

# Energy Projects: Which Do I Do First?



**Presented by: Gerry Pageau, P.Eng.**



# COURSE OUTLINE

Week 1: Harnessing Solar Energy on the Coast

Week 2: Improving the efficiency of HVAC systems

Week 3: Upgrading the building envelope

Week 4: Domestic hot water, lighting & appliances



# Improving the efficiency of HVAC systems

1. Introduction: Why a Heat Pump?
2. Background: Terminology & Nomenclature
3. Heat Pumps: What is a heat pump? How does it work?
4. Heat Pumps: What are the benefits?
5. Heat Pump Myths

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# INTRODUCTION

Why a Heat Pump?



# Why a Heat Pump?

## Reduce Heating Cost

- A natural gas furnace costs 0.14x more to operate than a heat pump.
- Baseboards or electric furnace cost 1.5x more.
- Propane costs 2.3x more.
- Heating Oil is the most costly at 5.5x more than a heat pump.

## Example home needing 100 GJ/y of heat

- A natural gas furnace costs \$230/y more to operate than a heat pump.
- Baseboard or electric furnace costs \$2,464/y more.
- Propane costs \$3,744 more.
- Heating Oil is the most costly at \$8,956/y more than a heat pump.



# Why a Heat Pump?

## Reduce GHG Emissions

- Buildings in BC represent 11% of province's total CO<sub>2</sub> emissions.
- 54% of BC homes are heated by fossil fuels.
- Heat Pumps are an ideal replacement for conventional fossil fuel heaters.
- Heat Pumps use electricity rather than fossil fuels so dramatically reduce GHG.
  
- A natural gas furnace emits 59x more GHG (kg eCO<sub>2</sub>/ekWh) than a heat pump powered by BC Hydro electricity.
- Propane causes 74x more GHG emissions.
- Heating Oil is the worst offender at 95x more GHG than a heat pump.

# 2

## BACKGROUND INFORMATION

Common terms you need to know for heating systems.



# TERMINOLOGY & NOMENCLATURE

## Gigajoule (GJ)

- Metric unit of energy consumption
- You may be familiar with the old imperial system which used British Thermal Units (BTU)
- 1 GJ = 947,817 BTU or more commonly 0.948 mmBTU.
- 1 GJ = 25.5 cu ft of natural gas
- 1 GJ = 277.8 kWh

## Kilowatts (kW)

- Measure of power (energy per unit time)
- 1 kW = 3,412 BTU/h
- 1 kW = 0.28 tons of refrigeration







# TERMINOLOGY & NOMENCLATURE

## KILOWATT HOUR (kWh)

- Amount of energy consumed by the heater
- 1 kWh = 1 kW of power expended over 1 hour

## KILOWATT HOUR (kWh)

- Amount of energy produced by the heater
- 1 kWh = 1 kW of power produced over 1 hour

## Heater Efficiency (%)

- Efficiency = 
$$\frac{\text{energy produced} \times 100}{\text{energy consumed}}$$
- Baseboard = 100% eff
- Heat Pump = 250% eff
- Old gas furnace = 80% eff
- New gas furnace = 95% eff



# TERMINOLOGY & NOMENCLATURE

## Heating Degree Day

- The degrees that a day's average temperature is below 18°C (65°F)
- $HDD = (18 - (\max \text{ temp} - \min \text{ temp})) / 2$
- If average temp is above 18 °C then HDD=0
- Degree days are based on the assumption that when the outside temperature is above 18°C, we don't need heating to be comfortable.
- HDD is a measure of how much (in degrees) and for how long (in days) the temperature was below 18°C.
- HDD is used to estimate the energy required to heat a building.

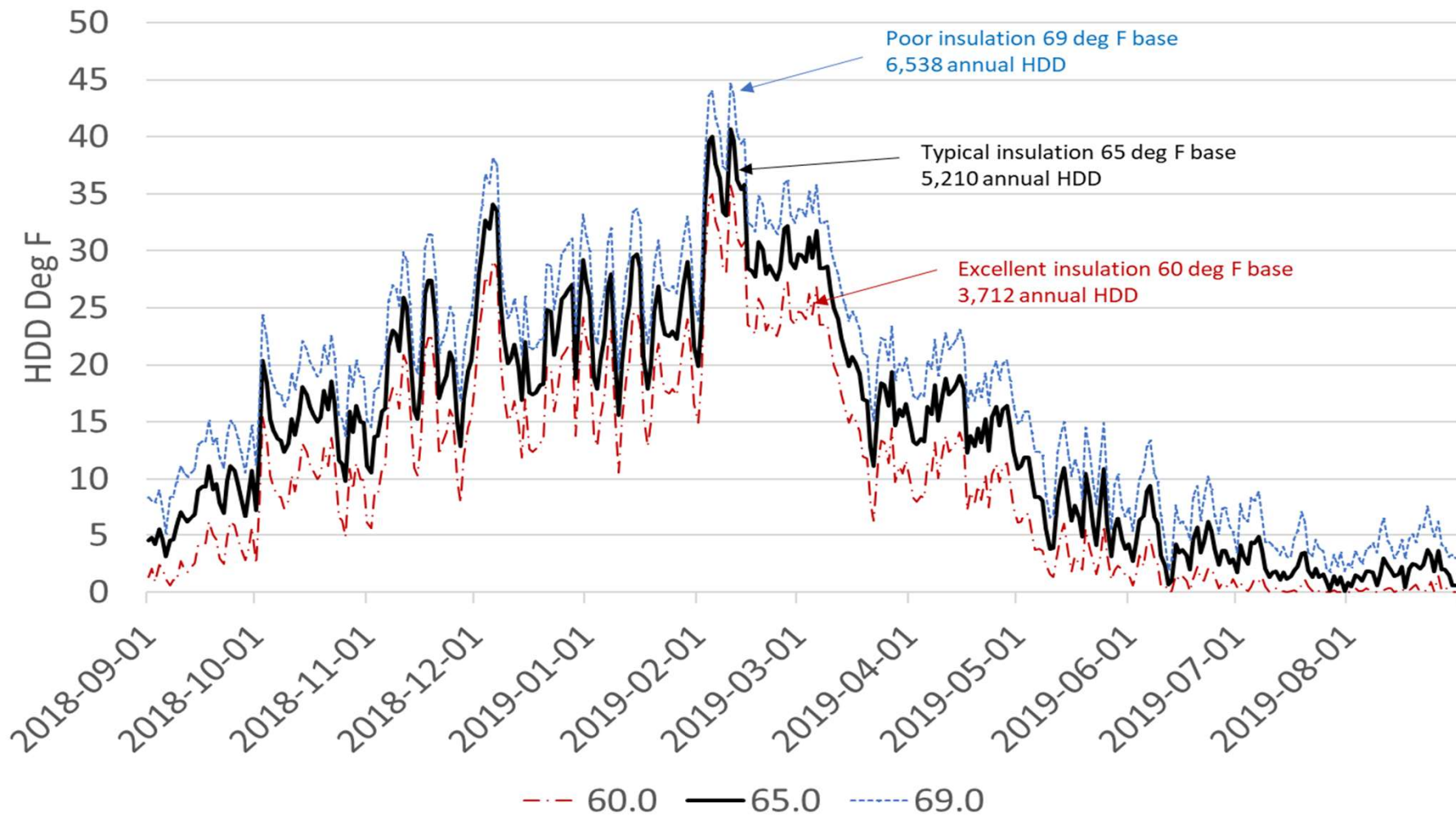


# TERMINOLOGY & NOMENCLATURE

## Cooling Degree Day

- The degrees that a day's average temperature is above 24°C (75°F)
- $CDD = ((\text{max temp} - \text{min temp}) - 24) / 2$
- If average temp is below 24 °C then CDD=0
- Degree days are based on the assumption that when the outside temperature is below 24°C, we don't need cooling to be comfortable.
- CDD is a measure of how much (in degrees) and for how long (in days) the temperature was above 24°C.
- CDD is used to estimate the energy required to cool a building.

# Heating Degree Days for 1-Sep-2018 to 31-Aug-2019 Using 3 Base Temperatures



# 3

## HEAT PUMPS

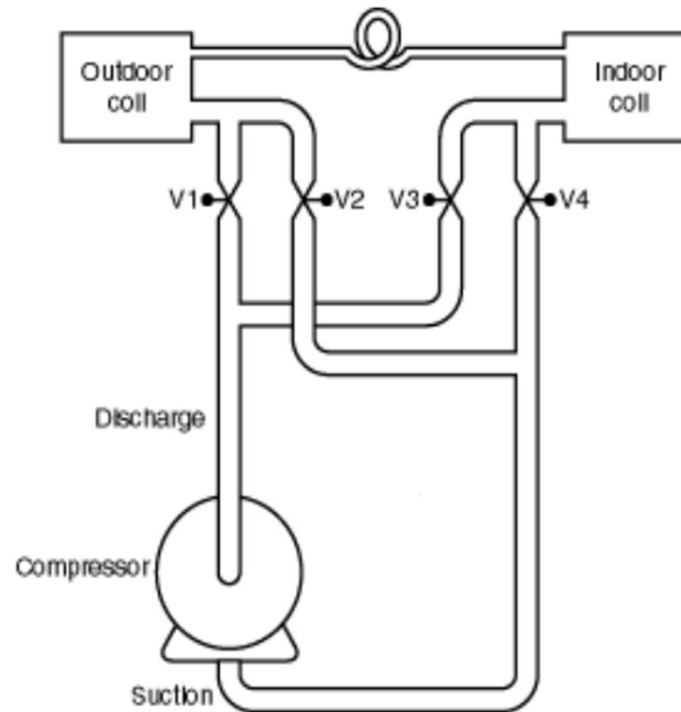
What is a heat pump and how does it work?

# Conservation of Energy

## A Funny Thing Happens when Gas is Compressed

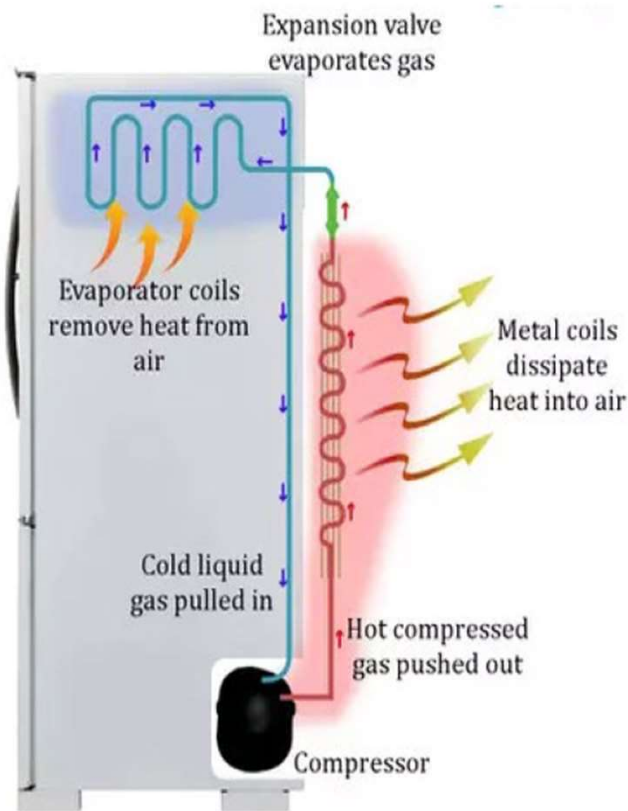
- If you compress a gas, then the temperature of that gas increases in direct ratio to the pressure increase.

$$T_2 = T_1 \times P_2 / P_1$$





# Your refrigerator is a kind of heat pump



Heat is removed from inside a refrigerator and the temperature inside the refrigerator drops.

The coils on the back of the refrigerator give off the heat that is removed from the refrigerator.



# Electric to lower GHG footprint, heat pump to keep cost down



Shift towards  
electrification  
in homes

Heat pumps  
are 300%  
energy efficient



## HEAT PUMP BENEFITS

- Increased efficiency
- 2 for 1 heating and cooling
- Long-lasting

(In comparison, electric baseboards are 100% efficient)



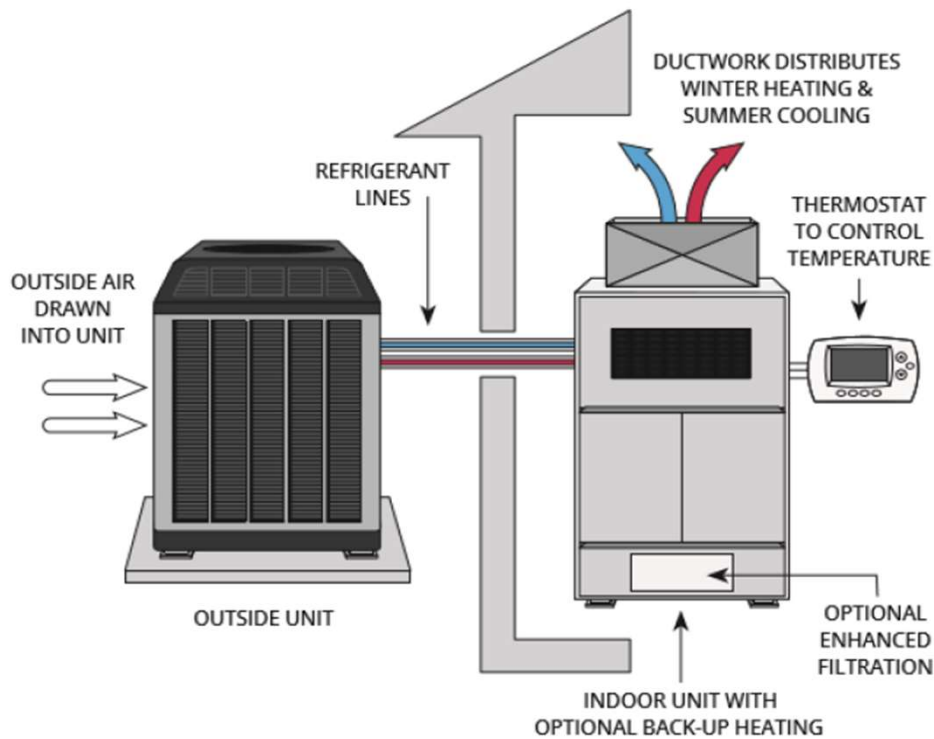


# How does a heat pump work - video

<https://youtu.be/iQaycSD5GWE>

Thanks to BC Hydro for this youtube video.

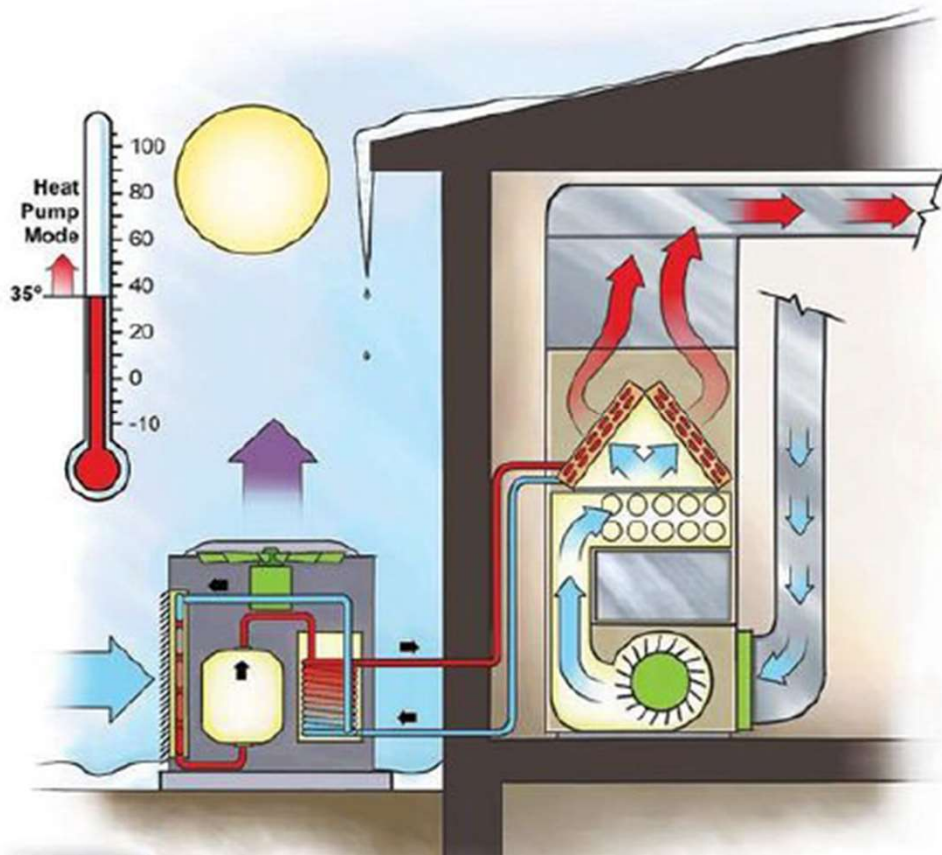
# Types of heat pumps: Central Ducted



- Uses **ductwork connected to vents** in your home to circulate warmed or cooled air.
- Provides whole home heating and cooling.



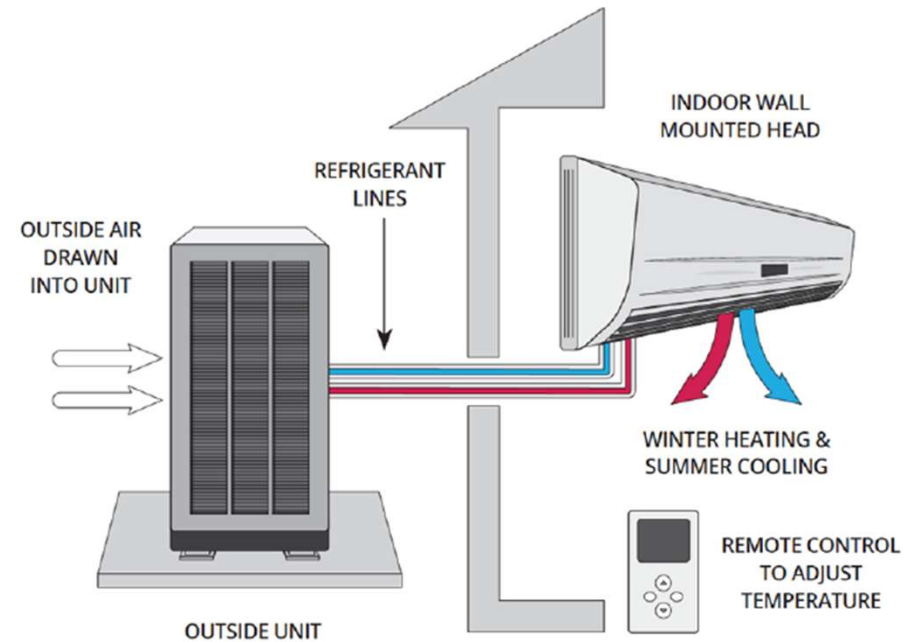
## Types of heat pumps: Dual Fuel Ducted



- Central ducted heat pump with integrated gas or propane furnace for backup during extremely cold weather.
- Requires purchasing & maintaining two heating systems.
- Not needed on the Sunshine Coast as we don't get too cold for heat pump.

# Types of heat pumps: Ductless mini split

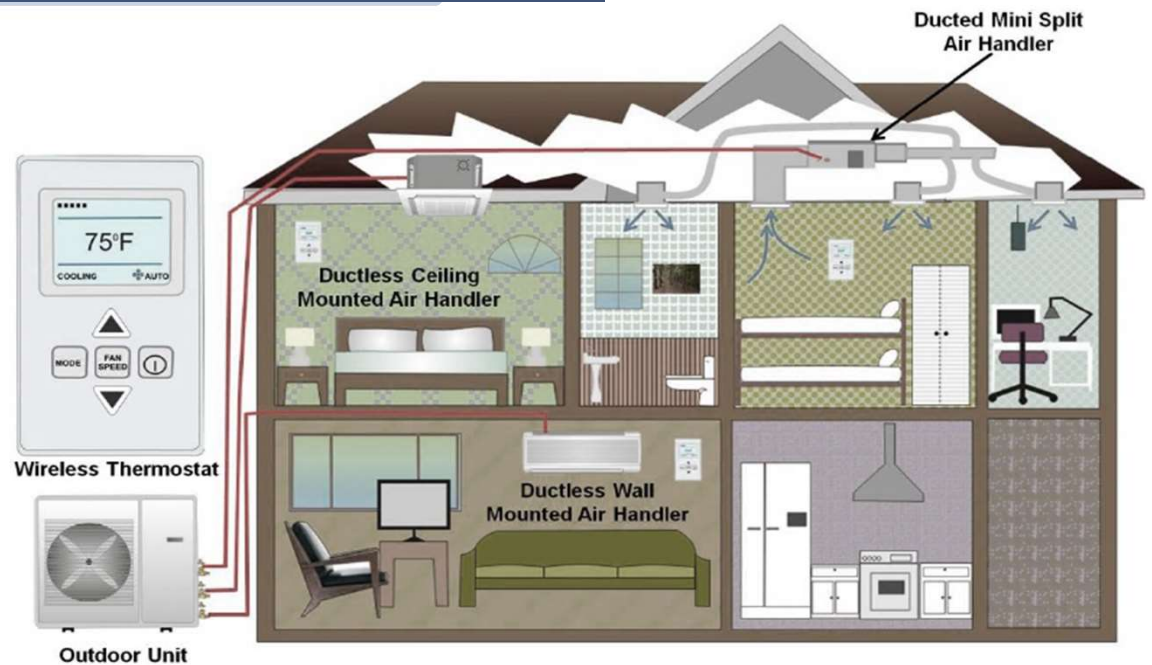
- Provides heating and cooling via **indoor heads**, without the use of ducts.
- Provides **zonal heating and cooling**.



# Types of heat pumps: Ducted mini split

Other common names include:

- Mini-split
- Multi-split
- Split system
- Ducted mini-split\*



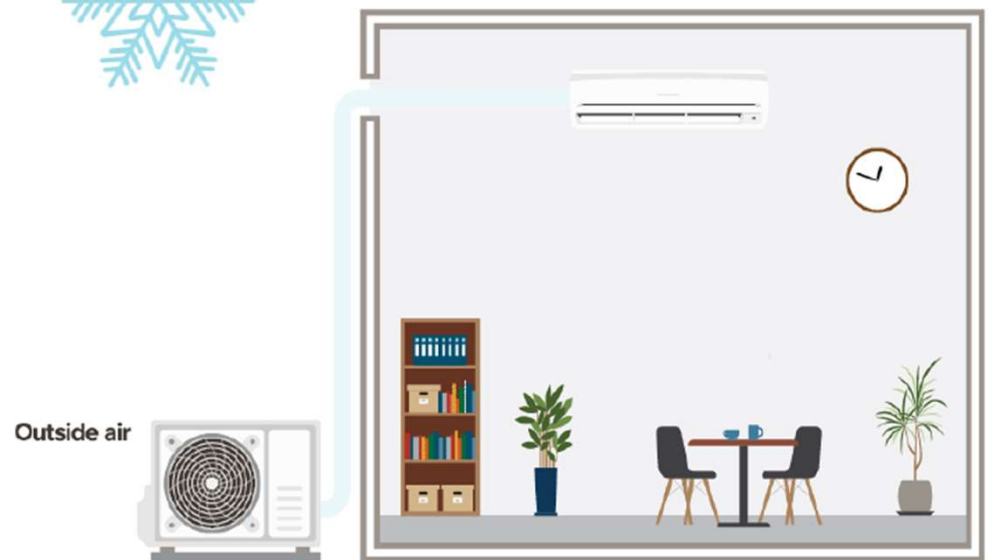
\*Some ducted mini-split systems may be classified as a central heat pump, check [Qualifying Product List](#).

[https://basc.pnnl.gov/sites/default/files/HVAC%20132minisplit-5\\_DS2014.jpg](https://basc.pnnl.gov/sites/default/files/HVAC%20132minisplit-5_DS2014.jpg)

# Types of heat pumps: Cold Climate



## Winter



- Work efficiently in conditions **down to -25 degrees Celsius**
- Maintaining an efficiency of over 200% at -18 degrees Celsius
- Talk to your contractor if a cold climate heat pump is right for your home
- Ducted or ductless options



# Types of heat pumps: Choosing Ducted or Ductless

| Factor                              | Central Ducted Heat Pump         | Ductless Mini-Split Heat Pump |
|-------------------------------------|----------------------------------|-------------------------------|
| Heating                             | ✓                                | ✓                             |
| Air Conditioning                    | ✓                                | ✓                             |
| Air Filtration                      | options for high quality add-ons | limited options               |
| Dehumidification                    | ✓                                | ✓                             |
| Zonal Heating                       |                                  | ✓                             |
| Existing Ductwork/central heating   | ✓                                |                               |
| No Ductwork or inefficient Ductwork |                                  | ✓                             |



## Types of heat pumps: Other Reasons for Ductless

- You want zonal heating
- You have an open concept building
- You are replacing baseboards or wood stove
- You are replacing a gas fireplace
- You want to remove ductwork during renovation
- You want a system with lower operating cost for only part of your building such as a common area, basement suite or addition.



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# HEAT PUMPS

What are the benefits?

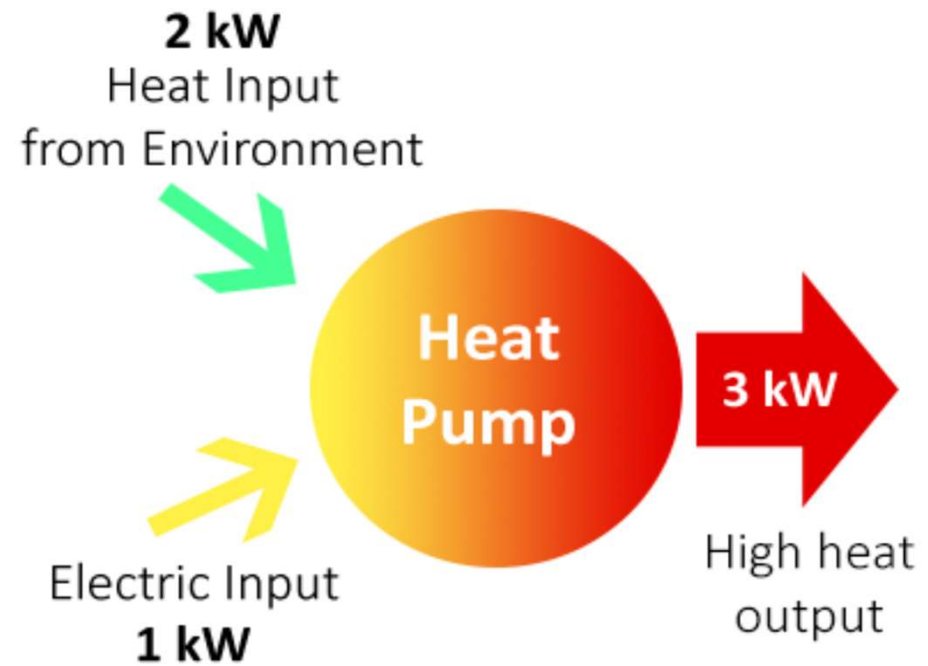


## Heat Pump Benefits

- The most energy efficient heating and cooling system currently available
- Year-round comfort
- A climate friendly home
- A healthier home
- You pay no carbon tax on your energy bill

# Heat Pump Benefits

- The most energy efficient heating and cooling system currently available, 3 to 4 times better than high efficiency gas or baseboard heating.
- The most cost effective heating system





## Heat Pump Benefits

### **Better indoor air quality:**

- Provides cooling on hot summer days as well as dehumidification
- Provides heat in winter
- Provides air filtration to help rid your home of indoor pollutants, dust and pollen.



## Heat Pump Benefits

### **Zone temperature options:**

- Ductless air to air heat pumps (mini-splits) meet the comfort needs of different members of the household
- Heat/cool the rooms you are using

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# HEAT PUMPS

What are the myths?

# Heat Pump Myths

## Myth #1: Heat Pumps are expensive to purchase:

|                                 | High efficiency gas furnace                  | Central ducted heat pump                       |
|---------------------------------|--|--|
| Equipment and installation cost | Range \$6,000 to \$18,000<br>Average \$7,000 | Range \$12,000 to \$27,000<br>Average \$18,000 |
| Rebates available               | Up to \$1,000                                | Up to \$11,000                                 |
| Cost after rebates              | Average \$6,000                              | Average \$7,000                                |

Source:



# Heat Pump Myths

## Myth #2: Heat Pumps are Noisy

| Heat Pump | Clothes Dryer | Toilet Flushing |
|-----------|---------------|-----------------|
| 50-60 dB  | 60-70 dB      | 75+ dB          |



Source:  **cleanBC**  
our nature. our power. our future.

City of Vancouver has a Heat Pumps & Noise  
FAQ here:

<https://vancouver.ca/files/cov/heat-pump-noise-guide.pdf>



# Heat Pump Myths

## Myth #2: Heat Pumps are Noisy

### Locate Away from Property Line

- Avoid the side yard
- Favour the front or rear yard

### Keep Away of high travel and weather-exposed areas

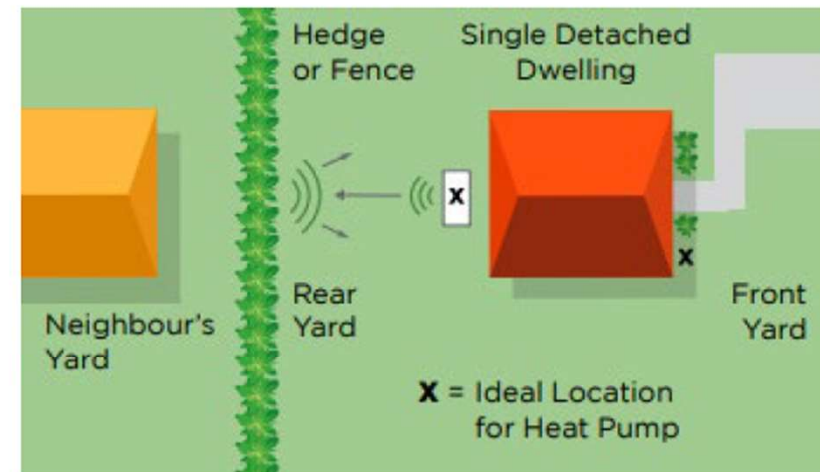
- The unit should not be under a drip line

### If you can see it, you can usually hear it


- Use existing barriers like fences, landscaping, or decks
- Keep the unit away from neighbouring windows
- Ensure sufficient air flow clearance
- Consider acoustic barriers

### Mount the unit on the ground

- Mount on a solid base such as a concrete pad
- Installed with rubber pads or dampeners to minimize vibration



<https://vancouver.ca/files/cov/heat-pump-noise-guide.pdf>

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- These next slides are thanks to a Clean BC webinar I attended earlier this year and are taken directly from their slide deck.

# AVAILABLE REBATES



# Two Stackable Programs



**Provincial** – CleanBC Better Homes and Home Renovation Rebate Program (CBC)



**Federal** – Canada Greener Homes Grant (CGHG)

All rebates/grants are stackable up to 100% of the upgrade cost (excluding tax)

# Heat Pump Provincial Rebates and Federal Grants – Overview

| Upgrade                                   | Canada Greener Homes Grant | CleanBC Electric to Heat Pump Rebates | Estimated Total (Electric to Heat Pump) | CleanBC Fuel Switch Rebates | Estimated Total (Fossil Fuel to Heat Pump) |
|---|----------------------------|---------------------------------------|---|-----------------------------|--|
| Ductless Mini-Split Heat Pump Single Head | \$0                        | \$1,000                               | <b>\$1,000</b>                          | \$6,000                     | <b>\$6,000</b>                             |
| Ductless Multi-Split Heat Pump            | Up to \$5,000              | \$1,000                               | <b>Up to \$6,000</b>                    | \$6,000                     | <b>Up to \$11,000</b>                      |
| Central Ducted Heat Pump                  | Up to \$5,000              | \$2,000                               | <b>Up to \$7,000</b>                    | \$6,000                     | <b>Up to \$11,000</b>                      |
| Dual Fuel Heat Pump                       | Up to \$5,000              | -                                     | <b>Up to \$5,000</b>                    | \$3,000                     | <b>Up to \$8,000</b>                       |
| Air-to-water Heat Pump                    | \$0                        | -                                     | <b>\$0</b>                              | \$3,000                     | <b>\$3,000</b>                             |

# Provincial Heat Pump Rebates – Eligibility Criteria

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- Eligible homes (Single family, side-by-side rowhome or duplex, mobile home on permanent foundation)
- Rebate values dependant on participant's **primary space heating system prior to the heat pump installation**
- Must serve as the **primary space heating system** for the home;
- **Maximum one (1) primary space heating system** rebate per home;
- **Rebates cannot exceed the cost** of the invoice and paid cost of the upgrade;
- Must be found on CleanBC **Heat Pump Qualifying Product List**.

# Heat Pump Rebates:

## BC Hydro Electrically heated homes

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- Electrically heated homes in BC Hydro's Service Area must meet a **minimum electricity consumption** to be eligible.
  - Check eligibility by entering your BC Hydro account number and home's square footage at [bchydro.com/hero/eligibility](https://bchydro.com/hero/eligibility)

| Heat Pump Type   | Rebate Amount |
|--|---------------|
| Ductless <b>Mini Split</b> Heat Pump (Single Head)<br>HSPF ≥ 10.00, SEER ≥ 16.00, Variable Speed Required                  | \$1000        |
| Ductless <b>Multi-Split</b> Air Source Heat Pump (Two or more Heads)<br>HSPF ≥ 9.30, SEER ≥ 16.00, Variable Speed Required | \$1000        |
| <b>Tier 2 Central Ducted</b> Heat Pump<br>HSPF ≥ 9.30, SEER ≥ 16.00, Variable Speed Required                               | \$2000        |

\*Replacing or adding to an existing heat pump is not eligible for provincial rebates

# Heat Pump Rebates:

## Fossil fuel heated homes

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For converting from oil, natural gas, or propane to a heat pump

| Heat Pump Type   | Rebate Amount<br>(BC Hydro Territory) |
|--|---------------------------------------|
| Ductless <b>Mini Split</b> Heat Pump (Single Head)<br>HSPF $\geq$ 10.00, SEER $\geq$ 16.00, Variable Speed Required                  | \$6000                                |
| Ductless <b>Multi-Split</b> Air Source Heat Pump (Two or more Heads)<br>HSPF $\geq$ 9.30, SEER $\geq$ 16.00, Variable Speed Required | \$6000                                |
| <b>Tier 2 Central Ducted</b> Heat Pump<br>HSPF $\geq$ 9.30, SEER $\geq$ 16.00, Variable Speed Required                               | \$6000                                |



# Heat Pump Rebates:

## Fossil fuel heated homes... Continued

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For converting from oil, natural gas, or propane to a heat pump

| Heat Pump Type   | Rebate Amount     |
|--|-------------------|
| <b>Dual Fuel Ducted</b> Heat Pump<br>HSPF $\geq$ 9.30, SEER $\geq$ 16.00<br>(no variable speed required) | \$3000            |
| <b>Air-to-Water</b> Heat Pump  | \$3000            |
| <b>Combined</b> Space & Hot Water Heat Pump  | Up \$4000 + \$300 |
| <b>Electric Service Upgrade</b><br>Upgrade electrical service to 100, 200, 400 amp service               | \$500             |

# Heat Pump Low-Interest Financing Program

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- Interest Rates of **0%** over 60 months (5 years)
- Loans of **\$1,000** to **\$40,000** available
- Access CleanBC financing **OR** the CleanBC heat pump rebate, **but not both**.
- Upgrades **must** be installed by a **Finance Registered Contractor**.
- Homes must be switching from fossil fuel (oil, gas, propane) to a heat pump
- Same heat pump requirements as the provincial heat pump rebates

# Canada Greener Homes Grant (CGHG)

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- Up to \$5,000 towards upgrades plus up to \$600 towards EnerGuide Evaluations
- **Heat Pump grants** range between **\$2,500 and \$5,000**
- Homeowners **must register** in the Homeowner Portal and have **both a Pre- and Post-Retrofit EnerGuide Home Evaluation**
- Home must be homeowner's primary residence
- **Grants can stack** with the CleanBC rebates, up to 100% of the total cost

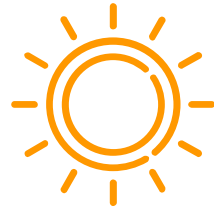


# Canada Greener Homes Loan

## Invest in your home

Improve your home's energy efficiency with a Canada Greener Homes Loan

- Launched June 17<sup>th</sup>, 2022
- Stackable to the \$5,000 grant
- Loans up to \$40,000 Interest-free
- Registration and EnerGuide required
- Repayment over 10 years



**THANK YOU!**

**Do you have any questions?**

