GEOTHERMAL ENERGY

What is geothermal energy?

Geothermal energy is heat within the earth. The word geothermal comes from the Greek words *geo* (earth) and *therme* (heat). Geothermal energy is a renewable energy source because heat is continuously produced inside the earth. People use geothermal heat for bathing, to heat buildings, and to generate electricity.

The Earth is full of energy. Deep under the surface of the Earth, hot magma moves around creating thermal energy. If you have ever witnessed a geyser spew out hot water from deep underground, or seen images of a volcano, you've seen geothermal energy. Geothermal energy as an industry means finding ways to harness this energy and utilizing it to provide electricity to power our homes, office buildings, and factories.

Geothermal energy comes from deep inside the earth

The slow decay of radioactive particles in the earth's core, a process that happens in all rocks, produces geothermal energy.

The earth has four major parts or layers:

- An inner core of solid iron that is about 1,500 miles in diameter
- An outer core of hot molten rock called magma that is about 1,500 miles thick.
- A mantle of magma and rock surrounding the outer core that is about 1,800 miles thick
- A crust of solid rock that forms the continents and ocean floors that is 15 to 35 miles thick under the continents and 3 to 5 miles thick under the oceans

Scientists have discovered that the temperature of the earth's inner core is about 10,800 degrees Fahrenheit (°F), which is as hot as the surface of the sun. Temperatures in the mantle range from about 392°F at the upper boundary with the earth's crust to approximately 7,230°F at the mantle-core boundary.

The earth's crust is broken into pieces called tectonic plates. Magma comes close to the earth's surface near the edges of these plates, which is where many volcanoes occur. The lava that erupts from volcanoes is partly magma. Rocks and water absorb heat from magma deep underground. The rocks and water found deeper underground have the highest temperatures.

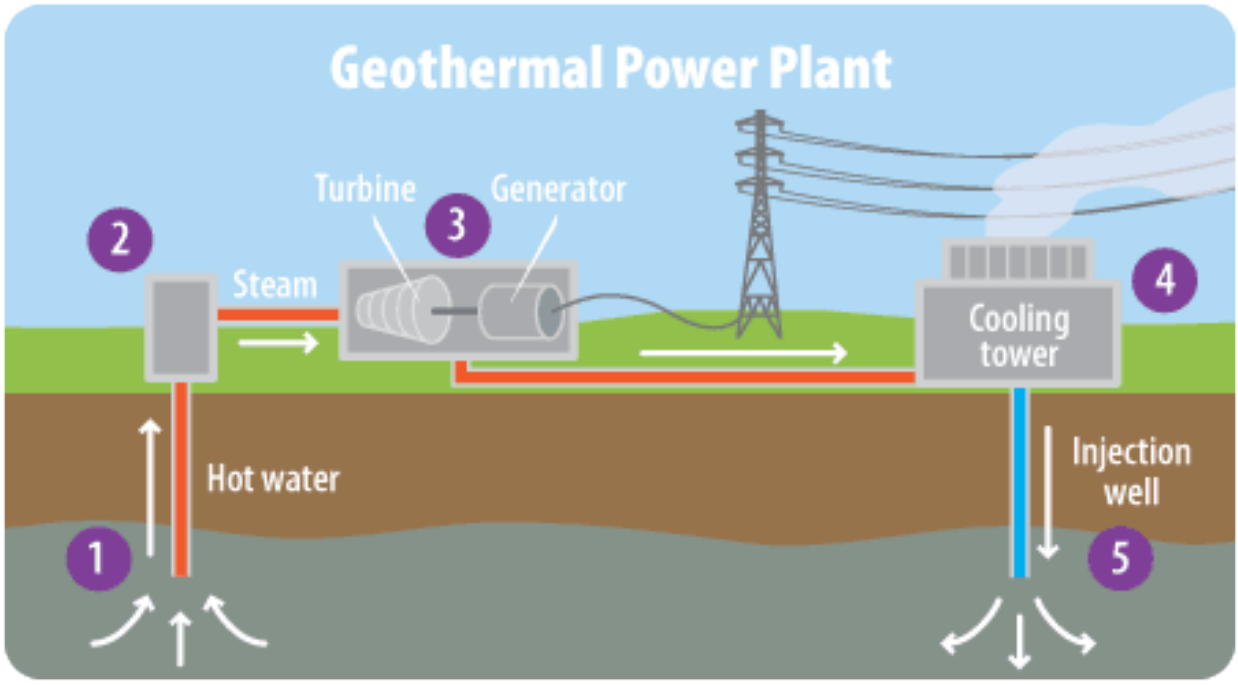
Characteristics of geothermal energy

The general characteristics of geothermal energy that make it of significant importance for both electricity production and direct use include:

- Extensive global distribution; it is accessible to both developed and developing countries.

- Environmentally friendly nature; it has low emission of sulphur, CO2 and other greenhouse gases.

- Indigenous nature; it is independent of external supply and demand effects and fluctuations in exchange rates.
- Independence of weather and season.
- Contribution to the development of diversified power sources.



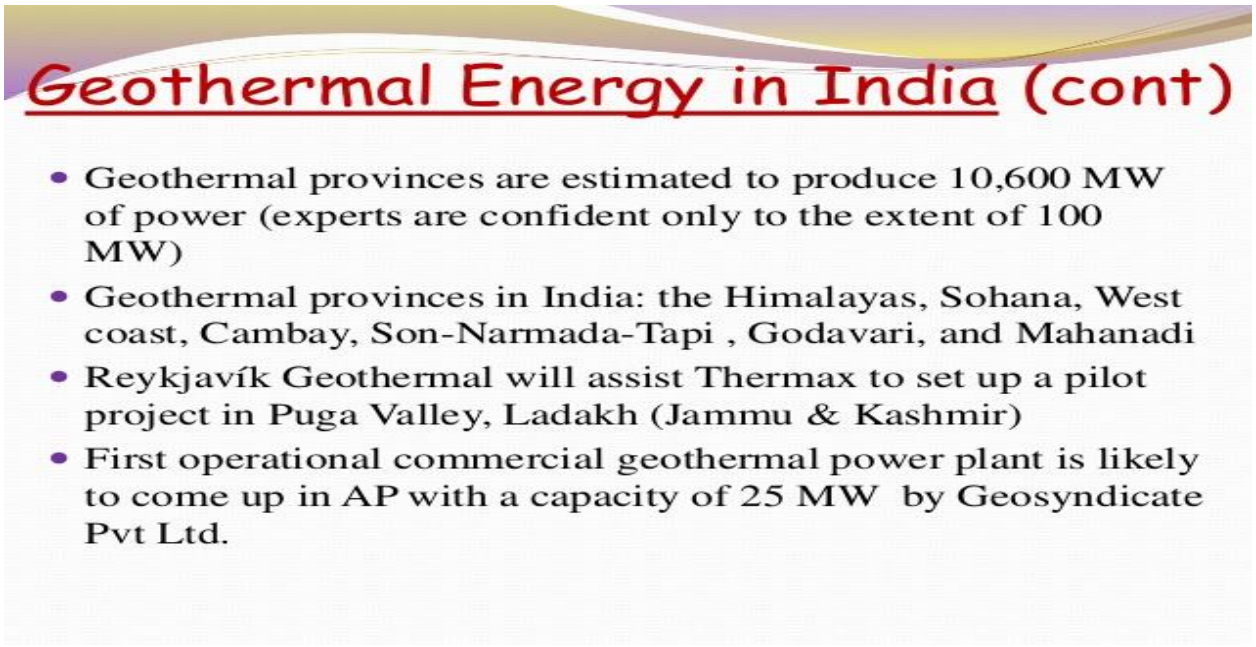
One of the methods of extracting geothermal energy is through geothermal power plants. These are facilities that are created to pipe the heated water up from underground, then they use this hot water and the steam it produces to generate electricity. Geothermal power plants use a variety of methods to produce electricity. The different types of geothermal power plants include binary cycle pants, flash steam plants, and dry steam plants.

Binary cycle geothermal plants pass the hot water from geothermal work reservoirs through a heat exchanger, which takes the heat from the water and transfers it to an industrial fluid that has a lower boiling point. The heating of that industrial fluid creates steam, which turns turbines and produces electricity. Meanwhile, both flash steam plants and dry steam plants utilize the steam from the hot water in geothermal

reservoirs to power turbines. Dry steam plants pipe the steam itself up in geothermal reservoirs, while flash steam plants draw up some of the water which then turns to steam.

Other methods of harnessing geothermal energy include geothermal heat pumps and direct geothermal energy. In the case of direct geothermal energy, this means pumping up hot water directly from the geothermal reservoirs and running it through a heat exchanger to heat a building. This is only possible when a geothermal reservoir, like a hot spring, is near the Earth's surface. A geothermal heat pump, by contrast, uses a system of pipes under a building to regulate a building's temperature. The heat from warm water can be pulled out with a heat exchanger and used to heat a house or other buildings, while the process can be reversed in the summer and the building cooled thanks to the water running beneath it.

Geothermal energy is thermal energy, which is generated through the natural hot springs. In India, by the time, geothermal energy installed capacity is experimental; however, the potential capacity is more than 10,000 MW. Himalayan Province e.g. Himachal Pradesh, Jammu & Kashmir, etc.



Current Projects –There are no operational geothermal plants in India.

Geothermal Field	Estimated (min.) reservoir Temp (Approx)	Status
Puga geothermal field	240^{o}C at 2000m	From geochemical and deep geophysical studies (MT)
Tattapani Sarguja (Chhattisgarh)	120^{o}C - 150^{o}C at 500 meter and 200 Cat 2000 m	Magnetotelluric survey done by NGRI
Tapoban Chamoli (Uttarakhand)	100^{o}C at 430 meter	Magnetotelluric survey done by NGRI
Cambay Garben (Gujrat)	160^{o}C at 1900 meter (From Oil exploration borehole)	Steam discharge was estimated 3000 cu meter/ day with high temprature gradient.
Badrinath Chamoli (Uttarakhand)	150^{o}C estimated	Magneto-telluric study was done by NGRI Deep drilling required to ascertain geothermal field
Geothermal Field	Reservoir Temp (Approx)	Status
Surajkund Hazaribagh (Jharkhand)	110^{o}C	Magneto-telluric study was done by NGRI. Heat rate 128.6 mW/m^{2}
ManikaranKullu (H P)	100^{o}C	Magneto-telluric study was done by NGRI Heat flow rate 130 mW/m^{2}
Kasol Kullu (H P)	110^{o}C	Magneto-telluric study was done by NGRI

The Pros of Geothermal Energy

Harnessing geothermal energy is a highly efficient process, which produces few to no emissions, and is extremely reliable and renewable.

- It is a renewable energy source
- The energy formation is highly efficient
- Does not emit greenhouse gases such as CO2
- Long-term savings after installation
- Low operating costs
- A reliable and abundant source of energy

Renewable

Unlike fossil fuels, which are of a finite quantity, geothermal energy is renewable. As long as the earth exists, there will be geothermal energy for us to use. This means that while some fossil fuels could potentially run out a few decades, geothermal energy will be a viable form of energy for billions of years to come.

Highly Efficient

Using geothermal energy is extremely efficient. Because heat energy can be drawn out of the water so easily, it can be used to produce electricity and heat houses with very little energy wasted. There are also few outside costs associated with geothermal energy, with no fuel being needed for the harnessing of geothermal energy from water as an example.

No Emissions

Geothermal energy has the least environmental impact on any form of energy production. No emissions are released from the process of extracting thermal power from geothermal reservoirs, meaning that its carbon footprint is essentially zero. There may be a few emissions involved in the construction of a geothermal power plant.

Significant Savings

Using geothermal energy can save homeowners a significant amount of money. Heating and cooling houses with pipes can cut energy bills by between 25% to 60% every year, which is enough to offset the investment costs of a geothermal heating/cooling system in only a few years.

Reliable and Abundant

Other forms of alternative energy, such as solar and wind power, are less stable and reliable than geothermal power. While wind can die down and the sun only shines for part of the day, geothermal power is reliable and constant, which makes them excellent ways to meet base energy demands.

The Cons of Geothermal Energy

The biggest drawbacks of geothermal energy include high initial investment costs, the fact that it is only usable in certain regions, and that it can create geologic instability.

- Can only be installed in certain locations that have a geothermal heat source
- The high initial investment to build and install
- Sometimes requires pumping of fluids into the Earth, causing a host of potential issues
- Sometimes requires discharge which can be environmentally damaging
- Energy output could vary through time

Limited to Certain Areas

Geothermal power in only viable in certain regions of the world where geothermal reservoirs exist. This is much like how sufficient deposits of gas and other fossil fuels only exist in certain regions.

High Initial Price Point

Those who are interested in using geothermal energy to cool and heat their houses will have to invest between $10,000 to $20,000 dollars. While the costs would pay themselves off in around 5-10 years, the startup cost can be prohibitively expensive.

Creates Instability

Geothermal power plants can create geologic instability. Hydraulic fracturing is a process used to obtain geothermal power, and it can cause earthquakes by altering the fundamental structure of the land the plant sits on.

Environmentally Damaging Discharge

While geothermal energy doesn't emit greenhouses gases, the processes involved with the creation of geothermal power plants can pollute the environment. The process of digging geothermal wells often releases greenhouse gas into the atmosphere, and compounds like silica can be discharged during this process as well.

Sustainability Worries

Though geothermal power is typically considered a sustainable resource, the overuse of geothermal reservoirs can deplete them. Geothermal reservoirs refill after rainwater penetrates into the ground, but in order for these reservoirs to be sustained, they must be carefully utilized so that the rate of use does not exceed the rate of replenishment. Geothermal power plants must carefully manage how they use geothermal reservoirs for them to be truly sustainable.

Ultimately geothermal energy provides clean and renewable energy, but it is limited in use to regions with viable geothermal reservoirs.