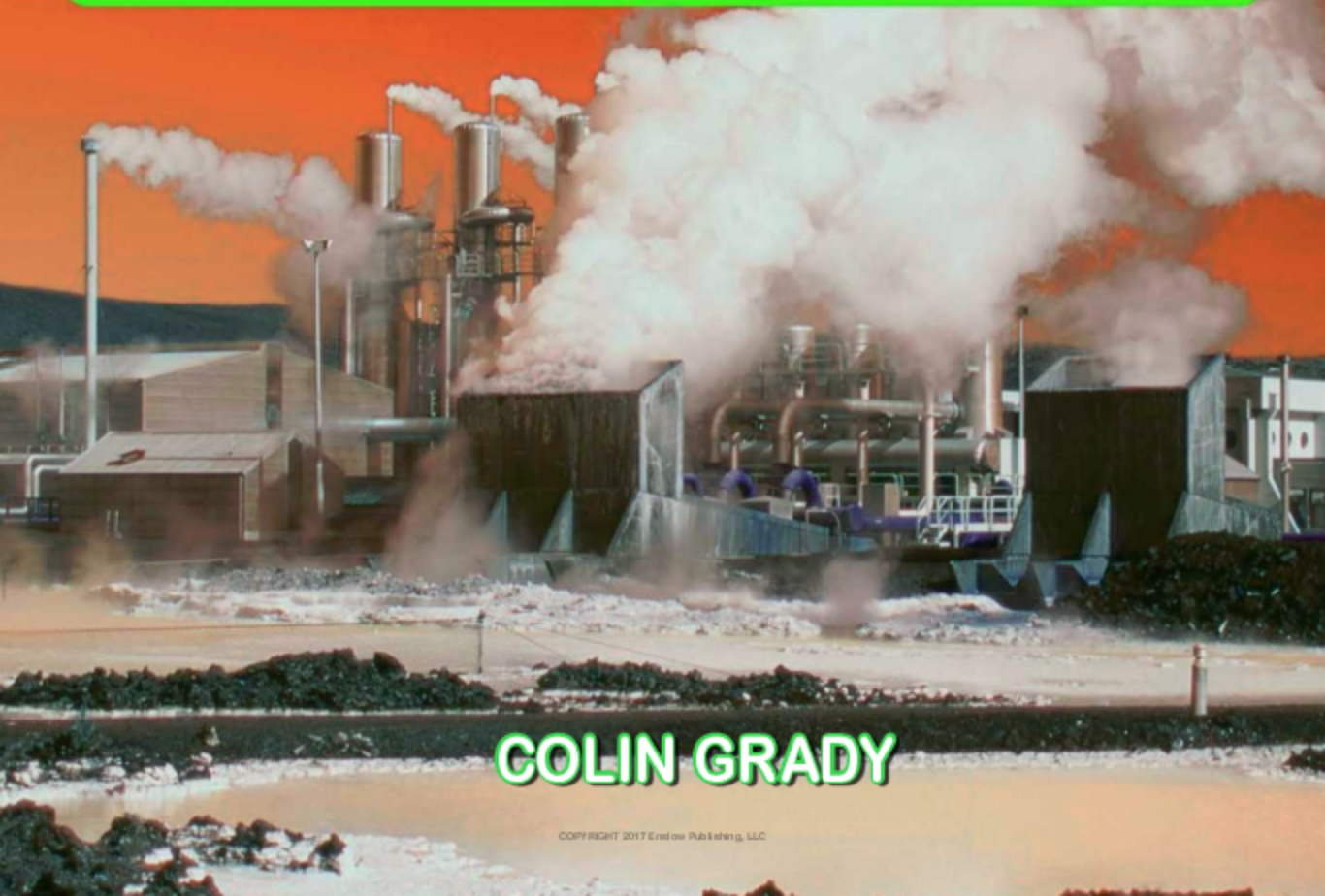




SAVING THE PLANET THROUGH GREEN ENERGY

GEO THERMAL ENERGY



COLIN GRADY



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WORDS TO KNOW

ancestors Relatives who lived long ago.

cycle Actions that happen in the same order over and over.

engineers Masters at planning and building engines, machines, roads, and bridges.

erupts Breaks open.

furnaces Things in which heat is produced.

generated Made.

geysers Springs that send up jets of hot water or steam.

greenhouses Buildings that trap heat to make it warm enough to grow plants.

pressurized Under a force that pushes things together.

temperature How hot or cold something is.

turbines Motors that turn by a flow of water or air.


HEAT FROM UNDER THE GROUND



What is geothermal energy? It is the heat that comes from inside Earth. It is warmer deeper under ground, thanks to Earth's geothermal energy. Black ants know all about this! When the cold winter weather is coming, they move their nests deeper under the ground. They do this so that they do not freeze. If you go about 10 feet (3 meters) down, the ground stays between 50 and 60° F (10–16° C). If you dig even deeper, you will find the **temperature** getting warmer and warmer.

People use geothermal energy to heat or cool buildings and to make electricity. Geothermal energy is a rather clean energy

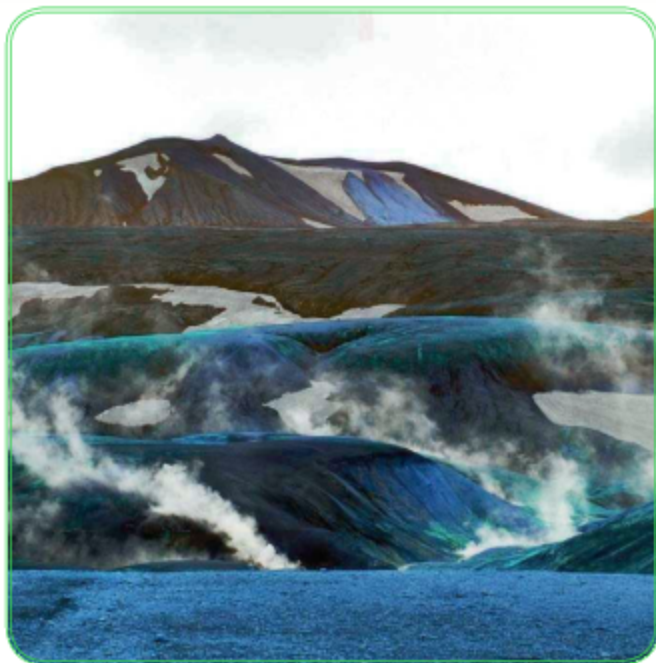
HEAT FROM UNDER THE GROUND



source. We do not pollute when we use it. Geothermal energy is also renewable. That means we cannot use it up.

ENERGY FROM EARTH'S LAYERS

Earth has three layers. They are the crust, mantle, and core. The core is at Earth's center. This is the hottest layer. It is still hot from when Earth formed, more than four billion years ago. Much of Earth's heat is **generated** in the core and flows out to the mantle, Earth's middle layer.

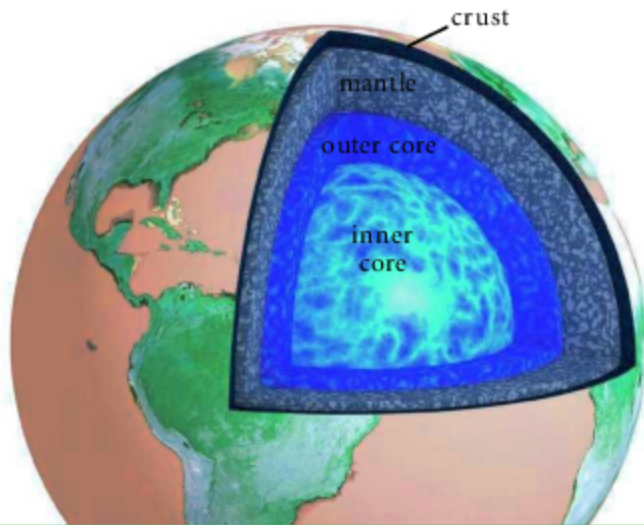


There are places on Earth where heat escapes as hot steam. Geothermal energy can be used as a clean energy source.

GEOHERMAL ENERGY



The mantle contains melted rocks, called magma. Magma heats up water deep underground. When water reaches Earth's crust, or outside layer, it causes hot springs and **geysers**. This superheated water can be used to make electricity. It also powers geothermal energy systems. Earth's crust is warmed by the sun. We use energy from the crust for geothermal energy systems called geothermal heat pumps.



The magma in Earth's mantle heats up underground water. This very hot water can be used for energy.



HARNESSING HEAT FROM HOT WATER

There are as many as five hundred geysers at Yellowstone National Park. They shoot hot water into the air. Long before there was a park, early Native Americans used these geysers. They cooked food and bathed in the hot water. Other ancient people used hot springs and geysers, too. The ancient Chinese and Japanese built baths around hot springs. The ancient Romans piped hot water out of hot springs and into their bathtubs.

In 1904, Italians went beyond what their Roman **ancestors** had done. They created the first geothermal power plant. The plant used steam that rose out of holes in the ground to make electricity.

GEOTHERMAL ENERGY



Native Americans used geysers, like this one at Yellowstone National Park, to cook food and take baths.

PUTTING HOT WATER TO WORK

If you live near a hot spring, it is not hard to come up with uses for the hot water. For example, the people of Reykjavík, Iceland, use their hot springs to heat buildings.

The hot springs are many miles away, so a pipeline carries the

water to the city, where it is stored. They pipe hot water from the storage tanks into nearby buildings for heat.

Geothermal energy can also help plants grow. Farmers build **greenhouses** that use

HARNESSING HEAT FROM HOT WATER

geothermal energy in some places where farming is hard. Inside the greenhouses, there are pipes full of hot water drawn up from under the ground. The hot water warms both the soil and the air inside the building. People use this method to grow vegetables in Hungary, Italy, Iceland, and New Mexico.



A greenhouse in Iceland uses geothermal heating to grow flowers.

GEOHERMAL ENERGY TIMELINE

- 4 billion years ago** Earth forms as a fiery ball. It begins to cool off slowly.
- 10,000 years ago** Early Native Americans cook and bathe in the geysers in what is now Yellowstone National Park.
- 79 CE** Mount Vesuvius **erupts**. It destroys the geothermal-heated Roman baths in Pompeii, Italy.
- 1892** **Engineers** in Boise, Idaho, use hot springs to heat local buildings.
- 1904** Engineers in Lardello, Italy, make electricity with the first geothermal power generator.
- 1948** Carl Nielsen builds the first geothermal heat pump in his home in Ohio.
- 1960** Pacific Gas and Electric starts the first large dry steam power plant in the United States, at the Geysers, in California.

- 1974** Engineers in Los Alamos, New Mexico, start working with hot dry rock electricity systems.
- 1980** Brawley, California, becomes home to the first US flash power plant.
- 1981** The first binary geothermal power plant begins producing energy in Raft River, Idaho.
- 2005** The Energy Policy Act of 2005 becomes US law, making geothermal energy more competitive with fossil fuels for making electricity.
- 2015** The amount of electricity able to be made by geothermal power in the world rises to 12.8 gigawatts (GW). That is enough to power more than four million homes for one year.

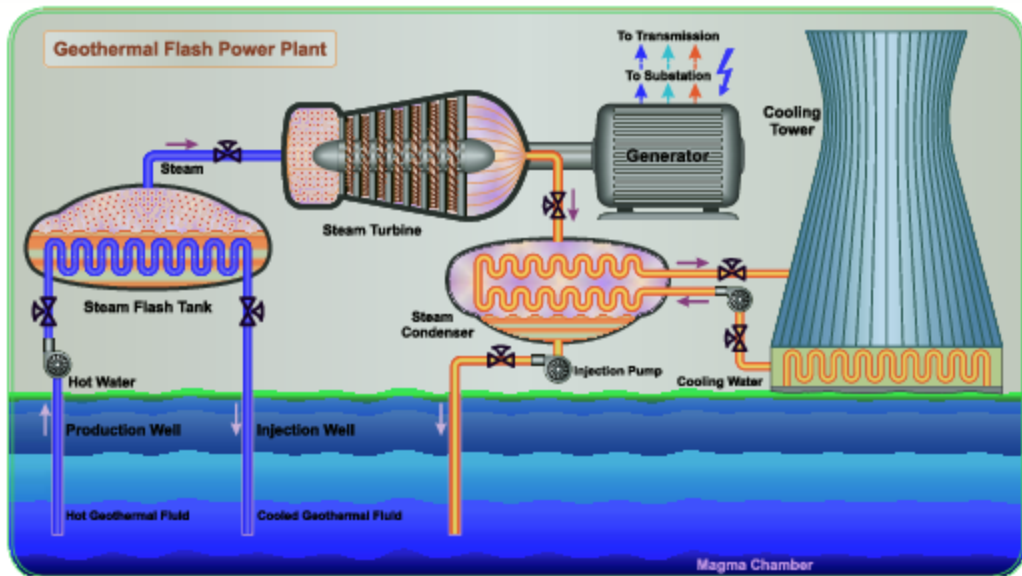
MAKING ELECTRICITY



A power plant is a place where electricity is made. Most of these plants use energy to heat water to very high temperatures, which creates steam. When the steam rises, it turns **turbines**, which make electricity. This is easy with geothermal power plants since most of them start out with superheated hot water.

There are several kinds of geothermal plants. In flash steam plants, engineers pipe hot, **pressurized** water from under the ground to the surface. When they lower the pressure, the water turns to steam, or flashes. In binary power plants, engineers use hot water to boil a liquid that creates steam to turn turbines.

MAKING ELECTRICITY



In geothermal power plants, hot water from under the ground can be turned into steam. The steam turns the turbines to make electricity.

ELECTRICITY WITH DRY ROCKS

There are places where there is underground heat but no nearby water. Engineers are finding ways to bring water to these hot spots. Then people will be able to use the geothermal

GEOTHERMAL ENERGY

energy there. Hot dry rock, or HDR, systems are one way to do this.

Scientists in Los Alamos, New Mexico, began building the first HDR system in 1970. The system used three wells, each about 2 miles (3 km) deep. Engineers sent cold water down the first well. The cold water hit the hot rocks and broke them. The water turned hot. Some of it turned to steam. The steam and water then rose up through the other wells and turned turbines.

A photograph of four young women sitting on a light-colored sofa. They are all looking down at their mobile devices. From left to right: the first woman has long dark hair and is wearing a brown patterned sweater; the second woman has long dark hair and is wearing an orange patterned sweater; the third woman has long blonde hair and is wearing a tan sweater; the fourth woman has her hair in a bun and is wearing a brown patterned sweater. The background is a plain wall.

Cell phones and other devices need electricity. When geothermal energy is used to make the electricity, there is less pollution to the planet.

HEATING HOMES AND BUILDINGS

Making electricity is one use for Earth's heat. Engineers have also found ways to heat buildings with heat from Earth's crust when there is no water source. They use a heat pump to capture geothermal energy.

A heat pump starts by moving water through the ground. The water warms up. The warm water heats a gas called Freon. Next, the hot Freon enters a machine called a compressor. The compressor presses the gas into a smaller area. This makes the gas even hotter. A fan blows air over the hot Freon. The air warms up and is used to heat the building. In time, the compressor lets the Freon out. The gas cools off, and the **cycle** starts again.

GEOTHERMAL ENERGY

WHY DOESN'T EVERYONE USE GEOTHERMAL ENERGY?

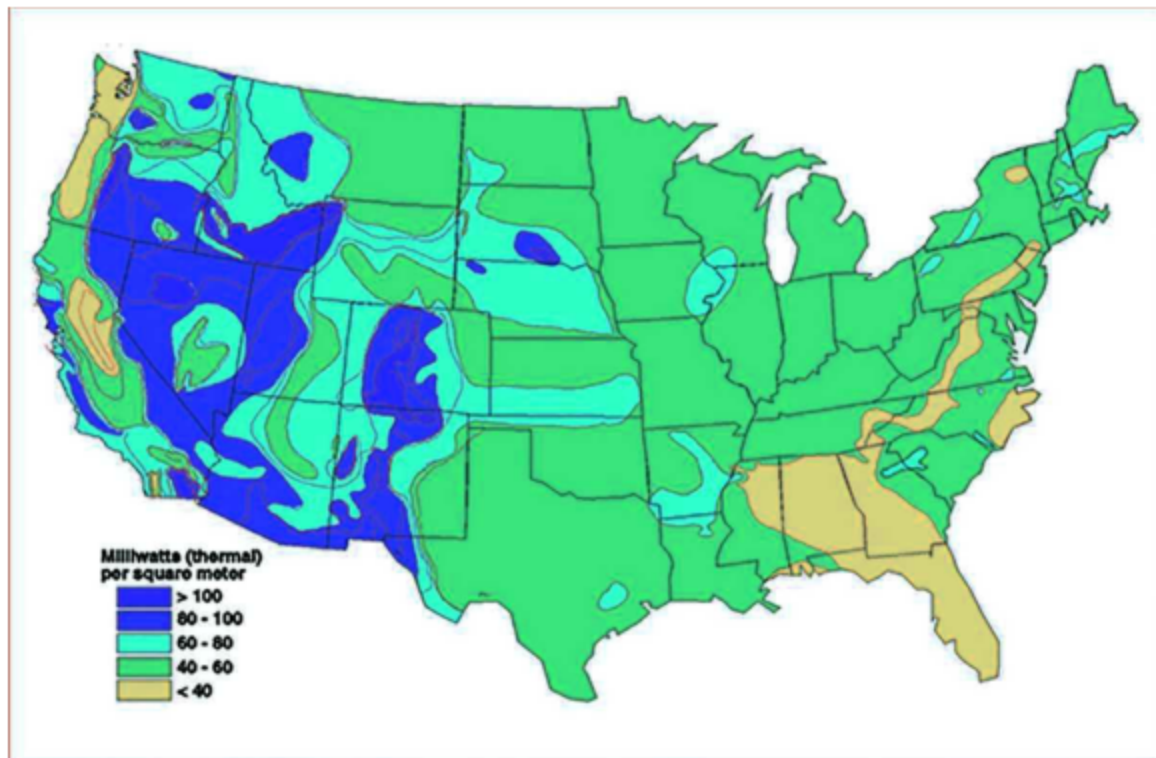
One of the biggest problems with geothermal power plants is that not everyone can use

them. Geothermal power plants make clean energy, but they have to be built near a source of geothermal heat. Or in the case of Iceland, the water must be pumped to the larger cities. In North America, most of those sources are in the West.



Pipes for a geothermal heating system are placed in the ground. The pipes help bring heat to a home.

HEATING HOMES AND BUILDINGS



The colors on this United States map show the underground temperature up to 4 miles (6 km) deep. The darkest red areas are the hottest; the light blue areas are the coolest. You can see that the warmest areas are in the West.

GEOHERMAL ENERGY

A second problem is that engineers find that some geothermal power plants run out of steam. They are fixing this problem by adding more water. For example, the city of Santa Rosa, California, pipes its cleaned wastewater to a group of geothermal plants called the Geysers. The water keeps the power plants working.

A third problem is that the water that rises to the surface is not necessarily pure. Many times it contains salts and has to be treated before it is used.



THE FUTURE OF GEOTHERMAL ENERGY

Power from geothermal energy is reliable and kind to our planet. It is also cost effective. Some countries, such as the Philippines, make more than a quarter of their electricity from geothermal heat. Geothermal energy use is becoming more and more common. Some new schools use geothermal heat pumps instead of **furnaces** or air conditioners. Farmers can keep fish in ponds warmed by geothermal heat. Running pipes of warm water under sidewalks can keep them clear of snow.

Engineers are now looking for ways to get more energy from Earth. They are

GEOHERMAL ENERGY



Steam from a geothermal power plant is used to make electricity. The more heat we can use from Earth, the less we will need to use fossil fuels.

experimenting with drilling deeper to collect more heat. They are finding places where magma can be easily reached. Back in 2007, twenty-four countries used geothermal heat to make electricity. Today, that number is growing!

FURTHER READING

BOOKS

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- Britcher, Angela. *The Pros and Cons of Geothermal Power*. New York, NY: Cavendish Square, 2016.
- Centore, Michael. *Renewable Energy*. Broomall, PA: Mason Crest, 2015.
- Doeden, Matt. *Finding Out About Geothermal Energy*. Minneapolis, MN: Lerner Publications Co., 2015.
- Kopp, Megan. *Living in a Sustainable Way: Green Communities*. New York, NY: Crabtree Publishing Co., 2016.
- Sneideman, Joshua. *Renewable Energy: Discover the Fuel of the Future with 20 Projects*. White River Junction, VT: Nomad Press, 2016.

WEBSITES

Energy Star Kids

energystar.gov/index.cfm?c=kids.kids_index

Learn more facts about energy and how you can save energy and help the planet.

NASA's Climate Kids: Energy

climatekids.nasa.gov/menu/energy

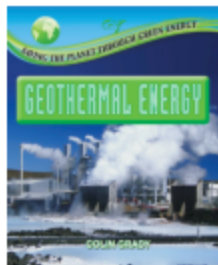
Lots of fun facts and links about energy.

US Energy Information Administration

eia.gov/kids

Read about the history of energy, get facts about the types of energy, learn tips to save energy, and link to games and activities.

Book Index



Geothermal Energy

Geothermal Energy *Colin Grady. Saving the Planet Through Green Energy* New York, NY: Enslow, 2017. 24 pp.

In this book, readers learn about geothermal energy, the clean energy source used to heat or cool buildings and to make electricity without polluting our planet. There are future plans for using this geothermal energy on a wider level, so learn more about this exciting resource.

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