Chapter 6

India's Stakeholders: Opportunities and Implications for Geothermal Growth and Development

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India's geothermal sector will touch a range of stakeholders and industries—indigenous communities, farmers, hospitals, universities, security forces, environmental groups, and more. Its success depends on effectively engaging these stakeholders. Early community consultation, robust environmental and social safeguards, and strategic pilot projects and partnerships can help the nation realize its geothermal potential—and reduce energy costs, strengthen resilience, create jobs, and ensure local benefits.

India is home to more than 1.4 billion people who represent a rich mosaic of languages, ethnicities, and communities—many with deep historical ties to the land they inhabit. As the geothermal sector in India grows, it will increasingly intersect with and bring benefits to a diverse set of stakeholders: central and state government agencies, public sector energy enterprises, private developers, universities and research institutions, industrial users, and agricultural interests.

Crucially, this growth will also touch rural communities, farmers, and landholders whose livelihoods may be affected by project siting and resource use. In ecologically sensitive regions—such as parts of the Himalayas or tribal territories—early and meaningful engagement with local governing bodies, village councils (*panchayats*), and indigenous leadership will be essential. Such collaboration can help address concerns related to environmental impacts, water use, and land rights while building trust and ensuring that geothermal development proceeds in a socially responsible and inclusive manner.

As reflected in Chapter 8, "Policy and Regulatory Pathways to Catalyse Geothermal in India," setting national targets for geothermal power generation, industrial heat, and cooling—together with the proposed national cooling mission—offers an opportunity to connect local priorities with national ambitions.

Achieving these goals will depend on early engagement and cooperation between communities, local governments, and developers to ensure the benefits of geothermal energy are widely shared.

This chapter examines the range of constituencies relevant to India's geothermal future and explores the opportunities and challenges for each group. By fostering inclusive dialogue and transparent decision-making, India can lay the groundwork for a geothermal sector that delivers economic, environmental, and social benefits while respecting the diverse interests of its people.

RELEVANT STAKEHOLDERS

Indigenous Communities

Some of the most important stakeholders with regard to geothermal energy are indigenous groups (also known as *Adivasis*, or *original inhabitants* or *first dwellers*). Although these groups have some benefits in terms of access to educational facilities, government jobs, and other programmes, they generally live in marginal ecologies. Many of these locations, however, are rich in various resources, including geothermal resources.[1] Since many of these areas are relatively remote, geothermal energy can be the ideal resource to tap to provide basic amenities such as electricity, heating, and cooling. Many indigenous groups already use geothermal resources as part of their indigenous medical system. For instance, in the Sowa Rigpa medicine system, practiced on the Tibetan plateau, hot springs are an important form of treatment for a number of ailments.[2]

New geothermal development should ensure it does not undermine indigenous groups, and all geothermal planning should include local indigenous groups. This inclusion could be via increased investment in the welfare of these groups through monetary benefits, resource allocation, meaningful skills training and education, and sustainable development. These efforts could help shift the conversation around resource extraction from indigenous lands in India, which have often been associated with challenges such as displacement, marginalisation, and environmental degradation.[3]

KEY INDIAN STAKEHOLDERS

- **Indigenous and local communities**
- **Environmental and civil society groups**
- **Agricultural and industrial sectors**
- **Universities and research institutions**
- **Defence, public health, public education, and public infrastructure agencies**
- **State and central governments**

Environmentalists

It is also important to engage with environmental groups that focus on the ecological impacts of human activities, such as air pollution, greenhouse gas emissions, deforestation, and biodiversity loss. Renewable and clean energy sources such as geothermal can offer practical solutions to many of these challenges. However, geothermal development may also present environmental risks that could diminish its perceived benefits if the risks are not managed responsibly—particularly while the sector is still emerging. Environmental and civil society organisations working across areas such as environmental protection, social justice, and rights-based development can play a constructive role as partners to help ensure geothermal projects are implemented equitably and sustainably. Poorly managed projects risk both harming local communities and undermining broader public support for geothermal energy in India. (Chapter 9, "Environmental Benefits and Considerations in India: Balancing Renewable Expansion and Ecological Stewardship in the Geothermal Sector," outlines in more detail the benefits, potential risks, and solutions to these issues.)

Agriculture and Allied Sectors

Agriculture and related sectors can also play an important role in promoting the use of geothermal resources. Agriculture sectors are among the biggest contributors to the Indian economy; together, they represent more than 16% of the gross domestic product (GDP) and support more than 44% of the population.[4] Any change in this sector therefore has far-reaching impacts.

To reduce the energy consumption and greenhouse gas emissions from farming, geothermal energy could be used to manage temperature and humidity in greenhouses and to dry crops and other produce. (For a more detailed case study on geothermal use for sustainable agriculture, see Chapter 3's "Case Study: Harnessing Earth's Heat for Sustainable Agriculture: Geothermal Cold Storage in Himachal Pradesh.")

Hospitals and Health Care

India has a large health care sector that includes public and private agencies, as well as many pharmaceutical manufacturers. While private health care establishments tend to be concentrated in urban areas, public sector health care centres are spread across the country. Each centre requires dependable energy and connectivity to provide consistent services to patients. And in more remote areas, geothermal can provide a more reliable, cheaper, and cleaner source of cooling (or heating) and—where possible—electricity. The national cooling mission discussed in Chapter 8, "Policy and Regulatory Pathways to Catalyse Geothermal in India," would go towards ensuring locations such as these health centres have efficient and affordable cooling for essential public services and can provide cooling even when the grid is under stress.

Universities and Educational Institutions

The Center of Excellence for Geothermal Energy (CEGE) in Gujarat is an institutional pioneer for exploring geothermal resources in India. Founded in 2013 as part of the Pandit Deendayal Energy University, its sole intention is to explore geothermal energy in India. Along with the CEGE, India has premier technology universities spread across the country via the Indian Institute of Technology (IIT) network. Institutions that are part of the IIT network have both the resources and the intellectual capacity to develop affordable technologies, which can then be transferred to the energy sector in due course. Additionally, companies from the energy sector can form partnerships with IIT universities to develop relevant and clean technology that can harness geothermal energy.

Beyond research and technology collaborations, educational institutions could benefit greatly from the use of geothermal energy, particularly for cooling. Geothermal cooling uses the stable temperatures underground to regulate building climates efficiently, reducing reliance on electricity-intensive air-conditioning systems. For schools—from nurseries and primary schools to universities—this cooling can mean more comfortable classrooms, lecture halls, and dormitories throughout the year, even during India's hottest months.

In addition to providing comfort, geothermal cooling can significantly reduce energy costs for educational institutions, allowing funds to be redirected towards learning resources and student programmes. It also contributes to a smaller carbon footprint, which can help schools meet sustainability goals and serve as living laboratories for students to learn about clean energy technologies. Across India's diverse climate zones, geothermal systems offer a reliable, low-maintenance solution that can operate consistently, even in remote or rural areas where grid electricity may be limited or expensive.

India's Security Forces

Indian security forces (including the Indian Army and paramilitary forces) have bases and forward posts in a wide range of areas, including the Indian Himalayan region, the Thar Desert, and other parts of the country. Because many of these locations are remote and not connected to the electrical grid, they must rely on diesel-powered generators and coal-based systems for space heating and cooling—an unsustainable practice because the fuel has to be transported to each location.

Fortunately, many of these regions are rich in geothermal resources, which can be harnessed to provide heating, cooling, and—in some locations—electricity. One example is the use of space heating in areas with severe winters, all while reducing both operational costs and the greenhouse gas emissions associated with maintaining these facilities.

Indian security forces have already been experimenting with various renewable energy technologies to meet their energy needs, especially solar, wind, and micro-hydroelectric projects. However, geothermal energy could offer a better way to meet the military's energy needs, especially since many bases are located in areas with hot geysers, making them especially well suited to hydrothermal or conventional geothermal development.

As discussed in Chapter 8, "Policy and Regulatory Pathways to Catalyse Geothermal in India," the Indian Army's Net Zero Energy Building in Jhansi, commissioned in 2025, provides a compelling demonstration of geothermal energy. The facility uses 10 vertical boreholes, each 120 metres deep,[5] that are connected to a closed-loop ground source heat pump system, which maintains indoor temperatures at 22°C even when outdoor extremes reach 43°C.[6] Supported by rooftop solar photovoltaics, the building functions as an off-grid geothermal-cooled system and serves as a replicable model for cantonment and institutional infrastructure across India.

The Defence Research and Development Organisation under the Ministry of Defence and the Indian Army Corps of Engineers are two important sub-agencies that can shepherd the adoption of these technologies at various scales for use by Indian security forces.

As noted in Chapter 8, public procurement can provide a structured and centralised pathway for testing, scaling, and standardising new geothermal technologies. This controlled environment can also reduce early-stage risks, accelerate learning, and establish benchmarks for performance—giving an important boost to the adoption of geothermal energy in India more broadly. Over time, the technologies proven in these public projects can then be adapted and deployed for broader civilian and commercial use.

Airports

India has one of the fastest-growing aviation sectors in the world.[7] In addition to several privately owned airline companies, India's government has also launched various plans—such as the Regional Connectivity Scheme (Ude Desh ka Aam Naagrik) and the National Master Plan for Multi-Modal Connectivity (PM Gati Shakti)—that aim to improve regional and intermodal connectivity. Airports are managed by the Airports Authority of India and require a secure, reliable source of electricity, as well as energy for space cooling and heating facilities. Geothermal energy is an ideal resource that can provide a round-the-clock, reliable source of energy while also reducing environmental impact.

INSIGHTS FROM CURRENT GEOTHERMAL PROJECTS

As mentioned in Chapter 2, "Where Is the Heat? Exploring India's Subsurface Geology," geothermal resources in India have been identified in northern, western, and northeastern India, with promising prospects in the states of Ladakh, Himachal Pradesh, Uttarakhand, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Sikkim, Arunachal Pradesh, and Meghalaya. While preliminary studies have been carried out in some of these areas, the country has only a handful of active geothermal projects, including one in Dholera in Gujarat and two in Ladakh in the Puga Valley in the northwest Himalayan region (one is in testing at Leh Airport and the other at the University of Ladakh). These projects, which are in various stages, provide deeper insight into the dynamics of landownership, stakeholder impacts, and opportunities for the sector's development in India.

Puga Valley Project

Puga Valley, in the Changthang region of Ladakh in northern India, contains extensive zones of high-temperature geothermal potential for electricity generation. The valley—at 4,000 metres above sea level—lies southwest of the Indus Suture Zone and features mud pools, borax hot springs, rangelands, and sulphur deposits across 15 square kilometres.[8]

Ladakh is a remote, high-altitude region separated from mainland India by the Himalayas. It experiences extremes of temperature—from below -30°C in winter to above 30°C in summer—and relies mainly on groundwater for water supply. While the region was connected to the national grid in 2019, transmission lines do not extend to Puga Valley, where many communities still depend on solar technologies.

Geothermal research in Puga dates back to the 1970s, but progress remained limited until 2020, when Prime Minister Narendra Modi announced Ladakh's inclusion in India's carbon-neutral development plan.[9,10] In 2021, the Administration of Union Territory of Ladakh (AUTL), the Ladakh Autonomous Hill Development Council (LAHDC,

NATURAL GEYSERS IN PUGA VALLEY

Figure 6.1: The natural geysers dotting the Puga valley, 170 kilometres east of Ladakh's capital, Leh. Source: Shutterstock

Leh), and Oil and Natural Gas Corporation Limited (ONGC) Energy Centre Trust (OECT) signed a memorandum of understanding to develop a geothermal power plant. LAHDC, Leh, agreed to provide land—preferably public—and AUTL would secure all necessary permits and clearances. A joint venture between AUTL, LAHDC, and OECT has later phases planned, with potential grid-connected power providing much-needed local income.

A key feature of the project is its financing: AUTL is not liable for the high up-front costs, making the model replicable for other sites such as Chumathang, which is between about 30 kilometres and 40 kilometres west of Puga. LAHDC's participation provides a degree of democratic representation, though affected communities remain underrepresented in decision-making.[11,12]

Puga Valley lies partly within the Changthang Wildlife Sanctuary and has long been used by nomadic pastoralists and Amchi healers who practise Sowa Rigpa, the Tibetan system of medicine. These practitioners have traditionally used the valley's hot springs for healing, but drilling and restricted access have disrupted their work and displaced some local people without compensation. While verbal promises have been made to ensure communities benefit from this work, these agreements have not been formalised, and most project jobs require skills that locals currently lack. In addition, the project has encountered some setbacks during implementation due to higher-than-expected fluid pressures, which resulted in concerns around water pollution and local wildlife impact. Drilling has since resumed after upgrading drilling equipment, with an initial target of generating 1 megawatt of electricity.

The absence of a clear regulatory framework for geothermal development compounds many environmental and stakeholder challenges. Without an Environmental Impact Assessment—because many renewable projects are exempt[13]—the country does not have any mechanism to address the social and ecological impacts that have emerged. Introducing proper environmental and social safeguards could prevent similar issues in future projects.

The Puga Valley project, India's first geothermal electricity initiative, represents both a learning opportunity and a test case. OECT has partnered with ÍSOR, Iceland's national geothermal agency, to bring global expertise to the project. If managed transparently and inclusively, Puga could demonstrate how geothermal energy can advance India's national clean energy goals while delivering tangible local benefits. Success will depend on capacity building, job creation, and equitable participation for the people of Ladakh.

Kushok Bakula Rinpoche Airport in Leh

There is a small geothermal project in development at Kushok Bakula Rinpoche Airport in Leh, the main airport in Ladakh. The scope and details of the project are not clear, but various stakeholders have said the project is meant for heating, with the possibility of generating 2,500 kilowatts of electricity.[14] The Airports Authority of India has control of the airport premises, as the airport is a high-security zone. Presumably, this project is in line with the national government's stated vision to make Ladakh a carbon-neutral region and to meet India's global targets in cutting greenhouse gas emissions.

This project is handled by the Central Public Works Department (CPWD), which hired an Indian consulting firm, S.A.P. Automation, to provide expertise to execute this project. The project will benefit local communities, security forces, and tourists. CPWD will also gain knowledge about executing geothermal projects and hopefully will be able to execute more in the future.

University of Ladakh

CPWD also works with S.A.P. Automation on campus at the government's University of Ladakh. The project is for a ground source heat pump at a dormitory to generate 850 kilowatts of electricity.[15] The project will benefit students and faculty and spread awareness about geothermal technologies. In addition, it should help CPWD build capacity to design and execute small geothermal projects for other stakeholder groups. Similar projects are reported to be underway at two government-owned facilities: Sonam Norboo Memorial Hospital in Leh and a site in Kargil.

Dholera, Gujarat, Western India

Dholera is located 60 kilometres north of Bhavnagar city in the Ahmedabad district of Gujarat. Due to its location along the Western Marginal Fault in Cambay

Basin, Dholera had a number of thermal springs.[16,17] The Dholera site is regarded as the first site in India where geothermal resources have been used for building heating—and to generate 20 kilowatts of electricity to demonstrate its potential.[18] The project is located on the state-run campus, Pandit Deendayal Energy University, and was developed by CEGE in the Dholera Special Investment Region (DSIR). DSIR is a collaboration between Gujarat state and the government of India in which the state supplies the land (this time at the university) and the national government invests funds to develop infrastructure and promote industrial development in the region.[19]

The primary beneficiaries of the geothermal project should be the industries that invest and establish infrastructure in the region. The consultant on the Dholera project was Seros Energy, a privately held Indian oil field services company that specialises in drilling operations. Once again, this partnership should expand the knowledge of geothermal and the new technologies advancing the industry.

CONCLUSION

India's geothermal development must move forward in partnership with the communities and institutions it will affect the most. The country's diverse stakeholders—from indigenous groups to research institutions and industrial users—will determine whether or not geothermal becomes a trusted, inclusive, and transformative energy source. The experience of early projects such as Puga Valley underscores that success depends not only on technology and investment but also on dialogue, transparency, and equitable participation.

To build a strong foundation for geothermal growth, we recommend taking action with the following stakeholders:

1. **Indigenous and local communities:** Ensure early consultation and genuine participation through frameworks that protect land rights and cultural heritage. Establish benefit-sharing mechanisms and community training programmes so geothermal projects deliver tangible improvements in livelihoods.
2. **Environmental and civil society groups:** Engage environmental advocates as partners in project planning and oversight, and ensure they are aware of geothermal's many benefits. Integrate environmental and social safeguards, including mandatory Environmental Impact Assessments, to strengthen public trust and minimise ecological risks.
3. **Agricultural and industrial sectors:** Promote direct-use geothermal applications—such as greenhouse heating, crop drying, and process heat—to reduce energy costs and emissions. Encourage pilot projects that demonstrate economic gains for rural industries.
4. **Universities and research institutions:** Expand partnerships between government, academia, and industry to accelerate geothermal research and innovation. Support field-based training and technology transfer programmes to build the technical workforce needed for large-scale deployment.
5. **Defence, public health, public education, and public infrastructure agencies:** Prioritise geothermal heating and cooling at military bases, health centres, hospitals, schools, airports, and public buildings in remote and high-demand regions. Use public procurement to test and standardise new technologies that can later be adapted for civilian use.
6. **State and central governments:** Expand on the current National Policy on Geothermal Energy to further clarify permitting, ensure transparent revenue sharing, and align fiscal incentives with energy security and decarbonisation outcomes. (See Chapter 8, "Policy and Regulatory Pathways to Catalyse Geothermal in India," for more information.)

Growing India's geothermal heating, cooling, and electricity capacity presents a tremendous opportunity for the country. Realising this potential will require many more projects and deeper engagement with stakeholders across sectors and regions. Taken together, these efforts can turn India's geothermal resources into a shared national asset that supports communities, industries, and institutions alike. Done well, geothermal development can strengthen energy resilience, create skilled jobs, and ensure that the benefits of clean energy are distributed equitably across India's diverse landscape.

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