IEA HPT COUNTRY REPORT: CANADA OVERVIEW OF HP POLICY & RD&D ACTIVITIES

CanmetENERGY In Varennes
Purpose: **Understand current landscape** for heat pumps in Canada
Showcase work to **address market needs and support adoption**

**Policy**
- Policy Drivers
- HP related policies, programs

**Context**
- Climate, energy markets
- Snapshot: ASHP potential

**HP RD&D**
- Supporting adoption across Canada
**Canadian Context: Policy Drivers**

- **2030**
  - Emission Reduction Plan: 40% below 2005 levels

- **2035**
  - Net zero grids (draft reg.)

- **2050**
  - Net zero emissions

**Built Environment: Key Focus Area**

18% of national direct emissions

- Residential Buildings:
  - 56% of res. bldgs use fossil fuel heating
  - Space, Water Heating: 99% of res. bldg emissions
Canada’s 2030 Emission Reduction Plan
“Regulatory standards, incentive framework to support transition off fossil fuels for heating”

Current National Policy & Programs
Canada Greener Homes Program: HP Incentives (HPs #1 upgrade under program)
Oil to HP Affordability Grant
Canada Green Buildings Strategy (in development)
- Standards, incentive framework for transition off fossil fuels for heating
CANADIAN CONTEXT: SUPPORTING POLICY

Select Regional Policies

- **CLEAN BC Rebate Program**
  - City of Vancouver
  - Jan 2023: No AC only systems
  - Up to $6K CAD for HPs

- **Home Energy Retrofit Accelerator**
  - City of Edmonton: Up to $5K CAD for HPs

- **Home Energy Rebate Plus**
  - Up to $7.8K CAD for HPs

- **Efficient HP Program**
  - Up to $2.8K CAD for HPs

- **NS Heating System Rebate**
  - Up to $1.6K CAD for HPs
**CANADIAN CONTEXT: CLIMATE**

- **Whitehorse, YK**
  - Climate: Subarctic
  - HDD: 6580
  - CDD: 10
  - $T_{\text{design}}$: -41.1°C (-42°F)

- **Vancouver, BC**
  - Climate: Marine
  - HDD: 2825
  - CDD: 40
  - $T_{\text{design}}$: -7.2°C (19°F)

- **Edmonton, AB**
  - Climate: Very Cold
  - HDD: 5120
  - CDD: 20
  - $T_{\text{design}}$: -30.0°C (-22°F)

- **Winnipeg, MB**
  - Climate: Very Cold
  - HDD: 5670
  - CDD: 170
  - $T_{\text{design}}$: -32.8°C (-27°F)

- **Montreal, QC**
  - Climate: Cold-Humid
  - HDD: 4200
  - CDD: 250
  - $T_{\text{design}}$: -22.8°C (-9°F)

- **Halifax, NS**
  - Climate: Cold-Humid
  - HDD: 4000
  - CDD: 100
  - $T_{\text{design}}$: -16.1°C (3°F)

- **Toronto, ON**
  - Climate: Cold-Humid
  - HDD: 3520
  - CDD: 280
  - $T_{\text{design}}$: -17.8°C (0°F)

- **Vancouver, BC**
  - Climate: Subarctic
  - HDD: 5670
  - CDD: 170
  - $T_{\text{design}}$: -32.8°C (-27°F)

**HDD = Heating Degree Days**
**CANADIAN CONTEXT: ENERGY**

- **Whitehorse, YK**
  - Electricity: $0.14/kWh, 113 gCO$_2$/kWh
  - NG: N/A
  - Fuel Oil: $2.18/L

- **Vancouver, BC**
  - Electricity: $0.14/kWh, 20 gCO$_2$/kWh
  - NG: $15.31/GJ
  - Fuel Oil: $2.18/L

- **Edmonton, AB**
  - Electricity: $0.18/kWh, 670 gCO$_2$/kWh
  - NG: $8.27/GJ
  - Fuel Oil: $2.18/L

- **Winnipeg, MB**
  - Electricity: $0.11/kWh, 1.3 gCO$_2$/kWh
  - NG: $12.25/GJ
  - Fuel Oil: $2.18/L

- **Toronto, ON**
  - Electricity: $0.16/kWh, 30 gCO$_2$/kWh
  - NG: $15.00/GJ
  - Fuel Oil: $2.42/L

- **Montreal, QC**
  - Electricity: $0.10/kWh, 1.5 gCO$_2$/kWh
  - NG: $17.15/GJ
  - Fuel Oil: $2.27/L

- **Halifax, NS**
  - Electricity: $0.18/kWh, 760 gCO$_2$/kWh
  - NG: $33.96/GJ
  - Fuel Oil: $2.07/L

- **Winnipeg, MB**
  - Electricity: $0.18/kWh, 760 gCO$_2$/kWh
  - NG: $33.96/GJ
  - Fuel Oil: $2.07/L

*Utility Rates as of Nov. 2022, including carbon tax and rate riders.*
Transition NG Furnace to Air-Source (air-air) HPs: Utility Rates (2022 snapshot)

Note: Sample analysis (specific home, HP type, etc.)
Results dependant on utility rates, HP type, archetype
Subject to change in future
Grey areas on map: NG not available
CANADIAN CONTEXT: TRANSITION TO HP

Air-source (air-air) HPs in Canada: Key element of space heating decarbonisation

Energy, GHG, cost impacts depend on regional, integration

Energy Use: Decrease in all cases
GHG Emissions: Decrease in most regions*
Utility Costs: Savings dependant on region

NG Furnace → Central CC ASHP

Energy Use: Decrease in all cases
GHG Emissions: Decrease in most regions*
Utility Costs: Decrease in all regions

Oil Furnace → Central CC ASHP

Transition from elec. BB to HP also yields energy, GHG, cost savings

Note: Results dependant on utility rates & system costs used, and may change in future

* Fed Govt.: Target Net-zero electricity grids by 2035
WHAT OTHER BARRIERS EXIST?

Driving HP adoption also means considering other issues

How do systems actually perform?
Performance ratings for Canada

How can deployment be supported?
Training/guidance on HP integration
Support to codes, standards

Implications of large HP adoption
Grid impacts of HP adoption
Flexibility provided by HP sys.
SUPPORTING ADOPTION: HP PERF. RATINGS

Evolution of Air-source HP Regulations (min performance)

Prior to Jan 1, 2023
(Split Central HP)
HSPF (Region V) ≥ 7.1
SEER ≥ 14

Jan 1, 2023 – Dec 31, 2024
(Split Central HP)
**HSPF2** (Region V) ≥ 6.0
SEER2 ≥ 14.3
(5F test point optional)

Jan 1, 2025 and later
(Split Central HP)
**HSPF2** (Region V) ≥ 6.0
SEER2 ≥ 14.3
(5F test point required)

Additional work: Supporting development of new load-based test standard (EXP 07)
Collaboration between NRCan, other organizations to support development of new test standard (SPE- 07)

CSA SPE-07
(In development)
Load-based
More realistic perf. estimate
Identifies variation btwn HPs
Adapted to Canadian climates

Current Standard
Struggles to reflect in-field perf. in Canada
SUPPORTING ADOPTION: HP SIZING

Improving HP Sizing: Maximizing HP Performance Benefits

NRCan ASHP Sizing & Selection Toolkit
Framework for sizing, selecting air-source HPs in Canada
Webinars/training to support installers (Market need)

Simulation-based Sizing Analysis
How should I size based on region, home?
Sample map of balance point temperatures
Understanding HP elec. demand critical for greater adoption

Sample: Transitioning from NG Furnace to HPs in Toronto

- **VCHP** Max when full elec. aux, $T_{\text{Outdoor}} < T_{\text{Min,HP}} (-23^\circ C)$
- **CCHP** Max demand: HP + elec. aux ($T_{\text{Min}} = -23^\circ C$)

Extended HP ($T_{\text{min,HP}} = -25^\circ C$) range reduces increase

How do different ASHP tech. influence demand?
How can HPs provide flexibility via controls, storage?
High Temperature HPs (HTHP) as Retrofits in C/I Buildings (Annex 60 work)

**HTHP: Strong potential as C/I HP retrofit solution**
Connect to HT heating sys. w/o need for costly renovation
Enables low-T DH, heat recovery, renewable integration
Our Work: Testing, modelling, assessment tool development

**HTHP Assessment Tool** (Under development)
Comparison of various HVAC systems
- Boiler/chiller, conven. HP, HTHP (various config)
- GHG, energy, operational costs
BEYOND RESIDENTIAL SECTOR: INDUST. SECTOR

High Temperature HPs (HTHP) for Industrial Applications (Annex 58 work)

Source temperatures up to 90°C

Sink temperatures up to 150°C

Refrigerant Options: R718, R744, others

HTHP: Solution to support decarbonisation of industrial processes
Evaluation of HTHP potential in industrial processes
Understanding Canadian market and refrigerant options
Elec Demand and Flexibility of HP Systems
HPs must be optimized to support peak management
R&D Activity: HP + Thermal Storage systems (Grid Optimized HPs), Advanced controls

Transition to Low-GWP Refrigerants
Transition to low-GWP refrigerants requires new solutions
R&D Activities: CO₂-based HP systems and thermal networks
Refrigerant mixtures for cold climates

First Cost of GSHPs
GSHPs are an efficient solution, but have high first cost
R&D Activity: Compact ground heat exchangers
CO₂ DX GSHPs
Standing Column Wells
KEY TAKEAWAYS

Heat Pumps: A Key Element of Canada’s Decarbonisation Strategy
ASHPs: Breakeven or savings on annual utility costs under most scenarios/regions
National & regional policy driving increased uptake

Market Support Activities Critical to Driving Uptake
Proper sizing and integration needed to capitalize on system potential
Training, industry support needed to broaden awareness of best practise

R&D for Next Generation Canadian Systems
Focus on affordable systems well adapted to Canada
Strong need for energy flexible HP systems, retrofit solutions