Power from Geothermal Energy

History

The word geothermal comes from Greek “geo” meaning “Earth” and “therme” meaning “Heat”. Since [Ancient Times] people have used geothermal hot springs for bathing, cooking and even healing purposes. Geothermal energy is derived from superheated water inside the earth. The earth’s core can reach temperatures of over 9,000 degrees Fahrenheit and the heat from the earth’s core is constantly moving toward the earth’s surface. The rock surrounding the core sometimes heats up enough to melt creating magma which then floats closer to the surface and carries the heat from below. Sometimes this molten rock pushes to the surface as lava, but typically it stays beneath the surface and heats ground water that has seeped underground from rainfall. Eventually some of this heated water makes its way back to the surface as hot springs or geysers.

Throughout the years, engineers have been perfecting ways of harvesting geothermal water to use it to power homes and businesses. In Larderello, Italy in 1904, Prince Piero Ginori Conti tested the first geothermal power generator and lit 4 light bulbs. Seven years later, in 1911, the world’s first geothermal power plant was built in Larderello. Eventually, in 1958, New Zealand become the second producer of geothermal energy in the world and now these power plants exist worldwide.

Pros and Cons

Pros:

- If the geothermal water is drilled correctly, there are no harmful emissions put into the air.
- There are no fossil fuels being used up and sending harmful byproducts into the air.
- A geothermal power plant takes up a relatively small area of land and can be integrated as a functional addition to a landscape such as the Svartsengi plant in Iceland which provides heated, mineral-rich water for a nearby man-made lagoon. Superheated water is pumped from the ground near a lava flow and used to turn a turbine which generates electricity. Then the steam and hot water is used to provide heat for the municipal water heating system. Finally, the water is fed into the lagoon for recreational and medicinal use.
- Geothermal power plants also require minimal maintenance once established.

Cons:

- Geothermal power plants can only be placed where underground geothermal reservoirs exist – usually in volcanically active areas or along tectonic boundaries and the rocks have to be suitable for proper drilling.

- If the drilling for a power plant is done incorrectly, harmful minerals and gases can be released from underground and pollutants can be released into the air. Once a drilling site is damaged, it can be almost impossible to get rid of the pollutants.

- There is also always a slight chance that a geothermal reservoir will dry up or lose steam.

How it Becomes Usable Energy

Power Plants:

Geologists, geochemists, drillers and engineers test various sights to locate geothermal reservoirs underground. Once a geothermal production well is drilled, hot water and/or steam travels up the wells to the earth's surface where it can be used to generate electricity or for other energy saving purposes. Depending on the well, geothermal power plants either run off of steam or hot water from the ground, so there are 3 types of plants that can be created.

A "dry" steam reservoir releases steam from the ground, but very little water, so steam provides the force to spin a turbine generator and create electricity.

A "flash" power plant uses hot water from a hot water reservoir. Hot water ranging from 300-700 degrees Fahrenheit comes up through the production well. As it reaches the surface, pressure is released and "flashes" into steam which powers a turbine that creates electricity.

A "binary" system uses water that is not necessarily hot enough to flash into steam, but the heat from the water is used to boil other substances such as isopentane which boils at a lower temperature than water. As the isopentane boils, the liquid flashes to vapor which is used to spin turbine blades and generates electricity.

In most, if not all, of these processes, the used geothermal liquid is returned to the underground reservoir to be naturally reheated and used again.

Direct Uses:

People soak in hot springs to soothe aching muscles and to relieve other ailments

Geothermal pipes are laid underground and are used to help farmers keep the ground from freezing to ensure the proper growth of plants. They are also placed under city streets and sidewalks to keep them from freezing over in colder temperatures.

Geothermal water is used in industry to pasteurize milk, dry lumber and to wash wool.

A second most common use for geothermal water, aside from hot spring bathing, is heating buildings. Using geothermal heat pumps, heated water and other liquids are pumped through pipes to a device

called a heat exchanger. The heat exchanger takes the heat from the liquid and uses it to heat the air inside the home.

Cool Facts

- Geothermal energy supplies less than 10 % of the world's energy.
- Geothermal energy is sustainable because hot water can be re-injected into the ground.
- Geothermal energy suitable areas aren't widely spread.
- Humans have enjoyed geothermal energy in the form of hot springs for thousands of years. The oldest known spa fed from a hot spring is believed to be a stone pool found on Lisan Mountain in China, built in the 3rd century BC.

Classroom Activities

Geothermal Power Plant

Scroll down to Letter E, and click on Energy Quest.

Geothermal Power Plant Model

Geothermal Power Plant Science Fair Project
NOTE: Heat source required: hot plate can replace stove top

Geothermal Hot Springs

How a Hot Spring Works Information and Experiment (experiment toward bottom of the page)

Resource Links

http://geothermal.marin.org/pwrheat.html

http://www.sciencekids.co.nz/sciencefacts/energy/geothermalenergy.html

Related WV Science Content Standards and Objectives

Next Generation Science Standards

Science and Engineering Practice

Analyzing and Interpreting Data

Construction Explanations and Designing Solutions

Developing and Using Models

Planning and Carrying Out Investigations

Cross Cutting Concepts

Cause and Effect

Systems and System Models

Energy and Matter

Structure and Function

Stability and Change

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

PS2.B Forces and Motion

PS2.B Types of Interactions

PS3.A Definitions of Energy

PS3.B Conservation of Energy and Energy Transfer

PS3.C Relationship between Energy and Forces