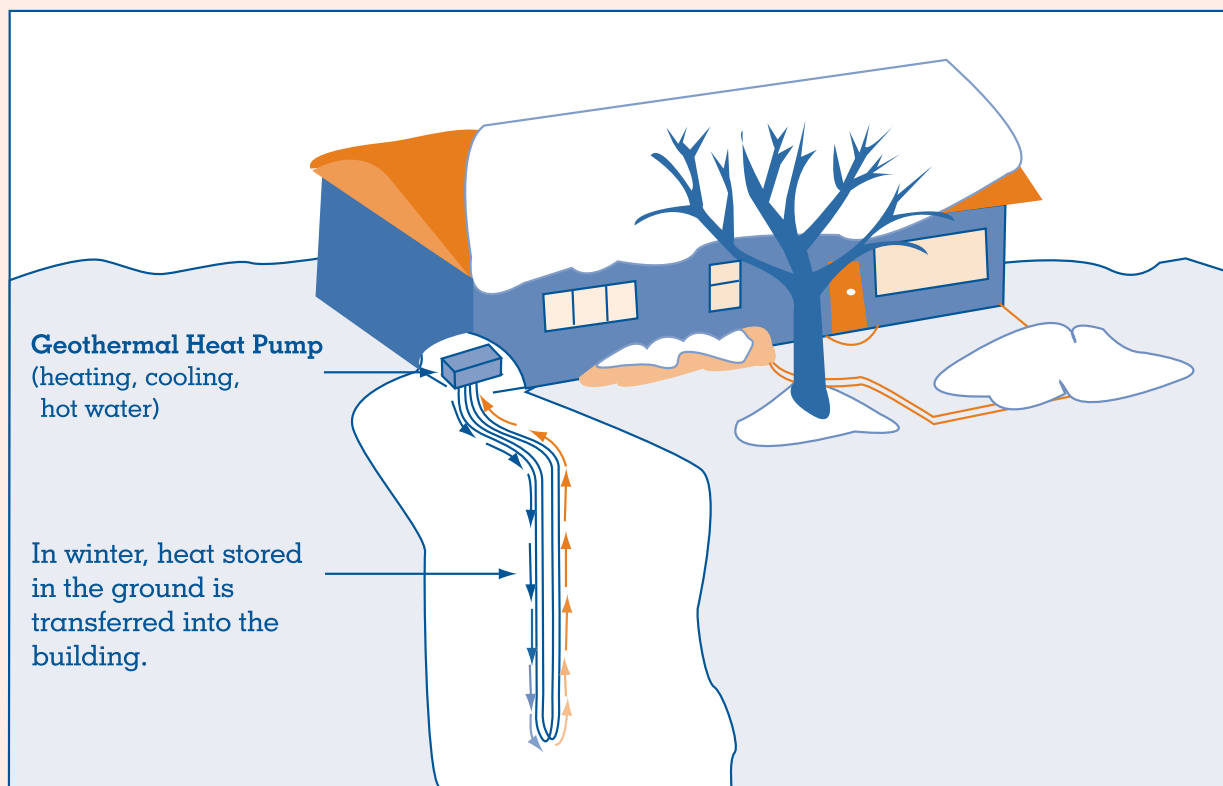


# Case Study 2 Info Sheet: Geothermal Energy

## How It's Used

Earth's temperature a few feet below the ground surface is relatively constant everywhere in the world, about 7° to 21°C (45° to 70°F), while the air temperature can change from summer to winter extremes. A geothermal heating system takes advantage of the relatively constant temperatures of soil and water beneath the ground to provide heating and cooling all year long.

**Figure 1.5: How a Geothermal Heat Pump Works**



Geothermal energy can be used in any part of the country for heating and cooling with the use of heat pumps. Also called ground source heat pumps, the pumps capture the ground's steady supply of energy and move it inside buildings. Geothermal heat pumps exchange heat with the earth through a system of buried plastic pipes called a ground heat exchanger. Energy systems are in either closed-loop or open-loop designs. In a closed-loop system, water or an antifreeze solution is circulated through the pipes. During the winter, the fluid collects heat from the earth and transports it through the pipe loops into the building for heating. In the summer, heat from the building is transferred into the pipes and is conducted into the cooler ground. This process cools the building and creates free hot water in the summer (see **Figure 1.5**).

The less common open-loop systems operate through a similar process. An open-loop system circulates a constant source of water, such as water from a well (ground water), or a stream or pond (surface water), through the pipes. For this system, a locale needs an ample, steady, and relatively clean supply of water. Eagle Ranch could not use an open-loop system.

Heat pumps need electricity to concentrate and circulate the energy. In general, geothermal heat pumps use less energy than conventional heat pumps, which pull in the air around them. In the winter, for example, a conventional heat pump will pull in air from the outside to heat a home, whereas a geothermal heat pump will pull up energy from the warm ground. The electricity to run a geothermal heat pump can be generated by a diesel or propane generator or by a renewable energy source, such as solar panels.

In areas where there are geothermal reservoirs of hot water near Earth's surface—such as in the western states, Alaska, and Hawaii—this water can be piped directly into facilities and used to heat buildings. Some cities pipe the hot water under roads and sidewalks to melt snow. District heating applications use networks of piped hot water to heat buildings in whole communities. (This was how the United States' first systemwide use of geothermal energy began in 1893 in Boise, Idaho. Pumping in the water from a hot spring, the system provided heat to 200 homes and 40 businesses.) However, Eagle Ranch is not considering this option.

## Environmental Issues

Environmentally, the direct use of geothermal energy produces few to no pollutants. However, pollutants may be emitted during the generation of the electricity used to power the heat pump, depending on the source of the electricity. The systems are extremely quiet and small. However, although it's a relatively infrequent occurrence, the release of warm water from the system into a body of water could cause environmental problems.

## Cost

The cost of a geothermal pump system depends on the size of the building. In general, geothermal systems typically require an initial investment of about \$2,500 to \$3,500 for every 450 to 550 square feet of floor space in a building. Costs also include purchasing or generating the electricity to run the pumps.