from 2007 and the 1990 baseline level as well (Table 4).

Table 4 – 1990-2020 per Person Energy Use by Sector (Gigajoules per person)

Sector	1990 (Pop. 307,000)	2005 (Pop. 349,000)	2020 (Pop. 417,000)	Change from 1990
Transportation	59	58	41	-31%
Residential	43	42	34	-21%
Industrial, Commercial & Institutional (IC&I)	66	68	58	-12%
Total	**168**	**168**	**132**	**-21%**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

Figure 2 – Change in Energy Use in London, Per Person by Sector Since 1990

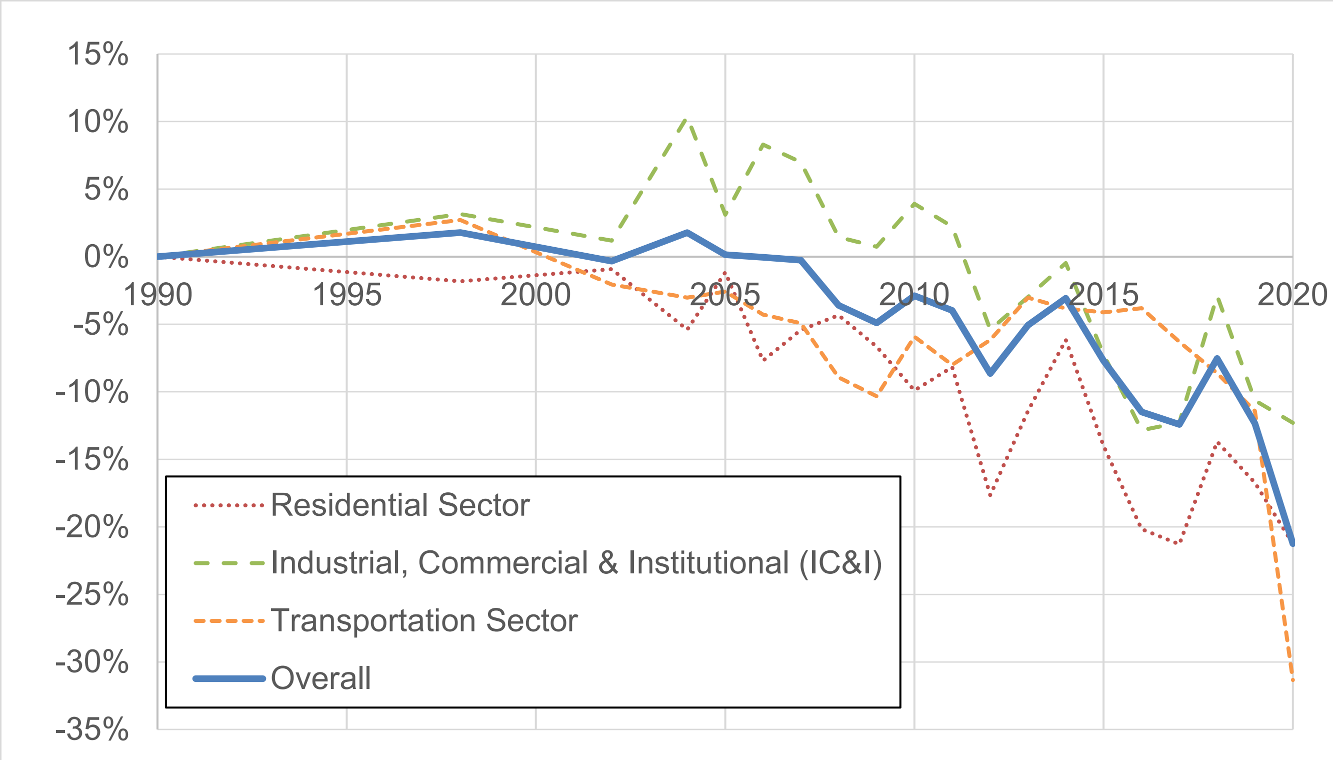


Figure 2 illustrates the change in energy consumption in London by sector on a per person basis, using 1990 as the baseline year. Overall, since the mid 2000s, the trend has been downwards, with the weather-related impacts of the "Winter that Wasn't" of 2012 (very warm winter), the "Polar Vortex" of 2014 (very cold winter), and the combination of a colder winter and warmer summer in 2018 being clearly visible, especially for the residential sector. The major impact of the COVID-19 pandemic on transportation energy use in 2020 is also very apparent.

4.1 Transportation Energy Use

In the early 2010s, transportation energy use was increasing, with the volume of fuel sold in London increasing year-over-year between 2011 and 2016. However, this trend reversed in 2017 and the volume of fuel sold continued to drop through to 2019. This recent trend may not be driven by fuel prices since the average fuel prices at the pumps actually decreased by about 10 cents per litre between 2018 and 2019. Therefore, this could be due to a combination of fewer trips by car and improving vehicle fuel economy.

Registered Vehicles in London

The City started to track local vehicle registration data beginning with 2010 data to try and gain additional insight into transportation energy use.

Prior to COVID-19, vehicle ownership in London has grown by over four per cent every year on average between 2010 and 2019, much faster than London's overall population growth. As of December 2019, there were almost 292,000 light-duty vehicles registered in London – an increase of almost 89,000 since 2010. When compared to Census data on Londoners between the age of 20 and 84, vehicle registration increased from 0.75 per person in 2010 to an estimated 0.94 per person in 2019.

However, as of December 2020, the number of light-duty vehicles registered in London dropped by six per cent down to just over 273,000 vehicles. This works out to about 0.86 vehicles per person aged 20 to 84.

The vehicle registration data is showing a mix of positive and negative trends.

On the positive side:

- fuel-efficient compact cars remain the most-popular vehicle segment in London.
- the number of hybrid and/or electric vehicles in London are almost six times higher in 2020 compared to 2010.
- There are now over 1,000 electric vehicles registered in London.
- 0.8% of new 2020 Model Year vehicles registered were electric vehicles and 3.9% were mild hybrid vehicles

On the negative side, high gas consumption sport utility vehicles and large pick-ups continue to gain in popularity as the relative number of minivans and mid-sized sedans decline.

Additional detail is provided in Table 5 below.

Table 5 – Vehicle Ownership Statistics for London

	2010	**2020**	**Change**
Total registered vehicles	202,800	273,300	35%
No. of adults 20-84 years old	271,000 (estimate)	317,000 (estimate)	17%
Vehicles per adult	0.75	0.86	15%
Hybrid gas-electric vehicles (excluding plug-in hybrids)	840	3,720	+ 2,880
Plug-in electric vehicles	0	1,020	+ 1,020
Fuel use per vehicle (GJ/year)	71	54	-24%
Average vehicle age	n/a	7 years (2014 models)	
Top five vehicle segments (share of vehicle registrations)	Compact car (22%) Mid-sized car (14%) Minivan (10%) Compact SUV 10%) Full-sized car (7%)	Compact car (23%) Compact SUV (22%) Mid-sized car (11%) Large pickup (9%) Intermediate SUV (8%)	

Transportation Data from Google's Environmental Insights Explorer

The City of London was amongst the first cohort of Canadian cities to participate in Google's Environmental Insights Explorer project. This project makes use of Google Maps data such as building shapes and mobility data (from tracking the movement of smart phones equipped with GPS) to estimate greenhouse gas emissions from cities.

There are some limitations to this data, in that not everyone travels with a smart phone on hand or with location services enabled on their phone. However, their transportation data has provided some useful insights, namely that trips to/from London have a large impact on emissions even through they are far fewer in number of trips.

The Environmental Insights Explorer tool has also provided data on 2020, which confirms the impact that COVID-19 has had on transportation. Table 6 summarizes the 2019 and 2020 transportation trip information for London from the Environmental Insights Explorer.

Table 6 – Total Trip Distance Travelled by Mode and Destination for 2019 and 2020

Travel Mode	Destination	2019 Total Trip Distance (km)	2020 Total Trip Distance (km)	Change
Automobile	Inbound	1,581,600,000	1,170,900,000	-26%
Automobile	Outbound	1,590,100,000	1,165,300,000	-27%
Automobile	In-Boundary	1,402,100,000	999,100,000	-29%
Cycling	In-Boundary	12,000,000	14,500,000	21%
Walking	In-Boundary	53,700,000	42,100,000	-22%
Transit	In-Boundary	56,200,000	39,100,000	-30%
VIA Rail	Inbound	30,600,000	n/a	n/a
VIA Rail	Outbound	32,100,000	n/a	n/a

Note that cycling was the only travel mode that saw an increase in distance travelled in 2020, with a 21 per cent increase in 2020. Increases in cycling was also seen in other Ontario cities with Environmental Insights Explorer data. This has been noted in cities world-wide, with the reduction of vehicle traffic on roads encouraging more people to use bicycles for transportation. Many North American reports and articles highlighted the increase in bicycle sales in 2020 including London, Ontario.

Trips made by walking were also down in 2020, which can be attributed primarily to the closure of schools, post-secondary education campuses, and workplaces during the COVID-19 pandemic.

This highlights the importance of City-led transportation initiatives such as rapid transit and the Cycling Master Plan. According to London's *Smart Moves 2030 Transportation Master Plan*, around 84 per cent of all personal trips made in London during the weekday afternoon peak period are made in personal vehicles, and most of these only have one occupant – the driver.

4.2 Energy Use and the Local Economy

Energy use per person related to the industrial, commercial, and institutional sector in 2020 was 12 per cent lower than 1990 and 18 per cent lower than 2007. London Hydro and Enbridge have also been increasing efforts to promote energy conservation and demand management with their business client base.

Another way to measure improvements in energy efficiency of the local economy is to compare it to Gross Domestic Product (GDP). According to the Conference Board of Canada, the COVID-19 pandemic reduced the greater London area's GDP by six per cent. However, most of this reduction is expected to be reversed once the COVID-19 pandemic has ended.

However, since 1990, London's GDP has grown significantly. Using statistics from the London Economic Development Corporation (LEDC) and the Conference Board of Canada, London's GDP (in constant 2012 dollars – i.e., excluding inflation) has grown by 63 per cent between 1990 and 2020.

Using these GDP estimates for 1990, London's energy productivity - GDP generated per unit energy used in London's employment sector - has improved by 37 per cent. Table 7 illustrates this in more detail. This means that local businesses are producing products and services more efficiently and/or moving towards producing products and services of higher value for the same amount of energy used.

Table 7 – 1990-2020 Energy Productivity of London's Employment (IC&I) Sector

	1990	1998	2007	2020
Gross Domestic Product ($ millions GDP[1])	$10,600[2]	$12,800[2]	$16,900	$17,300
Energy Used by IC&I Sector (Terajoules - TJ)	20,200	22,500	25,100	24,100
Energy Productivity ($GDP per Gigajoules - GJ)[3]	$524	$569	$675	$717
Improvement in Productivity Since 1990		9%	29%	37%
Average Annual Productivity Improvement		1.0%	2.0%	0.6%

A number of London's major employers have taken a leadership position on energy management, but there are still many opportunities to reduce energy use in the employment

1 – GDP data based on the London Census Metropolitan Area (includes St. Thomas & Strathroy), prorated by 77% based on population of London, and adjusted to constant 2012 dollars based on the Consumers Price Index (CPI) for Ontario

2 – Extrapolated from 2007 GDP data for London CMA based on changes to Ontario's real GDP for 1990 and 1998

3 – London's GDP divided by energy used in IC&I sector

sector, particularly amongst small-to-medium sized enterprises who may not have the human, financial, and/or technical resources to manage their energy use effectively.

4.3 Energy Commodities Used in London

The breakdown of energy use and GHG emissions by commodity is outlined in Table 8.

Natural gas was the largest source of energy used in London in 2020, accounting for 47 per cent of all energy used. Natural gas use decreased by one per cent from 2019. Gasoline was the second largest source of energy, accounting for 21 per cent of London's energy use. Total gasoline use decreased by 18 per cent from 2019. For transportation fuels, at least 90 per cent of all the gasoline sold in gas stations in London was ethanol blended gasoline (10% ethanol) according to Kent Marketing. Electricity accounted for 21 per cent of all the energy used in London. Electricity use decreased by two per cent from 2019.

Compared to 2019, the weather in 2020 had an overall warmer winter, cooler spring, warmer summer, and warmer autumn. Warmer summer weather increases the demand for electricity used for air conditioning, while warmer winter and autumn weather decreases the demand for natural gas used for heating.

For electricity, it is important to note that over 90 per cent of the electricity generated in Ontario comes from emissions-free sources. In 2020, as reported by the Independent Electricity System Operator (IESO), 60 per cent of Ontario's grid electricity was supplied by nuclear generating stations, while hydroelectric generating stations supplied 25 per cent and other renewable sources of electricity (wind, biomass, solar) provided nine per cent of our electricity needs. Natural gas-fired generating stations provided almost seven per cent of Ontario's supply.

Table 8 – 2020 Community Energy Use by Energy Commodity

Energy Commodity	Total Used	Energy (Terajoules)	Energy (%)
Natural Gas	697,000,000 m^3	25,900	47%
Gasoline[1]	328,900,000 L	11,400	20%
Electricity	3,162,000 MWh	11,400	21%
Diesel[1,2]	108,700,000 L	4,200	8%
Aviation fuel[2]	6,900,000 L	300	< 1%
Propane[1]	27,400,000 L	700	> 1%
Ethanol (blended into gasoline)	30,000,000 L	600	> 1%
Fuel Oil[1]	15,000,000 L	600	> 1%
	Total	**55,100**	

NOTE: due to rounding of numbers, individual numbers may not add up to the total

1 – includes some data prorated from Ontario consumption data provided by Statistics Canada; 2019 data

2 – aviation and freight fuel data prorated from Canada consumption data provided by Statistics Canada; 2020 data

However, one important concept that needs to be understood is thermal efficiency. Whenever any fuel is burned in an engine to create mechanical energy or used to make steam to spin a turbine to generate electricity, only a small portion of thermal energy ends up being converted to mechanical or electrical energy. The rest of the energy often ends up being lost as “waste heat”. For example, the amount of thermal energy converted into power by steam-driven turbines in electricity generating stations is usually about 33 per cent, or in other words you need to use three units of heat energy to make one unit of electrical energy. The conversion rate is higher for combined cycle gas-fired power plants, which can reach about 50 per cent conversion of heat energy into electricity.

This is the same for internal combustion engines used in vehicles, which are about 35 per cent efficient when running in highway driving, and about 20 per cent efficient overall when you take into account the fuel wasted in city driving associated with waiting at stop lights and other situations where the engine idles. Replacing internal combustion vehicles with battery-powered electric vehicles is more efficient overall, even more so when sources like hydroelectricity are used.

When the thermal efficiency of converting heat into power in electricity generating stations is considered, a different picture of energy needs emerges, as seen in Table 9.

Table 9 – 2020 Energy Use in Electricity Generation Accounting for Thermal Efficiency

Source of Energy[1]	Energy (Terajoules)	Energy (%)
Uranium[2]	20,500	79%
Hydroelectric	2,900	11%
Natural Gas[3]	1,500	6%
Wind	910	4%
Solar[4]	60	0.2%
Biofuels[2]	90	0.4%
Total	**25,900**	

NOTE: due to rounding of numbers, individual numbers may not add up to the total
1 – Based on IESO 2019 annual electricity generation data from transmission-connected sources
2 – Assumed 33% thermal efficiency for generating electricity
3 – Assumed 50% thermal efficiency for generating electricity
4 – IESO data for solar only includes large transmission-connected solar farms. The Ontario Energy Board estimates that solar PV accounts for over 2% of power generation when smaller, local embedded generation is included

Table 9 helps illustrate the fact that electricity is not an energy resource, but the conversion of one form of energy (e.g., thermal energy in the case of nuclear and natural gas, gravitational potential energy in the case of hydroelectricity, kinetic energy in the case of wind) into electrical energy. In most cases, the remaining heat from large electricity generation plants is wasted. For London’s electricity needs, 26,700 terajoules of energy resources were consumed to provide London with 11,600 terajoules of electricity – the remaining 15,100 terajoules of energy was waste heat that was not utilized. However, this table helps to illustrate that greater use of cogeneration (or combined heat and power) and non-fuel renewables (hydro, wind, solar) will help to reduce this waste. Note that there are other “losses” that occur in energy distribution, such as line losses from power transmission, which have not been quantified.

Table 10 outlines the trend in per person energy commodity use since 1990.

Table 10 – 1990-2020 per Person Energy Use by Energy Commodity (GJ per Person)

Energy Commodity	1990	2005	2020	Change from 1990
Natural Gas	67	69	62	-7%
Gasoline (including ethanol-blended gasoline)	41	40	29	-30%
Electricity	34	37	27	-21%
Diesel	13	13	10	-22%
Fuel Oil	7	4	1	-81%
Aviation fuel	3	2	1	-80%
Propane	2	2	2	-31%
Total	**168**	**168**	**132**	**-21%**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

5 ENERGY EXPENDITURES AND ENERGY GENERATION

5.1 Energy Expenditures in London

Using information on utility billing rates and fuel price data from Kent Marketing, the total cost of energy use can be estimated. Note that these costs also include costs for the distribution and delivery of the energy commodity, as well as taxes on these commodities. A full description of the methodology is outlined in Appendix A (Section A.3).

Energy use and associated expenditures on energy are a significant operating cost for many businesses. In addition, for many Londoners, the rising costs of gasoline and electricity have put pressure on day-to-day household expenses, often requiring households to cut back on discretionary purchasing.

Understanding how much is collectively spent on energy, and the opportunities arising from energy conservation, is important for London. Table 11 outlines the total estimated costs associated with the energy commodities used in London.

Table 11 – Total Estimated Cost by Energy Commodity in 2020

Energy Commodity[1]	Cost ($ million)	Share (%)	Energy (terajoules)	Price per gigajoule
Gasoline (including ethanol-blends)	$367	27 %	12,000	$31
Electricity	$560	42 %	11,400	$49
Natural Gas	$285	21 %	25,900	$11
Diesel[1]	$97	7 %	4,200	$27
Propane	$24	2 %	700	$32
Fuel Oil	$16	1 %	600	$27
Total	**$ 1,346**		**54,500[1]**	**$24**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

1 – excludes diesel for railway freight transportation and aviation fuels

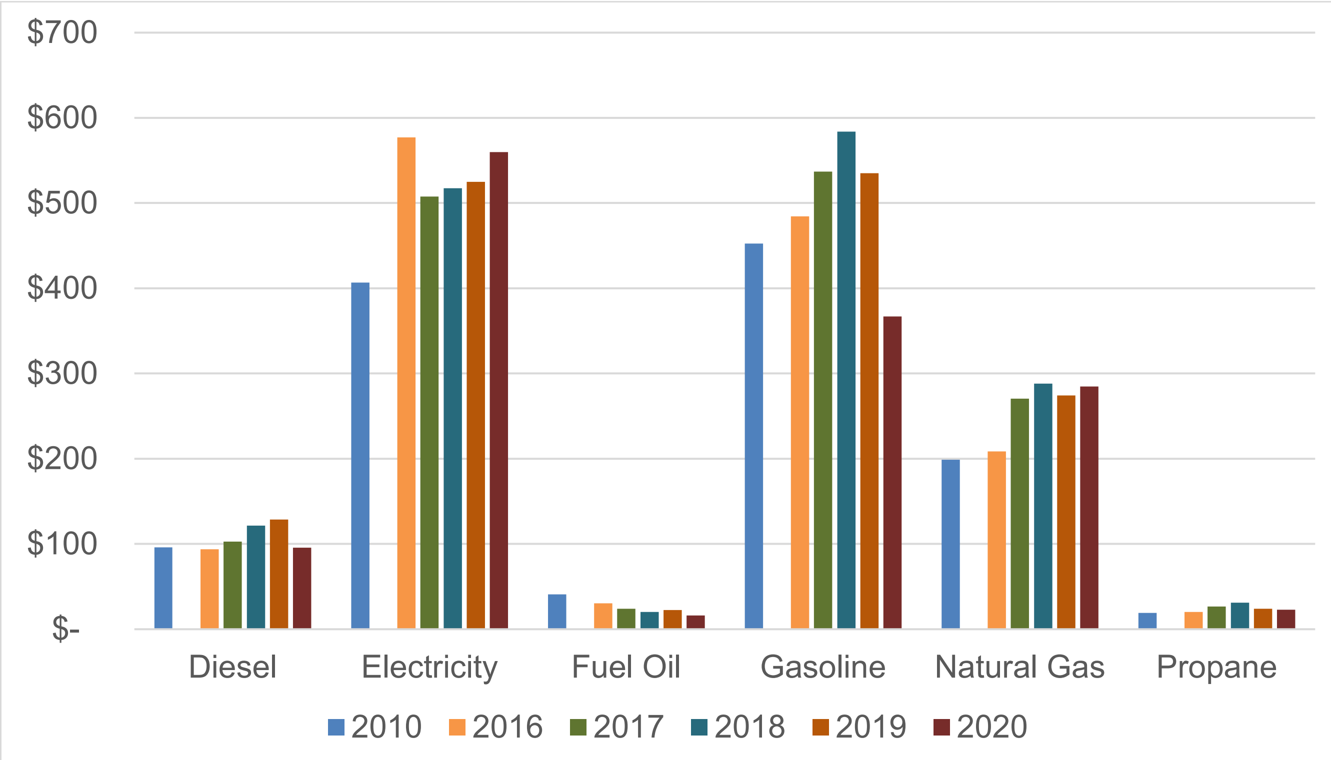
It is estimated that Londoners spent about $1.35 billion on energy in 2020, a decrease of 11 per cent from 2019.

As noted earlier, the work-from-home and stay-at-home orders due to COVID-19 reduced the demand for gasoline. As a result, the price for gasoline in 2020 decreased by 13 per cent. In total, Londoners spent about $170 million less on gasoline in 2020 than they did in 2019.

Electricity accounts for 42 per cent of total energy costs, due to electricity being the most expensive energy commodity used by Londoners.

Natural gas use accounts for only 21 per cent of energy costs, even though it is the largest source of energy we use, because of the low price of natural gas even with the $30 per tonne carbon price in place during 2020.

Figure 3 – Trend for Total Energy Commodity Costs (Millions) by Commodity in London



It is important to note that costs could have been higher. If 2010 is used as a baseline year in terms of energy use per capita, as noted in Figure 4, recent improvements in energy efficiency have created ongoing savings. In 2020, it is estimated that $380 million in energy costs were avoided through energy efficiency as well as the unique COVID-19-related reductions in transportation fuel use. Added up year-over-year, London has avoided over $1.3 billion in energy costs due to improved efficiency since 2010.

In recent years, every percentage that Londoners reduce their energy use results in around $13 million staying in London.

Information from utility billing rates and fuel price data can also be used to provide a reasonable estimate where the money is spent by Londoners on energy, as illustrated in Table 11. Out of the $1.35 billion spent on energy in 2020, it is estimated that 18 per cent of this money stayed in London, most of which goes towards London Hydro's and Enbridge's local operations. This is higher than previous years due to the impact of the COVID-19 pandemic. The rest leaves London. On average, from 2010 to 2019, between 85 per cent and 88 per cent of the annual expenditure on energy has left London's local economy.

With the drop in global oil commodity prices due to the COVID-19 pandemic related reductions in transportation fuel use, Western Canada's share of our energy dollars has dropped significantly. In 2014, Londoners and London businesses sent about $440 million of their energy dollars to Western Canada compared to about $180 million in 2020.

About $420 million of our energy dollars also goes to electricity generators in Ontario like Bruce Power and Ontario Power Generation, as well as Ontario's electricity transmitter, Hydro One.

Figure 4 – Trend for Total Energy Costs Compared to 2010 Energy Efficiency Baseline

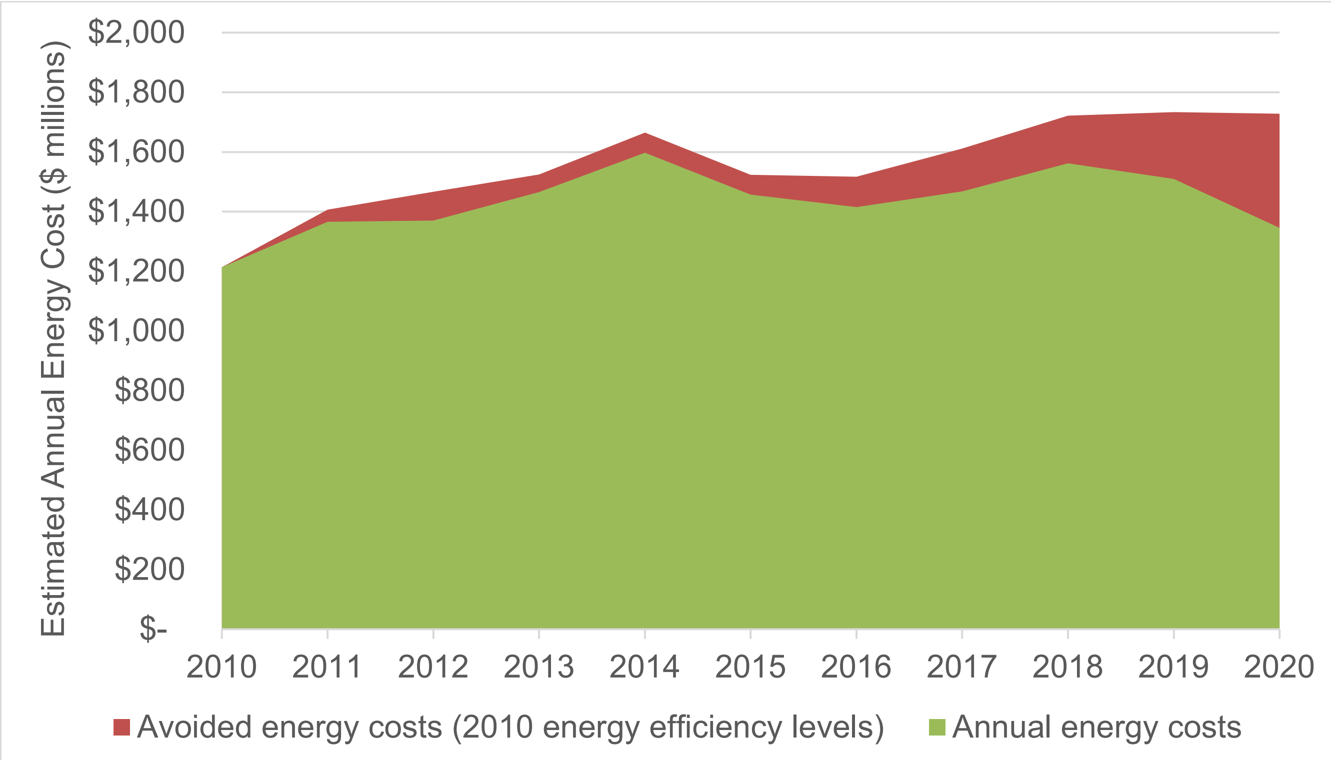


Table 11 – Estimated Share of Energy Revenue (2020)

Commodity	London Region	Ontario - Business	Ontario - Government	Western Canada	Canada - Government	United States
Diesel	>1%	2%	2%	2%	1%	-
Electricity	5%	31%	4%	-	1%	-
Fuel Oil	<1%	<1%	<1%	<1%	<1%	-
Gasoline	4%	6%	6%	8%	4%	-
Natural Gas	6%	3%	4%	3%	1%	4%
Propane	1%	1%	<1%	-	<1%	-
Total	**18%**	**43%**	**16%**	**13%**	**7%**	**4%**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

A portion of the money collected from federal and provincial taxes and other utility bill fees does help pay for other government services in London. For example, the City of London gets a portion of the gasoline tax to help pay for improvements to local transportation, other infrastructure, and environmental projects. Also, energy conservation incentives offered by utility companies are also funded through utility bills, as it is usually more economical to invest in conserving energy rather than it is to build new power plants.

The federal government also applies their carbon pollution pricing backstop in Ontario given that Ontario no longer has a carbon pricing system in place. Most of the funds collected by the backstop are used for the Climate Action Incentive provided when filing personal income tax returns, with the remaining used for funding federal climate action programs such as the Incentives for Zero-Emission Vehicles program. City staff estimate that about $65 million was collected through the carbon pricing backstop in 2020.

5.2 Energy Generation in London

London has almost 90 megawatts (MW) of local electricity generation capacity installed to date, an increase of about 1 megawatt from 2019. Currently, there is 68.3 megawatts of gas-fired co-generation, 17.9 megawatts of solar photovoltaic (PV), 2.85 megawatts of biogas, and 0.675 megawatts of hydro-electric power generation in operation in London.

Most of London's local generating capacity is associated with natural gas combined heat and power cogeneration plants, used in four different applications:

- **District energy** - London District Energy (38.7 MW) is a "merchant plant" that sells the power to the Independent Electricity System Operator and the thermal energy (steam for heating, chilled water for cooling) to buildings in central London. London District Energy has recently doubled its capacity to deliver combined heat and power at its Colborne Street facility.

- **Industrial** - Ingredion (14.1 MW) and Labatt Brewery (4.2 MW) generate steam as well as electricity "behind-the-meter" for use in their operations.

- **Hospital campus** – the London Health Sciences Centre (9.6 MW) Victoria Hospital campus generates both steam and electricity for hospital buildings, including the ability to keep the heat and power in the event of an emergency.

- **Micro-scale** – small scale combined heat and power systems (under 100 kilowatts) are in use at the Canada Games Aquatic Centre and H.B. Beal Secondary School for pool heating as well as electricity "behind-the-meter" for use in their operations.

6 TRANSLATING ENERGY USE INTO GREENHOUSE GAS IMPACT

6.1 Greenhouse Gas Emissions for 2020

Energy use in London was responsible for almost 2.6 million tonnes of greenhouse gas (GHG) emissions (expressed in terms of equivalent carbon dioxide, or CO_2e) in 2020. Table 12 provides additional information on GHG emissions associated with the various sources of energy used in London.

Table 12 – 2020 GHG Emissions by Energy Commodity

Energy Commodity	Energy (Terajoules - TJ)	GHG Emissions (kilotonnes CO_2e)	GHG (%)	GHG Intensity (tonnes/TJ)
Natural Gas	25,900	1,320	51%	51
Gasoline (including ethanol)	12,000	760	29%	63
Diesel	4,200	300	11%	70
Electricity	11,400	100	4%	8
Aviation Fuel	300	20	1%	68
Propane	700	40	2%	60
Fuel Oil	600	40	2%	70
Total	**55,100**	**2,570**		

NOTE: due to rounding of numbers, individual numbers may not add up to the total

Energy use is responsible for 95 per cent of all GHG emissions from human activity in London. Not only does burning fossil fuels such as gasoline, diesel, and natural gas produce carbon dioxide – the most common GHG associated with human activity – but the use of electricity also contributes to GHG emissions.

Over 90 per cent of Ontario's electricity was generated from emissions-free sources in 2020, such as nuclear and hydro-electric generating stations as well as renewable sources (wind and solar). However, as reported by the Independent Electricity System Operator, Ontario still relies on fossil fuels such as natural gas to generate almost seven per cent of the electricity we use. In 2020, it is estimated that every 1,000 kilowatt-hours of electricity generated in Ontario produced about 30 kilograms of carbon dioxide emissions. This is ten times better than it was 16 years ago (2003), when electricity generated in Ontario produced around 300 kilograms of carbon dioxide emissions.

The remaining five per cent of GHG emissions are methane emissions from the anaerobic decomposition of organic materials in the active and closed landfills located in London as well as commercial sector waste disposed in landfills outside London, and nitrous oxide emissions from sewage sludge incineration.

The City of London currently has the following GHG reduction targets:

- a 15% reduction from 1990 levels by 2020,
- a 37% reduction from 1990 levels by 2030, and
- net-zero emissions 2050.

In April 2021, the federal government revised its 2030 target to aim for a 40 to 45 per cent reduction in GHG emissions from 2005 levels as well as net-zero emissions by 2050. To date, the provincial government has not revised its 2030 target for a 30 per cent reduction from 2005 levels and has not established an emission reduction target beyond 2030.

In 2020, total GHG emissions were estimated to be 2.72 million tonnes of equivalent carbon dioxide, or 22 per cent lower than the 1990 level. This is well below the 15 per cent reduction target set for 2020. However, it is important to note the extraordinary impact of the COVID-19 pandemic on emissions.

As mentioned earlier, the COVID-19 pandemic had a significant impact on transportation fuel use, with an associated 20 per cent drop in transportation GHG emissions between 2019 and 2020. Warmer weather in the winter and autumn also reduced the demand for natural gas used for heating, with an associated seven per cent drop in residential GHG emissions between 2019 and 2020.

Seasonal weather variations can affect energy use and associated emissions significantly. However, over the last ten years, winter average temperatures and most summer average temperatures have been warmer than normal (as defined by Environment Canada's 1971-2000 climate data for London - see Appendix B).

Figure 5 illustrates the total GHG emission trend since 1990 in comparison to the targets used for London, for Ontario, and for Canada (with the minimum 40 per cent reduction target shown in the chart). The increase in GHG emissions began to stabilize around 2002 after a continued climb from 1990. Since 2005 there has been a downward trend driven by a combination of cleaner electricity generation and improved energy efficiency.

Figure 5 - Targets vs. Actual GHG Emissions from London

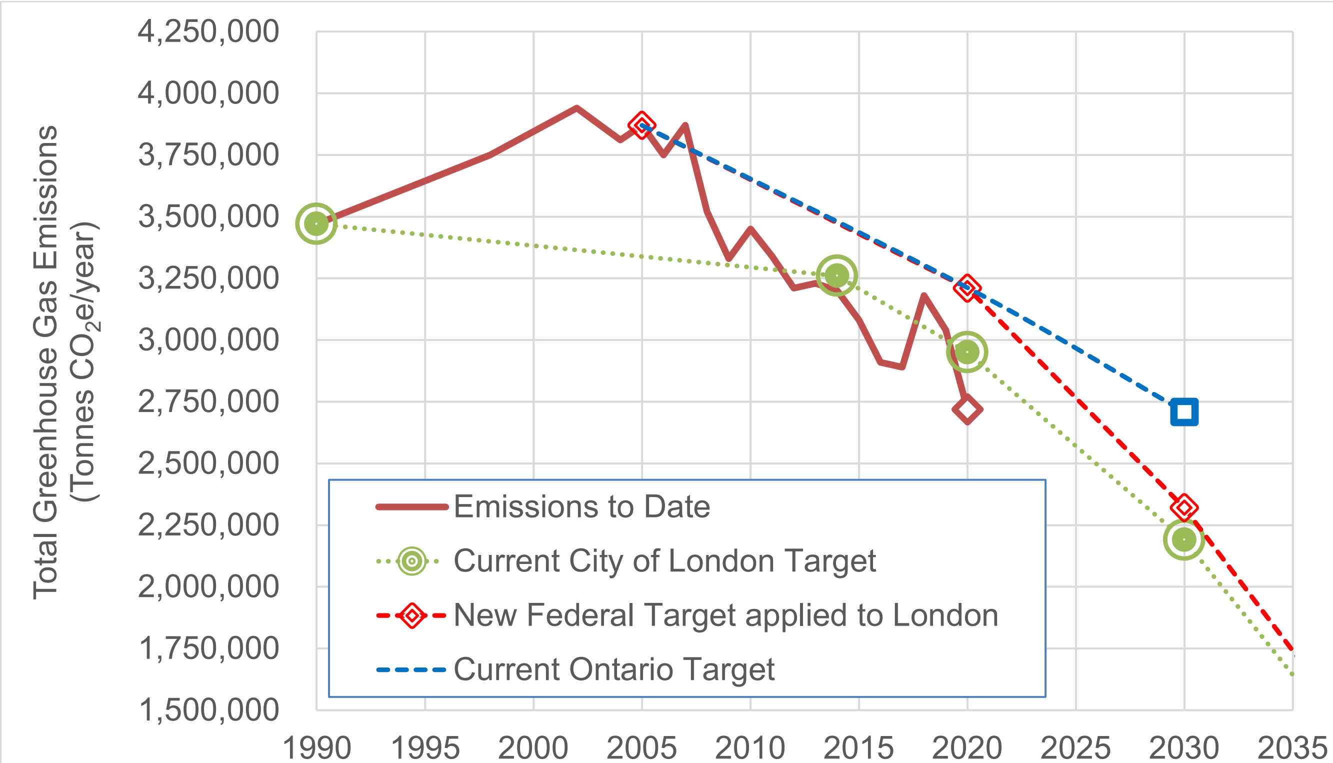


Table 13 illustrates the GHG emission trends by sector, including landfill gas emissions. As seen in Table 13, transportation and the industrial, commercial, and institutional sectors have the greatest contribution.

Table 13 – 1990-2020 Community GHG Inventory in London (kilotonnes CO_2e per year)

Sector	1990	2005	2020
Transportation	1,290	1,400	1,100
Residential	730	850	540
Industrial, Commercial & Institutional	1,120	1,380	940
Landfill Gas Emissions & Sewage Incineration	300	240	150
Total	**3,440**	**3,870**	**2,720**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

The community energy model developed by the Canadian Urban Institute for the Integrated Energy Mapping for Ontario Communities project, combined with provincial Broader Public Sector (BPS) energy data, was used to estimate a more-detailed breakdown of GHG emissions by building type, as shown in Table 14.

Table 14 – 2020 Breakdown of GHG Emissions by Subsector

Sector	Sub-sector	GHG Emissions (kilotonnes/year)
Transportation	Fuel sold at gas stations	740
Transportation	Road freight transport	220
Transportation	Corporate fleets	60
Transportation	London Transit	20
Transportation	Railway freight transport	40
Transportation	Domestic aviation	20
Residential	Low-density homes	460
Residential	Medium-density townhomes	80
Industrial, Commercial & Institutional	High-density residential buildings	50
Industrial, Commercial & Institutional	Commercial – office buildings	160
Industrial, Commercial & Institutional	Commercial – retail & warehouses	250
Industrial, Commercial & Institutional	Industrial	310
Industrial, Commercial & Institutional	Institutional - schools	20
Industrial, Commercial & Institutional	Institutional - hospitals	50
Industrial, Commercial & Institutional	Institutional - colleges & universities	80
Industrial, Commercial & Institutional	Institutional - municipal energy use	10
Waste Management	W12A Landfill	90
Waste Management	Closed landfills	30
Waste Management	IC&I waste disposed outside London	20
Wastewater Treatment	Sewage sludge incineration	10

In terms of per person emissions, as illustrated in Table 15 and Figure 6, emissions today are 42 per cent lower than they were back in 1990 (11.3 tonnes per person in 1990 versus 6.5 tonnes per person in 2020).

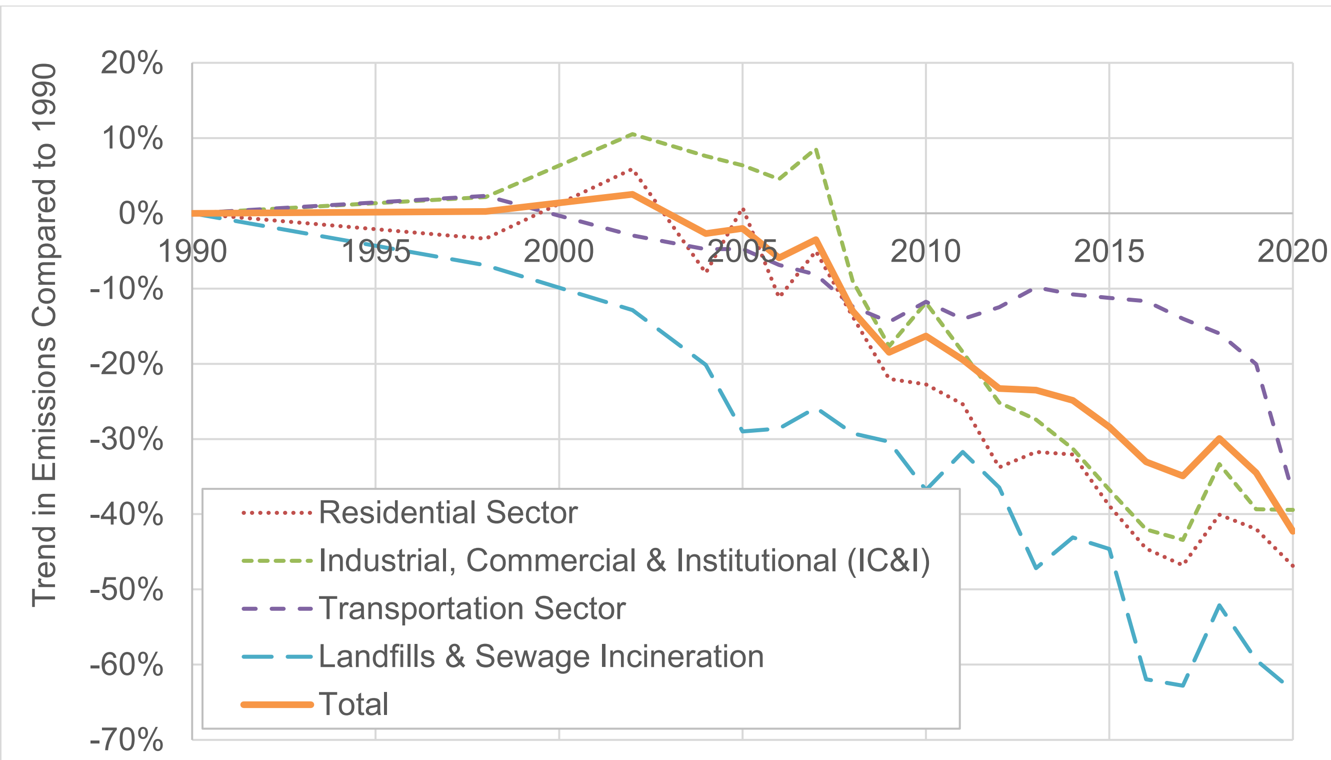
This reduction in GHG emissions has been created by a reduced GHG intensity for Ontario’s electricity grid, improved home energy efficiency, reduced energy use in the business sector, and the City of London landfill gas collection and flaring system at the W12A Landfill. Transportation emissions are also lower due to improved fuel efficiency, the use of ethanol-blended gasoline (10% ethanol by volume) as well as vehicle tailpipe emission controls that have reduced emissions of nitrous oxide.

Table 15 – 1990-2020 per Person GHG Inventory in London (tonnes per person)

Sector	1990 (Pop. 307,000)	2005 (Pop. 349,000)	2020 (Pop. 417,000)	Change from 1990
Transportation	4.2	4.0	2.6	-37%
Residential	2.4	2.4	1.3	-47%
Industrial, Commercial & Institutional	3.6	3.9	2.2	-39%
Landfill Gas Emissions & Sewage Incineration	1.0	0.7	0.4	-63%
Total	**11.2**	**11.1**	**6.5**	**-42%**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

Figure 6 – Change in GHG Emissions in London, Per Person by Sector, Since 1990



It is important to note these GHG emission estimates do not include emissions (indirect emissions) associated with the extraction, production, and transportation of materials, fuels, food, and consumer products (e.g., emissions from produce grown and transported from California, consumer products made and transported from China.) This is consistent with the approach taken by other Canadian cities reporting GHG emissions through the Partners for Climate Protection program. However, it is important to recognize the fact that the production and transportation of the consumer goods purchased do have an environmental impact, and that some types of goods (e.g., meat and dairy products) do have a larger impact than others. Additional information on consumption-related household GHG emissions are provided in Section 7 – Household Energy Use and Emissions.

6.2 Publicly Reported Local Emitters

In 2019, the provincial government required facilities that emit more than 10,000 tonnes of greenhouse gases to report their emissions on an annual basis. In London, there are eight facilities that have reported their emissions, including Fanshawe College who report voluntarily, as shown in Table 16. Note that these are direct emissions only, and do not include emissions associated with electricity use or vehicle fuel use.

The district heating steam plant at Western University provides heat for buildings on the Western University campus as well as the neighbouring London Health Sciences Centre University Hospital. In the case of London District Energy, these emissions are associated with providing steam heating and chilled water to buildings, as well as generating electricity. Many building owners served by London District Energy, including the City of London and St. Joseph's Health Care, include their share of these emissions within their energy and GHG reporting.

It is important to note that these "large emitters" only accounted for 15 per cent of London's total GHG emissions.

Table 16 – Annual GHG Emissions from Reporting Facilities (tonnes CO_2e per year)

Reporting Facility	2010	2013	2019
Fanshawe College of Applied Arts and Technology	3,143	2,924	3,007
3M Canada	N/A	N/A	10,316
Ingredion Canada Incorporated	124,320	115,988	126,752
Labatt Breweries of Canada LP	26,594	27,503	29,335
London Health Sciences Centre (Victoria Campus)	37,108	41,707	51,874
Western University (steam plant)	51,364	47,322	54,163
London District Energy	39,844	44,622	34,476
Great Lakes Copper	N/A	N/A	12,581
Kaiser Aluminum	N/A	N/A	16,566
W12A Landfill – Corporation of the City of London	160,430	106,349	102,025
Greenway Pollution Control Centre – Corporation of the City of London	N/A	N/A	12,653
Total	**442,803**	**386,415**	**453,748**
Percentage of total emissions from London	**13%**	**12%**	**15%**

The institutional sector – municipal government, colleges and universities, schools, hospitals – is also required to report its energy use and associated GHG emissions to the Province of Ontario through Ontario Regulation 397/11. These emissions will be for the organization as a whole, not just one specific facility or building. Table 17 summarizes the data reported for 2018, the most recent information available from the provincial government. Note that this information will include emissions from electricity use but does not include emissions from vehicle fuels. Also, in the case of the City of London, the province's reporting requirements do not require electricity use for street lighting and sports field lighting to be reported.

Table 17 – Ontario Regulation 397/11 Reporting Organizations in London

Reporting Organization (based on building electricity and fuel use)	Annual GHG Emissions 2018 (tonnes CO_2e)
University of Western Ontario	56,095
London Health Sciences Centre	49,876
Thames Valley District School Board	14,283
St. Joseph's Health Care London	14,210
City of London	10,548
Fanshawe College	5,144
London District Catholic School Board	9,005
Conseil scolaire de district des écoles catholiques du Sud-Ouest	447
County of Middlesex (buildings in London)	564
Conseil scolaire de district du Viamonde	273
Municipality of Thames Centre (building in London)	5
Boreal College	4
total	**160,456**
Percentage of industrial, commercial, and institutional emissions	**16%**
Percentage of total emissions from London	**5%**

7 HOUSEHOLD ENERGY USE AND EMISSIONS

Providing estimates of energy use and greenhouse gas emissions for an average household in London provides a clearer understanding the current situation (i.e., what to focus efforts on) and identify opportunities for improvements. These estimates can be made using the following assumptions:

- For electricity and natural gas, divide the total residential customer energy use by the number of customers
- For gasoline, divide the total retail sales of gasoline by the number of households in London
- For propane, divide the estimated total residential use of propane by the number of households in London

Electricity and natural gas use can be broken down further based on provincial data on typical energy use breakdown in Ontario homes.

Greenhouse gas emissions from organic waste in curbside waste can be estimated by dividing the annual GHG emissions from the W12A Landfill by the number of households in London.

Note that these estimates best reflect those Londoners who live in single-family homes.

Table 18 – Estimated Average Household Energy Use and Emissions in London for 2020

Household Activity	Average Monthly Use over the Year	Average Monthly Cost over the Year	Average Annual Cost	Average Annual GHG Emissions (tonnes CO_2e)
Gasoline use (vehicles)	169 litres	$173	$2,070	4.3
Natural gas use	172 m^3	$71	$850	3.9
Home heating		*$55*	*$660*	*3.0*
Hot water heating		*$16*	*$190*	*0.9*
Electricity use	680 kWh	$122	$1,470	0.25
Air conditioning		*$16*	*$190*	*0.03*
Appliance & plug load		*$39*	*$470*	*0.08*
Lighting		*$12*	*$140*	*0.02*
HVAC fan motor		*$55*	*$660*	*0.11*
Propane use	6 litres	$11	$120	0.1
Food waste in garbage		n/a	n/a	0.7
Total		**$377**	**$4,520**	**9.3**

NOTE: due to rounding of numbers, individual numbers may not add up to the total

7.1 Consumption (Scope 3) Greenhouse Gas Emissions

As noted earlier, it is important to recognize the fact that the production and transportation of the consumer goods we purchase do have an environmental impact, and that some types of goods (e.g., meat and dairy products) do have a larger impact than others. At this point in time, there is no easy-to-use methodology to estimate this at the community-wide scale.

However, with the information contained within the Environmental Commissioner of Ontario report, *Climate Pollution: Reducing My Footprint*, that report's estimates of consumption-related GHG emissions per person for Ontario residents can be compared to the GHG emissions from the direct use of energy and from waste shown in Table 18.

Table 19 – Estimated Average Household Consumption-Relation GHG Emissions in London

Household activity or purchases	**Average Annual Lifecycle GHG Emissions (tonnes CO_2e per household)**
Air travel – domestic	0.4
Air travel – international	2.7
Food – beef (e.g., enteric fermentation, processing, transportation)	1.1
Food – other (e.g., fertilizer, farm fuel use, processing, transportation)	2.0
Home – raw material extraction & processing, home construction	0.7
Home – natural gas extraction & processing, pipeline transportation	1.2
Other purchased goods & services (e.g., clothing, electronics, internet)	7.0
Vehicle – raw material extraction & processing, parts manufacturing & assembly	1.6
Vehicle fuel – oil extraction, fuel refining, pipeline transportation	1.0
Total Consumption (Scope 3) Emissions	**17.7**

As can be seen from Table 18 and Table 19, greenhouse gas emissions associated with the manufacturing and delivery of the goods purchased by the average household is larger than the emissions from the direct use of energy and from waste. This highlights the importance climate change mitigation of several environmental initiatives such as:

- Food waste reduction
- Buying durable products
- Buying local products
- Recycling and the circular economy (end-of-product-life material recovery and reuse)
- Repurposing and renovating existing buildings

8 SUMMARY AND CONCLUSIONS

8.1 Energy Use

The impact of the COVID-19 pandemic on transportation energy use was significant, which was 20 per cent lower 2019 overall. In particular:

- the local retail sales of gasoline and diesel at gas stations dropped by 21% because of many London workplaces shifting to work from home as well as reduced discretionary trips associated with stay-at-home orders and similar restrictions.

- Londoners took the opportunity provided by quieter roads to use their bikes for trips, with the estimated total distance of trips taken by bike in London increasing by 20% in 2020.

- The number vehicles registered in London in 2020 decreased by 6%.

It is anticipated that the shift to working-from-home will remain in place at London's workplaces after the COVID-19 pandemic is over, although this is not likely to be a full-time shift for everybody. It is also anticipated that the interest in cycling for transportation will continue to grow.

Residential (single-family home) energy efficiency has seen improvement, driven by energy conservation programs such as the former federal and provincial home energy audit and retrofit programs, along with utility conservation and demand management programs. New home construction in London has seen energy efficiency improvements driven by voluntary participation in efficiency programs such as Energy Star New Homes, as well as the 2012 Ontario Building Code.

Over the last ten years, energy efficiency for London's industrial, commercial, and institutional sector has been improving. London has many examples of local employers who have acted on energy efficiency and conservation.

In summary, specific highlights of recent community energy use progress and longer-term trends, include:

- The total amount of energy used in London in 2020 was 55,100 terajoules. This is an 8% decrease from the previous year (2019).

- Londoners are using energy more efficiently – on a per person basis, Londoners and London businesses used 21% less energy overall in 2020 than used in 1990.

- London is producing more goods and services for every unit of energy used – on a dollar gross domestic product (GDP adjusted for inflation) per unit energy basis, London's industrial, commercial, and institutional sector improved the value of goods and services produced per unit of energy used by 37% between 1990 and 2020.

- About $1.35 billion was spent by Londoners and London businesses on energy in 2020. Over 80% of this money left London.

- London is spending less money on energy – improvements in energy efficiency compared to 2010 levels of efficiency (on a per person basis and applied to activity in 2019) avoided about $380 million in energy costs had there been no improvements.

Vehicle ownership in London has grown by 35 per cent since 2010, or over double the pace that London's population has grown. The number of "green" vehicles in London (i.e., hybrids and electric vehicles) is over five times higher than it was in 2010. There are now over 1,000 electric vehicles registered in London. However, the number of "gas guzzling" SUVs and pick-up trucks in London has also increased.

8.2 Opportunities for London

Out of the $1.35 billion spent on energy in 2020, it is estimated that about 18 per cent of this money stayed in London. London would benefit from keeping more of its money in London. Every percentage that Londoners reduce their energy use results in approximately $13 million staying in London.

For example, the average household in London, living in a single-family home, spent about $380 every month on energy in 2020. This is about $70 a month lower than 2019, most of this due to reduced vehicle use associated with working from home as well as stay-at-home orders.

Money saved through energy efficiency and conservation can be used for other purposes, whether that's paying down debts faster or purchasing other goods and services (or a combination of both). Also, investing in energy saving retrofits, local sustainable energy projects and local energy production creates local jobs.

8.3 Greenhouse Gas Emissions

From a GHG reduction perspective, credit should be given to the previous Government of Ontario for following through in its plans to replace coal-fired power generation plants with cleaner sources, such as nuclear, hydroelectric, natural gas, and renewables, as well as encouraging electricity conservation. GHG emissions from the province's electricity grid are now 90 per cent lower than they were ten years ago.

The reductions in energy use noted above are also a contributor to London's significant reductions in GHG emissions. Federal vehicle emission standards and provincial ethanol in gasoline requirements have also helped to reduce transportation GHG emissions. Finally, the City of London's landfill gas collection and flaring system represents the largest source of GHG emissions reduction directly under municipal government control.

In summary: the use of energy in London has had the following GHG impacts:

- Total GHG emissions in 2020 were about 2.7 million tonnes of equivalent carbon dioxide – the top three sources in 2020 were personal vehicles (27%), single-family homes (20%), and commercial buildings (17%).

- London's total GHG emissions in 2020 were 22% below 1990 levels – an 11% decrease from the previous year due to the impact of COVID-19 in transportation energy use as well as a warmer winter and autumn.

- London met and exceeded its 2020 goal to reach 15% reduction from 1990 levels.

- Londoners' per-person GHG emissions are significantly lower – on a per person basis, Londoners and London businesses released 42% fewer GHG emissions in 2020 than they did in 1990.

In terms of household GHG emissions, the average household emitted 9.3 tonnes per year. As with cost, about half (47%) of this came from burning gasoline. Natural gas used for space heating and water heating accounted for 42 per cent of emissions. Organic waste in the landfill accounted for about seven per cent. Given Ontario's clean electricity grid, using electricity in the home only accounts for two per cent of household GHG emissions.

Whether emissions continue to decrease depends upon the impact of energy and fuel conservation efforts, provincial and federal climate change policies, climate trends, economic growth, and consumer choices. It is also important to note that these actions also contribute to reductions in air pollution emissions (e.g., nitrogen oxides, volatile organic compounds) from fossil fuel use.

The quantification of GHG emissions from the consumption of goods and services used by Londoners and London's employers is a growing area of interest for the City of London. Almost all these GHG emissions occur outside London. For consumer goods, most of these emissions occur outside of Canada. However, Londoners and London's employers can influence these emissions by the choices made regarding the goods and services they use.

APPENDIX A - METHODOLOGY

This document builds upon two foundational energy use and GHG emissions inventories that have been developed for London and related data, specifically:

- The 1995 *City of London Air Emissions Study*, prepared by SENES Consultants in association with Proctor & Redfern Limited and Torrie Smith Associates. It provided the baseline inventory for the community (1990) and municipal operations (1992).

- The London Energy/Air Emissions Reduction Strategy Task Force report in March 2000 titled *Air Emissions and Energy Use in the City of London.* This report revised the baseline 1990 community inventory and provided an update to the community inventory using 1998 data. It also provided an emissions and energy use business-as-usual forecast for 2001, 2006, 2012, and 2016.

Since 2003, City of London (Environmental Programs) staff has maintained and updated the community energy use and GHG emissions inventory on an annual basis.

The methodology employed is consistent with the GHG emission inventory protocol provided by ICLEI Canada for participants in the Federation of Canadian Municipalities' Partners for Climate Protection (PCP) program. The *2012 Community Energy & Greenhouse Gas Inventory: Challenges & Opportunities* report was reviewed by ICLEI and FCM staff as part of the City of London's Milestone 5 recognition for the PCP program.

The GHG inventory includes Scope 1 and Scope 2 emission sources, plus those Scope 3 emission sources required by the Global Covenant of Mayors:

- Scope 1 - GHG emissions from fuel use and landfills within the boundary of the city

- Scope 2 - Indirect GHG emissions that occur outside of the city boundary because of electricity consumption within the city

- Scope 3 - Other indirect emissions that occur outside of the city boundary because of activity within the city:
    - solid waste disposal (IC&I waste disposed in landfills outside London)
    - domestic aviation
    - railways

The remaining Scope 3 emissions, other indirect emissions and embodied emissions that occur outside of the city boundary because of activities of the city, are not included in the inventory, such as:

- marine transportation of goods
- embodied emissions upstream of power plants
- embodied emissions in fuels
- embodied emissions in imported construction materials
- embodied emissions in imported goods
- embodied emissions in imported food

A.1. Community Inventory Data Collection

Data for the community inventory is available for 1990, 1998, 2002, and 2004-2020 unless otherwise noted below. The inventory information used for the residential sector is based on the following:

- Annual electricity use data was provided by London Hydro. Note that this excludes multi-unit residential buildings, which are considered to be commercial accounts by London Hydro.
- Annual natural gas use data was provided by Union Gas. Note that this excludes multi-unit residential buildings, which are considered to be commercial accounts by Union Gas.
- Other home heating fuel data (e.g., propane, fuel oil) was obtained from Statistics Canada end-use energy data for Ontario prorated by population to estimate use within London. Note that the latest information is from 2019.

The inventory information used for the business and institutional sector is based on the following:

- Annual electricity use was provided by London Hydro. Note that this includes General Service < 50 kW , General Service > 50 kW , Large Users > 5000 kW, Users with Embedded Services (e.g., co-generation plants), sentinel lights, and street lighting.
- Annual natural gas use was provided by Union Gas. Note that this includes industrial, commercial, and institutional accounts.
- Other fuel data (e.g., fuel oil, kerosene) developed from Statistics Canada end-use data for Ontario prorated by population to estimate use within London. Note that the latest information is from 2019.

The inventory information used for the transportation sector is based on the following:

- Annual retail transportation fuel sales data for gasoline, ethanol-blended gasoline (E10) and diesel was provided by Kent Group. Given that London is a self-contained urban area, it is assumed that all transportation fuel used by London residents and businesses are purchased within London. This information has the benefit of being current (2020 data).
- Diesel use for public transit was provided by London Transit.
- Diesel use for road freight transportation was estimated using national-level 2020 data from Statistics Canada, prorated by population, to provide estimates that reflected the impact of the COVID-19 pandemic on road freight transportation.
- Diesel used for railways was developed from Statistics Canada energy end-use data for Ontario prorated by population to estimate use within London. Note that the latest information is from 2019.
- Community non-retail (i.e., commercial and other institutional) transportation fuel data developed from Statistics Canada end-use energy data for Ontario prorated by

population to estimate use within London. Propane identified as being used in the commercial and industrial sector is assumed to be used as transportation fuel only. Note that the latest information is from 2019.

- Aviation fuel use was estimated using national-level 2020 data from Statistics Canada, prorated by population, to provide estimates that reflected the impact of the COVID-19 pandemic on air travel.

The inventory information used for landfills is based on the following:

- Annual waste quantities placed within the landfills for each calendar year.
- For the W12A landfill, the emission reductions associated with the landfill gas collection and flaring system are based on continuously measured landfill gas flow rate and methane concentration at the landfill flare.
- The global warming potential of methane of 25, as per the Intergovernmental Panel on Climate Change's *Fourth Assessment Report* and used by the federal government in its GHG emissions reporting.

The inventory information used for waste generated in London and disposed outside of London is based on the following:

- GHG emissions were estimated by taking the reported GHG emissions from the Twin Creek Landfill and Ridge Landfill for 2016 and dividing it by London's share of the annual fill rate at these landfills. City of London Solid Waste Management staff estimated the volume of London's industrial, commercial, and institutional (IC&I) sector solid waste disposed outside of London to be around 83,000 tonnes – 45,000 tonnes to the Twin Creek Landfill and 8,000 tonnes to landfills in Michigan.
- For the 1990 to 2016 period, the amount of IC&I waste per capita was assumed to be the same as reported last year, namely 0.31 tonnes per person. GHG emissions were estimated based on the Ontario Waste Management Association' Cap & Trade Research spreadsheet model for Ontario waste sector; based on the model's estimated 0.75 tonnes CO_2e emitted per tonne waste disposed at large landfills. It was assumed 50% landfill gas capture from 2002 to 2019, only 25% landfill gas capture for 1998, and no landfill gas capture for 1990.

As a result of London having joined the Global Covenant of Mayors in 2015, it is recommended that nitrous oxide emissions from sewage treatment be included within London's energy and GHG emissions inventory as per the Global Protocol for Community-Scale GHG Emission Inventories (GPC). Nitrous oxide is a combustion by-product from the incineration of sewage sludge and its formation is influenced by incinerator operating conditions (i.e., combustion temperature).

Since 2008, annual stack testing at the Greenway Wastewater Treatment Plant sludge incinerator has included the measurement to nitrous oxide alongside other air pollutants. Table A-1 summarizes the nitrous oxide stack test results.

Table A-1: Summary of 2008 – 2020 Stack Test Results for Nitrous Oxide (N_2O) Emissions from the Greenway WWTP Sewage Sludge Incinerator

Year	Measured average emissions g/s	Measured average emissions kg/h	Estimated annual emissions tonnes/y	Estimated annual CO_2e tonnes/y
2008	0.1	0.4	3	1,000
2009	1.1	3.9	28	8,800
2010	1.1	3.9	28	8,700
2011	1.2	4.4	32	9,900
2012	1.0	3.5	26	7,900
2013	0.2	0.6	4	1,400
2014	1.1	4.1	29	9,100
2015	1.0	3.7	26	8,200
2016	0.3	1.1	7	2,300
2017	2.4	8.6	65	20,000
2018	1.7	6.0	43	13,000
2019	1.5	5.5	33	10,200
2020	0.8	3.0	18	5,500

As can be seen from the table above, measured emissions of nitrous oxides can vary from year to year.

A.3. Greenhouse Gas Emission Factors for Energy Commodities

Greenhouse gas emissions associated with energy use were calculated based on the emission factors provided by *Canada's National Inventory Report 1990-2019*, except for the 2020 grid-average emission factors for Ontario, which have been estimated based on the 2020 electricity supply mix for Ontario reported by the IESO, combined with the data from *Canada's National Inventory Report 1990-2019*. A summary of emission factors has been provided in Table A-2.

All GHG emissions are expressed in terms of equivalent carbon dioxide (CO_2e), based on the global warming potentials (GWP) of the various GHG emissions provided by *Canada's National Inventory Report 1990-2019.*

Table A-2 – Greenhouse Gas Emission Factors and Energy Conversions

Source of Emission	Emission Factor (CO_2e)	Information Source
Electricity - Ontario 2020	0.03 kg/kWh	Estimated based on IESO information for 2020
Electricity - Ontario 2019	0.03 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2018	0.03 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2017	0.02 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2016	0.04 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2015	0.04 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2014	0.04 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2013	0.08 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2012	0.11 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2011	0.11 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2010	0.14 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2009	0.12 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2008	0.17 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2007	0.24 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2006	0.21 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2005	0.25 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 2002	0.29 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 1998	0.23 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
Electricity - Ontario 1990	0.22 kg/kWh	National Inventory Report, 1990-2019 - ANNEX 11
natural gas	1.90 kg/m^3	National Inventory Report, 1990-2019 - ANNEX 6
fuel oil	2.73 kg/L	National Inventory Report, 1990-2019 - ANNEX 6
propane	1.54 kg/L	National Inventory Report, 1990-2019 - ANNEX 6
gasoline	2.31 kg/L	National Inventory Report, 1990-2019 - ANNEX 6
diesel	2.71 kg/L	National Inventory Report, 1990-2019 - ANNEX 6
gasoline (E-10)	2.08 kg/L	National Inventory Report, 1990-2019 - ANNEX 6

A.4. Cost Estimates for Community Energy Use

Information on the cost of using petroleum products is based on information available from Kent Marketing Services, specifically:

- Annual retail prices (including tax) and wholesale prices for regular-grade gasoline, mid-grade gasoline, premium-grade gasoline, diesel, and furnace oil;
- Crude oil price component associated with retail fuels, allocated to Western Canada (Alberta and Saskatchewan) which is the source of oil for refineries in Sarnia;
- The refiners operating margin, which is the difference between annual crude oil prices and wholesale prices, allocated to Ontario (refineries in Sarnia);
- The Harmonized (Federal and Provincial) Sales Tax and Federal Fuel Excise Tax; and
- The marketing operating margin, which is the difference between annual retail prices the wholesale prices and federal and provincial taxes, allocated to London (gas stations).

This allocation method was reviewed and accepted as being reasonable in 2013 by Kent Marketing.

Information on the cost of using electricity is based on customer rate structure information available on London Hydro's website, specifically:

- The Rate Component ($/kWh), the Loss Adjustment Factor, and (where applicable) the Global Adjustment, which is allocated to Ontario reflect the cost to generate electricity in Ontario;
- Delivery-related costs (Distribution Variable Charge, Network Charge, Connection Charge, Rate Rider for Tax Change, and Rate Rider for Variance Account), which is allocated to London to reflect London Hydro's operations;
- Transmission-related costs, which is allocated to Ontario to reflect Hydro One's operations; and
- Regulatory-related and Government-related charges (e.g., Ontario Hydro Debt Retirement, HST).

This allocation method was reviewed and accepted as being reasonable in 2013 by Wattsworth Analysis, the City of London's energy procurement advisor.

Information on the cost of using natural gas is based on customer rate structure information available on Union Gas's website, specifically:

- The Gas Commodity Rate, the Gas Price Adjustment, and Transportation, which is allocated to a mix of Western Canada (conventional gas wells) and United States (shale gas) to reflect the sources of natural gas supply and transporting this gas to Ontario ;
- Storage-related costs, which is allocated to Ontario to reflect Union Gas's regional and Ontario-wide storage and distribution operations;

- Delivery-related costs, which is allocated to London to reflect Union gas's local operations to supply natural gas to customers in London; and
- The HST.

This allocation method was reviewed and accepted as being reasonable by Wattsworth Analysis.

APPENDIX B - 2003-2019 HEATING & COOLING DEGREE DAYS FOR LONDON

Heating degree day (HDD) is a measurement tool used to estimate energy demand needed to heat a home or business. A similar measurement, cooling degree day (CDD), reflects the amount of energy used to cool a home or business.

It is based on the average outdoor air temperature over an entire day. The heating needs for a home or a building are generally directly proportional to the number of HDD at that location. Heating degree days are defined relative to a base temperature; the outside temperature above which a building needs no heating. For homes, a daily average temperature of 18 °C is used as this base. Therefore, if the average temperature for a day was 8 °C, then the HDD would be 10 for that day. Similarly, if the average temperature for a day was -2 °C, then the HDD would be 20 for that day. A typical winter month would have about 700 HDDs in London.

Environment Canada produces Climate Normal data ranges over a historic 30-year period. Over the last 10 years, most winters and summers have been warmer than they were over the 1971-2000 period.

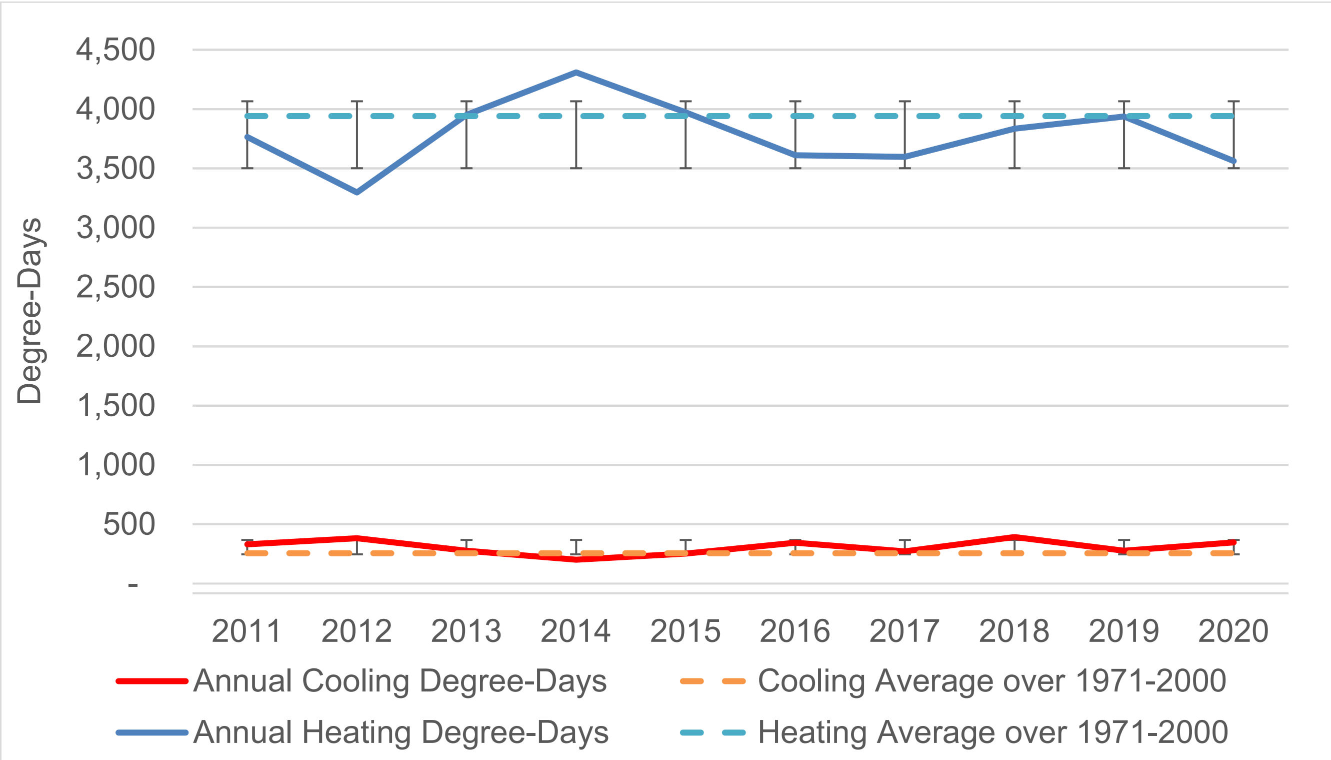
Table B-1 – Annual Residential Heating and Cooling Degree-Days for London

Year	Heating Degree-Days	Cooling Degree-Days	Heating - Difference from 30 Year Average	Cooling - Difference from 30 Year Average
2010	3,664	369	-7%	44%
2011	3,766	330	-4%	29%
2012	3,297	381	-16%	49%
2013	3,951	276	0%	8%
2014	4,309	201	9%	-21%
2015	3,971	254	1%	-1%
2016	3,615	343	-8%	34%
2017	3,597	271	-9%	6%
2018	3,836	392	-3%	53%
2019	3,937	277	0%	8%
2020	3,562	347	-10%	36%
Average for 2010-2020 period	**3,773**	**313**	**-4%**	**22%**
30-year average (1971-2000)	**4,058**	**236**		

Notes: 1. Climate Normal data based on the 1971-2000 period
2. Heating and cooling degree-days based on the daily average difference from 18°C

Using this data, it can be assumed that, over the last 10 years, building heating needs were about four per cent lower than they would have been back in the 1971-2000 period, and that air conditioning needs were 22 per cent higher.

Figure B-1 – Annual Residential Heating and Cooling Degree-Days for London



Report to Civic Works Committee

To: Chair and Members
Civic Works Committee
From: Kelly Scherr, P.Eng., MBA, FEC
Deputy City Manager, Environment & Infrastructure
Subject: 2020 Corporate Energy Consumption and Activities Report
Date: August 31, 2021

Recommendation

That, on the recommendation of the Deputy City Manager, Environment & Infrastructure and City Engineer, the following actions **BE TAKEN:**

a) this report on the 2020 Corporate Energy Consumption and Activities Report **BE RECEIVED** for information; and,

b) this report **BE CIRCULATED** to the Advisory Committee on the Environment (ACE) for their information.

Executive Summary

The Ontario Electricity Act (1998), under Regulation 507/18, requires all public agencies to prepare and publish annually updated reports on the energy consumption and greenhouse gas (GHG) emissions for City's facilities. Since 2014, public agencies are also required to prepare a Conservation and Demand Management (CDM) Plan and update it every five years.

The 2019-2023 Corporate Energy Conservation and Demand Management (CDM) Plan, the most recent plan, has the following targets using 2018 as the baseline year:

- A 5% reduction in total annual energy use by 2023;
- A 10% decrease in energy use per capita; and
- Keep annual total energy cost increases within five percent of 2018 costs.

The secondary long-term goals identified in this plan are to monitor and track the City's water consumption starting in 2018 and investigate possible pathways for achieving net zero emissions by 2050 or sooner.

In 2020, the Corporation of the City of London spent $17.6 million on energy for municipal operations. Total energy used in 2020 was eight percent lower than the 2018, the baseline year used for the 2019-2023 CDM Plan. Energy-related greenhouse gas emissions from corporate energy use in 2020 was 17,500 tonnes per year. Corporate energy use in 2020 was influenced by COVID-19 pandemic restrictions, primarily in office environments. Corporate energy management activities continued in 2020, with projects completed in 2020 contributing $200,000 in annual energy cost savings, with an additional $160,000 received in incentives from energy utilities.

The City's performance in 2020 is currently exceeding the 2023 targets established in the 2019-2023 CDM Plan as follows:

Goal	2018 Baseline	2023 Reduction Target	Progress as of end of 2020
Reduction in total energy use	-	5%	8%
Total energy use (million Equivalent kilo-watt hours - ekWh)	174	165	160

Goal	2018 Baseline	2023 Reduction Target	Progress as of end of 2020
Energy performance for service delivery (ekWh/person)	436	394	386
Energy related GHG emissions (tonnes)	18,700	17,800	17,500
Total energy costs (millions)	$17.9	$18.8	$17.6
Water consumption (thousands m^3)	646	-	587

It is expected that, except where investments are made to create sustainable reductions, energy and water use trends will return to a more typical level once City office facilities are fully staffed post-pandemic. Since the first year of baseline energy data was collected in 2007, however, the City's water and energy performance has been improving year over year with:

- Energy performance for service delivery (ekWh/person) 31% better than 2007;
- Total greenhouse gas emissions 61% lower than 2007; and,
- Total water consumption 29% lower than 2007.

Since 2014, the start of the first CDM Plan, there have been several other key outcomes:

- The City has received approximately $3 million in incentives for energy management projects; and,
- The City has avoided about $20 million in utility costs through the combination of energy conservation projects and energy commodity procurement strategies.

In 2020, there was a shift in focus from making decisions based just on the reduction of energy usage towards making decisions from an integrated climate change perspective, particularly as it related to projects and funding opportunities for projects. Many internal studies are underway to identify net-zero emission opportunities at individual facilities including operations centres, community centres, and wastewater treatment facilities The development of the Climate Lens Process in 2020 and 2021 has increased the visibility and awareness of the need for energy conservation measures for City facilities, programs, projects, and operations.

Linkage to the Corporate Strategic Plan

Municipal Council continues to recognize the importance of managing energy costs, energy conservation, and climate change and other related environmental issues in its 2019-2023 - Strategic Plan for the City of London. Specifically, London's efforts in climate change mitigation address three of the five Areas of Focus, at one level or another:

- Building a Sustainable City
- Growing our Economy
- Leading in Public Service

Analysis

1.0 Background Information

1.1 Previous Reports Related to this Matter

Relevant reports that can be found at www.london.ca under Council and Committee meetings include:

- Report to the October 22, 2019 Civic Works Committee (CWC) Meeting, 2018 2019-2023 Corporate Energy Conservation and Demand Management (CDM) Plan (Agenda Item #2.8)

1.2 Context

Addressing the Need for Action on Climate Change
On April 23, 2019, the following was approved by Municipal Council with respect to climate change:

> *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.*

The 2020 Corporate Energy Consumption and Activities Report is the measurement tool to highlight The Corporation of the City of London's progress towards meeting its energy reduction and greenhouse gas reduction targets along with other targets and directions.

Background
The Ontario Electricity Act (1998), under Regulation 507/18, requires all public agencies to prepare and publish:

- Annually updated reports on the energy consumption and greenhouse gas (GHG) emissions for City's facilities; and,
- A Conservation and Demand Management (CDM) Plan starting in 2014 and to update this plan every five years.

The Annual Energy Consumption and GHG Emissions Report submissions can be found on the City's open data catalogue.

The provincial reporting requirement does not include significant corporate energy users such as street lighting and corporate fleet fuel use, nor other needs such as sports field lighting. However, these energy needs are included within the scope of the 2020 Corporate Energy Consumption and Activities Report, as in previous years, as it is imperative that all energy uses and impacts within the City's control are continuously examined for reduction opportunities.

The 2019-2023 Corporate Energy Conservation and Demand Management (CDM) Plan has the following targets, using 2018 as the baseline year:

- A 5% reduction in total annual energy use by 2023;
- A 10% decrease in energy use per capita; and,
- Keep annual total energy cost increases within five percent of 2018 costs.

The secondary long-term goals identified in this plan were to:

- Monitor and track the City's water consumption starting in 2018; and,
- Investigate possible pathways for achieving net zero emissions by 2050 or sooner

To achieve these goals, planned, proposed, and behavioural initiatives were identified in the CDM Plan for each service area and the primary goal was further divided into individual goals. All City service areas are separated into two areas: buildings and vehicle fleet. Additionally, wastewater treatment, water operations and traffic signals and streetlights are monitored separately in the Environment & Infrastructure service area.

2.0 Discussion and Considerations

A collaborative process to implement the action items in the 2019-2023 CDM Plan was introduced with major service areas during the development of the CDM Plan in 2019. Bi-weekly meetings with Facilities and monthly meetings with Fleet and Wastewater Treatment Operations teams are held to review current energy consumption, progress towards CDM goals, and to discuss future projects and initiatives as these service areas contribute to highest energy consumption. Regular quarterly meetings are also held with other service areas who have direct control over energy use and GHG emissions. These focused staff meetings facilitated sharing of best practices and the identification of measures and initiatives that will work towards achieving the overall 2019-2023 CDM plan goal.

Highlights from the 2020 report (Appendix A) are below in two categories:

1. Corporate Energy CDM Plan Progress
2. Summary of corporate energy CDM actions taken in 2020

The 2020 Corporate Energy Consumption and Activities Report can be found on the Get Involved London Climate Emergency Action Plan website.

2.1 Corporate Energy CDM Plan Progress

Table 1 outlines the City's overall progress towards the 2019-2023 CDM Plan goals as of 2020:

Table 1 – 2019-2023 CDM Plan Target Tracking

Goal	2018 Baseline	2023 Reduction Target	Progress as of end of 2020
Reduction in total energy use	-	5%	8%
Total energy use (million Equivalent kilo-watt hours - ekWh)	174	165	160
Energy performance (ekWh/person)	436	394	386
Energy related GHG emissions (tonnes)	18,700	17,800	17,500
Total energy costs (millions)	$17.9	$18.8	$17.6
Water consumption (thousands m^3)	646	-	587

In terms of assessing options for achieving net-zero emissions for the Corporation by 2050 or sooner, City staff are currently working on an internal net-zero analysis study. In support of this activity:

- In 2020, Facilities staff commissioned a study to look at the feasibility of retrofitting fifteen existing City facilities, including the A.J. Tyler Operations Centre, Exeter Road Operations Centre, and Earl Nichols Arena, to be net-zero energy or near net-zero emission buildings through the implementation of heat pump technology. Preliminary results indicate that these retrofits are financially feasible.

- Request for Qualifications have been received for companies to test the deployment of large-scale net-metered solar PV power generation at wastewater treatment plants and water supply pumping stations.

In the 2019-2023 CDM Plan, the corporate CDM primary goals are further divided to individual service areas. The performance to date is summarized in Table 2.

Overall, the City's performance in 2020 is currently exceeding the 2019-2023 CDM Plan's goals. The performance in 2020 was influenced by COVID-19 pandemic restrictions limiting in-office work and reduced employee travel requirements. A similar consumption pattern to 2020 might be observed in 2021 as well as the pandemic continues. While the pandemic restrictions have impacted usage in 2020, corporate energy management activities also continued in 2020.

Table 2 – Individual Service Area 2019-2023 CDM Plan Tracking

Service Area	2018 Baseline	2023 Reduction Target	Progress as of end of 2020
Buildings – energy use (million ekWh)	68.3	64.1	62.6
Wastewater treatment – energy efficiency (ekWh/megalitre)	738	671	628
Traffic and streetlights – energy use (million ekWh)	18.4	15.1	17.7
Water supply – energy use (million ekWh)	8.7	7.8	8.9
Fleet operations – GHG emissions (tonnes CO_2e)	7,340	7,090	6,910

2.2 Summary of Corporate Energy CDM Actions Taken in 2020

The City's corporate energy team worked closely with various service areas within the City, utility personnel, and industry experts to retrofit existing buildings, construct new buildings, and upgrade equipment and processes.

An important part of the process also involves securing incentives and funding opportunities and post-project monitoring and verification of savings. The City tracks the energy savings achieved from projects once they are complete. Projects completed in 2020 contributed $200,000 in annual energy cost savings, with an additional $160,000 (one-time incentive) received in incentives from utility providers.

2020 highlights include:

- Aeration Blower Upgrades - Upgrades to all aeration blowers at wastewater treatment plants to new efficient turbo blowers were initiated in 2016 and were completed in 2020. This work is estimated to provide over $600,000 in energy savings annually. Over $1 million in incentives is being provided from the Ontario Independent Electricity System Operator (IESO) to support this work.

- Electric Ice Resurfacers - In 2020, the City made the decision to replace all compressed natural gas (CNG) ice resurfacers with electric resurfacers. Four unit are now ready to go into service when arenas re-open and four additional units are planned for use in the 2021/2022 arena season.

- Green Fleet – The City commissioned its first two CNG packers for solid waste collection services. This started the process of moving away from fossil fuel for the packers, as the long-term goal is to use renewable natural gas (RNG) from the W12A landfill as fuel in the City's waste collection fleet.

- Insulation Upgrades - Arena glass walls were replaced with insulated panels at Bostwick Community Centre.

- Organic Rankine Cycle (ORC) Engine Project - The City completed most of the installation of the ORC engine for waste heat recovery for power generation at Greenway Wastewater Treatment Facility in 2020. When commissioned in 2021, this will offset 475 kilowatts of electrical grid consumption, which represents over 12 percent of the City's overall CDM Plan goal for energy reduction by 2023.

2.3 Corporate Energy CDM Plan Progress Since 2007

Since 2007, the first year for baseline energy data, the City's energy performance has been improving year over year with:

- Energy performance for service delivery (ekWh/person) 31% better than 2007;
- Total greenhouse gas emissions 61% lower than 2007; and,
- Total water consumption 29% lower than 2007.

The introduction of the first CDM Plan in 2014 provided the City with an opportunity to review its energy management program initiatives and proposed energy targets. It provided the groundwork for successful implementation of energy management decisions and actions within all corporate operations, particularly those that begin to take actions needed to respond to the City of London's Climate Emergency Declaration.

The City has seen a number of key achievements since 2014, as listed below:

- Met and exceeded its 2014 CDM target for a 10% reduction in energy use by 2020, with a 16% reduction in total energy consumption;
- Received approximately $3 million in energy conservation and management incentives;
- Invested in deepening the culture of conservation within the Corporation's operations by having regular employee engagement activities and awareness programs;
- Avoided about $20 million in energy costs through the combination of energy conservation projects and energy commodity procurement strategies; and,
- Improved energy performance (energy used per capita for service delivery) by 25%

2.4 Development of the Climate Lens Process

The Climate Lens Process was designed to ensure that climate emergency issues are part of the decision-making processes throughout the Corporation. To date, it has been considered in a number of areas of the Corporation. The Climate Lens Process will take this experience and new knowledge to significantly increase climate emergency activities and actions. The objectives associated with the creation and use of the Climate Lens Process are to:

- Ensure climate emergency issues are included in decision-making and evaluation of existing plans, programs and projects;
- Establish a clear process for accountability and tracking of climate emergency issues, including collection of information on decision outcomes and tracking the progress of projects/programs implemented; and,
- Elevate understanding of the importance of climate emergency issues in decision-making across the Corporation.

The Climate Lens Process includes the following five streams of activities:

1. Master Plans, Guidelines and Strategies
2. Existing and New Projects/Programs
3. Quick Assessment of Existing Operations
4. Annual Budget Updates & Multi-year Budgets
5. Building Climate Change Capacity

The Climate Emergency Screening Tool (CEST) can be used in the Climate Lens Process especially when it is customized for an area. The customized CEST is used to guide the screening of projects and programs for key climate emergency issues and opportunities for improvement.

The development of the Climate Lens Process in 2020 and 2021 has increased the visibility and awareness of the need for energy conservation measures for City facilities, programs, projects, and operations.

2.5 Development of the Climate Emergency Action Plan

The development of a Climate Emergency Action Plan is a fundamental and required response to the City of London's climate emergency declaration. The goals are to improve London's resilience to climate change impacts, reduce London's greenhouse gas emissions by at least 37% below 1990 levels by 2030 and reach net-zero emissions by 2050.

A recent report to Council's Strategic Priorities and Policy Committee on April 27, 2021 provided an update on the plan's engagement and development to date. City staff are currently reviewing the ideas and feedback collected from residents and businesses submitted between October 2020 and April 2021 as part of the development of the plan. Opportunities for input continue and can found at https://getinvolved.london.ca/climate

The 2020 Corporate Energy Consumption and Activities Report, reporting on corporate energy use and resulting greenhouse gas emissions, and the background data behind it, are part of the foundation for the development of the Climate Emergency Action Plan (CEAP). The CEAP is currently scheduled to be submitted to the Strategic Priorities and Policy Committee (SPPC) in late fall 2021.

Conclusion

Overall, 2020 saw a large shift in focus from making decisions based on the reduction of energy usage to decision-making from an integrated climate change perspective, particularly as it related to projects and funding opportunities for projects. Many internal studies are underway to identify net-zero opportunities at individual facilities.

The City will always require energy to run its facilities, vehicles, and operations, but the strategic management of energy usage, emissions, investment in renewable technologies and a keen focus on climate change can help use less, become carbon neutral and greener overall.

Prepared by:	**Sneha Madur, B.Eng., M.Eng., CEM** **Corporate Energy Management Engineer**
Prepared by:	**James Skimming, P.Eng.** **Manager, Energy & Climate Change**
Prepared and Submitted by:	**Jay Stanford MA, MPA** **Director, Climate Change, Environment & Waste Management**
Recommended by:	**Kelly Scherr, P.Eng., MBA, FEC, Deputy City Manager, Environment & Infrastructure**

Appendix A 2020 Corporate Energy Consumption and Activities Report

c. Anna Lisa Barbon, CPA, CGA, Deputy City Manager, Finance Support
Tim Wellhauser, CIM, Director, Fleet and Facilities

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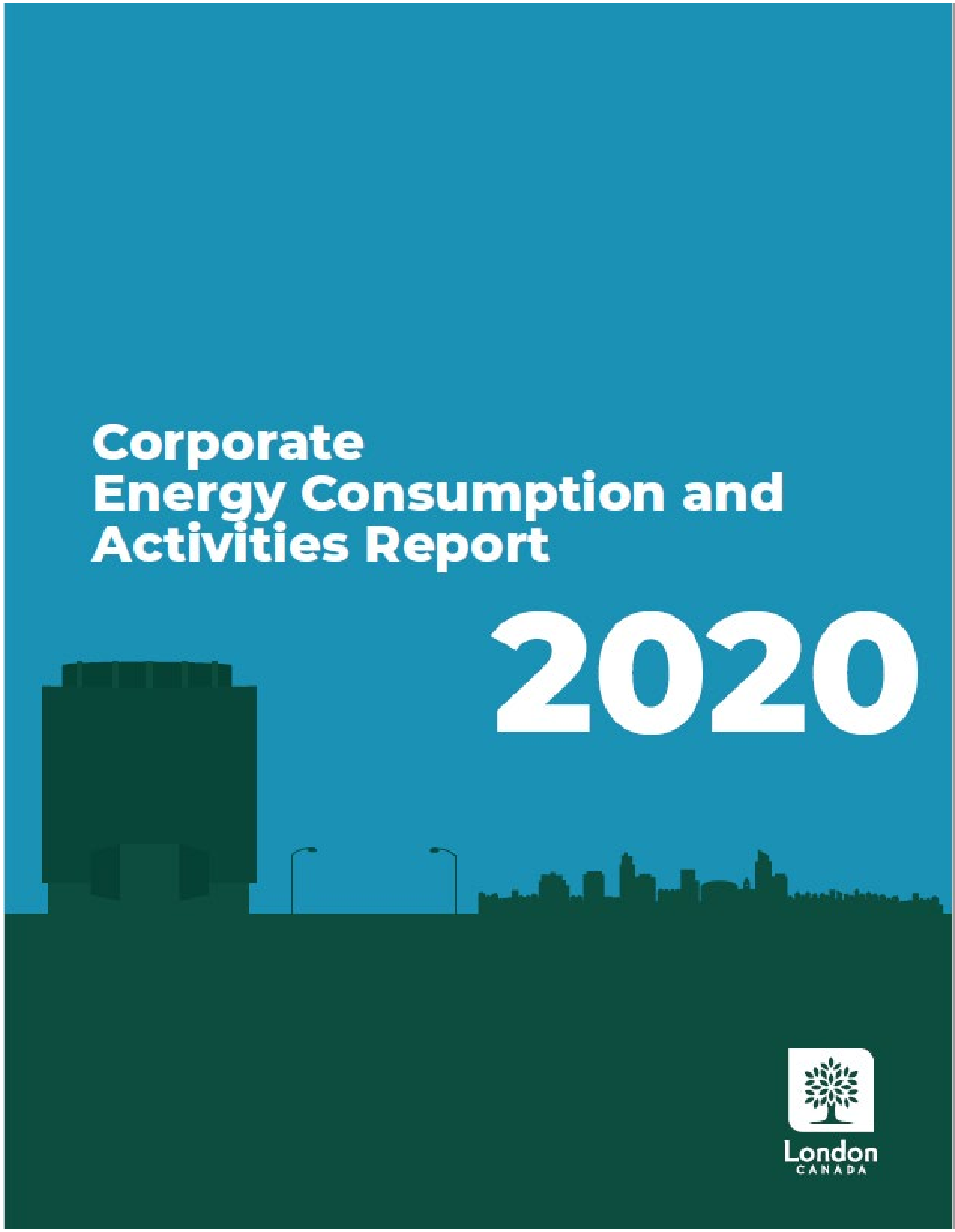
2020 Corporate Energy Consumption and Activities Report

london.ca

Contents

Executive Summary

The Executive Summary for the 2020 Corporate Energy Consumption & Activities Report is now a stand-alone document.



1. Background

In 2009, the Ontario legislature passed the *Green Energy Act (GEA).* As one of its objectives, the GEA aimed to increase energy conservation by introducing measures to help Ontarians manage energy use. The GEA's Regulation 397/11 (now the O. Reg 507/18, Electricity Act 1998), requires all public agencies to prepare and publish:

- Annually updated reports on the energy consumption and greenhouse gas emissions for City's facilities.
- A Conservation and Demand Management (CDM) Plan starting in 2014 and to update this plan every five years. The CDM Plan outlines strategies for identification and implementation of CDM projects throughout City facilities. The first plan was released in July 2014, and an updated 2019-2023 CDM Plan was released in August 2019.

The Ontario Regulation 507/18 reporting requirement does not include significant corporate energy users such as street lighting and corporate fleet fuel use, nor other needs such as sports field lighting. However, these energy needs are included within the scope of this Corporate Energy Consumption and Activities Report as it is imperative that all energy uses and impacts within the City's control are continuously examined for reduction opportunities.

2. Alignment with Existing Strategies

This report and the CDM Plan align with:

1. The City's Climate Emergency Declaration: On April 23, 2019, the following was approved by the municipal Council with respect to Climate change:

   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

2. Climate Emergency Action Plan (CEAP)– The development of the Climate Emergency Action Plan will be a fundamental response to the City's climate emergency declaration. The goals will be to improve London's resilience to climate change impacts, reduce London's community-wide greenhouse gas emissions by at least 37 per cent below 1990 levels by 2030 and reach net-zero by 2050. The 2019-2023 CDM plan's long-term goals closely align with CEAP.

3. City of London Strategic Plan – Building a Sustainable City is one of the Strategic Areas of Focus in the 2019-2023 Strategic Plan with a key performance indicator being to conserve energy and increase actions to respond to climate change and severe weather.

3. Collaboration with Service Areas

A collaborative process to implement the energy conservation action items was introduced with major service areas during the development of the CDM Plan in 2019. Bi-weekly meetings with Facilities and monthly meetings with Fleet and Wastewater Treatment service areas are held to review current energy consumption, progress towards CDM goals and to discuss future projects and initiatives as these service areas contribute to highest energy consumption. Regular quarterly meetings are also held with other service areas who have direct control over energy use and greenhouse gas emissions. These focused staff meetings facilitated sharing of best practices and identification of measures and initiatives that will work towards achieving the overall 2019-2023 CDM plan goal.

Further, the implementation and development of the Climate Lens Process as discussed in section 7.2 in this report, includes collaborative work with every service area and operational units within the Corporation to work together towards the common net-zero goal by 2050 or sooner.

4. Methods and Limitations of Measurement

The City procured the EnergyCap software in 2007 to log monthly utility bills for municipally owned and administered buildings and facilities. This software has the capability to track, monitor and capture data to assist the City with reporting consumption and providing historical data.

Fleet fuel use data is provided from the PetroVend fuel management software system which is used for tracking vehicle fuelling at operation centers.

The annual energy consumption and greenhouse gas emissions for the City does not include energy consumed in leased office space where the utility costs are incorporated in the leasing agreements. This energy use and greenhouse gas emissions are captured in the 2020 Community Energy Use & Greenhouse Gas Emissions Inventory report.

4.1 Service Areas and Energy Consumption

The City manages diverse operations of buildings, including office spaces, community centres, arenas, and fire halls which use energy for interior and exterior lighting, heating and cooling of buildings and energy associated with maintaining recreational services like pools and arenas. The City also manages linear assets such as wastewater treatment plants, water supply and pumping facilities, traffic lights, and City fleet operations. Ninety per cent of the energy consumed by linear assets is electricity associated with running and maintaining the processes.

For this report, all the City's service areas are divided in the following categories to compare their individual contribution to City's total energy consumption:

- Buildings
- Wastewater Treatment Plants

- Water Supply Operations
- Traffic Signals & Streetlights, and
- Fleet Operations

4.2 Sources and Emission Factors for Greenhouse Gas

greenhouse gas emissions within City operations are contributed by consumption of electricity, natural gas, steam, chilled water, diesel, and gasoline. Among these, fleet fuel, followed by natural gas and steam have highest emissions per equivalent kWh of fuel as shown in table 1.

Table 1: Commodity Emission Factors - Grams of CO_2 equivalent per equivalent kilowatt-hour (kWh)

Commodity	2020
Electricity	30
Natural Gas	182
Diesel	262
Gasoline (E-10 blend)	237
Steam	143
Chilled Water	98

Table Notes:

- The electricity emission factors are based on The Atmospheric Fund report (TAF) https://taf.ca/wp-content/uploads/2019/06/A-Clearer-View-on-Ontarios-Emissions-June-2019.pdf.
- Steam and chilled water are supplied by London District Energy (LDE) for City's downtown office building locations and its associated emissions have been provided by LDE.
- Gasoline and diesel have highest emission factors and are used in City fleet vehicles.

5. Performance to 2019-2023 CDM Plan Goals

The City's 2019-2023 CDM Plan primary goal is to achieve a five per cent reduction on overall annual energy use by 2023. The baseline year is 2018. Tied to this goal are:

- A ten per cent reduction in energy use per capita,
- 900 tonnes of avoided greenhouse gas emissions by 2023, and
- Keeping the total energy cost increases within five per cent from 2018 baseline year.

The secondary long-term goals identified in this plan are:

- Monitor and track the City's water consumption starting in 2018, and
- Investigate possible pathways for achieving net zero emissions by 2050 or sooner

To achieve these goals, Planned, Proposed, and Behavioural initiatives were identified in the CDM Plan for each service area and the primary goal was further divided into individual goals for each service area. All the City service areas are separated into five areas as below:

- Buildings
- Wastewater & treatment operations
- Water pumping operations
- Traffic signals & streetlights, and
- Vehicle fleet

Identified in Table 2 is the City's detailed progress towards the 2019-2023 CDM goals to date:

Table 2 – 2019-2023 CDM Plan Target Tracking

Goal	2018 Baseline	2023 Reduction Target	Progress as of end of 2020	Notes
Reduction in total energy use from 2018 baseline	-	Down by 5%	Down by 8%	Exceeded target (mostly due to COVID-19 shutdowns, which reduced buildings energy consumption).
Total Energy use (million ekWh)	174	165	160	Exceeding target so far.
Energy Performance (ekWh/person)	436	394	386	Exceeding target so far.
Energy related greenhouse gas emissions (tonnes)	18,700	17,800	17,500	Exceeded target by 2% so far due to: • COVID -19 shutdowns • Greenway incinerator off for two months for Organic Rankine Cycle (ORC) project installation.
Total Energy Costs (millions)	$17.9	$18.8	$17.6	2% below baseline so far (within target).

Goal	2018 Baseline	2023 Reduction Target	Progress as of end of 2020	Notes
Monitor and Track water consumption (thousands m^3)	646	-	587	6% reduction year over year so far.

In terms of assessing options for achieving net-zero emissions for the Corporation by 2050 or sooner, City staff are currently working on an internal net-zero analysis study. In support of this activity:

- Ameresco has completed a net-zero energy buildings pathway study involving 16 buildings, and
- Request for Qualifications have been received for companies to test the deployment of large-scale net-metered solar PV power generation at wastewater treatment plants and water supply pumping stations.

In the 2019-2023 CDM Plan, the corporate CDM primary goals are further divided to individual service areas. This performance is tracked in Table 3:

Table 3 – Individual Service Area 2019-2023 CDM Plan Tracking

Service Area	2018 Baseline	2023 Reduction Target	Progress as of end of 2020	Notes
Buildings (million ekWh)	68.3	64.1	62.6	Decrease in consumption due to COVID-19 shutdowns.
Wastewater Treatment Operations (ekWh/megalitre)	738	671	628	Energy efficiency exceeded 2018 target. This is mostly due to natural gas being turned off at Greenway incinerator for two months for ORC project.

Service Area	2018 Baseline	2023 Reduction Target	Progress as of end of 2020	Notes
Traffic and Streetlights Operations (million ekWh)	18.4	15.1	17.7	3% decrease as of 2020 and on track towards 2023 target. Phase 1 and Phase 2 LED conversion of streetlights are resulting in continued energy savings year over year.
Water Supply Operations (million ekWh)	8.7	7.8	8.9	4% increase in electricity consumption led to overall energy increase. Electricity increase was due to a 3% increase in water supply.
Fleet operations (tonnes CO_2e greenhouse gas emissions)	7,340	7,090	6,910	Decrease in fuel emissions by almost 6% in 2020 compared to 2018 and exceeded target. This is due to reduced diesel consumption in 2020 by conversion of 4 solid waste packers to CNG. Use of CNG contributed to only 0.03 tonnes of greenhouse gas in 2020.

Overall, the City's performance in 2020 is currently exceeding the 2019-2023 CDM goal. The performance in 2020 was influenced by COVID-19 restrictions. A similar consumption pattern to 2020 might be observed in 2021 performance as well, as the pandemic continues in 2021. However, corporate energy management activities also continued in 2020. A complete list of 2020 corporate energy activities are provided in Section 7 and Appendix B of this report.

6. Corporate Annual Energy Analysis

In 2020, the City's energy use is categorized by consumption, associated emissions, and costs by commodity. The 2020 energy data are also normalized to London's population to measure improvements in efficiency. This allows City to demonstrate and relay to Londoners the energy consumed in relationship to service delivery provided by the City.

For this report, all the 2020 energy emissions data are compared to below two years:

- 2007 – as this was the first year that City started measuring and monitoring its corporate energy consumption.
- 2018 – as this is the baseline year for the updated 2019-2023 CDM Plan

6.1 Total Corporate Energy Consumption

With the use of the EnergyCap software, the City has ability to breakdown and report annual energy consumption by the commodity and by service area.

Table 4 – Total Energy Consumption by Commodity

Energy Consumption (ekWh)	2007	2018	2020	Change from 2007	Change from 2018
Electricity	108,328,000	98,448,000	89,893,000	-17%	-9%
Natural Gas	58,682,000	42,430,000	40,889,000	-30%	-4%
Steam	3,499,000	3,269,000	2,093,000	-40%	-36%
Chilled Water	1,759,000	1,521,000	913,000	-48%	-40%
Diesel Fuel	20,129,000	22,194,000	20,306,000	0.8%	-9%
Gasoline	6,718,000	6,889,000	6,667,000	-1%	-3%
Total	199,115,000	174,751,000	160,761,000	-19%	-8%

Table 4 shows the City's energy consumption by commodity, which amounts 160 million equivalent kilowatt-hours (kWh) in 2020. Electricity represents the 56 per cent of all the energy used by the City. Out of this, more than 50 per cent is consumed by electricity-intensive operations such as water supply and wastewater treatment plants, 20 per cent is consumed by streetlights and traffic lights, and the remaining 30 per cent is consumed for maintain building ventilation, lighting, and office equipment.

Natural gas is second highest commodity, representing 25 per cent of the total energy consumption. Most of the natural gas is used for space heating and hot water heating, but approximately eight to ten per cent of the total natural gas is used for wastewater sludge incineration at Greenway Wastewater Treatment Plant every year.

Diesel and gasoline are consumed by variety of fleet vehicles and equipment which include waste collection trucks, snowplows, off-road construction equipment, and portable hand-held tools used by Parks & Recreation.

Steam and Chilled water account for only one per cent of the total energy consumption each and is completely used by administration buildings owned by the City in downtown London including City Hall. Steam and chilled water are supplied by London District Energy.

Overall, total energy use is 20 per cent lower compared to 2007 and eight per cent lower compared to 2018. Energy associated with heating and cooling buildings (steam, electricity, chilled water, and natural gas) have shown greatest reduction from 2007. This shows that energy efficiency measures in place since 2007 have played a major role in conservation.

6.2 Total Corporate Energy Consumption Per Capita

The City's energy consumption is a direct function of serving the public, businesses, and visitors of London. The trends in consumption reported is significant to the services provided to the community. London continues to grow in population and increased services are required to support that growth. It is important to capture energy usage per capita to demonstrate the City's achievements in energy reductions while continued growth occurs in London.

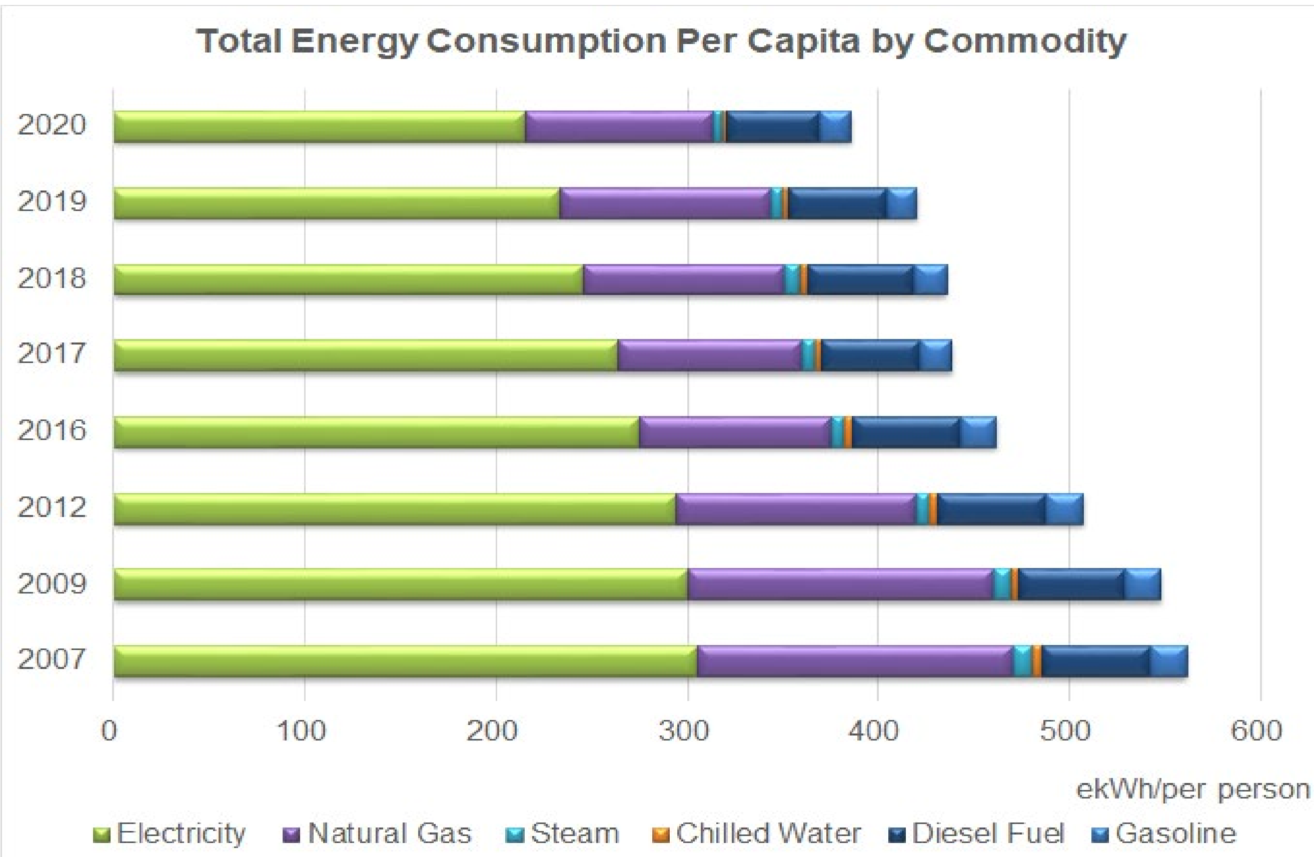


Figure 1: Corporate Total Energy Consumption per Capita by Commodity Type

Figure 1 shows total energy consumption per capita by commodity which is explained as follows:

- London's population has grown by almost 18 per cent (62,000 people) since 2007. Thirteen years of data show continued improvement of corporate energy use per capita with an overall reduction of 31 per cent in 2020 compared to 2007.

- In 2020, the City improved energy efficiency by over twelve per cent compared to 2018. This significant reduction in 2020 is mostly due to offices and community service centers being shutdown in 2020 due to the COVID-19 pandemic.

- London's population increased by four per cent in 2020 from 2018, while corporate energy use per person decreased by twelve per cent from 2018.

6.3 Total Corporate Energy Consumption by Service Area

Separating the municipal service by categories gives the City the ability to see where progress is being made and the opportunity to target areas for improvements.

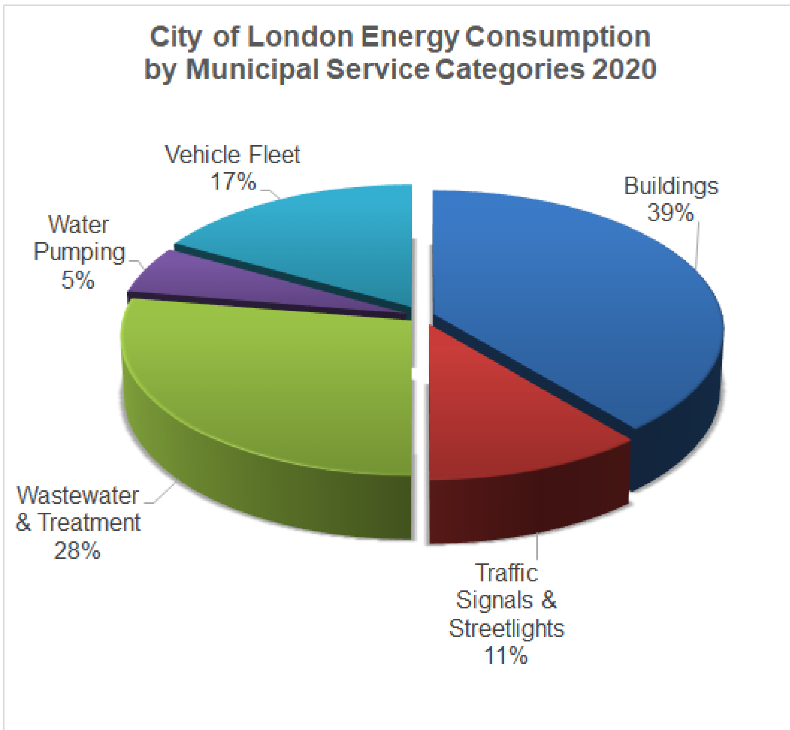


Figure 2: City of London 2020 Energy Consumption by Municipal Service Categories

Figure 2 is a pie chart showing buildings as the highest energy consumer at 39 per cent followed by wastewater treatment operations at 28 per cent, fleet operations at 17 per cent, traffic signals & streetlights at eleven per cent, and water operations at five per cent.

Figure 3, a stacked bar graph, represents the overall energy consumption (ekWh) by the municipal service categories since 2007. The last six years are highlighted in this figure to show continuous improvement year over year since 2015.

Most of the energy consumption reductions have been observed in buildings, wastewater treatment operations and traffic signals & streetlights.

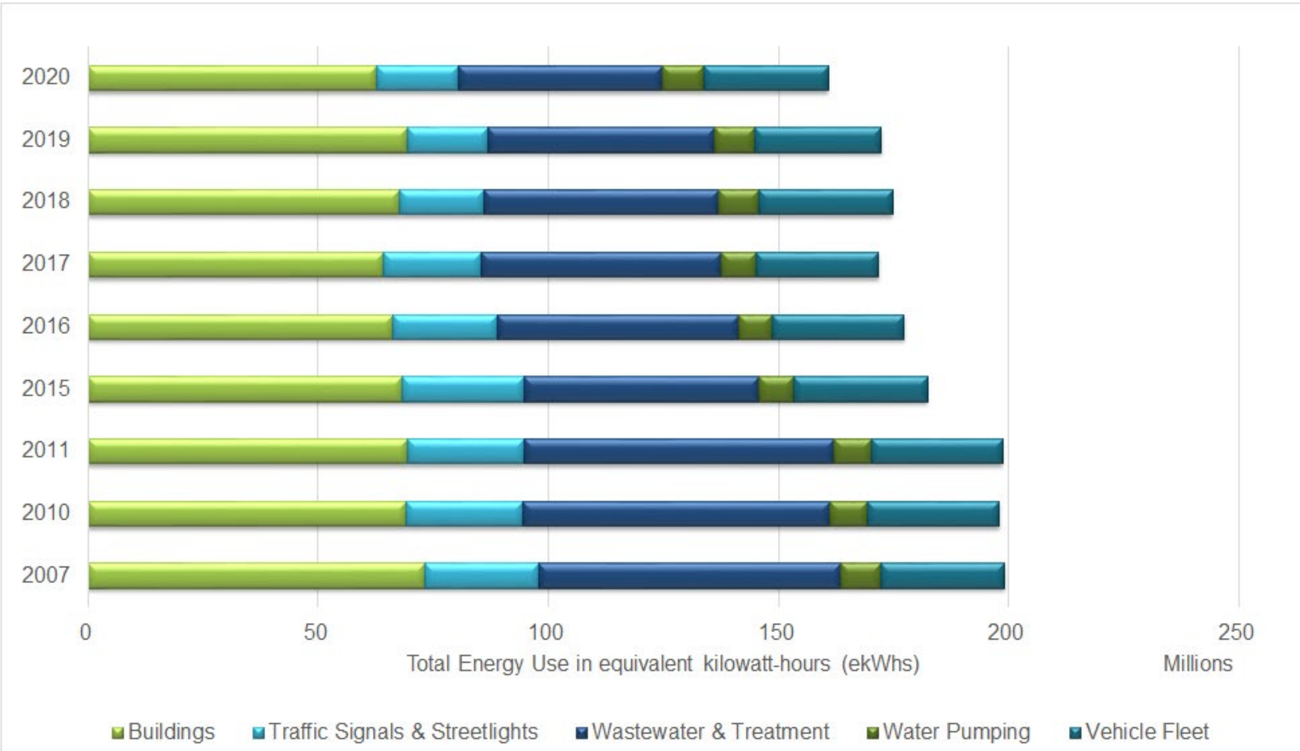


Figure 3 – Total Energy Consumption by Service Area (ekWhs)

Buildings reduced energy consumption by 17 per cent compared to 2007 and eight per cent to 2018. Most of these reduction from 2007 are a result of heating, ventilation, and air conditioning (HVAC) upgrades and LED lighting upgrades at Buildings.

Wastewater treatment continues to see improved energy efficiency as a result of HVAC upgrades, aeration blower upgrades and utilizing waste heat. There was 30 per cent drop in natural gas at wastewater treatment operations in 2020 alone compared to 2019 due to the sludge incinerator at the Greenway Wastewater Treatment Plant being shut off for two months for the installation of the Organic Rankine Cycle (ORC) engine. With the completion of the ORC engine commissioning in 2021 and boiler upgrades at Greenway in 2022, the natural gas consumption at the plant is expected to drop further by five to ten per cent by end of 2022.

Traffic signals and streetlights have seen an 18 per cent decrease from 2007 and a four per cent decrease from 2018. However, electricity use has remained the same over the last two years as the first two phases of the LED streetlighting project are completed. There is an opportunity to further reduce streetlights consumption by completing the third phase of decorative and side streetlights conversion from halogens to LEDs. However, the current cost of decorative LED fixtures is high and does not meet the City's business case requirements.

Fleet fuel consumption has remained the same since 2018 and is influenced directly by activities undertaken by different service areas. Although total consumption increased by just under one per cent compared to 2007, the per capita consumption shows a decrease by 14 per cent. This shows that the efficiency of fleet operations increased over the years.

Adding the new Southeast Reservoir Pumping Station (SERPS) water supply facility in 2017 increased water supply's overall energy consumption by two per cent compared to 2007 and 2018. However, on-going energy efficiency efforts at this new facility and other water supply facilities will help reduce energy consumption in the next five years.

6.4 Total Energy-Related Corporate Greenhouse gas Emissions

In 2020, greenhouse gas emissions from energy use were six per cent (1,200 tonnes) lower than 2018 and 61 per cent lower compared to 2007. Figure 4 shows the greenhouse gas reduction trend since 2007. Greenhouse gas reductions have been observed across the corporation since 2007, except for Fleet.

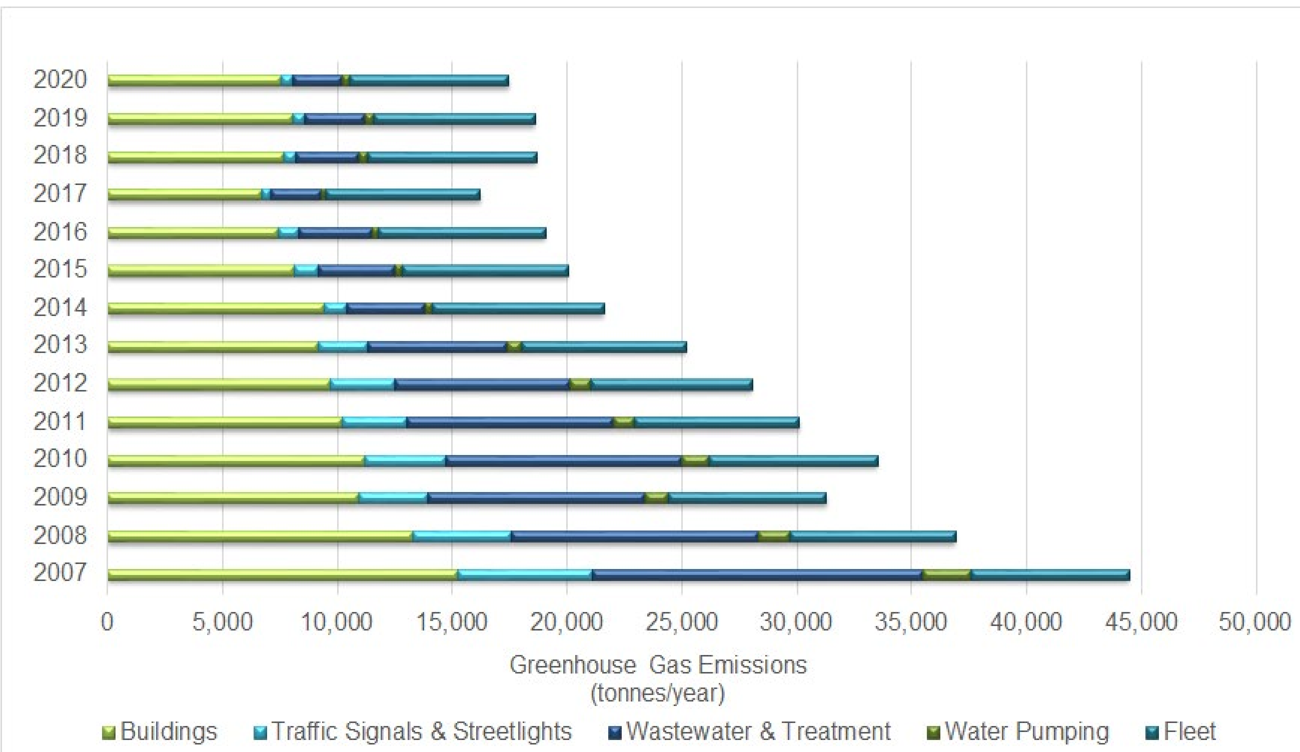


Figure 4 – Corporate Energy-Related Greenhouse Gas Emissions since 2007

Fleet's greenhouse gas emissions are now a larger share of corporate energy-related emissions due to emissions from burning gasoline and diesel as explained in section 4.2 of this report.

Wastewater treatment operations have reduced their greenhouse gas emissions by 21 per cent (580 tonnes per year) since 2018. Most of these reductions per cent between 2019 and 2020 were due to the sludge incinerator at Greenway being shutoff for two months in 2020 for the installation of the ORC engine. However, since 2007, wastewater has seen overall reductions of 85 per cent (12,300 tonnes per year) due to the sludge dewaterer eliminating the need to constantly burn natural gas for sludge incineration, as well as energy efficiency projects as waste heat recovery, aeration blowers, and HVAC upgrades.

Most of the emission reductions are due to a cleaner electricity grid in Ontario due to increased conservation efforts and cleaner sources of energy used to generate electricity in Ontario:

- 90% reduction in electricity-related emissions
- 44% reduction in steam-related emissions, due solely to corporate actions
- 23% reduction in natural gas related emissions, due solely to corporate actions

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

This could result in corporate energy related greenhouse gas emissions increasing over the 2019-2023 timeframe even with the planned energy savings, given that electricity represents about 60 per cent 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.

6.4.1 Net Zero Emissions Pathway by 2050

The City is currently working on developing projects and initiatives towards achieving its long-term target of Net-zero by 2050 or sooner as part of its 2019-2023 CDM Plan and as part of next steps of Climate Emergency Action Plan. Figure 5 shows City's performance to date towards achieving net zero by 2050. With 2020 emissions being 17,500, the actual emissions till date are below the trendline to net-zero by 2050.

The electricity emission factor is expected to increase from 30 to 85 grams of CO2 equivalent per kilowatt hour between 2021 and 2035 as Ontario nuclear power generators are undergoing refurbishment and natural gas generators would be used to compensate for the lost capacity during this period.

In terms of assessing options for achieving net-zero emissions for the Corporation by 2050 or sooner, City staff are currently working on an internal net-zero analysis study. In support of this activity:

- Ameresco has completed a net-zero energy buildings pathway study involving 16 buildings
- Request for Qualifications have been received for companies to test the deployment of large-scale net-metered solar PV power generation at wastewater treatment plants and water supply pumping stations

London District Energy is currently working on making its own steam and chilled water generation free of fossil fuels in the next ten years, which will directly help reduce City's emissions and contribute towards achieving net-zero goal by 2050 or sooner as a community.

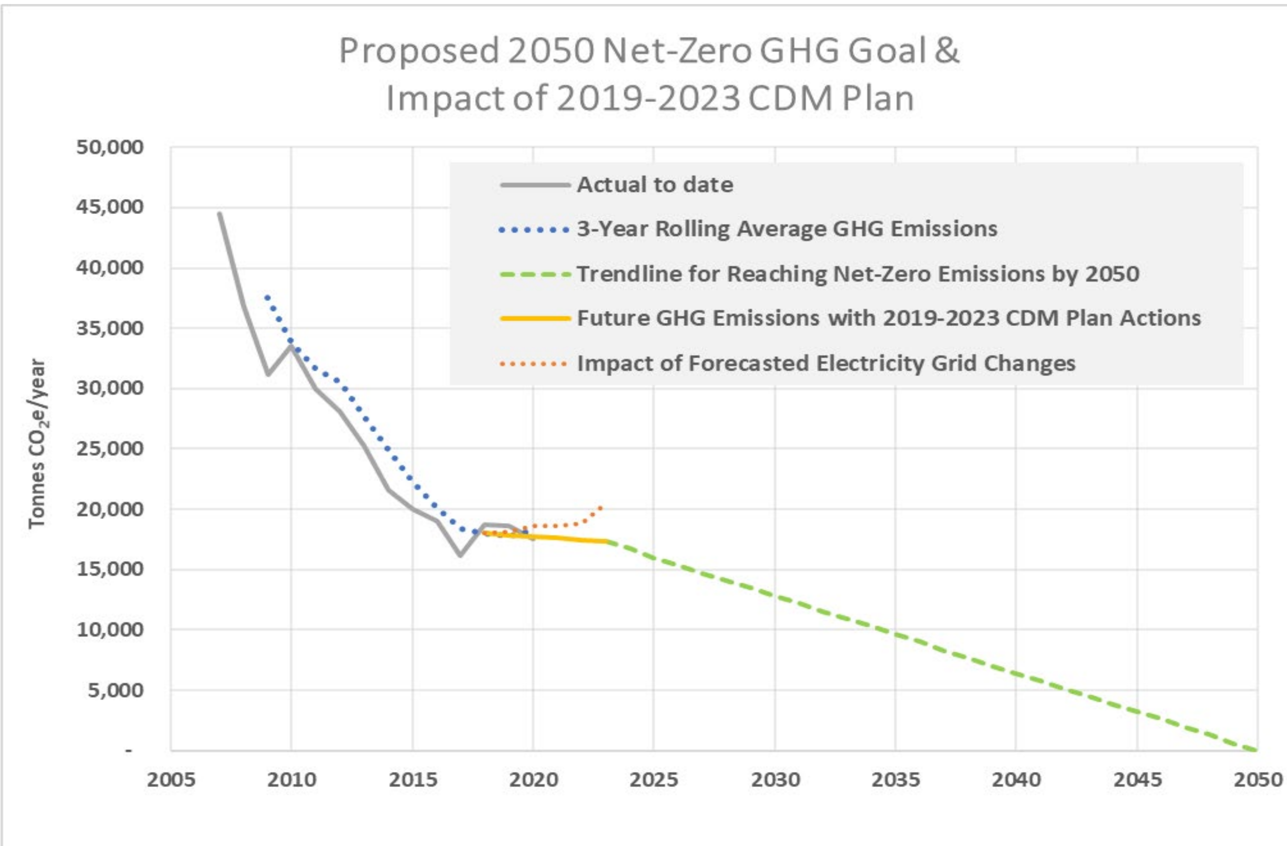


Figure 5 – Greenhouse Gas Emissions to Date and Progress Towards Goals

6.4.2 Non-Energy Related Greenhouse gas Emissions

The City also has direct control over two major sources of greenhouse gas emissions not associated with energy use:

- Methane emissions from the W12A Landfill as well as closed landfills; and
- Nitrous oxide (N_2O) emissions from the incineration of sewage sludge at the Greenway Wastewater Treatment Plant.

In fact, methane emissions from landfill sites are significantly larger in magnitude than energy related greenhouse gas emissions. With the installation and ongoing expansion of the landfill gas collection and flaring system at the W12A landfill, the City has made significant reductions in greenhouse gas emissions as seen in Table 3.

Table 5 – Summary of Landfill Gas Flaring at W12A Landfill

Year	Methane Flared (tonnes)	Equivalent CO_2 Reduced (tonnes)	Cumulative Methane Flared (tonnes)	Cumulative CO_2e Reduced (tonnes)
2004	852	21,000	852	21,000
2005	1,975	49,000	2,827	70,000
2006	1,800	45,000	4,627	115,000
2007	1,441	36,000	6,068	151,000
2008	1,845	46,000	7,914	197,000
2009	2,282	57,000	10,196	254,000
2010	2,324	58,000	12,520	312,000
2011	2,658	66,000	15,177	378,000
2012	3,237	81,000	18,415	459,000
2013	4,516	113,000	22,931	572,000
2014	4,165	104,000	27,096	676,000
2015	4,299	107,000	31,395	783,000
2016	5,989	149,700	37,384	932,700
2017	6,380	159,500	43,764	1,092,200
2018	4,292	107,300	48,056	1,199,500
2019	5,246	131,200	53,302	1,330,700
2020	6,791	169,800	60,093	1,500,500

As a result of London having joined the Compact of Mayors in 2015, nitrous oxide (N_2O) emissions from sewage treatment are now included within London's energy and greenhouse gas emissions inventory as per the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Nitrous oxide, a potent greenhouse gas with 310 times the global warming potential of carbon dioxide, is a combustion by-product from the incineration of sewage sludge and its formation is influenced by incinerator operating conditions (i.e., combustion temperature).

Since 2008, annual stack testing at the Greenway Wastewater Treatment Plant sludge incinerator has included the measurement to nitrous oxide alongside other air pollutants. Table 6 summarizes the nitrous oxide stack test results.

Table 6- Summary of 2008 – 2017 Stack Test Results for N_2O Emissions from the Greenway WWTP Sewage Sludge Incinerator

Year	Measured average N_2O emissions g/s	Measured average N_2O emissions kg/h	Estimated annual N_2O emissions tonnes/y	Estimated annual CO2e tonnes/y
2008	0.1	0.4	4	1,200
2009	1.1	3.9	34	10,700
2010	1.1	3.9	34	10,600
2011	1.2	4.4	39	12,000
2012	1.0	3.5	31	9,600
2013	0.2	0.6	5	1,700
2014	1.1	4.1	36	11,000
2015	1.0	3.7	32	10,000
2016	0.3	1.1	9	2,900
2017	2.4	8.6	65	20,200
2018	1.7	6.0	43	13,200
2019	1.5	5.5	33	10,200
2020	0.8	3.0	16	5,100

As can be seen from the table above, measured emissions of nitrous oxide can vary from year to year.

As Environment and Climate Change Canada has reduced the reporting threshold for facility emissions to 10,000 tonnes per year of carbon dioxide equivalent emissions for the 2017 reporting year, the Greenway Wastewater Treatment Plant is now required to report its emissions.

6.4.3 Total Corporate Greenhouse Gas Emissions by Employee Travel

City staff have estimated the greenhouse gas emissions impact associated with employees commuting to work as well as work-related travel in 2017. These types of greenhouse gas emissions indirectly induced by an organization are referred to as "Scope 3" greenhouse gas emissions, with Scope 1 being greenhouse gas emissions directly from corporate activities and Scope 2 being greenhouse gas emissions from the generation of electricity used in corporate activities:

> *Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g.,*

transmission & distribution losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Greenhouse gas emissions have been estimated for the following:

- Car allowance reimbursements – based on 2017 reimbursement expenditures from Finance, a $0.50/km mileage reimbursement rate, and an assumed 10L/100km average passenger vehicle fuel economy:

- Corporate travel – based on 2017 total travel and convention expenditures from Finance, an assumption of one-third of these costs being air travel costs, published data an average airfare cost per kilometre travelled, and published air travel greenhouse gas emissions per passenger-kilometre travelled; and

- Employee commuting – based on the 2014 City of London Mobility Survey results, average commuting distance based on employee home postal codes, and an assumed 10L/100km average passenger vehicle fuel economy.

Table 7: Summary of 2017 Employee Travel Greenhouse Gas Emissions

Activity	Cost	Estimated fuel use (L/year)	Estimated greenhouse gas Emissions (tonnes CO_2e/year)
Car allowance	$255,000	51,000	110
Air travel (estimated)	$240,000	not applicable	460
Employee commuting	not applicable	1,200,000	2,500
Total	**$495,000**		**3,500**

These provide an order-of-magnitude estimate of the significance of these activities and will be used to help set priorities, particularly for promoting transportation demand management activities (e.g., carpooling, cycling, telecommuting, and transit) for City of London employee commuting.

Given that about 870 City employees were working from home as of March 2020, it is estimated that commuting related greenhouse gas emissions decreased by about 750 tonnes in 2020.

6.5 Water Consumption

Water is the second highest utility cost for the City. In 2020 alone, water cost was $2 million for the City and hence is an important utility to monitor and track consumption. Figure 6 shows total water consumed by the City plotted along cooling degree-days (CDD – a measure of how hot the summer weather was for that year), given that water use for municipal buildings tends to increase during hot weather when it also tends to be dry. The majority of the water consumed at municipal buildings is for public facilities or employee use. Also, the portion of water consumed by buildings and wastewater treatment plants is identified in the graph.

Figure 6 also shows:

- Buildings consume 80 per cent of the total water consumed by City.
- Buildings water consumption is influenced by weather i.e., with hotter weather, as measured by cooling degree days, water consumption and vice versa.
- Wastewater operations consume about 20 per cent of the total water consumed by the City. Majority of this usage is in summer months to flush and clean wastewater holding tanks at pumping stations.
- Wastewater operations water consumption is stable year over year since the past six years.

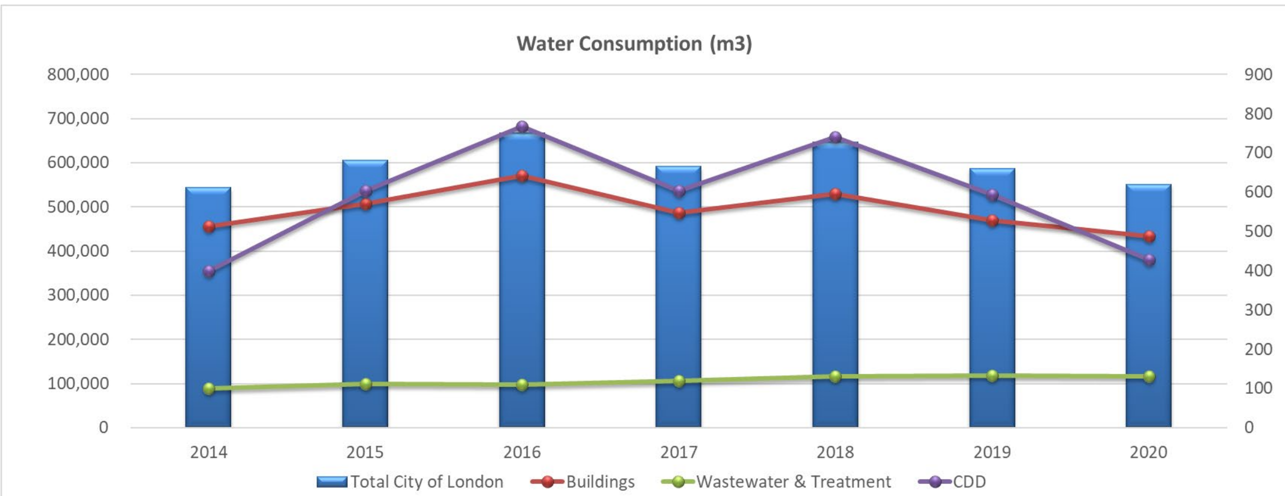


Figure 6 – Total Water Consumption (m3)

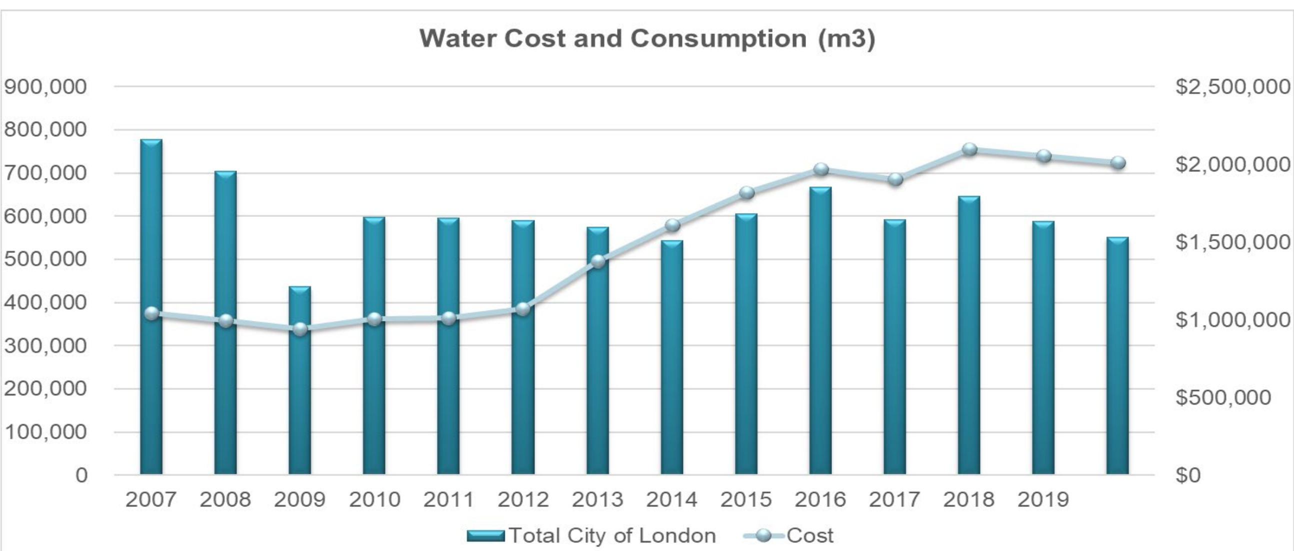


Figure 7 – Water Cost and Consumption (m3)

Figure 7 shows how water consumption has been reduced by 29 per cent from 2007 to 2020. During the same period, water cost increased by double due to the changes made to water billing between 2012 and 2014.

6.6 Corporate Energy Cost

Total corporate energy costs continue to increase with the price of electricity in Ontario being the major contributor. However, corporate energy management practices by the City including cost avoidance measures through procurement, building retrofits, and other conservation measures assist in continued efforts to reduce amounts of energy used to help reduce the market cost increase.

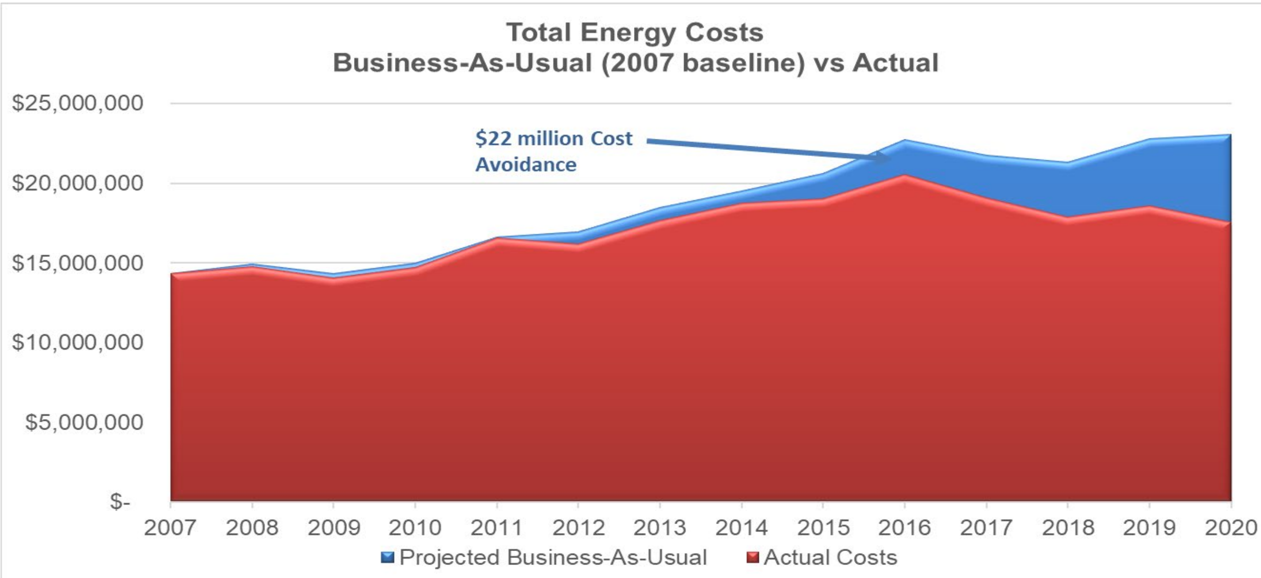
Table 8 – Energy Costs by Commodity

	2007	2018	2020	Change since 2007	Change since 2018
Electricity	$9,289,000	$13,520,000	$14,003,000	51%	4%
Natural Gas	$2,350,000	$1,029,000	$1,251,000	-47%	22%
Steam	$273,000	$192,000	$151,000	-45%	-21%
Chilled Water	$251,000	$277,000	$196,000	-22%	-29%
Diesel Fuel	$1,518,000	$2,133,000	$1,410,000	-7%	-34%
Gasoline	$664,000	$755,000	$587,000	-12%	-22%
Total City of London	$4,345,000	$17,906,000	$17,598,000	23%	-2%

Total energy costs in 2020 were $17.6 million, 23 per cent higher than 2007 and slightly lower by two per cent compared to 2018. As shown in Table 8, electricity price plays a major role in overall commodity costs. Though electricity consumption went down by 17 per cent since 2007, total electricity costs increased by over 50 per cent in the same period.

Figure 8 shows that approximately $5 million in energy costs were avoided in 2020 compared to 2007 levels and more than $22 million in avoided energy costs have been accumulated since 2007.

Figure 8 - Avoided Energy Costs (Accumulated)



The City requires several different initiatives to sustain and/or reduce energy costs. The cost per capita is continuing to drop between 2016 and 2020 (from $54 per person to $42 per person in 2020). The energy improvements and cost avoidance measures being implemented today are trying to avoid and sustain the market changes and inflation costs the City is faced with in the associated costs to procure energy.

6.6.1 Utility Procurement

The City of London uses energy procurement strategies to mitigate the cost of energy. To assist the City of London in preparing forecasts for long-term budgetary considerations, Blackstone (the City's energy procurement advisor) has provided the following commodity price escalation estimates shown in Table 9. These projections in market forecasts give the City the opportunity to prepare for increased operating costs and to develop additional measures to mitigate some of these financial impacts. Specific notes regarding each commodity follow.

Table 9- Utility Price Forecast - Annual Commodity Escalation Estimates

	2022	2023	2024	2025	2026
Electricity Rates	0.6%	3.0%	2.9%	1.7%	1.8%
Natural Gas Rates	-0.8%	8.9%	10.4%	9.1%	8.4%
Steam	1.3%	3.6%	5.8%	5.1%	4.9%

Electricity:

Ontario is a unique electricity market in that the majority of costs consumers face are outside of the actual wholesale energy price, or Hourly Ontario Energy Price (HOEP). The bulk of costs are paid through Global Adjustment (GA), which covers the cost of building new assets, maintaining existing infrastructure, and delivering conservation and demand management programs. Ontario continues to maintain a diverse grid-connected electricity supply mix with approximately 33 per cent of generation capacity coming from nuclear, 29 per cent from natural gas, 23 per cent from hydro, 12 per cent from wind, solar and small amounts from biofuel. Despite the diverse supply mix, natural gas pricing plays a prominent role in determining HOEP as natural gas generators are often the marginal units setting price in Ontario – particularly in summer and winter.

Blackstone is projecting a significant increase in electricity commodity costs for 2022. This stems from 1) Blackstone's confident natural gas forecast, which would put upward pressure on HOEP, and 2) generally higher forecasted demand in 2022 as the province recovers and the economy re-opens after COVID-19. Beyond 2022, electricity prices continue to rise as additional nuclear generators undergo refurbishment, resulting in a greater reliance on more expensive natural gas generation.

Costs outside of HOEP make up most of the City's costs, particularly in the form of GA. Taking into consideration GA, regulatory, and delivery charges, Blackstone forecasts a moderate decrease in 2022 resulting primarily from 2020 COVID-19 GA deferrals being paid off in 2021. Post-2022, Global Adjustment, as well as utility regulatory and delivery charges are forecasted to steadily rise year-over-year at an inflationary pace.

Natural Gas:

The City currently has its natural gas supply secured at variable index prices until October 2021. Beyond this time, City will work with Blackstone to hedge portions of the City's natural gas supply in future years to take advantage of the current low pricing environment before the price escalations mentioned in Table 9 are fully realized.

So far, 2021 has shown higher commodity costs compared to last year. In contrast, we are in a relatively lower storage environment with less production as well as stronger export and demand expectations. This has created a higher pricing environment which is expected to continue over the winter and into 2022. It is expected that production levels will trend upwards towards highs set in early 2020, but it is still unclear as to how long that will take.

Uncertainty remains around the existing supply/demand balance for the rest of summer 2021. Industrial demand will be a driving factor as the economy begins to recover from COVID-19 shut-downs. Blackstone expects electricity demand to increase as lockdowns are lifted and more jurisdictions reopen, which will drive natural gas demand for electricity generation. Weather is another wildcard, as expectations for cooling demand change frequently and will cause greater volatility on prices this summer due to lower storage levels.

In 2023-2024 it is expected that overall commodity prices will decrease over time as more production begins to come online, and storage moves towards more favorable levels.

Even though commodity pricing forecasts are lower post-2022, overall costs are projected to increase once escalation of utility delivery fees and carbon charges are factored in. These are the primary drivers of costs in the outer years evaluated, out until 2026. Carbon charges will increase once again in April 2022 from $40 to $50 per tonne, but there is currently legislation before parliament to continue increases out until 2030. It is expected that the carbon price will increase an additional $15/tonne per year out until 2030, reaching $170/tonne.

City will be working with Blackstone in reviewing low carbon alternatives for the City, such as renewable natural gas (RNG).

Steam:

Steam input costs are strongly tied to natural gas, as this is the main input cost for steam. Carbon costs will also factor into steam costs as London District Energy passes on carbon charges to its client base. As a result of these factors and expected costs increases from London District Energy, it is forecasted that costs for steam will rise slowly over the coming years.

7. Energy Conservation

One of the energy reduction strategies the City employs is the completion of energy conservation projects and Culture of Conservation Activities. Upgrades to existing corporate buildings by installing energy efficient lighting and equipment or utilizing new technologies can help to improve operational efficiencies, cost effectiveness, and help meet corporate targets for energy intensity and greenhouse gas reductions. With global attention on climate change, greener public buildings are an expectation by staff and communities and will help move the City toward meetings its strategic and corporate goals.

The City's corporate energy team work closely with various service areas within the City, utility personnel and industry experts to retrofit existing buildings, construct new buildings, and upgrade equipment and processes. An important part of the process also involves securing incentives and funding opportunities and post project monitoring and verification of savings. The City tracks the energy savings achieved from projects once they are complete. The 2020 contribution from project savings was $200,000 and $160,000 in incentives. Cumulatively, a total of $5.7 million in savings since 2010 for projects and incentives.

2020 Highlights:

Electric Zambonis:

- In 2020, City made an important decision to replace all compressed natural gas (CNG) ice resurfaces with electric resurfaces. Four ice resurfacers are now ready to go into service (when arenas re-open) and four additional units planned for the 2021/2022 arena season.
- London was one of the first cities in North America to make this move.
- This project will result in 290 tonnes of greenhouse gas savings annually.

Renewable Energy

- Facilities conducted net-zero energy study of the A.J. Tyler Operations Centre and 15 other buildings with Ameresco with a focus on PV generation.
- Wastewater Operations is investigating wastewater heat recovery technology at its new Dingman Creek pumping station.
- Solar Photovoltaic (PV) opportunities and challenges were identified at wastewater treatment plants and water supply plants in 2020. Further work is underway.

Insulation Upgrades:

- Facilities replaced arena glass walls with insulated panels at Bostwick Community Centre.
- This project resulted in $35,000 in savings per year.

Electric Vehicle Charging:

- Installation of electric vehicle chargers at nine community locations, such as community centers and arenas, are currently underway through the land-lease agreement with ChargeCrew signed in 2020.
- City installed seven chargers for employees and public use at A.J. Tyler Operations Centre and City Hall.

Aeration Blower Upgrades

- Continuation of upgrades to all aeration blowers at wastewater treatment plants to new efficient turbo blowers was completed in 2020.
- This project will result in $600,000 in energy savings annually.
- Over $1 million in incentives from IESO have been identified at this time (monitoring and verification is still in progress).

Smart Lights Retrofit Project

- LED lights with individual dimming capability were installed at J. Allen Taylor building.
- This will result in $10,000 in annual savings.
- $4,000 in incentives from IESO have been received.

Organic Rankine Cycle Engine (ORC) Project

- The City completed most of the installation of the ORC engine for waste heat recovery for power generation at Greenway Wastewater Treatment Facility in 2020.
- When this starts operating in 2021, this will offset 475 kilowatts of electrical grid consumption, representing over 12 per cent of the City’s overall goal for energy reduction by 2023.

Demand Response Program

- The City's Arva pumping station and South East Reservoir Pumping Station (SERPS) enrolled into 2020 Demand Response (DR) program from IESO to avoid blackouts during high energy demands in Ontario.
- Both the facilities together received $10,000 in incentives for actively participating and reducing demand during peak hours in 2020.

Green Fleet

- City commissioned four CNG packers for waste collection as part if its fuel switching project from diesel to CNG. Fuel switching to CNG reduces emissions and noise, removes toxic pollutants from the air and enhances the lifecycle of the asset.
- In 2020, contracts were signed to switch more municipal fleet light duty vehicles to hybrids and electric vehicles.
- In 2020 Fleet approved purchasing of Hydraulic Bush Chippers for forestry use. Replacement of the diesel engines currently used with gasoline powered engine units will provide environmental benefits. Gasoline powered engines have an idle down control system which reduce the RPM of the engine to an idle position when high power demands are not required resulting in both reduced greenhouse gas emissions, fuel consumption and reduce costs compared to diesel engines.

Indoor/Outdoor Lighting Upgrades

- Facilities installed LEDs at Canada Games Aquatic Centre, Dearness Home, Adelaide operations Centre, and Fire Hall 9.
- This project will result in annual savings of $16,000.
- $9,000 in incentives from IESO have been received.

Heating, Ventilation and Air Conditioning Upgrades

- HVAC optimization at Dearness home and Eldon House.
- $10,500 per year in energy savings annually will be achieved.

Greenway lighting upgrades

- As part of continuous lighting upgrades to LEDs, greenway wastewater treatment plants aeration blower building replaced its building lights to LEDs in 2020.
- $3,000 in energy savings annually will be achieved.
- $2,000 in incentives from IESO have been received.

7.1 Development of the Climate Lens Process

The Climate Lens Process was designed to ensure that climate emergency issues are part of the decision-making processes throughout the Corporation. To date, it has been considered in a number of areas of the Corporation. The Climate Lens Process will take this experience and new knowledge to significantly increase climate emergency activities and actions. The objectives associated with the creation and use of the Climate Lens Process are to:

1. Ensure climate emergency issues are included in decision-making and evaluation of existing plans, programs, and projects.
2. Establish a clear process for accountability and tracking of climate emergency issues including collection of information on decision outcomes and tracking the progress of projects/programs implemented.
3. Elevate understanding of the importance of climate emergency issues in decision-making across the Corporation.

The Climate Lens Process includes the following five streams of activities:

1. Master Plans, Guidelines and Strategies
2. Existing and New Projects/Programs
3. Quick Assessment of Existing Operations
4. Annual Budget Updates & Multi-year Budgets
5. Building Climate Change Capacity

The Climate Emergency Screening Tool (CEST) can be used in the Climate Lens Process especially when it is customized for an area. The customized CEST is used to guide the screening of projects and programs for key climate emergency issues and opportunities for improvement.

The development of the Climate Lens Process in 2020 and 2021 has increased the visibility and awareness of the need for energy conservation measures for City facilities, programs, projects, and operations.

8. Conclusion

Overall, 2020 saw a large shift in focus from making decisions based on the reduction of energy usage to decision-making with a climate change perspective, particularly as it related to projects and funding opportunities for projects. Many internal studies are underway to identify net-zero opportunities at individual facilities.

The City declared a climate emergency to focus its future development, infrastructure, corporate energy planning and community engagement to improve the City's resiliency plans and favorable climate change outcomes.

The City will always require energy to operate its facilities, vehicles, and operations, but strategic management of energy usage, emissions, investment in renewable technologies and a keen focus on climate change can help use less, become carbon neutral and greener overall. Detailed energy consumption and cost numbers along with energy project incentives are listed in Appendix A and B.

Appendix A – Energy Consumption and Cost Tables

Total Energy Consumption

Table A-1 – Consumption by Commodity 2018-2020 (2019-2023 CDM Plan baseline tracking)

Energy Consumption (ekWh)	2018	2020	Change since 2018	% Change
Electricity	98,448,000	89,893,000	(8,555,000)	-9%
Natural Gas	42,430,000	40,889,000	(1,541,000)	-4%
Steam	3,269,000	2,093,000	(1,176,000)	-36%
Chilled Water	1,521,000	913,000	(608,000)	-40%
Diesel Fuel	22,194,000	20,306,000	(1,888,000)	-9%
Gasoline	6,889,000	6,667,000	(222,000)	-3%
Total City of London	174,751,000	160,761,000	(13,990,000	-8%

Table A-2 – Energy Consumption by Commodity 2007 – 2020

Energy Consumption (ekWh)	2007	2020	Change since 2007	% Change
Electricity	108,328,000	89,893,000	(18,435,000)	-17%
Natural Gas	58,682,000	40,889,000	(17,793,000)	-30%
Steam	3,499,000	2,093,000	(1,406,000)	-40%
Chilled Water	1,759,000	913,000	(846,000)	-48%
Diesel Fuel	20,129,000	20,306,000	177,000	0.88%
Gasoline	6,718,000	6,667,000	(51,000)	-1%
Total City of London	199,115,000	160,761,000	(38,354,000)	-19%

Energy Consumption by Municipal Service Categories

Table A-3 Consumption by Municipal Service Categories 2018 – 2020

Energy Consumption (ekWh)	2018	2020	Change since 2018	% Change
Buildings	67,659,000	62,576,000	(5,083,000)	-8%
Traffic Signals & Streetlights	18,421,000	17,773,000	(648,000)	-4%
Wastewater & Treatment	50,823,000	44,535,000	(6,288,000)	-12%
Water Pumping	8,764,000	8,903,000	139,000	2%
Vehicle Fleet	29,083,000	26,973,000	(2,110,000)	-7%
Total City of London	174,750,000	160,760,000	(13,990,000)	-8%

Table A - 4 – Energy Consumption by Municipal Service Categories 2007 – 2019

Energy Consumption (ekWh)	2007	2020	Change since 2007	% Change
Buildings	73,225,000	62,576,000	(10,649,000)	-15%
Traffic Signals & Streetlights	24,762,000	17,773,000	(6,989,000)	-28%
Wastewater & Treatment	65,594,000	44,535,000	(21,059,000)	-32%
Water Pumping	8,687,000	8,903,000	216,000	2%
Vehicle Fleet	26,847,000	26,973,000	126,000	0%
Total City of London	199,115,000	160,760,000	(38,355,000)	-19%

<u>Total Energy Consumption per Capita by Municipal Service Categories</u>

Table A-5 Energy Consumption Per Capita 2018 – 2020

Energy Consumption (ekWh) by Service Area per person			Change since 2018	Change since 2018
	2018	2020	Variance	% Change
Buildings	169	150	(18.7)	-11.1%
Traffic Signals & Streetlights	46	43	(3.3)	-7.2%
Wastewater & Treatment	127	107	(19.9)	-15.7%
Water Pumping	22	21	(0.5)	-2.3%
Vehicle Fleet	73	65	(7.8)	-10.8%
Total City of London (ekWh/pp)	436	386	(50.3)	-11.5%
London's Population	401,000	417,000	(16,000)	-4%

Table A-6 Energy Consumption Per Capita 2007-2020

Energy Consumption (ekWh) by Service Area per person			Change since 2007	Change since 2007
	2007	2020	Variance	% Change
Buildings	206	150	(56)	-27.2%
Traffic Signals & Streetlights	70	43	(27)	-38.9%
Wastewater & Treatment	185	107	(78)	-42.2%
Water Pumping	24	21	(3)	-12.8%
Vehicle Fleet	76	65	(11)	-14.5%
Total City of London (ekWh/pp)	561	386	(175)	-31.3%
London's Population	355,000	417,000	(65,000)	17.5%

Total Energy Costs per Capita by Municipal Service Categories

Table A-7 – Energy Costs Per Capita 2018- 2020

Energy Costs by End Use per person			Change from 2018	Change from 2018
	2018	2020	Variance	% Change
Buildings	$ 12.90	$ 3.19	$ 0.29	2.2%
Traffic Signals & Streetlights	$ 8.45	$ 8.88	$ 0.44	5.2%
Wastewater & Treatment	$ 13.45	$12.53	$ (0.92)	-6.9%
Water Pumping	$ 2.66	$ 2.82	$ 0.16	6.0%
Fleet	$ 7.20	$ 4.79	$ (2.42)	-33.5%
Total Energy Cost Per Person	$ 44.66	$ 42.20	$ (2.45)	-5.5%
London's Population	401,000	417,000	(16,000)	-4%

Table A-8 – Energy Cost Per Capita 2007- 2020

Energy Costs by End Use per person			Change since 2007	Change since 2007
	2007	2020	Variance	% Change
Buildings	$ 14.31	$ 13.19	$ (1.12)	-7.8%
Traffic Signals & Streetlights	$ 5.29	$ 8.88	$ 3.59	68.0%
Wastewater & Treatment	$ 12.59	$ 12.53	$ (0.07)	-0.5%
Water Pumping	$ 2.07	$ 2.82	$ 0.75	36.2%
Fleet	$ 6.15	$ 4.79	$ (1.36)	-22.1%
Total City of London	$ 40.41	$ 42.20	$ 1.80	4.4%
London's Population	355,000	417,000	(62,000)	17.5%

Appendix B - 2020 Energy Project Incentives

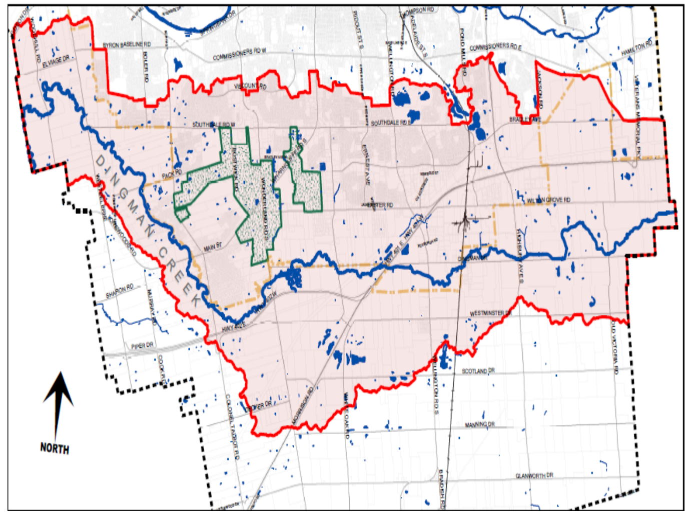
Organization	Project	Year	Incentive	Status
EnelX	Demand Response	2020	$509	Received
EnelX	Demand Response	2020	$946	Received
Enbridge	Bostwick feasibility Study	2020	$4,000	Received
London Hydro	Retrofit lights with LEDs	2020	$2,266	Received
London Hydro	Exterior and Parking lot lights retrofit	2020	$6,218	Received
London Hydro	HVAC controls upgrade	2020	$2,114	Received
London Hydro	Lighting controls & upgrades at AJT	2020	$9,166	Received
London Hydro	Replace glass wall in arena with insulated panels - Bostwick	2020	$32,000	Received
London Hydro	Adelaide ops Centre - lights retrofit	2020	$6,352	Received
London Hydro	Fire hall 9- lights upgrade	2020	$581	Received
London Hydro	Dearness - BAS upgrades	2020	$81,221	Received
London Hydro	Greenway Fluorescent lights	2020	$1,500	Received
Enbridge	Adelaide Ops Centre ERV	2020	$400	Received
Enbridge	Oxford Ops Centre ERV	2020	$500	Received
Enbridge	AJ Tyler Ops Centre ERV	2020	$235	Received
Enbridge	AJ Tyler Bldg. 8 ERV	2020	$350	Received
Enbridge	EROC main ERV	2020	$200	Received
Enbridge	EROC Bldg. 2 ERV	2020	$450	Received
Voltus	Demand Response for SERPS & ARVA	2020	$10,000	Received
			$0	In Process
			$159,007	Total

City of London
Notice of Study Initiation

Dingman Creek Subwatershed Stage 2 Lands Municipal Class Environmental Assessment

PUBLIC NOTICE **SEPTEMBER 2, 2021**

Purpose of Study



The purpose of the Dingman Creek Subwatershed Stage 2 Lands Municipal Class Environmental Assessment (EA) is to update the regulatory floodplain for Dingman Creek and assess potential flood mitigation and stormwater servicing alternatives to address imminent and future flooding and erosion risk within the subwatershed.

Through the EA, a range of flood mitigation and stormwater management strategies will be developed. The recommended approach will guide future development, identify mitigative and adaptive flood control works and align with the City's vision for the creek corridor to integrate natural heritage, stormwater management and recreational uses.

Process

The EA study will be undertaken in accordance with the *Ontario Environmental Assessment Act* and will cover all necessary phases of the Schedule 'C' EA Process. This process includes definition of the problem/opportunity, identification and evaluation of alternative solutions, and selection of a preferred one. There will be opportunity throughout the process for public input, including future Public Information Centres. As the study progresses, information and notices will be posted on the City's "Get Involved" website: https://getinvolved.london.ca/dingmancreek

Your feedback is important to us

To provide comments, request additional information, or receive future correspondence related to the project, please contact a member of the project team below:

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Environmental Services Engineer
City of London
(519) 661-2489 ext.5593
asones@london.ca

Fuad Curi, P.Eng.
Project Manager
KGS Group Inc.
(905) 848-7884 ext.516
fcuri@kgsgroup.com

Under the *Freedom of Information and Protection of Privacy Act* and the *Environmental Assessment Act*, unless otherwise stated in the submission, any personal information such as name, address, telephone number and property location included in a submission will become part of the public record files for this matter and may be released, if requested, to any person.

London Hydro

Advisory Committee on the Environment (ACE) Communication

October 6th, 2021

Overview

- About London Hydro
- System Planning
- Ontario's Electricity Supply & GHG Emissions
- Enabling Locally Generated Electricity
- Customer Engagement Solutions/Green Button
- Environmental Sustainability at London Hydro

About London Hydro

- London Hydro Inc. is a wholly-owned subsidiary of the Corporation of the City of London
- Owns and maintains the electrical distribution grid.
- 162,000 residential and commercial customers.
- Employs over 300 employees.
- Delivers highly reliable and safe electricity to its customers.
- Procures wholesale market services from the IESO and transmission services from Hydro One at regulated prices.

See: https://www.londonhydro.com/about-us/about-london-hydro/strategic-plan

London Hydro's License to Operate

ED-2002-0557

ONTARIO ENERGY BOARD

London Hydro

The OEB's Mandate

- Setting natural gas and electricity rates and prices
- Monitoring the financial and operating performance of electrical utilities
- Providing consumers with the information they need to better understand energy matters
- Protecting energy consumers' interests
- Developing regulatory policy to meet emerging energy trends and challenges

Governing Legislation

- Ontario Energy Board Act, 1998, the Electricity Act, 1998 and the Energy Consumer Protection Act, 2010

Source: https://www.oeb.ca/oeb/_Documents/Documents/Energy_Sector_Regulation-Overview.pdf

IESO Regional Planning Overview

- IESO Coordinates Regional Plans every 5 years, with local distribution companies, Hydro One, and communities.
- Plans are 20 year outlook, and include projections of Distributed Energy Resources (DERs), Conservation and Demand Management, and adoption of Electric Vehicles.
- London Hydro has sufficient capacity for additional load for at least the next 10 years.
- Capacity for additional DERs is declining as new resources are connected.

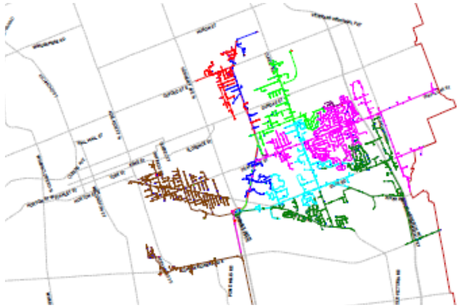
Ontario's 21 Planning Regions

Source: https://www.ieso.ca/en/Get-Involved/Regional-Planning/Southwest-Ontario/London-Area

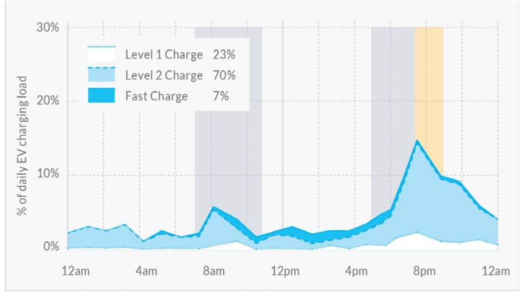
See the IRRP: https://www.ieso.ca/en/Get-Involved/Regional-Planning/Southwest-Ontario/London-Area

Capacity Planning

- Future Capacity by Area / Feeder – for new loads (residential, commercial, industrial) and load growth such as electrification of Heating and Transportation



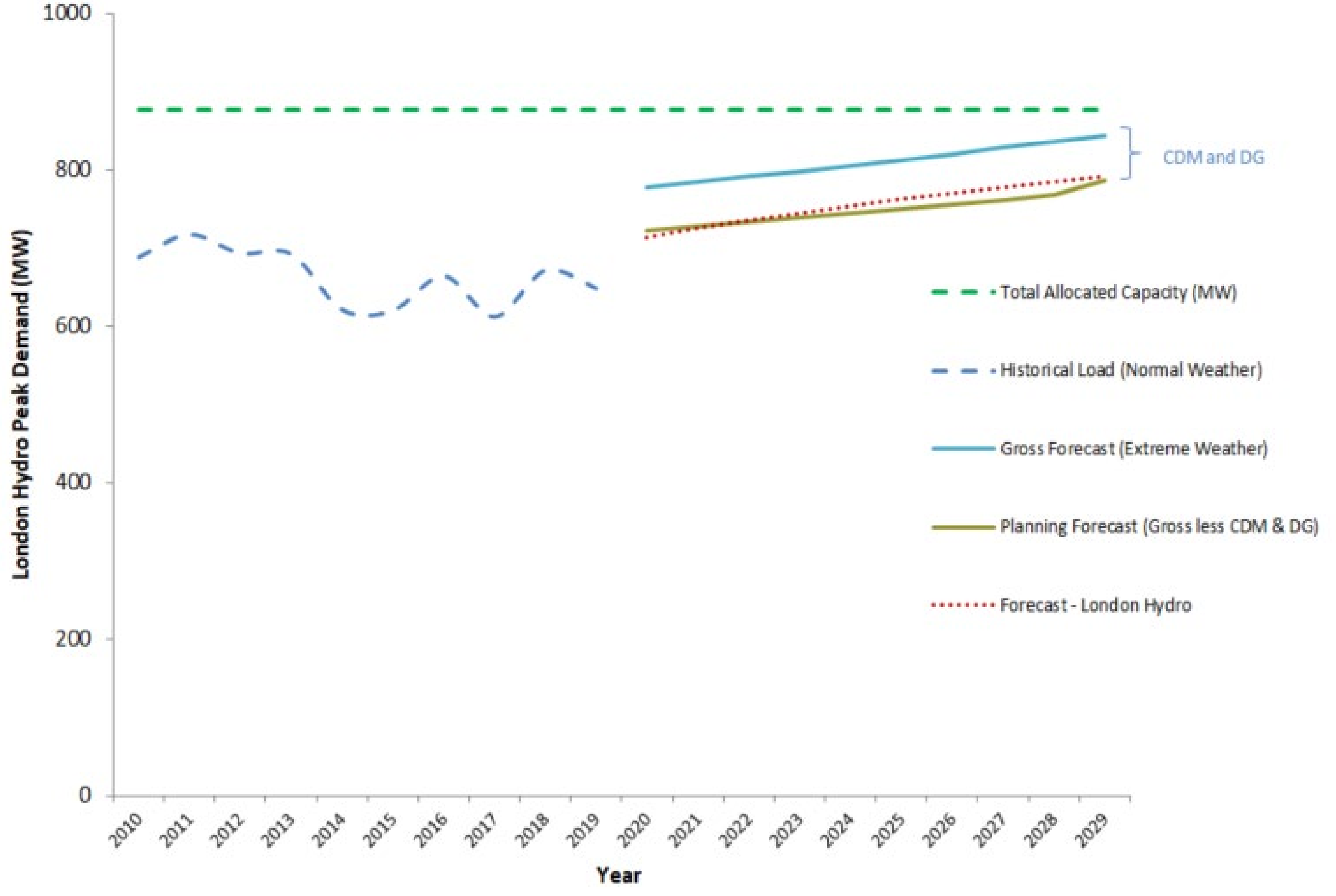
- Monitoring Loads – using Smart Meter data, transformer loads are reviewed, EV charging locations tracked



- Regular consultations with municipal planners, developers, large use customers

- Engaged with LTC regarding electrification of the transit system

Capacity Planning

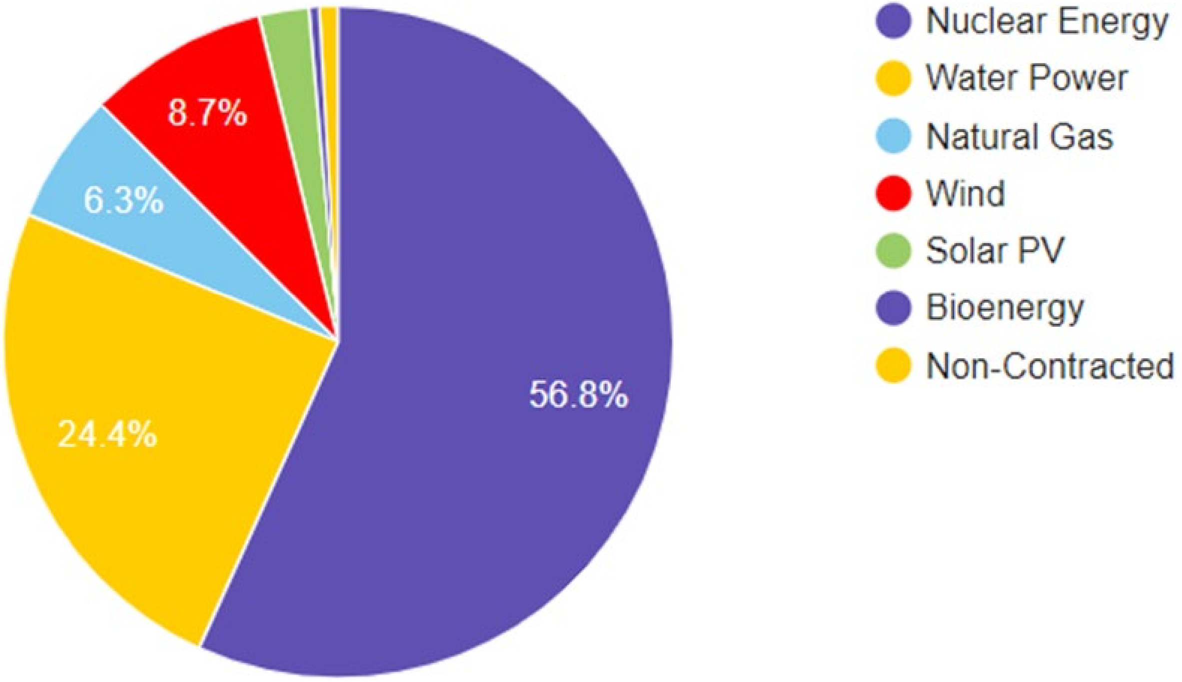


- Sufficient capacity for at least 10 years
- Margin for unexpected load growth due to EVs, fuel switching, new customers

Ontario's Electricity Supply

- 36.0% Renewable
- 92.8% non-emitting

Ontario System-Wide Electricity Supply Mix: 2020 Data



Electricity sources*	%
Nuclear Energy	56.8
Water Power	24.4
Natural Gas*	6.3
Wind	8.7
Solar	2.4
Bioenergy**	0.5
Non-Contracted***	0.9

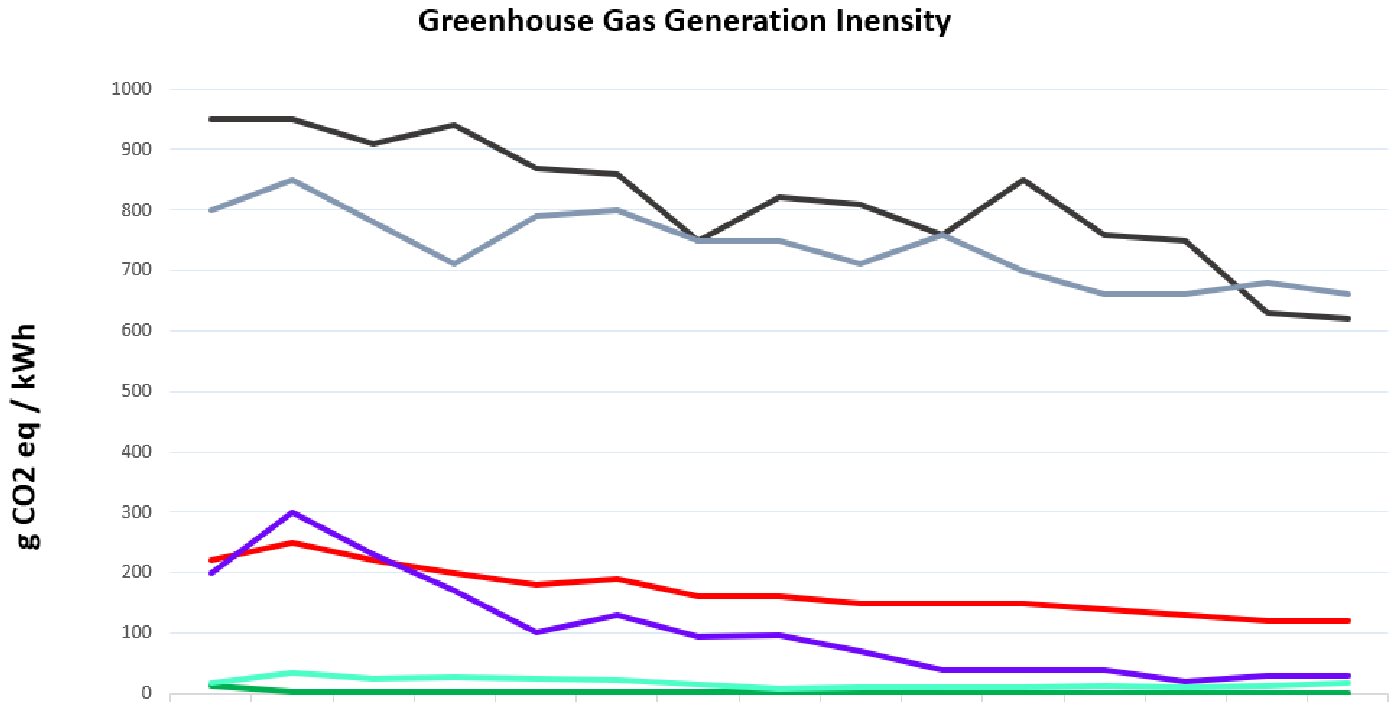
* Includes Lennox and dual fuel (natural gas/bioenergy) consistent with IESO.

** IESO's embedded generation data set combines biomass and gas.

*** Non-Contracted represents a variety of fuel types that the IESO is unable to categorize due to a lack of information from Local Distribution Companies (LDCs).

Source: https://www.oeb.ca/sites/default/files/2020-supply-mix-data-update.pdf

Ontario’s Electricity Supply & GHG Emissions



	1990	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canada (Ave)	220	250	220	200	180	190	160	160	150	150	150	140	130	120	120
Quebec	13	3.6	3.9	2.5	3.6	2.5	2.3	2.9	2	1.4	1.1	1.2	1.2	1.3	1.2
British Columbia	17	35	25	28	25	23	14	8.2	11	11	9.2	12	9.5	12.4	18.6
Ontario	200	300	230	170	100	130	93	96	70	40	40	40	20	30	30
Alberta	950	950	910	940	870	860	750	820	810	760	850	760	750	630	620
Saskatchewan	800	850	780	710	790	800	750	750	710	760	700	660	660	680	660

Source: Canada’s Submission to the United Nations Framework Convention on Climate Change National Inventory Reports, 2014 and 2021
https://unfccc.int/documents?f%5B0%5D=country%3A867&f%5B1%5D=document_type%3A3517&f%5B2%5D=language%3AEnglish

Distribution Losses

- Electrical distribution system upgrades
- Voltage conversions
- Continuous improvement plans
- Losses reduced from ≈ 4% to 3% over the last 7 years
  - saved 233,150 MWh
  - reduced GHG emissions by 7,766 t CO_2e

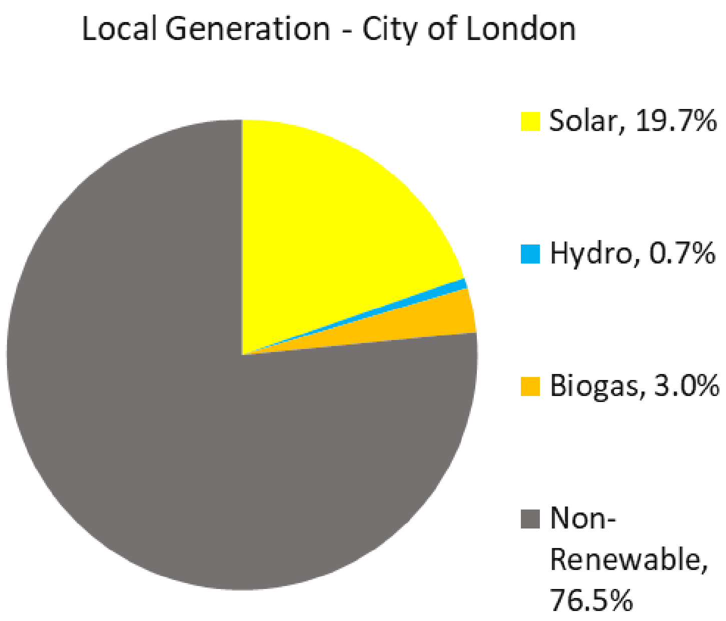
Locally Generated Electricity

Customer's Generation Connections

by the end of 2020,

- LH enabled 423 customer generation connections
  - 89,710 kW of local power
  - 21,348 kW (23.5%) from renewable energy sources

City of London Generation Types



Locally Generated Electricity

Thinking of becoming a Renewable Energy Generator?

Early Consultation is Key

When planning a project, consult London Hydro as early as possible in the planning phase.

(Restricted Feeders)

This could save you major headaches and money down the road.

https://www.londonhydro.com/accounts-services/generation
generation@londonhydro.com

Locally Generated Electricity

Thinking of becoming a Renewable Energy Generator?

Generation Size Categories

< 10kW

- No Connection Impact Assessment (CIA) study required

10kW to 500kW

- London Hydro CIA study required

500kW to 10,000kW

- London Hydro and Hydro One Distribution CIA required

>10,000kW

- London Hydro, Hydro One Dx, Hydro One TX and the IESO need to perform studies

https://www.londonhydro.com/accounts-services/generation
generation@londonhydro.com

Locally Generated Electricity

Thinking of becoming a Renewable Energy Generator?

Net Metering

- Must be renewable
- Can have batteries along with renewable
- Net Metering uses the LDC system as storage system
- Two-way flow

Load Displacement

- Behind the meter generation
- Can be any form of generation, however it is almost exclusively non-renewable
- Mainly natural gas
- Diesel backup
- Recently it has been BESS – ICI Program (IESO 5 peaks)
- Non-exporting

https://www.londonhydro.com/accounts-services/generation

generation@londonhydro.com

Locally Generated Electricity

Thinking of becoming a Renewable Energy Generator?

ACCOUNTS & SERVICES ▾ OUTAGES ▾ PROJECTS & OPERATIONS ▾ ABOUT US ▾ SAFETY CAREERS

ELECTRICITY RATES | GENERATION | CONSERVATION | WATER

Application to Connect

Fill out the application to connect a micro-generator to London Hydro.

FILL OUT THE APPLICATION

https://www.londonhydro.com/accounts-services/generation

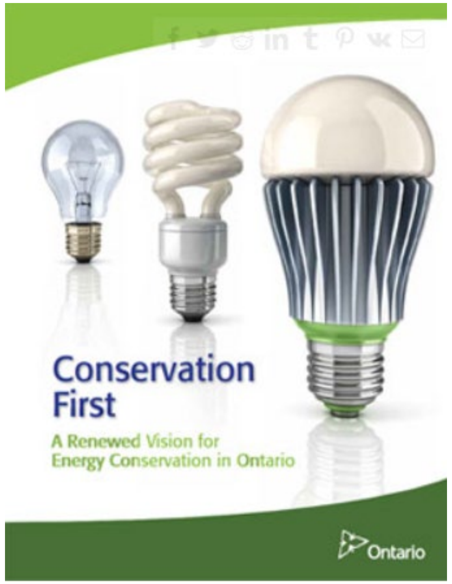
generation@londonhydro.com

Conservation Demand Management (CDM)

Since 2013 London Hydro CDM programs

- reduced customers' electricity use by 231,046 MWh
- Reduced customers' GHG emissions by 8,044 t CO_2e

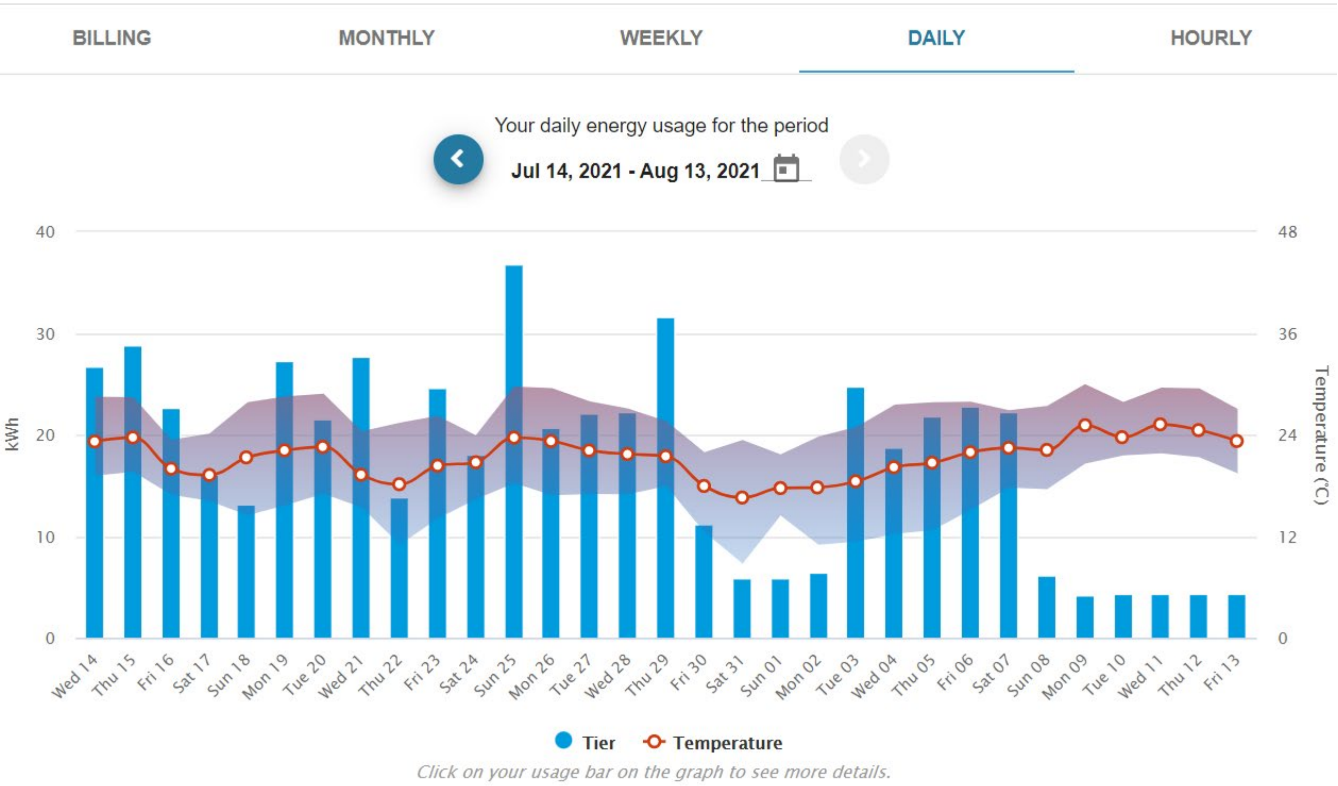
saveONenergy



Customer Engagement Solutions

MyLondonHydro

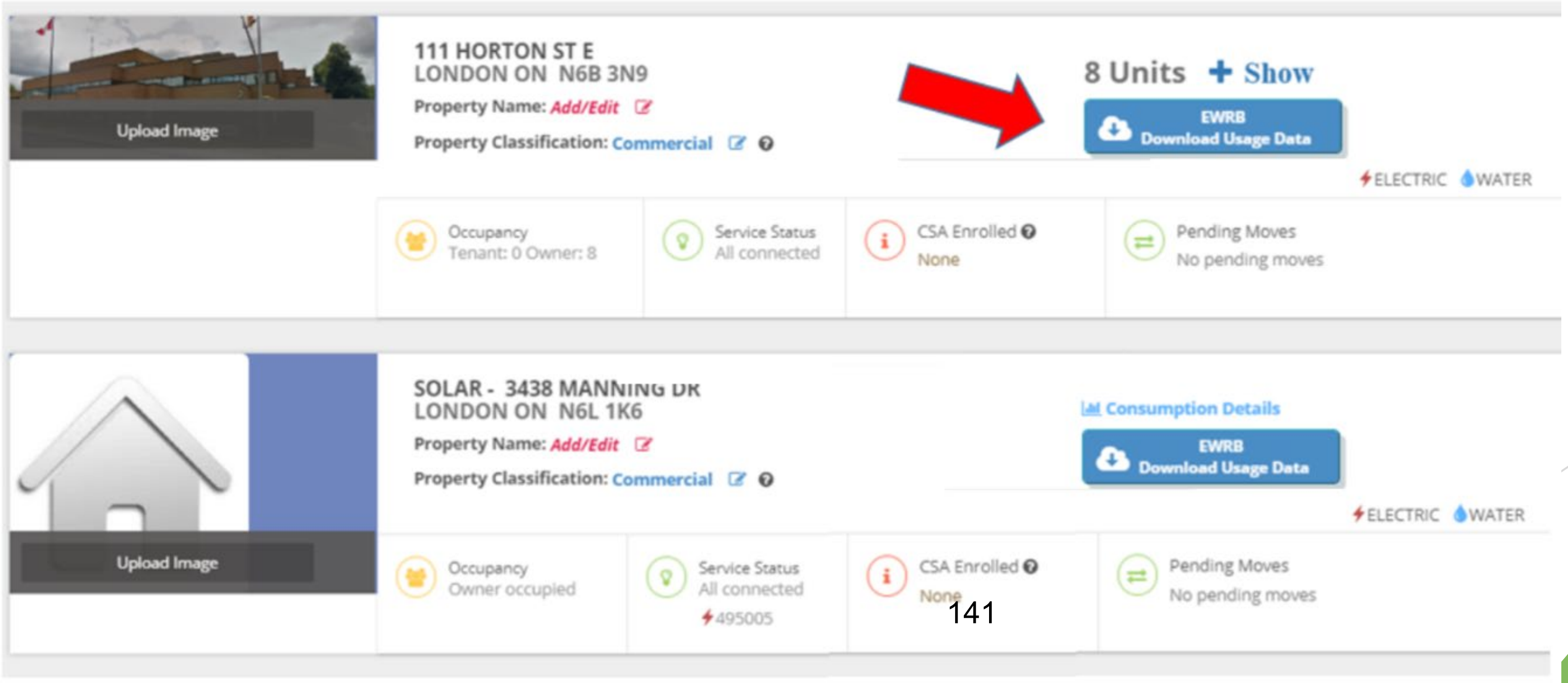
- Utility account portal for electricity and water consumption, billing and notifications



NOTIFICATION TYPE	EMAIL	SMS/TEXT	PHONE
Outage Where possible we will notify you if there is an outage affecting your electric service.	ON	ON	OFF
Outage Restoration Time Where possible, you will be notified of any changes in the expected time that power will be restored.	ON	ON	OFF
Overdue Payment Notifications When possible, you will be notified if $100 or more is past due	ON	ON	OFF
High Electricity Usage Alert You will be notified if your weekly usage is more than your notification threshold. Click here to configure the notification threshold. (Your current alert threshold is **1 times your weekly average**)	ON	ON	
Continuous Water Flow (i) You will be notified if there is continuous flow of water. Click here to configure the notification threshold. (Your current alert threshold is **12 hours of continuous usage**)	ON	ON	
High Water Consumption (i) You will be notified if your monthly usage is more than your notification threshold. Click here to configure the notification threshold. (Your current alert threshold is **13 m^3**)	ON	ON	
Low Water Consumption (i) You will be notified if your monthly usage is less than your notification threshold. Click here to configure the notification threshold. (Your current alert threshold is **5 m^3**)	ON	ON	

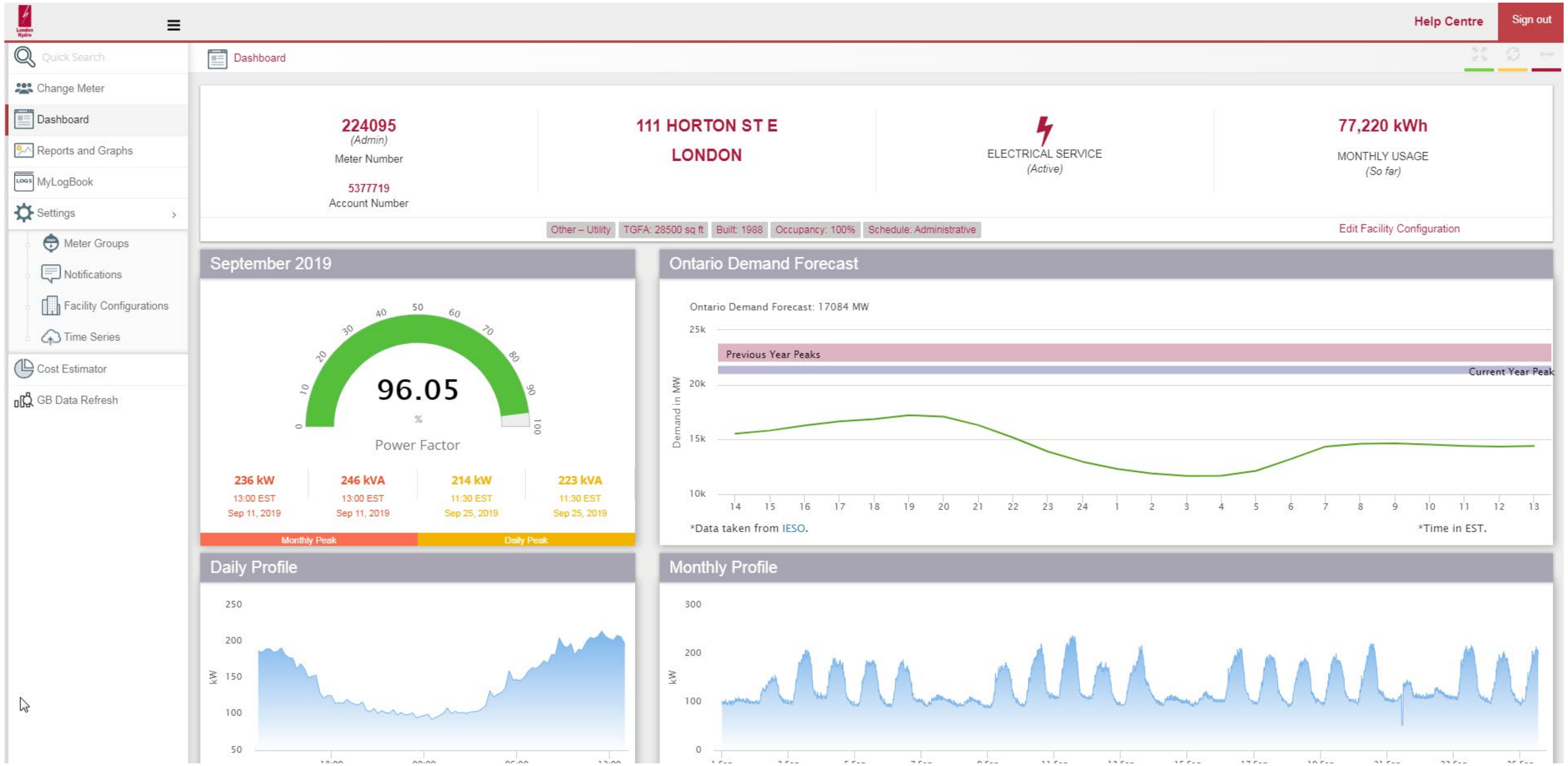
Property Management Portal

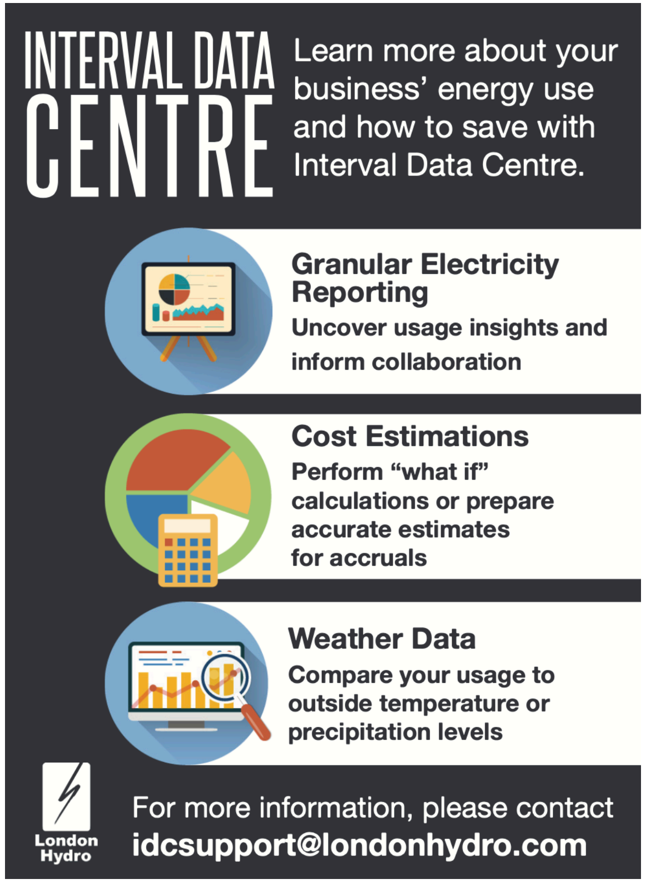
- Includes tools to assist Property Managers and their Delegates
- Supports Energy and Water Reporting and Benchmarking (EWRB)
  - 50,000 sq. Ft or larger commercial, industrial, multi-unit residential and other building types are required to annually report energy and water consumption to the Minister of Energy



Interval Data Center / Commerce

- Commercial and Industrial Customers

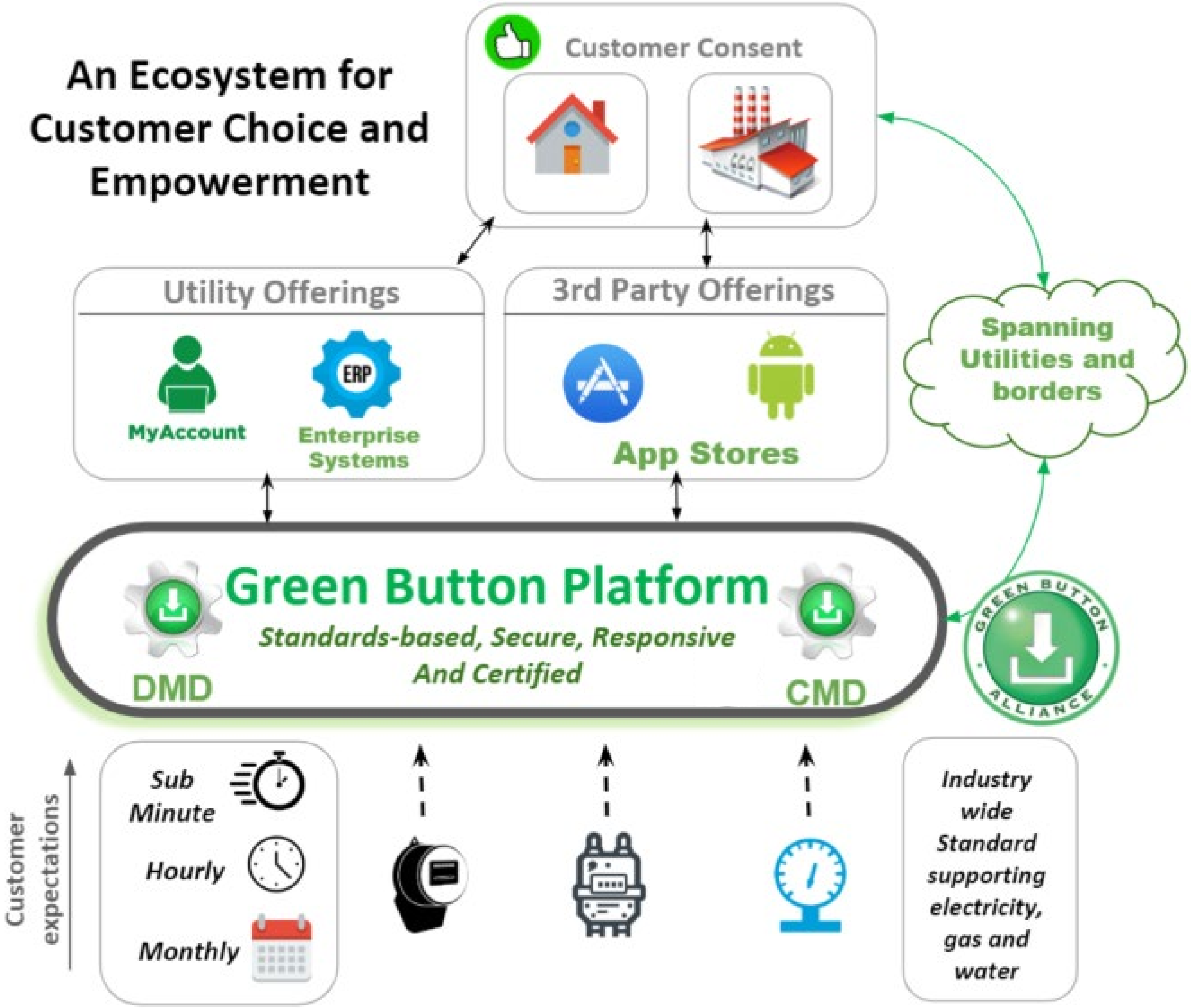




Green Button Required for Utilities by Nov 2023

The Green Button Initiative is an industry-led effort which:

- Enables **customer choice** of energy management software solutions, services and apps
- Enables **easy and secure access** to energy usage information in a consumer/computer friendly format
- Includes three types of data: **Electricity, Natural Gas, and Water Usage**
- Ensures customer **data privacy** & **secure transmission** of data
- Enables utility customers **better control** over energy usage, reduction of consumption, and lowering their costs



Sustainable Energy Pilots

London Hydro

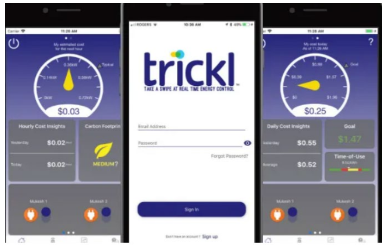
Empowering Sustainable Energy Actions

Piloted Innovative Electricity Price Plans

- real-time energy information program
- critical peak pricing program

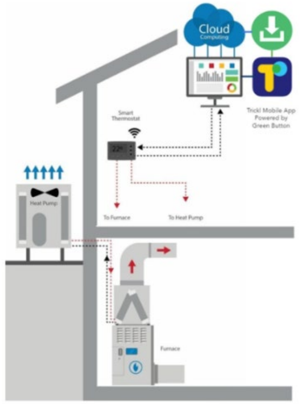
Plus Pilot energy conservation project

- smart home devices to test leading-edge energy management tools



London Hydro, Enbridge and City of London Pilot (2021)

- Advanced hybrid heating system
- high-efficiency gas furnaces and electric air-source heat pumps
- integrated smart controls integrates weather and fuel costs
- reduced energy costs and GHG emissions



Sustainable Transportation

EV charging pilot with Elocity informed customer actions

- real-time data for on/off control
- cost per charge & expected mileage per charge

London Transit Commission

- Engaged stakeholder
- Facilitating Electrification of Transit

EV Curbside Charging Stations

- Co funded, operate 6 downtown EV charging stations

Distributed Energy Resources

West 5 net-zero energy community – Utility Scale Smart Micro Grid

- Canada’s first large-scale, fully integrated, net-zero energy community
- data management and communications
- electric vehicle infrastructure
- solar power generation
- battery storage

Sustainability at London Hydro

OUR WORKPLACE AND THE ENVIRONMENT

OUR WORK AND THE ENVIRONMENT

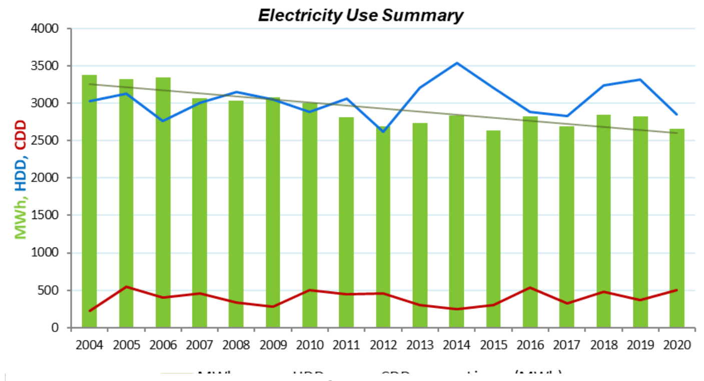
OUR TRANSPORTATION AND THE ENVIRONMENT

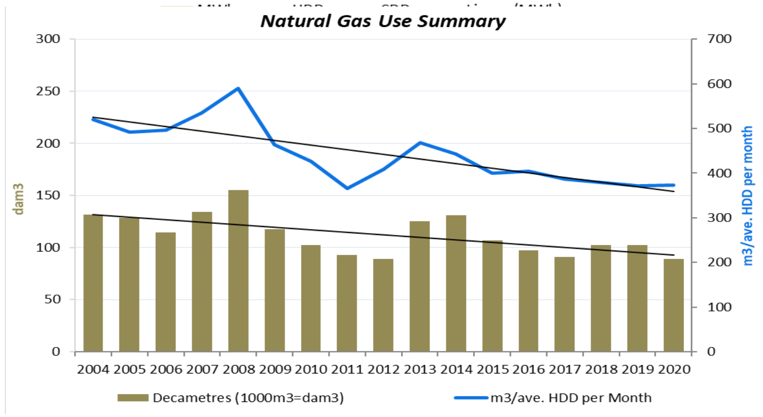
OUR COMMITMENT TO THE ENVIRONMENT

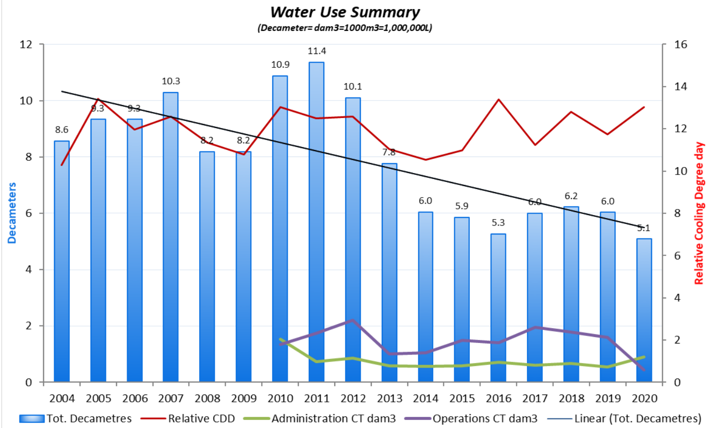
Where we Work

Our Workplace and the Environment

Energy and Water Resources







Since 2004, London Hydro has reduced

- Electricity Use by 21.4%
- Natural Gas Use by 28.2%
- Water Use by 40.2%

In 2020, London Hydro owned solar installations

- Generated 465,399 kWh
- Representing 17.5% of 2020 electricity use

The Way We Move

Our Transportation and the Environment

Fleet Management

Idling and Fleet Management Systems

- Idling management systems saved 42,000 l (99 t CO_2e) in 2019 and 2020

Strategic Purchasing Plans

- 10 PHEVs, 17 Hybrids

Monthly Fuel Use Summary

Fleetio

The Way We Green

Our commitment to the Environment

Raw Material Use

Reduce

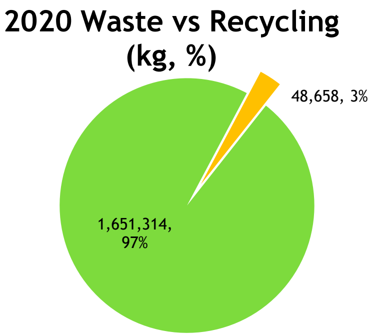
- Think B4U Print
  (215 trees since 2013)*
- Aeroplan® Paperless Billing (70,000 customers)
- (≈ 1,500 trees since 2014)
- Σ 1,715 trees saved (both programs)

* source: conservatree.org
1 tree =8,333 sheets
1 ton paper (907.2 kg) = 12 trees

Reuse

- 270 refurbished transformers (TE) in 5 years
  170 tonnes of raw materials
- 350 km of cable injected in last 10 years
  548 tonnes of raw material
- Total 718 t of raw material (TE & Cable)

Recycle



- App. 1,651 tonnes recycled

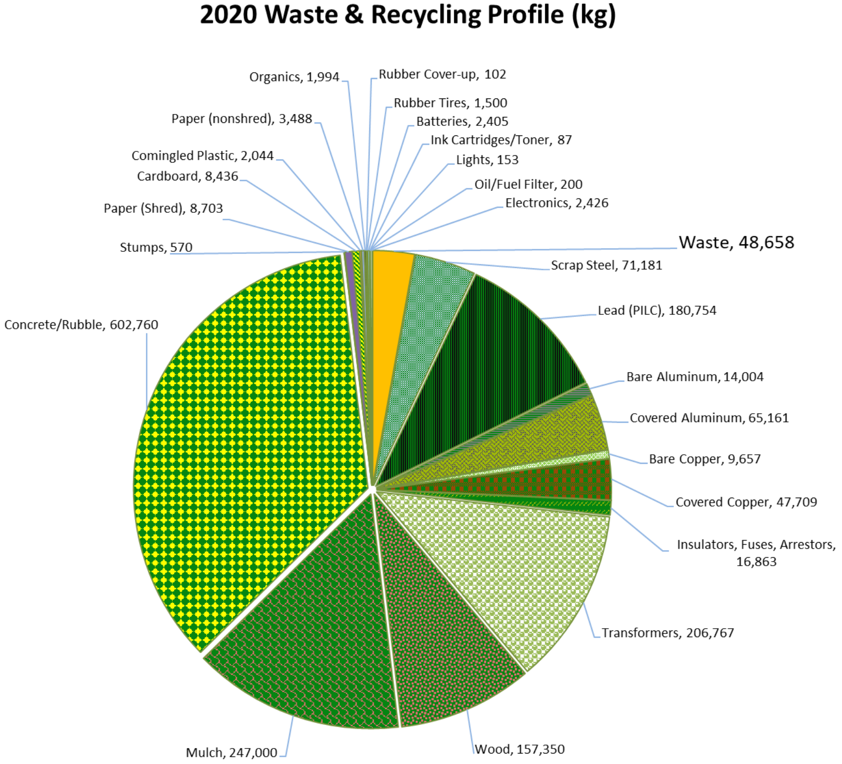
The Way We Green

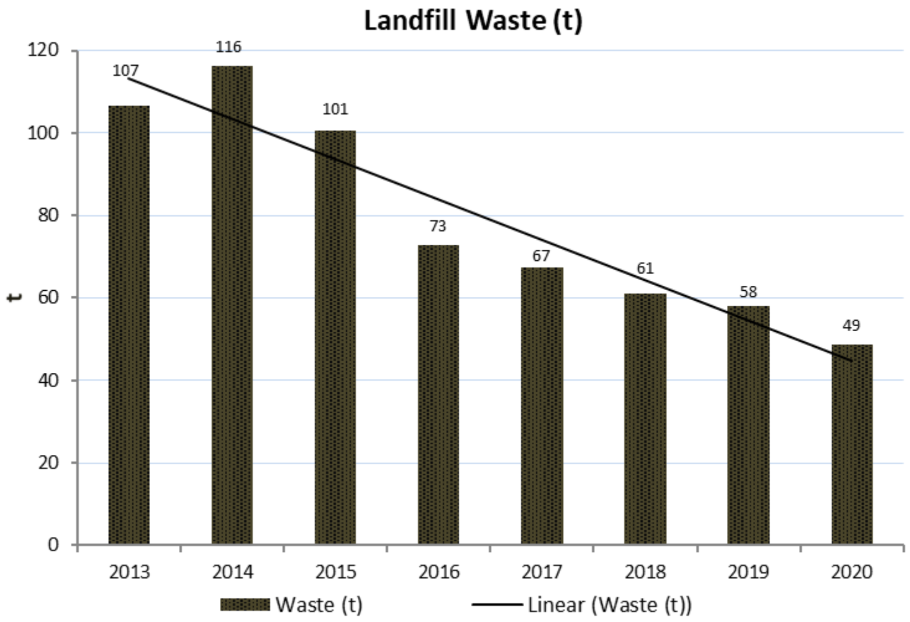
Our commitment to the Environment

Landfill Waste

Recycling to Reduce Waste to landfill

- 54% landfill waste reduction since 2013
- Insulator Diversion Program
  - 111.2 tonnes YTD since 2016



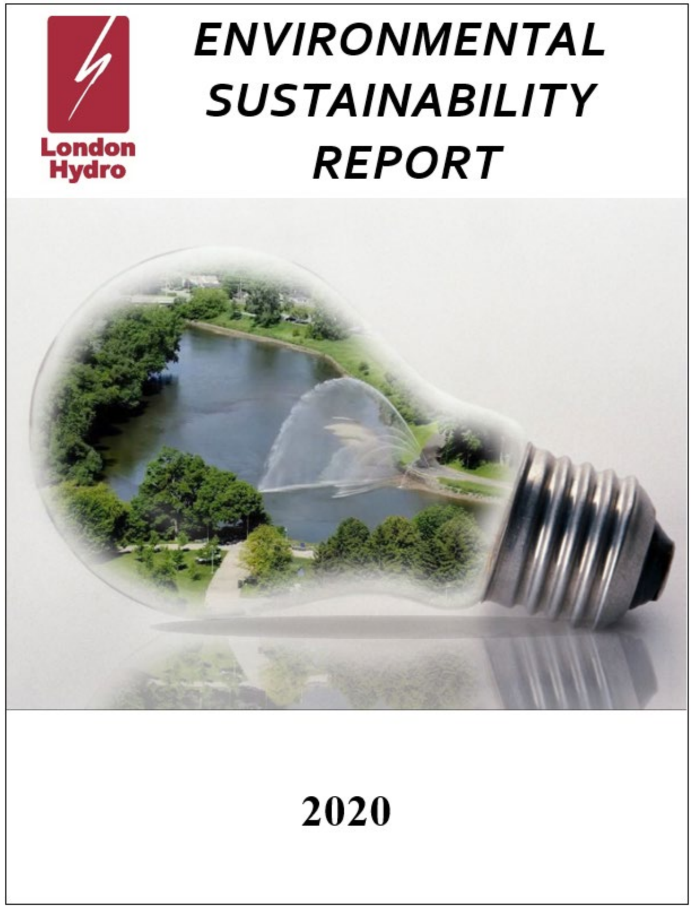


The Way We Green *Our commitment to the Environment*

Community Engagement and Communications

- Annual Earth Day Cleanup Event
- Annual Environmental Sustainability Report
  - Annual Carbon Footprint

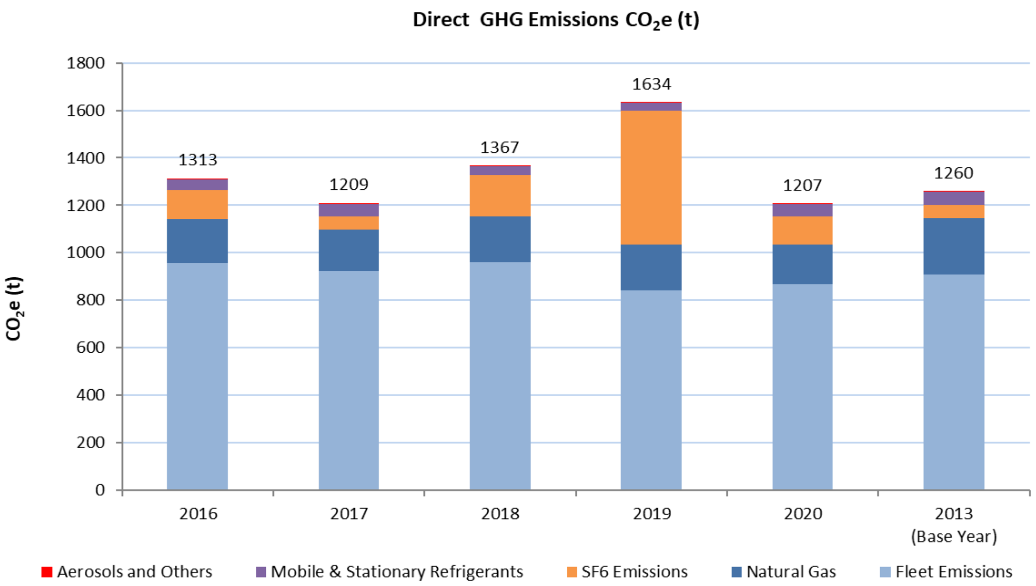
ANNUAL EARTH DAY EVENT

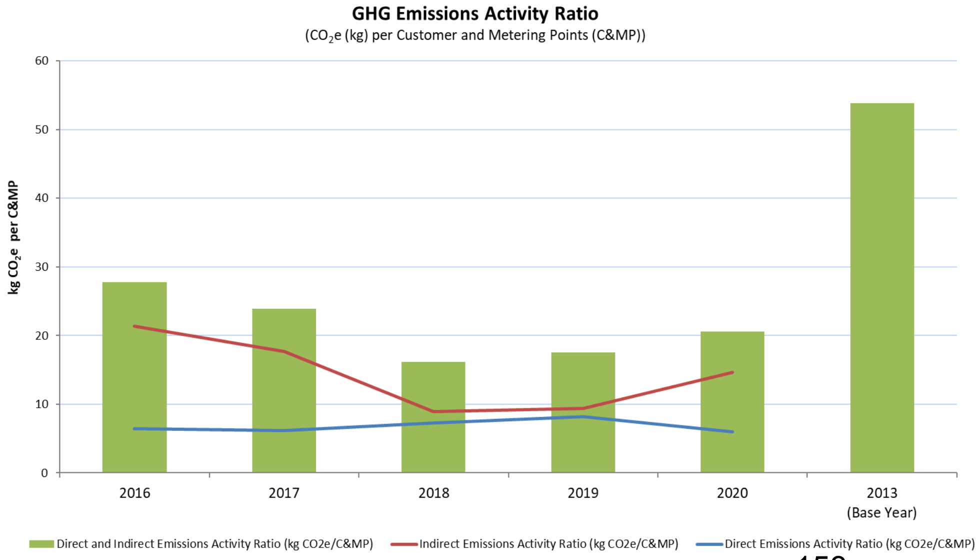


https://www.londonhydro.com/about-us/about-london-hydro/sustainability-reports

The Way We Green *Our commitment to the Environment*

London Hydro's GHG Emissions





https://www.londonhydro.com/about-us/about-london-hydro/sustainability-reports

QUESTIONS

300 Dufferin Avenue
P.O. Box 5035
London, ON, N6A 4L9

Windermere Road Improvements, City of London
Municipal Class Environmental Assessment Study
Notice of Public Information Centre #2

The Study

The City of London is undertaking a Municipal Class Environmental Assessment (EA) study to identify intersection, active transportation, and transit improvements to the Windermere Road corridor between Western Road and Doon Drive (see map). The study will also assess the potential to connect active transportation facilities along Richmond Street from Windermere Road to the Thames Valley Parkway trail system. In addition, the accessibility improvements along the corridor and intersections will be implemented to accommodate road users of all ages and abilities.

The Process

The study is being conducted in accordance with the requirements of Schedule 'C' projects as outlined in the Municipal Class EA document (2000, as amended in 2007, 2011 and 2015), which is approved under the Ontario Environmental Assessment Act.

Online Public Information Centre

The purpose of this online Public Information Centre (PIC) is to present the alternative design concepts, environmental impacts and proposed mitigation measures, the Recommended Design Alternative, and next steps. While this project information would typically be presented at a public information centre event, adjustments are being made to ensure public safety and follow COVID-19 restrictions on public gatherings.

The City of London is committed to informing and engaging the public about this study and will be hosting a live webinar via videoconference using the Zoom platform on November 8, 2021 from 5 p.m. to 7 p.m. to present a project update, answer questions, and collect feedback from attendees. A link to the meeting will be posted on the City of London's Get Involved website, at getinvolved.london.ca/windermere. The webinar will also be recorded and posted on the project website on November 9, 2021.

We recognize that not everyone will be able to access this information online. If you require any accommodation to access the project information or online material, please contact the City Project Manager, Paul Yanchuk, noted below and we will work together to best share the information with you.

Paul Yanchuk, P.Eng
City of London
Tel: 519-661-2489 ext. 2563
Email: pyanchuk@london.ca

Kevin Welker, P.Eng., Project Manager
Stantec Consulting Ltd.
Tel: 226-919-5979
Email: kevin.welker@stantec.com

Personal information collected on this subject is collected under the authority of the Freedom of Information and Protection of Privacy Act. With the exception of personal information, all comments will become part of the public record and may be included in project documentation.

This notice first published on October 28, 2021.

Map of the Windermere Road improvements study area.