9.6 Alternative Energy Sources: Geothermal Energy

Geothermal energy is the energy contained deep within Earth. Although the quantity of geothermal energy is virtually unlimited, it is not easily accessible everywhere. Few places on Earth are located near highly concentrated sources of geothermal energy. Volcanoes, geysers, and hot springs are sources of geothermal energy.

Figure 1 Iceland gets a lot of its electricity from geothermal energy.

Geothermal energy is a non-polluting renewable energy source. Over 20 countries in the world use geothermal energy to generate electricity. These include the United States, Iceland, and New Zealand (Figure 1). In Canada, we have an experimental geothermal-electrical site in British Columbia, in the Meager Mountain–Pebble Creek area.

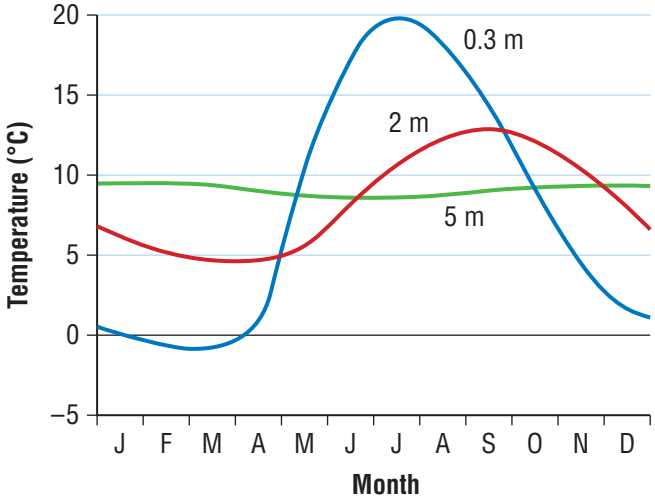

Figure 2 The ground temperature at different depths throughout the year in Ottawa, Ontario

Geothermal Energy and Heat Pumps

You do not need a power plant to take advantage of geothermal energy. The ground outside and around your house contains a huge amount of thermal energy. Around most of Ontario, the temperature of the ground several metres below the surface remains relatively constant throughout the year. It never freezes, even in the coldest winter months. For example, in the Ottawa area, the ground temperature at a depth of 5 m remains close to 9 °C throughout the year (Figure 2).

There is a relatively easy way to transfer thermal energy from the ground below a house into the house. You are already very familiar with this technology. It is the same device used in refrigerators, freezers, and air conditioners—a heat pump. A heat pump is a device that moves thermal energy from one location to another. Look at the functions performed by the different heat pumps listed in Table 1.

Table 1 Uses of Heat Pumps

Type of heat pump	Function
air conditioner	transfers, or removes, thermal energy from the air inside a building (or car) to the air outside the building (or car)
refrigerator or freezer	transfers, or removes, thermal energy from the air inside a refrigerator or freezer to the air outside the refrigerator or freezer
geothermal heat pump	transfers thermal energy from deep in the ground to the air inside a building

Many houses are now being built with geothermal heat pumps, rather than natural gas furnaces, for heating. A geothermal heat pump system consists of water-filled pipes that are buried underground near a building (Figure 3). A pump circulates the water through the pipes. In the winter, the water removes thermal energy from the ground and brings it into the building. Here, it is concentrated by the heat pump, and then circulated by an air delivery system. In the summer, the heat pump can be operated in reverse, so the water transfers thermal energy from the building back into the ground.

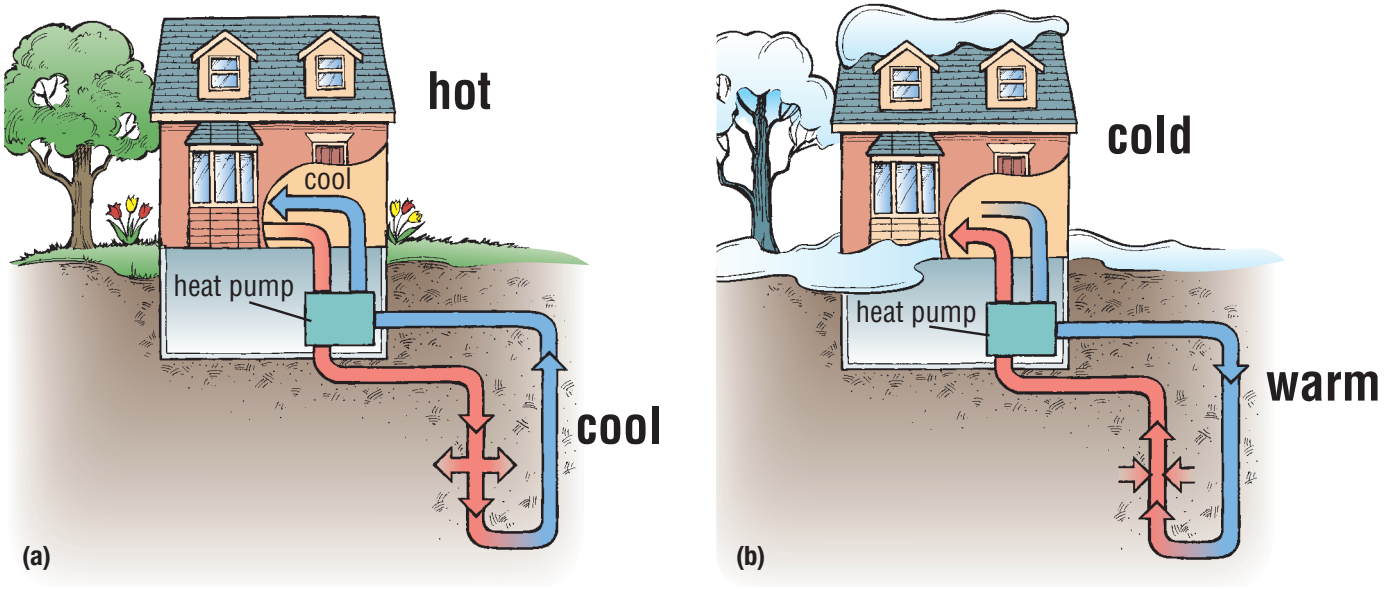

Figure 3 A geothermal heat pump transfers energy to and from the ground to keep a house (a) cool in summer and (b) warm in winter.

Geothermal heat pumps are very efficient. They only use a small amount of electrical energy to transfer a very large amount of thermal energy. Heat pumps are better for the environment than the more common furnaces. They also cost much less to operate. Using a geothermal heat pump to heat a home can cost 80 % less than using a natural gas–fired furnace. The disadvantage is that installing heat pumps can be very expensive.

To learn more about geothermal energy and geothermal heat pumps,
Go to Nelson Science

CHECK YOUR LEARNING

1. Describe an idea in this section that has added to your understanding of heat and the environment. Share your new ideas with a classmate.
2. What are two technologies that use geothermal energy?
3. Describe three different uses for a heat pump.
4. Describe the relationship between soil temperature and depth.
5. Describe two advantages and two disadvantages of using a geothermal heat pump to heat and cool a home.