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Ministry of New and Renewable Energy
Geothermal Energy Division

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Notification

Subject: - National Policy on Geothermal Energy – reg.

India's transition to renewable energy (RE) is crucial for meeting its ambitious climate change targets and the commitment to achieve net-zero emissions by 2070. Owing to India's distinctive geological formations, geothermal energy can be a significant additional resource.

2. To facilitate the exploration and development of untapped geothermal energy resources, and following extensive stakeholders' consultations, the Ministry of New and Renewable Energy (MNRE) hereby announce the release of the "National Policy on Geothermal Energy."

3. This issues with the approval of Hon'ble Minister, NRE.

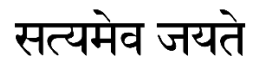

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To:

All Concerned

Enclosure:

National Policy on Geothermal Energy



NATIONAL POLICY ON GEOTHERMAL ENERGY

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1. Introduction

- a. India's renewable energy (RE) growth is vital for achieving ambitious climate change targets and the 2070 Net Zero Goal. India's geothermal potential, rooted in its unique geological settings, remains largely untapped. While solar, wind, bioenergy, and hydropower dominate RE capacity, geothermal energy can be a significant additional resource. Geothermal Energy is included under the "Ministry's Allocation of Business Rules".
- b. Geothermal energy harnesses heat stored within the Earth's crust. High-enthalpy resources, often associated with volcanic regions, geysers and hot springs are primarily used for electricity generation. Low- to medium-enthalpy resources such as hot rocks and shallow ground layers, are better suited for direct-use applications (e.g. heating and cooling, agri-food, aquaculture) and geothermal heat pumps. A geothermal system typically consists of multiple components which can be categorized as, production and reinjection (wells, pumps), transport (pipelines), distribution (heat exchangers) and end-use application. Geothermal power offers notable advantages, including 24/7 electricity generation, reliable baseload supply, enhanced grid stability, lower life-cycle greenhouse gas (GHG) emissions, improved energy security, especially in remote inaccessible areas. Geothermal energy is a site-specific renewable source of energy specifically suitable for catering to the energy needs of remote/interior localities. For the oil and gas industry, geothermal provides opportunities to apply drilling expertise and repurpose idle wells, extending asset value while supporting the low-carbon transition.
- c. The primary applications for geothermal energy include electricity generation, a wide range of direct use (such as district heating, greenhouses, aquaculture, food drying, industrial processes and geo-tourism), as well as space heating/cooling through ground source heat pumps (GSHPs). GSHPs operate with shallow ground temperatures of about 10-25°C, delivering efficient heating and cooling for individual buildings. Other applications with potential could include geo-tourism, greenhouse heating for agri-businesses, drying of horticulture produce, etc. Emerging opportunities also exists in cold storage, desalination and retrofitting abandoned oil wells for geothermal production. The global geothermal power generation capacity stood at 15.4 Gigawatts (GW) at the end of 2024. United States is the leader in geothermal capacity followed by Indonesia and Philippines.
- d. Geothermal development has challenges primarily related to high upfront costs and exploration risks which require policy mechanisms to engage both private and public sector investment (through incentives, subsidies and risk mitigation) and streamlined regulatory processes. Considering the possible utility of geothermal energy as a substitute of heat as well as energy source, the Ministry of New & Renewable Energy (MNRE) has formulated policy for the exploration and development of geothermal resources in India.
- e. "National Policy for Geothermal Energy" henceforth shall be called as "**the Policy**" in this document. **The Policy** has been developed to enable the exploration and development of untapped geothermal energy resources in India. The Policy is issued by the **Ministry of New and Renewable Energy**, hereafter called "**The Ministry**", which is the nodal agency for the exploration, development and production of new and renewable energy sources in India. Various **State Nodal Agencies** including Renewable Agencies representing the State Governments would be called "**Agencies**". A **project developer** interested in the exploration/development of geothermal resources will be termed "**developer**" henceforth.
- f. The policy is to be followed by all stakeholders (Ministries, State Governments, Public and Private Companies, Agencies, Academics, Entrepreneurs, Startups, etc.) involved in exploring and utilizing

geothermal resources in India. Central government, State governments and agencies may issue additional guidelines or incentives for geothermal energy development which is both sustainable and bankable. These policy guidelines will be reviewed from time to time, based on stakeholder feedback.

- g. The relevant provisions of various Acts/Regulations/Rules such as the Oilfields (Regulation Development) Act (ORDA 1948) and its Amendments, the Mines and Minerals (Development and Regulation) Act (MMDR Act 1957), the Environment Protection Act (1986), the Electricity Act (2003), the Forest (Conservation) Act (1980), the Wildlife (Protection) Act (1972), and the Water (Prevention and Control of Pollution) Act (1974) etc. shall be applicable depending upon the location of project.
- h. The regulatory and stewardship responsibilities for geothermal energy shall be with the Ministry.

2. Vision and Goals

Vision:

“To establish geothermal energy as one of major pillars of India’s renewable energy landscape, contributing significantly to national climate commitments, 2070 Net Zero Goal, and energy security while establishing a sustainable, secure, and responsible geothermal energy sector.

Goals:

- I. To improve research capabilities on geothermal energy development and deployment, advanced geothermal exploration, improve drilling techniques, geothermal reservoir management & cost-effective power generation, and direct-use technologies adoption.
- II. To collaborate with Ministries, international geothermal development bodies and national research institutes to incorporate global best practices in exploration, resource assessment, and technology deployment.
- III. To deploy geothermal heating and cooling solutions, including ground source heat pumps (GSHPs) and other direct-use applications to decarbonize buildings, agriculture, industries, etc.
- IV. To establish and promote advanced geothermal exploration through coordination with the oil and gas sector, involving deep and multilateral drilling, repurposing of abandoned wells for large-scale power generation in India.
- V. To Build a robust public-private ecosystem for long-term development of Geothermal Sector
- VI. Capacity building and knowledge sharing

3. Cost of Geothermal Power Plants

Geothermal power projects are capital intensive and site specific. The cost of a geothermal power plant includes exploration and resource assessment; drilling of production and injection wells; field infrastructure, geothermal fluid collection and disposal systems, and other surface installations; project development costs; and grid connection costs; type of power plant (Organic Rankine Cycle, dry steam, flash, or binary), well productivity (the number of wells), and other geothermal field characteristics. It varies from site to site.

Geothermal plants have no fuel cost, only O&M expenses and typically achieve high-capacity utilization factors above 80%, making them a reliable source of baseload renewable power.

4. Geothermal Potential Sites

Since 1973, Geological Survey of India (GSI) has identified 381 hot springs with surface temperatures ranging from 35°C to 89°C. Apart from Himalayan regions where reservoir/resource

temperatures can reach around 200°C, India generally falls within a medium to low heat enthalpy zone, with resource temperatures of 100°C to 180°C. This makes it suitable for a range of direct applications such as GSHP for building heating/cooling, greenhouse heating, and cold storage etc.

The **10 geothermal provinces** in India identified by GSI are: (i) Himalayan Geothermal Province; (ii) Naga-Lusai; (iii) Andaman Nicobar Islands; (iv) Son-Narmada Tapi (SONATA); (v) West Coast; (vi) Cambay Graben; (vii) Aravalli; (viii) Mahanadi; (ix) Godavari; (x) South Indian Cratonic.

Currently, GSI has identified following geothermal energy sites:

- a) Puga, Chumathang, Gaik, Demchok, Nubra, (Panamik), Galhar, in UT, Ladakh
- b) Sidhu, Jammu and Kashmir
- c) Manikaran, Kasol, Tattapani, Tapri in Himachal Pradesh
- d) Tapoban, Gari, Joshimath, Juma, Jamunotri, Ganganani, Beda, Joti, Nyu, Dar, Bheti in Uttarakhand
- e) Tsachu (Tawang), Takshing, Arunachal Pradesh
- f) Polok, Yumesamdong, Sikkim
- g) Sohna, Haryana
- h) Bhimband (Munger), Bihar
- i) Surajkund, Tantloi, in Jharkhand
- j) Bakreshwar, West Bengal
- k) Tattapani in Chhattisgarh
- l) Anthoni, Madhya Pradesh
- m) Dholera, Tuwa, Tulsishyam, Gujarat
- n) Deulajhari (Athmallik), Attri, Odisha
- o) Unhavare (Khed), Sativali, Tural, Maharashtra
- p) Manuguru, Telangana

The Geothermal rift basins have high geothermal potential due to their geological features and tectonic frameworks. However, geothermal projects can be established at sites across the country that have potential. Additionally, with the advancement in technologies such as Enhanced Geothermal Systems (EGS)/Advanced Geothermal Systems (AGS), potential new sites for geothermal are expected to open up.

The Ministry shall facilitate the creation of a geothermal resource data repository through Intergovernmental/inter-agency collaboration, for example with the Ministry of Mines, the Ministry of Earth Sciences, Directorate General of Hydrocarbons, and international partnerships, institutes such as the Geological Survey of India (GSI), National Data Repository (NDR), Central Ground Water Board (CGWB), and the CSIR-National Geophysical Research Institute (CSIR-NGRI), and coordination with the oil and gas industry on data (abandoned and existing oil wells), drilling expertise, mineral identification and equipment sharing including for geophysical surveys.

The Directorate General of Hydrocarbons (DGH) Data Repository may be made available for utilization by eligible operators or developers for geothermal prospective analysis, subject to compliance with the procedures and guidelines prescribed under the National Data Repository framework. Operators or developers shall be permitted to conduct geothermal resource assessment surveys for research and development purposes, as well as detailed assessments. Upon completion of the planned surveys, operators shall be required to submit all acquired geothermal data to the designated geothermal data repository

Developers shall carry out detailed resource assessments and techno-economic feasibility studies, commensurate with the project's scale and stage, to inform design and investment for projects related to power generation, heating and cooling, geo-tourism, greenhouse heating for agri-business, and drying of horticulture produce, etc.

5. Scope of Geothermal Energy Systems

The following items/systems shall be considered under the scope of the policy:

- i. Geothermal Resource Assessment: The resource assessment shall involve Geological, Geochemical and Geophysical surveys and exploratory drilling. It can be standardized with international norms, including the UNFC (United Nations Framework Classification) for Geothermal Energy.
- ii. Geothermal Drilling: Various parameters including depth, extraction technology, subsurface characterization will guide the permitting process for regulating shallow and deep geothermal energy exploitation and drilling technology to be employed.
- iii. Geothermal Power Production systems can be dry steam plants, flash steam plants, binary cycle plants, and Organic Rankine Cycle (ORC). Geothermal plants are modular, and can be installed in incremental units as needed. Enhanced Geothermal System (EGS) projects can be developed to extract heat from hot rocks where natural water flow is limited or absent.
- iv. Direct use of geothermal energy from low temperature wells or hot springs, can be utilized for applications such as cold storage, paper pulp industry, fruits and vegetable drying, food processing, green housing, aquaculture, bathing centers, tourism skin care centers, geothermal and botanical parks for entertainment purposes.
- v. Ground (geothermal) Source Heat Pump (GSHP) uses the earth's relatively constant temperature between 16 – 30°C at a depth of 5-20 m to provide cooling, drying, space heating, etc. GSHP is effective in all types of climate zones and can be deployed anywhere in India on 24/7 basis. They can be closed loop or open-loop systems.
- vi. Emerging Innovative Technologies such as Enhanced Geothermal Systems (EGS), Advanced Geothermal Systems (AGS), hybrid geothermal power systems (integrated with solar PV, solar thermal), Closed-Loop Systems, geothermal energy storage, offshore geothermal wells and Deep Direct-Use Applications (e.g., industrial process heating, desalination, and large-scale district heating) etc. are also considered under the Framework.
- vii. Extracting geothermal energy from abandoned oil and gas wells: This leverages the drilling/exploration skills and wells' data available in the oil and gas sector. Oil and gas operators may explore and develop geothermal energy projects by retrofitting inactive or unproductive wells subject to their technical and operational feasibility.
- viii. By-products: Geothermal energy harnesses thermal heat stored within the Earth's crust, which may result in the extraction of minerals as an incidental activity. Entrepreneurs or project developers extracting valuable mineral by-products such as silica, borax, cesium, lithium, and other alkali minerals can enhance project economic viability and potentially reduce tariffs. Extraction of these minerals will be subjected to the rules and payment of royalty under the MMDR Act. The project developer will be allowed to extract minerals in the project area only after obtaining the permission and grant of mineral concession under the MMDR Act.

6. Developmental Model for Deployment

Different phases of geothermal power plant project development include surface exploration, exploration drilling, pre-feasibility report, environmental assessment, production well drilling, feasibility report, design, and construction of power plant, testing commissioning, well- monitoring,

reservoir management, and operation.

Currently, 100% FDI is allowed in renewables. Preference shall be given to indigenous geothermal technologies for reduction of dependency on imported equipment by encouraging local innovation in drilling and downhole measurement/monitoring technologies and reservoir management. Technology for the safe, non-polluting use of geothermal fluids or by-products including their re-injection to the geothermal source shall be preferred. Preference in central funding assistance, if any, to the Northeastern Region and special category states to support the development of the geothermal sector shall be provided. The government shall explore mechanisms to share geological exploration risk with developers.

MNRE shall prioritize the conversion of existing abandoned oil and gas wells into geothermal plants through collaborative ventures involving the Ministry of Petroleum and Natural Gas (MoPNG), the Directorate General of Hydrocarbons (DGH), and oil companies. Equipment and Material procured under Essentiality Certificate (EC) for Oil and Gas operations can be directly utilised for geothermal projects. Various economic feasibility models including but not limited to revenue sharing, milestone-based payment and others shall be explored by the government.

a) Joint Venture Opportunities

- i. Joint ventures between oil and gas companies, mineral companies, and geothermal developers can combine expertise and financial resources, enabling the funding and development of large-scale geothermal power plants and projects.
- ii. Where feasible, oil and gas production facilities—such as pipelines, power generation systems, and processing plants—can be repurposed for geothermal energy, minimizing the need for significant capital investments in new infrastructure.

b) Financing Mechanisms

The government may explore the possibility of one or a combination of measures to improve the viability and bankability of geothermal projects.

- i. The Ministry supports geothermal research, resource assessment, and pilot/demonstration projects under the MNRE R&D Scheme on “Renewable Energy Research and Technology Development Programme (RE-RTD notified vide OM No. 223/90/2017-R&D dated 09.12.2021)”.
- ii. The government also encourages FDIs & funding from donor organizations including bilateral and multilateral entities, and philanthropic organizations in the form of grants/loans/any other mechanism.
- iii. The government may explore the possibility of the following Financing Mechanisms: Long-term concessional loans from Public and Private Sector Financial Institutions, Sovereign Green Bonds, Viability Gap Funding (VGF), Loans/Grants for Risk Mitigation, Feed-in-tariff, etc.

c) Fiscal Mechanisms

The government may explore following Fiscal mechanisms to support Geothermal Sector: Import duty exemptions on geothermal equipment, machinery, and services, GST exemption on equipment, machinery, and services related to geothermal energy, Tax holidays on geothermal projects,

Accelerated Depreciation, and Property tax exemptions for Geothermal GSHP/Heating/Cooling users, etc.

The above mechanisms shall be subject to further recommendations/approvals from competent Ministries/Departments.

d) Regulations

The support mechanisms for power production, transmission, distribution shall also apply to geothermal projects, including Inter-State Grid Access, ISTS transmission waiver, Open Access charges waiver, RE Must-Run Rules, eligibility for RPO and inclusion in the Indian Carbon Credit Trading Scheme etc. Further, Geothermal Ground Source Heat Pumps (GSHP) and traditional geothermal district heating and cooling systems may be promoted under the National Building Code.

MNRE, in coordination with MoEFCC, may develop Environmental & Social Impact Assessment guidelines, if necessary, for geothermal projects, leveraging international best practices and case studies.

7. Guidelines for States and Union Territories

- a) The project developer may approach State Governments regarding the allocation of potential geothermal zones/blocks/sites. The geothermal exploration permit and land lease may be provided by the State Government.
- b) To enable geothermal operations in areas overlapping with existing oilfields, the Ministry shall evaluate each proposal on merit. If found technically and operationally feasible without interfering with petroleum activities, the Ministry may engage with MoPNG to develop an appropriate coordination mechanism. Upon positive assessment, The Ministry shall grant consent for exploration and development of geothermal energy.
- c) Exploration activity can be taken up in the area already under prospecting license after recommendation of the proposal by the Ministry.
- d) **Permitting Process:** To support the timely implementation of these projects, the Ministry shall facilitate a streamlined **single-window support system**. States shall designate a nodal agency/department dealing with renewable energy for facilitating necessary permissions, clearances, monitoring and implementation of geothermal projects. The nodal agency of the respective state will act as a single window and facilitate to get all mandatory and statutory clearances (such as land, water, forest, and environment, priority access to intra-state transmission, etc.) required for setting up a geothermal project.
- e) Developers must adhere to state government regulations concerning land allotment and environmental, and social clearances. To address community concerns, project developers shall conduct stakeholder consultations and incorporate adequate compensatory measures, particularly in tribal and remote areas.
- f) State governments may allocate the possible geothermal sites/ blocks for exploration for three years with a provision for an extension of two years. An additional two-year extension may be considered for geothermal projects in high altitude areas (such as geothermal potential areas in Ladakh, Arunachal, etc.) considering limited seasonal working window and logistic

constraints due to difficult terrain. Additionally, the sites/blocks may be allocated for further development for power generation or direct-use applications for up to 30 years, with a provision for further extension depending on resource availability.

- g) To promote geothermal technology, the State Governments may facilitate Govt. land allotment/lease at concessional prices.
- h) Ministry of Defense clearance, if required, may be taken up on case-to-case basis.
- i) The clearance and permission procedures may be streamlined through a portal and conducted concurrently wherever possible to ensure speedy deployment.

8. Implementation of the Policy

The Ministry shall serve as the nodal Ministry for the implementation of Geothermal Energy based projects.

To implement the policy, the Ministry intends to adopt the following mechanisms:

- a) Technology collaboration with pioneering countries, having expertise in geothermal sector may be explored under the international cooperation framework and including engagement with relevant international organizations for peer exchange and knowledge sharing.
- b) Partnerships with multilateral donor organizations, development finance institutions (DFIs), may be explored for grants and concessional finance.
- c) Under the MNRE R&D Scheme (RE-RTD), projects may be taken up on detailed geothermal resource assessment and pilot projects shall be taken up on power production, and direct-use applications. A detailed national level program shall be considered for development subsequently for providing financial and fiscal support.
- d) Soft loans may be made available by IREDA and others financing institutions.
- e) Centres of Excellence (CoE) in Geothermal Energy may be established for technical support, capacity building, and implementation of geothermal projects. The CoE shall be developed as a self-contained, industry driven center integrating scientific/technical base as well as the place for technology development and deployment expertise.
- f) The Ministry will release periodic progress reports to evaluate milestones achieved including resource assessments, pilot project completions, and policy updates.
- g) The Ministry may issue detailed guidelines with standard operating procedure (SOP) for the implementation of geothermal projects in the country.