POWER SMART*

Geothermal heat pumps for homes

Manitoba Hydro

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INVEST IN COMFORTABLE, ENERGY-EFFICIENT,
ENVIRONMENTALLY RESPONSIBLE HOME HEATING AND COOLING.

What's Inside

Saving Money & the Environment

WITH A GEOTHERMAL HEAT PUMP

Whether you are replacing a worn out home heating and cooling system, or planning to build a new home, consider a geothermal heat pump — the most energy efficient, comfortable, and environmentally friendly heating and cooling system available.

Geothermal heat pump systems are often more expensive to install than other heating and cooling systems, but the energy savings achieved will pay back your investment over time. To further assist you with the cost of installation, Manitoba Hydro provides a convenient Residential Earth Power Loan.

In terms of economics, the best time to install a geothermal heat pump is when you are building a new home or replacing a heating system that is near the end of its useful life.

Many homeowners also consider a heat pump when they are thinking of installing a central air conditioner, especially if they are also considering replacing their heating system. Additional savings are also available by using the heat pump to supply hot water, or even heat outdoor swimming pools.

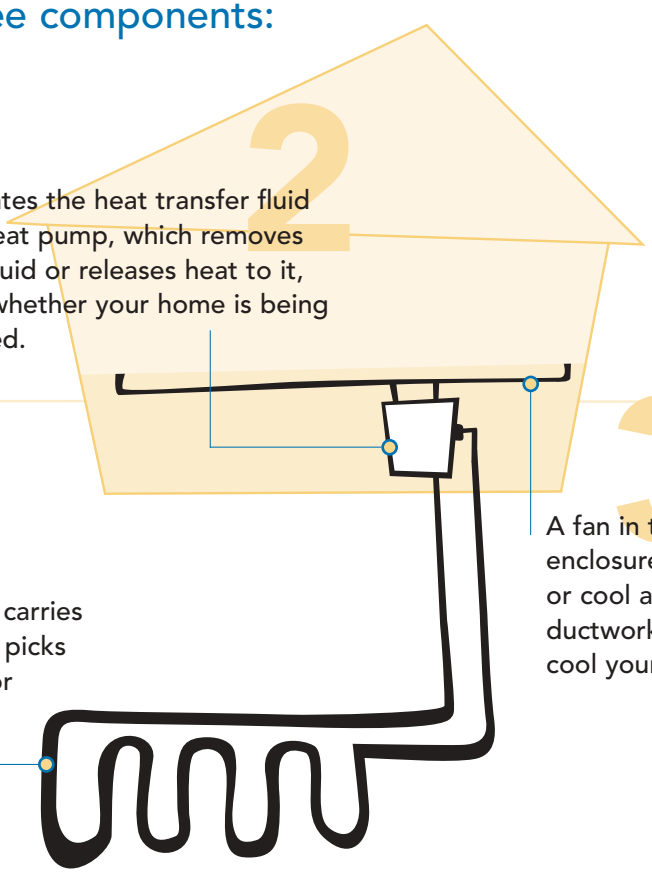
Installing a heat pump is not a project for the do-it-yourselfer. You will need to hire a qualified contractor who can ensure that the system is properly sized for your home and who can handle the specialized installation tasks.

Before you decide to install a geothermal heat pump unit, ask your contractor to do a computerized payback analysis, which will help you determine if a heat pump is the right choice for you based on economics.

The Earth Power Loan

Manitoba Hydro now offers Residential Earth Power Loans of up to $15,000 to cover the additional cost of installing a geothermal heat pump, compared with a conventional heating and cooling system. You can pay off the loan conveniently on your energy bill. In addition, each month your heat pump will reduce your bill considerably (see chart on page 5). In some cases your heat pump may save more on your energy bill than your monthly payment on the Earth Power Loan, making the loan pay for itself.

Geothermal heat pump systems, often called GeoExchange or Earth Energy systems, generally have three components:



2 The pipe circulates the heat transfer fluid through your heat pump, which removes heat from the fluid or releases heat to it, depending on whether your home is being heated or cooled.

3 A fan in the heat pump enclosure blows warm or cool air through your ductwork to warm or cool your home.

1 A system of buried pipe carries a heat transfer fluid that picks up heat from the earth or releases heat to it.

Geothermal Heat Pumps

THE BENEFITS TO YOU

Heat pumps are a high efficiency, environmentally responsible, and worry-free solution to year-round home comfort. They save on air conditioning and water heating costs as well as space heating costs.

Economical

The savings begin from the day your unit starts operating. For a typical home, compared with an electric heating system, geothermal heat pumps cut your space heating costs by two thirds. For example, switching from electric heat to a heat pump typically saves $667 a year in space heating costs for an average bungalow.

Environmentally Friendly

Each year the earth absorbs enough energy from the sun to create a constant soil temperature ranging from 4°C to 10°C (40°F to 50°F) in Manitoba. Geothermal heat pumps make use of this constant temperature to heat or cool your home while reducing greenhouse gas emissions and minimizing your impact on the environment.

Comfortable

Compared with conventional heating and cooling systems, a geothermal heat pump system warms or cools air in smaller temperature rises, for a much more uniform level of heat. Duct sizes are generally larger than those for conventional fossil fuel furnaces, supplying the same amount of heating at a lower temperature. Some customers have said that even if they didn't save a single cent, they would still install a heat pump system for the extra comfort.

Reliable

Today's heat pumps have evolved into reliable and cost-effective systems based on experience gained in the operation of more than one million geothermal systems world-wide. Warranties for heat pumps are generally 5 to 10 years, and for underground piping 25 to 50 years.

Safe

Because heat pumps do not burn fossil fuels, there is no risk of accumulations of the "silent killer"– carbon monoxide.

Versatile

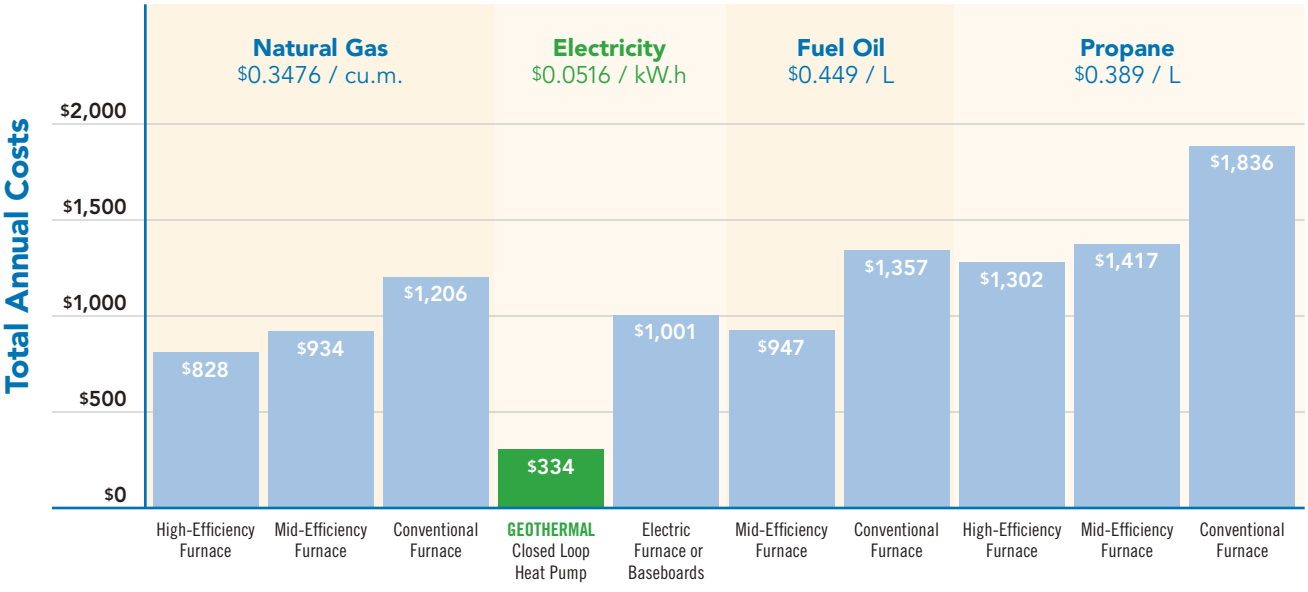
A geothermal heat pump moves heat into the house in winter and out of the house in summer, eliminating the need for a separate air conditioning system.

Low Maintenance

Maintenance is similar to conventional systems. However, with a heat pump system, there is no outside unit that requires annual maintenance and cleaning.

How You Save on Home Heating with a Heat Pump

Heating costs for an average 1000-1200-square-foot residence (family of four). Rates shown are effective May 1, 2002. For the latest version of this chart, check Manitoba Hydro's website at www.hydro.mb.ca.

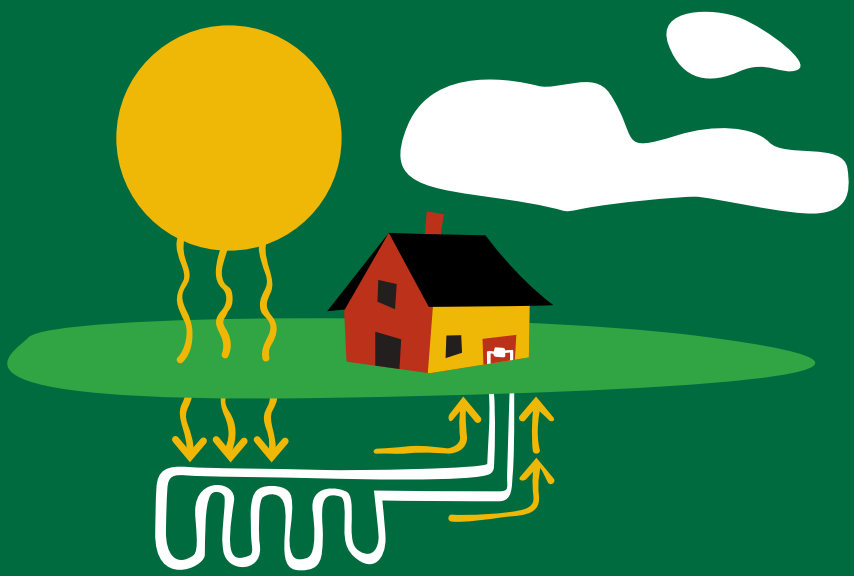


Types of Space Heating Systems

Remember: geothermal heat pumps will also save on your water heating and air conditioning costs.

HOW DOES A

Geothermal Heat Pump Work?



A geothermal heat pump works much like your kitchen refrigerator, which extracts heat from food and passes it into the kitchen through coils on the back of the refrigerator. The difference is that a heat pump can operate in heating as well as cooling mode, eliminating the need for a separate furnace and air-conditioner.

A geothermal heat pump moves or "pumps" heat out of, or back into, the earth instead of making heat by burning fossil fuel or circulating current through an electric element.

Heat pumps are usually connected to the earth through high-density polyethylene pipe buried horizontally or vertically. The pipe carries a heat transfer fluid that stays at roughly the same temperature as the earth around the piping.

After circulating through the piping in the ground, the mixture is piped into your home, where it is connected to the heat exchanger in your heat pump. In winter, the mixture in the pipes absorbs heat from the earth and distributes it to your home. In summer, the system works in reverse, with the mixture absorbing heat from your home and sending it back to the earth.

A geothermal system can heat and cool homes in urban or rural settings. Piping can be installed under a lawn, landscaped area, driveway, or the house itself.

Geothermal heat pumps can also exchange heat with well water and lake water. If your heat pump uses well water, the water is circulated directly through the system and returned to the ground through a second well on your property.

Geothermal heat pumps are able to use a device known as a desuperheater to provide free or low-cost hot water. In summer, the desuperheater recovers some of the "waste" heat from the air conditioning to heat the hot water. In winter, some of the capacity of the heat pump is diverted from space heating to heat domestic hot water.

Geothermal heat pumps do not burn fossil fuels or waste energy. As a result, they do not create emissions of greenhouse gases, which have been linked to global warming. For that reason, and also because they use so little electricity, the U.S. Environmental Protection Agency considers geothermal heat pumps the most environmentally friendly form of home heating and cooling in the world.

Ground Loop Configurations

WHICH ONE SUITS YOUR HOME?*

1 Horizontal Closed Loops

These are a common installation in Canada. Horizontal loops are installed where soils can be excavated easily. Since they take up more land area than any other loop system, they are used where space permits.

A trench is dug on the property, and the pipe is buried in one continuous loop or a series of parallel loops. Landscaping may be required on renovation installations.

2 Vertical Closed Loops

Vertical loops are often used in city lots where land area is limited, or where it would be difficult to dig the more economical horizontal loops. Several pairs of pipes with a U-bend assembly at the bottom are inserted into a series of deep bore holes.

Vertical closed loops are the most expensive, but also the most efficient design, because the under-earth level of heat increases and stabilizes with depth.

3 Lake or Pond Closed Loops

If a pond or lake is available, the heat pump loops can utilize the water rather than the soil to transfer heat. The pipe loop must be weighted properly to remain on the bottom of the lake and to avoid shifting caused by the movement of spring ice.

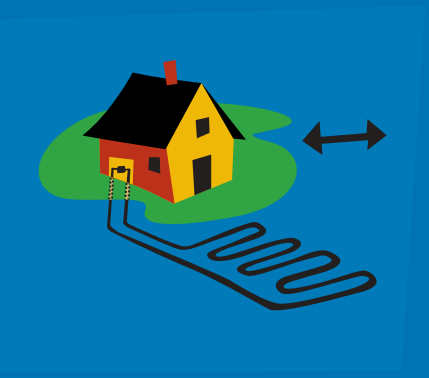
Lake or pond loops are usually less expensive to install than trenching into the ground.

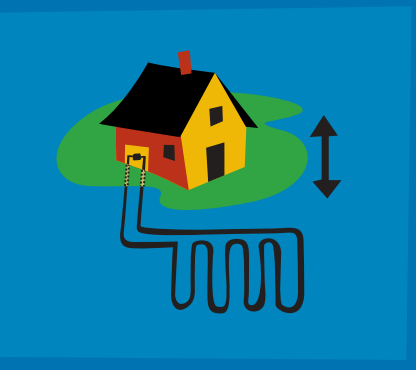
4 Water or Well Open Loops

Open loop systems extract heat directly from water in a lake or drilled well, returning the cooled water to the lake or well in accordance with environmental regulations.

Water sources with high levels of salt, chlorides, or other minerals are not recommended for most units. Ensure that your contractor has obtained all necessary approvals from the appropriate environmental authorities in your area.

Geothermal heat pump systems use four basic ground loop configurations that can turn your back yard into a source of power. All designs are roughly equal in energy efficiency. One of the designs will suit your situation, depending on a variety of factors, including soils, availability of groundwater, and the size of your yard. In a very few situations, installing a geothermal heat pump may not be possible.





*Source: Earth Energy Society of Canada

A Residential Earth Power Loan

CONVENIENT LOW-INTEREST FINANCING ON YOUR ENERGY BILL

Your contractor will assist you in completing your Manitoba Hydro Earth Power Loan application.

Manitoba Hydro offers homeowners Residential Earth Power Loans of up to $15,000 to cover the additional cost of installing a geothermal heat pump compared with a conventional heating and cooling system.

Under the loan, the additional monthly cost of installing a geothermal heat pump rather than a conventional system becomes more economical. As well, the monthly energy savings provided by the heat pump help offset your monthly loan payments (see page 13).

The maximum term of the loan is 15 years at an interest rate of 8.5%. The loan can be paid off on your Manitoba Hydro energy bill.

To qualify for a Residential Earth Power Loan, you must be:

- a customer of Manitoba Hydro
- approved for credit from Manitoba Hydro
- owner of the home where the heat pump is to be installed.

The loan is available through participating contractors, who will look after the paperwork for you.

How to Make Your Loan Application

Your geothermal heat pump contractor will assist you by:

- **filling out the loan application for you**
- **submitting a heat-loss calculation for your house to determine the size of system you need**
- **installing the system and supplying you with a commissioning report**
- **providing a site plan to show the location of your ground loop.**

Once you have signed to indicate your satisfaction with the completed installation, the contractor will submit completed cost forms to Manitoba Hydro. We will pay the contractor for the amount of the loan and add the loan to your energy bill.

Type of Heat Pump

To qualify, your new geothermal heat pump must be tested and rated under CSA Standard C-13256. Note that geothermal heat pump systems must be installed to meet the specifications of CSA C448, Canada's national design and installation standard for heat pump systems.

Air-source heat pumps do not qualify.

Renovation, Replacement or New Construction

The heat pump can be installed in your current home or in new construction.

Contractor Training

One of the eligibility criteria for taking out the Residential Earth Power Loan is that the contractor has completed a training course, such as the International Ground Source Heat Pump Association's (IGSHPA) installer course or individual manufacturers' courses.

For a listing of IGSHPA accredited contractors in Manitoba, visit the Manitoba Hydro web site at www.hydro.mb.ca or www.igshpa.okstate.edu.

How an Earth Power Loan

HELPS PAY FOR ITSELF

As demonstrated in the charts opposite, the energy efficiency of geothermal heat pumps can make the additional cost of installation compared to a conventional system very affordable. In some cases, the average monthly savings achieved by your new heat pump system will be worth more than the extra costs of financing the system – this means that from your first Residential Earth Power Loan payment, you will be ahead economically. And, the energy efficiency of a heat pump system means you help protect yourself from increases in energy prices that may occur over time. All this in addition to purchasing a high-quality, environmentally friendly heating and cooling system.

The following scenarios apply to planned or already constructed 1200 and 2000 square-foot homes in southern Manitoba built to conventional standards, with average costs for space heating and cooling, and hot water heating.

Renovation

HEAT PUMP VS CONVENTIONAL ELECTRIC HEATING AND COOLING

In the renovation scenario, the homeowner decides to install a geothermal heat pump system, including a desuperheater to help with hot water heating, to replace an aging electric furnace and provide air conditioning. The analysis assumes that the ductwork in the home would not need to be modified to accommodate the geothermal heat pump system.

	Installing a Conventional Electric System ($)	Installing a Geothermal Heat Pump System ($)*	Amount Borrowed for 15 years at 8.5% ($)	**Monthly Loan Payment ($)****	**Average Monthly Energy Savings ($)**
1200 square-foot bungalow	3,000	9,800 – 13,000	6,800 – 10,000	65.69 – 96.60	74.64 – 91.16
2000 square-foot two-storey	3,600	11,400 – 16,500	7,800 – 12,900	75.35 – 124.61	115.77 – 153.81

RENOVATION SCENARIO: R-12 WALLS, R 20 ATTIC, R5 BASEMENTS, DUAL-PANE WINDOWS

New Construction

HEAT PUMP VS CONVENTIONAL ELECTRIC HEATING AND COOLING

In the new construction scenario, the homeowner decides to install a geothermal heat pump system, including a desuperheater to help with hot water heating, instead of installing a conventional system consisting of an electric forced-air furnace, electric hot water heater, and central air.

	Installing a Conventional Electric System ($)	Installing a Geothermal Heat Pump System ($)*	Amount Borrowed for 15 years at 8.5% ($)	**Monthly Loan Payment ($)****	**Average Monthly Energy Savings ($)**
1200 square-foot bungalow	5,000	12,400 – 14,200	7,400 – 9,200	71.48 – 88.87	52.43 – 60.45
2000 square-foot two-storey	6,700	15,900 – 18,100	9,200 – 11,400	88.87 – 110.12	76.69 – 86.16

NEW SCENARIO: R-20 WALLS, R 40 ATTIC, R20 BASEMENTS, TRI-PANE WINDOWS

Savings will vary among homes. Ask your geothermal heat pump contractor to do a computerized economic analysis for your home, comparing expected energy savings to costs.

*Prices include labour and the following components: heat pump, pumping unit, thermostat, electrostatic filter, vertical ground loop, auxiliary/backup heater, desuperheater, ductwork (new construction only).

**Monthly Earth Power Loan payments will be higher than shown if the total cost of the heat pump system is financed.

Figures provided are estimated installation costs as of July 2002. Contact your heat pump contractor for actual estimates.

Checklist for Hiring a Qualified Contractor

WHAT TO ASK

This checklist will help you take the guesswork out of hiring an experienced, qualified contractor to install a geothermal heat pump system.

Ask Around

Ask friends, relatives, work colleagues, and neighbours for the names of contractors they recommend.

You can also request membership lists from contractor or trade associations that have codes of ethics and membership criteria. Or visit on-line lists available from Manitoba Hydro (www.hydro.mb.ca), IGSHPA (www.igshpa.okstate.edu) and the Earth Energy Society of Canada (www.earthenergy.ca).

Try to get the names of two to four contractors.

Qualify the Contractors

Ask contractors for references and check them. Any contractor you are considering to do work in your home should be happy and willing to supply this information.

Do not hire a contractor who is unwilling to provide you with references from past customers.

Check references by calling the homeowners and asking them if the work was done properly, on time, and on budget. Was follow-up warrantee work done promptly and properly? Would they hire the contractor again?

Obtain Estimates/Proposals

To be fair to contractors, ask for more than two but not more than four estimates/proposals.

The estimate/proposal should be in writing and contain at least the following information:

- cost and details of equipment or materials to be used (names, models, size, etc.)
- cost of labour
- total cost, including taxes and permit fees
- expected payment schedule
- estimated start and completion dates for the work
- a statement that the contractor carries liability insurance and Worker's Compensation coverage
- details of warranties or guarantees
- details of contractor cleanup during the work and on completion
- details of the homeowner's responsibilities
- a statement that the contractor will instruct the homeowner on the operation and maintenance of any equipment, and provide any required operation manuals.

Evaluate the proposals to make sure they cover the same work and use equivalent materials.

Protect Yourself with a Written Contract

- After selecting a contractor, ask them to prepare a contract based on their estimate/proposal.
- Read the contract carefully and do not sign an incomplete contract.
- Make sure that all of the items covered in the estimate/proposal are covered in the contract.
- Check all terms and conditions. Read the fine print. Any changes to the work or standard conditions in the contract must be initialled by both you and the contractor.
- Without a contract, you have very little chance of resolving disputes if the work is of poor quality, incomplete, or otherwise unsatisfactory.
- Never consider entering into any "verbal" agreements. Always get things in writing.

Questions to Ask

CONTRACTOR NAME

ADDRESS

PHONE

FAX

EMAIL

BUSINESS LICENSE NO.

How many geothermal heat pumps have you installed?

What are the names and phone numbers of two customers you have done work for in the last year whom I could call as references?

NAME

PHONE

NAME

PHONE

What form of agreement do you require before undertaking work in a home?

- ○ verbal agreement
- ○ written quotation signed by the homeowner
- ○ contract specifying the work to be done, and the start and completion dates.

Do you carry property damage and public liability insurance?

○ Yes ○ No

If yes, with which insurance company?

How much liability insurance coverage do you have?

Are you bonded?

○ Yes ○ No

What is the value of your bonding?

Are you and your staff members of a trade association or organization?

○ Yes ○ No

- ○ Earth Energy Society of Canada
- ○ International Ground Source Heat Pump Association (IGSHPA)
- ○ Heating, Refrigerating and Air Conditioning Institute (HRAI)
- ○ Manitoba Renovation Contractors Association (MRCA)
- ○ Construction Association of Rural Manitoba (CARM)
- ○ Local Chamber of Commerce
- ○ Better Business Bureau
- ○ Other

Aside from yourself, who will actually do the work?

- ○ the contractor
- ○ contractor's employees
- ○ sub-trades
- ○ Other

What is the training or accreditation of employees to be involved in the installation?

- ○ International Ground Source Heat Pump Association (IGSHPA)
- ○ Certified by individual heat pump manufacturer

Answers to Your Questions

Q ***How popular are heat pumps in Manitoba?***

A As of December 2001, the total number of heat pumps installed in Manitoba was more than 2,500.

Q ***What if I have a small lot in the city? Will there be enough room to install the buried piping?***

A A geothermal system can heat and cool homes in city or rural settings anywhere in Canada. Piping can be installed under your lawn or other landscaped areas, driveways, or the house itself. Vertical piping loops are more expensive but save space and are more efficient. Horizontal loops are less expensive to install but take up more space and are less efficient.

In locations with bedrock near the surface, contractors may bury piping in a horizontal configuration. Or they may install loops of piping in a nearby lake or other body of water, a practice that is increasingly popular in cottage areas. Only in rare situations is it impractical to install ground loops for a geothermal heat pump system.

Q ***How does a geothermal heat pump differ from an air-source unit?***

A The air-source heat pump, which absorbs heat from the outdoor air in winter and releases building heat into the outdoor air in summer, is common in other parts of Canada. In Manitoba it is common to use heat pumps to draw heat only from the ground or ground water since the air temperature in Manitoba's winter is too severe to provide effective air-source heating.

Q ***Will a geothermal heat pump system provide 100% of my home's space heating?***

A A heat loss calculation will determine how much heat is required to heat your home, but most systems are sized to meet less than the full design load. Homeowners receive excellent performance and savings with a unit designed to provide 70-75% of the total heat loss for the building. These systems rely on an electric backup heater inside the heat pump or ductwork to provide supplemental heat on very cold mornings during the winter. In all cases, full cooling load can be met by the system. Some dealers prefer to install a system that meets 100% of heat loss. This eliminates the need for supplemental heating but increases the cost of installation because it requires more pipe and/or a larger heat pump.

Q ***How is the efficiency of a geothermal heat pump measured?***

A A heat pump's efficiency is measured by its coefficient of performance (COP). This is determined by dividing the energy output of the heat pump by the electrical energy needed to run the heat pump system. The higher the COP, the more efficient the heat pump is. COP's of 2.5 to 3 are typical for today's heat pumps. This means that for every unit of electricity that is used to operate the heat pump, 2.5 to 3 units of heat are generated.

The efficiency for a heat pump – 250% to 300% – can be compared with an electric furnace at 100%, a high efficiency natural gas furnace at 92%, and a mid-efficiency natural gas furnace at 80%.

Q ***Does a closed-loop system affect the environment?***

A The pipe used is a high-density polyethylene plastic that has no environmental impact on the surrounding earth. To help you avoid accidentally cutting the loop, your contractor should supply you with a dimensioned site plan. Remember to "call before you dig."

Need More Information?

For more details on geothermal heat pumps or on improving the comfort of your home with the help of a Residential Earth Power Loan call 1-888-MBHYDRO (1-888-624-9376).
Or visit our web site at www.hydro.mb.ca.

Other web sites of interest:

- **Earth Energy Society of Canada**
  www.earthenergy.org
- **NRCan's Canadian Renewable Energy Network**
  www.canren.gc.ca
- **Geothermal Heat Pump Consortium, Inc.**
  www.geoexchange.org

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