

Energy beneath your feet

Countries are taking to geothermal power. India could too—provided the government wakes up

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When the Romans came across hot water springs in Britain, they built elaborate bathing complexes in the area using the springs to feed their swimming pools. They were one of the earliest users of geothermal energy. Geothermal simply means 'earth's heat'. The temperature at the earth's core is as high as on the surface of the sun. The massive amount of heat energy stored in the bowels of the planet is increasingly becoming an area of interest for energy-starved nations looking for alternative energy sources.

Countries like the Philippines and Iceland generate 15-20% of their electricity from geothermal sources. With clean and renewable energy becoming a high priority, many countries are now showing a keen interest in geothermal power. According to the Australian Geothermal Energy Association, Australia is investing \$7 billion with the aim of deriving 5% of its energy from geothermal sources.

In spite of having a tinderbox beneath its surface in many areas, India, however, has not made much progress in tapping its geothermal resources. This abject state of affairs stems from the apathy of the government, which doesn't even have a policy for geothermal projects. This could change in the coming years, as geothermal is finally hitting second gear in India. With states like Gujarat and Chhattisgarh offering incentives for cleaner power generation, a handful of companies are showing interest in geothermal power. These include LNJ Bhilwara, NTPC, Tata Power, and smaller players like Avin Energy and Geosyndicate.

To the centre of the earth

Geothermal energy is considered renewable because the heat emanating from the earth's interior is essentially limitless and is expected to remain so for billions of years. Further, unlike solar and wind, it is available 24 hours a day and 365 days a year. Also, it emits around 80% less greenhouse gases compared to coal, oil and methane.

So, how does it work? Deep inside the earth's crust, there is a lot of heat radiating from a sea of molten rocks. Sometimes they erupt as volcanoes or flow out as hot springs. The idea is tap at least a fraction of this massive amount of heat energy, and convert it into electricity. First, scientists locate geothermal hotspots; then, they identify fractured rock surfaces through which heat can be released. Next, wells are dug to release heat energy in the form of steam and hot water, and are used to drive turbines, which, in turn, produce electricity.

Energy Underground

In geothermal power, initial costs are high, but operating costs are minimal

	Size (mw)	Construction time (years)	Operating costs	Average cost per unit (Rs)	Fuel supply constraints
Coal	500-1000	4	Medium/low	1.19-2.50	Regional
Hydro	1,000	5-10	Low	0.40-0.50	Geographical
Gas/liquid	250	2	Highest	4.20-12	Limited domestic reserves
Nuclear (PHWRs) *	500-700	4-5	Medium/low	2.50-2.70	Limited domestic reserves
Wind	3	0.5	Low	2.5	Limited areas
Geothermal	20	3	Low	3-3.50	In proven areas, abundant

* Pressurised heavy water reactors

Source: Industry reports

India was one of the earliest countries to begin geothermal projects, starting as far back as 1973, when the Geological Survey of India (GSI) started exploring sites rich with geothermal energy. In the 1980s, a 5 kw (kilo watt) plant was set up in Manikaran in Himachal Pradesh. Another project was planned in Tatapani in Chhattisgarh in the 90s, only to be called off.

Today, with high oil prices and climate concern, there is renewed interest in geothermal energy. But the challenges are many. The biggest challenge for Indian companies will be to acquire the technical expertise and equipment to drill into geothermal reservoirs. "There is an acute shortage of drilling equipment," says Ahsan Absar, a geologist and advisor at LNJ Bhilwara, a Noida-based diversified group.

LNJ Bhilwara is interested in generating geothermal energy in Puga Valley, in Jammu and Kashmir; the valley was identified as a geothermal hotspot in 2006. LNJ Bhilwara has sought the state government's approval and is waiting for a decision on land allocation. "If we get permission now, the project should commence by 2012," says Absar.

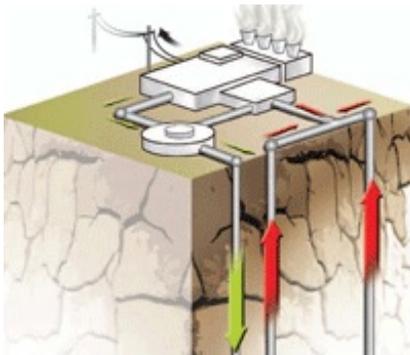
The group has tied up with Glitnir, an Iceland-based investment bank, to develop geothermal power plants in the country. Bhilwara will have a 60% stake in the \$10 million joint venture. The river in the Puga valley is frozen for eight months. So, geothermal power is more viable than hydroelectric power there, says Absar. A 20-25 mw (mega watt; 1,000 kw equals 1 mw) power plant can meet 40% of the energy needs of the valley. It will take about three years and Rs 250 crore to generate 25 mw of power. Transmission costs will go up to Rs 1 crore per km, but operating costs will be minimal, he says. The state government will buy the power from LNJ Bhilwara. "We may be asked to provide 15-20% as free power, but things will become clear once we sign the power purchase agreement with them," says Absar.

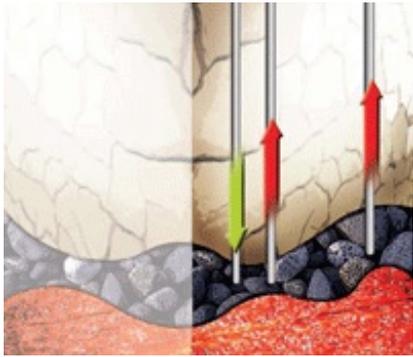
How it works

- 1 Wells are drilled into the heat reservoirs to bring the hot water and steam to the earth's surface
- 2 The heat energy thus piped out is used to power turbines in the power plant
- 3 The turbine spins the generator, producing electricity
- 4 The used water is routed back into the earth's crust

Identified Sites

Puga Valley (J&K)
Tatapani (Chhattisgarh)
Godavari Basin
Manikaran (Himachal)





Pradesh)
Bakreshwar (West Bengal)
Tuwa (Gujarat)
Unai (Maharashtra)
Jalgaon (Maharashtra)

The Players

Geosyndicate and Australia's
Panx Geothermal
LNJ Bhilwara and Icelandbased
Glitnir
Tata Power
NTPC
Avin Energy Systems

Drilling is expensive—Rs 10 crore for a km. Depending on the region, geothermal projects have to dig 1-3 km. Even then, a company can dig all the way down, only to find that the heat is not adequate. If they do find a good hotspot, they have to set up a power plant, which requires big upfront costs. According to estimates, it costs \$3.45-4.25 million per mw to build a geothermal power station; by comparison, a wind power plant costs about \$2 million per mw.

Abhijit Gokhale, Industry Analyst, South Asia and Middle East, Energy and Power Systems Practice, Frost and Sullivan, makes a case for geothermal over wind. "A geothermal plant works non-stop, unlike wind and solar. A 30 mw geothermal plant generates 250 gw (1,000 mw equals 1 giga watt) of power annually, while a wind energy plant produces about 87 gw, as, on an average, it runs for only one-third of the day.

Another active project is the Tatapani project in Chhattisgarh, which is being revived. Says S Shukla, Director, Chhattisgarh Renewable Energy Development Agency (CREDA): "We have floated a global tender, and are inviting global players, as they have the technical expertise." The proposed project will be a public-private partnership (PPP). The first right to purchase the power will be given to the Chhattisgarh State Electricity Board.

Underground and ignored

Apart from Chhattisgarh, Andhra Pradesh and Jammu and Kashmir are also actively

looking at geothermal power. But they are yet to get any support from the Ministry of New and Renewable Energy (MNRE), which was formed to handle issues relating to generating power from alternative energy sources. "Solar and wind energy are proven, and involve less investment and have high availability. So, why invest in geothermal?" says a senior government official.

Geothermal energy research has also been a victim of poor funding. Competing with oil and gas exploration for geological expertise, and with only minimal backing from the government, very few companies have ventured into the sector. Says Gokhale: "Other than a few sporadic and half-hearted attempts, the government has done practically nothing to exploit this vast reserve of free energy."

Only 4.9% of electricity in India comes from non-conventional energy sources, far less in relation to available resources. The country can produce 10,000 mw of geothermal electricity, according to the MNRE. "It can produce three to four times more," counters M Chandrasekharam, Head, Centre of Studies in Resources Engineering, IIT, Bombay, and the founder of Geosyndicate, a geothermal power company.

Geosyndicate has partnered Australia's Panx Geothermal, and has begun exploring geothermal resources in the Godavari basin. The Andhra Pradesh government is willing to buy the power generated, says Chandrasekharam. "We will be able to sell power at Rs 3.50-4 per unit, the same as a coal-based plant."



New horizons

The government is silent on power purchase agreements, tax sops and subsidies, all of which can help convert potential into performance

The challenge for Indian companies would be to bring down costs to a level where it is economical to develop small geothermal fields in places like the Puga Valley, where even a small 5 kw project can electrify rural areas. "Solar plants require large tracts of land, and it is viable in a country like Saudi Arabia. But how will you get so much land in a country like ours," asks Chandrashekaram.

Geosyndicate is planning small geothermal projects with less than 25 mw capacity here. The company has started exploration in the Godavari Basin and is looking at Puga Valley too.

NTPC, India's largest power producer, is also reportedly looking for sites to set up a geothermal project of around 30 mw. Possible locations include Puga Valley, Manikaran and some hot-spring sites in Uttaranchal. Tata Power has also expanded its renewable energy portfolio by picking up a 10% stake in Geodynamics, an Australian geothermal company.

Gujarat-based Avin Energy Systems is also planning to set up geothermal power projects in the state. Says Avinash Brahmbhatt, founder, Avin Energy: "I have compiled data and identified sites that will give high yields of geothermal energy." But when he approached the state government, he was appalled by the response. "They did not even know what geothermal energy is," says Brahmbhatt. Government indifference is the biggest hurdle today, as there is complete silence on power purchase agreements, tax breaks, subsidies and other incentives, all of which can make a difference in converting potential to performance.

Abroad, governments are moving fast. According to the Earth Policy Institute, the number of countries generating geothermal power could double to about 50 by 2010. High-profile and successful investors and companies—Warren Buffett, Google, Goldman Sachs and Morgan Stanley, to name a few—are also investing in geothermal. Today, geothermal generates only 1% of the world power, or about 10,000 mw. About 80% of this is accounted for by the US, the Philippines, Mexico, Indonesia and Italy. If India is to join in, the government needs to start taking geothermal seriously.

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