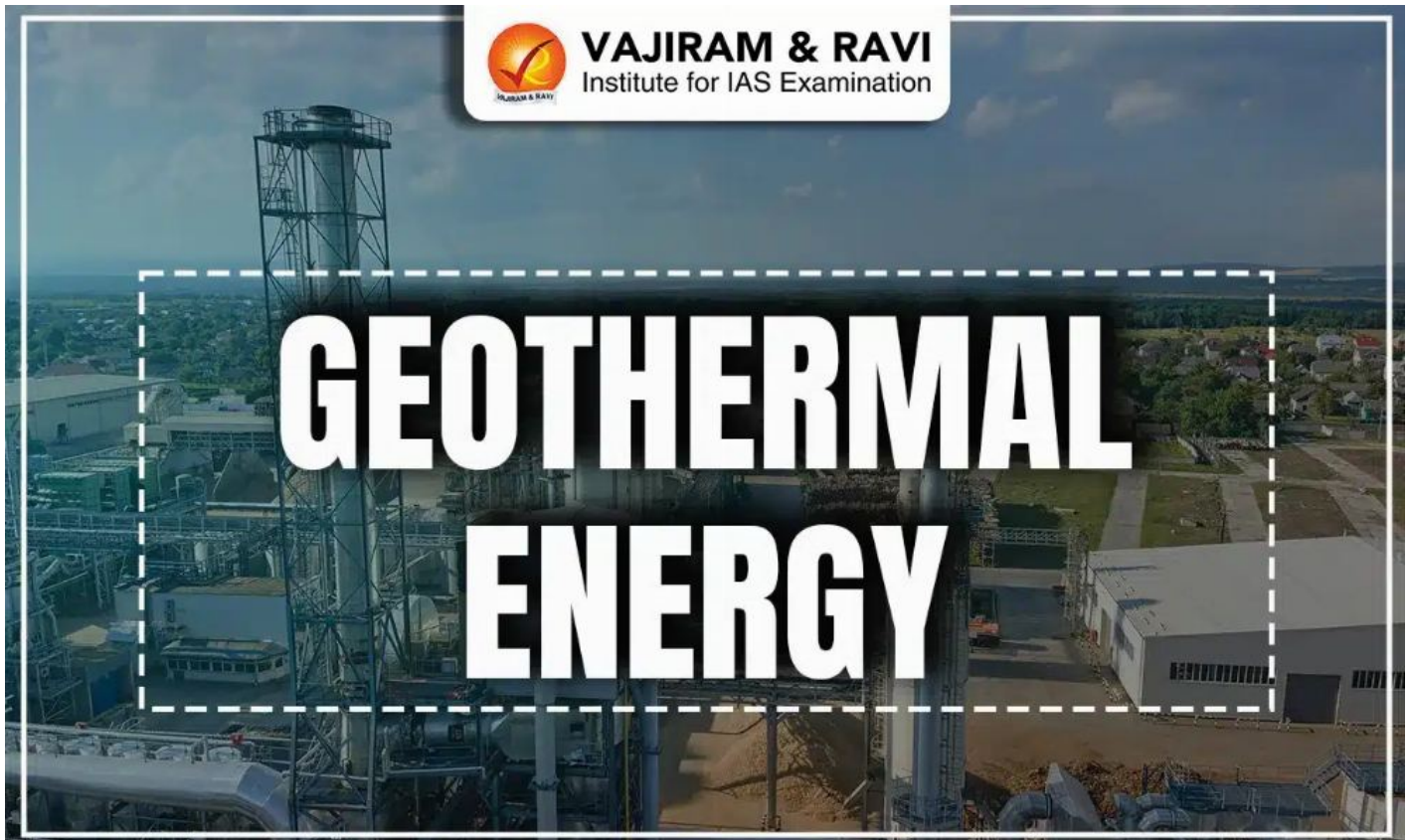


Geothermal Energy, Definition, Types, Sources, Advantages

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Geothermal Energy is produced by the natural heat that exists inside the Earth due to radioactive decay and residual heat from the Earth's formation. This heat is captured using two methods- drilling into hot aquifers where hot water and steam is combined into power turbines and generators and secondly by drilling into hot rocks in the Earth's crust. In this article, we are going to cover geothermal energy, its types, advantages and disadvantages.

Geothermal Energy

Geothermal Energy is the form of natural heat that is found inside the Earth's crust and stored in molten rocks called magma. The constant decay of naturally present radioactive materials inside the Earth is the main source of Earth Heat. This produces high amounts of energy that comes to the surface in the form of hot springs, geysers and steam vents. Most geothermal energy sources are present near tectonic plate boundaries and this heat is used both directly for heating and indirectly to generate electricity by passing steam through turbines.

Geothermal Energy Naturally Occurring Sources

The sources of Geothermal Energy includes:

- Hot Springs: Created when underground water heated by geothermal heat rises to the surface.
- Lava Fountains: Found in active volcanic areas where magma comes out of the ground.
- Geysers: Like hot springs, but instead of calm flow, water erupts violently in bursts.
- Mudpots or Mud Pools: Acidic hot springs with very little water, where rocks break down to form bubbling mud.
- Hydrothermal Vents: Openings on the seafloor where very hot water escapes and creates clouds of smoke when it meets cold seawater.

Geothermal Energy Different Types

There are two different types of geothermal energy produced:

Liquid Dominated Reservoirs

This is the most common type of geothermal energy found all over Earth. The heated liquid present in these reservoirs has a temperature ranging between 150°C to 200°C. This liquid present is mostly in the form of water.

Vapor Dominated Reservoirs

The temperature of the steam stored in the reservoirs ranges from 240°C to 300°C. To avoid any contact with water, the boundaries of these reservoirs are non-permeable.

Geothermal Energy Electricity Generation

Geothermal energy is used to produce electricity using the following ways:

- Deep wells (1–2 km) are drilled into reservoirs to release hot steam or water.
- In vapor-dominated reservoirs, steam is directly used to run turbines.
- In liquid-dominated reservoirs, hot water heats another fluid that turns the turbine.
- After use, fluids are pumped back underground to reheat and be reused, making the system sustainable.

Geothermal Energy in India

Geothermal studies in India began in the 1970s. The Geological Survey of India (GSI) and the Council of Scientific & Industrial Research (CSIR) were responsible for exploring sites. More than 300 locations have been identified and grouped into seven provinces:

1. The Himalayas (North and Northeast)
2. Sohana near Delhi
3. Cambay (Gujarat)
4. Western Coastal Region
5. Son-Narmada-Tapi (SONATA) Basin
6. Mahanadi Basin

7. Godavari Basin

Most sites are of medium or low potential, with temperatures below 200°C. According to the Ministry of New and Renewable Energy (MNRE), India has the potential to produce 10 GW of geothermal power, but no large power plant exists yet.

Geothermal Energy Sites in India

Here is a list of sites where geothermal activity is being explored for electric power production:

Major Geothermal Sites in India for Electric Power Production	
Geothermal Site in India	Location
Puga valley	Ladakh
Chummathang	Ladakh
Cambay	Gujarat
Tattapani	Chattisgarh
Khammam	Telangana
Ratnagiri	Maharashtra

Here is a list of potential Indian Sites that can be used to extract Geothermal Energy:

Major Geothermal Sites in India for Direct Heat Use Application	
Geothermal Site in India	Location
Rajgir	Bihar
Parvati valley	Himachal Pradesh
Tapoban	Uttarakhand
Sohana	Haryana

Surajkund	Jharkhand
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Geothermal Energy Applications

Geothermal Energy can be used in the following ways:

- **Electricity Generation:** Large-scale use of Earth's heated liquid to supply renewable electricity.
- **Heating Buildings:** Heat pumps and direct systems use constant underground temperatures to heat buildings efficiently.
- **Agriculture:** Used for greenhouses, aquaculture, and soil warming. This helps in increasing the growing season and increasing crop yield.
- **Industrial Work:** The stable energy can help in drying wood, farming fish, and paper production.
- **Balneology:** Hot springs and mud pools used for bathing and therapy.
- **Ground Source Heat Pumps:** Reduce heating and cooling costs in homes.
- **Snow Melting:** Heated pipelines under roads and walkways melt snow.
- **District Heating:** One central geothermal system supplies heat to many buildings.

Geothermal Energy Government Initiatives in India

The Government of India has taken up a number of initiatives to promote the use of Geothermal Energy:

- Geothermal studies have been supported by the Government of India since the 1970s.
- India has targeted 500 GW of non-fossil fuel energy by 2030, including geothermal.
- The aim of the Indian Government is to harness 10 GW of geothermal energy by 2030.
- In 2021 the ONGC signed a deal with Ladakh to build India's first geothermal plant at Puga Valley.
- The NTPC has been working on a 300 MW geothermal project at Tattapani, Chhattisgarh.

Geothermal Energy Environmental Effects

While the use of geothermal energy is clean, there are various environmental effects of this energy on the environment. These include:

Even though geothermal energy is clean, it can still harm the environment:

- Plants release gases that may cause acid rain and global warming.
- Hot water may contain harmful gases and heavy metals.
- Drilling can disturb the land, causing quakes or landslides.
- Radioactive gases may also be released during drilling.

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