



**Government of India  
Ministry of New and Renewable Energy  
(Geothermal Division)**

**GEOTHERMAL FAQ'S**



**1. WHAT DOES THE WORD "GEOTHERMAL" MEAN?**

**Answer:** "Geothermal" comes from the Greek words geo (earth) and therme (heat). So, geothermal means earth heat.

**2. WHAT IS GEOTHERMAL ENERGY?**

**Answer:** Geothermal energy is the heat stored in earth crust. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

**3. DOES INDIA HAVE GOOD GEOTHERMAL POTENTIAL?**

**Answer:** No, India is in Low Geothermal Potential region with low/medium heat enthalpy (medium range of 100-180°C and less than 100°C is low enthalpy). Also Geothermal electricity generation is site and technology specific in India. As per the submitted reports of resource assessment Geological Survey of India (GSI) has identified estimated geothermal potential of 10,000 MW in India.

**4. HOW DEEP INTO THE EARTH CRUST GEOTHERMAL ENERGY IS AVAILABLE?**

**Answer:** The geothermal energy stored in the earth crust is available at a depth of about 3-4 km and estimated to be  $43 \times 10^6$  EJ corresponding to about  $1194 \times 10^6$  TWh.

## **5. WHY IS GEOTHERMAL ENERGY A RENEWABLE RESOURCE?**

**Answer:** Because its source is the almost unlimited amount of heat generated by the Earth's core. Even in geothermal areas dependent on a reservoir of hot water, the volume taken out can be reinjected, making it a sustainable energy source.

## **6. HOW MUCH LAND IS REQUIRED FOR GEOTHERMAL POWER PLANT?**

**Answer:** Land requirement in geothermal power plant is very less i.e. 0.75 - 1.2 acres/ MW as compared with solar which requires 5-8 acres/ MW.

## **7. HOW DOES GEOTHERMAL HEAT GET UP TO EARTH'S SURFACE?**

**Answer:** The heat from the earth's core continuously flows outward. It transfers (conducts) to the surrounding layer of rock, the mantle. When temperatures and pressures become high enough, some mantle rock melts, becoming magma. Then, because it is lighter (less dense) than the surrounding rock, the magma rises (convects), moving slowly up toward the earth's crust, carrying the heat from below.

Sometimes the hot magma reaches all the way to the surface, where we know it as lava. But most often the magma remains below earth's crust, heating nearby rock and water (rainwater that has seeped deep into the earth) - sometimes as hot as 700 degrees F. Some of this hot geothermal water travels back up through faults and cracks and reaches the earth's surface as hot springs or geysers, but most of it stays deep underground, trapped in cracks and porous rock. This natural collection of hot water is called a geothermal reservoir.

## **8. WHAT ARE THE BENEFITS OF USING GEOTHERMAL ENERGY?**

**Answer:** First, it's clean. Energy can be extracted without burning a fossil fuel such as coal, gas, or oil. Geothermal fields produce only about one-sixth of the carbon dioxide that a relatively clean natural-gas-fueled power plant produces, and very little if any, of the nitrous oxide or sulfur-bearing gases. Binary plants, which are closed cycle operations, release essentially no emissions. Geothermal energy is available 24 hours a day, 365 days a year.

## **9. WHAT IS THE CAPITAL COST INVOLVED IN GEOTHERMAL POWER PLANT?**

**Answer:** The cost of geothermal power plant is site and technology specific, the average rough capital cost on not exceeding basis stands 25-30 Cr per MW.

## 10. WHICH COMPANIES AND PSU'S ARE INVOLVED IN GEOTHERMAL EXPLORATION IN INDIA?

**Answer:** Indian companies in collaboration with foreign companies are in geothermal power generation venture. Name of the companies/PSU are given below

- ONGC Energy Center (OEC) with Talboom, a Belgian firm
- National Thermal Power Corporation Limited (NTPC)
- National Hydroelectric Power Corporation Limited (NHPC)
- Reykjavik Geothermal, Iceland and Thermax, India
- Icelandsbanki, Iceland; Mannvit, Iceland and Bhilwara Group, India have set up a Joint - Venture i.e. Bhilwara Mannvit Green Energy Ltd (BMGEL).
- Kaldara Iceland and Hindustan Turbomachinery, Bangalore.
- Tata Power with Origin Energy Ltd., Australia.
- Geosyndicate Power Pvt Ltd.
- Avin Energy System
- Geothermal Exploration Company Ltd.

## 11. HOW IS GEOTHERMAL ENERGY IS MORE EFFECTIVE COMPARED WITH OTHER RE TECHNOLOGY?

**Answer:** As per the international reports a 1 MW Geothermal Power Plant generates about 8.3 Millions Units (MU) per MW per annum compared to Solar 1.6 MU per MW, Wind 1.9 MU per MW and Hydro 3.9 MU per MW. Comparison chart of Geothermal with other RE technologies is provided below.

S.No	Renewable Resource	Cost per MW	Avg Units produced Per MWe Per Year	Levellised Tariff Cost by CERC 2014	Ratio of Capital Cost to the total Generation
1	<b>Geothermal</b>	Rs 30.0 Cr	8.3 MU	Rs 12.0	Rs 36.1
2	<b>Solar Thermal (with storage)</b>	Rs 25.0 Cr	2.01MU	Rs 11.8	Rs 124.3
2	<b>Solar PV</b>	Rs 6.91 Cr	1.66 MU	Rs 9.42	Rs 41.6
3	<b>Wind</b>	Rs 6.03 Cr	1.93 MU	Rs 5.76	Rs 31.2
4	<b>Hydro</b>	Rs 7.35 Cr	3.90 MU	Rs 3.80	Rs 18.8

## 12. WHERE IS GEOTHERMAL ENERGY AVAILABLE IN INDIA?

**Answer:** The various assessment studies and surveys undertaken so far have resulted in the identification of 340 hot springs across India in 7 geothermal provinces.



- **Geothermal Provinces/ geothermal Belts:** Himalayas, Sohana, West coast, Cambay, Son-Narmada-Tapi (SONATA), Godavari, and Mahanad.
- **Potential States:** Jammu & Kashmir , Chhattisgarh, Himachal Pradesh, West Bengal, Gujarat, Maharashtra, Madhya Pradesh, Bihar, Jharkhand, Andra Pradesh, Orissa, Haryana.

### **13. WHAT ARE THE ENVIRONMENTAL IMPACTS OF USING GEOTHERMAL ENERGY?**

**Answer:** Geothermal technologies offer many environmental advantages over conventional power generation:

- Emissions are low. Only excess steam is emitted by geothermal flash plants. No air emissions or liquids are discharged by binary geothermal plants.
- Reinjection/Recycle of Ground Water: Salts and dissolved minerals contained in geothermal fluids are usually reinjected with excess water back into the reservoir at a depth well below groundwater aquifers. This system will prolong the life of the reservoir as it recycles the treated wastewater.
- Mineral Extraction: Some geothermal plants do produce some solid materials, or sludges, that require disposal in approved sites. Some of these solids are now being extracted for sale (zinc, silica, and sulfur, for example), making the resource even more valuable and environmentally friendly.

### **14. HOW EFFICIENT IS THE GEOTHERMAL SYSTEM?**

**Answer:** A geothermal power plant is having a PLF of 90% and Ground Source Heat Pumps (GSHP's) have COP of greater than 6 (HVAC system have COP of 3 to 4) and the EER values upto 27.

### **15. WHAT ARE THE DIFFERENT TYPES OF GEOTHERMAL POWER PLANTS?**

**Answer:** There are three geothermal power plant technologies being used to convert hydrothermal fluids to electricity: dry steam (when geothermal temperature is between 180 °C and 200 °C), flash steam (when the geothermal energy is available at 150 °C -180°C temperature) and binary cycle (when geothermal temperature is between 100 °C and 150 °C). In India the binary cycle plant is successful as India is in Low Geothermal Potential region with low/medium heat enthalpy (between 100°C -150°C or less than 100°C).

### **16. DO GEOTHERMAL SYSTEM REQUIRE MUCH MAINTENANCE?**

**Answer:** No. In fact, geothermal systems are practically maintenance free. When installed properly, the buried loop will last for generations. And the other half of the operation--the unit's fan, compressor and pump--is housed indoors, protected from the harsh weather conditions. Usually, maintenance cost is less Rs 0.2 /KWh, periodic checks and filter changes are the only required maintenance.

### **17. APART FROM POWER PRODUCTION WHAT OTHER WAYS WE CAN USE GEOTHERMAL ENERGY?**

**Answer:** Geothermal water is used around the world, even when it is not hot enough to generate electricity. Anytime geothermal water or heat are used directly, less electricity is used. Using geothermal water 'directly' conserves energy and replaces the use of polluting energy resources with clean ones. The main non-electric ways we use geothermal energy are DIRECT USES and GEOTHERMAL HEAT PUMPS.

### **18. WHAT IS GROUND SOURCE HEAT PUMP (GSHP)?**

**Answer:** Ground Source Heat Pumps (GSHP's) use the earth's relatively constant temperature between 16 – 24 °C at a depth of 20 feet to provide heating, cooling, and hot water for homes and commercial buildings. GSHP harvests heat absorbed at the Earth's surface from solar energy. The temperature in the ground below 6 meters (20 ft) is roughly equal to the mean annual air temperature at that latitude at the surface it uses the earth as a heat source (in the winter) or a heat sink (in the summer). GHP's is effective in all kind of climate zones or can be deployed anywhere in India on 24 x 7 bases.

- **Heating:** Earth's heat (the difference between the earth's temperature and the colder temperature of the air) is transferred through the buried pipes into the circulating liquid and then transferred again into the building.
- **Cooling:** During hot weather, the continually circulating fluid in the pipes 'picks up' heat from the building - thus helping to cool it - and transfers it into the earth

### **19. HOW EFFICIENT IS A GSHP?**

**Answer:** The GSHP is one of the most efficient residential heating and cooling systems available today, with heating efficiencies 50 to 70% higher than other heating systems and cooling efficiencies 40 to 50% higher than available air conditioners. That directly translates into savings for you on your utility bills.

### **20. WHAT IS THE CAPITAL COST OF GSHP?**

**Answer:** Cost of the GSHP is site specific for normal soil it cost's around Rs 1 Lakhs to 1.5 Lakhs per Tones but if the rock is encountered during boring then cost get increased.

## 21. WHAT ARE THE DIRECT USES OF GEOTHERMAL ENERGY?

**Answer:** Direct District Heating System appropriate for sources below 150°C

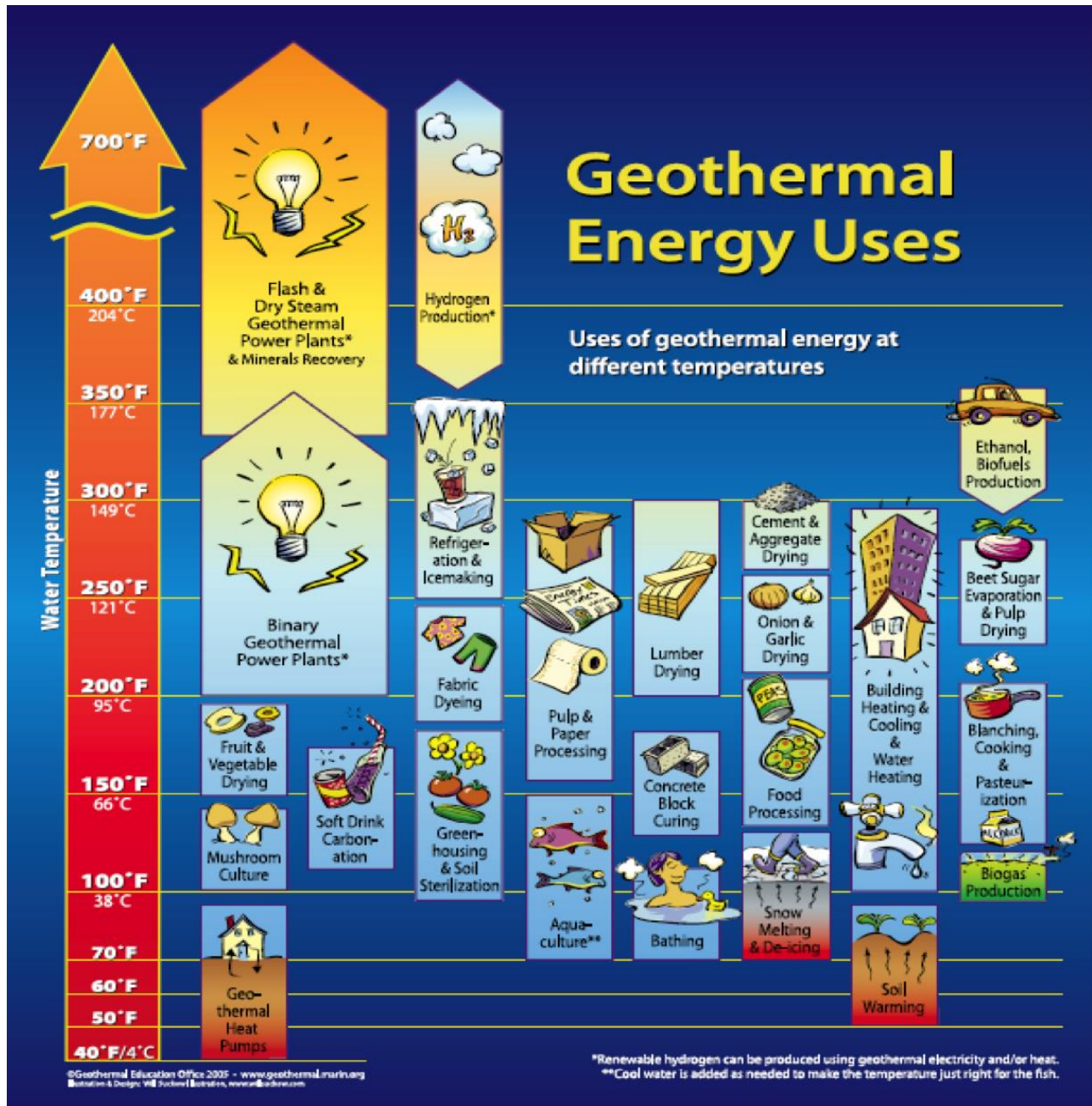
- Air conditioning
- Space heating
- Industrial processes
- Drying
- Greenhouses
- Aquaculture
- Hot water
- Tourist Resorts and pools
- Melting snow
- Cold Storage
- Poultry & Fish Farming
- Mushroom Farming
- Horticulture





## 22. WHAT ARE USES OF GEOTHERMAL ENERGY AT DIFFERENT TEMPERATURE?

Answer: Temperature wise use of geothermal energy is provided in the figure below





### **23. CAN ONE SYSTEM DO HEATING AND COOLING BOTH?**

**Answer:** Yes. A GSHP can be a combination heating/cooling and hot water heating system. You can change from one mode to another with a simple flick on your indoor thermostat. Using a desuperheater, some GSHPs can save you up to 50% on your water-heating bill by preheating tank water.

### **24. HOW MUCH LAND SPACE REQUIRED FOR GROUND-SOURCE HEAT PUMP (GSHP)?**

**Answer:** Trenches should be at least two meters deep to harness a consistent year-round heat source. Trenches will need 50-80 meters of pipe per kilowatt (kW), or 10 meters of 'slinky' coiled pipe per kW, with at least 5 meter distance between trenches with coils. So a typical 8kW heat pump requires around 400m<sup>2</sup> of ground area for slinky coils. Note, however, that this will depend on a number of factors, including ground conditions.

Boreholes need 20-50 meters of pipe per kW, and will usually be 100-150 meters deep. You may need 2-4 pipes per borehole, or more than one borehole. The Pipe diameter should be 20 to 40mm for best performance.

### **25. ARE GROUND SOURCE HEAT PUMP IS AN ESTABLISHED TECHNOLOGY?**

**Answer:** Yes, GSHP systems are common, particularly in the USA, Canada, Sweden, Switzerland and Germany. The principles of ground source heat pumps were first described by Lord Kelvin in the 1850s and continuous development since they were first used commercially more than 50 years ago has greatly improved their efficiency and reliability. They now provide a proven, cost-effective, safe and environmentally friendly alternative to fossil fuels.

### **26. WHAT IS THE PAYBACK PERIOD ON A GEOTHERMAL HEAT PUMP SYSTEM?**

**Answer:** The payback period varies significantly, as geothermal systems are customized to individual homes. Factors that influence the payback period include:

- new home vs. retrofit (existing) home;
- cost of the geothermal heat pump system;
- size of home;
- Energy efficiency of the home and the age/type of heating/cooling system the geothermal heat pump is replacing.

*Roughly the estimated payback period of Geothermal Heat Pump is 2 to 3 Years.*

## 27. WHAT ABOUT SEVICING AND MAINTENANCE OF GSHP?

**Answer:** As with any valuable plant a ground source system should be covered by an annual maintenance agreement with the supplier. However, routine maintenance requirements are very low. A ground source heat pump can be expected to last over 40 years – longer than a combustion boiler – and the ground heat exchanger should have a life of over 50 years.

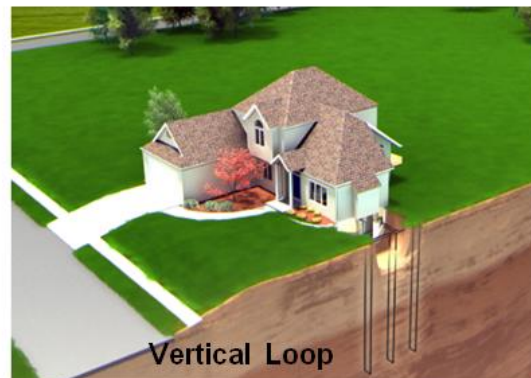
## 28. WHAT ARE THE DIFFERENT TYPES OF GEO-EXCHANGE SYSTEMS AVAILABLE?

**Answer:** The common two types of GHPs in use are

1) earth-couple (closed loop) system that uses sealed pipes/tubes-placed vertically or horizontally, through water or a mixer of water and antifreeze circulates transferring heat to and from the earth.

- Horizontal Loop
- Vertical Loops
- Surface Water Based Loops (Ponds, Rivers etc)

2) Water source (open loop) system where water from the underground aquifer pumps water to the heat exchanger[9]. Between the two, earth coupled GHPs are very popular because they are very adoptable.



### **29. WHICH INDIAN COMPANIES ARE INVOLVED IN GROUND SOURCE HEAT PUMP'S?**

**Answer:** List of the Indian companies which are involved in the Ground Source Heat Pumps is provided below

- Thermax India
- Danfoss India
- Overdrive Engineering Pvt Ltd
- Green India Buildings Systems & Services Pvt Ltd (GIBSS)
- Enfra Solution India Pvt Ltd
- Geothermal India Pvt Ltd
- Geoclinic Pvt Ltd
- Solar India Solutions Pvt Ltd

### **30. WHY WE SHOULD GO FOR GROUND SOURCE HEAT PUMPS?**

**Answer:** Following are some point due to must go for a GHSP's

- Proven technology in Abroad from last 50 years with Worldwide installed capacity of 53 GW<sub>t</sub> in 43 countries.
- Reduces power consumption by more than 50%. Hence saves electricity and money.
- Payback period of 2-3 years and after that it can be used for 50 year free of cost.
- Can easily be installed anywhere in India or it can be retrofitted with existing HVAC system for higher efficiency.
- It has both heating and cooling features and can be used as per the seasonal requirement.
- Very Low maintenance cost and has system life of 50 years.
- Environment friendly.