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Introduction to Air Source Heat Pumps Installation Best Practices Series for Commercial Buildings

Peter Rowles
P.Eng., Energy Management Consultant

Agenda

1. Introduction to air source heat pumps (ASHP)
2. Overview of ASHP systems
3. Common HVAC systems
4. Installation process
5. Common myths
6. Motivations and barriers for building owners
7. Overview of ASHP installer series for commercial buildings (modules)
8. Question and answer

Objectives

- Understand what a heat pump is, how it works, particularly in cold climates – define cold climate
- Understand the potential benefits of heat pump adoption
- Understand the common myths surrounding air source heat pump (ASHP) applications in commercial buildings in Ontario
- Understand the motivations and barriers faced by building owners with ASHP installations in Ontario
- Understand objectives of ASHP installer series for commercial buildings

Save on Energy Program Updates

- **Retrofit program** prescriptive incentives for most **non-lighting measures** increased as of October 30, 2023. Many **doubled**, including for **air source heat pumps**. Visit the Retrofit program website for the updated measures and incentives.
- The **Instant Discounts program** for lighting launched **December 18, 2023.** Program incentives are directly to distributors, enabling them to offer instant point-of-sale discounts on energy-efficiency lighting to customers.
- **Strategic Energy Management program** offers a two-year, cohort-based learning model to organizations with at least 3,000,000 kWh annual energy consumption.
- The **Existing Building Commissioning program** provides financial incentives for businesses to hire qualified commissioning providers and to receive pay-for-performance incentives for savings achieved.

Save on Energy Training and Support

- **Save on Energy's Training and Support program** delivers webinars, coaching workshops and information resources to energy professionals across Ontario on a range of topics, including energy data, efficient electrification and heat pumps, all at no cost to participants.
- We also offer **incentives of up to 50% for 18 energy-efficiency training courses** and of up to 75% to Enbridge customers for several courses.
- All our training and support resources, including webinar recordings, information sheets, guides and case studies, can be found on the **Training and Support page** of the Save on Energy website. For more information, please contact us at trainingandsupport@ieso.ca

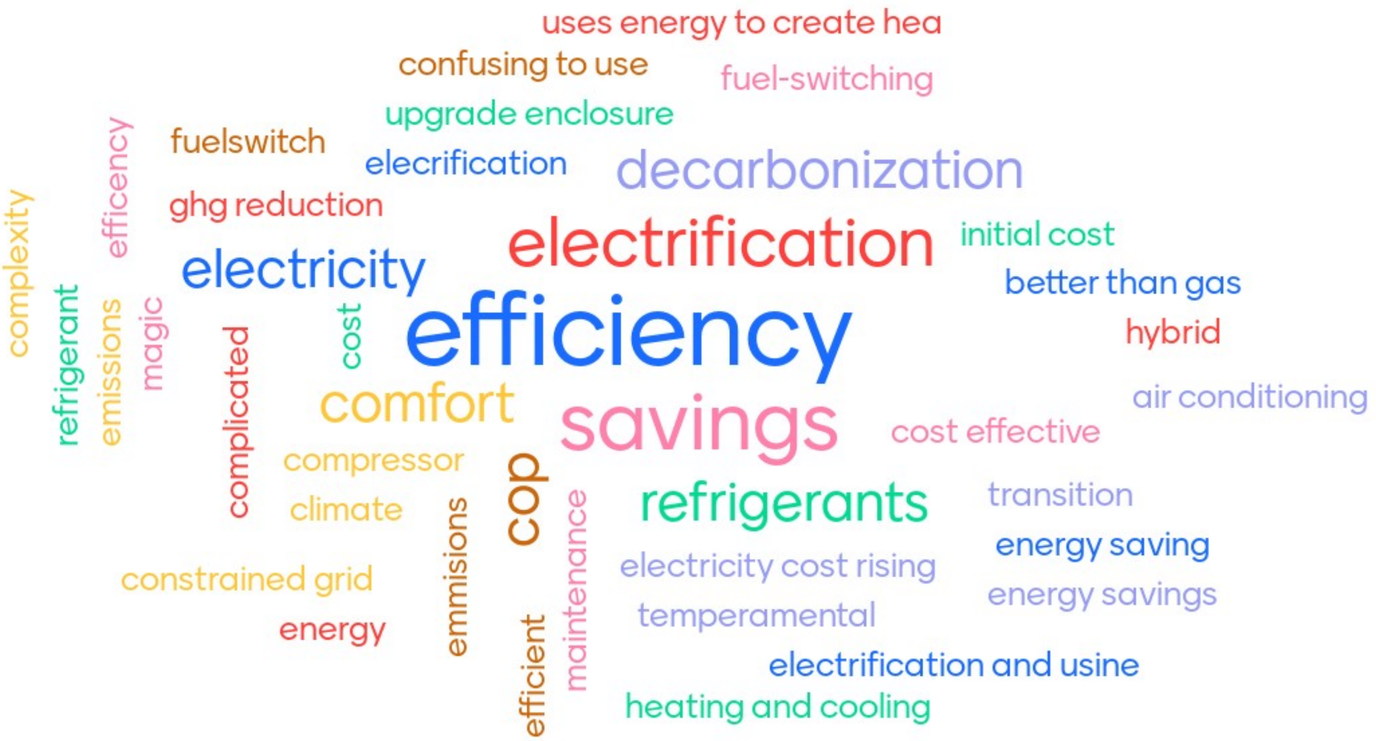
Poll

1. **What one word comes to mind when you think about heat pumps?**
2. **What experience do you have with heat pumps?**

Mentimeter

What one word comes to mind when you think about heat pumps?

57 responses



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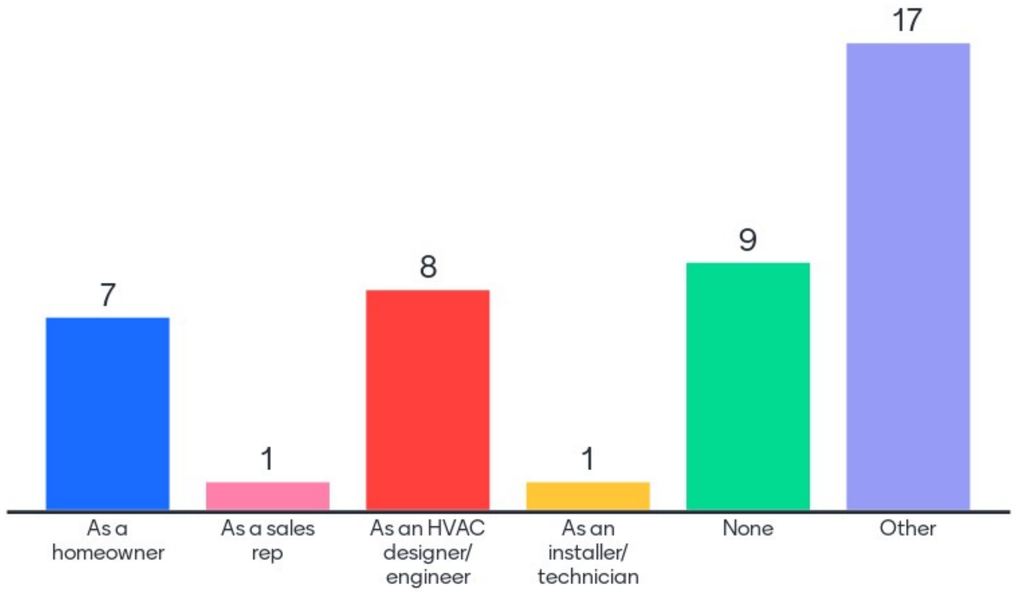
What experience do you have with heat pumps?



What is a heat pump?

A heat pump is an electrically driven device that extracts heat from a low temperature place (**a source**) and delivers it to a higher temperature place (**a sink**). NRCan

Air source heat pumps (ASHP)

During the heating season, the heat pump extracts warmth from the outdoor air. In the summer cooling season, it expels heat outdoors.

Heat pumps vs. furnaces or boilers




	ASHP	Electric heating	Natural gas heating	Diesel
Efficiency	Up to 400%	Up to 100%	Up to 97%	Up to 80%
Maintenance	Minimal	Variable	Moderate	High
Environment friendly	Yes*	Yes*	No	No

Benefits of heat pumps

Energy efficiency

Versatility

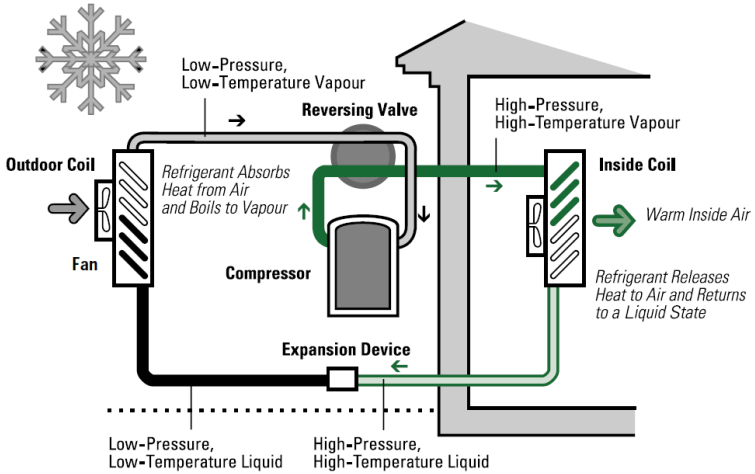
Environmental friendliness

Cost savings

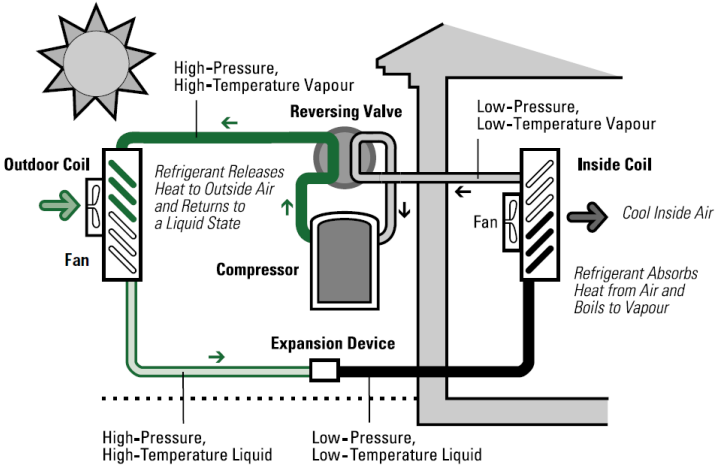
Consistent comfort

Air-source heat pumps: cycles

Heating mode



Cooling mode

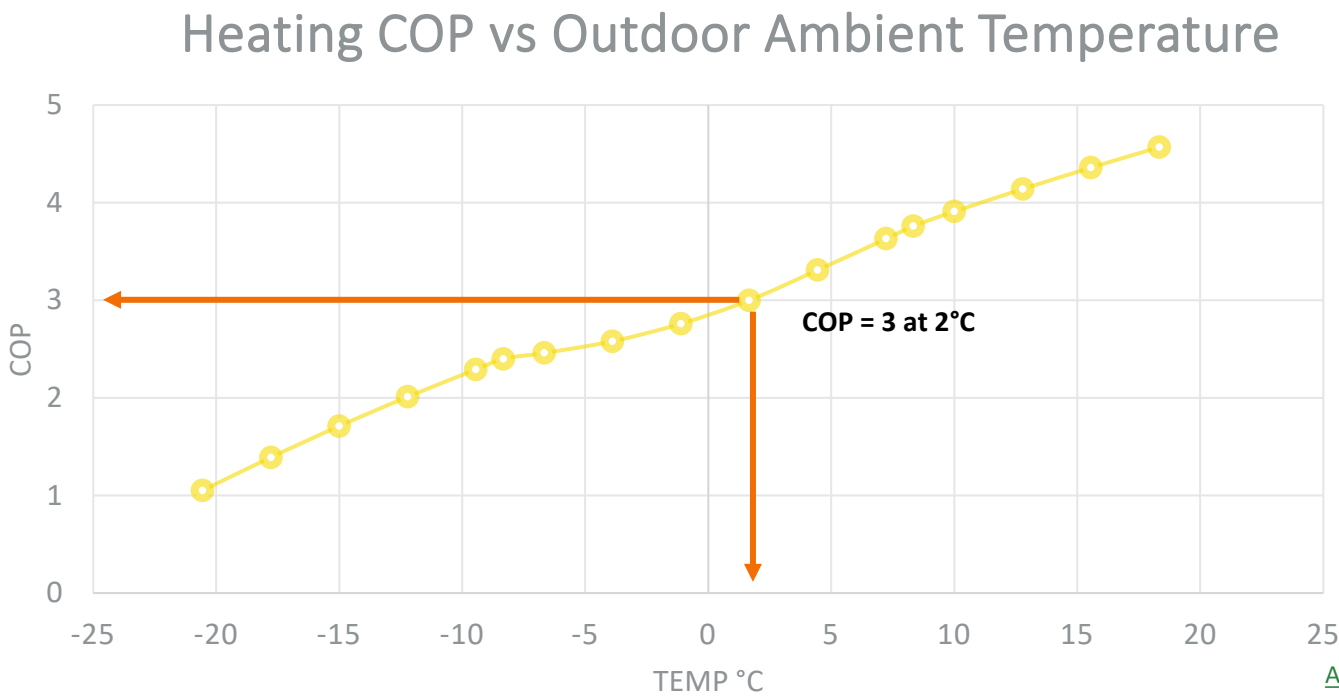


Heat pump performance

Common efficiency terminology for heat pumps:

- **Coefficient of Performance (COP)** – ratio of heat energy delivered to purchased electrical energy used to drive compressor and fans
- **Energy Efficiency Ratio (EER)** – effectively the cooling COP using mixed energy units, Btu/h cooling capacity divided by electrical energy input in Watts (W).
- **Heating Seasonal Performance Factor (HSPF)** – ratio of heat delivered over full heating season (Btu) to total energy (Wh) consumed by heat pump over same period
- **Seasonal Energy Efficiency Ratio (SEER)** – ratio of cooling delivered over full cooling season (Btu) to the total energy (Wh) consumed by heat pump/air conditioner.

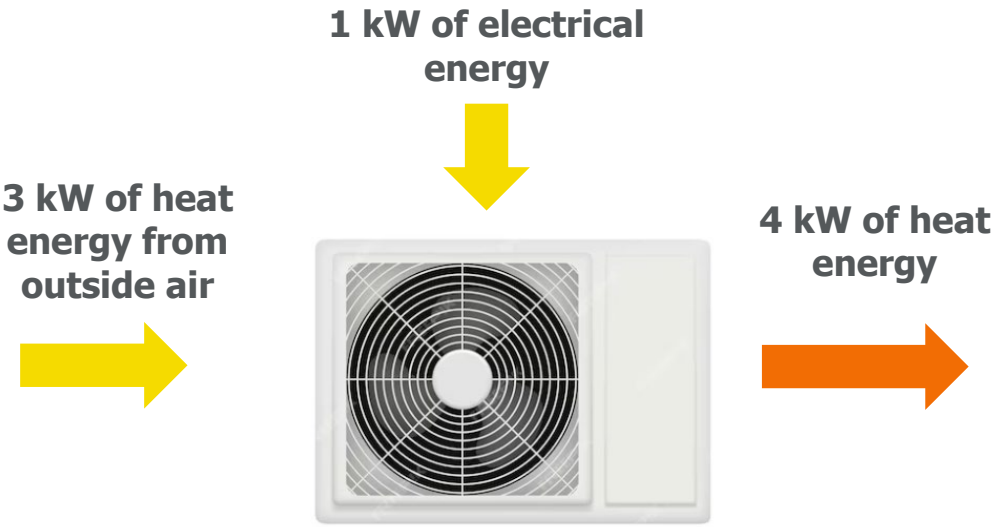
COP of ASHP vs. temperature



Source: NRCan
Air-Source heat pump sizing and selection guide

Coefficient of performance for heat pumps

The **coefficient of performance** (COP) of air-source heat pumps typically ranges from between **2.0** and **5.4**, at 8°C.



COP Performance = Heat energy out/Electrical energy in

COP Performance = 4/1 = **4**

Seasonal efficiency

Cooling Seasonal Performance, SEER:

- Minimum SEER (Canada): 14
- Range, SEER in Market Available Products: 14 to 42

Heating Seasonal Performance, HSPF

- Minimum HSPF (Canada): 7.1 (for Region V)
- Range, HSPF in Market Available Products: 7.1 to 13.2 (for Region V)

HSPF factors are provided for **ASHRAE Climate Zone V**, which has a similar climate to Ottawa. **Actual seasonal efficiencies may vary depending on your region.**

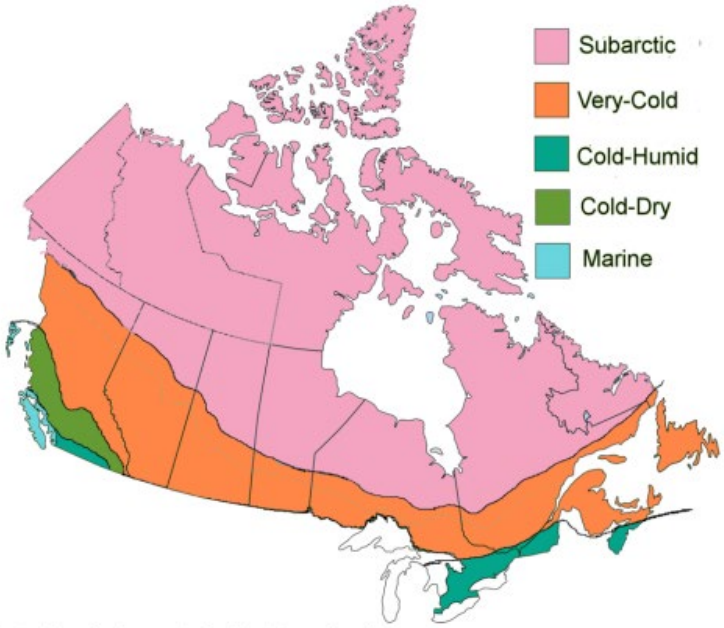
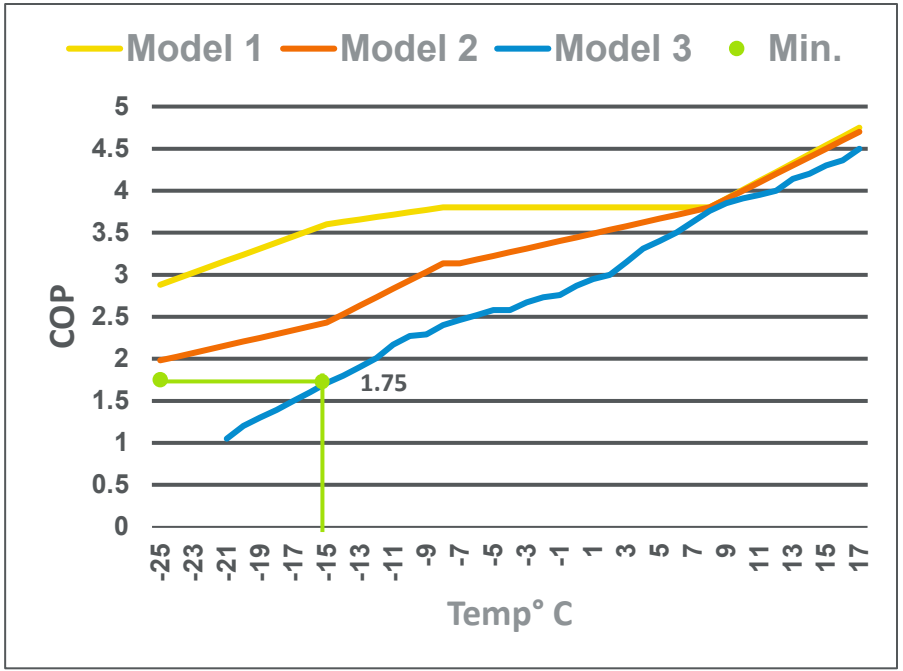


Figure 23: Climate Zone Assignments for Heat Pump Applications

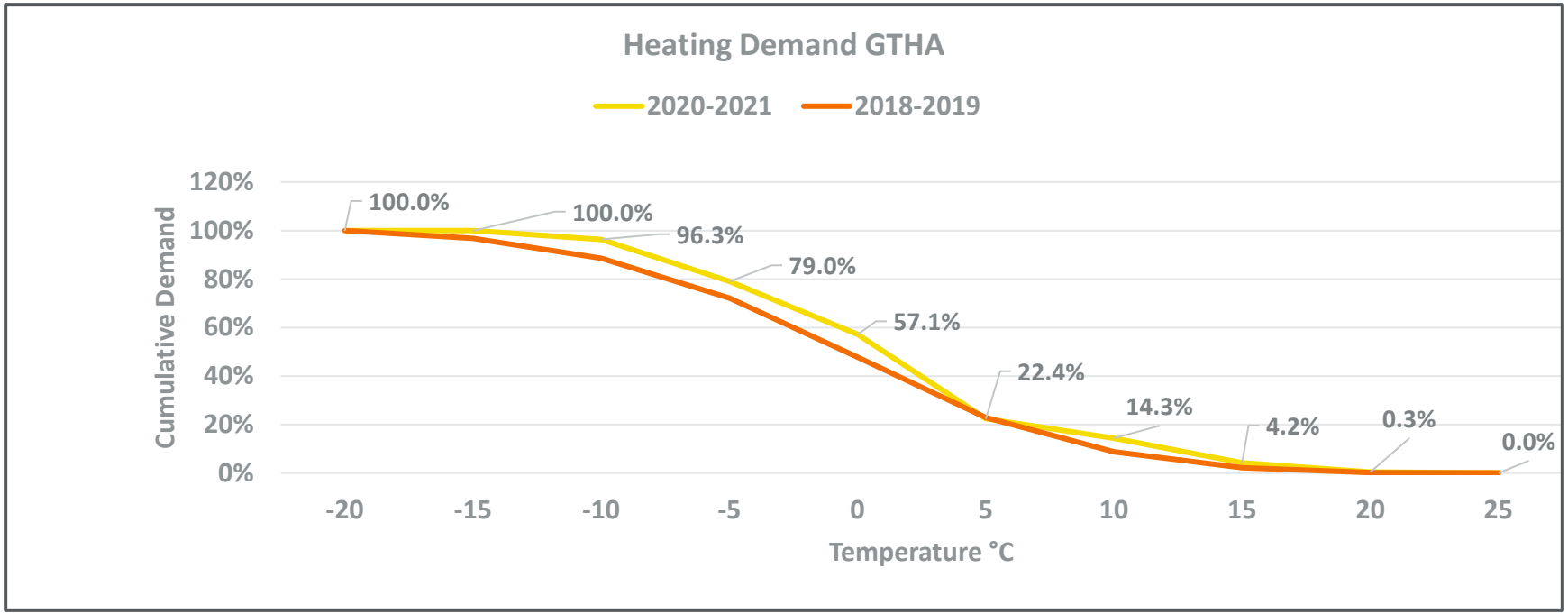
Cold climate performance

COP = Output Power ÷ Input Power

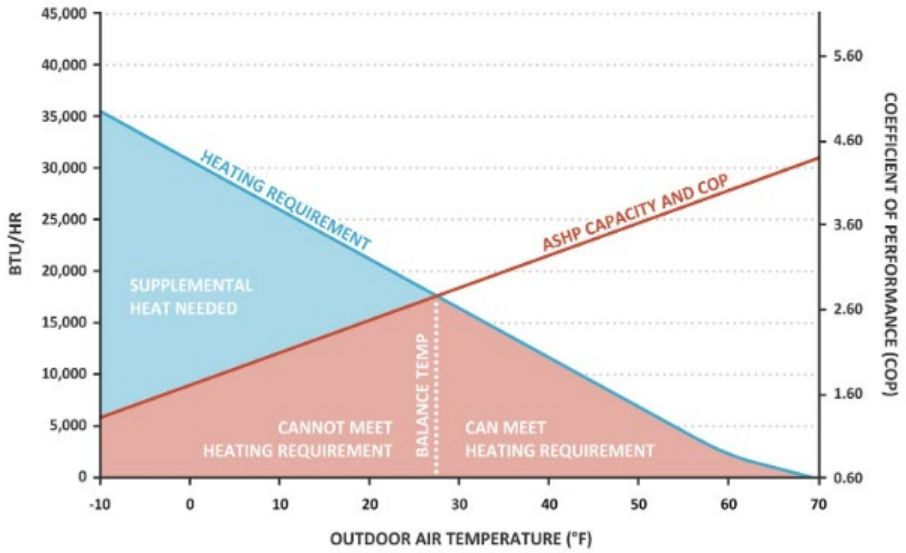
- ENERGY STAR® classifies a cold climate heat pump as one that can maintain a COP of at least 1.75 at -15C (5F)
- Some models perform better at lower outdoor air temperatures than others



Annual heating demand



Balance point of air source heat pumps



Sources : Aspiration energy

The heat pump capacity is the amount of heat that the equipment can deliver. Capacity declines with outdoor air temperature.

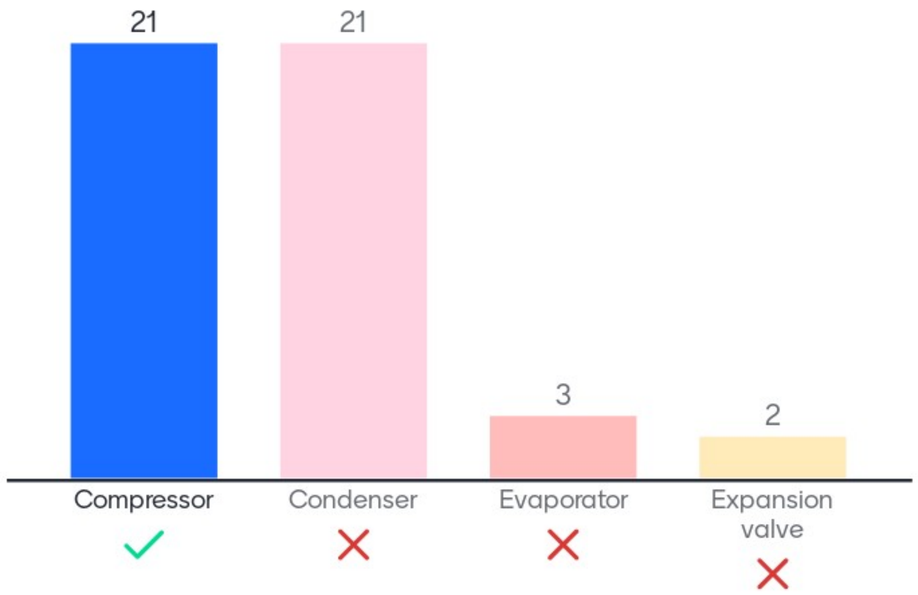
Heat load is the amount of heat required by a process to maintain a certain temperature.

A balance point is the approximate ambient temperature at which the maximum heating capacity of the heat pump matches the heating requirement of the application.

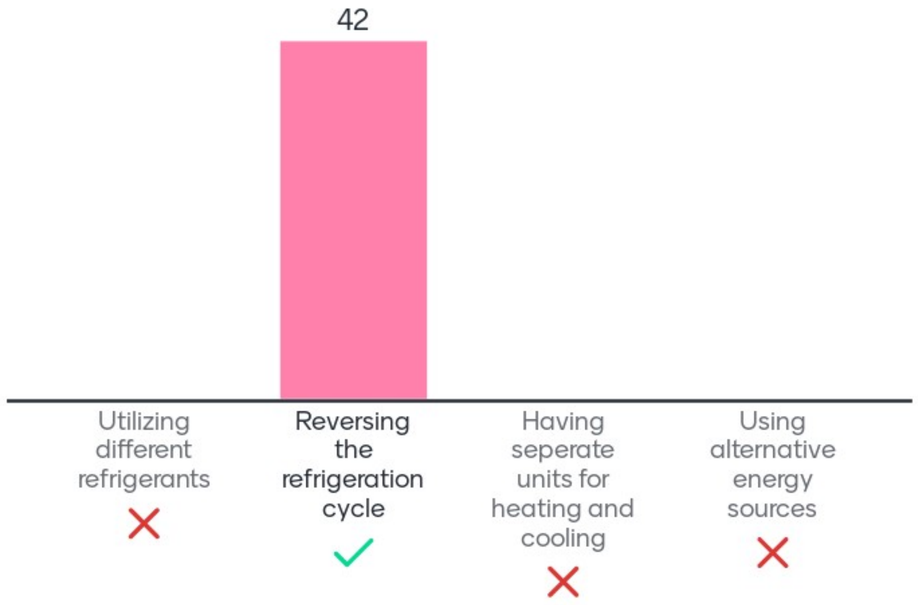
Knowledge check

Multiple choice quiz

What component in a heat pump system is responsible for transferring heat between the indoor and outdoor environments?

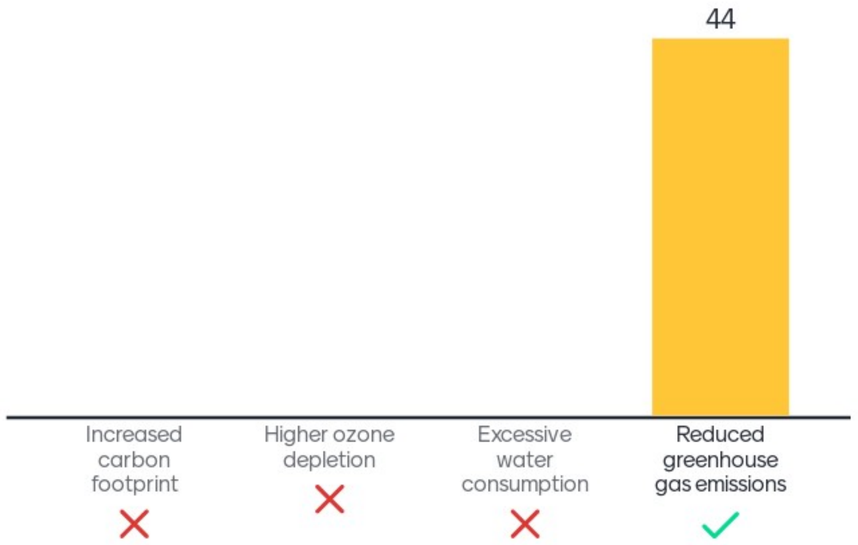


In a commercial building, how does a heat pump system provide both heating and cooling without separate equipment?



Mentimeter

Which environmental benefit is associated with the use of heat pumps in commercial buildings?



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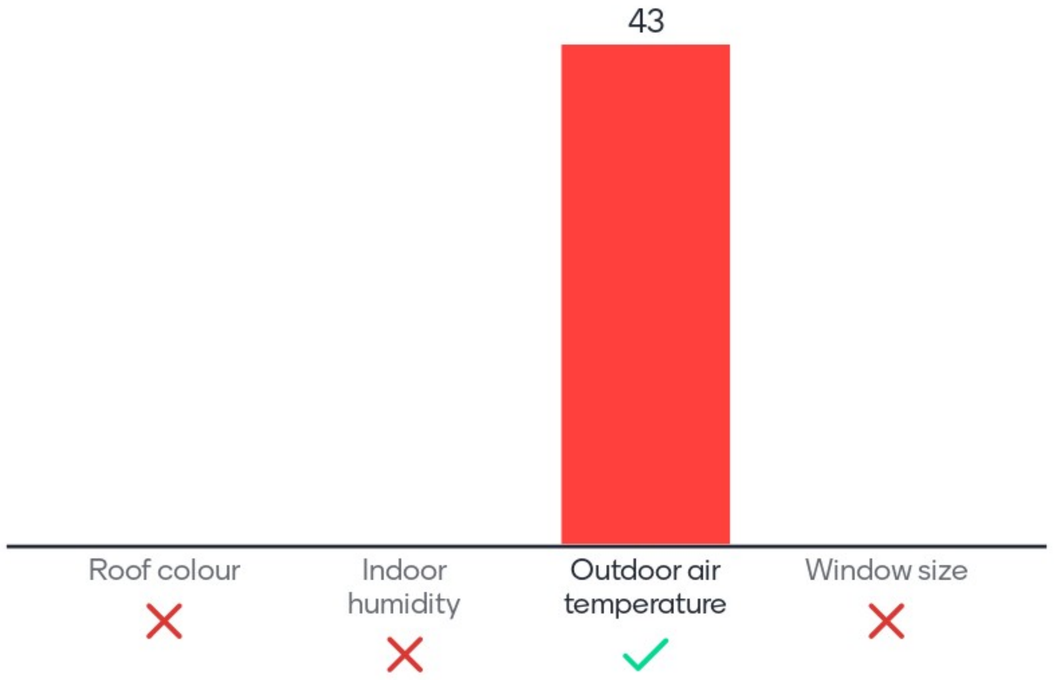
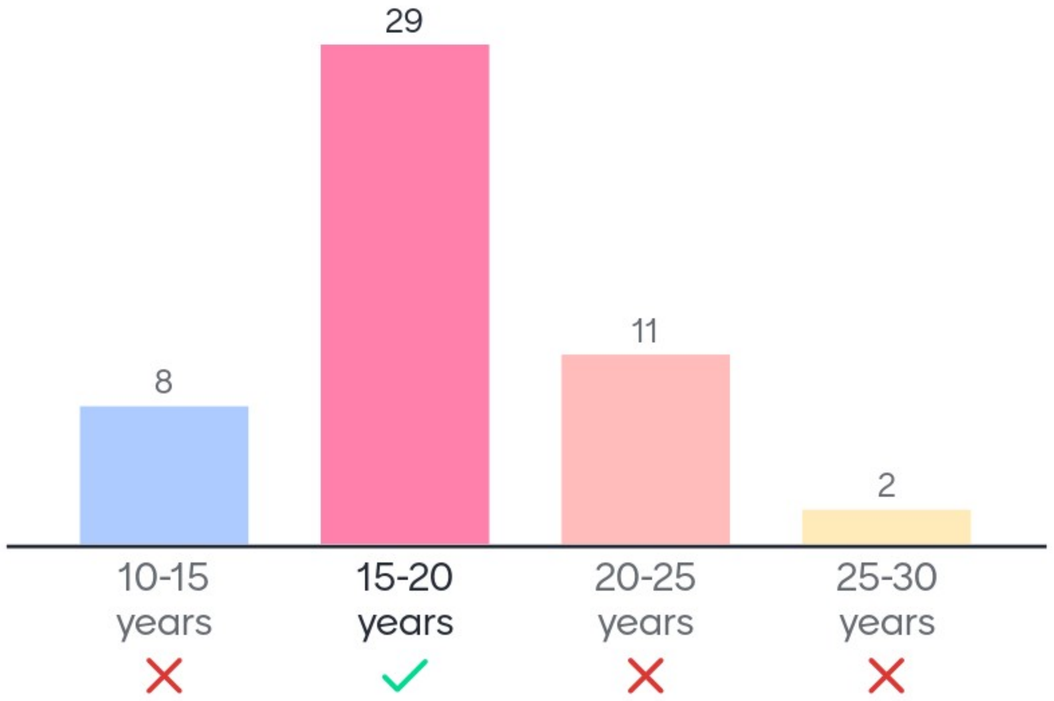
Which factor impacts the efficiency of an air-source heat pump in a commercial building?



What is the typical lifespan of an air-source heat pump in a commercial building?



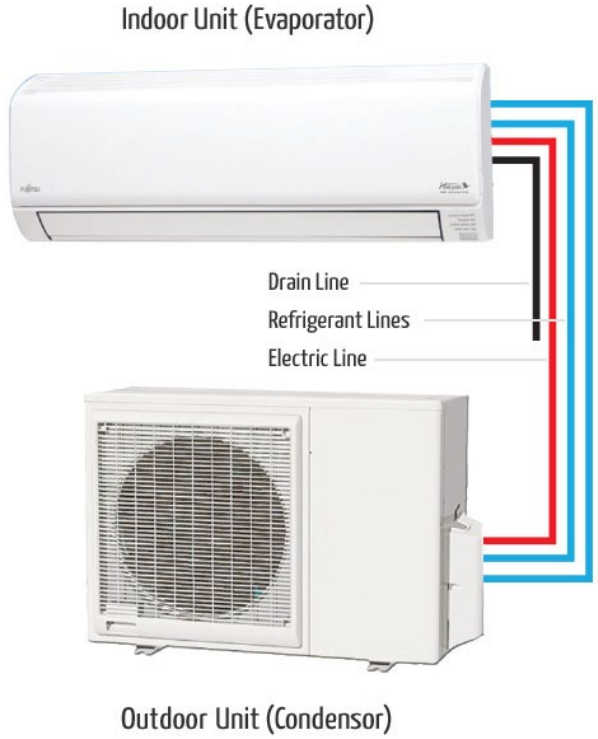
Common heat pump systems: commercial applications

1. Single-split systems
2. Multi-split systems
3. Packaged or rooftop terminal units (RTUs)
4. Variable refrigerant flow (VRF)
5. Hybrid heat pumps

Single split

This unit connects one indoor system to an outdoor one. Most commercial buildings prefer it due to its affordability and suitability for small commercial spaces.

The single-split systems work perfectly for buildings that contain many small facilities.

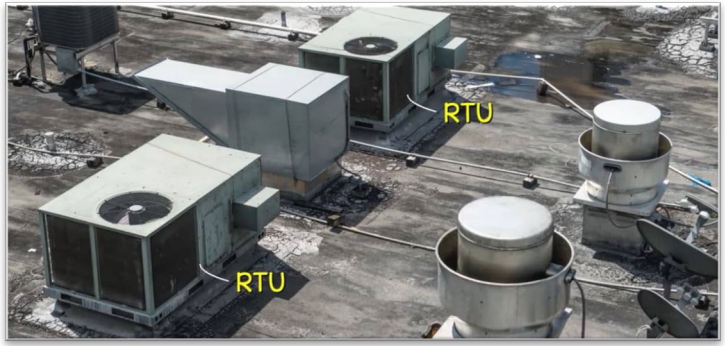


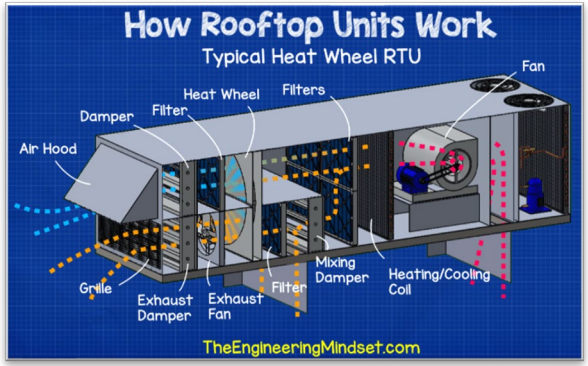
Multi split

Multi-split systems take up less outdoor space and allows for better management over indoor units. These systems can connect multiple indoor units to one outdoor unit.

Packaged or rooftop terminal units

A rooftop unit (RTU) is a type of HVAC system that is typically used in commercial and industrial buildings. RTUs are usually located on the roof of a building, and they work to provide heating, cooling, and ventilation for the interior spaces.



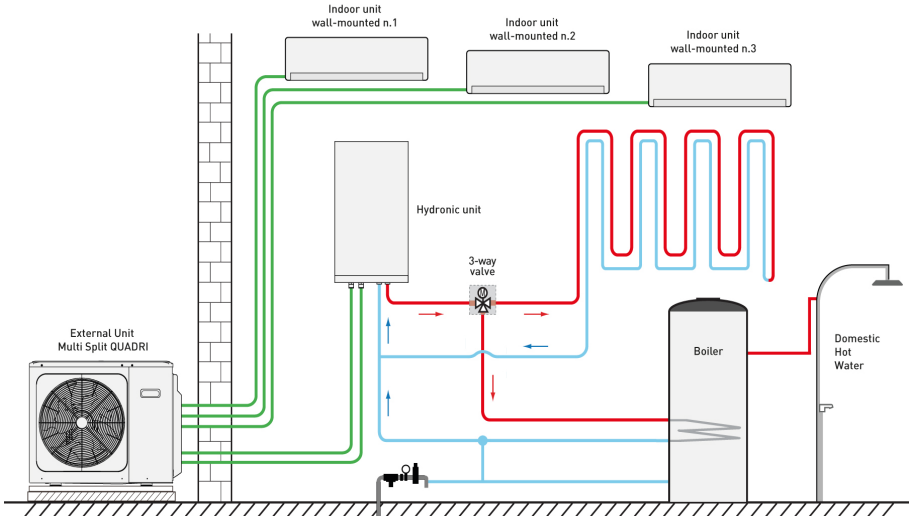


Variable refrigerant flow (VRF)

- Referred to also as the variable refrigerant volume (VRV). Like the multi-split system, it links multiple indoor systems to an exterior one.
- The VRV is ideal for facilities that need customized cooling and heating in zones like office buildings, factories, and restaurants. However, this system's costs and installation fees are high compared to other options, and control schematics are more complex.

Hybrid heat pump

- Designed for either cooling or heating, the hybrid heat pump has a back-up heating system as a part of its split system setup.
- This configuration is suitable for commercial buildings in colder climates, such as retail centers, gyms and schools.



System comparison

Single split	Multi split	Rooftop unit (RTU)	Variable refrigerant flow (VRF)	Hybrid system (heat pump and backup)
• Straightforward: one indoor unit connected to one outdoor unit. • Generally, energy-efficient for smaller spaces or individual rooms.	• Takes up less outdoor space. • Better control over individual indoor units, allowing for customized temperature zones.	• Centralized and suitable for medium to large commercial spaces. • Accessibility of the roof simplifies maintenance and repairs.	• Adjust to the actual heating or cooling needs of different zones simultaneously. • Allows for precise control and zoning of individual spaces, improving energy efficiency.	• Combines the efficiency of a heat pump with the reliability of a furnace or boiler, while also providing cooling options. • Offers a backup heating source in case of issues with one of the systems or to manage extreme cold.

Steps for installation

Prior to starting installation, certified contractors should consider the following factors that notably impact the feasibility of air source heat pumps:

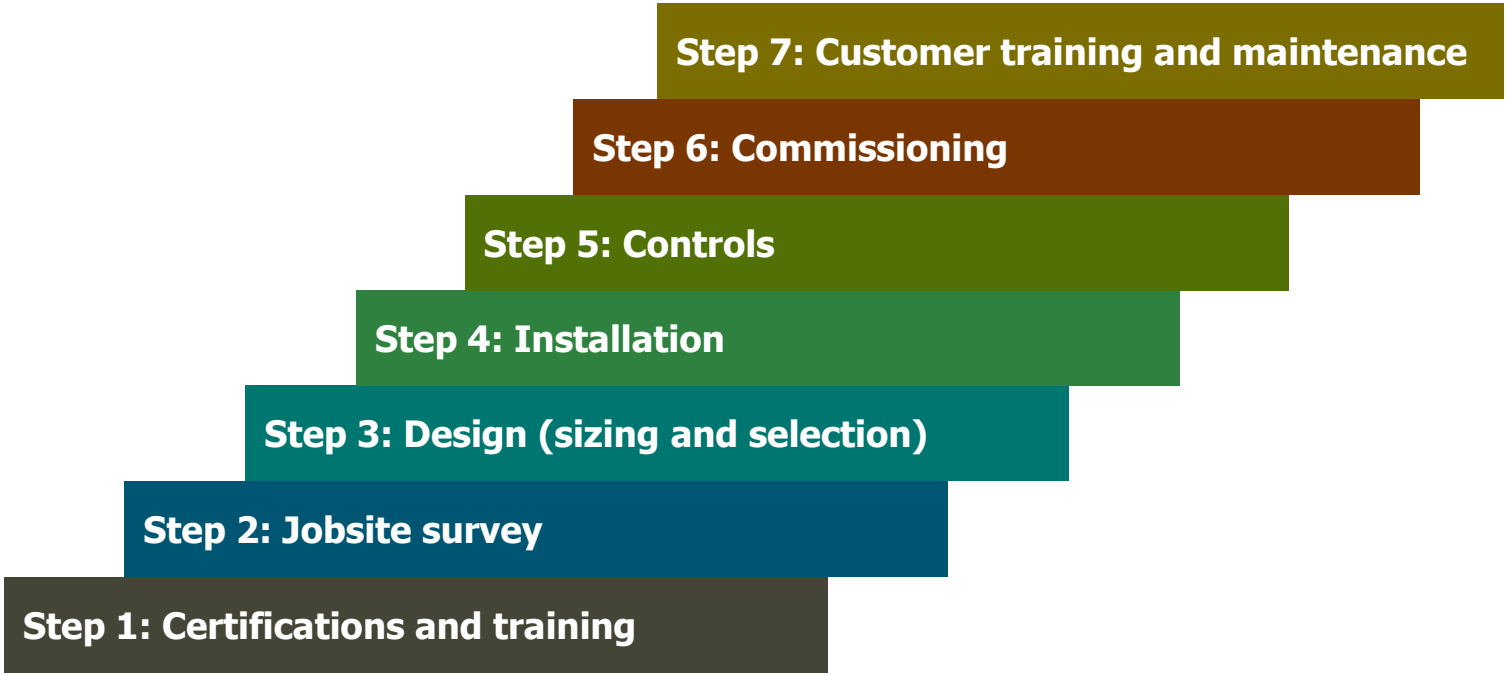
Codes, standards and regulations

Existing heating and cooling system

Supplementary heating options

Financial support

Steps for installation



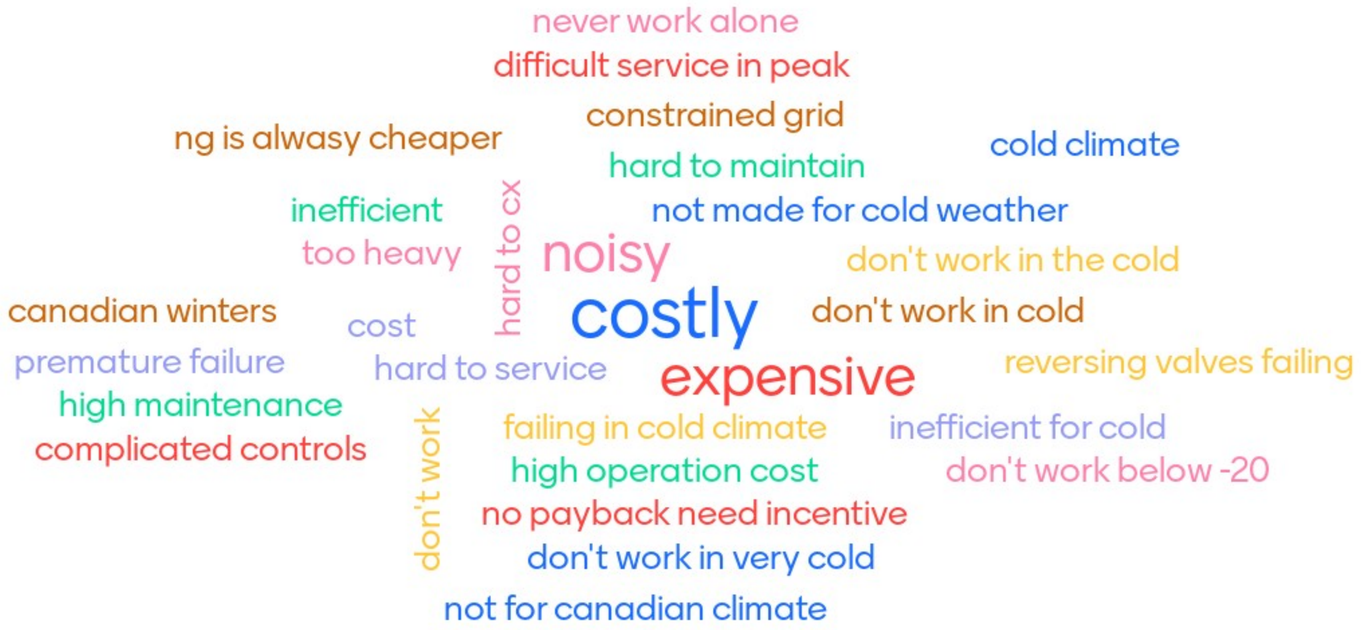
Discussion and poll

Heat pump stories discussion

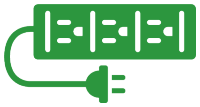
What have you heard about heat pumps that might be a myth?

What have you heard about heat pumps that might be a myth?

34 responses



Common myths about heat pumps



Ontario is too cold for heat pumps to work!

Heat pumps are only for heating!

Installation of heat pumps is overly complicated!

Common myths about heat pumps

Heat pumps always require back-up heating!

Heat pumps are noisy!

Heat pumps are inefficient compared to furnaces and boilers!

Understanding motivations and barriers for building owners

1. Energy efficiency
2. Environmental sustainability
3. Government incentives
4. Cost savings
5. Energy independence
6. Long-term investment
7. Reduced maintenance
8. Increased asset values

1. High initial costs
2. Lack of awareness
3. Perceived reliability issues
4. Technical challenges
5. Space requirements
6. Access to financing
7. Split incentives

Coming soon!
ASHP Installation Best Practices Workshop

Overview of Training Course Modules

Stay tuned to register for our interactive full-day Installation Best Practices Workshop to learn more.

Introduction to Heat Pumps

- State of the market
- Heat pumps and cold climates
- Myths, motivations and barriers in the commercial market

Sizing and Selection

- Understanding the situation
- Getting the load calculations right
- Options and opportunities
- Making the sale

Integrating Heat Pump Systems

- Ducted systems
- Ductless systems
- VRF systems
- Air to water systems
- Hybrid opportunities

Installation and Commissioning

- Outdoor unit placement
- Refrigerant and line sets
- Tight ductwork
- Electrical connections
- System testing and commissioning

Control Systems

- Selecting the right controller
- Controlling supplemental systems
- Finding the thermal and economic balance points

User Training and Maintenance

- Control system and logic
- Maintenance requirements: DIY and professional service
- System manual
- Service contracts

Thank you!

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