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Electric Heat Pump Guidance for Insurers, Agents, and Brokers

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Canada

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PURPOSE

Electric heat pumps are a key technology towards a decarbonized building sector - both in Canada and worldwide. This Natural Resources Canada document helps provide insurance providers, brokers and the industry as a whole with up-to-date information on the performance and capabilities of modern electric cold climate heat pumps. The goal is to help the insurance industry increase awareness of this type of clean technology as adoption continues to grow in Canada.

ABOUT HEAT PUMPS

Electric heat pumps are a mature, ultra-efficient technology that is proven to provide reliable heating cooling, and water heating in buildings. Over 180 million heat pumps are currently installed throughout the world, in both cold and warm climates, including Canada, the United States, and Europe. Modern heat pumps are more reliable and provide heat down to much lower temperatures than older heat pumps. For instance, cold climate air source heat pumps developed in recent years can provide comfort level heat down -30°C.

Furnaces and boilers provide space heating through the combustion of a fuel such as natural gas or heating oil. While efficiencies have continually improved, they still remain below the theoretical maximum of 100%. Furnaces and boilers do not have the ability to provide both heating and cooling, as is the case for electric heat pumps.

Heat pumps operate on a different principle. The electricity input into the heat pump is used to transfer thermal energy between the inside and the outside of a building. Cold climate electric heat pumps can reach efficiency levels of 150-350%[1] in winter, meaning that they are capable of providing much more thermal energy in the form of heating and cooling for a building than the amount of electric energy used to pump it.

In order to heat a building, heat pumps typically extract heat from the ground or the air. Air source heat pumps extract heat from ambient air. Ground source heat pumps extract heat from subsurface soil or water.

There are two general types of air source heat pumps:

1. **Air to Air Heat Pumps:** These units heat or cool the air inside a building and represent the vast majority of air-source heat pump installations in Canada. They can be further classified according to the type of installation:
    a) Ducted – The indoor coil of the heat pump is located in a duct. Air is heated or cooled by passing over the coil, before being distributed via the ductwork to different locations in the building.
    b) Ductless – The indoor coil of the heat pump is located in an indoor unit. These indoor units can be located recessed in the ceiling, on the floor, or against the wall of an occupied space, and heat or cool the air in that space directly. Referring to these units, you may see the terms mini- and multi-split:

[1] Natural Resources Canada. Heating and Cooling with a Heat Pump. Found here.

    i. Mini-Split: A single indoor unit is located inside the building, served by a single outdoor unit.
    ii. Multi-Split: Multiple indoor units are located in the building and are served by a single outdoor unit.
2. **Air to Water Heat Pump:** Less common in Canada, air-water heat pumps use a heat exchanger to heat or cool water and can be used in buildings with hydronic (water-based) distribution systems such as low temperature radiators, radiant floors, or fan coil units. In heating mode, the heat pump provides thermal energy to the hydronic system.

Ground-source heat pumps use the earth or ground water as a source of thermal energy in heating mode, and as a sink to reject energy when in cooling mode. These types of systems contain two key components:

1. **Ground Heat Exchanger:** This is the heat exchanger used to add or remove thermal energy from the earth or ground. Various heat exchanger configurations are possible.
2. **Heat Pump:** Ground-source heat pumps use a fluid flowing through the ground heat exchanger as their source (in heating) or sink (in cooling).

Like air-source heat pumps, ground-source heat pumps can either heat/cool the air inside a building or serve a water-based hydronic loop.

TODAY'S HEAT PUMPS

Cold climate air source heat pumps today operate down to winter temperatures experienced in regions where the majority of Canada's population resides. New heat pump models have variable speed capability allowing them to match their heat output to the needs of the building and achieve far greater cold weather performance. Modern, cold-climate heat pumps can operate reliably down to -30°C. In colder areas of the country, heat pumps will be able to take on much of the heating and cooling load, but there may still be a need for an auxiliary heat source. In these colder regions, auxiliary heating will be needed in order to provide 'comfort-level' heat to a building. In some regions, auxiliary heating may only be needed to prevent damage in extreme cold. But for the most populated regions in Canada, properly sized and installed heat pumps can reliably supply comfort level heat year-round. In net zero energy homes in regions in Canada with design heating temperatures > -30°C, as well as many homes in regions with mild climate, cold climate heat pumps can be sized such that they are the only required means of heating.

Heat pumps are designed to be reliable. Manufacturers have minimum operating temperature specifications for their equipment down to which the heat pump will consistently supply heat. Below these temperatures, auxiliary heating may be needed. Heat pumps, like any heating equipment, will need auxiliary heating if sized too small.

Heat pumps are, and will continue to be, a practical and energy efficient choice for a large majority of Canadians. Heat pumps are already a practical alternative for most of Canada's most populated regions. In the coming decades, the period of time throughout the year where the temperature falls below -30°C is expected to decrease significantly across the

country. As a result, even more regions will be able to take advantage of heat pumps with a reduced need to draw upon auxiliary heating.

	Historic mean number of -30°C days (1976-2005)	Projected mean number of -30°C days (1976-2005)
St. John's	0	0
Halifax	0	0
Moncton	0.2	0
Montreal	0.44	0
Quebec City	2.4	0.5
Ottawa	0.9	0.2
Toronto	0	0
Winnipeg	12.3	4.4
Saskatoon	13.7	6.3
Calgary	3.7	1.7
Edmonton	7.4	3.2
Prince George	5.8	0.1
Vancouver	0	0

Source: Canadian Climate Atlas, climateatlas.ca

In regions where auxiliary heating is needed, it is easy to accommodate. Integrated auxiliary heating options (electric and natural gas) are available on centrally-ducted heat pump systems and stand alone backup electric heating options can be supplied through supplemental electric baseboards.

- **Auxiliary (or backup) heating is typically integrated into ducted air source heat pump systems.** Homeowners purchase a single unit that includes both a heat pump and an auxiliary heating unit. This auxiliary heating can use electricity or natural gas.
- **Ductless heat pumps do not have integrated backup heating elements.** However, these units are often installed in buildings with existing heating systems or can easily be accompanied by baseboard heaters in regions where auxiliary heating is required.

Heat pumps will need regular maintenance. Air source heat pumps automatically defrost their exterior units as needed, and often include heating coils to prevent ice build-up or freezing around critical components. However, if not properly maintained or subjected to unusual conditions, like any equipment, they too can fail.

Overall, most operational issues can be addressed with workforce education and training. Where specific issues exist, they may require specific accommodations tailored by a knowledgeable professional.

From a risk perspective, residential insurers should take a 'whole-home' approach. Any heating system, whether oil, gas, or electric, can be undersized for the building it serves. Modern cold climate air source heat pumps that are properly sized and installed can provide

whole home comfort-level heating throughout the winter. Only in the coldest regions would these heat pumps need to rely on auxiliary heating to avoid cold weather risks such as frozen pipes. CSA F280-12, the standard used to size heating and cooling equipment in Canada (which is referenced in National and Provincial building codes), states that the total heat output capacity of all heating systems installed in a building shall be not less than 100% of the total building heat loss. From a risk perspective, there is no difference between a heat pump providing the sole means of heating to a home vs. an oil, gas or propane furnace or electric resistance heating system, all of which require electricity to function and all of which may encounter equipment failure requiring emergency repair.

Buildings installing modern heat pumps that are sized and installed properly should not be treated any differently than buildings with traditional electric furnaces or baseboard heating. Insurance policies should not distinguish between buildings properly heated with a heat pump and those heating with other forms of electric heating. So long as the equipment is sized and installed to heat the whole home sufficiently to avoid cold weather risks and meet occupant comfort expectations as well as meet code requirements, heat pumps and traditional heating options should be seen as comparable.

Check out our website

canada.ca/heatpumps