Geothermal Energy in India

Why in news?

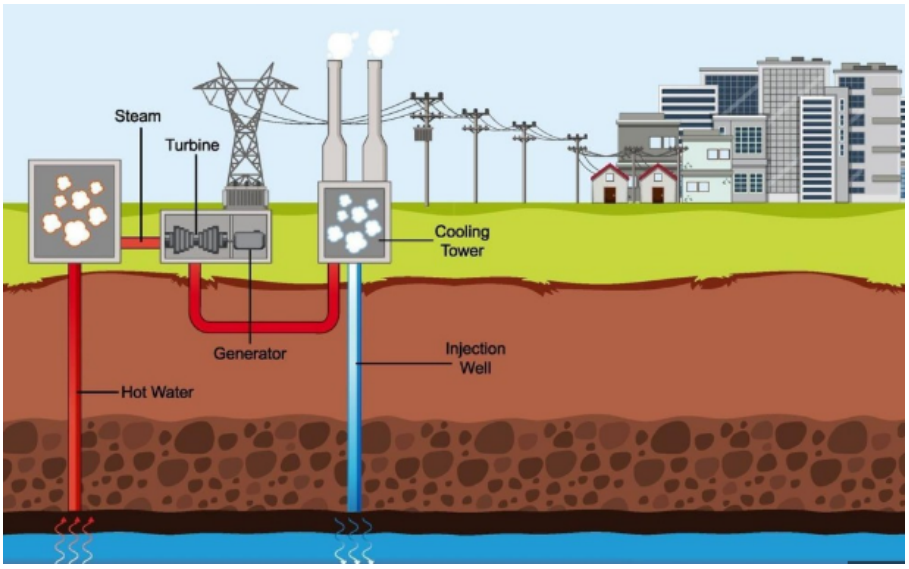
Recently, Minister of New and Renewable Energy has highlighted that Indian government is working on extensive exploration of potential geothermal site in India and in developing pilot plants.

What is geothermal energy?

- **Geothermal energy** - It is the energy that is stored in the form of heat beneath the earth's surface.
- **Usage** - To generate electricity and for other heating applications.
- **Source** - Energy from the formation of the planet and the decay of radioactive isotopes inside earth's core, such as potassium-40 and thorium-232.
- **Extraction** – From the underground pools of steam and hot water trapped in hot spot region in earth crust.

*Molten rocks formed in the deeper hot regions of earth's crust are pushed upward and trapped in certain regions called '**hot spots**'.*

- There are three primary methods of geothermal energy production based on geological conditions and resource characteristics
- **Dry Steam Power Plants** - *Steam from underground reservoirs* is directly used to fuel turbines, generating electricity with remarkable efficiency.
- It is ideal for areas with naturally occurring steam reservoirs.
- **Flash Steam Power Plants** – It is applied in geothermal reservoirs containing *water at higher temperatures* greater than 182°C.
- As this *superheated water flows upward* through wells under its own pressure, the decrease in pressure causes some of the water to flash into steam which is then separated & used to power turbines.



- **Binary Cycle Power Plants** - It is used in regions with *lower temperature geothermal resources* (between 107-182°C).
- Heat from hot water is used to *boil a secondary working fluid*, typically an organic compound with a low boiling point and the vaporized working fluid drives the turbines.

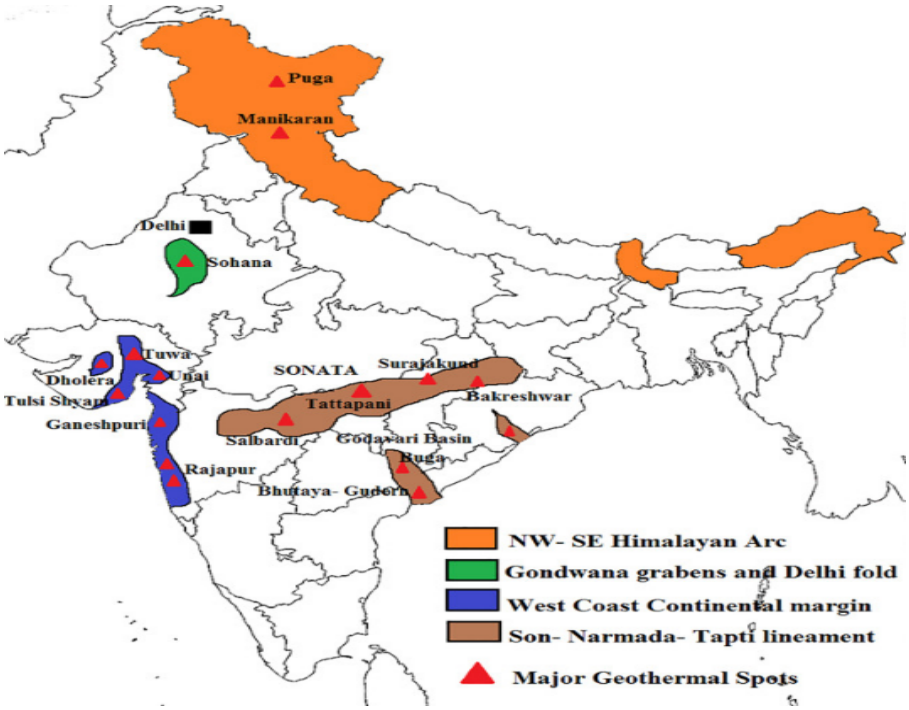
What are the advantages of geothermal energy?

- **Environmental Benefits** - It is a clean energy source with minimal release of greenhouse gases or air pollutants.
- **Renewable Energy** - Earth's heat is constantly replenished, ensuring a long-term renewable energy source.
- **Reliability and Consistency** – They can generate electricity 24/7, 365 days a year and thus makes it as an excellent source of baseload power, crucial for maintaining a stable electricity grid.
- **Higher energy conversion efficiency** – It can produce more electricity with less energy input compared to many other power generation methods.
- **Limited Land Use** – They require a much smaller land area compared to wind farms or solar panel arrays thus minimizing their impact on the surrounding environment.
- **Energy Independence** - Developing domestic geothermal resources could significantly reduce dependence on imported fossil fuels, enhancing energy security and independence.
- **Reduced energy cost** - Increased power generation will make electricity reliable and affordable for households and businesses.

What is the status of geothermal energy in India?

- **Potential** –Through the report '*Geothermal Atlas of India 2022'*, Geological Survey of India, has identified ***10 GW*** of geothermal power capacity in *350 identified locations* across various regions.
- **4 Major potential regions**
  - Northwest-Southeast Himalayan Arc
  - Gondwana Grabens and Delhi fold
  - West Coast continental margin

    - Son-Narmada-Tapti lineament
- Tatapani-Surajkund belt, covers Chhatisgarh and Jharkhand, Cambay in Gujarat with reservoir temperatures about 175 °C ± 25 °C.
- Areas in Jharkhand, Bihar, MP, Maharashtra, Gujarat and Telangana have reservoir temperatures about 60 °C ± 10 °C.



- **Current plants –** 2 plants, both are run by ONGC
    - **Himachal Pradesh** – Parvati Valley, *Manikaran*
    - **Ladakh –** *Puga - Chumathang* geothermal sites of

What are the measures taken by India?

- **Pilot Project** - A 20 kW pilot geothermal power plant has been commissioned by Singareni Collieries Company Limited (SCCL) in the Manuguru area in Telangana which utilizes a closed loop Binary Organic Rankine Cycle Process technology.
- **Indigenous technologies** - Development of technologies through the Renewable Energy Research and Technology Development Programme (RE-RTD) has been successfully demonstrated.
- **Financial support** – Government provides up to *100% financial support to government and non-profit* research organizations and *up to 70% to industry, start-ups, private* institutes, and entrepreneurs.
- **International collaboration** – India has signed MoUs with Iceland, Saudi Arabia and USA on geothermal energy development.
- Renewable Energy Technology Action Platform (***RETAP***), launched in 2023, between India and the USA, has identified geothermal energy as a key area of collaboration.

What are the challenges in developing geothermal energy?

- **High upfront costs** – High initial investment is needed for exploration and setting the plant, thus yet to reach grid-parity.

- **Lesser investment** – High turnaround time of the project discourages private sector investments.
- **Location limitation** – Geothermal energy power plants can be setup in limited locations of geothermal energy availability.
- **Unviability** - Some potential geothermal sites are not considered techno-economically viable due to high altitude, difficult terrain, harsh weather conditions, very short working period and difficulty in evacuation of power.
- **Lack of technical expertise** – India's technology expertise in extracting geothermal energy is limited.
- **Unintended consequences** – Inadequate understanding about the long term impact of exploiting internal heat of earth.
- **Regulatory hurdles** – Lack of streamlined regulatory process disincentives private sector participation.
- **Seismic impact** – Geothermal energy extraction could trigger seismic events such as earthquakes.
- **Environment pollution** – Release of hot water and steam will affect local biodiversity.

What lies ahead?

- Develop a detailed exploration of geothermal provinces like the Himalayas and Cambay Basin.
- Attract investments through favorable policies, such as allowing 100% FDI for geothermal projects and private participation.
- Build expertise in geothermal technologies and operations through geothermal engineering programs and collaboration with experienced international players.
- Develop and adapt cost-effective geothermal technologies suitable for India's geological conditions.
- Create a clear and efficient regulatory framework for geothermal development to expedite project approvals.
- Pursue decentralized smaller-scale applications of geothermal energy, such as heating buildings and greenhouses.

References

1. The Print | Geothermal Energy
2. Economic Times | Geothermal Energy Exploration
3. PIB | Geothermal Energy Projects in India

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