Heat pumps pay off: Unlocking lower-cost heating and cooling in Canada

Technical Memo

Updated February 2024

Table of contents

1. Introduction

This report describes the methodologies and assumptions used to calculate the cost-competitiveness of different heating and cooling systems for households across Canada, as presented in *Heat pumps pay off: Unlocking lower-cost Heating and Cooling in Canada* as well as the accompanying home heating and cooling cost calculator.

This study analyzes different combinations of jurisdictions, building archetypes, and vintages, including:

- **Five Canadian cities** (Vancouver, Edmonton, Toronto, Montréal, and Halifax)
- **Four residential building archetypes** (single-detached house, rowhouse, multi-unit residence buildings (MURB) with in-unit HVAC systems, and MURB with central HVAC systems).
- **Three vintages** (1940, 1980, and 2023 (new construction))

The Canadian Climate Institute partnered with Dunsky Energy + Climate Advisors to realize this work.

2. Methodology

Using Dunsky's Heating Energy Decarbonization Model (HEAT™) Model, populated with up-to-date heating equipment and efficiency costing data as well as projected energy pricing data from major Canadian jurisdictions, we assessed the installation cost, average annual energy costs, and the available incentives and carbon price impacts of various gas and electric heat pump configurations.

2.1 Dunsky's HEAT™ Model

Dunsky's proprietary **heating decarbonization model (HEAT™)** was developed from the ground up to reflect the unique characteristics of cold-climate regions. HEAT™ comes built-in with thousands of heat pump measures, including all technologies (ductless, ducted, or hydronic; including ASHPs and GSHPs), and models how they perform in any configuration (hybrid-heating or peak-optimized all-electric). The model brings a sophisticated approach to assessing how state-of-the-art heat pump technologies perform – and can perform in the future – in any jurisdiction.

By combining sophisticated, hourly heat pump system performance modelling with a realistic and granular assessment of customer decision triggers and a comprehensive catalogue of technology specs, HEAT™ provides accurate adoption forecasts that are highly specific to the local context.

Paired with Dunsky's in-depth knowledge of heating decarbonization options, costs, strategic insights, and clear reporting, HEAT™ empowers our clients to make and defend informed decisions about their clean heat programs, policies, and strategies. It has been used across Canada and the U.S. to forecast heat pump adoption based on multiple scenarios and sensitivities; assess the potential for fuel switching as part of market potential studies; obtain highly accurate load impact assessments for electric utilities; and assess the level of market intervention necessary to reach efficiency, peak demand and/or climate objectives.

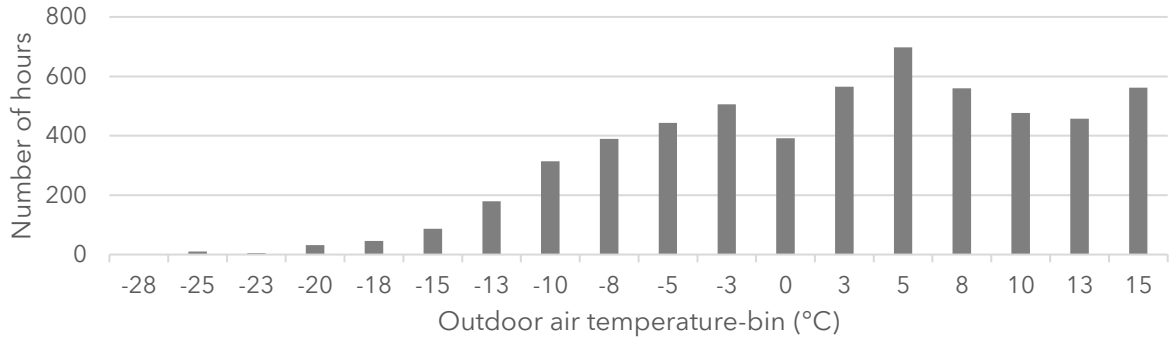
2.1.1 HEAT's Simulated Energy Performance

HEAT™ applies granular climate-specific HP performance, by accounting for hourly variation in outdoor air temperature (OAT), using weather files specific to each jurisdiction. It provides a highly accurate assessment of heat pump energy and hourly demand impacts by estimating heat pump capacity and performance as a function of OAT. By using location-specific, 8,760 hourly climate data and heat pump performance curves, HEAT™ provides a much more precise assessment of heat pump performance than the commonly used Heating Seasonal Performance Factor (HSPF) or Coefficient of Performance (COP).

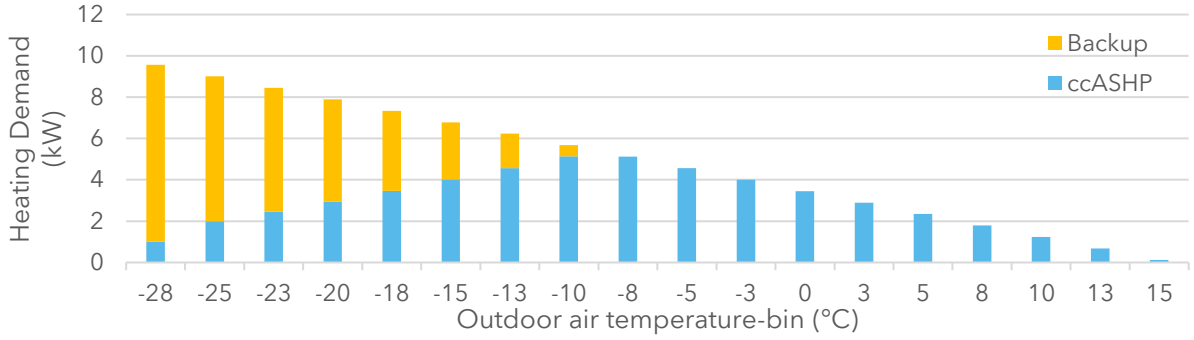
Illustrative Example

As an example, the following figures showcase the 8,760 hours for Montréal (future-looking weather represented here, refer to section 3.1.1).

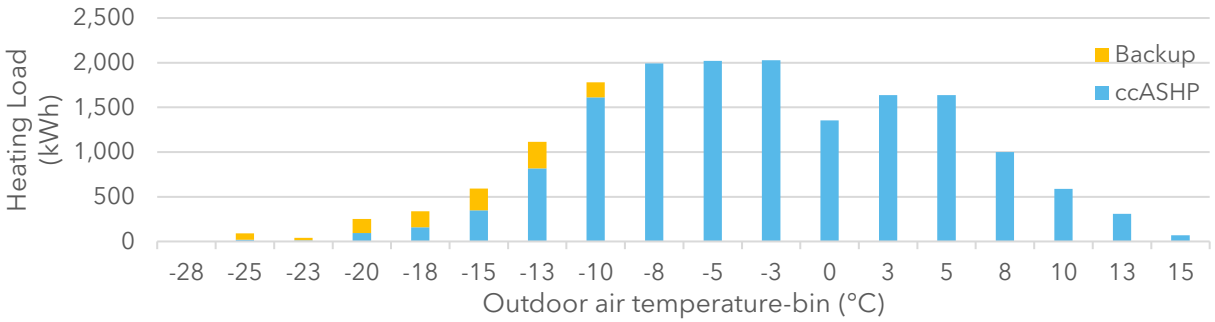
Note: hours are grouped into temperature bins for visualization and illustrative purposes, however, HEAT's analysis is conducted on the full 8760 hourly data.



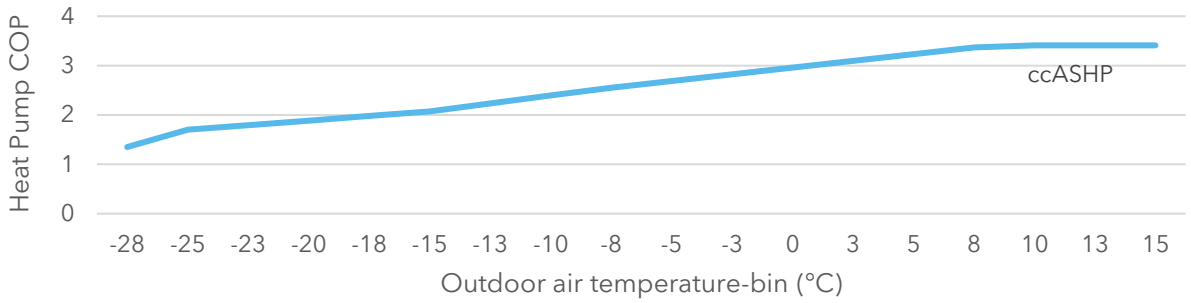
The building's heating demand is proportional to outdoor air temperature, and the figure below highlights a typical cold climate air-source heat pump (ccASHP) capacity, which varies according to outdoor air temperature. Under the sizing temperature of -8.3°C, the heat pump is not sized to cover the full heating load, and a backup heating source is required. However, the cold-climate heat pump can continue operating along with the back-up down to temperatures of approximately -28°C.



Multiplying the heating demand by the number of hours above for each temperature-bin, the following heating load profile is determined, where the heat pump, sized at the building's peak heating demand at -8.3°C, is able to meet around 94% of the annual heating load.



Finally, the ASHP's COP is calculated for each temperature using Dunsky's library of heat pump performance curves.



For the above **illustrative example**, the heat pump covers around 94% of the annual heating load with a calculated average seasonal COP of 2.8 for the heat pump itself - or 2.5 when including the 6% of the annual load for which the electric resistance backup is used.

Refer to Table 5 under section 3.3.3 Equipment Performance for calculated seasonal performance results according to the present study's archetypes and parameters.

Automated Sizing and Costing in HEAT

As heat pumps lose some capacity as outdoor temperatures drop, sizing strategies aim to determine the right balance to leverage the heat pump's high efficiency while limiting costly oversizing. The optimal sizing strategies can differ between partial (dual fuel/hybrid) and full (all electric) replacements, where the backup heating equipment can have various installation and energy cost considerations. HEAT automatically sizes all heating equipment based on each building's heating load, local climate data, and the specific sizing strategy (refer to section 3.3.2).

HEAT then computes all equipment costs through a cost versus capacity regression analysis for heat pumps (and furnaces and air conditioning units, where applicable). The regression allows the capital costs to be adjusted based on the sizing required for each specific case.

2.1.2 Economics Approach

Lifetime costs are presented as **average annual costs**, which include a range of costs averaged over the lifetimes of different technologies. This metric allows for a clear comparison of technologies with different up-front costs, operating costs, and life spans.

All **non-incentivized upfront costs can be financed** in the calculator (on/off toggle) at a varying interest rate, starting at 7% and slightly decreasing to 5.5% over a 10-year amortization period.

Rates forecasts are applied to each configuration's energy use, as detailed in section 3.4.

3. Inputs

This section provides details on the specific inputs used in this study.

3.1 Jurisdictions

3.1.1 Climate data

The analysis includes five Canadian cities:

- **Vancouver**, British Columbia
- **Edmonton**, Alberta
- **Toronto**, Ontario
- **Montréal**, Québec
- **Halifax**, Nova Scotia

As explained in section 2.1 Dunsky's HEAT™ Model above, the HEAT™ model requires hourly outdoor air temperatures for every modelled jurisdiction. Instead of backward-looking climate files (such as CWEC), the CCI decided to use "Future-shifted" climate files. The future-shifted climate files represent the **expected climate in the year 2035**, and were obtained by interpolating between the 2020 and 2050 weather files available from the Pacific Climate Impacts Consortium.[1] It should be noted that while a future-looking climate file is used, it does not change over the lifespan of the equipment.

Canadian Weather Year for Energy Calculation (CWEC)

"564 datasets created by joining twelve Typical Meteorological Months selected from a database of up to 30 years of CWEEDS hourly data. The months are chosen by statistically comparing individual monthly means with long-term monthly means for daily total global radiation, mean, minimum and maximum dry bulb temperature, mean, minimum and maximum dew point temperature, and mean and maximum wind speed." [2]

3.1.2 Energy and Carbon Pricing Forecasts

The Canadian Climate Institute provided Dunsky with energy price projections for both gas and electricity, each of which varies based on jurisdiction.

Forecasts for each jurisdiction are provided in section 3.4 below.

3.1.3 Available Heat Pump Incentives

The scope of this analysis considers select federal, provincial and municipal incentives which were available and accepting applications at the time the analysis was conducted.

[1] Pacific Climate Impacts Consortium. (2022). Weather files, version 2.2.

[2] Environment Canada. Engineering Climate Datasets.

Federal Incentives: Greener Homes Grant

The federal government's Greener Homes Grant provides incentives for ducted and ductless ASHPs (both standard and cold climate), as shown in Table 1.

Table 1. Federal Greener Homes Grants[3]

Primary Heating System	Greener Homes Grant
Ducted ASHP (with either gas or electric backup)	$4,000
Cold Climate Ducted ASHP	$5,000
Ductless ASHP	$2,500
Cold Climate Ductless ASHP	$2,500

For this analysis, the Greener Homes Grant is not applied to multi-unit residence buildings (MURBS), as renters are not eligible for them.[4,5] Similarly, the Greener Homes Grant does not apply to new construction and is omitted from the 2023 vintage.

Further, for the following jurisdictions considered in this analysis, the Greener Homes Grant is co-delivered with a program administrator within the jurisdiction:

- Nova Scotia (program is co-delivered by Efficiency Nova Scotia)
- Québec (program is co-delivered by the Québec government)
- Ontario (program is co-delivered by Enbridge)

In these jurisdictions, the program administrator may apply their own eligibility criteria. Specifically, in Nova Scotia and Québec, only cold-climate heat pumps are eligible for the Greener Homes Grant.[6,7] See Appendix A for a detailed table highlighting the Greener Homes Grant amount applied in each jurisdiction for the various building archetypes, vintages, and equipment configurations considered (which are further detailed in the subsequent sections).

[3] Government of Canada. (2024). Eligible retrofits and grant amounts.

[4] Government of Canada. (2024). Check your eligibility for the Canada Greener Homes Grant.

[5] Note: As the CCI wanted MURBS to show the perspective of low-income housing, we assume that all units are rented rather than owned.

[6] Efficiency Nova Scotia. (2023). Home Energy Assessment Rebate Guide.

[7] MELCCFP, Transition énergétique Québec. (2023). Rénoclimat.

Provincial and Municipal Incentives

In addition to the Federal Greener Homes Grant, this analysis also considered provincial and municipal incentives. As mentioned previously, only incentive programs accepting applications at the time of analysis were considered. Due to this, some provincial and municipal incentives which are currently over-subscribed and not accepting applications were not included. The incentive programs considered for each jurisdiction are summarized in Table 2.

A more detailed summary of incentive amounts and eligibility according to the various building archetype, vintage, and equipment configurations considered is included in Appendix B. Note that as per program requirements, the total incentive applied (including federal, provincial, and municipal incentives) was not allowed to exceed the invoiced amount of the upgrade.

It should also be noted that the analysis does not consider income-qualified programs. However, several of the jurisdictions assessed offer specific programs for low-income customers. These are summarized in Appendix C.

Table 2. Examples of incentives provided by provinces and municipalities and included in the model are listed below.

Jurisdiction	Incentive Program
Vancouver[8,9,10]	CleanBC Better Homes and Home Renovation Rebate Program • Dual Fuel Ducted Heat Pump Rebate • Ducted Heat Pump Rebate • Electrical Service Upgrade Rebate
Edmonton[11]	N/A
Toronto[12,13]	Enbridge • Savings by Design Residential Program • Affordable Housing Multi-Residential Program

[8] The City of Vancouver Heat Pump Top-Up program, which offers $4,000 to CleanBC Better Homes and Home Renovation Rebate Program participants, was excluded because it was fully subscribed as of summer 2023.

[9] CleanBC previously offered a Better Homes New Construction Program, but this program is closed as of January 1st, 2024.

[10] FortisBC previously offered a Natural Gas Furnace Rebate, but this rebate is no longer available as of January 1st, 2024.

[11] The city of Edmonton's Home Energy Retrofit Accelerator (HERA) and Building Energy Retrofit Accelerator (BERA) programs have been fully subscribed since November 2022 and June 2023, respectively.

[12] Enbridge offers a Hybrid Heating rebate for homeowners in other parts of Ontario, but not in Toronto. Enbridge provides the hybrid heating rebate in Ajax, Barrie, Pickering, Whitby, Sault Ste. Marie, St. Catharines, Peterborough, and London: homeowners in these regions can receive up to $4,500 for installing a hybrid heating system through the Clean Home Heating Initiative, funded by the Ontario Government.

[13] Enbridge previously offered a Home Efficiency Rebate (HER) program, which offered incentives for replacement gas furnaces, as well as top-up incentives for heat pumps receiving incentives through the Greener Homes Grant (administered by Enbridge in Ontario). However, as of January 19th, 2024 the HER program is no longer accepting applications, therefore these rebates were not included in the analysis.

Jurisdiction	Incentive Program
	• Affordable Housing Multi-Residential New Construction Program City of Toronto • Home Energy Loan Program (HELP) Incentives
Montréal	Québec government • Rénoclimat Program Hydro-Québec • Programme Solutions Efficaces • Programme LogisVert
Halifax	Efficiency Nova Scotia • Home Energy Assessment Rebates • Commercial New Construction Rebates • Affordable Housing Rebates • Heating System Rebates

3.2 Building Archetypes and Vintages

This study analyzes four residential building archetypes:

- **Single detached** house
- **Rowhouse**
- **Apartment** with in-unit HVAC systems in a multi-unit residence building (MURB)
- **Multi-unit residence buildings** (MURB) with central HVAC systems

Each archetype is then characterized into two or three vintages:

- Existing building built around **1940**
- Existing building built around **1980**
- New construction built around **2023**

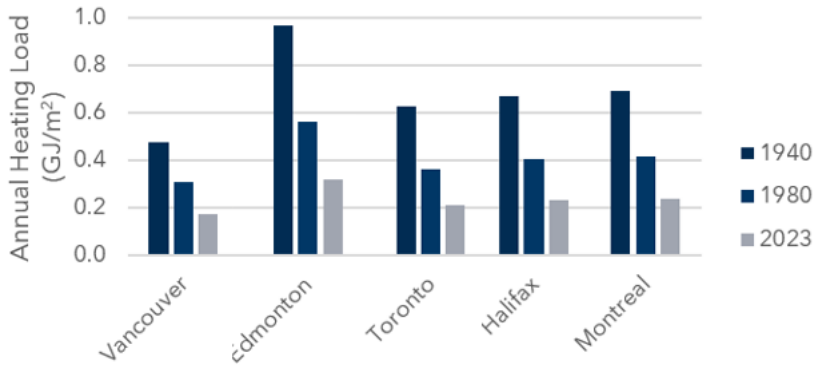
The residential and building archetype combinations considered are summarized in Table 3. These combinations were analyzed for each of the five cities.

Table 3. Building Archetypes and Vintages.

Archetype	**A: Single detached**			**B: Rowhouse**			**C: MURB** (20-unit condo)			
Vintage	A1: 1940	A2: 1980	A3: 2023	B1: 1940	B2: 1980	B3: 2023	1980		New 2023	
							C1: in-unit	C2: central	C3: in-unit	C4: central
Floor area	1770 sqft			1450 sqft			20 units of 1040 sqft each			

The heating loads per archetype for every jurisdiction and vintage are summarized below (Figure 1-Figure 3). All are based on provincial-level data from NRCan's Comprehensive Energy Use Database[14] and adjusted according to each city based on city-specific and population-weighted average provincial heating-degree and cooling-degree days.

Figure 1. Annual heating loads for single detached houses (with 2035 climate data).



[14] Table 33: Gross Output Thermal Requirements per Square Metre by Building Type and Vintage

Figure 2. Annual heating loads for rowhouses (with 2035 climate data)

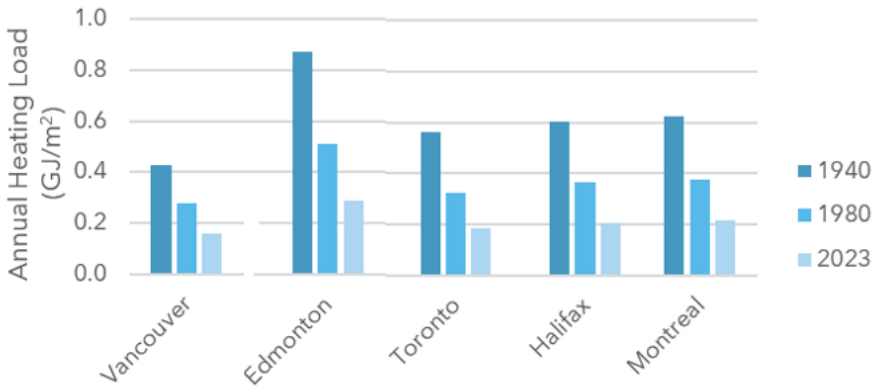
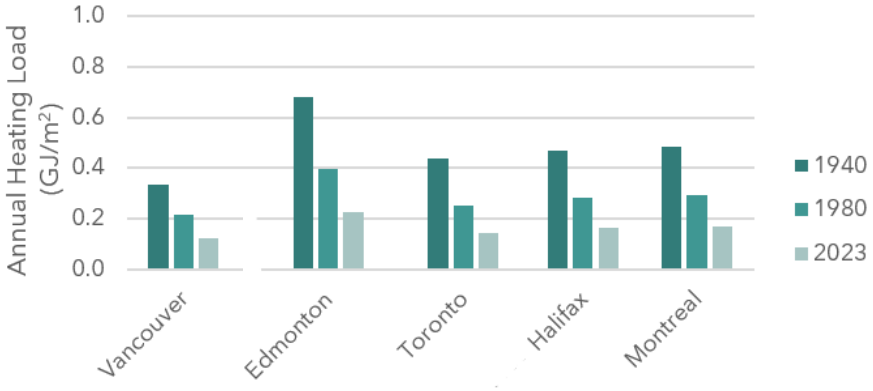


Figure 3. Annual heating loads for apartments and MURBs (with 2035 climate data; all per unit).



3.3 Equipment Configurations

For each of the building archetype and vintage combinations, this study analyzes four different equipment configurations in total:

- **One business-as-usual (BAU) configuration** with (mostly) gas-fired space heating equipment, with air conditioning (AC).
- **One hybrid configuration**, with a heat pump (HP) as the primary heating system and a gas-fired backup heating system. The HP also doubles as the space cooling equipment.
- **Two all-electric configurations**, one with a standard HP as the primary heating system and one with a cold-climate (cc) HP as the primary heating system. In the all-electric configurations, the backup is an electric resistance system. The HP also doubles as the space cooling equipment.

All equipment configurations are detailed in Figure 5 below.

Archetype C4 (newly constructed MURB with central HVAC) also includes a make-up air unit (MUA) for building ventilation with each archetype. As this make-up air is heated or cooled according to the building's conditioning requirements, this MUA covers a portion of the building's overall heating and

cooling load. This study assumes that the MUA covers roughly 40% of the overall building heating load and 40% of the overall building cooling load.

3.3.1 Electric Panel Upgrade

Figure below indicates for which configurations the costs of electrical panel upgrades are included in the analysis. In jurisdictions that currently have low penetration of AC, the additional cost for panel upgrades was also applied to the BAU configuration (which includes AC), and hybrid configuration. The underlying assumption is that in jurisdictions that already have a high penetration of air conditioning, buildings would not need panel upgrades for these configurations, as the current panel capacity should support the new equipment. However, in all jurisdictions, a panel upgrade cost was applied for all-electric configurations. It was also assumed that no panel upgrades are required in new buildings (2023 archetypes).

Overall, the need for a panel upgrade can range from 10%[15] to about 60% of cases depending on the jurisdiction, building stock, whether the building previously had an air conditioning unit, the size of the heat pump, and more.

For example, a study performed on 263 homes in Austin, Texas identified 59% of homes below the critical size of 200A.[16] Another study done for the City of Vancouver suggests that homes built between 1950 and 1970 are most likely to need a panel upgrade since they are built for 60A. [17]

[15] 10% is based on a study done by Dunsky for a Canadian jurisdiction. The data from this study is confidential and therefore cannot be reported.

[16] Addressing an Electrification Roadblock: Residential Electric Panel Capacity. Pecan Street, 2021. Figure 8.

[17] Homeowner's guide to Electrification. City of Vancouver, 2020. Accessed at https://sustain.ubc.ca/sites/default/files/2020-43_Barriers%20to%20electric%20panel%20upgrades_Kumar.pdf

Figure 4. Panel upgrade requirement and cost applicability flowchart.

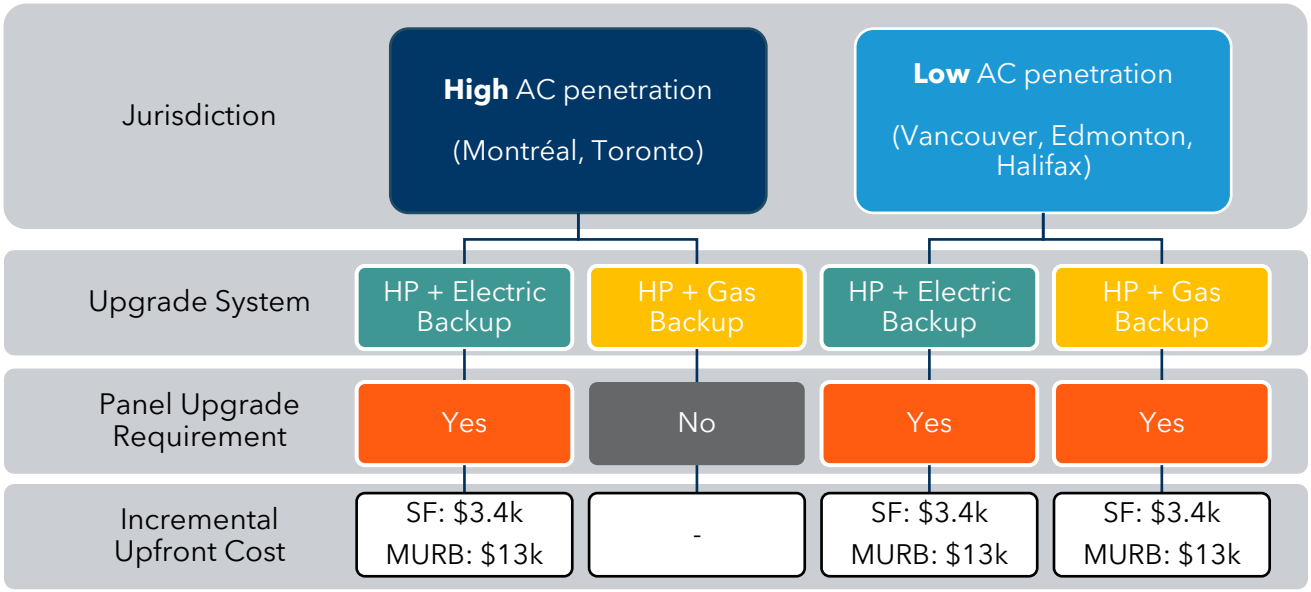


Figure 5. HVAC equipment configurations
(refer to the flowchart above for panel upgrades)

Archetype		**A: Single detached**			**B: Rowhouse**			**C: MURB** (20-unit condo building)			
Vintage		1940	1980	New 2023	1940	1980	New 2023	Apartment (in-unit HVAC)		MURB (central HVAC)	
								1980	New 2023	1980	New 2023
1	BAU + AC	Gas furnace + ducted AC			Gas furnace + ducted AC			Elec. baseboards + window ACs	Gas furnaces + ducted AC	Gas boiler & radiators + window ACs	Gas boiler & chiller (w/ 4-pipe fan-coils, AC) + gas MUA
2	Hybrid HP	Gas furnace + ducted HP			Gas furnace + ducted HP			N/A	Gas furnaces +ducted HP	Gas boiler & radiators + ductless HPs	Same as above, but with central ATWHP + hybrid MUA
3	All electric + standard HP	Electric furnace + ducted HP			Electric furnace + ducted HP			Elec. baseboards + ductless HPs	Ducted HPs + electric backup	Electric baseboards + ductless HPs	Standard VRF w/ ducted units + elec. HP MUA
4	All electric + cold-climate HP	Ducted ccHP + resistance backup			Ducted ccHP + resistance backup			Elec. baseboards + ductless ccHPs	Ducted ccHPs + electric backup	Electric baseboards + ductless ccHP	Cold-climate VRF w/ ducted units +elec. ccHP MUA

3.3.2 Sizing and Controls

For all heat pump configurations, the analysis accounts for sizing and control strategies for the standard and cold-climate heat pump systems, which align with industry norms and jurisdiction-specific rates (Table 4).

In all cases, **since heat pumps provide both heating and cooling services, their sizing must account for both requirements**. HEAT therefore calculates both heating and cooling needs, and calculates equipment capacity if sized in cooling, if sized in heating, and picks the higher value. Overall, almost all 1940 archetypes end up being sized for heating, while new construction archetypes are usually sized in cooling.

For heating, heat pumps are sized to cover the building heating load at a specified outdoor air temperature and may be controlled based on a switch-over temperature[18] or run in parallel with the backup heating system.

For hybrid heat pump systems, the sizing is typically based on the economic switch temperature, which represents the temperature at which the ratio of the heat pump efficiency to gas-fired backup equipment efficiency becomes less than the ratio of electricity rates to natural gas rates, and therefore it makes economic sense for the customer to switch to the backup system.

In the case of **all-electric heat pump systems**, the sizing temperature was set to -8.3°C, in line with Natural Resources Canada's guidelines (option 4C for heat pump sizing which covers most of the heating in mild to cold weather in most regions).[19] For these systems, when the building heating load exceeds the heat pump capacity, the heat pump and electric resistance back-up operate in parallel to meet the building heating load.

Table 4. Heat Pump sizing and control strategies.

Jurisdiction			Edmonton, Toronto	Vancouver	Montréal, Halifax
2	Hybrid HP	Sizing	Match full heating load at 0°C	Match full heating load at -5°C*	Match full heating load at -8.3°C
		Control	Switch at 0°C	Switch at -5°C*	Switch at -8.3°C
3	All electric + standard HP	Sizing	Match full heating load at -8.3°C*		
		Control	Run together		
4	All electric + cold climate HP	Sizing	Match full heating load at -8.3°C*		
		Control	Run together		

** Apart from Vancouver, where the climate data shows it never reaches that temperature. In Vancouver, the sizing temperature for heating is therefore the heating design temperature, which is defined as the 99.6th percentile temperature (which is -1.8°C based on the 2035 climate data).*

[18] Above the switch-over temperature, the heat pump provides all the heating, under the switch-over temperature the secondary system provides all the heating.

[19] NRCan – Natural Resources Canada. (2020). Air-Source Heat Pump Sizing and Selection Guide.

3.3.3 Equipment Performance

The HEAT™ model comes with Dunsky's library of heat pump performance curves. While this data is proprietary, it has been built from various sources listed below, complemented by Dunsky's professional judgment to ensure the various equipment performance curves are comparable and align with Dunsky's equipment costing.

The main references for heat pump performance curves include the following:

- AHRI Directory of Certified Product Performance[20] (median values from hundreds of listings)
- NEEP's cold climate ASHP product list[21] (median values from hundreds of listings)
- Minnesota Center for Energy and Environment field tests of ccASHPs[22]
- Manufacturer performance data tables for specific products

Adjustment factors are included to account for outdoor unit defrost cycles, and while we have added factors to account for real-world performance, we assume quality installs from trained contractors.

How these performance curves are used in the HEAT model is explained above under section 2.1.1 HEAT's Simulated Energy Performance.

Table 5 shows the resulting portion of the building's heating load covered by the heat pump, as well as the heat pump system's average COP delivered over the heating season (which takes into account the contribution of the back-up system).

Table 5. Calculated seasonal equipment and system performance (with 2035 climate data)

Jurisdiction	Configuration	Annual load covered by HP	Total seasonal system efficiency (COP)
Vancouver	2. Hybrid HP	99.9%	3.1
	3. All-electric + standard HP	100%	3.1
	4. All-electric + cold-climate HP	100%	3.3
Edmonton	2. Hybrid HP	30%	1.2
	3. All-electric + standard HP	74%	1.9
	4. All-electric + cold-climate HP	90%	2.3
Toronto	2. Hybrid HP	50%	1.4
	3. All-electric + standard HP	93%	2.5
	4. All-electric + cold-climate HP	98%	2.8
Montréal	2. Hybrid HP	73%	1.8
	3. All-electric + standard HP	85%	2.1
	4. All-electric + cold-climate HP	94%	2.5

[20] AHRI Certification Directory (ahridirectory.org)

[21] ASHP (neep.org)

[22] Air Source Heat Pumps | Center for Energy and Environment (mncee.org)

Jurisdiction	Configuration	Annual load covered by HP	Total seasonal system efficiency (COP)
Halifax	2. Hybrid HP	87%	2.2
	3. All-electric + standard HP	93%	2.5
	4. All-electric + cold-climate HP	98%	2.8

3.3.4 Equipment Costing

Dunsky leveraged heat pump costing data collected through past studies and conducted additional research to verify and update costing from various published sources to develop a cost versus capacity regression analysis for heat pumps and furnaces where applicable. The regression allows the capital costs to be adjusted based on the sizing required for each specific case, depending on location, archetype, vintage, and sizing strategy.

Sources we relied on include RSMeans, utility efficiency program Technical Reference Manuals, and publicly available retailer costs.

For the model to capture a wide range of upfront installation and equipment costs, a cost sensitivity is applied for the online calculator, representing +25% (high-cost sensitivity) and -25% (low-cost sensitivity) of the equipment cost data.

Table 6, Table 7, Table 8, and Table 9 below present the equipment costs for the "mid" cost case. The range reflects differing equipment costs in the different jurisdictions assessed, which have varying sizing strategies (refer to Table 4 above), varying sizing requirements at a given temperature due to differences in building envelope performance, as well as varying sizing requirements based on local climate.

Table 6. Capital cost assumptions for a Single detached house (mid-cost sensitivity).

Building vintage	1940	1980	2023
Central ducted air-conditioner	$4,990	$4,990	$4,760
Gas-fired furnace	$4,500 - $6,030	$4,080 - $4,850	$3,750 - $4,170
Standard central ducted air-source heat pump (sized at -5°C)	$7,570 - $8,180	$6,200	$5,760
Cold climate central ducted air-source heat pump (sized at -8.3°C)	$14,840* - $19,880	$12,870 - $13,260	$11,890
Electric duct-heater element (secondary heating system)	$880 - $1,810	$620 - $1,090	$420 - $680
Electric panel upgrade	Refer to section 3.3.1		

* The bottom of the range is for Vancouver, where the climate does not reach -8.3°C and the HP can therefore be undersized compared to all other jurisdictions. Excluding Vancouver, the range would be $18,390-$19,880.

Table 7. Capital cost assumptions for a Rowhouse (mid-cost sensitivity).

Building vintage	1940	1980	2023
Central ducted air-conditioner	$4,630	$4,630	$4,440
Gas-fired furnace	$4,190 - $5,320	$3,880 - $4,440	$3,630 - $3,940
Standard central ducted air-source heat pump (sized at -5°C)	$6,180 - $6,620	$5,490	$5,130
Cold climate central ducted air-source heat pump (sized at -8.3°C)	$12,020 - $15,740	$11,280	$10,490
Electric duct-heater element (secondary heating system)	$690 - $1,370	$500 - $840	$350 - $540
Electric panel upgrade	Refer to section 3.3.1		

Table 8. Capital cost assumptions for Apartments (mid-cost sensitivity).

Building vintage	1940	1980	2023
Window air-conditioners		$480	
Ductless mini-split heat pump		$5,100	
Cold climate ductless mini-split heat pump		$8,470	
Electric baseboards		$930 - $1,840	
Electric panel upgrade		Refer to section 3.3.1	

Building vintage	1940	1980	2023
Central ducted air-conditioner			$4,030
Gas-fired furnace			$3,490 - $3,660
Standard central ducted air-source heat pump (sized at -5°C)			$4,320
Cold climate central ducted air-source heat pump (sized at -8.3°C)			$8,680
Electric duct-heater element (secondary heating system)			$260 - $370

Table 9. Capital cost assumptions for MURBs (mid-cost sensitivity).

Building vintage	1940	1980	2023
Window air-conditioners		$480	
Gas-fired boiler		$1,090 - $1,890	
Ductless mini-split heat pump		$5,100	
Cold climate ductless mini-split heat pump		$8,470	
Electric baseboards		$930 - $1,840	
Electric panel upgrade		Refer to section 3.3.1	
Gas-fired boiler (including piping and accessories)			$4,980 - $5,240
Air-cooled chiller			$3,930
Air-to-water heat pump			$7,800
Variable refrigerant flow unit (VRF)			$7,510
Cold-climate variable refrigerant flow unit (ccVRF)			$9,710
Electric duct-heater element (secondary heating system)			$220 - $280
Gas-fired make-up air packaged rooftop unit			$1,500
Hybrid make-up air (MUA) packaged rooftop unit			$1,500
Electric heat pump make-up air (MUA) packaged rooftop unit			$1,500
Electric cold climate heat pump make-up air (MUA) packaged rooftop unit			$2,410

3.4 Energy and Carbon Pricing Forecasts

The Canadian Climate Institute developed the energy and carbon price forecasts.

The CCI provided Dunsky projections for both gas and electricity, each of which varies based on jurisdiction. Carbon pricing also impacts the rates paid by customers, and therefore the overall costs of different equipment configurations. Carbon pricing values are highlighted separately from rates in the results, to demonstrate this impact.

3.4.1 Natural Gas Price Forecasts

The Canadian Climate Institute provided the natural gas price forecasts.

The fixed and variable costs of natural gas (including transportation and storage, load balancing, and commodity costs) were obtained from 2023 provincial utility reports.

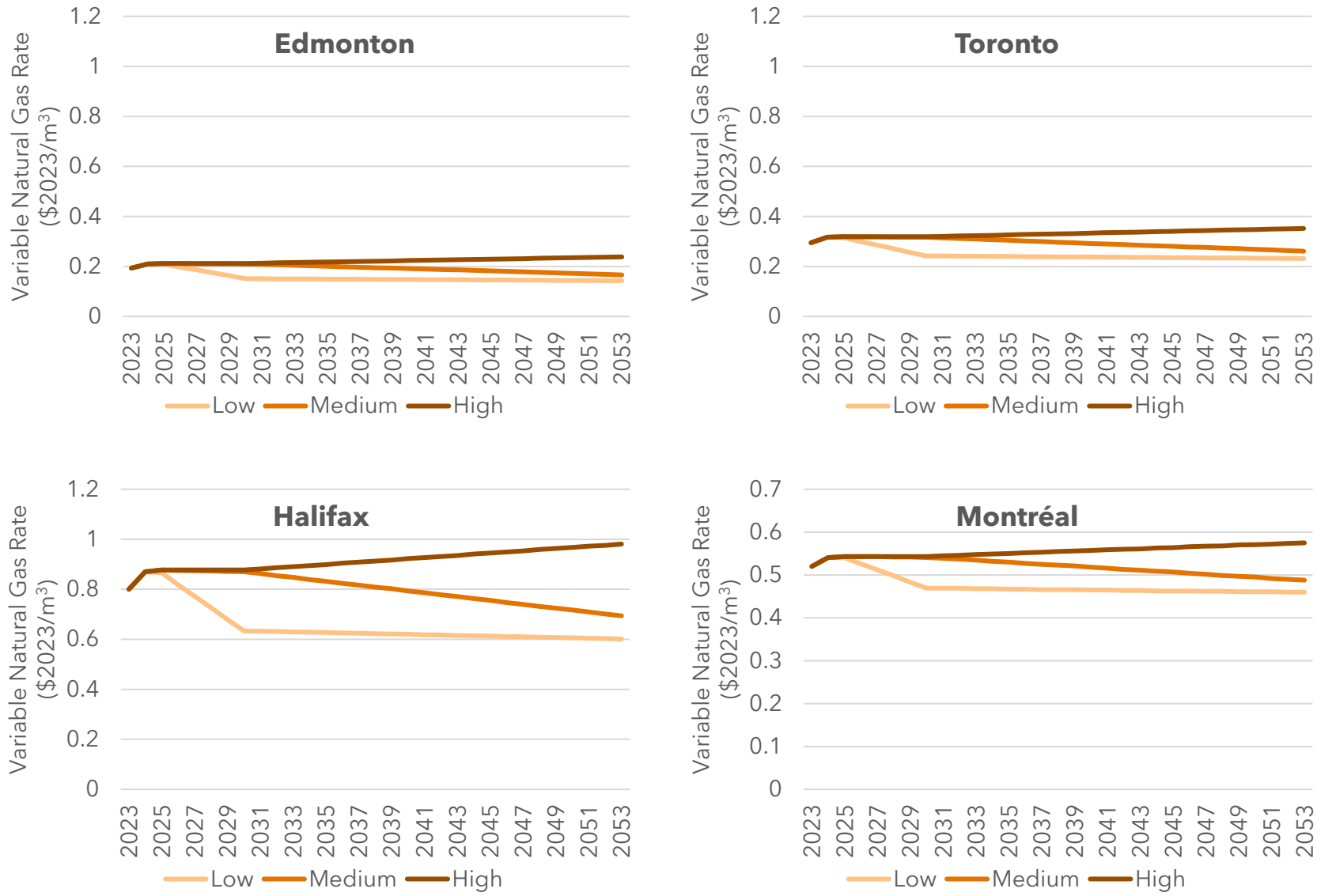
The projected high, medium, and low forecasts for variable natural gas prices (Figure 6) were developed based on the Canadian Energy Regulator (CER)'s Canada's Energy Future 2023 Henry Hub price forecasts for the Current Measures, Canada Net Zero and Global Net Zero scenarios.[23]

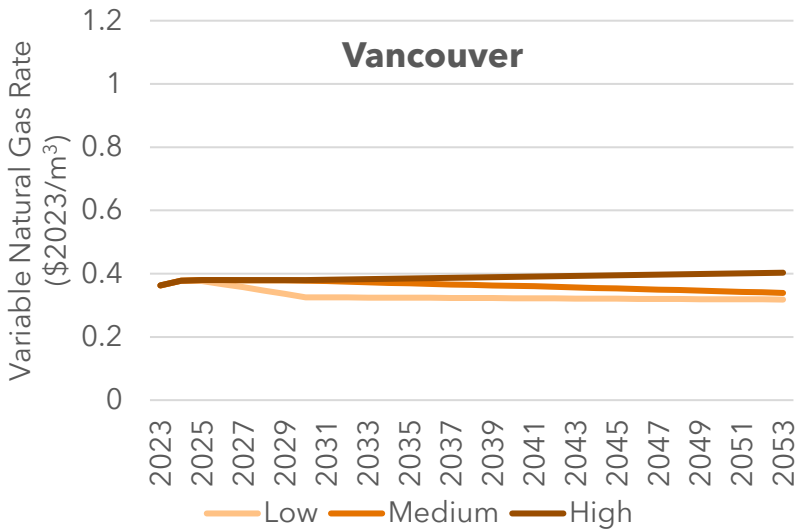
Table 10. Fixed cost of gas ($2023/month/household connection)

Jurisdiction	Fixed Monthly Cost	Source
Vancouver	$13	Fortis BC: Residential Natural Gas Rates
Edmonton	$28	ACTO: Current Rates, North Delivery
Toronto	$23	Enbridge Gas: New Natural Gas Rates
Montréal	$19	Énergir: Conditions of Service and Tariff
Halifax	$22	Eastward Energy: Eastward Energy Rate Table

[23] CER. (2023). Canada's Energy Future 2023.

Figure 6. Variable cost of natural gas in different cities modelled.




Vancouver
Variable Natural Gas Rate ($2023/m3)
1.2
1
0.8
0.6
0.4
0.2
0
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
2049
2051
2053
Low
Medium
High

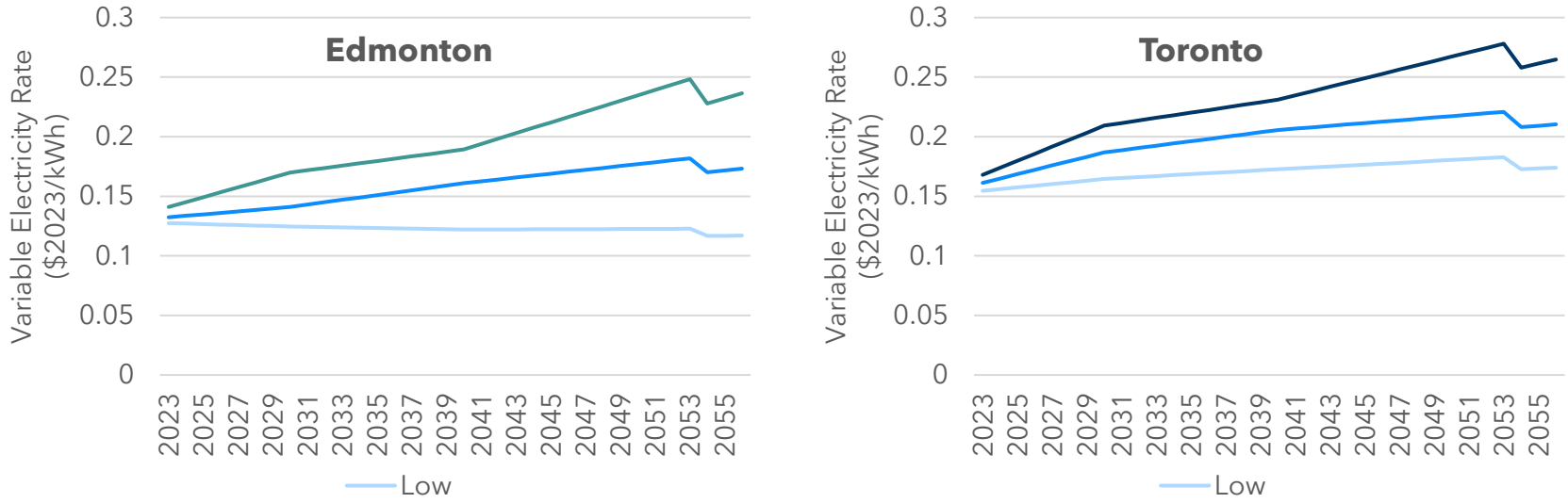
3.4.2 Electricity price Forecasts

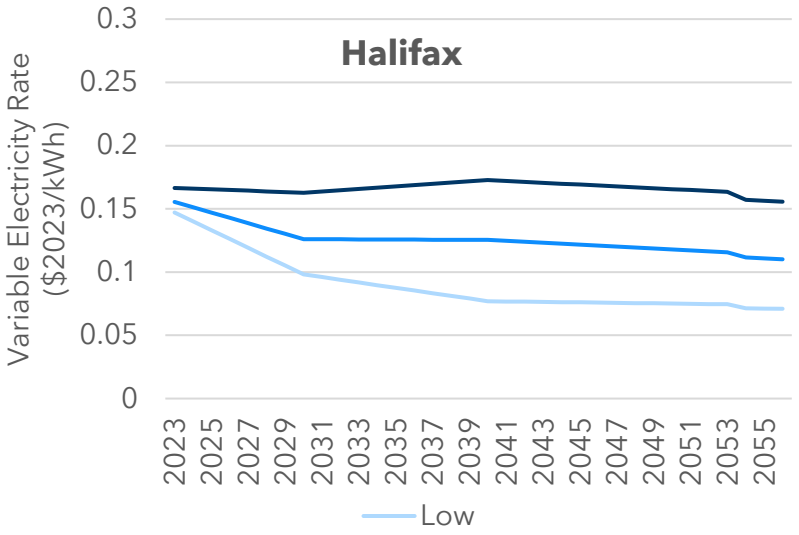
The Canadian Climate Institute provided the electricity price forecasts.

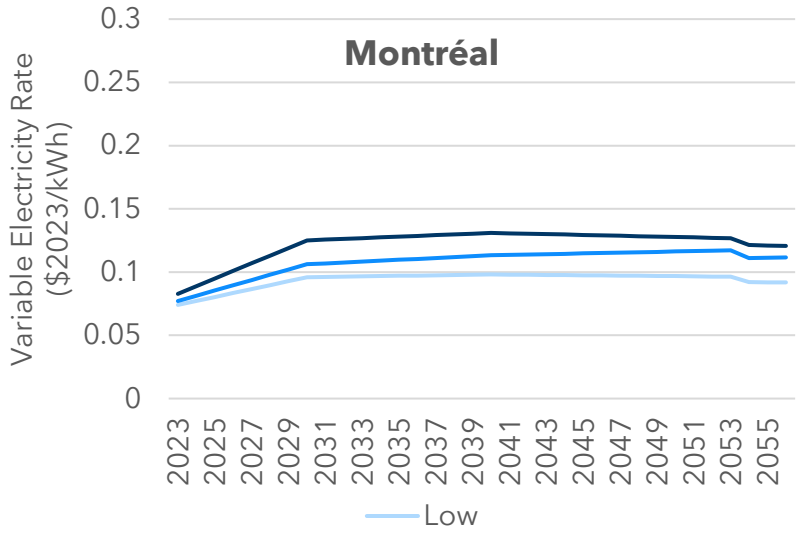
Electricity prices (Figure 7) are based on prior analysis in the Canadian Climate Institute's *Big Switch* report.

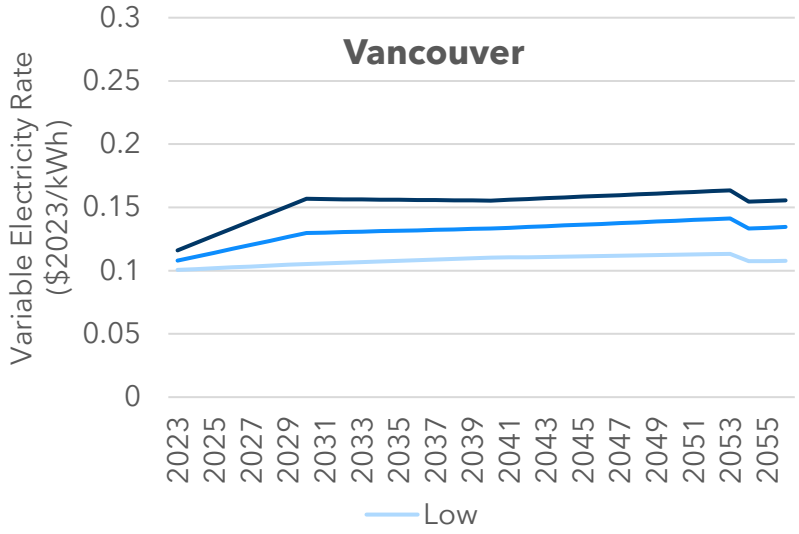
Electricity prices are modelled as a standard average $ per kWh, applied monthly. Optional rate structures with kW-based prices, Time-of-Use rates, dual-fuel or tiered rates, are not considered.

Figure 7. Variable cost of electricity ($/kWh) in different cities modelled.




Halifax
Variable Electricity Rate ($2023/kWh)
0.3
0.25
0.2
0.15
0.1
0.05
0
2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055
Low


Montréal
Variable Electricity Rate ($2023/kWh)
0.3
0.25
0.2
0.15
0.1
0.05
0
2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055
Low


Vancouver
Variable Electricity Rate ($2023/kWh)
0.3
0.25
0.2
0.15
0.1
0.05
0
2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055
Low

3.4.3 Emissions intensity Forecasts

The Canadian Climate Institute provided the emissions intensity forecasts.

The assumed emissions intensity of electricity generation provided by the CCI is based on modelling of an economy-wide net zero pathway developed by Navius Research. The following assumptions were made:

- A more-stringent scenario was used for Vancouver and Montréal which assumes no gas use post-2035.
- Edmonton's emissions intensity was adjusted to reflect early coal phase-out

Table 11. Emission intensity of electricity generation in different cities between 2023 and 2038 (gCO2e/kwh).

Jurisdiction	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Edmonton	221	167	111	88	67	49	33	18	18	18	18	18	18	17	17	17
Vancouver	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halifax	556	529	501	398	300	205	115	28	25	22	20	17	15	14	12	11
Toronto	39	45	51	43	35	27	19	11	11	11	10	10	10	10	10	10
Montréal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. Emission intensity of electricity generation in different cities between 2039 and 2053 (gCO2e/kwh).

Jurisdiction	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
Edmonton	17	17	17	17	17	17	17	17	17	18	18	18	18	19	19
Vancouver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halifax	10	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Toronto	10	9	9	9	9	9	9	9	9	9	9	9	10	10	10
Montréal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.4.4 Carbon price assumptions

Carbon pricing assumptions were provided by Canadian Climate Institute.

The carbon pricing assumptions provided follow the federal backstop carbon price, even in modelled jurisdictions that have a local carbon pricing system (Table 13).

Table 13. Carbon price assumptions ($/tonne, nominal) between 2023 and 2053.

Carbon price	2023	2024	2025	2026	2027	2028	2029	2030	2031 and later
$/tonne	$65	$80	$95	$110	$125	$140	$155	$170	$170

The federal backstop carbon pricing is applied to natural gas, and to applicable emissions from electricity generation based on the output-based pricing standard (OBPS) for electricity generation. The OBPS standard for solid fuels declines linearly from 650 tCO2e/GWh in 2020 to 370 tCO2e/GWh in 2030 and remains at 370 tCO2e/GWh after 2030. The OBPS standard for gaseous fuels is assumed to remain at 370 tCO2e/GWh for the duration of the study period.[24] The resulting carbon price assumptions for electricity generation are highlighted in

Table 15 and

Table 15.

[24] Government of Canada. (2019). Output-Based Pricing System Regulations: SOR/2019-266

Table 14. Carbon price assumptions (¢2023/kWh) between 2023 and 2038

Jurisdiction	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Edmonton	0.77	0.83	0.81	0.78	0.72	0.64	0.53	0.40	0.36	0.32	0.29	0.26	0.23	0.21	0.19	0.17
Vancouver	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Halifax	1.65	2.07	2.50	2.43	2.20	1.79	1.19	0.38	0.31	0.25	0.19	0.14	0.08	0.08	0.08	0.08
Toronto	0.06	0.09	0.11	0.11	0.11	0.10	0.09	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.05
Montréal	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 15. Carbon price assumptions (¢2023/kWh) between 2039 and 2053

Jurisdiction	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
Edmonton	0.15	0.13	0.13	0.13	0.13	0.13	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Vancouver	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Halifax	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Toronto	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Montréal	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Appendix A: Federal Incentives - Greener Homes Grant

Table 16. Federal Greener Homes Grants applied in Vancouver, Edmonton, and Toronto

Applicable Jurisdictions	Building Archetype	Vintage	Configuration	Greener Homes Grant: Amount Applied
Vancouver, Edmonton, and Toronto	MURB Central	1980	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	MURB In-unit	1980	3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	Rowhouse	1940	2. Hybrid HP	$4,000
			3. All-electric + standard HP	$4,000
			4. All-electric + cold-climate HP	$5,000
		1980	2. Hybrid HP	$4,000
			3. All-electric + standard HP	$4,000
			4. All-electric + cold-climate HP	$5,000
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	Single Detached	1940	2. Hybrid HP	$4,000
			3. All-electric + standard HP	$4,000
			4. All-electric + cold-climate HP	$5,000
		1980	2. Hybrid HP	$4,000
			3. All-electric + standard HP	$4,000
			4. All-electric + cold-climate HP	$5,000
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-

Table 17. Federal Greener Homes Grants applied in Halifax and Montréal[25]

Applicable Jurisdictions	Building Archetype	Vintage	Configuration	Greener Homes Grant: Amount Applied
Halifax, Montréal	MURB Central	1980	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	MURB In-unit	1980	3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	Rowhouse	1940	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	$5,000
		1980	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	$5,000
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-
	Single Detached	1940	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	$5,000
		1980	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	$5,000
		2023	2. Hybrid HP	-
			3. All-electric + standard HP	-
			4. All-electric + cold-climate HP	-

[25] The Greener Homes program in Québec is not additive to existing provincial incentives. Therefore, eligible customers will receive the provincial amount, and then a top up from Greener Homes to get to the $5,000 amount.

Appendix B: Provincial and Municipal Incentives

Table 18. Provincial and Municipal Incentive Programs Applied

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Vancouver	Single Detached	1940	1	0	0	CleanBC Natural Gas Furnace Rebates	Rebate no longer available as of 2024
Vancouver	Single Detached	1980	1	0	0	CleanBC Natural Gas Furnace Rebates	Rebate no longer available as of 2024
Vancouver	Single Detached	2023	1	0	0		-
Vancouver	Rowhouse	1940	1	0	0	CleanBC Natural Gas Furnace Rebates	Rebate no longer available as of 2024
Vancouver	Rowhouse	1980	1	0	0	CleanBC Natural Gas Furnace Rebates	Rebate no longer available as of 2024
Vancouver	Rowhouse	2023	1	0	0		-
Vancouver	MURB in-unit	1980	1	0	0		-
Vancouver	MURB central	1980	1	0	0		-
Vancouver	MURB in-unit	2023	1	0	0		-
Vancouver	MURB central	2023	1	0	0		-
Vancouver	Single Detached	1940	2	3000	500	CleanBC Natural Gas Furnace Rebates	Must be replacing an existing natural gas or propane furnace

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Vancouver	Single Detached	1980	2	3000	500	CleanBC Natural Gas Furnace Rebates	Must be replacing an existing natural gas or propane furnace
Vancouver	Single Detached	2023	2	0	0		-
Vancouver	Rowhouse	1940	2	3000	500	CleanBC Natural Gas Furnace Rebates	Must be replacing an existing natural gas or propane furnace
Vancouver	Rowhouse	1980	2	3000	500	CleanBC Natural Gas Furnace Rebates	Must be replacing an existing natural gas or propane furnace
Vancouver	Rowhouse	2023	2	0	0		-
Vancouver	MURB central	1980	2	0	0		-
Vancouver	MURB in-unit	2023	2	0	0		-
Vancouver	MURB central	2023	2	0	0		-
Vancouver	Single Detached	1940	3	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Single Detached	1980	3	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
							400 amp. Must be switching from fossil fuel
Vancouver	Single Detached	2023	3	0	0	CleanBC Better Homes New Construction Program	CleanBC New Construction Program has closed as of January 1, 2024
Vancouver	Rowhouse	1940	3	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Rowhouse	1980	3	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Rowhouse	2023	3	0	0	CleanBC Better Homes New Construction Program CleanBC Electrical Service Upgrade	CleanBC New Construction Program has closed as of January 1, 2024
Vancouver	MURB in-unit	1980	3	0	0		-

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Vancouver	MURB central	1980	3	0	0		-
Vancouver	MURB in-unit	2023	3	0	0		-
Vancouver	MURB central	2023	3	0	0		-
Vancouver	Single Detached	1940	4	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Single Detached	1980	4	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Single Detached	2023	4	0	0	CleanBC Better Homes New Construction Program	CleanBC New Construction Program has closed as of January 1, 2024
Vancouver	Rowhouse	1940	4	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
							400 amp. Must be switching from fossil fuel
Vancouver	Rowhouse	1980	4	6000	500	CleanBC Central Ducted Heat Pump Rebate CleanBC Electrical Service Upgrade	Vancouver is in BC Hydro electric territory, therefore qualifies for the higher amount (6000). Electrical service upgrade applies to panel upgrade to 100, 200, or 400 amp. Must be switching from fossil fuel
Vancouver	Rowhouse	2023	4	0	0	CleanBC Better Homes New Construction Program	CleanBC New Construction Program has closed as of January 1, 2024
Vancouver	MURB in-unit	1980	4	0	0		-
Vancouver	MURB central	1980	4	0	0		-
Vancouver	MURB in-unit	2023	4	0	0		-
Vancouver	MURB central	2023	4	0	0		-
Edmonton	Single Detached	1940	1	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	1980	1	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	2023	1	0	0		No rebates for new construction
Edmonton	Rowhouse	1940	1	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Edmonton	Rowhouse	1980	1	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	2023	1	0	0		No rebates for new construction
Edmonton	MURB in-unit	1980	1	0	0		-
Edmonton	MURB central	1980	1	0	0	Edmonton BERA	Building Retrofit Energy Accelarator (BERA)
Edmonton	MURB in-unit	2023	1	0	0		No rebates for new construction
Edmonton	MURB central	2023	1	0	0		No rebates for new construction
Edmonton	Single Detached	1940	2	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	1980	2	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	2023	2	0	0		No rebates for new construction
Edmonton	Rowhouse	1940	2	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	1980	2	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	2023	2	0	0		No rebates for new construction
Edmonton	MURB central	1980	2	0	0	Edmonton BERA	Building Retrofit Energy Accelarator (BERA)
Edmonton	MURB in-unit	2023	2	0	0		No rebates for new construction

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Edmonton	MURB central	2023	2	0	0		No rebates for new construction
Edmonton	Single Detached	1940	3	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	1980	3	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	2023	3	0	0		No rebates for new construction
Edmonton	Rowhouse	1940	3	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	1980	3	0	0	Edmonton HERA Program	Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	2023	3	0	0		-
Edmonton	MURB in-unit	1980	3	0	0		-
Edmonton	MURB central	1980	3	0	0		-
Edmonton	MURB in-unit	2023	3	0	0		-
Edmonton	MURB central	2023	3	0	0		-
Edmonton	Single Detached	1940	4	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	1980	4	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Single Detached	2023	4	0	0		No rebates for new construction

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Edmonton	Rowhouse	1940	4	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	1980	4	0	0		Home Energy Retrofit Accelerator Program is no longer available.
Edmonton	Rowhouse	2023	4	0	0		No rebates for new construction
Edmonton	MURB in-unit	1980	4	0	0	Edmonton BERA	Building Retrofit Energy Accelarator (BERA)
Edmonton	MURB central	1980	4	0	0	Edmonton BERA	Building Retrofit Energy Accelarator (BERA)
Edmonton	MURB in-unit	2023	4	0	0		No rebates for new construction
Edmonton	MURB central	2023	4	0	0		No rebates for new construction
Halifax	Single Detached	1940	1	-	0		-
Halifax	Single Detached	1980	1	-	0		-
Halifax	Single Detached	2023	1	0	0		No rebates for new construction.
Halifax	Rowhouse	1940	1	-	0		-
Halifax	Rowhouse	1980	1	-	0		-
Halifax	Rowhouse	2023	1	0	0		nothing came up for residential new construction
Halifax	MURB in-unit	1980	1	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Halifax	MURB central	1980	1	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied
Halifax	MURB in-unit	2023	1	0	0		-
Halifax	MURB central	2023	1	0	0		-
Halifax	Single Detached	1940	2	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	1980	2	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	2023	2	0	0		-
Halifax	Rowhouse	1940	2	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	1980	2	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	2023	2	0	0		-
Halifax	MURB central	1980	2	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied
Halifax	MURB in-unit	2023	2	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50%

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
							better than baseline - $0.13 per kWh
Halifax	MURB central	2023	2	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50% better than baseline - $0.13 per kWh
Halifax	Single Detached	1940	3	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	1980	3	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	2023	3	0	0		-
Halifax	Rowhouse	1940	3	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	1980	3	$400/ton	0	Efficiency NS Heating System Rebates	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	2023	3	0	0		-
Halifax	MURB in-unit	1980	3	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied
Halifax	MURB central	1980	3	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Halifax	MURB in-unit	2023	3	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50% better than baseline - $0.13 per kWh
Halifax	MURB central	2023	3	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50% better than baseline - $0.13 per kWh
Halifax	Single Detached	1940	4	$500/ton	0	Efficiency NS Home Energy Assessment Rebate	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	1980	4	$500/ton	0	Efficiency NS Home Energy Assessment Rebate	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Single Detached	2023	4	0	0		-
Halifax	Rowhouse	1940	4	$500/ton	0	Efficiency NS Home Energy Assessment Rebate	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	1980	4	$500/ton	0	Efficiency NS Home Energy Assessment Rebate	Does not apply for the replacement of existing heat pumps. Greener Homes only applies to Cold Climate HP
Halifax	Rowhouse	2023	4	0	0		No rebates for new construction.

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Halifax	MURB in-unit	1980	4	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied
Halifax	MURB central	1980	4	80% project cost	0	Efficiency NS Afforable Housing	rebates through the Affordable Housing Program are assumed to be applied
Halifax	MURB in-unit	2023	4	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50% better than baseline - $0.13 per kWh
Halifax	MURB central	2023	4	$0.13/kWH Savings	0	Efficiency NS Commercial New Construction	Commercial New Construction - performance based rebates. Tier 1, 25-50% better than baseline - $0.13 per kWh
Toronto	Single Detached	1940	1	-	0		Home Efficiency Rebate offered by enbridge - no longer appears to be available.
Toronto	Single Detached	1980	1	-	0		Home Efficiency Rebate offered by enbridge - no longer appears to be available.
Toronto	Single Detached	2023	1	-	0	Enbridge Savings by Design	Get incentives of $1650 per home for up to 50 homes - for builders
Toronto	Rowhouse	1940	1	-	0		Home Efficiency Rebate offered by enbridge - no longer appears to be available.

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Toronto	Rowhouse	1980	1	-	0		Home Efficiency Rebate offered by enbridge - no longer appears to be available.
Toronto	Rowhouse	2023	1	-	0	Enbridge Savings by Design	Get incentives of $1650 per home for up to 50 homes - for builders
Toronto	MURB in-unit	1980	1	-	0		No rebates
Toronto	MURB central	1980	1	-	0	Enbridge Affordable Multifamily Housing Program	Affordable Multi-Family Housing Program
Toronto	MURB in-unit	2023	1	-	0	Enbridge Affordable Multifamily Housing New Program	Affordable Multi-Family Housing New Construction
Toronto	MURB central	2023	1	-	0	Enbridge Affordable Multifamily Housing New Program	Affordable Multi-Family Housing New Construction
Toronto	Single Detached	1940	2	-	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Single Detached	1980	2	-	0	Enbridge Home Efficiency Rebate Plus	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
						City of Toronto Home Energy Loan Program	the base greener homes amount is included in the total.
Toronto	Single Detached	2023	2	-	0	Enbridge Savings by Design City of Toronto Home Energy Loan Program	Savings by Design Residential. Incentive provided to builders. Builders have to build at least 50 homes to receive the $1650 per home. Incentive level drops based on number of times builders participated in the program.
Toronto	Rowhouse	1940	2	-	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	1980	2	-	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	2023	2	-	0	Enbridge Savings by Design	Savings by Design Residential. Incentive

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
						City of Toronto Home Energy Loan Program	provided to builders. Builders have to build at least 50 homes to receive the $1650 per home. Incentive level drops based on number of times builders participated in the program.
Toronto	MURB central	1980	2	-	0		Affordable Multi-Family Housing Program
Toronto	MURB in-unit	2023	2	-	0		Affordable Multi-Family Housing New Construction
Toronto	MURB central	2023	2	-	0		Affordable Multi-Family Housing New Construction
Toronto	Single Detached	1940	3	2000	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Single Detached	1980	3	2000	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Toronto	Single Detached	2023	3	3650	0	Enbridge Savings by Design City of Toronto Home Energy Loan Program	Savings by Design Residential. Incentive provided to builders. Builders have to build at least 50 homes to receive the $1650 per home. Incentive level drops based on number of times builders participated in the program.
Toronto	Rowhouse	1940	3	2000	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	1980	3	2000	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	2023	3	3650	0	Enbridge Savings by Design	Savings by Design Residential. Incentive provided to builders. Builders have to build at least 50 homes to receive the $1650

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
						City of Toronto Home Energy Loan Program	per home. Incentive level drops based on number of times builders participated in the program.
Toronto	MURB in-unit	1980	3	-	0		-
Toronto	MURB central	1980	3	-	0		-
Toronto	MURB in-unit	2023	3	-	0		-
Toronto	MURB central	2023	3	-	0		-
Toronto	Single Detached	1940	4	2500	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Single Detached	1980	4	2500	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Single Detached	2023	4	4150	0	Enbridge Savings by Design	Savings by Design Residential. Incentive provided to builders. Builders have to build at least 50

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
						City of Toronto Home Energy Loan Program	homes to receive the $1650 per home. Incentive level drops based on number of times builders participated in the program.
Toronto	Rowhouse	1940	4	2500	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	1980	4	2500	0	Enbridge Home Efficiency Rebate Plus City of Toronto Home Energy Loan Program	Note: Increased rebates were available through a top-up from Enbridge's HER+ program, but the HER+ program is on pause since January 19th. For now, only the base greener homes amount is included in the total.
Toronto	Rowhouse	2023	4	4150	0	Enbridge Savings by Design City of Toronto Home Energy Loan Program	Savings by Design Residential. Incentive provided to builders. Builders have to build at least 50 homes to receive the $1650 per home. Incentive level drops based on number of times builders participated in the program.

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Toronto	MURB in-unit	1980	4	-	0		No rebates
Toronto	MURB central	1980	4	-	0		No rebates
Toronto	MURB in-unit	2023	4	-	0		No rebates
Toronto	MURB central	2023	4	-	0		No rebates
Montréal	Single Detached	1940	1	0	-		No rebates
Montréal	Single Detached	1980	1	0	-		No rebates
Montréal	Single Detached	2023	1	0	-		No rebates
Montréal	Rowhouse	1940	1	0	-		No rebates
Montréal	Rowhouse	1980	1	0	-		No rebates
Montréal	Rowhouse	2023	1	0	-		No rebates
Montréal	MURB in-unit	1980	1	0	-		No rebates
Montréal	MURB central	1980	1	0	-		No rebates
Montréal	MURB in-unit	2023	1	0	-		No rebates
Montréal	MURB central	2023	1	0	-		No rebates
Montréal	Single Detached	1940	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	Single Detached	1980	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	Single Detached	2023	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	Rowhouse	1940	2	0	-		No rebates for non-cold-climate heat pumps

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Montréal	Rowhouse	1980	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	Rowhouse	2023	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB central	1980	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB in-unit	2023	2	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB central	2023	2	$508/kW	-	Hydro-Québec Solutions Efficaces	Air to water heat pumps
Montréal	Single Detached	1940	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	Single Detached	1980	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	Single Detached	2023	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	Rowhouse	1940	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	Rowhouse	1980	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	Rowhouse	2023	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB in-unit	1980	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB central	1980	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB in-unit	2023	3	0	-		No rebates for non-cold-climate heat pumps
Montréal	MURB central	2023	3	$314/kW	-	Hydro-Québec Solutions Efficaces	VRF
Montréal	Single Detached	1940	4	$128/kW	-	Hydro-Québec Logis vert	$50 per heating MBH at -8.3°C

Jurisdiction	Building Archetype	Vintage	Config	Rebate: Heating Equipment ($)	Rebate: Electrical Service Upgrade ($)	Sources	Notes
Montréal	Single Detached	1980	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	Single Detached	2023	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	Rowhouse	1940	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	Rowhouse	1980	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	Rowhouse	2023	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	MURB in-unit	1980	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	MURB central	1980	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	MURB in-unit	2023	4	$128/kW	-	Hydro-Québec Logisvert	$50 per heating MBH at -8.3°C
Montréal	MURB central	2023	4	$508/kW	-	Hydro-Québec Solutions Efficaces	Packaged rooftop heat pumps and VRF

Appendix C: Income Qualified Programs

Table 19. Income qualified programs

Jurisdiction	Income Qualified Incentive Program
Vancouver	CleanBC Better Homes Income Qualified Program
Edmonton	N/A
Toronto	IESO Save On Energy – Energy Affordability Program[26]
Montréal	N/A
Halifax	Efficiency Nova Scotia Moderate Income Rebate

[26] The Energy Affordability Program is only available to homes heated by electricity.