“It is too cold for Air Source Heat Pumps to work in Alberta”

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Heat pumps are everywhere. You have one in your fridge. You will also have a heat pump if you have an air conditioner in your home or car. A heat pump uses a compressor and refrigerant to move heat efficiently from one place to another.

“Mild Climate” air source heat pump in an hotel room.

It is also common to have heat pumps that provide heat. Every time you stay in a hotel the unit under the window is a heat pump that provides both heating and cooling.

A heat pump transfers heat from a “source” to a “sink.” In your fridge the “source” is the food in your fridge and the “sink” is the air outside of your fridge. You can notice the heat coming from the bottom (or back) of your fridge – this is the heat that has been taken out of your food. The “source” cools off while the “sink” heats up.

In the hotel heat pump pictured, the unit moves heat from the room to the outside when cooling and from the outside air into the room when heating. It is called an **air source heat pump** (ASHP) as the source of heat is air. A reversing valve in the unit switches between heating and cooling when needed.

One of the challenges when building a net-zero energy (NZE) home is to find a way to electrically heat your home. Since the energy we generate in an NZE home will be electric (from solar) our heat will need to be electric. Heat pumps are an efficient way to electrically heat (and cool) our homes. A ground source heat pump (which pulls heat out of the ground) will work at any temperature. An air source heat pump (which pulls the heat out of the air) should be fairly close to the design low air temperature in your area.

What is the design low air temperature in your area? The building code has charts that specify the design low temperature for building designers. The chart specifies the minimum “design heating dry bulb temperature” for your location. You can look up the design low temperature for your location on this Hot 2000 Climate Map. Here are a few example design temperatures:

Location	*Design Temp*
Edmonton	-30 C
Calgary	-26 C
Toronto	-18 C
Vancouver	-4 C
Victoria	-3 C

A standard air source heat pump (as you see in hotel rooms) is typically rated to -15C (or warmer). I will call those “mild climate heat pumps.” Since most of the population in Canada is in Ontario, Quebec, and BC, a -15C rated heat pump works well for most of those locations. Hotels are ***designed*** in milder climates, so the heat pumps they use are all “mild climate” versions. There are millions of these “mild climate” air source heat pumps in use across north America, including most of the hotels in Alberta. You will see these “mild climate” air source heat pumps in widespread use in regions where electric heat is prevalent such as BC, Ontario and Quebec.

On those days when the temperature is below -15C, “mild climate” air source heat pumps have an auxiliary electric heater that provides additional heat. This auxiliary heat resistance heater is not as efficient as the heat pump but can keep the space warm when it is below -15C outside.

There are a number of reasons why electric heating may be used in cold climates. In some jurisdictions there is abundant hydro power and the utility companies promote widespread use of electric heating. Electric resistance heating has a very low installation cost so a home can be built inexpensively. Homeowners can also choose electric heating as a less carbon-intensive way to heat their home (especially when combined with solar). There are provincial and federal programs to convert fuel oil furnaces to electric heating to reduce carbon emissions. In our discussion we are looking at an electric source of heat on our way to making our homes Net-Zero energy.

Electric resistance heat (such as electric baseboards or space heaters) may cost more than other heating methods. There are 278 kWh in a Gigajoule (GJ) of energy. A typical contract price for electricity in Alberta is 8.80 cents/kWh and a contract price for gas is $4.10/GJ (camroseenergy.com 28 Jul 2025). If we calculate the price of 278 kWh of electricity (1 GJ) it would be $24.50 which is ~6 times higher than the equivalent price for 1 GJ of gas. To heat with electricity requires that we have a more efficient means of supplying heat.

Heat pumps are more efficient than electric resistance heating. When we use electric resistance heat, we will get 1 kWh of heat from each kWh of electricity we put into the heater. We call this a coefficient of performance (COP) of 1. Essentially it is 1 kWh/1 kWh which is 1 (or 100%). My ground source heat pump has a COP of 4.6, meaning that for each kWh of electricity it uses, I receive 4.6 kWh of heat from the unit. It is 460% efficient. By pumping my heat from the ground (ground source), I gain efficiency.

In an air source heat pump the efficiency varies according to the air temperature. In mild temperatures an air source heat pump can have a COP as high as 5. That decreases with air temperature until you get to the lowest design temperature for the unit. In a “mild climate” air source heat pump that low temperature will be about -15C. At the design low temperature, the heat pump typically has a COP of 1. The auxiliary resistance heater (COP of 1) can then supplement the heat as it gets to the lower limits of its range.

In the last few years, we have seen the introduction of cold climate air source heat pumps (ccASHP). These heat pumps are suitable for installation in colder climates. Here are some examples of ccASHP manufacturers that we have seen on the Eco-Solar Home Tour.

ccASHP	*Rated Temp*	*Comments*
Tosot	-30 C	
Senville (SENA)	-30 C	Small units
Napoleon	-30 C	Cdn manufacturer
Lennox	-28 C	
Mitsubishi	-25 C	
Arctic	-25 C	Cdn manufacturer, hydronic
Daikin	-23 C	
Nordic	-22 C	Cdn manufacturer

Cold climate ASHPs will normally have an electric resistance heater (auxiliary heat) that will act as a second stage of heat at very cold temperatures. We have seen some homes with ccASHPs that have chosen not to include an auxiliary heater; however, I don't recommend it.

One note. There are "mild climate" heat pumps on the market that are sold with a gas auxiliary heater. These units are often called "dual fuel" units. There are two problems with dual fuel units. First, a gas connection can have annual service charges up to $600/year, so you miss out on the savings from disconnecting gas. Second, the point of electrifying our heating is so that we can offset it with solar. You currently cannot offset gas use with solar so you would not be able to get to net-zero energy if you remain connected to gas.

To establish the size of the heat pump you need you should have a heat loss calculation done on your home. A home that is well-insulated and air-tight will require less heating capacity. Many contractors will "estimate" the heating capacity you need, but this often leads to a system that is too big and more expensive. An actual heat loss calculation done by a professional will make sure that you get the right size of heat pump. If you are planning insulation and air-tightness upgrades, have your heating calculation done to match your plan.

So, which electrical heating system is right for you as you work toward net-zero energy? If you are building a new home then you may be able to make the building envelope efficient enough so that you can use a modestly sized ccASHP. To build a new net-zero energy home we would suggest you find a builder that has experience with this type of building.

If you are renovating, then a deep energy retrofit can dramatically reduce the energy demands of your home. Once you add insulation and air-seal your home a bit better then a smaller electric heating unit should meet your needs.

The goal is to match the energy-efficiency of your home and heating system to the amount of solar you can reasonably install on your roof.

What are your next steps? We would recommend that you visit the Eco-Solar Home Tour each year in June. The tour lets you meet with the homeowners who have installed and are living with these types of heat pump systems. They can let you know what their experience has been with their heat pump and how they have achieved net-zero energy in their home.

You can find more information on heat pumps at NRCAN.
https://natural-resources.canada.ca/energy-efficiency/energy-star/heating-cooling-heat-pump

NRCAN has an Oil to Heat Pump Affordability program which offers a grant to homeowners who currently use a fuel oil furnace to help them upgrade to a heat pump. This program is available across Canada (including Alberta) for homeowners using fuel oil furnaces.

NRCAN has an Air Source Heat Pump Sizing Toolkit available. This is a very detailed calculation intended for design professionals.