

A Heat Pump Story in Richmond Hill Ontario

by Elizabeth Liu

A Richmond Hill resident, Elizabeth Liu, installed a cold climate air-sourced heat pump in early 2024 after learning about the technology from a citizen group, Climate Action Richmond Hill. She applied to the Home Efficiency Rebate Program for the installation (Enbrige, 2024).

Background Information

Archetype: Bungalow, with no tree canopy

Size: 1222 sq feet

Age: Over 70 years old

Energy retrofits implemented: Attic insulation; wall insulation of a bedroom, all windows replaced with 3-pane energy efficient ones

Major changes in gas or electricity use (apart from the heat pump): None



Heat pump installed at Elizabeth's residence

Heat Pump

Heat pumps are energy-efficient electrical appliances that provide both heating and cooling, and produce a lower carbon footprint (Natural Resources Canada, 2025).

Installation Details

- 2-Ton heat pump and smart thermostat installed
- 60,000 BTU gas-powered furnace installed as back-up heating
- Heat on: Oct - mid May, 20-21°C
- Cooling on: mid May - Sept, 24°C
- Thermostat controls the hybrid heating system - heat pump automatically switches to furnace when outdoor temperature falls below -10°C.
- \$6,000 (post HST) paid out of Elizabeth's pocket after \$7,100 rebate was applied

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Energy Use & Bill Changes (Mar 2024 – Feb 2025 compared to the year prior)

- 70% annual gas use reduction ([Appendix 1](#)).
- \$1,125 annual gas bill reduction observed. Of that reduction, an estimated \$802 (incl. HST) is usage-driven since 1,527 m³ less gas consumed ([Appendix 2](#)).
- 78 % annual electricity use increase ([Appendix 3](#)).
- \$767 electricity bill increase observed. Of that increase, an estimated \$631 (incl. HST) is usage-driven since 5633 kWh more electricity consumed ([Appendix 4](#)).
- A net usage-driven reduction of \$171 on the overall energy bill ([Appendix 4](#)).
- 6.27 metric tons of net carbon dioxide emission reduction ([Appendix 5](#), [Appendix 6](#)). Other greenhouse gases such as methane (CH₄) and nitrous oxide (N₂O) are not included, as they represent a relatively minor share of total greenhouse gas emissions in this study.

It is noteworthy that energy use and costs vary with factors such as regional climates, home archetypes and equipment performances (Ferguson & Sager, 2022). So, the data presented is not representative of all cases.

Greenhouse Gas Emission Reduction

6.27 metric tons of net carbon dioxide emission reduction is equivalent to

1.5 Gasoline-powered passenger vehicles driven for 1 year 

706 Gallons of gasoline consumed 

6,965 Pounds of coal burned 

506,909 Numbers of smartphones charged 

Calculations made with the [Greenhouse Gas Equivalencies Calculator](#) (EPA, 2024).

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Key takeaways

1. Know Your Home's Broader Energy Efficiency Strategy

A heat pump should be part of a broader energy-efficiency strategy. That includes insulation, high-performance windows, smart thermostats, etc. (Enbridge & IESO, 2025b). In Elizabeth's case, she implemented multiple retrofits beforehand. Reducing heat loss should be a priority before installing a heat pump.

2. Know the importance of energy audits

Government rebate programs begin with an energy audit (Enbridge & IESO, 2025a). It is a detailed study of home energy use and heat loss. Ideally, an audit is conducted before deciding on retrofits. However, in Elizabeth's case, her 6 contractors determined the heat pump size and model before an audit was completed.

3. Ask Certified Contractors Key Questions

It is important to ask how a heat pump's model and size was chosen. How does the system perform in summer and winter? It is important to compare contractors' models, costs, warranties and installation timelines. Manufacturer websites will be useful for comparisons.

4. Use the Heat Pump for More Than Just Cooling

Some contractors advised Elizabeth to use the heat pump only for cooling to avoid the cost of installing a back-up furnace. They all suggested limiting its operation to between 7 °C and 0 °C, claiming it could not meet heating demands at lower outdoor temperatures. But after reviewing the manufacturer's data, Elizabeth decided to run her heat pump down to -10°C—and found it could meet most of her home's heating needs.

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5. Double Check Gas Meter Readings

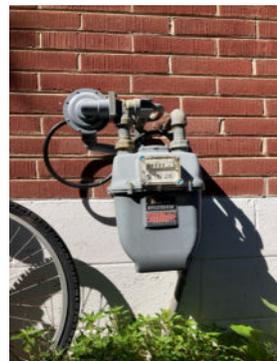
Uploading actual meter readings ensures homeowners pay what they use (Enbridge, 2025b). In Elizabeth's case, after submitting accurate readings, she was refunded over \$500 for the winter season as gas usage has dramatically declined ([Appendix 7](#)).

6. Cool the house more efficiently in summer

Elizabeth's heat pump use has increased electricity consumption year-round ([Appendix 8](#)). Replacing her 1.5-ton AC with a 2-ton heat pump (to match her 60,000 BTU furnace) has raised summer electricity use. Thermostat data revealed that she could have saved electricity in the summer by ventilating in late evenings.

7. Stay Engaged after Installation

Learn how the smart thermostat, heat pump, and furnace work together, and contact the providers if any issues arise. Monitor energy bills closely—especially in winter—and submit accurate gas meter readings. While electricity use may rise, good insulation will maximize heat pump efficiency. In summer, reduce heat gain with blinds, fans, and by ventilating during cooler parts of the day.



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Ideas for the Future

The government energy efficiency rebate program funded energy retrofits in over 100,000 households (Enbridge, 2024). Public participation and professional delivery of the program are key to maximizing its financial and environmental benefits. Environmental impacts of retrofits should also be considered.



In the case of heat pumps, we can ask:

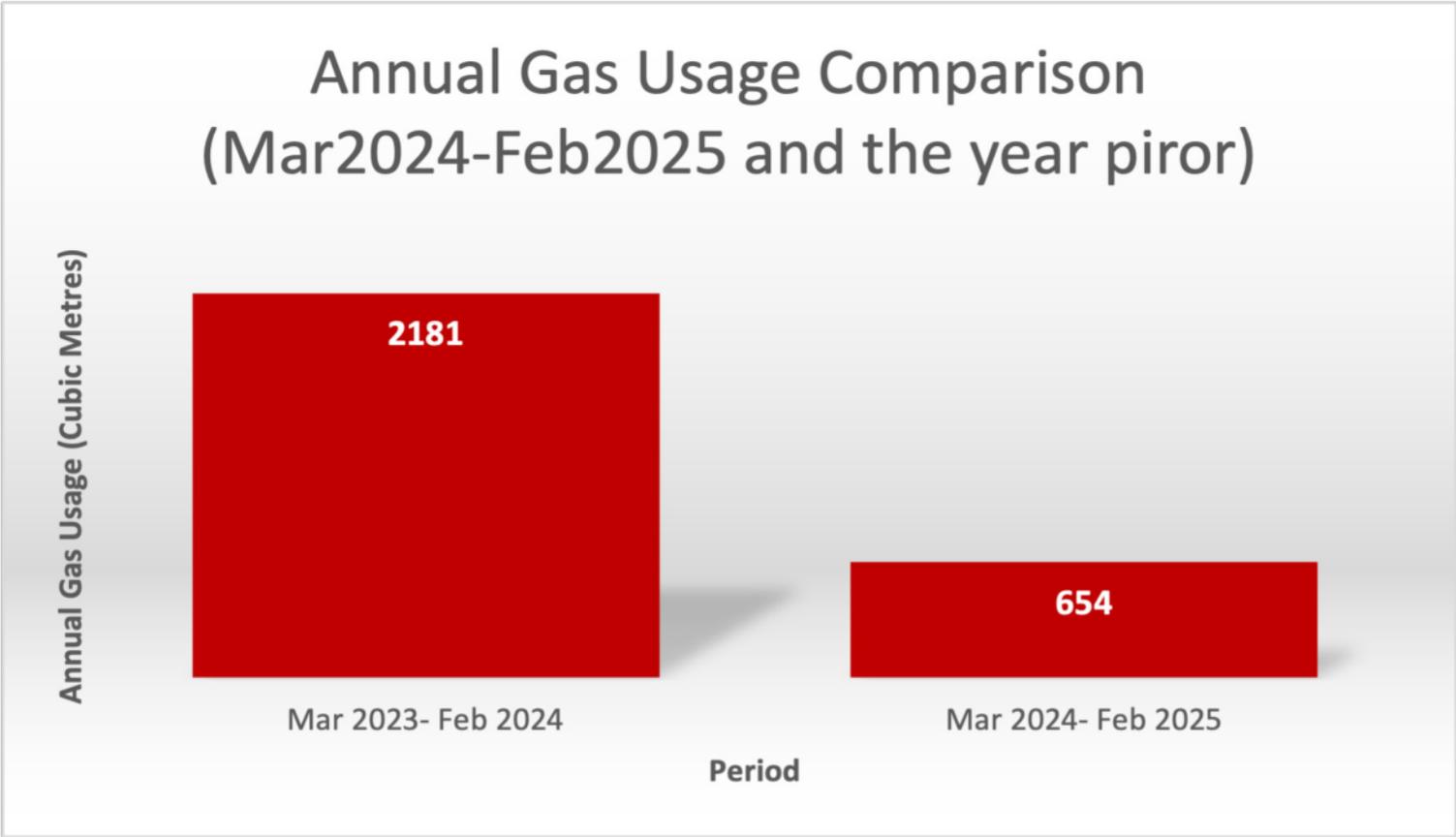
1. How can the public be educated about the importance of energy audits and ways to stay engaged after the heat pump installation to optimize home comfort and energy savings?
2. How can the industry be better equipped with knowledge about new technologies such as heat pumps to deliver informed energy solutions to the public?
3. Can the decommissioned furnace and air-conditioners be reused or recycled?

Acknowledgement

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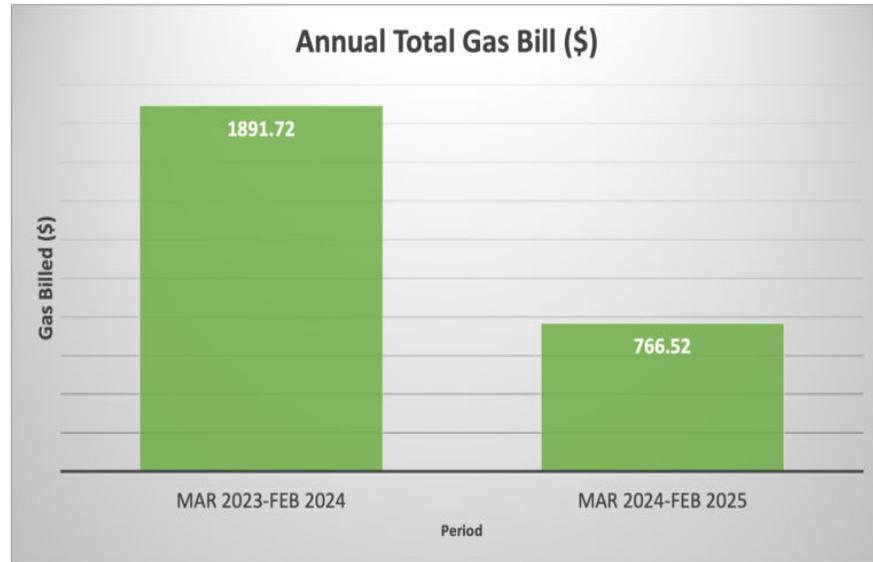
Appendix 1. Annual Gas Usage Comparison [Back to main body](#)



Source: Elizabeth’s gas provider, Enbridge.

Annual change in gas usage (m³): 654 m³- 2181 m³= - 1527 m³ (reduction)

Annual change in gas usage (%): (2181-654)/2181 x 100% = 70.01% (reduction)



Annual change in gas bill:
 $766.52 - 1891.72 = -\$1125.2 \approx -\1125

Note: An estimated \$320 of the gas bill reduction came from the removal of third-party charges on Enbridge gas bill from July 2024 onwards (i.e. Water Heater Rental).
 Source: Elizabeth 's gas bills

Source: Elizabeth's gas provider, Enbridge.

To determine how much the saving of \$1125 is attributed to reduced gas use, weighted average gas rate (i.e. gas supply and federal carbon charge) is calculated for year 1 and 2. Transportation rates, standard customer charge and cost adjustment are not included because their average rates have increased from year 1 to 2, and therefore, do not contribute to gas bill reduction (Sources: Elizabeth's gas bills). Delivery rate is excluded because of its minimal impact on the gas bill (Sources: Sources: Elizabeth's gas bills, [OEB - Historical natural gas rates detailed rates](#)). A total of \$320 third-party charge (i.e. water heater rental) was removed from July 2024 onwards (Source: Elizabeth's gas bills). Rate-driven and usage-driven savings in gas bills are then determined. Paasche (current-year usage) method is applied.

1) Gas Supply Charge (EGD effective gas supply price, ¢/m³) — quarterly values weighted by months in each study year (Sources: [OEB - Historical natural gas rates detailed rates](#))

Jan 2023→21.2666; Apr 2023→13.2318; Jul 2023→11.9070; Oct 2023→13.1971; Jan 2024→11.7575; Apr 2024→9.7413; Jul 2024→10.4826; Oct 2024→10.0975; Jan 2025→9.2221.
 (Sources: [OEB - Historical natural gas rates detailed rates](#)) Weighting for each study year: March = Jan rate; Apr-Jun = Apr rate; Jul-Sep = Jul rate; Oct-Dec = Oct rate

2) Federal Carbon Charge (¢/m³): **9.79** (Mar 31 2023) **12.39** (Apr 1 2023-Mar 31 2024) **15.25** (Apr 1 2024-Mar 31 2025). (Source: [Enbridge federal carbon charge](#))

3) Year 1 and Year 2 Weighted average gas rate (i.e. gas supply charge and federal carbon charge)

Year 1 (Mar 2023-Feb 2024)

Gas supply charge weighted average: 13.32 ¢/m^3

Carbon charge weighted average: 12.17 ¢/m^3

Total weighted average rate (year 1): $13.32 + 12.17 = 25.49 \text{ ¢/m}^3$

Year 2 (Mar 2024-Feb 2025)

Gas supply charge weighted average: 10.10 ¢/m^3

Carbon charge weighted average: 15.01 ¢/m^3

Total weighted average rate (year 2): $10.10 + 15.01 = 25.11 \text{ ¢/m}^3$

Calculate rate-driven change (after tax) using Paasche (current-year usage) method: $(\text{Normalized gas rate Yr 2} - \text{normalized gas rate Yr 1}) * \text{Usage in Yr 2} * (1 + \text{HST})$

$= (25.11 \text{ ¢/m}^3 - 25.49 \text{ ¢/m}^3) * 654 \text{ m}^3 * 1.13 = - \$ 0.0038 * 654 \text{ m}^3 * 1.13 = - \$ 2.8 \approx - \$ 3$

\$3 is the amount less paid solely due to gas rate drop, holding usage constant at Yr 2.

4) Usage-driven savings in gas bill: $(\text{Total gas bill reduction} - \text{rate-driven saving in gas supply \& federal carbon charge} - \text{removal of third-party charge}) = \$1125 - \$3 - \$320 = \$802$

Note: The change in a utility bill can be broken down into two components:

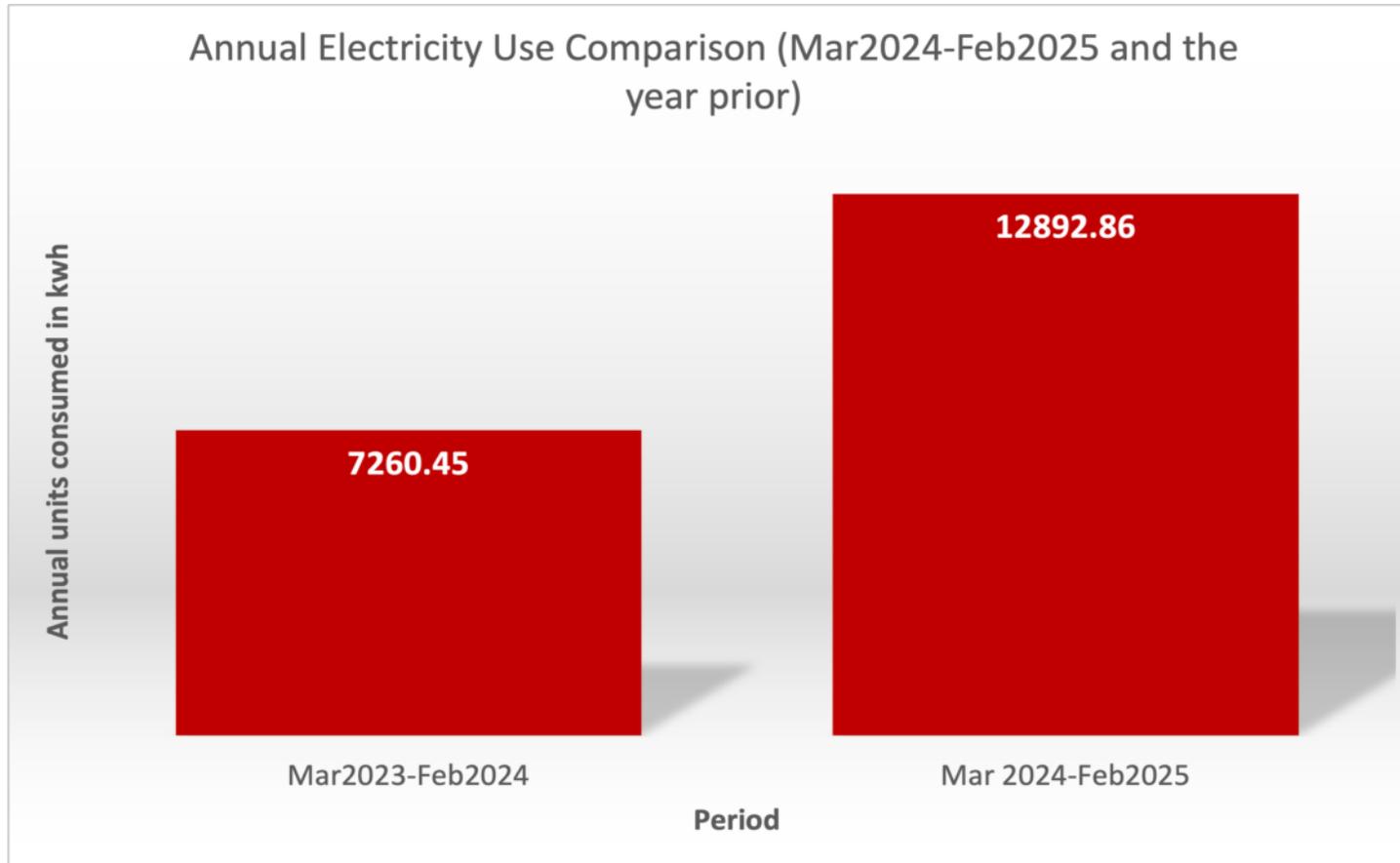
Change in utility cost = usage-driven change + rate-driven change

where Usage-driven change = $(\text{Usage Yr 2} - \text{Usage Yr 1}) * \text{Rate Yr 1}$

Rate-driven change = $(\text{Rate Yr 2} - \text{Rate Yr 1}) * \text{Usage Yr 2}$

5) Interpretation: A great portion of the savings in the gas bill (approx. \$802) were driven by lower gas use. The rest (approx. \$323) was due to minor rate-driven savings and the removal of third-party charges from Enbridge gas bill.

Appendix 3. Annual Electricity Use Comparison [Back to main body](#)

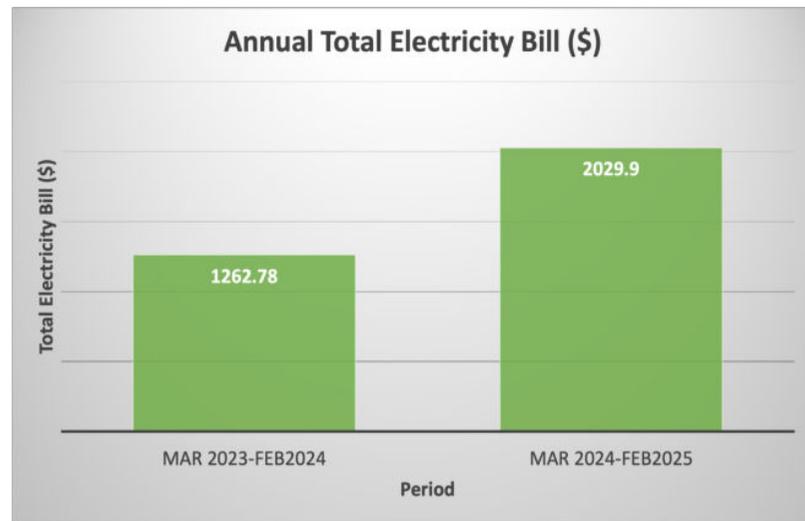


Source: Elizabeth's electricity provider, Alectra.

Annual change in electricity use: $12893\text{kWh} - 7260\text{kWh} = 5633\text{kWh}$

Annual change in electricity use (%): $(12893 - 7260) / 7260 \times 100\% = 77.58\%$ increase

Appendix 4. Annual Electricity Bill Change and Interpretation [Back to main body](#)



Source: Elizabeth's electricity provider, Alectra.

Annual increase in electricity bill: $\$2029.9 - \$1262.78 = \$767.12 \approx \767

To determine how much of the \$767 increase in electricity bill was attributed to usage, weighted time-of-use rates has to be calculated. Then the rate-driven increase in electricity charge can be determined. Increase in fixed charges and rate-driven increase in variable delivery charges are also calculated. Then, the usage-driven increase in electricity bill can be determined. Regulatory charges are excluded because of its minimal impact on the electricity bill. Paasche (current-year usage) method is applied.

1a) Weighted Time-of-Use (TOU) Rates:

Ontario households on TOU pricing pay different rates depending on when they use power: off-peak, mid-peak, and on-peak.

To compare fairly across years, a typical household blend is used (63% off-peak, 18% mid-peak, 19% on-peak). (Source: [OEB Regulated Price Plan](#), p.4).

Mar 2023-Oct 2023: Weighted average $\approx 9.2\text{¢/kWh}$ (7.4/ 10.2/ 15.1 ¢/kWh) (Off/Mid/On) (Source: [OEB historical electricity rates](#))

Nov 2023-Oct 2024: Weighted average $\approx 10.7\text{¢/kWh}$ (8.7/ 12.2/ 18.2 ¢/kWh) (Off/Mid/On) (Source: [OEB historical electricity rates](#))

Nov 2024-Feb 2025: Weighted average $\approx 10.0\text{¢/kWh}$ (7.6/ 12.2/ 15.8 ¢/kWh) (Off/Mid/On) (Source: [OEB historical electricity rates](#))

Appendix 4. Annual Electricity Bill Change and Interpretation [Back to main body](#)

1b) Blended rate within each period:

March–Oct 2023: 9.367 ¢/kWh Nov 2023–Oct 2024: 11.135¢/kWh Nov 2024–Feb 2025: 9.986 ¢/kWh

1c) Yearly weighted averages (Mar 2023-Feb 2024 and Mar 2024-Feb 2025)

Year 1 (8 months at 9.367 and 4 months at 11.135) = 9.96 ¢/kWh Year 2 (8 months at 11.135 and 4 months at 9.986) = 10.75 ¢/kWh

That is about an 0.8¢/kWh increase from year 1 to year 2.

1d) Weighted average of Ontario Electricity Rebate (OER)

OER: Mar 2023-Oct 2023 is 11.7%, Nov 2023-Oct 2024 is 19.3%, then Nov 2024 onwards OER is 13.1% (Source: [OEB newsroom 2022](#), [OEB newsroom 2023](#), [OEB newsroom 2024](#).)

Year 1 average OER is 14.23%. Year 2 average OER is 17.23%. Therefore, the mean of the two yearly OER average is 15.73%.

1e) Calculate rate-driven increase in electricity charge (pre-tax and pre-Ontario Electricity Rebate) using Paasche (current-year usage) method: (Yearly weighted average Yr2 - Yearly weighted average Yr1) * Usage of Yr 2 = (10.75¢/kWh - 9.96¢/kWh) * 12893 kWh = \$0.008 * 12893 kWh = \$103.14 ≈ \$103

Rate-driven increase in electricity bill (weighted average Ontario Electricity Rebate applied before applying HST):

[\$103*(1-0.157)] * 1.13 = \$98.11 ≈ \$98

\$98 is the additional amount paid solely due to higher electricity charge, holding usage constant at Yr 2.

2) Increase in fixed customer service charge and other fixed charges (part of delivery charge) from year 1 to year 2:

(\$33.48*10+\$34.35*2)- (\$31.59*12) = \$24.42 ≈ \$24 (Sources: [Alectra 2023](#), [Alectra 2024](#), [Alectra 2025](#))

3) Calculate rate-driven increase in variable delivery charge that scales with usage from year 1 to year 2 using Paasche (current-year usage) method:

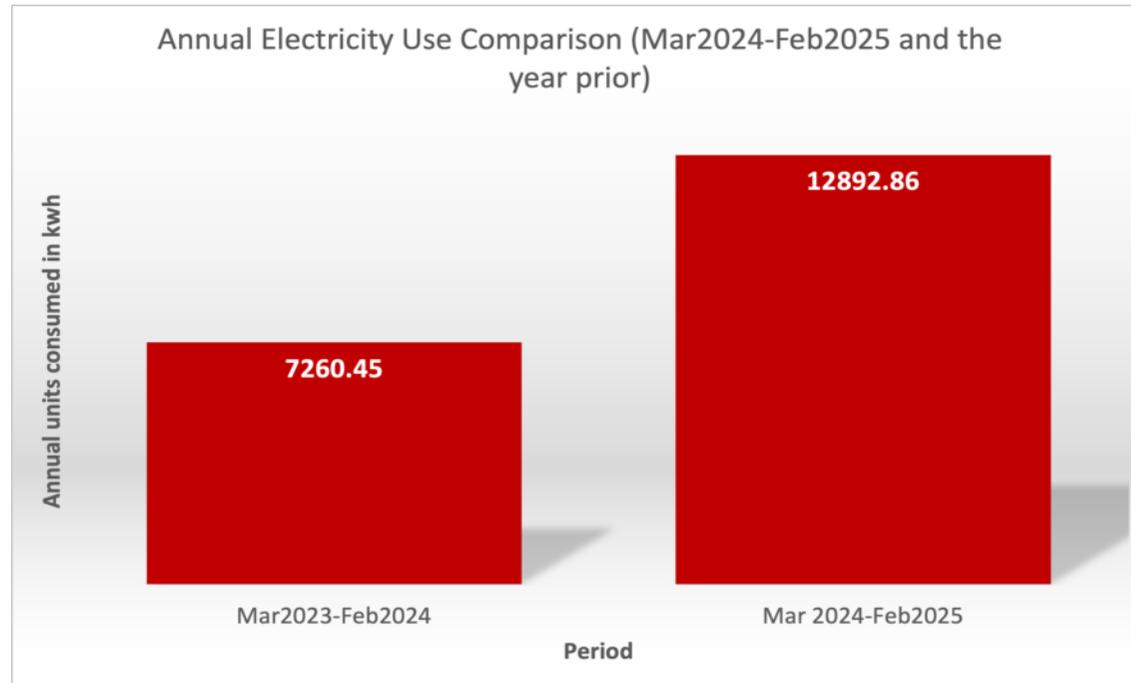
Year 1 average variable delivery rate: \$169.47/7260.45 kWh = \$0.0233/kWh. Year 2 average delivery rate: \$314.84/12892.86 = \$0.0244/kWh. (Sources: Elizabeth's Alectra bills)
(Average variable delivery rate Yr 2 - Average variable delivery rate Yr 1) * Usage Yr 2 = \$0.0011 * 12893 kWh = \$14.18 ≈ \$14

4) Usage-driven increase in electricity bill: (Total electricity bill reduction - rate-driven increase in electricity charge- increase in fixed charges -rate-driven increase in variable delivery charges)
= \$767-\$98-\$24 - \$14 = 631

Note: For the formula used to calculate the change in utility cost, see Appendix 2.

5) Interpretation: Most (\$631) of the \$767 annual increase in electricity bill is usage-driven. The net usage-driven effect (\$631 electricity increase minus \$802 gas reduction) yields a total reduction of \$171.

Appendix 5. Electricity Use and Carbon Dioxide Emission Changes [Back to main body](#)



Source: Elizabeth’s electricity provider, Alectra.

Electricity use annual increase: $12893\text{kWh} - 7260\text{kWh} = 5633\text{kWh}$

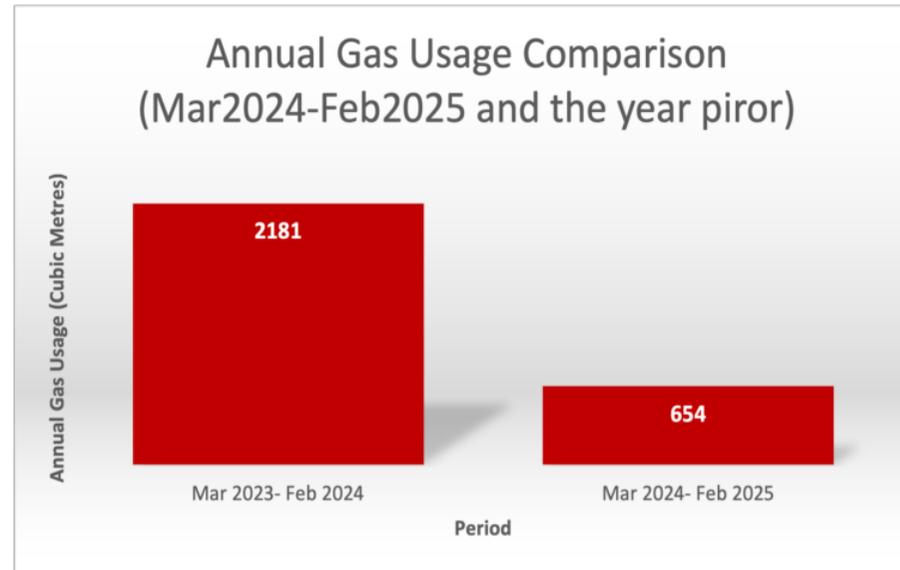
Generation & Consumption intensity in Ontario is 58g of carbon dioxide (CO₂) equivalent per kWh ([Environment and Climate change Canada, 2023, p.67](#))

CO₂ (g) equivalent per 5632.41kWh:

$5633\text{ kWh} \times 58\text{g} = 326,714\text{ g of CO}_2\text{ equivalent} = 0.33\text{ metric tons of CO}_2\text{ equivalent}$

Therefore, increased electricity use (Mar 2024- Feb 2025) compared to the year prior resulted in an increase of 0.33 metric tons of CO₂ equivalent.

Appendix 6. Gas Use and Carbon Dioxide Emission Changes [Back to main body](#)



Source: Elizabeth's gas provider, Enbridge.

Gas use annual reduction:

$$2181 - 654 = 1527 \text{ cubic meters (m}^3\text{)}$$

CO₂ emission factors for natural gas in Ontario is 4322 g CO₂/ m³ natural gas (marketable & non-marketable) (Source: [Environment and Climate Change Canada, 2024](#), p.3)

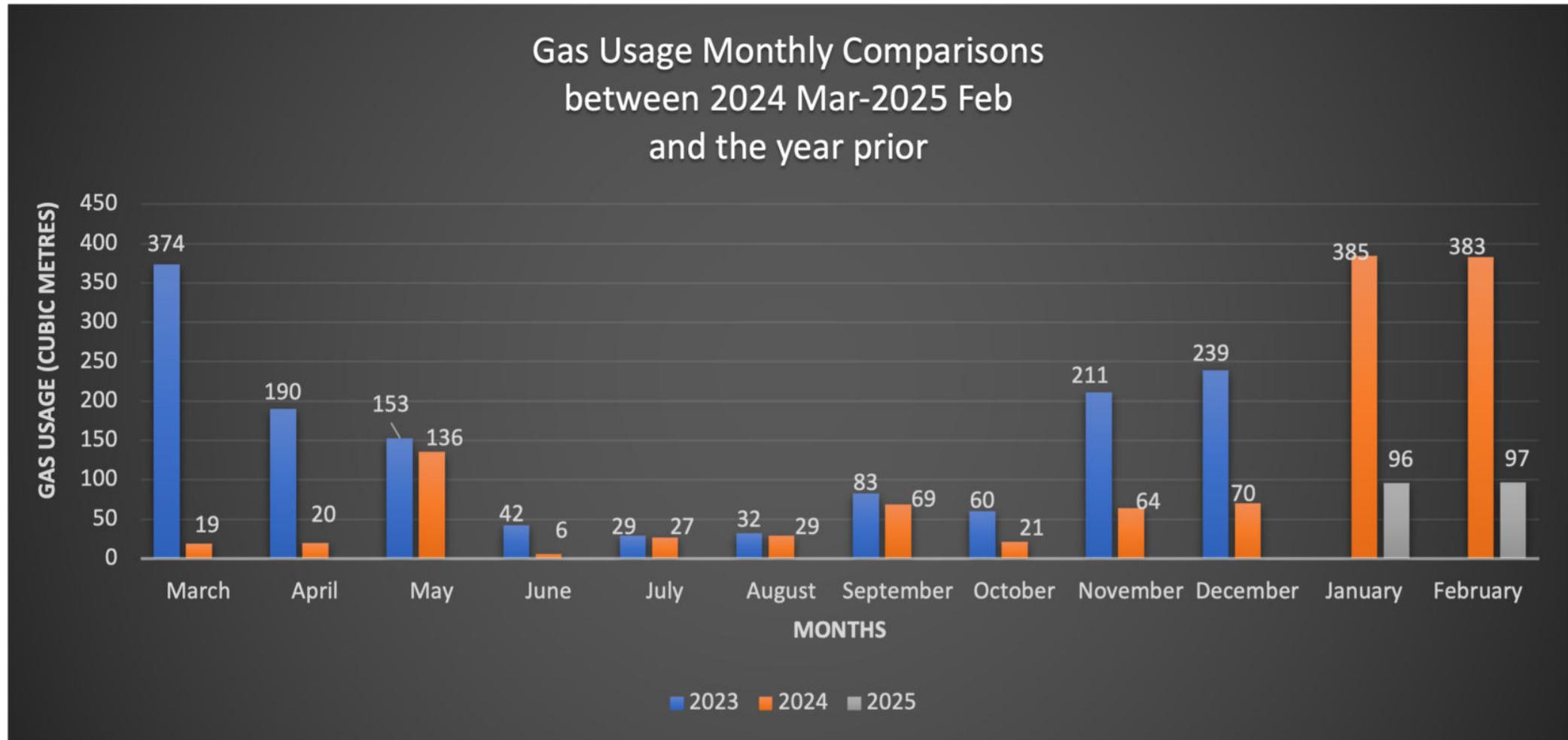
CO₂ (g) per 1527 m³ of natural gas:

$$1527 \text{ m}^3 \times 4322 \text{ g CO}_2 = 6,599,694 \text{ g of CO}_2 = 6.6 \text{ metric tons of CO}_2$$

Therefore, there is an emission reduction of 6.6 metric tons of CO₂ due to lower gas use; while there is an emission increase of 0.33 metric tons of CO₂ equivalent due to higher electricity use (Appendix 5).

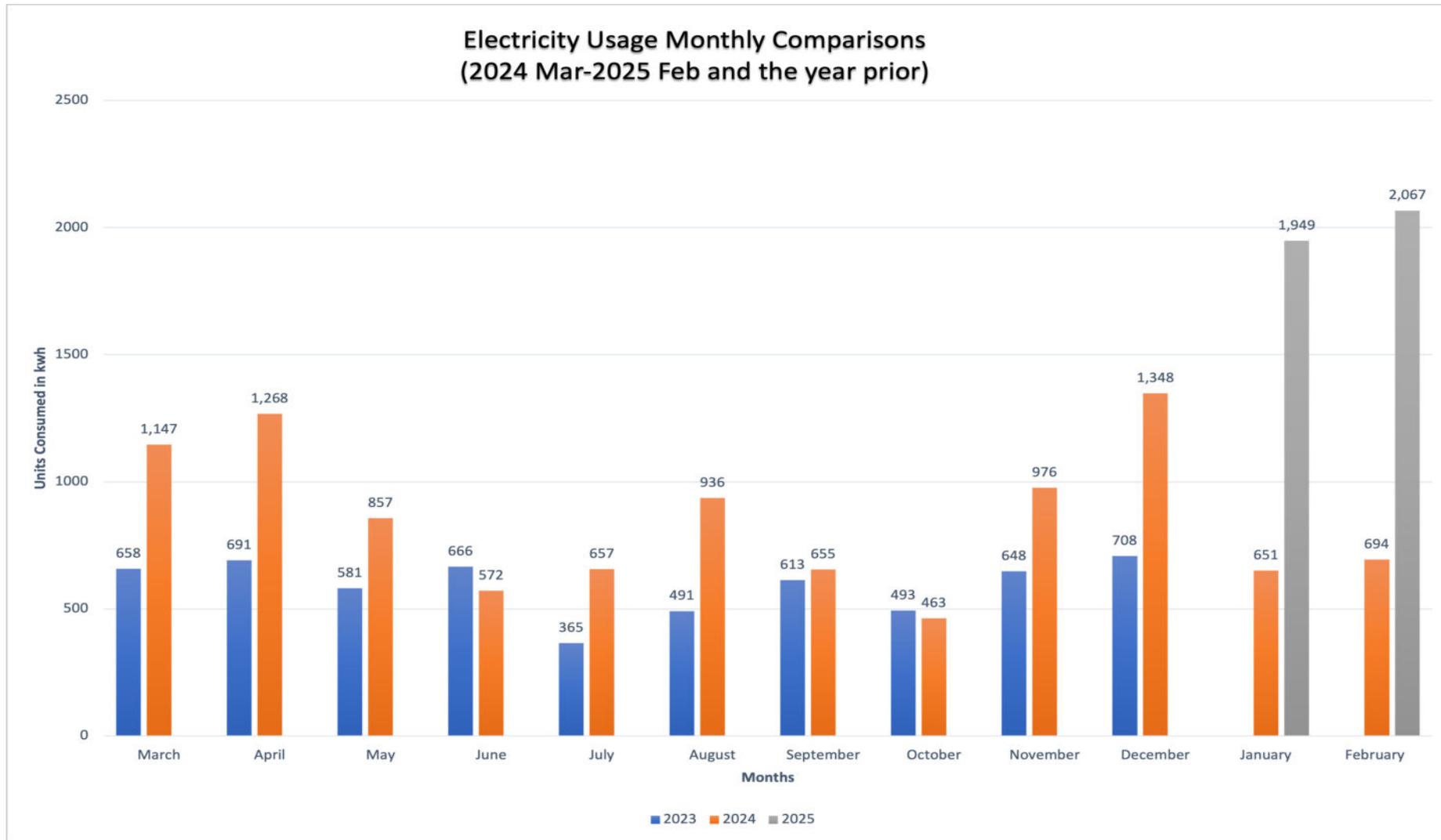
Net CO₂ equivalent emission reduction (Mar 2024- Feb 2025) compared to the year prior (metric tons):

$$6.6 - 0.33 = 6.27 \text{ metric tons of CO}_2 \text{ equivalent}$$



Source: Elizabeth's gas provider, Enbridge.

Appendix 8. Monthly Electricity Use Comparisons [Back](#)



Source: Elizabeth's electricity provider, Alectra.

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