2024 Community Energy Use and Greenhouse Gas Emissions Inventory

#LdnOnt ClimateAction

London CANADA

Land Acknowledgement

We acknowledge that we are gathered today on the traditional lands of the Anishinaabek (~~A~~Uh-nish-in-ah-bek), Haudenosaunee (Ho-den-no-show-nee), Lūnaapéewak (Len-ah-pay-wuk) and Attawandaron (Add-a-won-da-run).

We acknowledge all the treaties that are specific to this area: the Two Row Wampum Belt Treaty of the Haudenosaunee Confederacy/Silver Covenant Chain; the Beaver Hunting Grounds of the Haudenosaunee NANFAN Treaty of 1701; the McKee Treaty of 1790, the London Township Treaty of 1796, the Huron Tract Treaty of 1827, with the Anishinaabeg, and the Dish with One Spoon Covenant Wampum of the Anishnaabek and Haudenosaunee.

This land continues to be home to diverse Indigenous peoples (First Nations, Métis and Inuit) whom we recognize as contemporary stewards of the land and vital contributors to society. We hold all that is in the natural world in our highest esteem and give honor to the wonderment of all things within Creation. We bring our minds together as one to share good words, thoughts, feelings and sincerely send them out to each other and to all parts of creation. We are grateful for the natural gifts in our world, and we encourage everyone to be faithful to the natural laws of Creation.

The three Indigenous Nations that are neighbours to London are the Chippewas of the Thames First Nation; Oneida Nation of the Thames; and the Munsee-Delaware Nation who all continue to live as sovereign Nations with individual and unique languages, cultures and customs.

This Land Acknowledgement is a first step towards reconciliation. It is the work of all citizens to steps towards decolonizing practices and bringing our awareness into action. We encourage everyone to be informed about the traditional lands, Treaties, history, and cultures of the Indigenous people local to their region.

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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 2024;
- associated greenhouse gas (GHG) emissions; and
- energy expenditures in London.

London's Climate Emergency Action Plan (CEAP) was approved by Council in April 2023. Within the CEAP, listed under Area of Focus 10 – *Measuring, Monitoring and Providing Feedback* workplan, actions for the City of London include:

> 1.a. Continue to provide Londoners with the latest information on local greenhouse gas emissions and the expected impacts of climate change.
>
> 3.c. Provide Municipal Council with a report on community wide and corporate GHG emissions on an annual basis.
>
> 3.d. Provide the public with an easy-to-find and easy-to-use platform(s) and visuals for presenting information on Climate Emergency Action Plan implementation progress, community-wide GHG emissions, corporate GHG emissions, and progress on adaptation measures being undertaken.

The City of London's Climate Emergency Action Plan has set science-based GHG reduction milestones and targets for community-wide emissions:

- a 55% reduction from 2005 levels by 2030;
- a 65% reduction by 2035;
- a 75% reduction by 2040; and
- net-zero emissions by 2050.

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

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

For more information on the methodology used, please see Appendix A.

2. Community Energy Use

As shown in Table 1, total energy use in London in 2024 was 57,900 terajoules[1], 14 per cent above 1990 levels, and one per cent below 2005 levels.

Table 1 – 2005-2024 Total Community Energy Use by Sector (Terajoules per Year)

Sector	2005	2019	2024	Change from 2005
Transportation	20,200	21,300	20,100	0%
Residential	14,800	14,400	13,000	-10%
Industrial, Commercial & Institutional (IC&I)	23,800	23,900	24,800	5%
Total	**58,700**	**59,500**	**57,900**	**-1%**

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

Compared to last year:

- Energy used in the industrial, commercial, and institutional sector decreased by 1%,
- Energy used in single-family homes decreased by 4%, and
- Fuel used in transportation remained unchanged.

In terms of weather, London experienced a warmer than normal temperatures throughout 2024. As a result, energy demand for space heating was lower while demand for air conditioning was higher. See Appendix B for more information on weather trends.

London's industrial, commercial, and institutional buildings and facilities accounted for 43 per cent of all energy used in London. London Hydro and Enbridge include multi-unit residential buildings (apartment buildings and condominiums) under the category of commercial buildings. Transportation accounted for 35 per cent of all energy used in London, most of which was associated with personal vehicle use. Single family residential homes accounted for 22 per cent of all the energy used in London.

London's population has been growing faster than previously anticipated, with Statistics Canada estimating that the London Census Metropolitan Area's population grew by 3.8 per cent in 2023 and 3.2 per cent in 2024. Energy use per person in London was 124 gigajoules (GJ) per year in 2024, down 25 per cent from the 2005 baseline (Table 2).

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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)

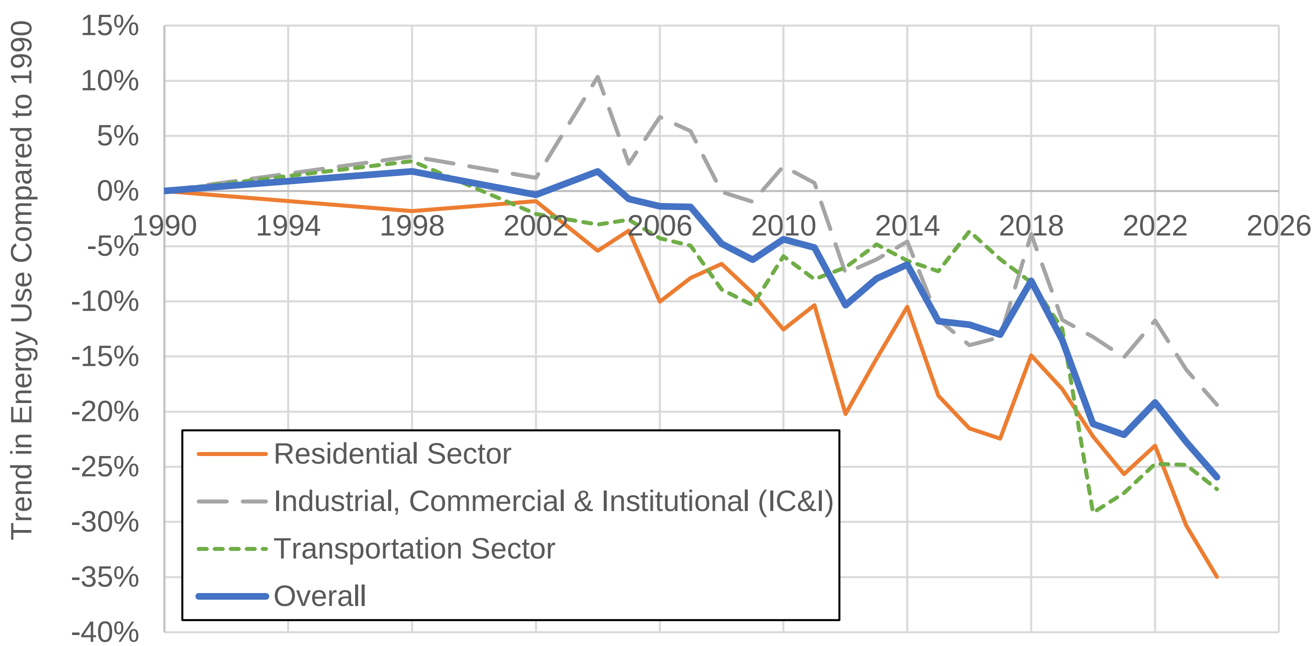
Table 2 – 2005-2024 Energy Use per Person by Sector (Gigajoules per Person)

Sector	2005 (Pop. 349,000)	2019 (Pop. 410,000)	2024 (Pop. 466,000)	Change from 2005
Transportation	58	52	43	-25%
Residential	42	35	28	-33%
Industrial, Commercial & Institutional (IC&I)	68	58	53	-21%
Total	**168**	**145**	**124**	**-25%**

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

Figure 1 illustrates the change in energy consumption in London by sector on a per person basis going back as far as 1990. As seen in the chart, energy use per person begins to improve starting around the mid 2000s. The major impact of the COVID-19 pandemic on transportation energy use in 2020 and 2021, followed by the continued use of hybrid work arrangements in many workplaces after the pandemic, can also be seen clearly. Improvements in home energy efficiency can also be seen clearly due to the combination of energy-efficient new construction as well as home energy retrofits.

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



2.1. Transportation Energy Use

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

Prior to COVID-19, vehicle ownership in London had grown by over four per cent every year on average between 2010 and 2019, much faster than London's overall population growth. However, as of December 2024, the number of light-duty vehicles registered in London dropped to over 294,000 vehicles. This works out to 631 vehicles for every 1,000 people.

The vehicle registration data shows a mix of positive and negative trends. On the positive side:

- the number of hybrid and/or electric vehicles in London were 16 times higher in 2024 compared to 2010;
- There are now almost 4,300 electric vehicles registered in London; and.
- 4.6% of new 2023/24 Model Year vehicles registered were electric vehicles and another 11.2% were hybrid (i.e., no plug) vehicles.

On the negative side, larger sport utility vehicles and pick-up trucks continue to gain in popularity, representing 31 per cent of new vehicles registered in 2024.

Additional detail is provided in Table 3 below.

Table 3 – Vehicle Ownership Statistics for London

Item	**2010**	**2019**	**2024**
Total registered vehicles	202,800	291,600	294,100
London's population	364,000 (estimate)	410,000 (estimate)	466,000 (estimate)
Vehicles per 1,000 people	557	711	631
Hybrid gas-electric vehicles (excluding plug-in hybrids)	840	3,200	9,340
Plug-in electric vehicles	0	830	4,280
Fuel use per vehicle (litres/year)	2,100	1,510	1,370

The City of London was among the first group of Canadian cities to participate in Google's Environmental Insights Explorer project. This project made 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 (inbound/outbound) account for about half of all personal vehicle emissions even though they are far fewer in number of trips.

2.2. Energy Use and the Local Economy

Another way to measure improvements in energy efficiency is to compare total energy use to Gross Domestic Product (GDP). Environment and Climate Change Canada uses a similar approach to measure progress on reducing emissions.

Since 2007 (no data available for 2005), 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 31 per cent between 2007 and 2024.

London's energy productivity - GDP generated per unit energy used - has improved by 33 per cent. Table 4 illustrates this in more detail. This means that the local economy is producing and using services more efficiently and/or moving towards producing products and services of higher value for the same amount of energy used.

Table 4 – Energy Productivity Improvements in London Since 2007

Indicator	2007	2024	Change
Gross Domestic Product ($ millions GDP[1])	$16,900	$21,100	31%
Total Energy Used (Terajoules - TJ)	58,700	57,900	-1%
Energy Productivity ($GDP per Gigajoules - GJ)[2]	$288	$382	33%

2.3. Energy Commodities Used in London

Natural gas was the largest source of energy used in London in 2024, accounting for 44 per cent of all energy used. Gasoline was the second largest source of energy, accounting for 24 per cent of London's energy use. Electricity accounted for 21 per cent of all the energy used in London.

Table 5 shows the overall trend in energy used per person since 2005, with energy efficiency and conservation trends noted for all energy commodities except for propane. The use of fuel

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

oil for heating has been replaced by natural gas in the urbanized areas of London and other urban centres of Ontario. Data from both Natural Resources Canada and Enbridge Gas indicated that about 300 to 400 homes in London, with most outside of the urban growth boundary, are still use fuel oil for heating.

Compared to the previous year, 2004 had an overall warmer winter and summer, which reduced the demand for natural gas used for heating but increased the demand for electricity used for air conditioning.

Table 5 – 2005-2024 Energy Use per Person by Energy Commodity (GJ per Person)

Energy Commodity	2005 (Pop. 349,000)	2019 (Pop. 410,000)	2024 (Pop. 466,000)	Change from 2005
Natural Gas	69	64	55	-21%
Gasoline (including ethanol in gasoline)	40	37	30	-27%
Electricity	37	28	26	-30%
Diesel	13	11	10	-20%
Fuel Oil	4.2	0.5	0.2	-92%
Aviation fuel	2.6	2.6	2.2	-31%
Propane	1.7	1.8	1.7	0%
Total	**168**	**145**	**124**	**-26%**

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

2.4. Energy Expenditures in London

Using information on utility billing rates and fuel price data from Kalibrate, 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. Understanding how much is collectively spent on energy, and the opportunities arising from energy conservation, is important for London. Table 6 outlines the total estimated costs associated with the energy commodities used in London.

It is estimated that Londoners spent $1.84 billion on energy in 2024, with recent trends in energy costs shown in Figure 2.

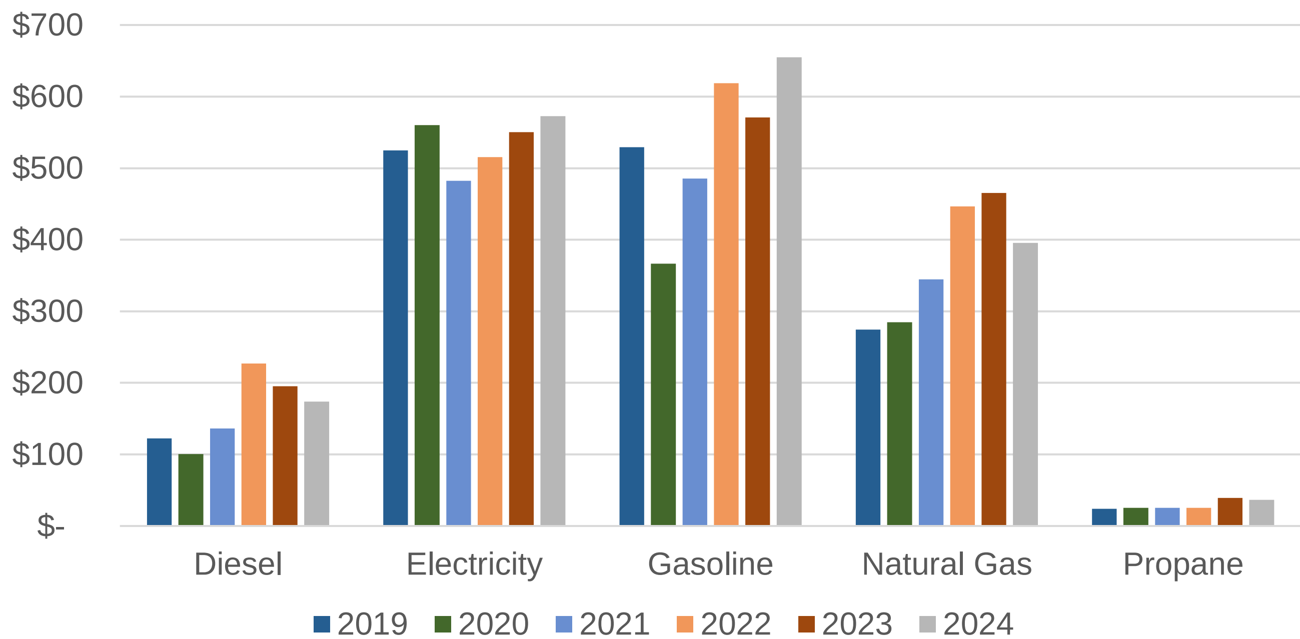
Table 6 – Total Estimated Cost by Energy Commodity in 2023

Energy Commodity[1]	Cost ($ million)	Share (%)	Energy (terajoules)	Price per gigajoule
Gasoline (including ethanol-blends)	$655	36%	13,800	$47
Electricity	$573	31%	11,900	$48
Natural Gas	$396	22%	25,400	$16
Diesel[1]	$174	9%	4,800[1]	$36
Propane	$37	2%	800	$46
Fuel Oil	$4	0.2%	100	$37
Total	**$1,837**		**56,800[1]**	**$32**

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

Natural gas is still the lowest cost energy source, even with the $80 per tonne carbon price in place during 2024.

Figure 2 – Trend for Total Energy Commodity Costs (Millions) by Commodity in London



On average, every percentage that Londoners reduce their energy use results in around $16 million staying in London every year.

[1] excludes diesel for railway freight transportation and aviation fuels

Information from utility billing rates and fuel price data can also be used to provide an estimate where the money is spent by Londoners on energy, as illustrated in Table 7. Out of the $1.84 billion spent on energy in 2024, it is estimated that 14 per cent of this money stayed in London, most of which goes towards London Hydro's and Enbridge's local operations. The rest leaves London.

Table 7 – Estimated Share of Energy Revenue (2024)

Commodity	London Region	Ontario - Business	Ontario - Government	Western Canada	Canada - Government	United States
Diesel	1%	2%	1%	4%	2%	-
Electricity	4%	22%	3%	-	1%	-
Gasoline	3%	7%	5%	15%	7%	-
Natural Gas	5%	2%	1%	2%	6%	3%
Propane	1%	<1%	<1%	-	<1%	-
Total	**14%**	**34%**	**11%**	**21%**	**17%**	**3%**

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 funded through utility bills, as it is usually more economical to invest in conserving energy rather than build new power plants.

The federal government also applied 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 were used for the Climate Action Incentive provided when filing personal income tax returns, with the remaining used for funding federal climate action programs for small businesses.

2.5. Energy Generation in London

London has 114.4 megawatts (MW) of local electricity generation and 8.2 megawatts of battery electricity storage system capacity installed to date. Currently, there are 87.1 megawatts of gas-fired cogeneration, 22.8 megawatts of solar photovoltaic (PV), 3.8 megawatts of biogas, and 0.68 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** - Enwave is a private operation that sells the power to the Independent Electricity System Operator and the thermal energy (steam for heating, chilled water for cooling) to buildings in downtown and central London from its Colborne Street facility.

- **Industrial** – Ingredion and Labatt Brewery generate steam as well as electricity "behind-the-meter" for use in their operations.

- **Hospital campus** – the London Health Sciences Centre Victoria Hospital campus generates both steam and electricity for hospital buildings, including the ability to keep the heat and power infrastructure operational 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 for pool heating as well as electricity "behind-the-meter" for use in their operations.

3. Greenhouse Gas Emissions

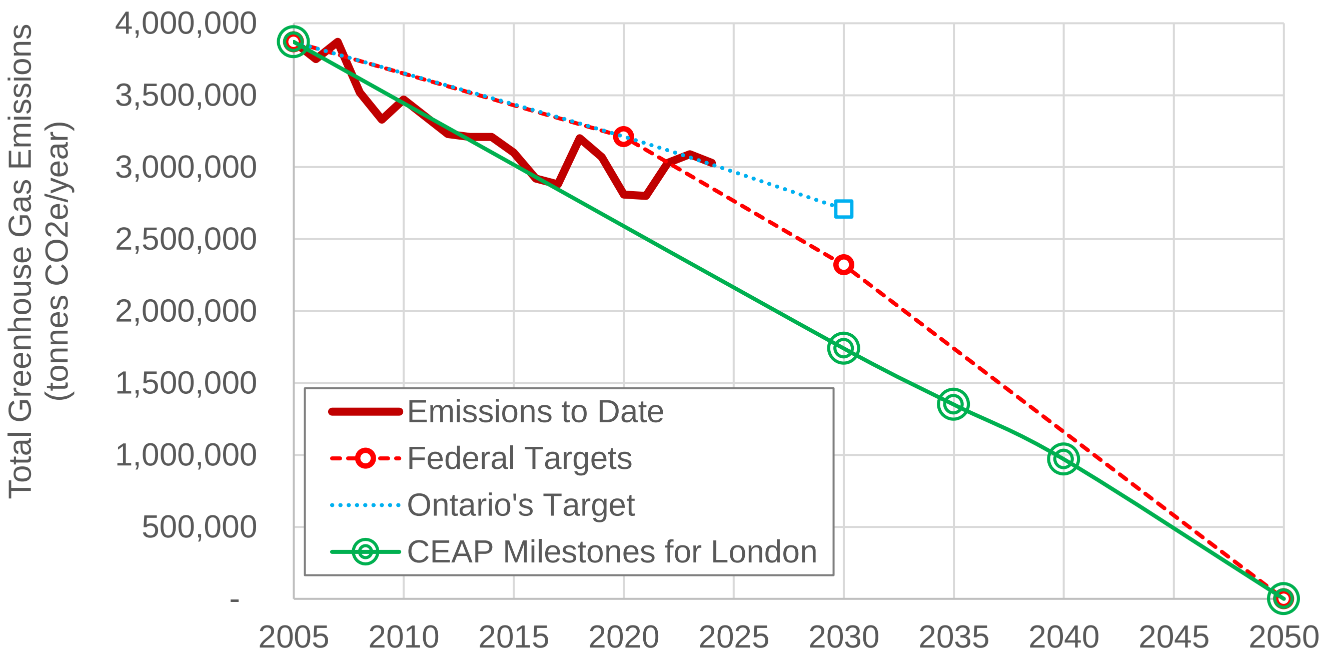
In 2024, total GHG emissions were estimated to be 3.03 million tonnes of equivalent carbon dioxide, or 22 per cent lower than the 2005 level.

Energy use is responsible for 94 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.

The remaining six 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.

Figure 3 illustrates the total GHG emission trend since 2005 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). Since 2005, there has been a downward trend driven by a combination of cleaner electricity generation and improved energy efficiency. However, since 2018, emissions to date have been above the trendline needed to meet our new science-based targets.

Figure 3 - Targets vs. Actual GHG Emissions from London



The cancellation of provincial renewable electricity contracts and electric vehicle incentives have contributed to the loss of momentum. London's emissions in 2024 would have been 120,000 tonnes lower had the emissions intensity of Ontario's electricity grid remained unchanged. For 2024 electric vehicle sales, as reported by S&P Global, Ontario's EV market share of 8.4 per cent was below the national average of 15.3 per cent and far behind Quebec and British Columbia at 32.9 per cent and 22.8 per cent respectively. London's EV market share is even lower, at 4.5 per cent in 2024.

Table 8 illustrates the GHG emissions trends by sector, including landfill gas emissions. As seen in Table 8, transportation and the industrial, commercial, and institutional sectors have the greatest contribution.

Table 8 – 2005-2024 Community GHG Inventory in London (kilotonnes CO_2e per year)

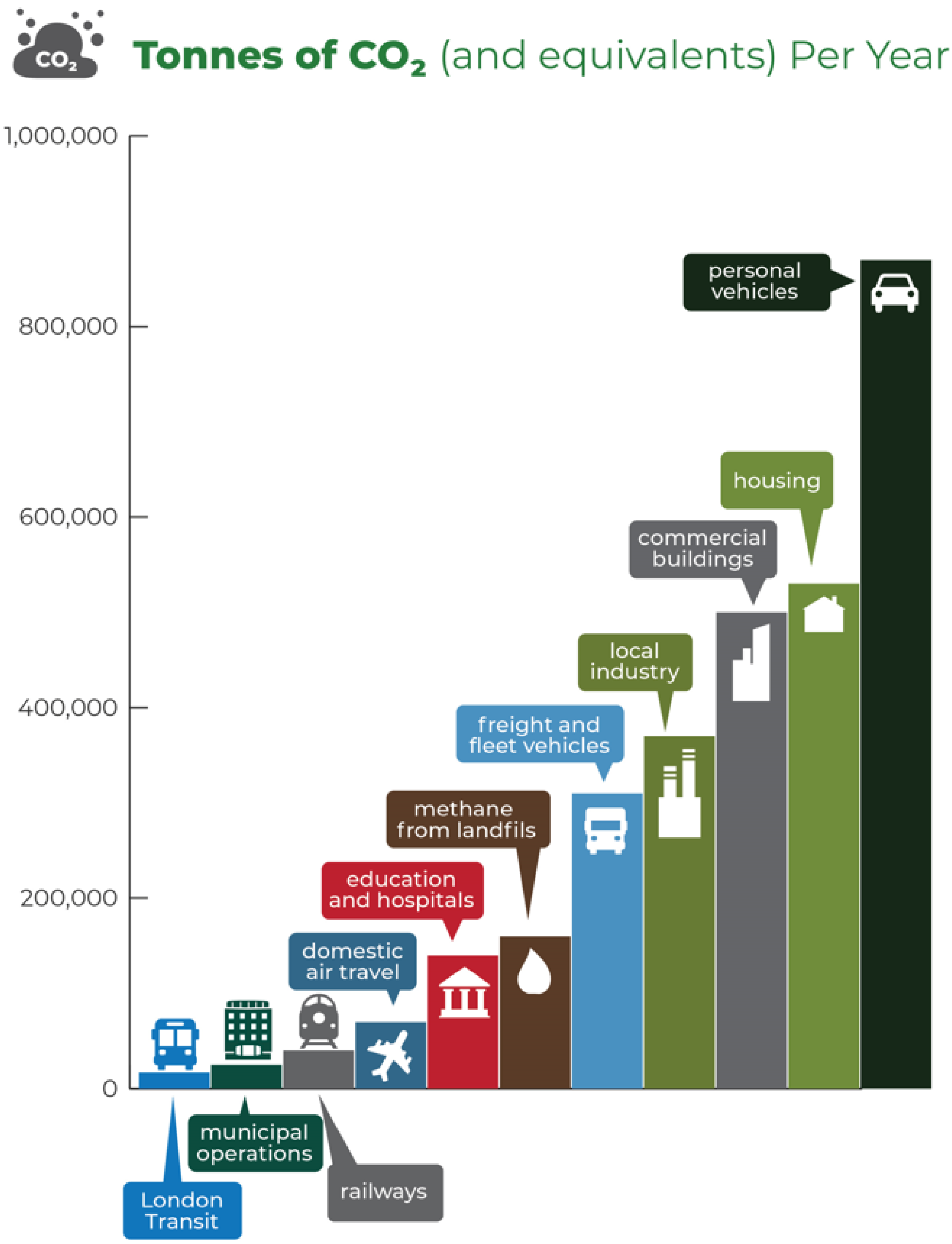
Sector	2005	2019	2024
Transportation	1,400	1,380	1,310
Residential	850	570	530
Industrial, Commercial & Institutional	1,380	910	1,030
Landfill Gas Emissions & Sewage Incineration	270	200	160
Total	**3,870**	**3,070**	**3,030**

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

Landfill gas emissions have decreased significantly since 2005 due to the installation of the landfill gas collection and flaring system at the W12A Landfill, London's active landfill. In 2024, the flaring system collected and destroyed around 7,670 tonnes per year of methane (215,000 tonnes per year of equivalent carbon dioxide), which is approximately 66 per cent of overall emissions from the landfill.

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 9.

Figure 4 - Greenhouse Gas Emissions by Sector in 2024



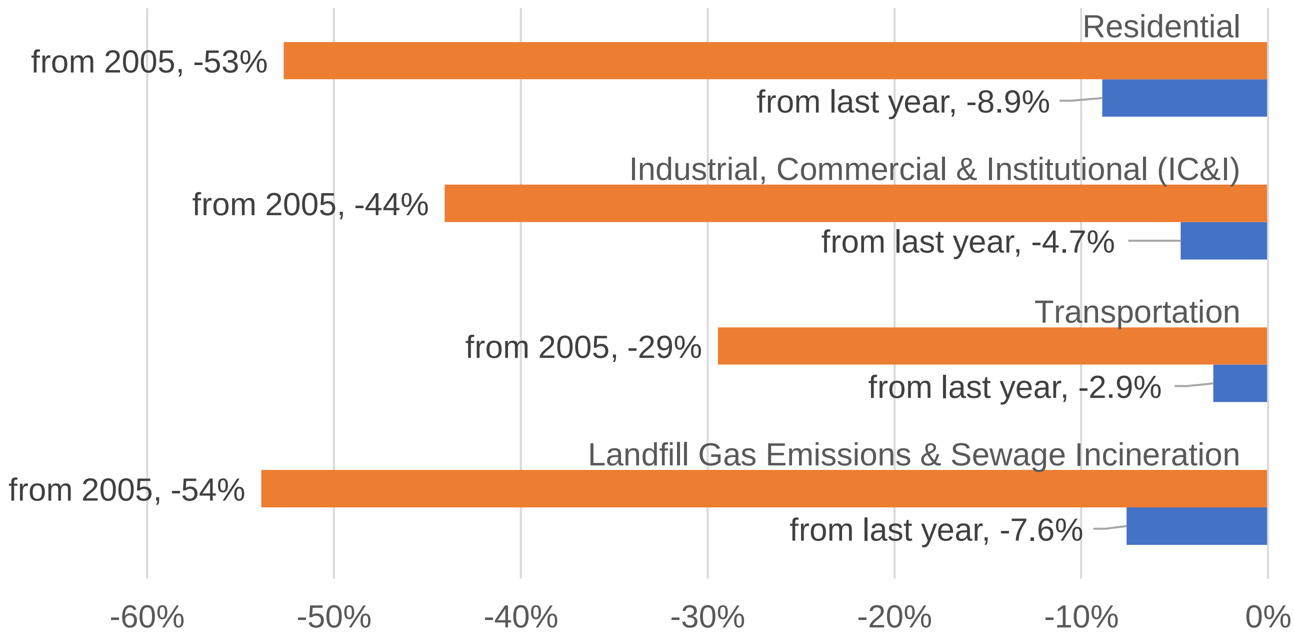
In terms of per person emissions, as illustrated in Table 9 and Figure 5, emissions today are 41 per cent lower than they were back in 2005.

Table 9 – 2005-2024 GHG Emissions per Person in London (tonnes per person)

Sector	2005 (Pop. 349,000)	2019 (Pop. 410,000)	2024 (Pop. 466,000)	Change from 2005
Transportation	3.98	3.36	2.80	-29%
Residential	2.40	1.39	1.13	-53%
Industrial, Commercial & Institutional	3.95	2.23	2.21	-44%
Landfill Gas Emissions & Sewage Incineration	0.76	0.50	0.35	-50%
Total	**11.1**	**7.5**	**6.5**	**-41%**

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

Figure 5 – Change in GHG Emissions per Person in London by Sector



This reduction in GHG emissions resulted from reduced GHG intensity of Ontario's electricity grid compared to 2005, improved home energy efficiency, reduced energy use in the business sector, and the improvement of the City of London landfill gas collection and flaring system at the W12A Landfill. Transportation emissions were also lower due to improved fuel efficiency, reductions in commuting due to the hybrid works arrangements adopted after the COVID-19 pandemic, the use of ethanol-blended gasoline (10% ethanol by volume), as well as vehicle tailpipe emission controls that reduced emissions of nitrous oxide.

It is important to note these GHG emissions 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 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.

3.1. Greenhouse Gas Emissions from Energy Use

Energy use in London was responsible for over 2.9 million tonnes of greenhouse gas (GHG) emissions (expressed in terms of equivalent carbon dioxide, or CO_2e) in 2023. Table 10 provides additional information on GHG emissions associated with the various sources of energy used in London.

Table 10 – 2023 GHG Emissions by Energy Commodity

Energy Commodity	Energy (Terajoules - TJ)	GHG Emissions (kilotonnes CO_2e)	GHG (%)	GHG Intensity (tonnes/TJ)
Natural Gas	24,400	1,320	46%	52
Gasoline (including ethanol)	13,800	870	30%	63
Diesel	4,800	360	12%	70
Electricity	11,900	220	8%	18
Aviation Fuel	1,000	70	2%	68
Propane	800	60	2%	61
Fuel Oil	100	10	<1%	70
Total	**57,900**	**2,860**		

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

About 84 per cent of Ontario's electricity was generated from emissions-free sources in 2024, 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 relied on fossil fuels such as natural gas to generate almost 16 per cent of the electricity we use, a higher share than in recent years.

For 2024, it is estimated that every 1,000 kilowatt-hours of electricity generated in Ontario produced 65 kilograms of carbon dioxide emissions. This is significantly better than it was 21 years ago (2003), when electricity generated in Ontario produced around 300 kilograms of carbon dioxide emissions. However, this does represent an increase in electricity emissions intensity from recent years when emissions were at or below 30 kilograms per 1,000 kilowatt-hours. As a result, this increase in emissions intensity is responsible for an additional 120,000 tonnes of emissions attributable to London in 2024.

3.2. Household Energy Use and Emissions

Providing estimates of energy use and greenhouse gas emissions for an average household in London offers a clearer understanding of the current situation (i.e., what to focus efforts on) and identifies 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; and
- 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 11 – Estimated Average Household Energy Use and Local GHG Emissions for 2024

Household Activity	Average Monthly Use over the Year	Average Monthly Cost over the Year	Average Annual Cost	Average GHG Emissions (tonnes CO_2e)
Gasoline use (vehicles)	164 litres	$260	$3,120	4.1
Natural gas use	149 m^3	$95	$1,150	3.5
Home heating		*$74*	*$880*	*2.7*
Hot water heating		*$22*	*$260*	*0.8*
Electricity use	660 kWh	$118	$1,420	0.51
Air conditioning		*$15*	*$180*	*0.07*
Appliance & plug load		*$38*	*$460*	*0.17*
Lighting		*$11*	*$140*	*0.05*
HVAC fan motor		*$53*	*$640*	*0.23*
Propane use	5 litres	$15	$180	0.1
Organic waste in garbage		$80	$1,000[1]	0.7
Total		**$516**	**$6,190**	**9.5**

[1] Estimated value of avoidable food waste, which makes up most but not all methane emissions from the W12A Landfill

3.3. Hydrofluorocarbons

Hydrofluorocarbons (HFCs) are refrigerants that were introduced to replace ozone-depleting refrigerants such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) under the Montreal Protocol. However, HFCs are potent greenhouse gases with a 100-year Global Warming Potential ranging up to 14,800 times higher than carbon dioxide. As a result, there is now a gradual phaseout of HFCs mandated under the Kigali Amendment to the Montreal Protocol, which came into force in 2019.

Emissions from local HFC use are not included in emissions inventories at the community scale as per the Federation of Canadian Municipalities' Partners for Climate Protection Program.

Canadian HFC use data is derived from bulk imports, and imports and exports of manufactured items such as refrigerators and air conditioners.

Surveys were performed by Environment Canada in 2012 to document practices in HFC use and disposal and to support the development of country-specific emission factors that are representative of Canada's circumstances for use in Canada's National Inventory Report.

Using the HFC emissions data for Ontario from Canada's National Inventory Report, the average per capita emissions from HFC use was estimated to be around 0.25 tonnes of equivalent carbon dioxide per person in 2023. This is lower than it was back in 2019, when it was estimated to be around 0.32 tonnes of equivalent carbon dioxide per person. Applying this to London's population works out to approximately 113,000 tonnes per year of equivalent carbon dioxide.

4. Summary and Conclusions

The impact of the COVID-19 pandemic on transportation energy use and emissions remained evident in 2024, with many London workplaces maintaining hybrid working arrangement after the pandemic as well as greater use of web-based meetings reducing the need for business-related vehicle trips.

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.

From a greenhouse gas emissions reduction perspective, credit should be given to the previous Government of Ontario for following through on 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. Since 2005, there has been an overall downward trend driven by a combination of cleaner electricity generation and improved energy efficiency.

The reductions in energy use noted above are also a contributor to London’s significant reductions in greenhouse gas emissions. Federal vehicle emission standards and provincial ethanol in gasoline requirements have also helped to reduce transportation greenhouse gas emissions. Finally, the City of London’s landfill gas collection and flaring system represents the largest source of greenhouse gas emissions reduction directly under municipal government control. Figures 6 and 7 show the main factors driving greenhouse gas emissions changes since 2005 and since last year, respectively, as well as the magnitude of emissions changes associated with each factor.

However, the cancellation of provincial renewable electricity contracts and the resulting increased reliance on natural gas fuelled power generation, combined with the cancellation of provincial-level electric vehicle incentives have contributed to the loss of momentum 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.

Figure 6 – Factors Driving Greenhouse Gas Emission Changes Since 2005

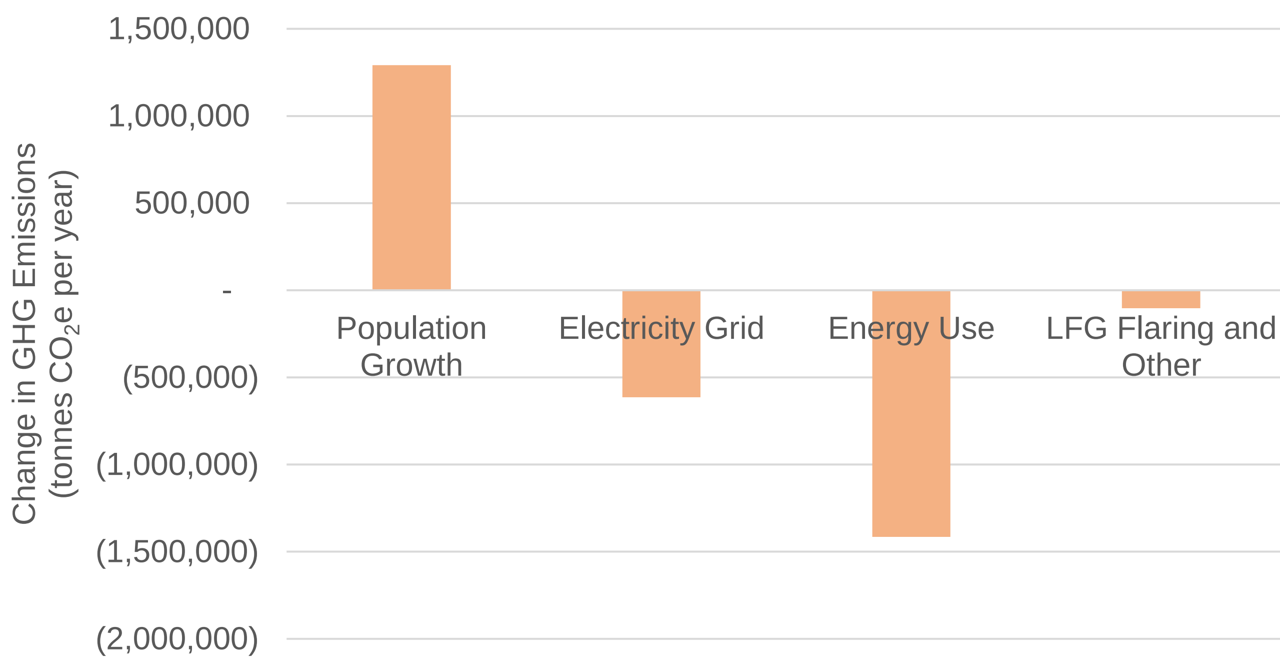
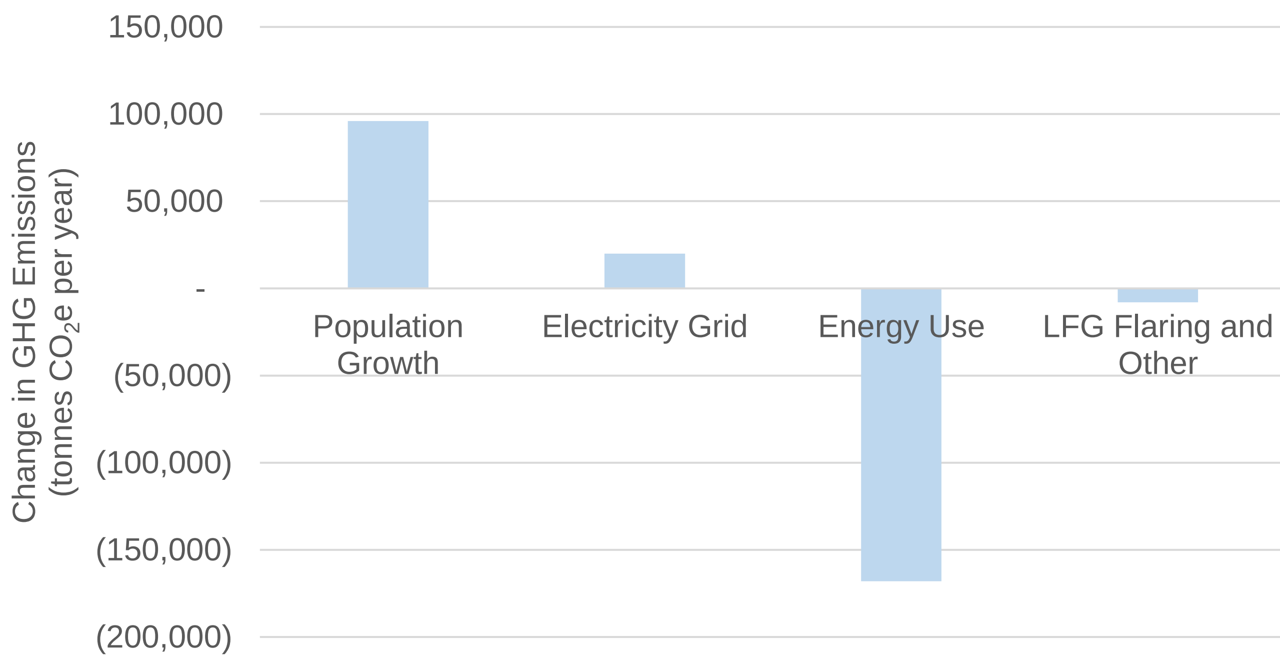


Figure 7 – Factors Driving Greenhouse Gas Emission Changes Since Last Year



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 2004-2024 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 Enbridge 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 2023.

- For fuel oil, home energy audit data from Natural Resources Canada was used to adjust estimates to take into account that natural gas has replaced fuel oil in areas where natural gas service has been provided. It is estimated that about 300-400 homes in London outside the urban growth boundary may still use fuel oil.

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 Enbridge 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 2023.

- For fuel oil, data from Ontario's Broader Public Sector reporting database was used to adjust estimates to take into account that natural gas has replaced fuel oil in areas where natural gas service has been provided.

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 Kalibrate Canada. 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 (2024 data).

- Diesel use for public transit was provided by London Transit.

- Diesel use for road freight transportation and 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 2023.

- 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 2023.

- Aviation fuel use was estimated using Ontario-level domestic aviation emissions data from *Canada's National Inventory Report 1990-2023,* prorated by population. Note that the latest information is from 2023.

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

- Annual waste quantities placed within the landfills for each calendar year. Note that the Scholl Canyon model is used by City staff for estimating methane generation in the landfill.

- 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 (GWP) of methane of 28, as per the Intergovernmental Panel on Climate Change's *Fifth Assessment Report* and the federal government's 2024 National Inventory Report for 2023 emissions.

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 2023, only 25% landfill gas capture for 1998, and no landfill gas capture for 1990.

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

Table A-1: Summary 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/hour	Estimated annual emissions tonnes/year	Estimated annual CO_2e tonnes/year
2008	0.1	0.4	3	800
2009	1.1	3.9	28	7,500
2010	1.1	3.9	28	7,400
2011	1.2	4.4	32	8,400
2012	1.0	3.5	26	6,800
2013	0.2	0.6	4	1,200
2014	1.1	4.1	29	7,800
2015	1.0	3.7	26	7,000
2016	0.3	1.1	7	2,000
2017	2.4	8.6	65	17,300
2018	1.7	6.0	43	11,300
2019	1.5	5.5	33	8,700
2020	0.8	3.0	18	4,400
2021	0.5	1.6	9	2,500
2022	1.2	4.4	26	6,900
2023	1.6	5.7	38	10,100
2024	1.4	5.1	15	4,000

A.2. 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 1990-2023*, except for the grid-average emission factors for Ontario for 2024, which have been estimated based on the 2024 transmission-connected electricity supply mix for Ontario reported by the IESO, combined with the data from Canada's National Inventory Report 1990-2023. 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 1990-2023.*

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

Source of Emission	Emission Factor (CO_2e)	Information Source
Electricity - Ontario 2024	0.065 kg/kWh	2024 IESO electricity supply mix
Electricity - Ontario 2023	0.059 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2022	0.049 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2021	0.043 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2020	0.037 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2019	0.029 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2018	0.030 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2017	0.019 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2016	0.041 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2015	0.043 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2014	0.042 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2013	0.077 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2012	0.110 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2011	0.110 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2010	0.140 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2009	0.120 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2008	0.170 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2007	0.240 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2006	0.210 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2005	0.250 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2004	0.220 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2003	0.300 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
Electricity - Ontario 2002	0.290 kg/kWh	National Inventory Report, 1990-2023 - ANNEX 11
natural gas	1.93 kg/m^3	National Inventory Report, 1990-2023 - ANNEX 11
fuel oil	2.76 kg/L	National Inventory Report, 1990-2023 - ANNEX 11
propane	1.55 kg/L	National Inventory Report, 1990-2023 - ANNEX 11
gasoline	2.30 kg/L	National Inventory Report, 1990-2023 - ANNEX 11
diesel	2.71 kg/L	National Inventory Report, 1990-2023 - ANNEX 11
gasoline (E-10)	2.07 kg/L	National Inventory Report, 1990-2023 - ANNEX 11

A.3. Cost Estimates for Community Energy Use

Information on the cost of using petroleum products is based on information available from Kalibrate Canada, 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 (now Kalibrate Canada).

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 Enbridge 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 Enbridge Gas's regional and Ontario-wide storage and distribution operations;
- Delivery-related costs, which is allocated to London to reflect Enbridge 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 - Heating & Cooling Degree Days for London

A heating degree day (HDD) is a measurement tool used to estimate energy demand needed to heat a home or business. A similar measurement, a 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.

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
2014	4,309	201	6%	-15%
2015	3,971	254	-2%	-8%
2016	3,615	343	-11%	46%
2017	3,597	271	-11%	15%
2018	3,836	392	-5%	66%
2019	3,937	277	-3%	17%
2020	3,562	347	-12%	47%
2021	3,449	336	-15%	42%
2022	3,793	295	-7%	25%
2023	3,404	201	-16%	-15%
2024	3,238	293	-20%	24%
Average	*3,701*	*292*	*-9%*	*24%*
Climate Normal (1971-2000)	**4,058**	**236**		

Using this data, it can be assumed that, over the last 10 years, building heating needs were about nine per cent lower than they would have been back in the 1971-2000 period, and that air conditioning needs were 24 per cent higher.