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EDITORIAL ANALYSIS

Heat from Below: India Drills Its First Geothermal Wells

THE HINDU

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The Hindu 23 July 2026 GS3

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THE LIFT LINE

The sun sets and the wind falls, but the heat beneath our feet never rests. India has finally begun to tap it.

WHY THIS EDITORIAL MATTERS FOR YOUR EXAM

India's clean-energy story has been written almost entirely in solar and wind, both of which share a defining weakness: they are variable, producing power only when nature cooperates. The commissioning of India's first exploratory geothermal wells in Ladakh marks a quiet but significant attempt to add a **firm, round-the-clock renewable** to the mix. For the aspirant, this is a chance to move beyond the familiar solar-and-wind narrative and understand the physics, geography and economics of a less-discussed clean source.

GS Paper 3: This falls squarely within energy security, environment and conservation, and developments in science and technology. It connects to India's climate commitments, the challenge of decarbonising the grid, and the special problem of powering remote, off-grid and border regions.

For **Prelims**, hold the specifics: **geothermal energy** is heat energy stored in the Earth's interior, and unlike solar and wind it is a **baseload renewable** available round the clock. India has commissioned exploratory **geothermal wells at Puga Valley in Ladakh**, one of the country's most promising geothermal provinces. Other prospective fields include **Tattapani in Chhattisgarh** and the **Himalayan and west-coast geothermal belts**. Plant technologies include **dry steam, flash and binary-cycle** plants, and **Enhanced Geothermal Systems (EGS)** for hot dry rock. The **Geological Survey of India (GSI)** maps resources and the **Ministry of New and Renewable Energy (MNRE)** anchors policy. India targets **500 GW of non-fossil capacity by 2030** and **net-zero by 2070**.

For **Mains**, the demand is to evaluate geothermal's potential and limits honestly, and to place it within a diversified energy transition rather than treating it as a silver bullet.

BACKGROUND AND CONTEXT

Geothermal energy has powered nations from Iceland to New Zealand for decades, yet India has long left its resource untapped despite promising surface signs. The country's geothermal potential is concentrated in a handful of provinces where hot springs, fumaroles and elevated ground temperatures betray the heat below. Puga Valley in eastern Ladakh has featured in geological surveys since the 1970s as one of the most promising sites, with surface manifestations that hinted at a substantial reservoir.

What changed is the convergence of need and capability. Ladakh is a cold, high-altitude, sparsely populated region where extending the conventional grid is expensive and diesel dependence is costly and polluting. A local, firm, clean source is therefore especially valuable. With the **Geological Survey of India** having refined the resource assessment and drilling capacity now available, exploratory wells have finally been sunk to confirm reservoir temperature, pressure and flow. It is a first step, not a finished power plant, but it converts a decades-old prospect into an active project.

THE CORE ARGUMENT / ISSUE

The baseload advantage

The single most important argument for geothermal is that it is available around the clock, independent of weather and season. This makes it a **baseload** or firm source that can anchor a grid otherwise dominated by intermittent renewables. As India adds vast quantities of solar and wind, the grid needs sources that can hold a steady output and balance the swings. Geothermal, alongside storage and hydropower, fills that role without burning fossil fuel.

The technology ladder

TECHNOLOGY	RESOURCE NEEDED	TYPICAL USE
Dry steam plant	High-temperature steam reservoir	Direct turbine drive at premium sites
Flash steam plant	High-temperature hot water	Most common utility-scale plants
Binary-cycle plant	Moderate-temperature water	Lower-temperature fields, wider applicability
Enhanced Geothermal Systems	Hot dry rock, engineered fractures	Frontier technology, expands usable area

Puga's moderate-to-high temperatures make it a candidate for flash or binary-cycle generation, while EGS could one day widen the map far beyond natural reservoirs.

The catch: geology and cost

Geothermal is not free of difficulty. Exploratory drilling is expensive and carries the risk that a reservoir underperforms. High-altitude, ecologically sensitive terrain raises construction and environmental costs. Managing mineral-laden geothermal fluids, reinjecting spent water to sustain pressure, and preventing induced seismicity all require careful engineering. These are manageable challenges, but they explain why geothermal has grown slowly and why disciplined resource assessment matters before large investment.

HOW TO THINK ABOUT THIS (ANALYTICAL FRAME)

Think of the energy transition as a portfolio problem. No single source is perfect: solar and wind are cheap but variable, nuclear is firm but capital-heavy and slow, hydropower is firm but geographically fixed and socially sensitive. Geothermal's distinctive contribution is that it is both **renewable and firm**, a rare combination, but it is **site-specific** and **capital-intensive up front**.

The right frame is therefore complementarity, not competition. Geothermal will not rival solar in scale, but it can do what solar cannot: deliver steady power in a cold, remote region and firm the grid. Judge it by whether it fills a gap in the portfolio, not by whether it can single-handedly power the country.

THE DIAGRAM IN WORDS

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Earth's interior heat -> reservoir in Puga Valley -> exploratory wells confirm temperature and flow -> flash or binary-cycle plant -> firm 24x7 electricity -> local grid for Ladakh -> reduced diesel dependence and firmed variable renewables
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WAY FORWARD

1. **De-risk exploration with public funding.** The State should bear the high upfront exploratory-drilling risk through GSI and MNRE, so that confirmed reservoirs can then attract private developers.
2. **Build a geothermal roadmap.** Move from a single pilot to a phased national plan covering Puga, Tattapani and the Himalayan and west-coast belts, with clear targets and a dedicated policy framework.
3. **Pair firm heat with local needs.** Beyond electricity, use geothermal directly for space heating, greenhouses and tourism in Ladakh, maximising value from a single well field.
4. **Safeguard fragile ecology.** Mandate reinjection of spent fluids, seismic monitoring and strict environmental appraisal so that a clean source does not damage a sensitive high-altitude landscape.

PYQ LINKAGE AND PRACTICE

UPSC frequently asks about India's renewable-energy strategy and the technologies that support it. A 2018 GS3 question asked how India can achieve energy security through renewable sources, and questions on the National Solar Mission and hydrogen have recurred. Geothermal is a fresh, less-crowded angle on the same theme of firm, low-carbon power.

Practice question: "Geothermal energy offers India a rare firm renewable, yet it remains barely tapped." Discuss the potential and constraints of geothermal power in India, with reference to the exploratory wells in Ladakh's Puga Valley. (15 marks, 250 words)

Sources: The Hindu Editorial, Ministry of New and Renewable Energy

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