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BUILDING EMISSIONS:
TOWARDS NET ZERO

To achieve net-zero emissions, it isn't enough to reduce buildings sector carbon emissions; they must be eliminated completely. The only way to achieve that is by focusing on fuel switching — moving away from natural gas for space and water heating, and instead switching to electric heating.

BUILDING EMISSIONS

Canada has a cold climate, so it comes as no surprise that one-tenth of all emissions nationwide are the result of heating Canadian homes and workplaces. In 2018, residential, commercial, and institutional space heating accounted for 73 Mt of CO2e emissions[1].

Province-wide, Ontario's transportation sector creates more carbon emissions than any other sector but, within major cities buildings account for most emissions. In Toronto, for example, buildings emit 57 percent of the city's total carbon emissions, compared to 36 percent from transportation, and seven percent from waste[2].

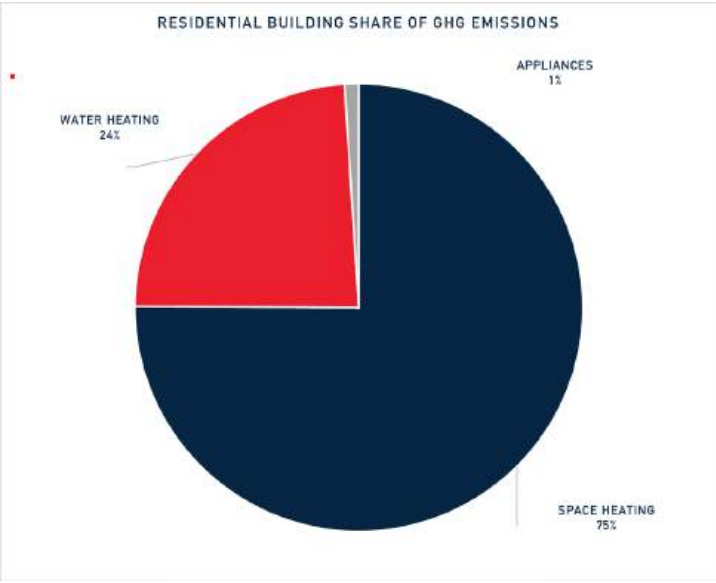
This larger share for building emissions reflects two key factors: first, the city has higher population density and more commercial and institutional buildings; and second, greater access to less carbon intensive forms of transportation like public transit, cycling, and walking. While tackling transportation emissions through electrification and investment in public transit should be a top priority across the province, it is easy to understand why cities may also place a great priority on building emissions.

Ontario's building sector, where emissions are almost entirely from space heating (i.e., heating homes and buildings) and water heating, accounted for 22 percent of total emissions province-wide in 2019. These emissions were split evenly between residential and commercial/institutional buildings. This latter category is comprised primarily of offices, schools, hospitals, and retail stores. Residential space heating accounted for approximately 10 percent of the province's total emissions in 2019, representing 15.8 Mt out of the province's total 163.2 Mt CO2e. Commercial/institutional space heating accounted for an additional 10.9 Mt.

In both the residential and commercial sectors, space heating accounts for the majority of GHG emissions from buildings nationwide. In the residential sector, space heating accounts for over two-thirds of total emissions.

TACKLING BUILDING EMISSIONS: SPACE AND WATER HEATING

When electricity is excluded from building sector emissions, the targets for reduction become very clear. Tackling building-sector carbon emissions requires focusing on only two areas that combine for 99 percent of residential building emissions – space heating and water heating.

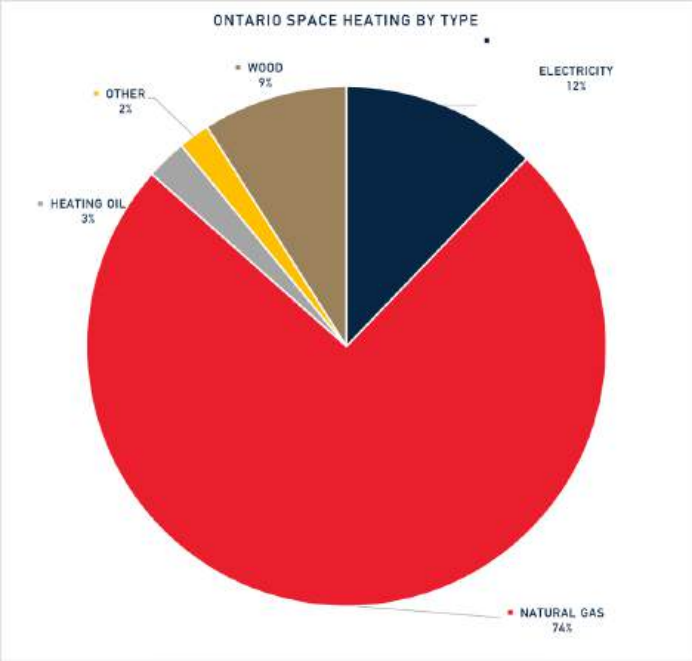


Individual conservation actions, like taking shorter showers or using cold water for laundry cycles, are important ways everyone can contribute to reducing the carbon footprint of water heating. However, the most significant way to reduce emissions from water heating is through fuel switching. Replacing our fossil fuel-based water heaters with emission-free forms of water heating like solar water heaters, heat pump water heaters, or tankless electric water heaters.

Natural gas, which has long been Ontario's most common heating fuel, has picked up an even greater share of the market over the last 20 years. As gas prices dropped over the last two decades, and higher efficiency gas furnaces became available, the province saw a shift towards greater

1 https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ca&rn=2&page=3
2 https://www.toronto.ca/services-payments/water-environment/environmentally-friendly-city-initiatives/transforMto/torontos-greenhouse-gas-inventory/

reliance on natural gas for home heating. From 2000 to 2018, the share of natural gas heating systems increased from 65 percent to 74.3 percent[3]. This is largely due to a shift from heating oil, which dropped from approximately 8.5 percent in 2000 to 2.5 percent in 2018. Compare this to Quebec, where 53 percent of space heating is powered by electricity, and only 7.2 percent by natural gas, and it becomes apparent that electrifying home heating is entirely possible in cold climates.

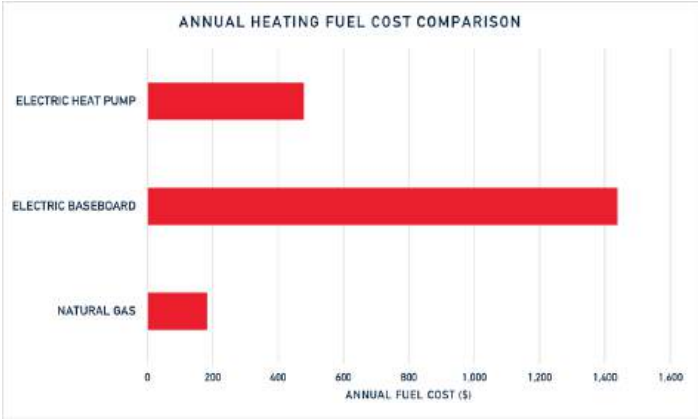


GAS HEATING VS ELECTRIC

In 2018, Ontario used a total of 297.4 petajoules (PJ) of natural gas for home heating[4]. One petajoule is the equivalent of one million gigajoules (GJ), or one billion megajoules (MJ). Natural gas bills normally account for gas usage in cubic metres (m3). When we talk about heating our homes, we are converting these energy sources to heat, which is measured in joules.

The amount of heat captured from the energy depends on the efficiency of the heating system. Electric baseboard heating converts 100 percent of the energy used to heat, while a high-efficiency 95 percent gas furnace will convert 95 percent of the energy used to heat. One cubic metre (m3) of natural gas produces 37.5 MJ of energy, so a 95 percent efficiency furnace would provide 35.6 MJ of heat to your home per m3 of natural gas used. By comparison, 1 kWh of electricity generates 3.6 MJ of heat[5]. In 2018, Ontario used a total of 297.4 petajoules (PJ) of natural gas for home heating. If Ontario were to replace all the heat generated by natural gas with electric baseboard heating, it would require approximately 83 TWh of additional electricity generation per year – more than three times the electricity generated at the Pickering Nuclear Generating Station per year.

Replacing gas furnaces with electric baseboard heating simply isn't an economical option for most Ontarians. As mentioned, one m3 of natural gas produces 35.6 MJ of heat using a 95 percent efficiency furnace, while 1 kWh of electricity produces 3.6 MJ of heat, almost 10 percent of the heat generated by one m3 of natural gas. But at current OEB regulated prices, one m3 of natural gas costs $0.145, while one kWh of electricity (assuming tiered pricing at the higher rate) costs $0.115, meaning it would cost 8 times as much to produce the same amount of heat with electric baseboard heating.



Fortunately, there are more cost-effective ways to heat a home with electricity. Electric heat pumps work by taking heat out of the air (air source heat pump) or ground (ground source heat pump), and pumping it into a home. Unlike furnaces, which are rated by efficiency based on the amount of heat retained, heat

3 https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=on&rn=5&page=0
4 https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=on&rn=5&page=0
5 https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/pdf/publications/Heating_with_Electricity.pdf

pump efficiency is measured by something called the Coefficient of Performance (COP). The COP measures the ratio between how many kWh of heat is pumped into the home and how many kWh of electricity is used to pump it. In Canada, air source heat pumps have a minimum requirement that works out to a COP of roughly 2.1[6], meaning that for every 1 kWh of electricity used, it pumps 2.1 kWh of heat into your home. Air source heat pumps can range from a COP of 2.1 up to approximately 3.9. Assuming a COP of 3.0, every kWh of electricity would generate 10.8 MJ of heat, meaning it would cost 2.6 times as much to heat your home with an air source heat pump compared to a 95 percent efficiency gas furnace. In this case, electric heating is still more expensive than natural gas, but it is important to point out that heat pumps not only heat homes in the winter, they also cool homes in the summer. Depending on the SEER rating of the heat pump, it may be more efficient than a traditional air conditioner, helping bring energy costs down in the summer.

If all of the heat generated by natural gas in Ontario was instead generated with heat pumps averaging 3.0 COP, Ontario would need approximately 27 TWh more electricity generated each year – more than what the Pickering Nuclear Generation Station currently produces.

Ontario needs to replace natural gas with electric heating to meet federal and provincial climate action commitments, which means, as it does for transportation, that the province needs to start building new electricity generation to meet the demand to come. To have meaningful emissions reductions from fuel switching, Ontario needs to ensure it is not powering the shift to electrified home heating by using GHG-intensive natural gas. Any new electricity generation must be from clean, carbon-free forms of electricity, including nuclear, hydro, and renewables.

The preference for natural gas heating in Ontario is primarily economic, due to the significant cost differential between electricity rates and natural gas prices. This differential has been artificially inflated for decades, as the lack of carbon pricing hid the true cost of natural gas. With a carbon pricing regime now in place, and set to increase over the next decade, the external costs of natural gas will begin to be reflected in the price and will close the price gap between natural gas and electricity rates.

A PLAN TO CUT BUILDING EMISSIONS

A plan to reduce carbon emissions from the buildings sector already exists. In December 2016, the Pan-Canadian Framework on Clean Growth and Climate Change was released by the federal and provincial governments. The framework called for a plan to make new buildings more energy efficient through new building codes, support for retrofitting existing buildings, improved energy efficiency standards for appliances, and support energy-efficient housing in Indigenous communities.

In its 2021 budget, the federal government introduced the Canada Greener Homes Grant, which provides up to $5,000 for home retrofits to improve energy efficiency. Home energy retrofits can go a long way to reducing the energy needed to heat homes, which reduces our carbon footprint and saves money on energy bills.

However, to achieve net-zero emissions, isn't enough to reduce buildings sector carbon emissions; they must be eliminated completely. The only way to achieve that is by focusing on fuel switching — moving away from natural gas for space and water heating, and instead switching to electric heating.

The cost of replacing an existing heating unit, particularly one that is not yet at the end of its lifecycle, with an efficient low-carbon unit, is cost prohibitive. The previously mentioned Canada Greener Homes Grant will provide $5,000 for the installation of a ground source heat pump or a cold climate air source heat pump. However, these systems can cost between $14,000 and $40,000[7]. Even

6 https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817

7 https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2019/market-snapshot-growing-heat-pump-adoption-how-does-technology-work.html

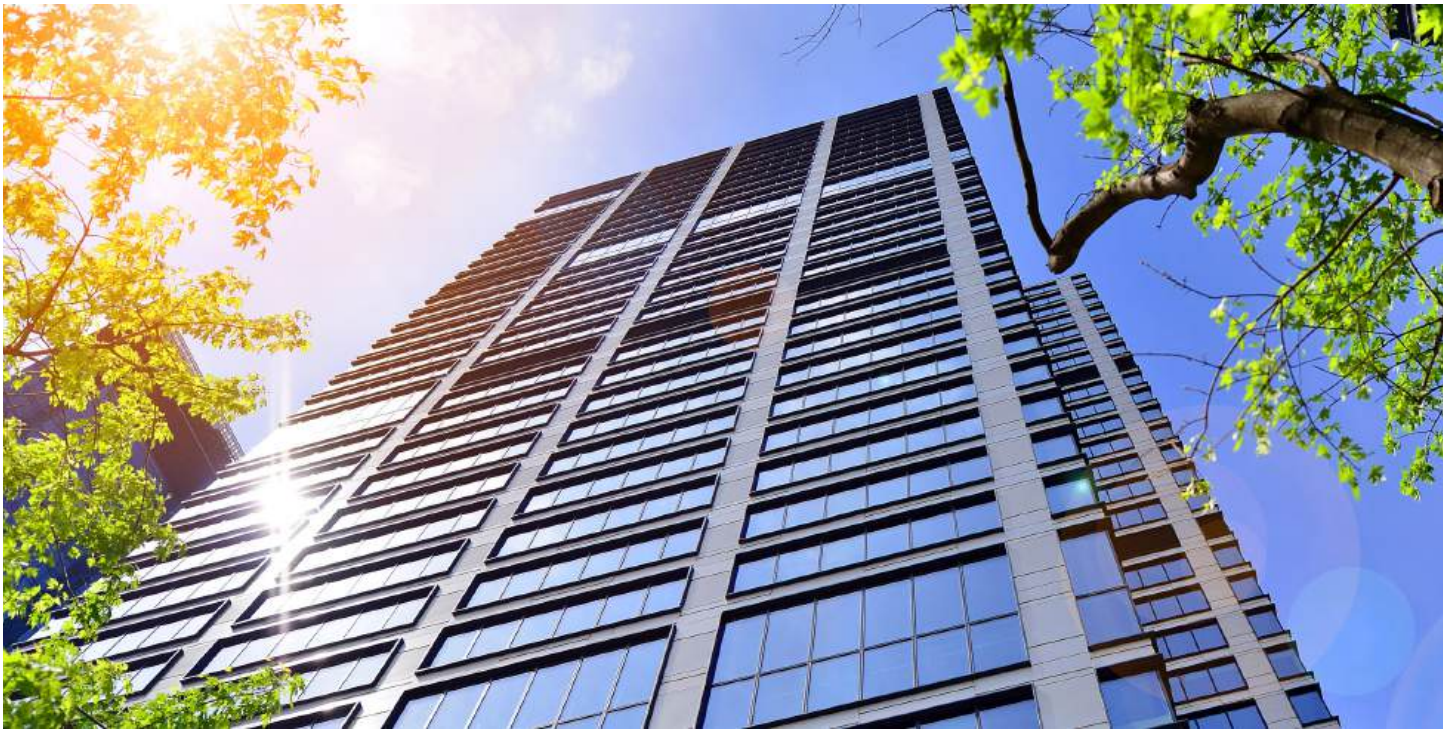
with the long-term energy cost savings, the upfront cost remains prohibitive to all but the most motivated and affluent homeowners.

To encourage investment in fuel switching, the province should look to replicate the City of Toronto's Energy Retrofit Loan program across the province. The Energy Retrofit Loan[8] program provides financing to homeowners for 100 percent of the total project cost at the City's rate of borrowing, with payment terms of up to 20 years. Adopting a similar program province-wide would allow homeowners across Ontario to finance major fuel switching projects while repaying the loan over time primarily through savings in energy costs.

Additionally, the province should commit to matching the total eligible amount provided under the Canada Greener Homes Grant. A matching program would increase the amount available to Ontarians looking to undertake energy retrofits and fuel switching from $5,000 to $10,000.

Finally, it is important to remember that to reduce carbon emissions through fuel switching, the electricity powering the switch needs to be generated by a clean energy grid. This is a point a recent Senate of Canada report on reducing building emissions highlighted.[9] Any significant shift towards electric space and water heating will require significant new electricity generation – replacing all gas furnaces with high efficiency heat pumps would require more new electricity generation than the Pickering Nuclear Station generates on an annual basis, for example. We need to ensure this power is generated through clean sources of electricity, like hydro, nuclear, and renewable energy.

A switch to clean electric heating in our buildings is not only possible, but also necessary to reach net-zero carbon emissions. ■



8 https://www.toronto.ca/services-payments/water-environment/environmental-grants-incentives/energy-retrofit-loans/
9 https://sencanada.ca/content/sen/committee/421/ENEV/reports/ENEV_Buildings_FINAL_e.pdf

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