Homeowner's Guide to **Heating With Electricity**

Electricity is the second most common heating source in Nova Scotia. It offers convenience, eliminates combustion or fuel storage concerns, and has predictable, regulated pricing.

Common electric heating systems include:

Electric Resistance Heat

Electric resistance heat is available in many different configurations. Advantages typically include relatively low equipment costs, space savings and low maintenance requirements. The major disadvantage of this type of system is high operating costs. Widely available systems include:

Electric baseboard heaters are quiet, easy to install, and simple to maintain. They are best suited to smaller energy efficient homes with low heating requirements or to add a little extra heat to a specific room. They are particularly useful as a back-up system for unit heaters such as mini-split heat pumps, wood or pellet stoves or electric thermal storage heaters.

An **electric furnace** combines electric elements and an air duct system to distribute heated air throughout a home.

Electric boilers heat water in insulated tanks containing electric heating elements. Heat is distributed around the home via hot water baseboards or a radiant in-floor system. This type of system may be eligible for Time of Use electricity rates.

Electric heating elements can be installed in a cement slab or under finished flooring to provide radiant floor heating. This system is most commonly used to warm up tile floors in bathrooms or kitchens.

Energy Efficient Electric Heating systems

Heat pumps have become a very popular heating option in Nova Scotia. Overall efficiencies continue to improve and systems are available for almost any application except baseboards and cast iron radiators which require higher water temperatures. Heat pumps can deliver more energy to the home than they need to operate since heat pumps absorb and concentrate outdoor heat rather than consuming energy directly or burning fuel like a conventional system does.

How does a heat pump work? Heat from the air, the earth or water is absorbed by coils filled with refrigerant. This causes the refrigerant to evaporate. The resulting gas is compressed to increase its heat content. When this high pressure passes through the condenser heat is released into the home. Heat pumps can also cool a home by reversing this process.

Types of Heat Pumps

The three main types of heat pumps are air-source, water-source, and ground-source. Water- and ground source units may also be called earth energy or geothermal systems. Air-source heat pumps are the most common type of heat pump. Types of heat pumps include:

A **central ducted heat pump system** can evenly heat (or cool) the entire house. This system includes an outside compressor unit, warm air ductwork and an indoor unit with a coil and fan that connects to the ductwork. As the outside air becomes colder, the home requires more heat but the heat pump's output drops, since the outside air the heat pump must extract heat from is colder. Eventually the heat pump can't meet all of the home's heating requirements without supplemental heat. 'All-electric' ducted air-source heat pumps are equipped with electric resistance heaters that automatically supply any additional heat required. Gas, oil or special time of use systems can also provide back-up heat in cold weather.

Ductless mini-split heaters heat (or cool) a specific room or area. They are not a central heating system. The outdoor unit contains the compressor and absorbs heat from the outside air. Refrigerant lines connect the outdoor unit to one to three indoor units that provide heat as a stream of warm air. Usually the indoor units are wall mounted, but ceiling mount units are also available.

Ductless mini-splits have become extremely popular heating system for smaller energy efficient new houses. They have also proven to be a popular retrofit for existing homes, especially homes with electric baseboard heat. Advantages include attractive operating cost savings, relatively simple installation and no need for ductwork. Power draw is also modest so electrical panel upgrades are usually not necessary in most homes.

Most ductless mini-split systems can continue to operate until outside air temperatures drop below -15°C to -20°C depending on the type of unit installed. Below that temperature the system will shut off and back up heat will be required. In many homes, electric baseboards are used to for backup heat.

'**Add-on' ducted heat pumps** operate in tandem with a warm air furnace (such as oil, propane or natural gas). Typically the heat pump is the main source of heat in milder weather when it operates most efficiently. The warm air furnace is the primary heating system on the coldest days.

Air to water heat pumps produce heated water (instead of air). Typically this type of heat pump would be connected to a low temperature water based distribution system such as a radiant floor. Air to water systems can also supply domestic hot water to the home.

Ground and water-source heat pumps (or earth energy systems) use heat from the ground, well or lake water as the heat pump's heat source. Since the temperature of the earth is largely independent of the weather, ground-source heat pumps can operate at a consistently high efficiency throughout the winter regardless of how cold outside air is. Most systems supply both home heat and hot water. The major drawback of this type of heat pump is its high installation cost and the need for a suitable water source or earth heat collection system.

Buying a heat pump – Heat pump efficiency is rated by three numbers; the Heating and Seasonal Performance Factor (HSPF); the Seasonal Energy Efficiency Rating (SEER) and the Energy Efficiency Ratio (EER). In all three cases the higher the number, the better the heat pump will perform. For a heating climate like ours, the HSPF is the most important number. The most efficient heat pumps are Energy Star qualified. Heat pumps with inverter technology improve efficiency and reduce equipment wear by modulating compressor operation to provide more even operation and fewer start/stop cycles. In our climate, a heat pump with a low cut out temperature is a definite advantage.

Installing a heat pump - Provincial regulations and manufacturer warranties both require that all heat pumps be installed by a licensed refrigeration technician. Geothermal systems should be installed by a firm certified by the Canadian Geoexchange Coalition.

Time-Of-Use (TOU) Electricity Rates

Time of use heating systems are not more efficient than other types of electric heating. In fact, they use the same amount of electricity as comparable baseboards, boilers or furnaces systems would. Savings result from shifting usage from peak periods when power is expensive to an off-peak time with discounted rates, not from using less electricity overall.

The key to the TOU rate structure is a specialized electric service meter that can record the amount of electricity consumed during specific time periods. This technology allows utilities to sell electricity at different rates throughout the day or week, depending on their cost of generation. To be eligible for Nova Scotia Power's optional 'time-of-use' (TOU) rate structure, homeowners must have a heating system that can store heat during off peak periods for use during the higher cost on peak periods.

Under the time of use rate structure, customers are charged approximately half the normal kWh rate on holidays, on weekends, and for 8 hours overnight (about 4760 hrs/ year). In December, January, and February electricity is sold for approximately 30 percent more than regular rates for 12 hours during weekday mornings and evenings (about 816 hrs/year). Standard household electric rates apply for the remaining 3184 hrs/year. Base connection charges for TOU meters are $96 / year higher than for a conventional electrical service.

All-electric' homes equipped to take advantage of the TOU rates typically see cost savings from 25 to 35 percent on their entire electric bill.

Warning - TOU rates apply to all household electricity use. To maximize benefits, homeowners need to be mindful of when they use electricity to minimize costs. Effective strategies include doing laundry on weekends, running your dishwasher overnight and timing off water heaters during periods when peak electricity costs are in effect.

Common types of heating systems approved for TOU rates include:

Electric Thermal Storage (ETS) Heaters - These devices are specifically made for TOU power rate applications. ETS heaters store heat in an insulated shell containing heat-absorbing bricks. Temperatures inside these heaters can reach over 100° F. The bricks are heated during off-peak time periods when electric costs are low. Heat is radiated into the room through the outside of the heater. If more heat is needed, a fan blows air through the heated bricks to deliver additional heat to the home.

High-Mass Radiant Floor Systems - Homes with high-massradiant floor systems are also eligible for TOU rate structures. Off-peak heat can be stored both in the slab itself and as hot water in an insulated tank. Controls that ensure that the slab is charged during off peak periods will be required to ensure that customers obtain maximum benefit from the TOU rate structure.

Specialized heat storage systems eligible for time-of-use rates are also available for hot water boilers, warm air systems and to as add on units for central heat pump systems. These systems are less common, due to their higher initial cost.

Typical Efficiencies	
Electric Baseboards	100%
Electric Furnaces	100%
Electric Boilers	100%
Electric Radiant	100%
Central Air to Air Heat Pump	190 – 200%
Mini-split Heat Pump	260 – 290%
Air to Water Heat Pump	270 -300%
Earth Energy System	300 - 400%
ETS systems	100%

Thermostats

Bi-metal thermostats used in many homes are often the cause of the large temperature swings and comfort problems people may associate with electric heat. These older style low-quality thermostats are inaccurate and can't respond fast enough or accurately enough to keep room temperatures within most people's comfort zone.

Electronic line voltage thermostats can almost eliminate temperature swings and will usually save energy too. An electronic thermostat costs about $40. Upgrade the thermostats in high-use rooms first, since that is where comfort improvements will be more noticeable.

Programmable or "setback" thermostats automatically lower and raise room temperatures. Reducing the temperature 5°C (10°F) overnight, or when no one is home, can cut your heating bill by up to 10 percent. Programmable thermostats can also improve comfort by warming your home to a comfortable temperature before you get up or return, so you can enjoy savings without sacrificing comfort.

Smart thermostats - For central systems, there are now smart thermostats that have additional features such as occupancy sensors, learning capabilities and remote control via smart phones.

References: Natural Resources Canada's "Heating and Cooling with a Heat Pump" publication

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