ENERGY EMISSIONS AND COST COMPARISON FOR HVAC SYSTEMS

Canada's 2030 Emissions Reduction Plan outlines a path for the building sector to achieve a 40% reduction in greenhouse gas emissions (GHG) by 2030. This has spurred organizations across the country to set their own net-zero targets and develop plans to meet their reduction goals.

Ontario has a clean electricity system, so **electrifying HVAC systems** — which typically account for about 50% of building energy consumption — is an effective way to advance climate change goals. Heat pump technology is at the forefront of this shift, with the potential to improve operating efficiency by a factor of two or more compared to conventional heating systems. Their high efficiency enables heat pumps to be cost-competitive with more carbon-intensive natural gas systems in the long-term. Despite the numerous benefits associated with adopting heat pumps, it is important to note that we have identified certain barriers to their widespread adoption. The following outlines benefits of embracing this technology.

BENEFITS

Electrification of heating end uses will yield large emissions reductions

Technologies exist today to electrify most end uses:

- Air-, ground- and water-source heat pumps
- Solar-thermal boilers

Heat pumps are up to five times more efficient than conventional systems, and the technology continues to improve

Economics of heat pumps are improving rapidly

BARRIERS

- Initial cost of heat pumps is still a barrier in retrofit scenarios (but prices are coming down)
- The cost difference between heating with gas and electricity is still large. Gas prices remain low and GHG pricing policies may take until 2030 to reach operating cost parity with heat pumps in Ontario.
- Design and installation can be more complex than conventional systems

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HEATING SYSTEM COMPARISON: OPERATING COSTS AND EMISSIONS

	Natural Gas Furnace	Electric Resistance	Heat Pump
System Efficiency	80%–98%	~100%	2.5–5.0 COP (250%–500%)
Average Heating Energy Cost	$0.27/m^3	$0.14/kWh	$0.14/kWh
Energy Cost – Equivalent Units	$0.04/kWh increasing annually to $0.06/kWh by 2030	$0.14/kWh	$0.03–$0.06/kWh
Emissions	1921 gCO_2e/m^3	30 gCO_2e/kWh	30 gCO_2e/kWh
Emissions – Equivalent Units	182 gCO_2e/kWh	30 gCO_2e/kWh	30 gCO_2e/kWh
Emissions Intensity For $ Spent On Heating	4550 gCO_2e/$ spent	214 gCO_2e/$ spent	42–85 gCO_2e/$ spent

Electrifying HVAC systems in existing buildings is a major undertaking, and there is no one-size-fits-all approach. Finding a solution that meets **your** specific environmental policy, technical and financial requirements may require long-term planning and multiple scenario analyses. Investing in planning and life-cycle analysis will result in systems that meet your specific needs.

THINGS TO CONSIDER WHEN PLANNING:

- **Energy efficiency** as a first step eliminates waste and supports your business case
- **Operating scenarios**: fully electric, hybrid systems, electrification of legacy systems
- **Capital costs**: design, equipment, integration with existing systems, control schemes
- **Operational costs** over the life cycle of equipment, including energy, maintenance, and carbon pricing