GEOTHERMAL

Geothermal energy is the heat of the Earth, which can be tapped into to produce electricity in power plants, and to use its warm water for industry, agriculture, bathing and cleansing. The environmental impacts associated with geothermal energy are much smaller than that of the fossil fuels: coal, oil and gas. Today, most of our energy supply come from these polluting fossil fuels, causing huge environmental problems. Although in use worldwide, its potential as an energy source is not fully utilised, thus geothermal offers a real option in future environmentally-friendly energy supply.

What is Geothermal Energy?

Geothermal energy means literally the heat of the Earth (Geo = Earth, Thermal = Heat). The majority of the available energy on this planet is heat energy, or thermal; the six miles of the Earth's crust contains 50,000 times as much energy as the fossil fuels oil, coal and gas. We can tap into this heat and use it for our energy needs.

Did you know…?

Geothermal energy methods have been used for the past 10,000 years!

The science bit…

Between the Earth's core and the Earth's crust there are large temperature changes. Starting from the crust, temperature changes by approximately 25 Degree Celsius (°C) for every one kilometre of depth, to around 7000°C at the Earth's core. The main source of geothermal energy is the constant upward flow of this heat from the Earth's red-hot interior toward the surface.

The first few metres of ground at the surface retain heat as well. However, this is not necessarily the result of geothermal energy but is more often stored solar energy from the sun (Ground source heat is explained in brief on the reverse of this sheet). Geothermal heat is hot enough to melt rock beneath the crust of the Earth, creating magma (which we sometimes see on the Earth's surface as lava). Most of the magma remains below and, like a built-in boiler, heats up all the surrounding rock. When underground water comes into contact with this heat it also gets very hot, sometimes to temperatures of 370°C . At certain places worldwide, especially at margins of continental plates and other places called 'Hot Spots', the heat is shallow enough that it can be accessed and used by man.

How did it all begin?

Archaeological evidence shows that the first human use of geothermal resources occurred more than 10,000 years ago in North America with the settlement of Paleo-Indians at hot springs (where underground water heated by geothermal energy escapes to the surface). The springs served as a source of warmth and cleansing. The first active exploitation of geothermal resources dates back to Roman times, where efforts were made to harness hot water for medicinal, domestic and leisure applications, whilst the first geothermal power plant was built in 1904 in Italy.

Ways in which this energy is used...

Wells and power plants...

A geothermal reservoir is a mass of fractured rock in the Earth's crust that is saturated with hot water or steam. To bring the water or steam to the surface, wells are drilled into them. If the fluid is hot enough steam bubbles will occur and cause the water to flow naturally to the surface, if the fluid is not hot enough then the wells may need a pump. Power plants utilise the hot water or steam from the wells by directing it to a turbine and generator to produce power (electricity), working much like any conventional power plant.

Above: Geothermal power plant at The Geysers, California USA, the largest dry steam production field in the world

Aquaculture and agriculture...

Geothermal water is commonly used for fish farming in the United States, speeding the growth of prawns and aligators amongst other things. It is also used in the highly competitive greenhouse industry worldwide for speedier growth and enabling summer-time crops and flowers to be grown during winter periods.

Did you know…?

In Iceland the heat from hot springs supplies water at 86°C to 95% of the buildings in and around Reykjavik, the capital city.

Environmental Impacts

The associated Carbon Dioxide (CO_2) emissions of generating electricity in a geothermal power plant are typically 1000 times less than that of a gas-fired plant, 1600 times less than an oil-fired plant, and as much as 1800 times less than a coal-fired plant. As well as this they give off little or no sulfur compared to fossil fuels and they emit no nitrogen oxides.

Geothermal installations require less land than many other energy resources and so can co-exist with almost any kind of land use including agriculture. In addition, drilling does not impact on the land by leaving scars on the landscape, mine shafts, tunnels, open pits, or waste heaps. Geothermal water doesn't contaminate groundwater becuase it is isolated by cemented well casing, and reservoirs are replenished by injecting waste water from the plant.

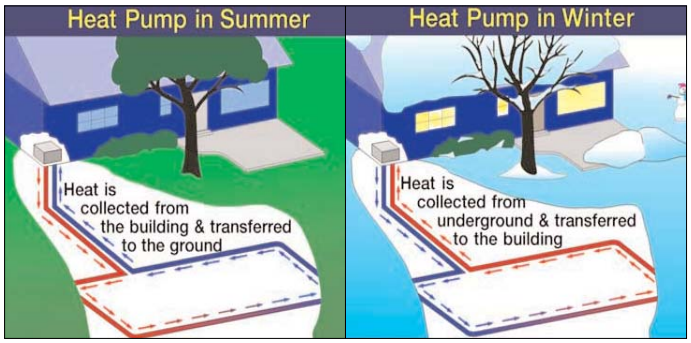
The future of geothermal energy…..

Hopefully, geothermal energy will play its role in a more sustainable energy strategy for human-kind, reducing or eliminating the use of polluting fossil fuels. At present geothermal power plants worldwide are supplying electricity to around 60 million people in 21, mostly developing, countries. However, it has the potential to serve 100% of the electrical needs of 39 countries, supplying over 620 million people in Africa, Central and South America and the Pacific.

Ground Source Heat

This type of energy is also stored in the Earth, the ground to be exact, but is not generated from any earthly source but from the sun. It is important to make this distinction as ground source heat is often confused with geothermal energy.

Quite simply, where the sun shines its heat energy warms up the ground and raises its temperature. In the UK the constant ground source heat temperature is around 12°C and can be utilised to heat and cool buildings. Pipe is buried underground in a trench or in a vertical well and water is pumped through it and heated by the underground energy. A heat pump can extract the ground's heat and transfer it into a building for space and water heating, or it can remove heat from a building and deposit it into the ground to cool the building during hot weather.



Above: Two digrams showing a Heat Pump for a house as it would be used in Winter and Summer, transferring heat to or from the building

Heat Pumps can only be considered a renewable form of energy if the electricity used to power the pump comes from a 'green' source too. This is because the associated CO_2 emissions of electricity are higher than other forms of energy.

So, even though a heat pump could provide 100% space and hot water heat requirements for a home, only 75% of the energy needed for the system comes form the ground and is renewable, the other 25% is in the form of electricity and is only renewable if it is generated from a renewable source too. If this can be the case with every ground source heat pump installed then they will also play an important role in a future sustainable energy strategy.

Sponsors: The National Energy Foundation, The Department of the Environment Transport and the Regions, Student Force, PowerGen

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