

FEBRUARY 29, 2024

Introduction to Air Source Heat Pumps: Installation Best Practices Series for Homes

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Agenda

1. Introduction to Air Source Heat Pumps (ASHP)
2. Overview of ASHP systems
3. System Layouts
4. Installation Process
5. Common Myths
6. Motivations and Barriers for Homeowners
7. Overview of ASHP Installer Series for Homes (Modules)
8. Overview of Resources Available

Objectives

- Understand what a heat pump is, how it works, particularly in cold climates
- Understand the potential benefits of heat pump adoption
- Understand the common myths surrounding residential air-source heat pump (ASHP) applications in Ontario
- Understand the motivations and barriers faced by homeowners with ASHP installations in Ontario
- Understand objectives of ASHP Installer series for homes
- Introduction to resources for contractors

About us

Peter Rowles, P.Eng, C.Dir

- Energy Management Consulting - 45 years experience

Heat Pump Experience

- Residential Air Source and Ground Source Heat Pumps
- Heat Recovery, Dehumidification and Hot Water Heat Pumps
- Design, manufacturing, supply and installation

HVAC Experience

- MURBs, shopping malls, retail stores, grocery stores, restaurants, strip malls, schools, retirement homes, health care, office buildings
- CMHC, HRAI, NRCC, NRCan, IESO, HVAC Manufacturers



Poll

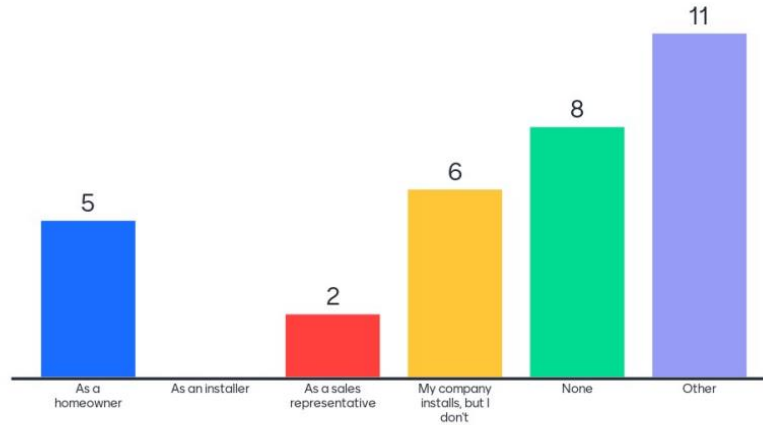
**What one word comes to mind when you think about heat pumps?
Do you have any experience with heat pumps?**

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

40 responses



Experience with Heat Pumps



Other:

HVAC system designer, distributor, HVAC contractor (gas)

Energy Advisor, energy manager, consultant

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

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



Ground Source

A ground-source heat pump uses the earth or groundwater as a heat source, while in summer it acts as a reservoir to discharge the heat extracted from the home.



Heat pumps vs. furnaces

| Capability |
|--|
| Heating efficiency |
| Initial cost |
| Operating cost |
| Environmental impact |
| Installation and space requirements |
| Safety considerations |



ASHP

| |
|--|
| Heats and cools your home |
| High efficiency: typically 175-300% |
| Higher upfront but may qualify for government incentives |
| Electricity rates can vary by time of use |
| More environmentally friendly since they do not burn fossil fuels directly |
| Easier to install and require less space |
| All electric systems may be safer for occupants |



FURNACES

| |
|---|
| Heats your home |
| Efficiency varies: 75-95% |
| Lower initial cost compared to ASHP |
| Depend on the cost of the fuel; natural gas has historically been lowest cost |
| The environmental impact of a furnace depends on the type of fuel it uses |
| May require more space |
| Eliminating fossil fuel use eliminates fire and carbon monoxide hazards |

Benefits of heat pumps



Energy
Efficiency



Versatility



Environmental
Friendliness



Costs
Savings

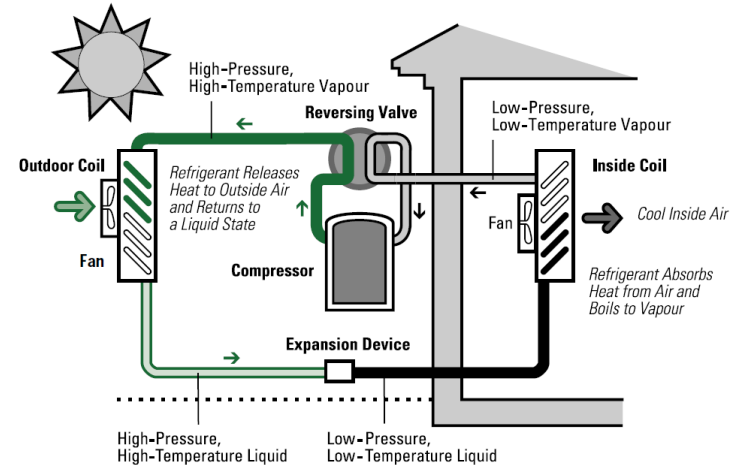
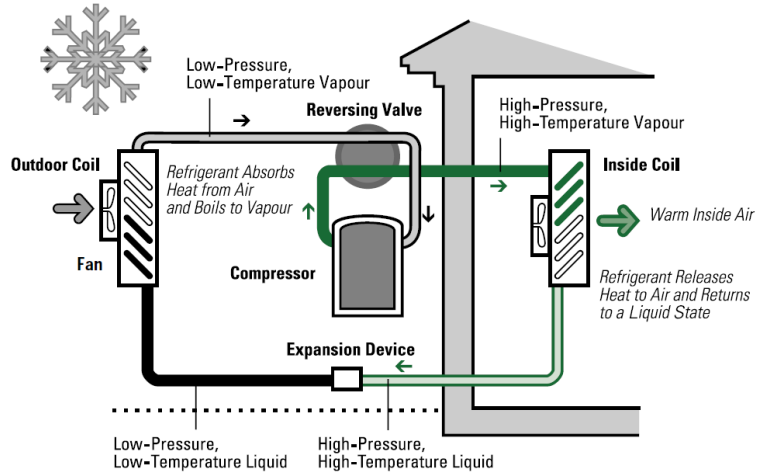


Consistent
Comfort



Zoning
Options

Air-source heat pumps: refrigeration cycles



Air-source heat pumps: technology overview

Centrally Ducted



Refers to whole-house home systems with central air handlers, typically used in homes equipped with central ducting

Ductless



Refers to an ASHP with any non-ducted indoor unit, including wall-mount air handlers, floor-mounted consoles and in-ceiling cassettes

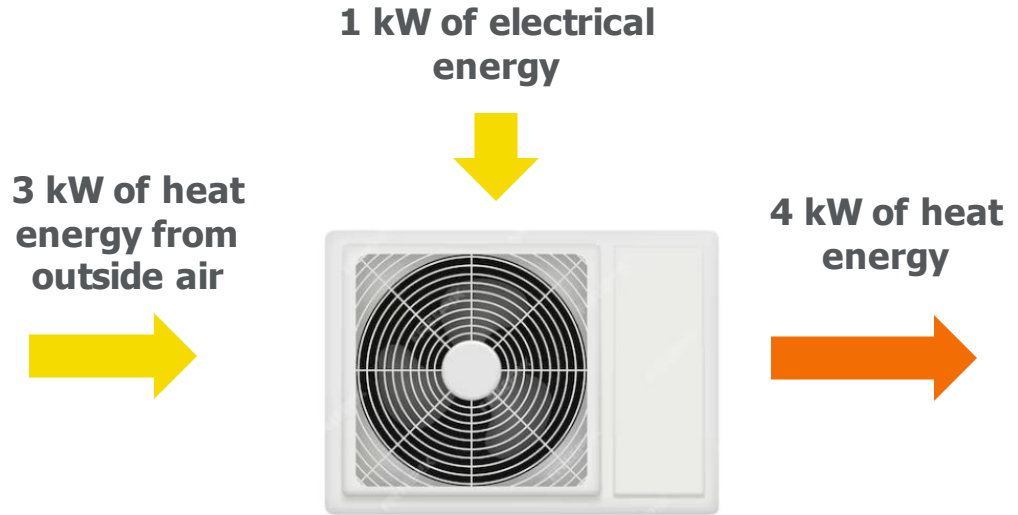
Mini-Ducted



Refers to an ASHP with concealed air handlers typically mounted in the ceiling area and short ducts that run to a number of rooms

Coefficient of performance for heat pumps

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

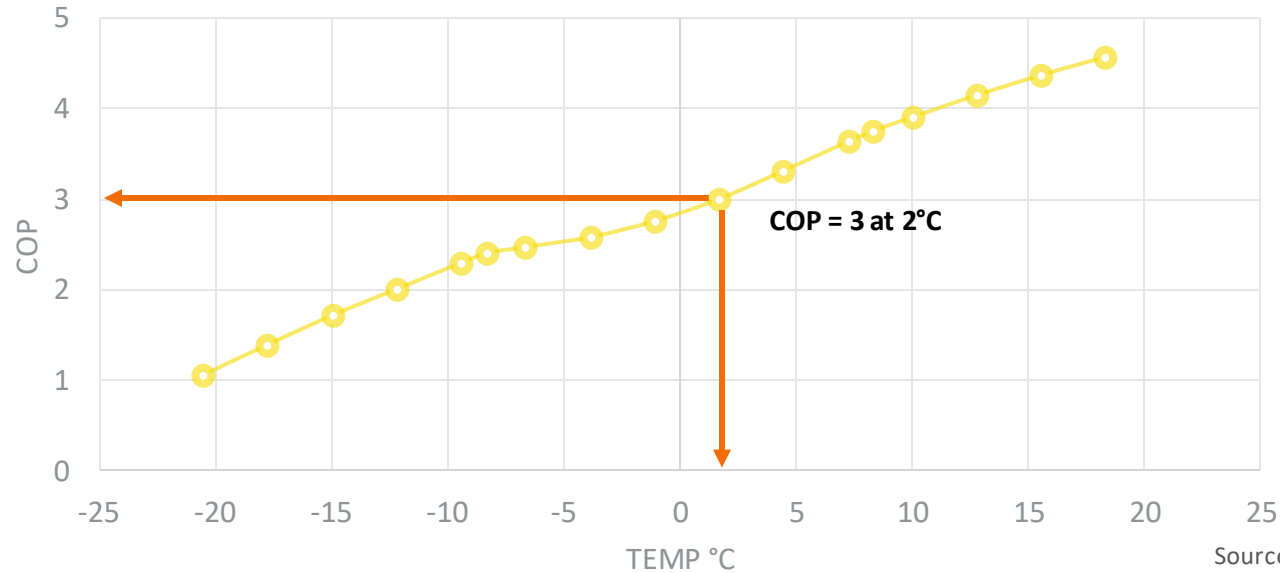


COP Performance = Heat energy out/Electrical energy in

$$\text{COP Performance} = 4/1 = 4$$

heat pump COP vs. temperature

COP vs Outdoor Ambient Temperature



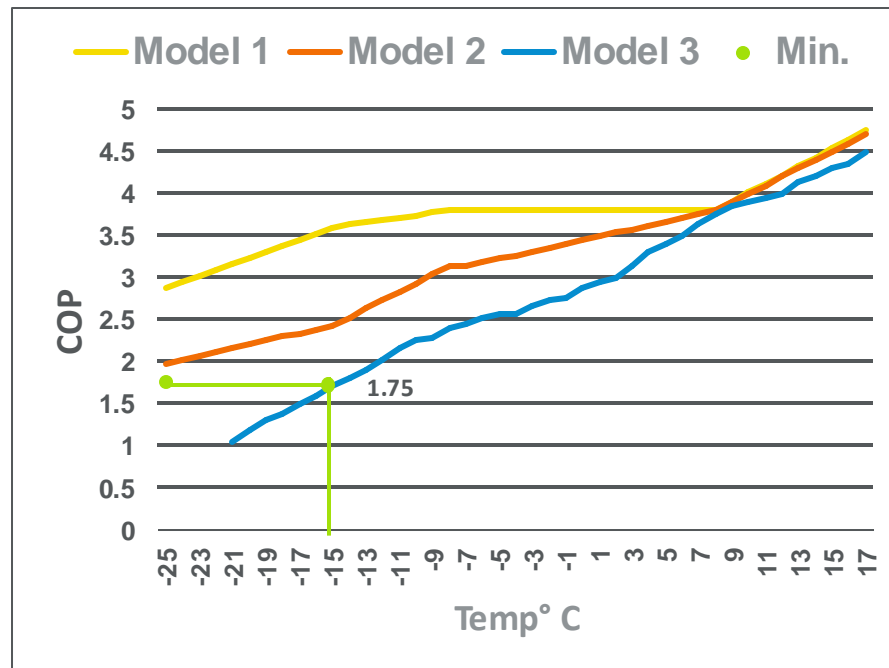
Source: NRCan

[Air-Source heat pump sizing and selection guide](#)

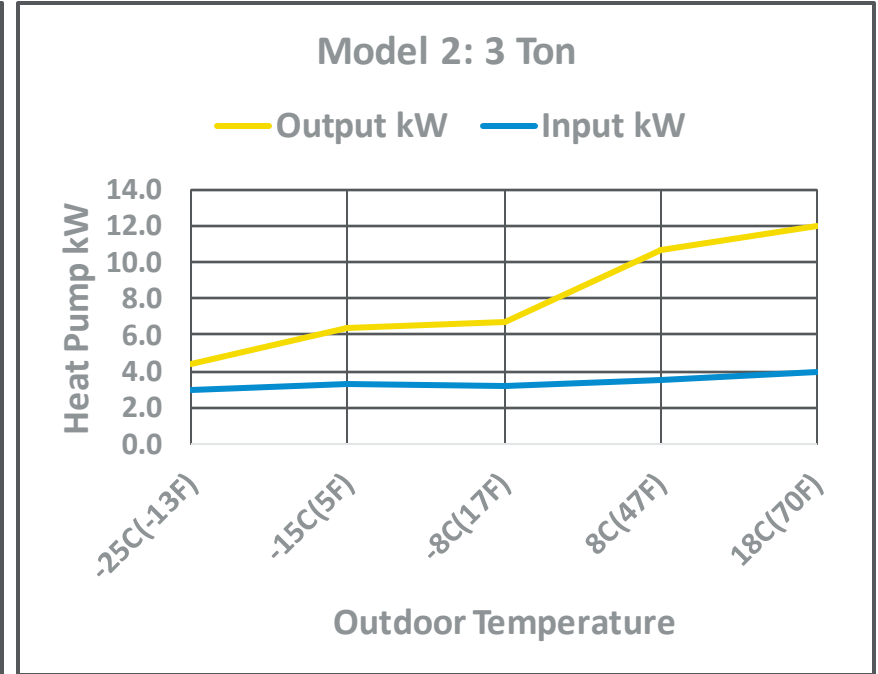
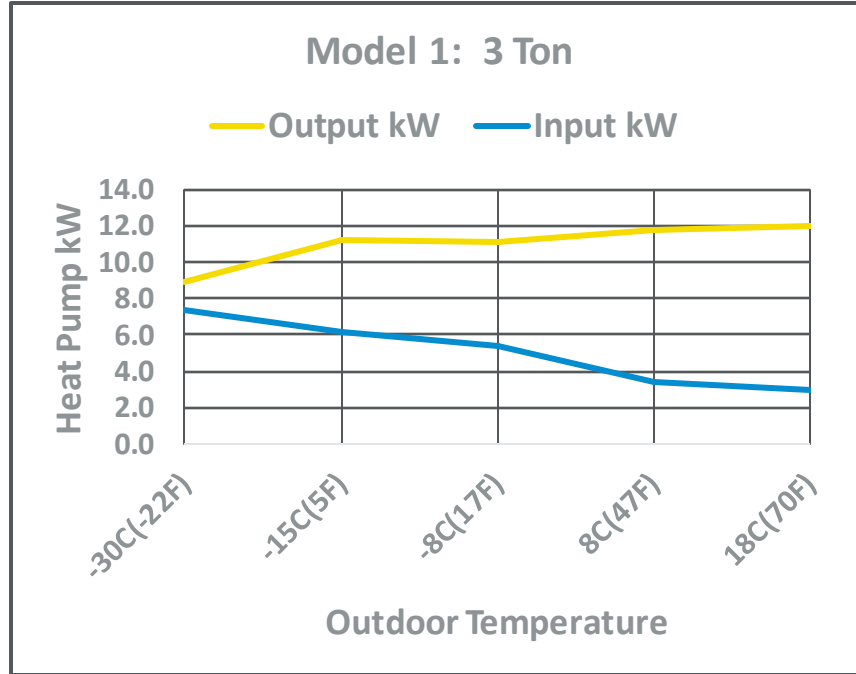
Cold climate performance

$$\text{COP} = \text{Output Power} \div \text{Input Power}$$

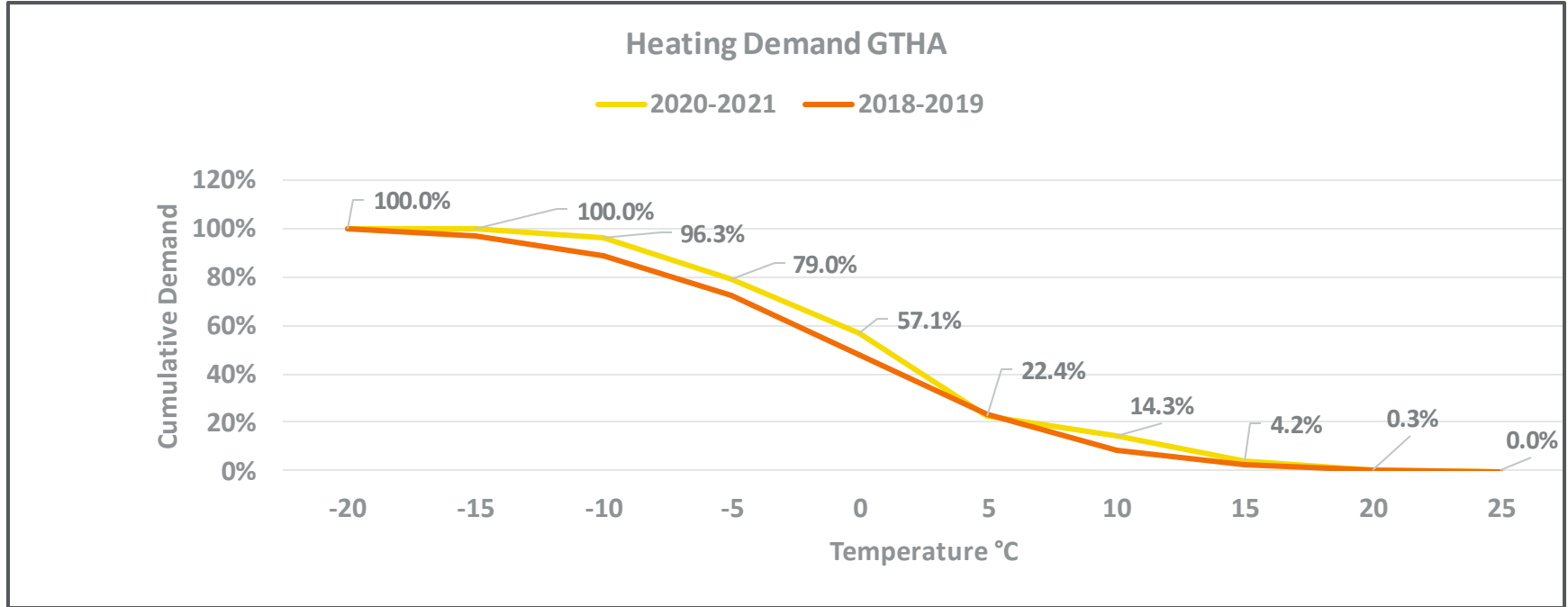
- ENERGY STAR classifies a Cold Climate Heat Pump as one that can maintain a coefficient of performance (COP) of at least 1.75 at -15C (5F)
- Some models perform better at lower outdoor air temperature than others



Cold climate performance – Model comparison



Annual heating demand

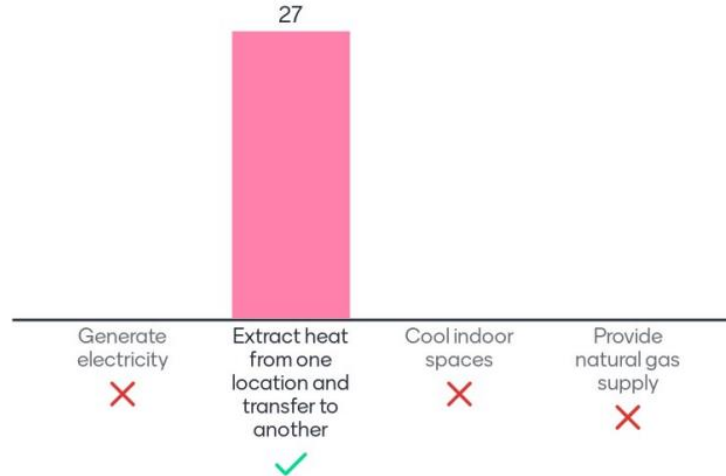




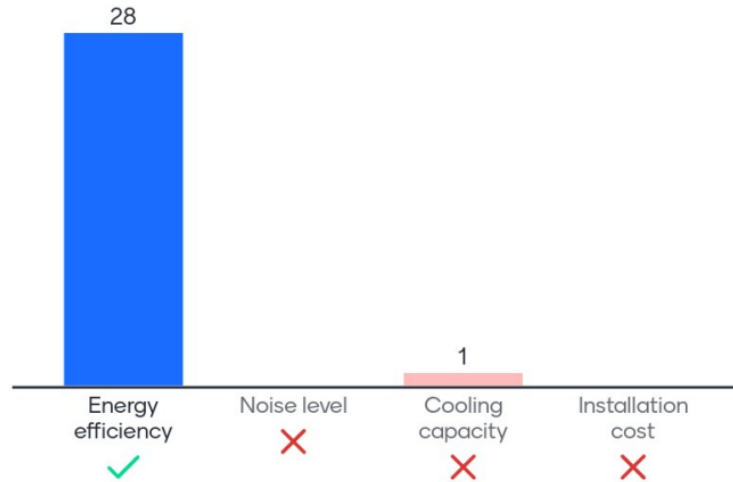
Knowledge check

Multiple choice quiz

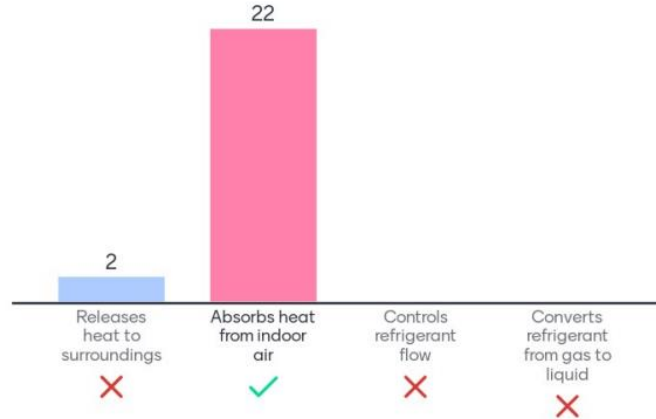
What is the primary function of a heat pump?



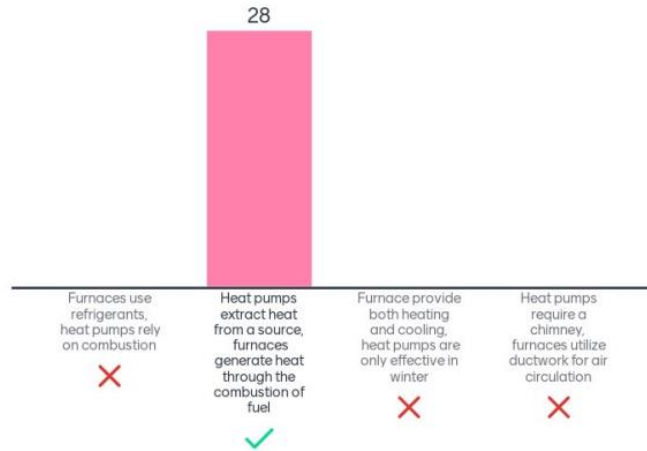
What is the coefficient of performance (COP) indicative of?



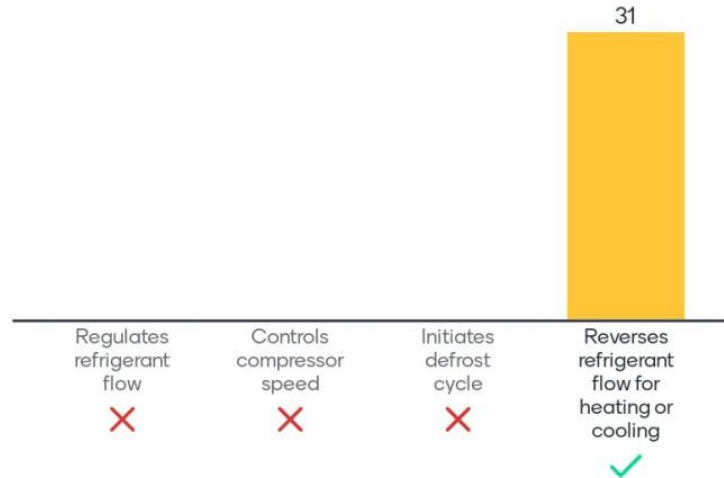
What role does the evaporator coil play in a heat pump's operation during the summer in cooling mode?



What is a key distinction between an air source heat pump and a furnace in terms of their heating mechanisms?

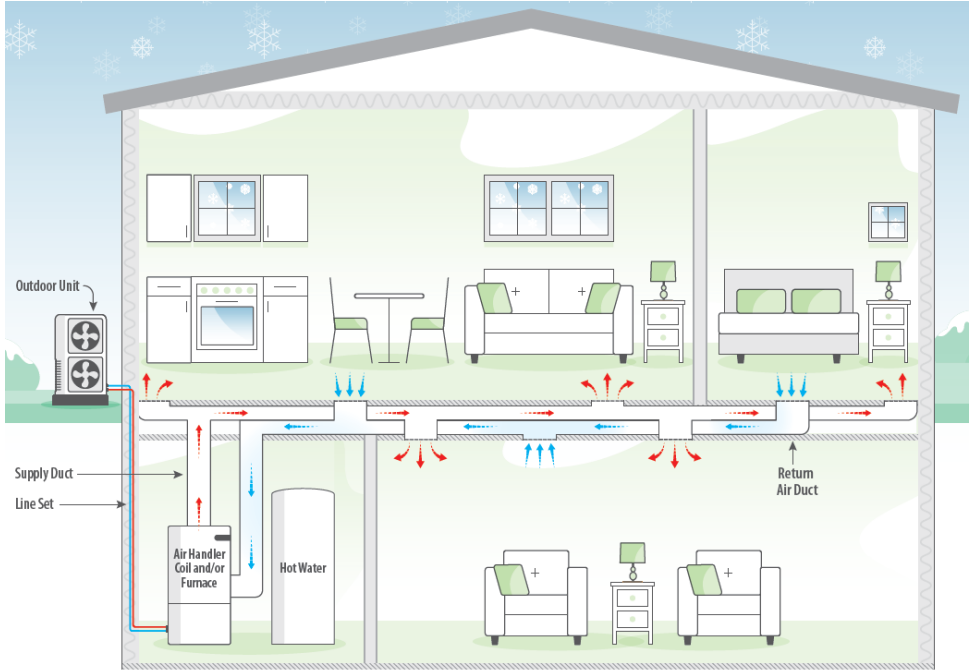


What is the purpose of the reversing valve in a heat pump system?



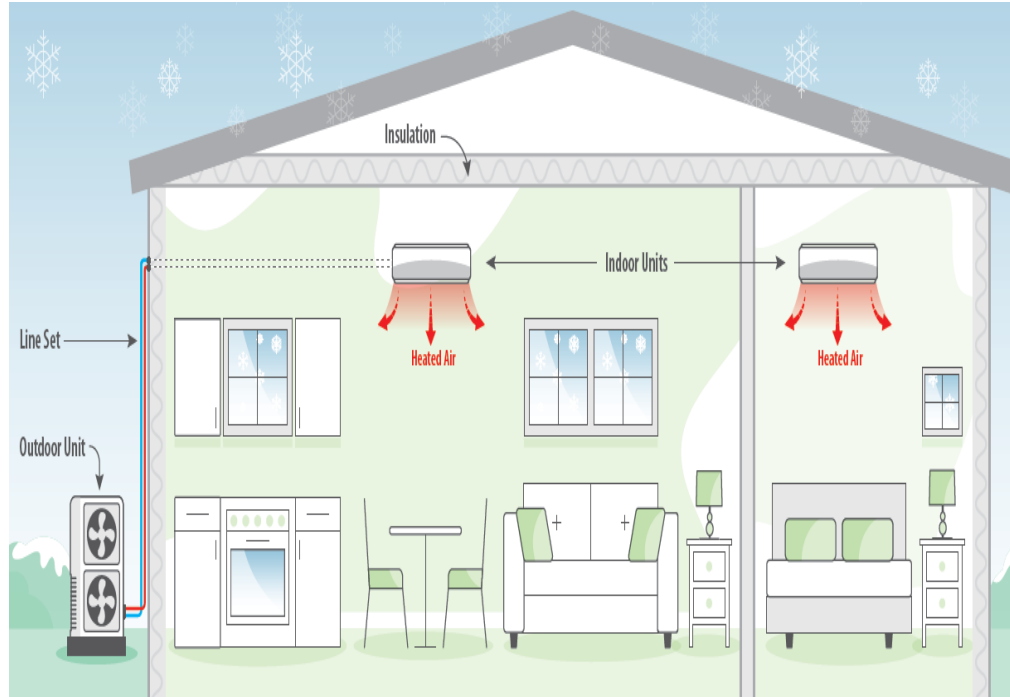


ASHP system layouts



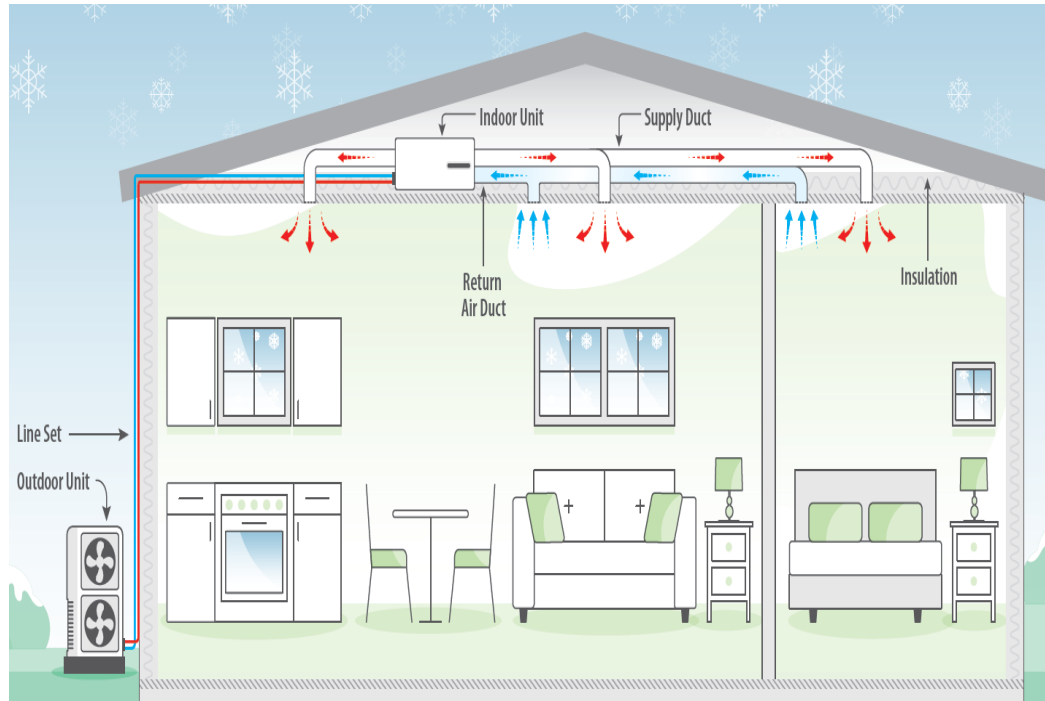
Centrally Ducted System

ASHP system layouts



Ductless System

ASHP system layouts (continued)

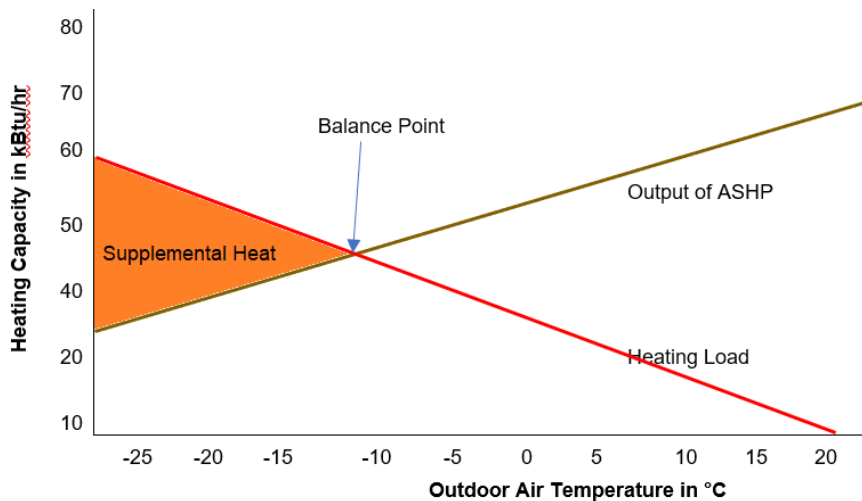


Mini-Ducted System

System comparison

| Centrally Ducted | Ductless Mini-Splits | Mini-Ducted |
|--|---|--|
| <ul style="list-style-type: none">• Integrated home system with outdoor unit, air handler and building-wide ductwork.• Efficiently transfers heat through air circulation in an existing duct network.• Suited for larger homes with well-maintained central heating/cooling ducts. | <ul style="list-style-type: none">• Designed for single or multi-zone setups.• Facilitates direct heat transfer by circulating refrigerant to indoor units situated near or within the conditioned space.• Well-suited for single-zone or isolated-zone homes lacking ductwork and for residences with undersized ducting. | <ul style="list-style-type: none">• Multi-zone system consisting of a single outdoor unit, air handler and a shorter ductwork connecting a few zones.• Facilitates heat transfer from the space to the refrigerant through air circulation in the duct.• Well-suited for medium-sized homes with multiple zones lacking ductwork and using baseboard heating. |

Air-source heat pumps: supplementary heating



Source : HPSC, Module 1 : Quality Installation of Forced Air Furnace and Air Source Heat Pump Retrofits in BC Homes

- Heat pump performance drops with colder temperature
- Supplementary heating may be needed at colder temperatures
- Two configurations:
 - Integrated with the heat pump system (e.g., electric resistance coil)
 - Supplemental heat (e.g., electric baseboards or fossil fuel furnace)

Hybrid heat pump systems



The ASHP outdoor unit, mounted on a wall to ensure adequate airflow and snow clearance.



Indoor furnace coil and ASHP interface.

Air-to-water heat pump systems

Air-to-water air-source heat pumps are less common.

They are more expensive than air-to-air systems but also can heat domestic water without the need for a standalone system.

They can also use fan coils to provide cooling.

There are currently no rebates for these systems.

- Can serve space and domestic water heating.
- Fan coil units can be used for cooling and heating as needed.
- Suitable for existing homes with hydronic heating systems; check that the heat pump's leaving water temperature meets the needs:
 - Radiators
 - Hot water baseboards
 - In-floor heating

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**

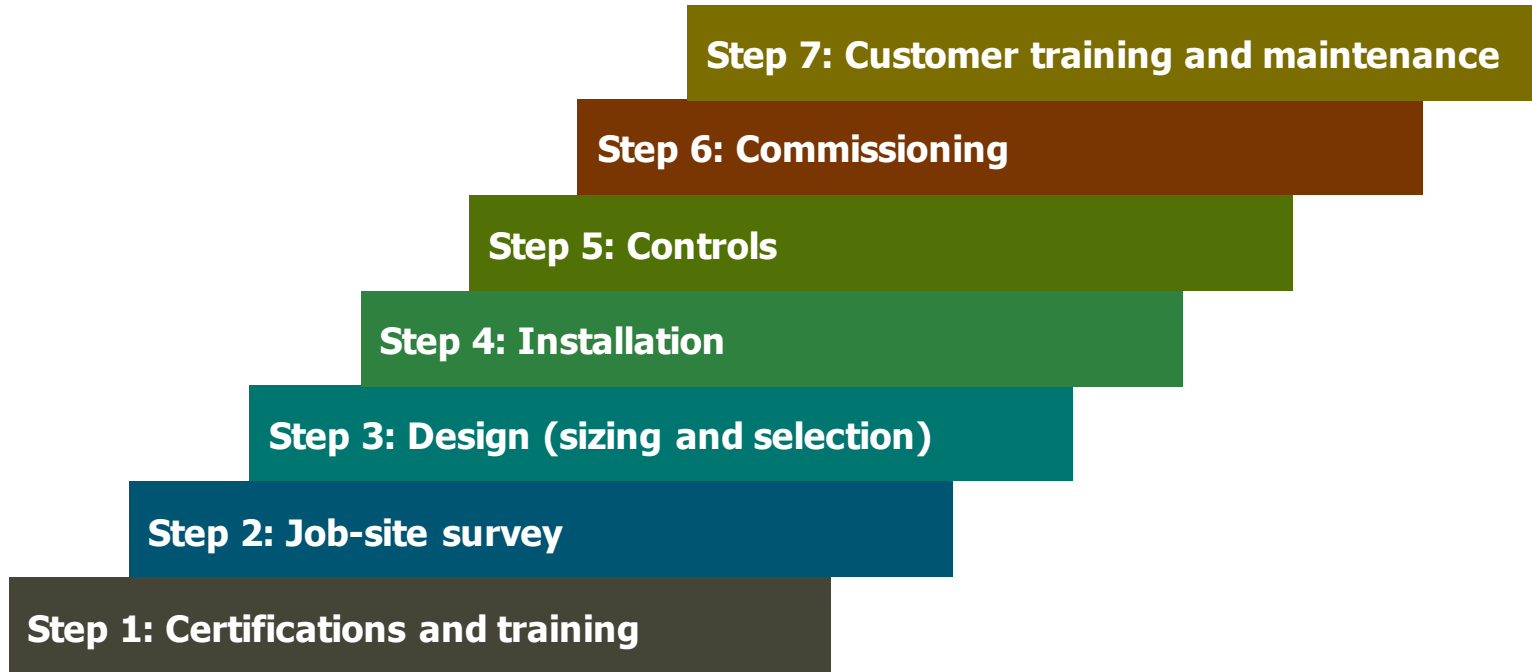


**Supplementary
heating options**



Financial support

Steps for installation



Discussion and poll

- 1. Heat pump discussion: sharing experiences with heat pumps**
- 2. What have you heard about heat pumps that might be a myth?**

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

don't work

cheaper

they are expensive

They are not good in a cold climate

They do not work in the cold

Heating Output at low temperature

Not able to operate efficiently at low temperatures

Only work with underfloor heating and not radiators



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

May not work effectively with sizing of an existing furnace duct system

Heat pumps are noisy

Not efficient during cold weather

Without taxpayer subsidies, very expensive for the consumer

Makes you more reliant on Electricity - higher rates to come our way.

Common myths about heat pumps



Heat pumps only work in warm climates!



Heat pumps are only for heating!



Installation of heat pumps is complicated!

Common myths about heat pumps



Heat pumps require back-up heating!



Heat pumps are noisy!



Heat pumps are inefficient compared to furnaces!

Understanding motivations and barriers for homeowners



1. **Versatility and reduced maintenance (one system for heating and cooling)**
2. **Climate consciousness**
3. **Long-term energy pricing stability**
4. **Comfort**
5. **Health and safety**

1. **Lower familiarity**
2. **Infrequent purchasing**
3. **Short replacement timeframes**
4. **Limited stock availability**
5. **Higher upfront cost**



ASHP Installation Best Practices Workshop

Overview of training course modules

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 residential market
- Selling heat pumps



Sizing and Selection

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



Integration of Heat Pump Systems

- Ducted systems
- Ductless and mini-ducted 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

Additional Tools and Resources for Installers



Sell sheets for air-source heat pumps

- Pre-Install
- Post Install



Guidance documents

- Sizing and Selection
- Quality Installation and Thorough Commissioning
- Regular Maintenance and Timely Repairs
- Environmental Responsibility



Checklists

- Annual Maintenance Checklist
- Data Collection Checklist for Scoping Visits

Thank you!

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