



Executive Summary

Unlocking Indonesia's Geothermal Potential

Project InnerSpace

By expanding beyond conventional geothermal power to next-generation systems, industrial heat, and district cooling, Indonesia can improve quality of life, add thousands of new jobs, promote a more equitable energy transition, reduce fuel imports, and decrease emissions.

Stretching from Sumatra to Papua, Indonesia spans thousands of islands, deep rainforests, high volcanoes, fertile valleys, and dense megacities. Its people and landscapes are as varied as its geology. Sitting along the Pacific Ring of Fire, the subsurface holds active volcanic arcs, young magmatic systems, and large sedimentary basins that concentrate the Earth's heat. All of these features mean that Indonesia has one of the world's richest endowments of geothermal resources. Heat rises beneath hydrothermal fields and across wide regions without natural fluids. That geological diversity underpins a broad menu of geothermal solutions.

Conventional hydrothermal projects remain an essential pillar for firm, clean electricity across Indonesia. (See Chapter 1, "Geothermal 101: Overview of Technologies and Applications.") Yet the nation's geothermal opportunity is larger—much larger. With advanced drilling and modern well construction,

next-generation systems can access heat in low-permeability formations and deliver direct-use heat for industry. These systems can also deliver reliable cooling for campuses and buildings. Broadening the national focus beyond conventional reservoirs substantially increases Indonesia's geothermal potential.

Indonesia's energy and climate plans reflect the need for this expanded view. National targets call for renewables to make up between 19% and 23% of the energy mix by 2030 and around 70% by 2060, yet the National Electricity General Plan (RUKN) and PLN's Electricity Supply Business Plan (RUPTL) envision only between 21 gigawatts and 23 gigawatts of geothermal capacity by 2060—about 5% of the projected electricity capacity.^{1,2} Fully tapping into Indonesia's resource base would strengthen the country's pathway to achieving net-zero status.



INDONESIA'S TOTAL GEOTHERMAL HEAT-IN-PLACE WITH PROTECTED AREAS

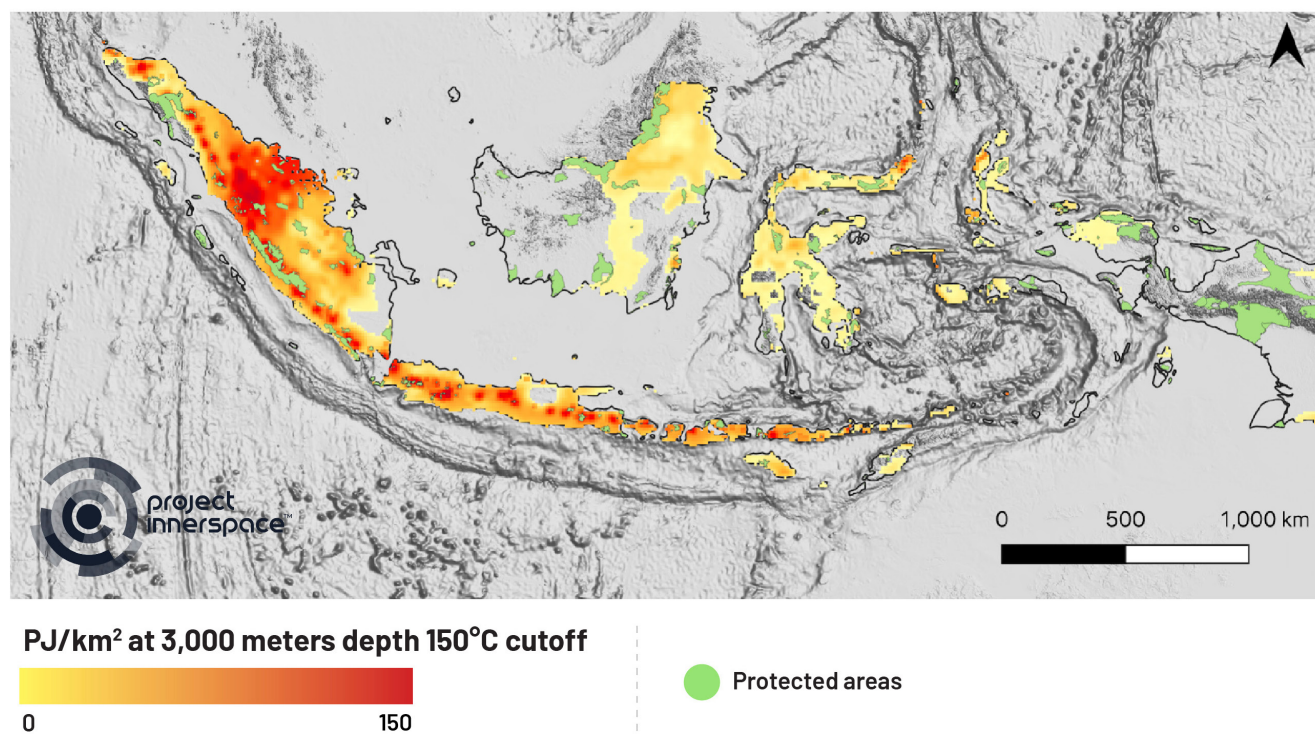


Figure ES.1: The map presents heat-in-place (HiP) estimates expressed in petajoules per square kilometer (PJ/km²) for a 3,000 meter thick interval between 0 meters and 3,000 meters depth, applying a minimum subsurface temperature cutoff of 150°C. Source: Project InnerSpace. (2025); UNEP-WCMC and IUCN (2025), Protected Planet: [The World Database on Protected Areas (WDPA)][On-line], [October/2025], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net

Given Indonesia's long history with geothermal, a strong regulatory foundation already guides geothermal electricity development, but it must evolve to reflect geothermal's multi-sector capabilities. Current instruments—such as the Energy Law, Electricity Law, National Energy Policy, RUKN, and RUPTL—still treat geothermal predominantly as an electricity resource. Recognizing geothermal as an asset for power, heat, and cooling can give investors and developers a clearer, more predictable basis for project development.

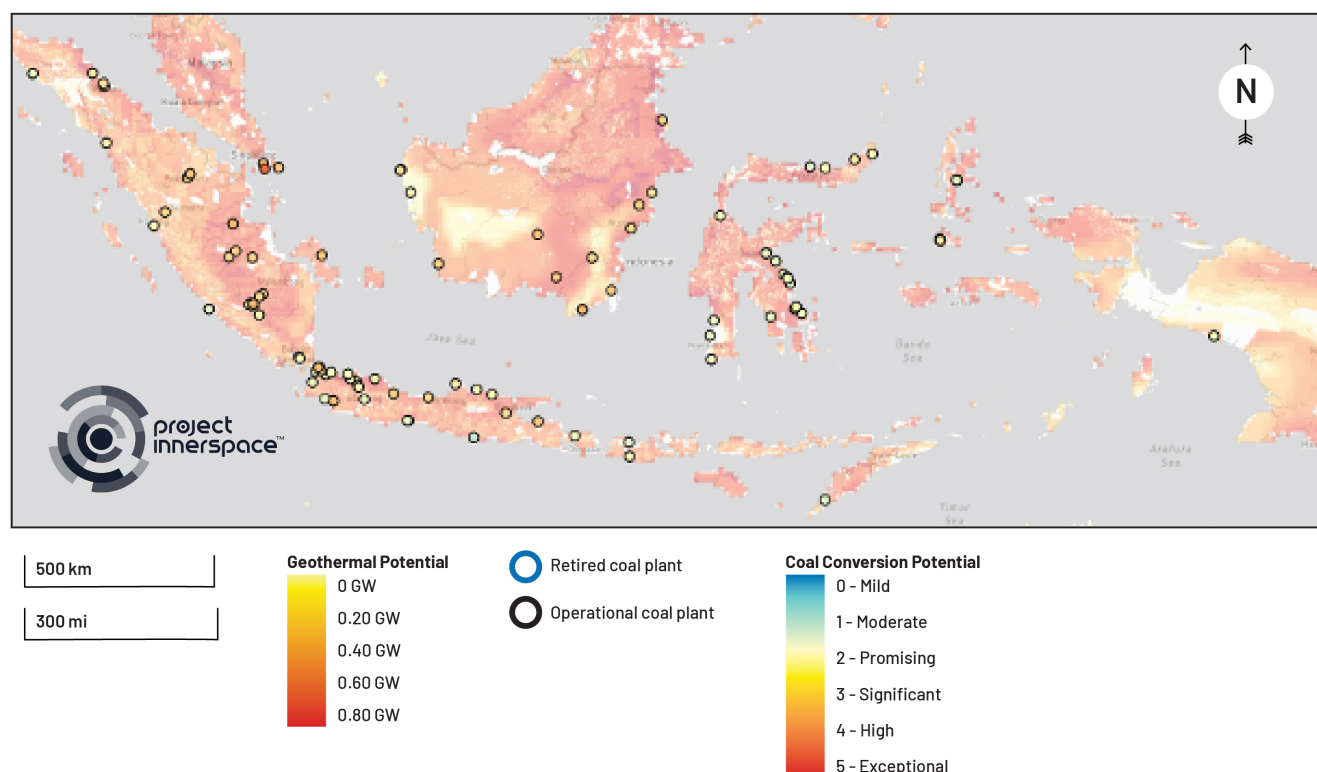
Analysis in Chapter 3 of this report estimates that Indonesia holds 2,160 gigawatts of geothermal technical potential—21 times the current installed capacity and much more than the current estimate of 27 gigawatts of hydrothermal resources (see **Figure ES.1**). The International Energy Agency (IEA) also estimates the nation has about 60 terawatts of thermal energy suitable for industrial heat and cooling.³ By 2050, geothermal

could meet nearly 90% of Indonesia's process-heat demand in key manufacturing sectors. (See Chapter 4, "Beyond Electricity: Indonesia's Thermal Energy Demand and Direct Use Potential.") In its recent report *The Future of Geothermal Energy*, IEA noted that in Southeast Asia, "next-generation geothermal could be an affordable domestic option to reduce current coal-fired dependency while ensuring continued energy security."⁴ In practical terms, this means Indonesia can combine proven hydrothermal development with modular next-generation systems, thermal networks, and district cooling to serve growing cities and industrial corridors.

This opportunity directly supports Indonesia's coal transition. Coal supplies about 40% of the nation's primary energy,⁵ and many industries rely on coal boilers for heat. Deploying roughly 15 gigawatts electric and 15 gigawatts thermal within a decade—ramping up to 25 gigawatts electric and 35 gigawatts



COAL FACILITIES OVERLYING GEOTHERMAL RESOURCES



ES.2: Map showing the cumulative geothermal potential between 0 meters and 5,000 meters, with a 150°C temperature cutoff, representing the minimum threshold for power generation, overlaid with coal-fired power plants and their suitability for geothermal conversion based on Project InnerSpace's Weighted Overlay Analysis. GW = gigawatts. Source: Project InnerSpace. (2025). [Today's Power Potential GW 5000m](#) [Power Generation Module]. GeoMap; Project InnerSpace. (2025). [Coal Plant WOA](#) [Indonesia Module]. GeoMap

thermal by 2045—could replace a significant share of this coal use. In the power sector, these additions could raise renewable generation to roughly 67% by 2045,⁶ enabling early retirement or repurposing of coal plants in Java and Sumatra, where geothermal prospects and demand align.

Recent regulations establish a pathway for retiring and replacing coal with renewable generation. Next-generation geothermal can accelerate these transitions by repurposing existing plant sites, leveraging nearby transmission nodes, and using plant wastewater to support engineered reservoirs (see **Figure ES.2**).

Legacy plants such as Suralaya and Bukit Asam sit close to high-quality geothermal zones and could serve as early conversion sites.

Indonesia's workforce has decades of geothermal development experience, supported by a deep pool of geoscientists and drillers. The country also has an experienced oil and gas sector whose rigs, services, and safety practices transfer readily to geothermal. Universities, state-owned enterprises, and private developers have long collaborated across exploration, drilling, and field operations, creating an integrated supply chain that can be expanded and redirected



to accelerate additional conventional geothermal development and next-generation demonstrations.

Increasing geothermal energy development also supports grid reliability. Indonesia's power system remains fragmented: Java–Madura–Bali and parts of Sumatra are interconnected, while many islands rely on smaller, isolated grids (see **Figure ES.3**). Nearly all renewable potential lies outside Java, even though Java consumes the bulk of the nation's electricity. RUKN anticipates major transmission expansion—48,000 kilometers of new lines and 108,000 substations—to close this gap. Strategically

sited geothermal plants can ease pressure on new infrastructure by providing firm, dispatchable power near demand centers; stabilizing grids; and reducing the storage and long-distance transmission needed to integrate solar and wind.

Taken together, expanding geothermal across electricity, industrial heat, and cooling positions this resource as a central pillar of Indonesia's pathway to 70% renewables by 2060. This expansion can reduce energy costs, attract private investment, create more than 650,000 jobs, improve grid stability, and enhance regional development.

INDONESIA'S GRID TO DATE

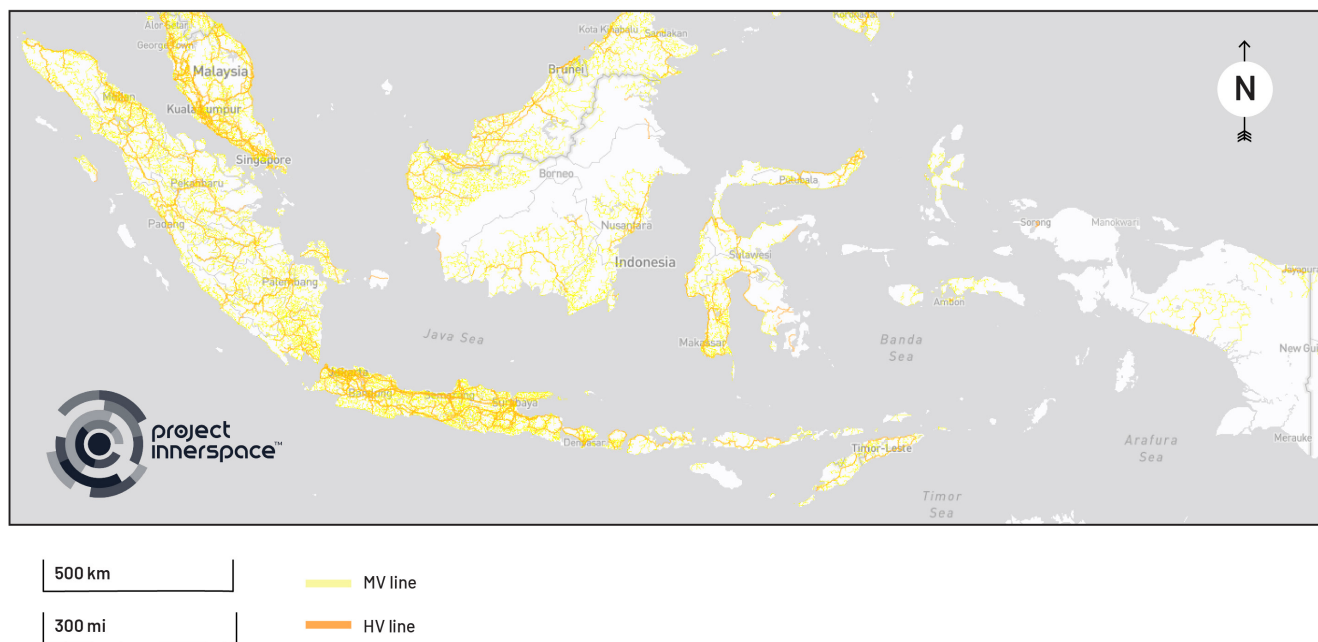


Figure ES.3: Indonesia's transmission network, highlighting Java's interconnection and the smaller, isolated grids of other islands. HV = high voltage; MV = medium voltage. Source: Arderne, C., Zorn, C., Nicolas, C., & Koks, E. E. (2020). [Predictive mapping of the global power system using open data](#). *Scientific Data*, 7, 19; OpenStreetMap contributors. (2023). [Planet OSM](#); OpenStreetMap. (n.d.). [OpenStreetMap](#).



Expanding geothermal in Indonesia beyond its current hydrothermal resources brings many advantages:

- **Energy independence:** The country can benefit from tapping domestic heat to cut fuel imports, anchor critical loads like industrial parks and data centers, and keep value in local economies.
- **Always on, everywhere:** Geothermal provides round-the-clock electricity and thermal energy; stabilizes still-fragmented systems; eases peaks with cooling; and can be sited across Java, Sumatra, Sulawesi, Bali–Nusa Tenggara, Kalimantan, and Papua.
- **Jobs and investment:** An expansion of geothermal can mobilize private capital; broaden Indonesian supply chains; and support more than 650,000 skilled jobs across exploration, drilling, construction, operations, and services.
- **Increased competitiveness:** The country has 60 terawatts of thermal potential that direct-use heat and district cooling can tap into in order to lower fuel costs for industry and buildings. Next-generation electricity expands siting options, tapping a technical base of about 2,160 gigawatts.
- **Low-impact, reuse-ready deployment:** Next-generation geothermal can be sited in less environmentally sensitive areas, uses far less land and new transmission than most alternatives, and repurposes retired coal sites and existing corridors to cut costs and speed delivery.
- **Cleaner air, lower emissions:** By replacing coal, diesel, and furnace oil in power, heat, and cooling, geothermal cuts greenhouse gases and local pollutants, helping Indonesia meet its renewable energy milestones through 2030 and its long-term clean energy goals by 2060 while also delivering immediate public health benefits.

LEGISLATION, REGULATION, AND RECOMMENDED POLICIES TO EXPAND INDONESIA'S GEOTHERMAL INDUSTRY

Indonesia's geothermal framework is evolving, but the country must make legal updates to fully unlock the next generation of geothermal development identified in this report. Priority actions include updating definitions and licensing to explicitly allow next-generation geothermal, direct-use heat, and district-scale cooling, giving developers and financiers the clarity required to move forward with confidence. The 10 recommendations outlined in Chapter 7, "Turning Potential into Power: A Policy Blueprint for Indonesia's Geothermal Transformation," build on existing Indonesian instruments and global best practices to provide that roadmap. (See **Figure ES.4**).

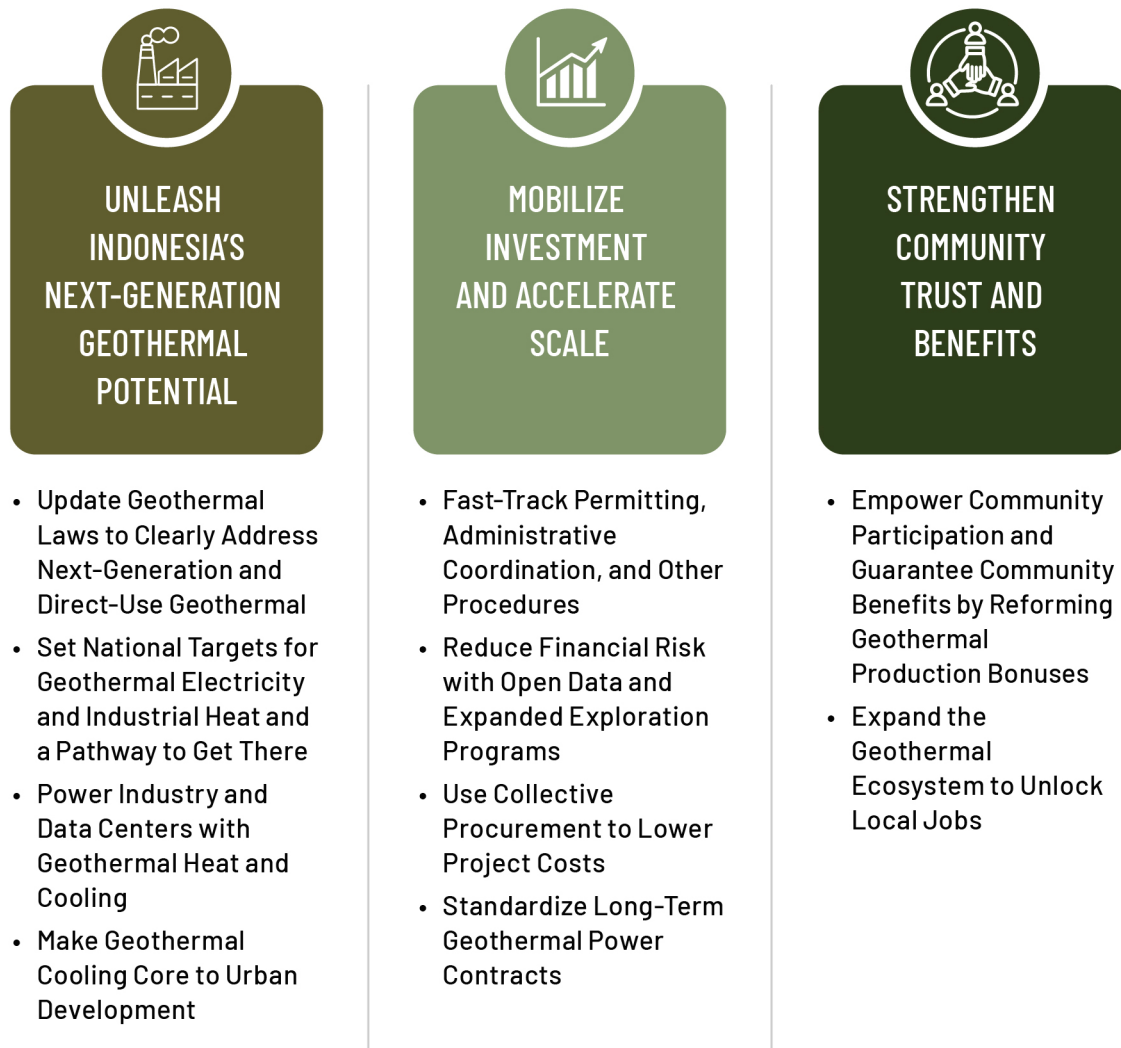
To reach the proposed national goals of 15 gigawatts electric and 15 gigawatts thermal by 2035, scaling to 25 gigawatts electric and 35 gigawatts thermal

by 2045, Indonesia needs a legal foundation that reflects how the sector is changing. Current statutes—particularly Geothermal Law No. 21/2014 and Government Regulation No. 7/2017, both written for conventional hydrothermal systems—do not yet recognize engineered reservoirs, closed-loop systems, or geothermal heat and cooling, despite their potential to meet nearly 90% of projected thermal demand by mid-century. Updating these instruments to clearly define next-generation geothermal and direct-use systems would be an important and immediate action that Indonesia could take to tap into its 2,160 gigawatts of technical potential.

Achieving these national deployment goals will also require more coherent and predictable permitting and stronger inter-ministerial coordination. Even with the Online Single Submission platform, geothermal projects still encounter fragmented authority, multi-step reviews, and slow approvals. A geothermal-specific fast lane anchored by the Ministry of



GEOTHERMAL POLICY RECOMMENDATIONS FOR INDONESIA



ES.4: Overview of 10 policy recommendations to help unlock a new era of geothermal growth in Indonesia. Source: authors.

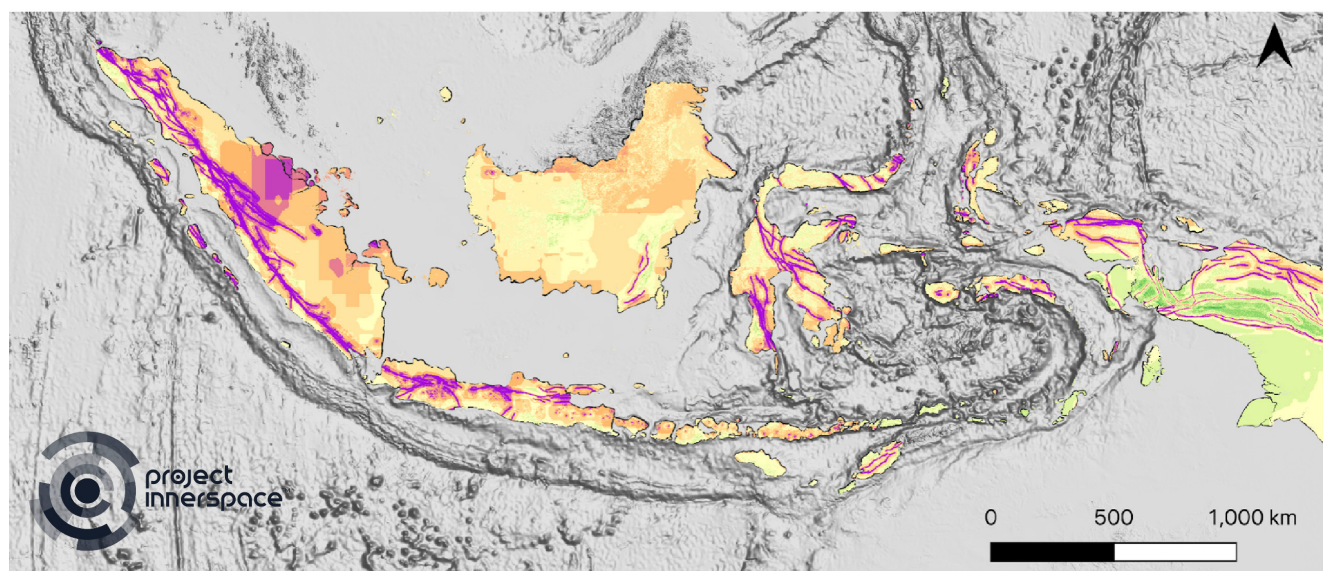
Energy and Mineral Resources (MEMR) as the single coordinating authority would streamline licensing, reduce duplicative procedures, and establish statutory timelines that match the urgency of Indonesia's 2035 and 2045 targets. Integrating updated Indonesia Standard Industrial Classifications (KBLIs) for direct-use heat and cooling—alongside expanded open-data requirements and accelerated implementation of early-stage risk-sharing mechanisms such as the Government Drilling Scheme⁷ and the Geothermal

Resource Risk Mitigation Project⁸—would give developers a clear, more dependable pathway from exploration to construction. Together, these reforms would help mobilize private and public capital at the scale required for Indonesia's next phase of geothermal growth.

Ultimately, long-term progress depends on community trust and clearly visible local benefits, especially as development expands into more regions. While



INDONESIA'S GEOTHERMAL RESOURCES MAP



Potential geothermal resources based on Weighted Overlay Analysis (WOA):

- Conventional (hydrothermal power)
- Next-generation (power)

Next-generation (direct use):

- Direct use and district cooling
- Low-temperature industrial heating and cooling
- Geothermal heating and cooling

Figure ES.5: Indonesia's geothermal resource map identifying regions best suited for geothermal technologies based on underlying thermal and subsurface characteristics, via the Project InnerSpace Weighted Overlay Analysis, designed to identify and prioritize areas with geothermal potential based on key geological and geophysical factors. Source: Project InnerSpace. (2025). *Indonesia Weighted Overlay Analysis Data Set*.

geothermal revenue sharing through Revenue Sharing Funds (DBH) provides a financial channel for host regions, outcomes vary widely and often lack transparency, fueling hesitancy.

Harmonizing geothermal revenues within a unified geothermal production bonus by consolidating DBH, non-tax geothermal revenues, and developer contributions would create a transparent, accountable system for investing in schools, clinics, geothermal cooling networks, industrial-heat pilots, and workforce training in host communities. Linking fund access to compliance with free, prior, and informed consent; corporate social responsibility obligations; and Certificates of Operational Worthiness can ensure

that communities participate directly in the rewards of development. A trusted, community-centered system will help sustain the pace of geothermal deployment required to meet Indonesia's 2035 and 2045 ambitions—and sets the stage for targeting development in the regions with the strongest resource potential.

EXPANDING THE SCOPE

Chapter 3, "Beneath the Archipelago: Indonesia's Geothermal Systems," and its supplement, "Expanding the Scope: Next-Generation Geothermal Opportunities," identify geothermal opportunities across Java, Sumatra, Sulawesi, Bali-Nusa Tenggara, Kalimantan, and Papua. Conventional hydrothermal remains essential at proven



fields, with step-outs, make-up wells, and capacity additions. In parallel, next-generation systems—which unlock heat in areas with limited permeability and fluids—expand the locations where geothermal projects can be located. This aspect includes the potential to repurpose energy and industrial installations such as retiring coal sites and brownfields, which reduces interconnection costs and takes advantage of existing roads, pads, and transmission.

Additionally, many next-generation designs have smaller surface footprints per unit of delivered energy, which simplifies environmental management and reduces potential community impacts. One result of this feature is that more communities and regions can take advantage of the technology. Next-generation systems can also pair with thermal storage to shift heat and cooling to daily peaks, offering operational flexibility across islands and grid types.

The combined portfolio—conventional where it is strongest and next-generation geothermal where it is most practical—can put Indonesia’s vast geothermal potential to full use. (See **Figure ES.5**).

INDONESIA’S MOST PROMISING OPPORTUNITY: DIRECT-USE GEOTHERMAL

Direct-use geothermal is Indonesia’s most promising and fastest-growing geothermal opportunity, with the potential to transform both industrial heat and urban cooling. Chapter 4, “Beyond Electricity: Indonesia’s Thermal Energy Demand and Direct Use Potential,” shows that geothermal could already meet 66.5% of national thermal demand, rising to nearly 90% by 2050 and displacing much of the coal and oil now used for process heat and cooling. Put another way: Today’s thermal sector emits roughly 241 metric tons of carbon dioxide equivalent (MtCO_{2e}). The shift to direct-use geothermal could avoid about 160 MtCO_{2e} annually and deliver 44% of Indonesia’s 2030 energy sector climate goal. The opportunity is especially strong in industries with temperature needs below 200°C heat—textiles, agro-processing, dairy, pulp and paper, and food and beverage—where geothermal can directly replace fossil-fired boilers.

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Cooling is the fastest-growing driver of electricity demand in Indonesia, with air conditioner ownership expected to reach 85% by 2050, placing heavy pressure on grids in major urban population centers. Geothermal cooling—via ground-coupled systems, aquifer-source cooling, and district cooling networks—offers a scalable, land-efficient alternative. For example, Europe is widely deploying geothermal heating in urban areas, and Indonesia could do the same for geothermal cooling. Meeting even 10% of Indonesia’s projected 2040 cooling demand with geothermal could avoid between 10 gigawatts and 15 gigawatts of peak power demand and prevent tens of millions of tons of carbon dioxide emissions each year.⁹ Doing so would also ease strain on the grid during the hottest hours.

Direct-use opportunities are available across industrial corridors, campuses, hospitals, airports, and new districts such as Nusantara, all of which can anchor geothermal networks for heating and cooling. Coastal and delta cities—where large populations and concentrated demand align with favorable geology—are especially well suited for subsurface cooling.

Scaling systems will require not only investment and efficient permitting but also a skilled, multidisciplinary workforce capable of drilling, operating, and maintaining next-generation geothermal systems. As Indonesia expands industrial heat applications and district cooling networks, developing this specialized talent—engineers, drillers, technicians, and system operators—becomes essential. Launching geothermal cooling pilots is the fastest way to build the skills, standards, and supply chains needed for nationwide deployment.



2030 VERSUS 2050 THERMAL DEMAND FOR INDUSTRIAL AND MANUFACTURING PROCESS HEATING

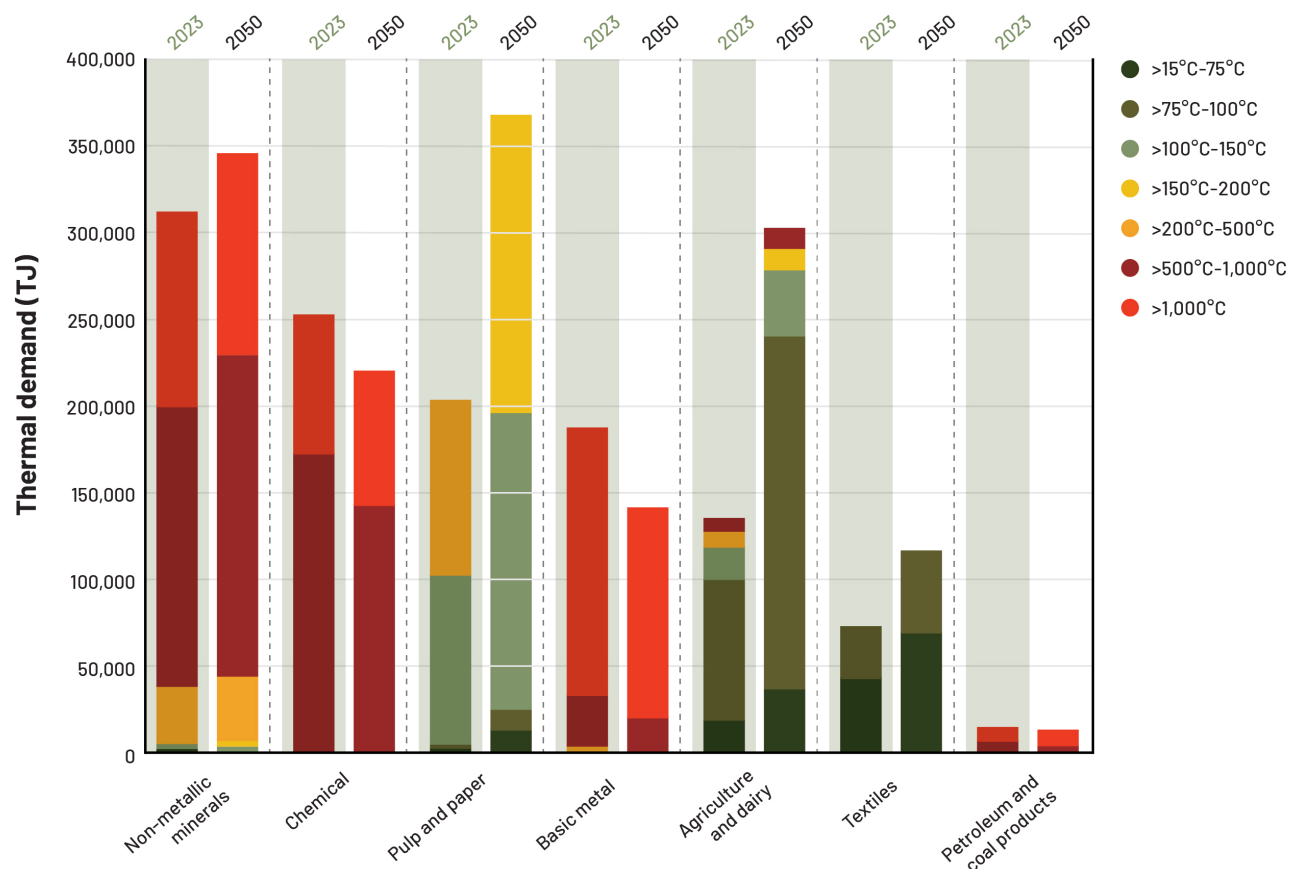


Figure ES.6: Indonesia's industrial and manufacturing total process heating thermal demand by temperature in the 2023 baseline year and the forecast for 2050. Full source list can be found at the end of Chapter 4, "Beyond Electricity: Indonesia's Thermal Energy Demand and Direct Use Potential."

Data Centers

Indonesia's exceptional subsurface heat resources should not be overlooked as an energy source for data centers. Geothermal can deliver clean, always-on power at the source and cut the levelized cost of electricity by between one-third and one-half compared with grid-dependent models. PLN already serves about 1 gigawatt of data center load, but demand is projected to reach 4 gigawatts by 2033, with the processing requirements of artificial intelligence (AI) potentially doubling or tripling that trajectory. Next-generation geothermal can unlock prime digital corridors such as Jakarta-Purwakarta, Surabaya, Batam, and Medan by

placing reliable, low-carbon baseload power directly beneath major fiber nodes and industrial clusters.

Batam is an especially strategic location because it can supply firm geothermal power with ultra-low latency across the strait to Singapore, a constrained data center hub. In other words, Batam can host green, high-density data processing centers that Singapore cannot site within its own borders, thereby functioning as an extension of Singapore's digital backbone. As global technology companies seek 24/7 low-carbon power for AI and cloud workloads, few countries combine geothermal capacity, fiber connectivity, and proximity to a world-class data hub as effectively as Indonesia.



TRANSFERABLE SKILL SETS FROM THE OIL AND GAS INDUSTRY

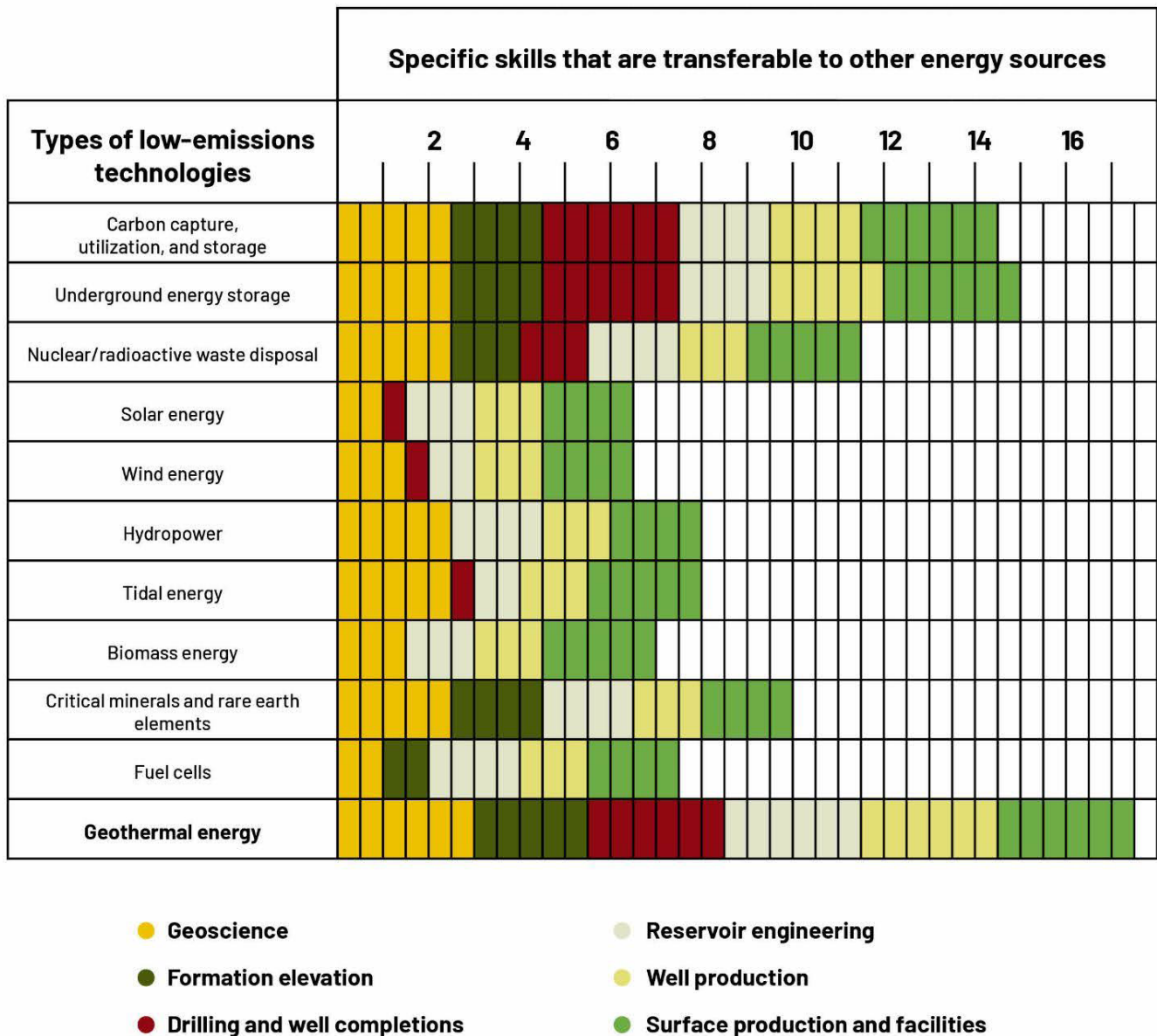


Figure ES.7: Geothermal ranks highest when considering the potential impact of transferring oil and gas skills into other energy transition and low-carbon technologies. Source: Tayyib, D., Ekeoma, P. I., Offor, C. P., Adetula, O., Okoroafor, J., Egbe, T. I., & Okoroafor, E. R. (2023). *Oil and gas skills for low-carbon energy technologies*. Society of Petroleum Engineers Annual Technical Conference and Exhibition.



POTENTIAL JOB TRANSITIONS FROM OIL AND GAS TO GEOTHERMAL

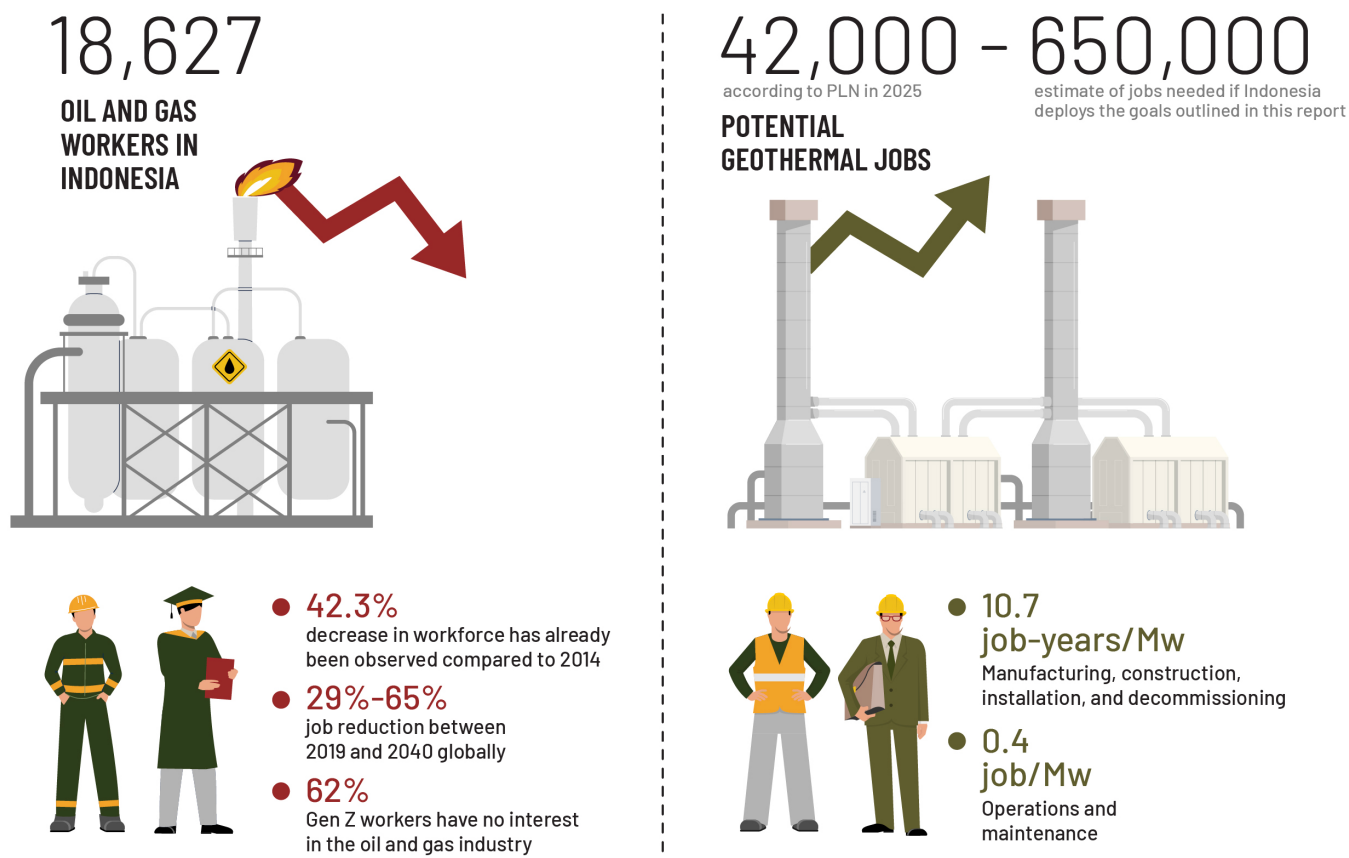


Figure ES.8: Estimated number of potential job transitions from oil and gas to geothermal. Source: Indonesian Petroleum Association. (2017). [Indonesia overview](#); Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas). (2023). [Annual report 2023](#); Ernst & Young. (2020). [Preparing for the future now: Rethinking the oil and gas workforce in 2040](#). EY Global; Halimatussadiyah, A., Irhamni, M., Riefky, T., Nur Ghiffari, M., & Razak Afifi, F. A. (2024). [Employment impacts of energy transition in Indonesia](#). Institute for Economic and Social Research, University of Indonesia; PLN. (2025). [PLN electricity supply business plan \(2025-2034\): Enhancing national energy resilience and sustainability](#). Government of Indonesia.

LEVERAGING EXISTING KNOW-HOW

Indonesia's oil and gas and conventional geothermal drilling ecosystem has rigs, drillers, cementing crews, logging specialists, stimulation teams, and project managers whose skills transfer directly to geothermal development (see **Figure ES.7**). Depending on how much geothermal is produced, estimates of new jobs created range from 42,000 to upwards of 650,000 if Indonesia

meets the combined electricity and thermal targets outlined in this report (see **Figure ES.8**). However, universities are not producing graduates at anywhere near this scale. Indonesia currently generates fewer than 20 geothermal-focused graduates per year. Meeting even the low end of workforce demand would require between six and seven times more graduates; the high end of the range would require between 15 and 30 times more. Indonesia's long oil and gas heritage



is one of its greatest assets for building a geothermal workforce and gives the country a ready-made talent pipeline that is well positioned to fill this gap.

This gap underscores the need for much stronger coordination among the Ministry of National Development Planning (Bappenas); MEMR; the Ministry of Manpower; and the Ministry of Education, Culture, Research, and Technology, whose mandates for planning, training, certification, and curriculum are currently fragmented and difficult for industry to navigate. Better institutional alignment—particularly through unified occupational mapping, standardized competency frameworks, and expanded certification pathways—will be essential to meet the pace and scale of geothermal development.

Highlighting this continuity through university outreach, vocational programs, and streamlined fast-track certifications can help the geothermal field attract students who might otherwise default to oil and gas, where career interest remains high. With the right investment in training and institutional coordination, Indonesia can grow a workforce that is not only capable of supporting gigawatt-scale geothermal expansion but also excited by the chance to help shape the country's clean energy future.

LOW-IMPACT GROWTH THAT SHARES BENEFITS LOCALLY

Geothermal's benefits extend beyond carbon and air quality gains; with the right governance, the sector can also strengthen social equity and shared prosperity. Indonesia already has the foundations for fair geothermal development through its revenue-sharing mechanisms and its emerging concept for a transparent geothermal fund, which can channel DBH allocations, royalties, and corporate commitments directly into *wilayah adat* (traditional territory) communities with clearer visibility and accountability. (See Chapter 6, "Common Ground: Building Trust and Transparency in Indonesia's Energy Transition.") Strengthening this approach will also support more effective administration across ministries, providing a clearer structure for how benefits are tracked, delivered, and reported at the national and regional levels. Improved coordination—particularly

among MEMR, the Ministry of Environment, the Ministry of Forestry, the Ministry of Home Affairs, and local governments—can streamline community engagement processes, reduce duplication, and ensure that geothermal development reinforces local trust while supporting inclusive regional development.

Finally, and most important, geothermal stands out as one of Indonesia's lowest-impact energy options. Much of the country's 2,160 gigawatts of geothermal technical potential lies outside protected ecosystems, and next-generation systems can access this heat without entering steep volcanic terrain or high-biodiversity conservation areas. Modern practices—such as closed-loop designs, improved reinjection, microseismic monitoring, and noise control—further minimize disturbance and safeguard water resources, strengthening Indonesia's commitment to environmental stewardship. (See Chapter 8, "Keeping Geothermal Green: Safeguarding Nature and Communities in a New Era of Growth.") These approaches keep land footprints small and avoid the large-scale clearing required by many other renewable technologies. Next-generation projects also rely heavily on civil works, construction, monitoring, and operations roles that can be filled by non-skilled and semiskilled workers, widening the pool of Indonesians who benefit directly from geothermal development while keeping sensitive ecological zones intact.

CONCLUSION

With vast resources and deep domestic expertise, Indonesia can expand geothermal into a national platform for not only electricity but also industrial heat, cooling, and data center growth. The pathway is clear: Set ambitious targets; update legal frameworks; scale direct use; and deploy next-generation systems in industrial parks, cities, and brownfields. Acting now will deliver reliable power, competitive energy for industry and data centers, cleaner air for communities, and a world-class domestic supply chain and workforce. Broadening Indonesia's geothermal focus will bring immediate benefits with cleaner air, lower energy costs, and new jobs, and these benefits will endure for decades through resilient power, reduced fuel imports, and steady progress toward national climate goals.



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- 4 IEA, 2024, p. 90.
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- 6 Several assumptions were made for the estimate: (i) Capacity factor was assumed at 80%, quoted from Ea Energy Analyses. (2024). *Technology data for the Indonesian power sector 2024: Catalogue for generation and storage of electricity*. https://gatrik.esdm.go.id/assets/uploads/download_index/files/c4d42-technology-data-for-the-indonesian-power-sector-2024-annoteret-af-kb-.pdf. (ii) Total generation for the higher geothermal capacity scenario was kept the same as in the total generation of MEMR, *National Electricity General Plan*, 2025. This was done by reducing the generation from coal.
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