

CITY OF NEW WESTMINSTER:

Achieving a High-Quality Heat Pump Upgrade

Prepared by:

Ryan Coleman and Sue Chung, Energy Save New West
Rob Pope, Ecolighten Energy Solutions

Prepared for:

Homeowner Webinar Series

March 5th, 2026

Housekeeping



During the presentation, use the chat box or raise your hand to ask questions.



Please remain silent unless you need to speak.



A Q & A session will follow the presentation.



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Achieving a High-Quality Heat Pump Upgrade

March 5th, 2026

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Introduction to Renovation Insights

- Natural Resources Canada (NRCan) Renovation Insights is a series of infosheets designed to support Canadians with knowledge building to maximize the benefits when investing in performance upgrades for your home.



Renovation Insights #1:
Building Enclosures



Renovation Insights #2:
Heating & Cooling

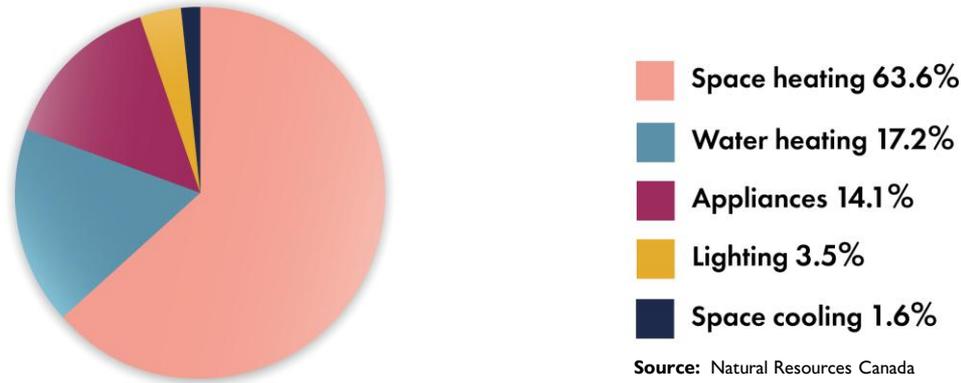


Renovation Insights #3:
Resiliency Upgrades

Today's Session!

The Opportunity with Home Heating and Cooling

- Did you know that home heating and cooling account for approximately **64% of the typical home's energy consumption**, and **13% of Canadian greenhouse gas emissions**?



- Investing in energy-efficient, low carbon cost-effective heating and cooling solutions is an effective way for Canadians to save energy, improve home comfort and reduce your emission



Topics

Part 1

Understanding Heat Pump Technologies

Part 2

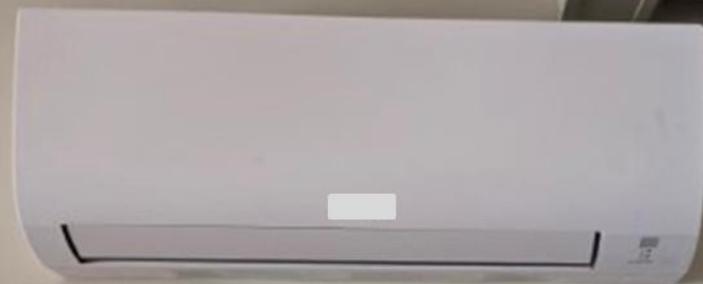
Steps to Achieve a High-Quality Installation

Part 3

Calculations to Inform Decision-Making

Part 4

Working With Professionals



Part 1

Understanding Heat Pump Technologies



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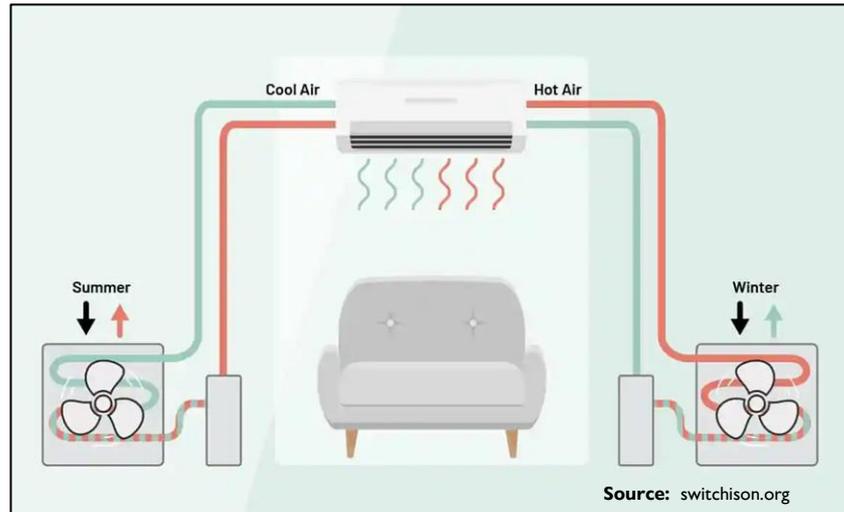
What is a Heat Pump?

- Heat pumps are a proven technology that have been used for decades, both in Canada and globally, to efficiently provide heating, cooling, and domestic hot water in homes.

COOLING

During warmer months, they also provide cooling by transferring heat from warm indoor air to the outside of your home

HEAT PUMP TECHNOLOGY



HEATING

During the cooler months, a heat pump extracts heat from the outside air, using electricity to increase the temperature of the heat and transfer it inside your home.

Types of Heat Pumps: All Electric

- Air-to-air heat pumps are the most common technology. There are three (3) main types: centrally ducted, mini-split ductless, and multi-split ductless.

Centrally-Ducted Heat Pump



Centrally ducted heat pumps distribute heat and cooling through ductwork connected to vents in each room.

Ductless Heat Pump

Mini-split
Multi-split
Concealed Ductless



Ductless heat pumps use a series of one or more indoor heads located throughout the home to distribute heating and cooling. A concealed ductless heat pump uses short ductwork to connect a single indoor unit to multiple rooms

Types of Heat Pumps: Dual Fuel or Hybrid

Dual-Fuel (Hybrid) Heat Pumps



Dual fuel (or hybrid) heat pumps typically combines an electric heat pump and a gas furnace. As outdoor temperatures change, the system alternates between the two fuel sources, maximizing comfort and efficiency while providing a homeowner the key benefits of both fuel sources.

Dual Fuel (Hybrid) Heating System: Controls

Dual fuel heating systems have two (2) options for switchover from heat pump to furnace operation and may employ either or both options depending on the technology.

- **Option 1** – Set-point deviation is typically 1°C to 3°C with time duration of 30 minutes or longer.
- **Option 2** – Thermostats using outdoor temperature sensor or information from local weather station.

Types of Heat Pumps: Dual Fuel or Hybrid

- A dual fuel (hybrid) retrofit in an existing home with forced air heating may require adding a heat pump to an existing gas furnace or installing a completely new system. Each retrofit option has its own unique considerations to optimize performance.



An older furnace (standard, mid-efficiency or high-efficiency) that requires replacement provides and opportunity to complete a full changeout for dual fuel capability.

Key technical considerations:

- Air Conditioning, Refrigeration, and Refrigeration Institute (AHRI) certification
- Potential existing ductwork limitations and ducting enhancements.
- Proper controls to ensure full interoperability



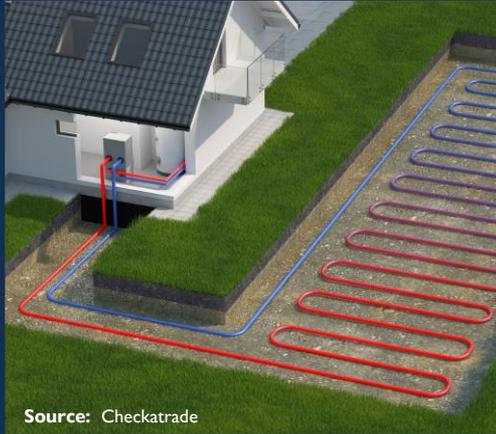
An existing high-efficiency furnace with service life remaining provides an opportunity to add a heat pump for dual fuel system capability.

Key technical considerations:

- Heat pump sizing with gas furnace
- Opportunities and limitations with single-stage, two-stage, and variable speed equipment
- Managing system air flows and static pressure

Types of Heat Pumps: Geothermal and Air-to-Water

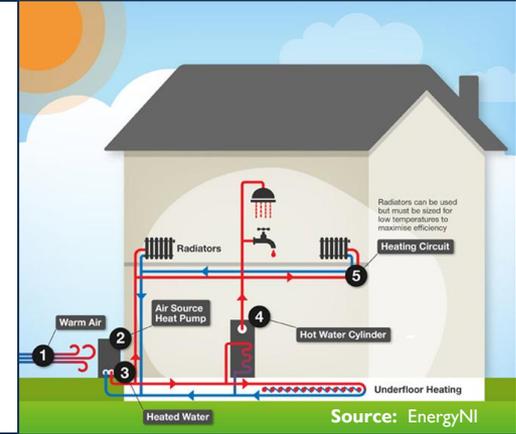
Geothermal Heat Pumps



Source: Checktrade

Ground source heat pumps utilize the moderate temperature of the ground to have high year-round efficiency. These systems have significantly higher upfront costs than air source heat pumps.

Air-To-Water Heat Pumps



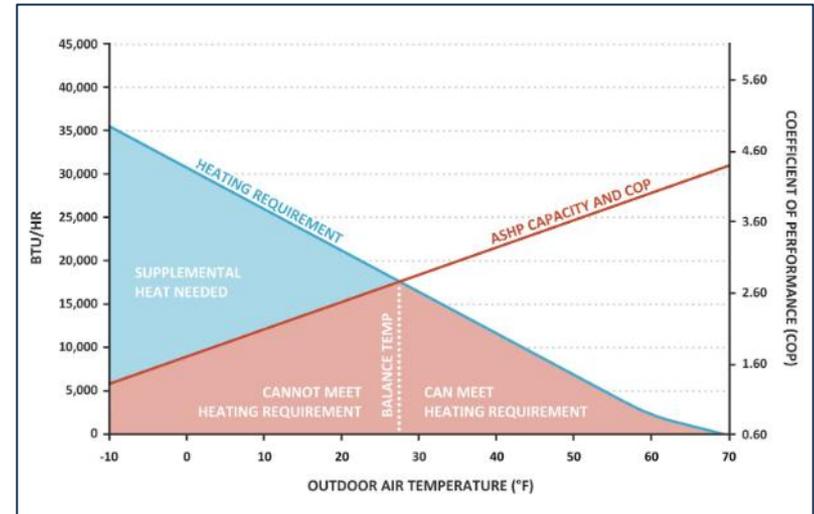
Source: EnergyNI

Air-to-water heat pumps take heat from the outdoor air, but they transfer it into a liquid distribution (hydronic) system. Air-to water heat pumps can be used for both space heating/cooling and domestic hot water.

Heat Pump Performance: Efficiency and Capacity

- Understanding **heat pump efficiency and capacity** is key to selecting the right system for year-round, energy-efficient heating and cooling.
- As outdoor temperatures drop, a heat pump will need to work harder to extract heat from colder air. This increases electricity consumption and lowers the coefficient of performance (COP) while also reducing the heat pumps capacity (BTU/h).

Heat Pump Performance (*example only*):
Efficiency & Capacity



Source: Interior Climate Solutions

Heat Pump Performance: HSPF and SEER Ratings

- Evaluating heat pumps involves reviewing **efficiency ratings** like HSPF2 (heating) and SEER2 (cooling), with higher numbers indicating better performance. Additional key factors include **compressor technology** and **cold-climate performance**.

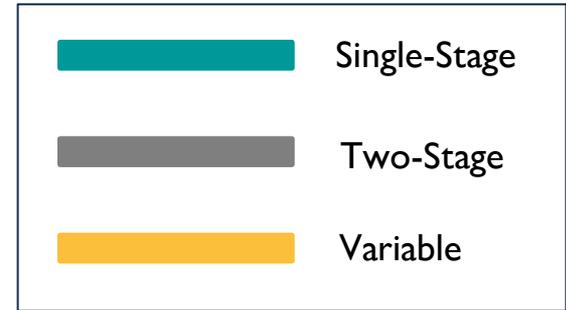
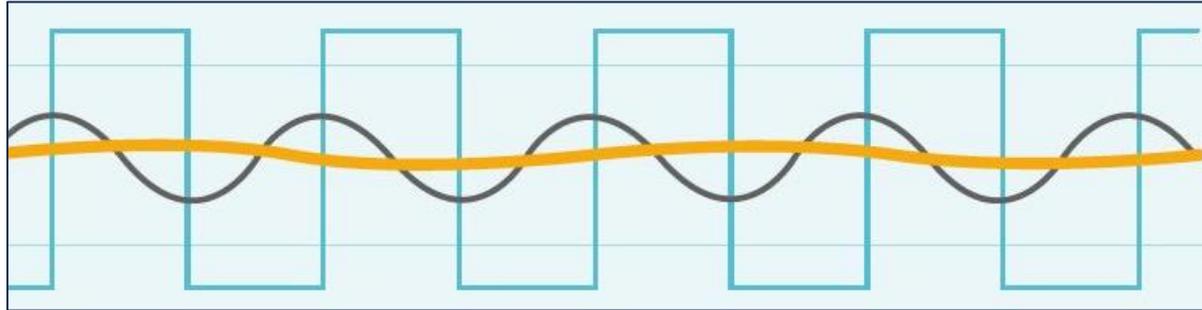


Heating Seasonal Performance Factor 2 (HPSF2) is a metric that measures the efficiency of a heat pump's heating mode.



Seasonal Energy Efficiency Ratio 2 (SEER2) measures the total heat removed from the conditioned space during the annual cooling.

Heat Pump Performance: Compressor Technology



- **Single-Stage:** Operates on a full-on or full-off schedule and works at 100% capacity all the time. It is the lowest up-front cost least efficient technology.
- **Two-Stage:** Offers better control and performance with higher efficiency than single-stage technology. These heat pumps work at 60% - 65% capacity for 80% of the time.
- **Variable Capacity:** These heat pumps can operate at the speed necessary to meet demand. They are 40% - 50% higher efficiency than conventional equipment and can serve multiple zones with a single outdoor unit.

Heat Pump Performance: Cold Climate

- **Cold climate heat pumps (CCHP)** are specially adapted to the harsh Canadian climate and can effectively heat your home with high efficiency and capacity even when outdoor temperatures are as cold as -30°C .
- CCHP are a proven technology to mitigate or eliminate (in some cases) the need for supplemental heating. Technology has been tested in Canadian winters since the early 2010s.
- Certified cold-climate heat pumps must maintain a COP of at least 1.75 and 70% of nominal capacity at 5°F (-15°C).



Approach to Supplemental and Back-Up Heating

- For a centrally ducted heat pump, supplemental heating is the additional heat that is needed if the heat pump cannot keep up with the heating needs of the home during peak cold conditions.
- With an all-electric system, supplementary heating is provided with electric resistance. With a dual fuel approach, supplemental heating may be provided by a high-efficiency furnace.
- This terminology should not be confused with “back-up” or “emergency” heat which is a heating source that should only come on if there is a failure of the primary heating system.





Part 2

Steps to Achieve a High-Quality Installation



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Homeowner Steps to a Quality Installation

- Optimized performance of an all-electric or dual fuel (hybrid) heat pump depends on **proper sizing, installation, and commissioning.**
- Industry research¹ on installed performance of equipment shows: “**50% to 70% of HVAC systems are improperly installed, causing them to be 10% to 50% less efficient** than if they received quality design, specification, and installation.”

1

Pre-Changeout

Homeowner interview
Home performance
Equipment review and testing

2

Calculations

F280-12 load calculations
Balance point calculations
Electrical panel / service

3

Installation

Equipment selection
Quality installation attributes
Control configuration

4

Verification

Equipment commissioning
Documentation
Homeowner education

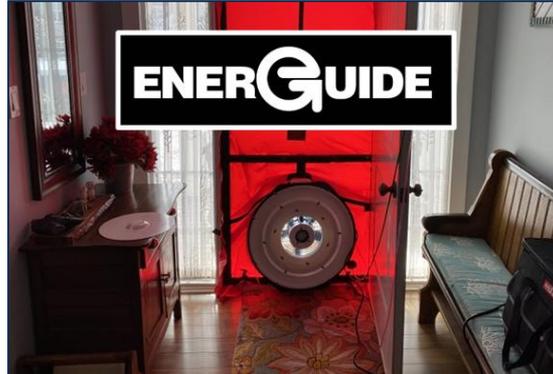
1. Robert Morris and Ean Jones, “Peak Demand and Energy Savings from Properly Sized Matched Air Conditioners,” American Council for Energy Efficient Economy (2008).

Step 1: Pre-changeout

- Pre-changeout procedures are designed to better understand the existing HVAC system and overall home performance that should inform proper heat pump sizing and equipment selection.



Homeowner Interview



Home Performance



Equipment Review & Testing

Step 1: Pre-changeout



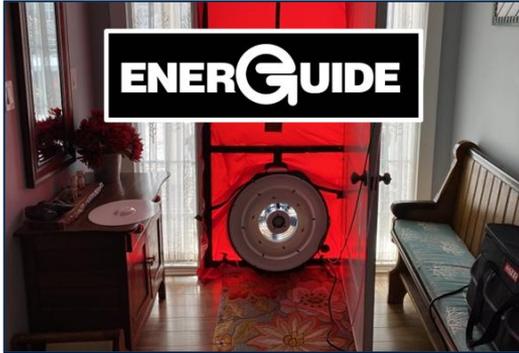
Homeowner discovery is a process of gathering information from the consumer to better understand their expectations and needs. This step is often overlooked to support informed decision making and recommendation on a heat pump system.

What is your experience with the existing HVAC equipment and distribution system?

What are your motivations for upgrading to a heat pump system?

Do you have any concerns with the heat pump outdoor unit placement?

Step 1: Pre-Changeout



Home performance including a determination of whether the homeowner has completed or planning to complete energy upgrades is important to understand since this may influence upgrade prioritization, equipment sizing and selection.



Performance assessment of the existing HVAC equipment is critical for gathering empirical data used to inform equipment options and potential limitations since a heat pump may operate at a different cubic foot per minute (CFM) of air flow.

Step 2: Calculations

- **Rule-of-thumb approaches should be avoided** with any heat pump retrofit. It is critical to complete the necessary calculations to avoid unintended consequences and poor system performance outcomes.



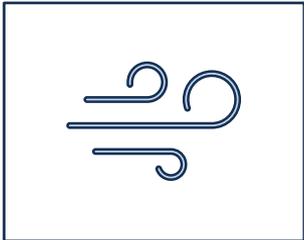
F280-12 Load Calculations:

Design heat loss and gain to determine equipment sizing.



Electrical Assessment:

Evaluation of electrical service / panel to confirm if upgrades needed.



Ductwork Evaluation:

Static pressure and air flow testing to confirm duct capacity.

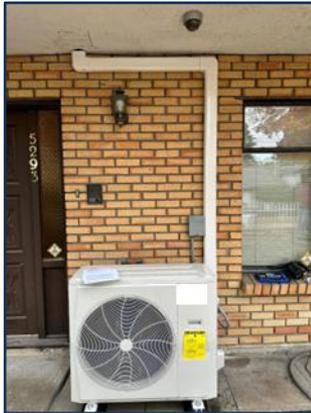


Balance Point:

Review heat pump performance and heat loss to confirm supplementary heating.

Step 3: Installation

- Selecting a good quality heat pump is only one part of the equation. Quality equipment should be matched with a high-quality installation and proper controls to optimize performance.



Outdoor Unit
Proper placement
Noise mitigation
Refrigerant lines

+



Indoor Unit(s)
Duct enhancements
High-efficiency filters
Condensate management

+



Controls
Connected / matched
Wired correctly

=



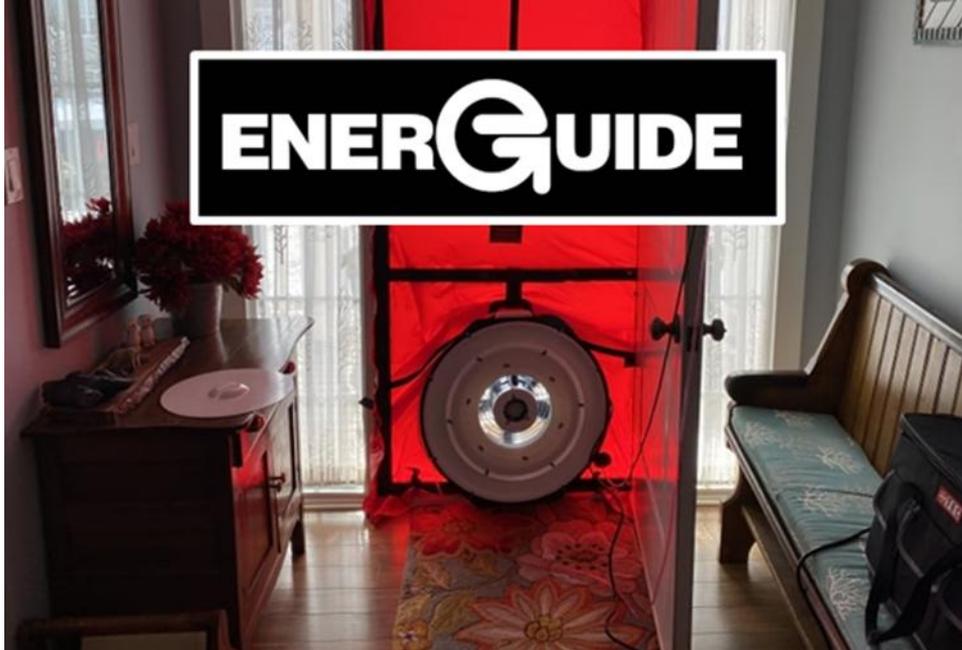
Step 4: Verification

- Performance verification with proper commissioning is often overlooked and is the final step needed to ensure a heat pump is operating at its optimal performance
- Contractor is responsible for completing all equipment start-up procedures and documentation of results.
- Commissioning has added benefit of providing the HVAC contractor baseline equipment performance results to support future servicing.



The logo for ENERGUIDE, featuring the word "ENERGUIDE" in white, bold, sans-serif capital letters on a black rectangular background. The letter "G" is stylized with a circular arrow around it.

ENERGUIDE



Part 3

Calculations to Inform Decision-Making



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Existing Industry Practices

- Too often a heat pump upgrade does not include adequate consideration to upfront planning and calculations to inform decision-making. This often leads to frustrated homeowners and poor installed performance of equipment.



Load Calculations:
Too often “rule of thumb”



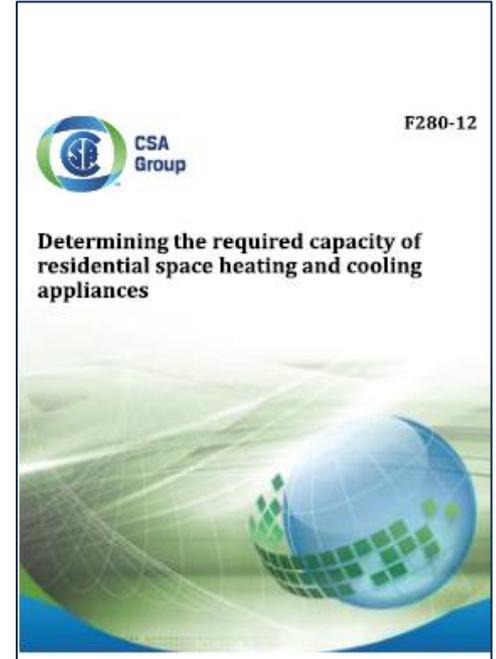
Ductwork Capacity
Guesstimation and not measured



Electrical Service / Panel:
Unnecessary Upgrades

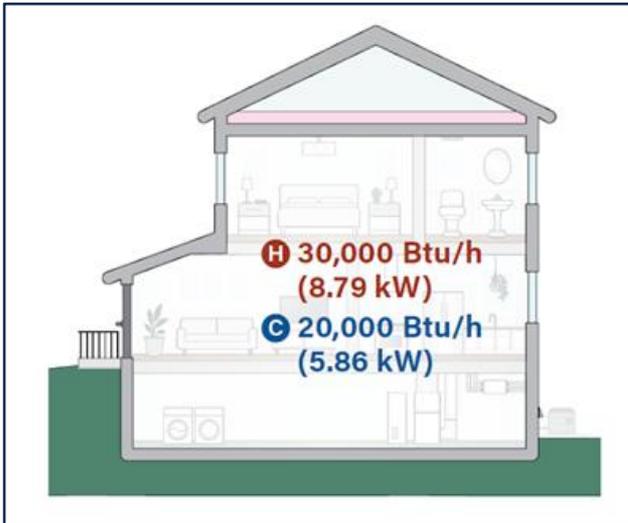
F280-12 Load Calculations

- CAN/CSA F280-12: Canadian Standards Association (CSA) standard on how to properly size residential space heating and cooling equipment that is nationally recognized and referenced in the BC Building Code (Section 9.33.5)
- Making sure this standard is used with a load calculation can:
 - ✓ Ensure a right-sized system
 - ✓ Ensure comfort
 - ✓ Reduce installed HVAC system costs

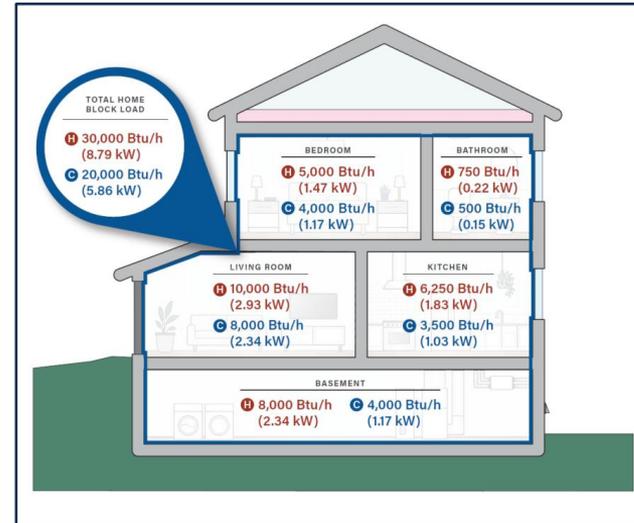


F280-12 Load Calculations: Block Load and Room-by-Room

- A block load calculates the heat loss/gain of the entire house as a single space. It is used for energy modelling and is typically used for retrofits on existing homes. A room-by-room is required for new construction and is the only approach that can adequately inform an HVAC system design.



VS



Using F280-12 Verified Software

- HVAC Designers of Canada has published a list of verified software tools that are compliant with CSA F280-12.
- Using verified software gives both the HVAC contractor, and those who rely on the outputs from the software, confidence that the tool can generate correct results in line with the CSA standard.



Verified F280 software tools are available at: <https://hvacdc.ca/f280-12-software/>

Evaluating Duct Capacity

- Direct airflow and static pressure measurement is the most reliable method to obtain the information required to understand existing ductwork capacity and predict the effect of airflow changes.
- At a minimum, contractors should assess static pressure to determine whether existing ductwork is adequate for the proposed new system airflow and if ductwork modifications are required.
- The air flow impacts the size and performance of the heat pump.



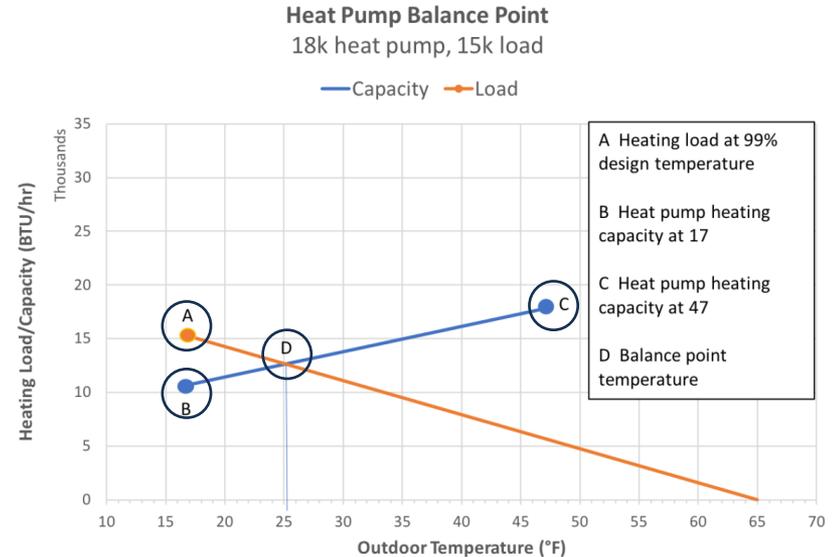
Evaluating Duct Capacity

- Centrally ducted heat pumps need higher airflow. The air flow impacts the size and performance of the heat pump.



Understanding the Capacity Balance Point

- **There is no such thing as a universal balance point.** Performance curves vary between various technologies, brands, and models of heat pumps.
- As the outdoor temperature lowers, the efficiency and capacity of the heat pump will also drop – at a rate dependent on the technology and quality of the heat pump.
- Calculating the thermal balance point requires the heat loss of the home plotted against the performance curve of the heat pump.



Electrical Service & Capacity

- Homeowners often wonder if their home's electrical panel will be able to support a new heat pump and the costs associated with upgrading it.
- Electrifying your home doesn't always require a service upgrade but your electrical contractor will have to do a load calculation to make sure your home has enough electrical capacity and it's required for the electrical permit.

1

Estimated Load: Canadian Electric Code (CEC) provides formulas for adding the loads of all appliances to determine the total load capacity requirement of your service.

This is a prescriptive methodology that is typically conservative in its estimation of the panel size and all other associated components of your service.

2

Demonstrated Load: CEC Rule 8 – 106 allows use of advanced meter data from actual electrical consumption to evaluate maximum amperage and demonstrated demand using utility data.

The Demonstrated Load approach will typically result in a smaller load requirement and may help avoid a panel upgrade.

Electrical Service & Capacity

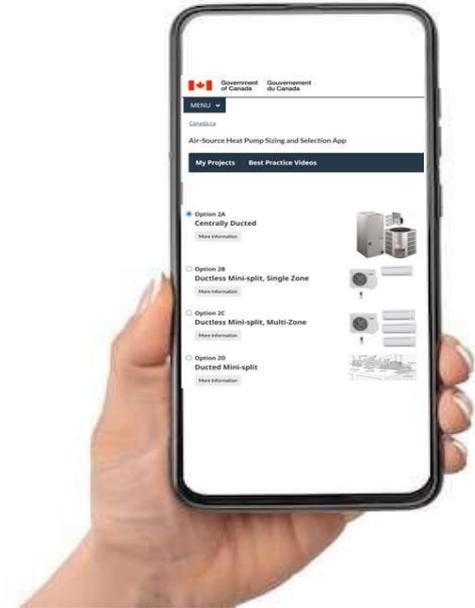
- Natural Resources Canada's **Spark Tool** uses advanced meter data to calculate peak amperage and demonstrated demand, so contractors can determine whether a main electrical panel actual requires and upgrade.
- To mitigate costly electrical panel and service upgrades, contractors can also provide homeowners a range of alternative options to accommodate a new heat pump including removal of unused circuits or load management technologies.

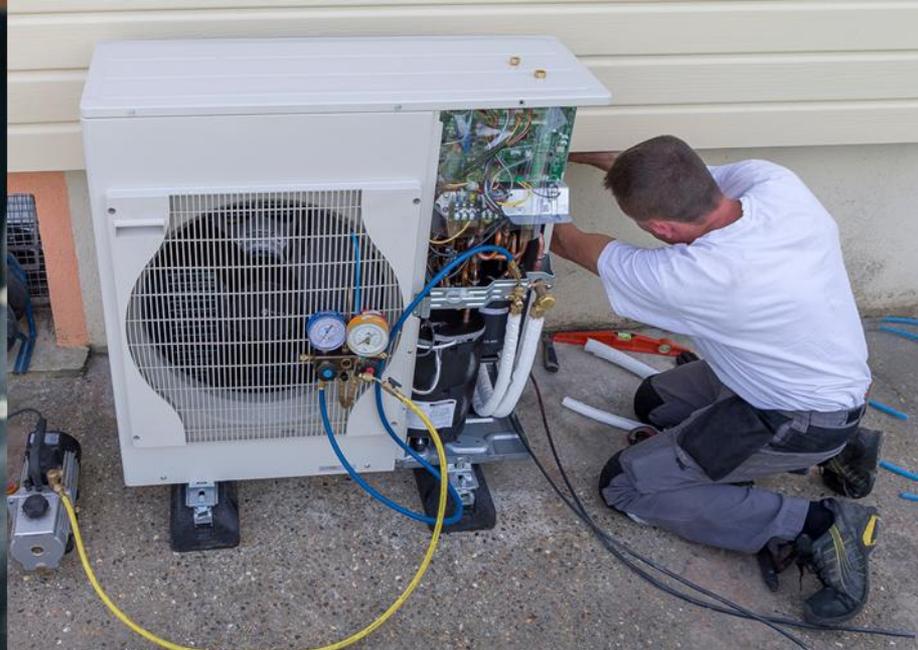


<https://canmet-energy.github.io/leep-spark-tool/>

Air-Source Heat Pump Sizing and Selection App

- Natural Resources Canada's **Air-Source Heat Pump Sizing and Selection App** is a new online tool available to support HVAC contractors with guidance on the process for sizing air source heat pumps.
- NRCan's app allows users to take a step-by-step approach to identifying the appropriate heat pump system for new construction or retrofit applications according to the design heating or cooling loads, duct capacity and other technical considerations.





Part 4

Working With Professionals



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Professionals Involved in a Heat Pump Retrofit

- Homeowners completing a heat pump retrofit will have the opportunity to work closely with their HVAC contractor and an Energy Advisor (in some cases).
- Collaboration includes a diligent process with proper calculations to inform decision-making designed to achieve best results.



Energy Advisor: What To Expect?

- Blower door testing
- Duct flow testing (some EAs)
- Electrical assessment (some EAs)
- F280-12 load calculation (some EAs)
- Energy modeling
- Homeowner information sheet
- Upgrade recommendations
- Rebate and incentive information



HVAC Contractor: What To Expect?

- Pre-changeout interview
- Existing system review and testing
- F280-12 load calculation
- Presentation of heat pump options
- Quality installation
- Permits
- Commissioning report
- Service and maintenance (option)

Energy Advisor: Benefits of Energy Evaluation

- Working with an Energy Advisor offers homeowners an independent technical support resource that can provide useful information to improve a heat pump retrofit.

Building Enclosure Upgrades

- Identification of air sealing, insulation, or window and door improvements that could be considered to reduce heat loss and potentially reduce heat pump system size.

Energy Modeling

- Data from energy modeling can be used to generate an F280-12 compliant load calculation for heat pump sizing and selection.

Enhanced Services

- Select Energy Advisors have additional training and tools to facilitate air flow testing, and electrical panel / service assessments to support project decision-making.

HVAC Contractor: Achieving A Quality Installation

- Quality installations provide substantial non-energy related benefits - improved occupant comfort, lower maintenance costs and longer equipment life-cycles.

“The most important day of an HVAC system is the day it is installed. Proper commissioning of the system is the only way to achieve the efficiency and long life for which the system was designed. It can also be the key to effective troubleshooting later.”

Product Manager
Johnson Controls Inc.

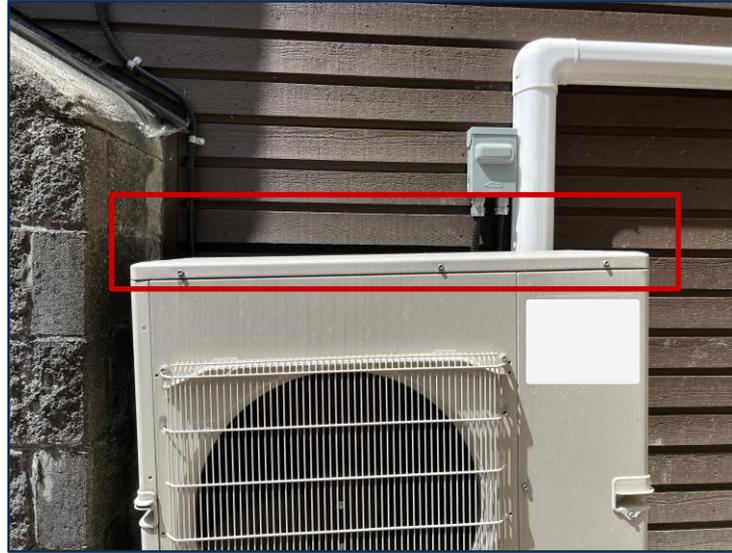


Quality Installation: Outdoor Unit

OUTDOOR UNIT LEVEL



OUTDOOR UNIT NOT LEVEL



Quality Installation: Noise Mitigation

NOISE MITIGATION APPLIED



NO NOISE MITIGATION APPLIED



Quality Installation: Refrigerant Lines

UV PROTECTED AND INSULATED



NOT UV PROTECTED



Quality Installation: Refrigerant Lines

UV PROTECTED AND INSULATED



NOT UV PROTECTED



Quality Installation: Refrigerant Lines

CONDUIT USED



CONDUIT NOT USED



Quality Installation: Matched System (Dual Fuel / Hybrid)

FULLY MATCHED EQUIPMENT



NOT MATCHED EQUIPMENT



Quality Installation: Matching Thermostat

MATCHING THERMOSTAT WITH HEAT PUMP SYSTEM



UNMATCHED THERMOSTAT WITH HEAT PUMP SYSTEM



Quality Installation: Thermostat Wiring

MATCHED WIRING AND THERMOSTAT



TWO-STAGE THERMOSTAT WIRED INCORRECTLY



Quality Installation: Filter Selection



Sealed filter cabinet



5" pleated high-efficiency filter



Accessible filter cabinet with 5" pleated high-efficiency filter



Quality Installation: Filter Selection



Plastic screen "filter" installed



Plastic screen "filter" installed in 1" filter rack



Metal screen "filter" installed



Quality Installation: Filter Cabinet

SEALED PRE-FABRICATED FILTER CABINET



MISSING FILTER DOOR



Quality Installation: Ducting

TAPERED TRANSITIONS
(SUPPLY & RETURN)



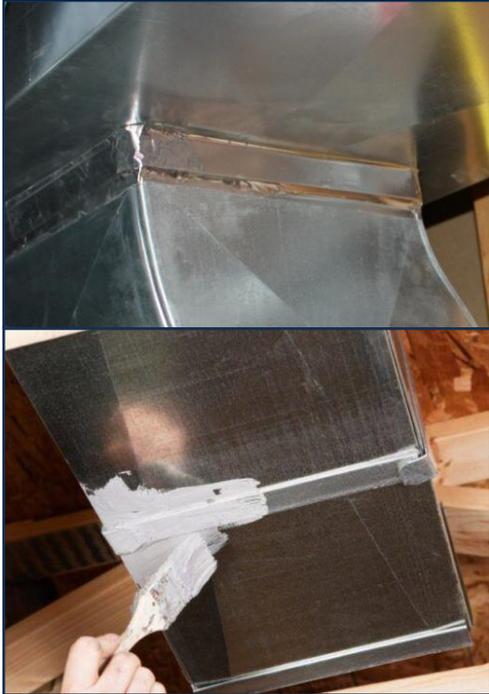
NON-TAPERED TRANSITIONS
(SUPPLY & RETURN)



Opportunity to improve air flow and reduce turbulence

Quality Installation: Ducting

SEALED DUCTWORK



UNSEALED DUCTWORK



Quality Installation: Building Penetrations

SEALED BUILDING PENETRATIONS



UNSEALED BUILDING PENETRATIONS



Commissioning: Central Air-Source Heat Pump

Commissioning

Example Contractor Checklist

Air-Source Heat Pump

- ✓ External Static Pressure
- ✓ Air Flow
- ✓ Controls
- ✓ Refrigerant Charge
- ✓ Commissioning Checklist

EXAMPLE: Heat Pump Commissioning Sheet

HEAT PUMP COMMISSIONING REPORT¹

Customer's Name:				Address:			
Heat Pump Equipment Information							
Manufacturer:		Model#	Outdoor Unit#		Indoor Unit#		
Heating capacity (BTU/h)		HSPF					
Cooling capacity (BTU/h)		EER (35°C)					
Design air flow (CFM)		SEER					
Variable speed HP compressor	YES / NO	Thermal balance point (°C)					
Duct design static pressure (IWC)							
Existing Heating System Being Replaced		Electric forced air w/out AC					
		Electric forced air w/ AC					
		Electric zonal					
		Air-source heat pump					
		Natural gas furnace					
		Other non-electric heating: _____					
Supplementary/Backup Heating System		Electric forced air w/out AC					
		Electric forced air w/ AC					
		Electric zonal					
		Natural gas furnace					
		Other non-electric heating: _____					
All tests performed in Test Only/Check Charge mode					YES / NO / NA		
External Static Pressure Test and Airflow							
Outdoor Air Temperature (°C)							
Test performed in heating or cooling mode?		Heating (if ≤18°C) / Cooling (if >18°C)					
Unit of Pressure Used		Supply Static Pressure					
Return Static Pressure		External Static Pressure					
Compressor suction pressure		Compressor head pressure					
Airflow at Evaporator (CFM)		Measurement method used			Trueflow/ Fan Curve / Temperature split / Other: _____		

¹ Installation of air-source heat pumps and air conditioners, CSA Standard C273.5-11 and Performance Tested Comfort Systems (PTCS) Air-Source Heat Pump Form

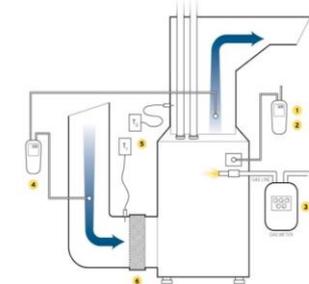
Commissioning: High-Efficiency Furnace (Dual Fuel / Hybrid)

Commissioning Example Contractor Checklist

Gas Furnace

- ✓ Gas Pressure (Inlet and Manifold)
- ✓ External Static Pressure
- ✓ Temperature Rise
- ✓ Clocking-the-meter
- ✓ Controls
- ✓ Commissioning Checklist

EXAMPLE: Gas Furnace Commissioning Sheet

Furnace Commissioning Sheet (required for furnace rebates only)			
Homeowner instructions: 1. Ask your contractor to complete this sheet. Your contractor will run a series of tests on your new high-efficiency furnace to gather the required data. 2. Submit a copy of this sheet with the rest of your rebate application package. 3. Keep a copy with your furnace. This sheet will provide valuable information when your furnace is serviced in the future.			
Why is commissioning important? Commissioning of a high-efficiency furnace ensures it is installed and operating correctly. The benefits of a properly commissioned furnace include lower operating costs, potentially greater equipment longevity, and less maintenance over its lifetime. Additional benefits include improved home comfort, and a furnace that will run smoothly and quietly.			
Contractor business name _____		Furnace installation date (MM/DD/YYYY) _____	
Installation address _____	City _____	Province _____	Postal code _____
Furnace make and model _____		Furnace serial number _____	
1. Inlet gas pressure (at high fire) _____ inches W.C.	2. Measure/let manifold gas pressure Type of furnace: <input type="checkbox"/> Modulating Skip to section 3 <input type="checkbox"/> Single stage High fire _____ inches W.C. <input type="checkbox"/> Two stage High fire _____ inches W.C. Low fire _____ inches W.C.	3. Clocking the meter (at high fire) CALCULATE BTU INPUT: _____ BTU/H	
4. External Static Pressures (at high fire) Supply Ductwork _____ inches W.C. Return Ductwork _____ inches W.C.	5. Temperature rise (at low and high fire) HIGH FIRE: LOW FIRE: RISE RANGE (as per manufacturer): Supply Air _____ °F Supply Air _____ °F High Fire _____ °F to _____ °F Return Air _____ °F Return Air _____ °F Low Fire _____ °F to _____ °F Total Rise = _____ °F Total Rise = _____ °F		
6. Filter Media Type _____ Measurements _____ MERV rating _____			
			
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Homeowner Education

HVAC Operation and Controls

- Homeowners may not be familiar with heat pump systems
- A complete walk-through is recommended to:
 - ✓ help them get familiarized with the new system
 - ✓ explain how the new system differs from previous one
 - ✓ demonstrate proper operation of the system
 - ✓ explain operation and programming of the Controls
 - ✓ identify remote components placed in locations other than the mechanical room

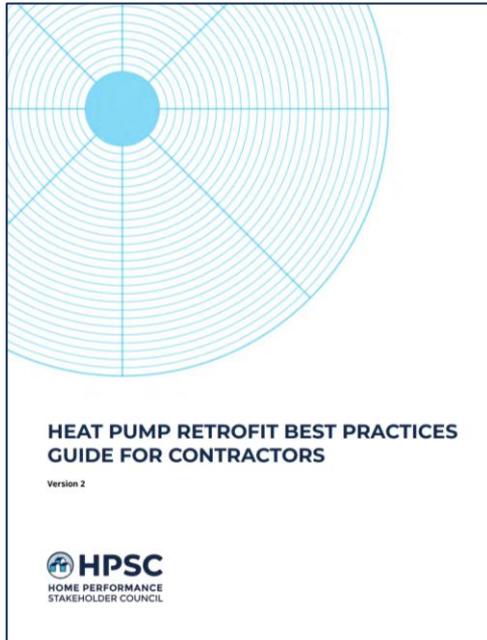


Key Learning

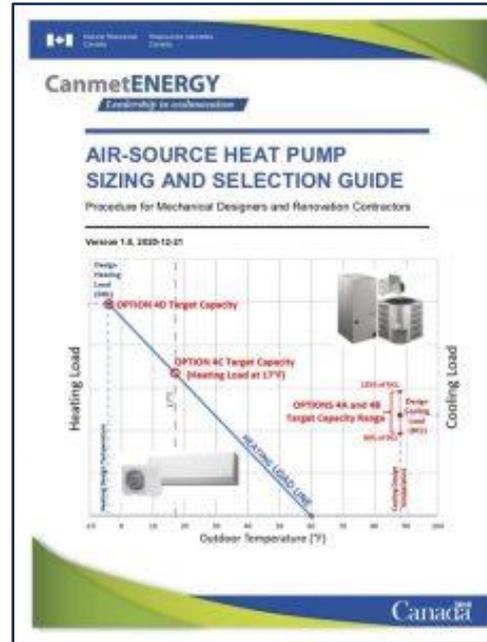
- 1. Be informed and be your own advocate.** Work with your HVAC contractor and Energy Advisor to ensure that all critical steps are followed through the heat pump retrofit process.
- 2. Optimizing a heat pump solutions requires a comprehensive approach.** This includes F280-12 load calculations, assessing ductwork capacity, quality installation, and system commissioning.
- 3. Load calculations using F280-12 with verified software tools supports right-sizing of heat pumps.** Proper equipment selection starts with right-sizing and avoids unintended consequences with rule-of-thumb approaches.
- 4. Invest in a quality installation to maximize benefits.** Cold climate heat pumps, matched systems, integrated controls, ducting enhancements, and high-efficiency filters provide value and support high performance outcomes.



Additional Resources



Best Practices Guide:
https://homeperformance.ca/wp-content/uploads/2025/11/HPSC-Heat-Pump-Retrofit-Best-Practices-Guide-for-Contractors_2025.pdf



Heat Pump Sizing Toolkit:
<https://natural-resources.canada.ca/maps-tools-and-publications/tools/modelling-tools/toolkit-for-air-source-heat-pump-sizing-and-selection/23558>



Best Practices Videos:
<https://natural-resources.canada.ca/energy-efficiency/homes/local-energy-efficiency-partnerships-leep/leep-videos/24757>



THANK YOU

Ryan Coleman

City of New Westminster
Energy Save New West

Rob Pope

Ecolighten Energy Solutions

Canada