CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

JULY 2025

# Unlocking Global Geothermal Energy: Pathways to Scaling International Deployment of Next-Generation Geothermal

Milo McBride, Daniel Helmeci, Debbra Goh,
and Daevan Mangalmurti

# Unlocking Global Geothermal Energy: Pathways to Scaling International Deployment of Next-Generation Geothermal

Milo McBride, Daniel Helmeci, Debbra Goh,
and Daevan Mangalmurti

Carnegie Endowment for International Peace
Publications Department
1779 Massachusetts Avenue NW
Washington, DC 20036
P: + 1 202 483 7600
F: + 1 202 483 1840
CarnegieEndowment.org

This publication can be downloaded at no cost at CarnegieEndowment.org.

## Contents

# Introduction

Geothermal energy's moment is here. Once constrained by niche geologic resources, the ability to produce ubiquitous, clean power and heat from the earth's crust is now on the horizon. Thanks to drilling advancements from the American fracking revolution, the global geothermal power potential has gone from an inconsequential fraction of demand to second only to solar power in renewable energy potential.[1] New techniques needed to deploy these systems are reaching first-of-a-kind commercial scale and cutting costs at notable rates. All the while, a new synergy is emerging with oil field servicing industries, offering a novel, sustainable energy solution for incumbents. The data is clear: new subsurface technologies to produce geothermal energy from abundant hot dry rock open this resource to new regions across the world.[2]

This paper provides an overview of these emerging technologies and then addresses which thirty countries are optimally positioned to help scale next-generation geothermal systems. The paper develops a taxonomy to understand which countries are home to ideal conditions for adopting next-generation geothermal technologies. It evaluates resource potential based on data from Project InnerSpace's GeoMap™ and catalogs industrial, policy, regulatory, and market indicators. Alongside many of the usual suspects for legacy geothermal developments and high potential, such as Germany, Indonesia, Kenya, Mexico, and Türkiye, the findings also indicate countries with long-term potential, such as Malaysia, Saudi Arabia, Tanzania, and Argentina. In-depth regional analyses then explore these opportunities. Lastly, the paper recommends domestic policies and multilateral actions that could stimulate these developments.

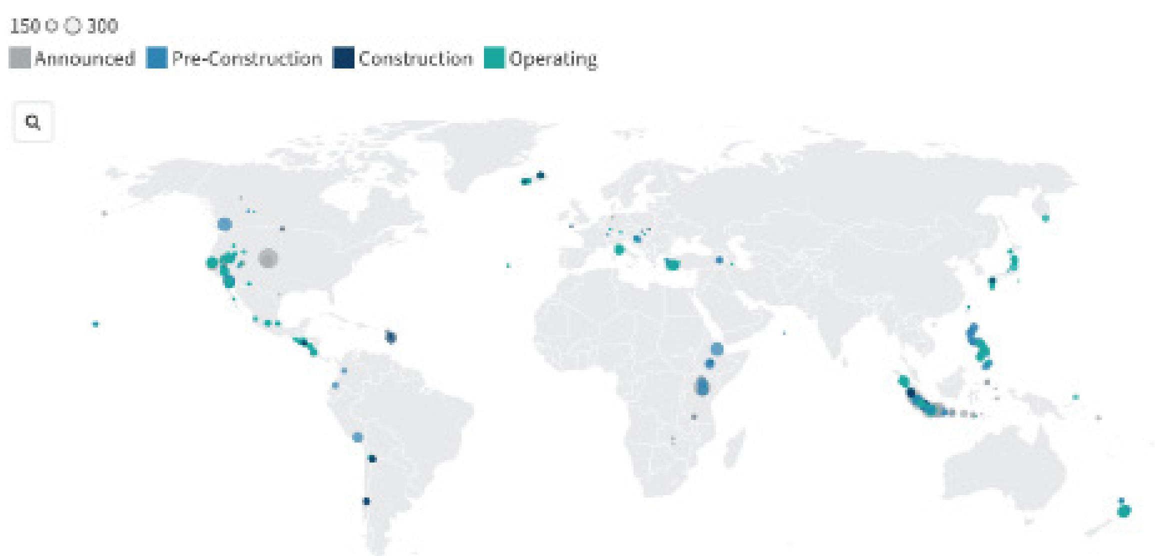
# The History of Heat

Geothermal power—extracting steam or hot water from hydrothermal reservoirs to propel a turbine—has been around for over a century. By the end of 2022, about 16 gigawatts of geothermal power had been installed in at least thirty countries and six continents (see figure 1), comprising a small fraction of the global electricity mix at about 0.34 percent.[3] First deployed in Italy in 1904, the technology quickly spread across the United States, New Zealand, and Japan during the postwar era.[4] During the energy crises of the 1970s, Iceland developed its geothermal resources to protect itself from fuel shocks and associated macroeconomic fall out.[5] By the early 1980s, geothermal began to spread across the Global South to countries such as Mexico, the Philippines, Türkiye, and, most notably, Kenya—today's geothermal success story.[6] Kenya's geothermal rise is a pertinent case study in this paper, as much of the know-how was successfully transferred from Iceland.[7] With support from the United Nations in the late 1970s, Icelandic institutions offered increasing amounts of training, field support, and mapping to Kenya's nascent industry over several decades.[8]

Since the 1990s, cheap natural gas and renewables such as wind and solar have outcompeted geothermal in new capacity additions.[9] This trend has coincided with the geothermal industry's inability to produce economies of scale, relegating much of the turbine equipment to a customized industry devoid of analogous technology learning rates observed in wind and solar.[10] In many saturated markets like New Zealand and the United States, hydrothermal

**Figure 1. Mapping Geothermal Power Sites**

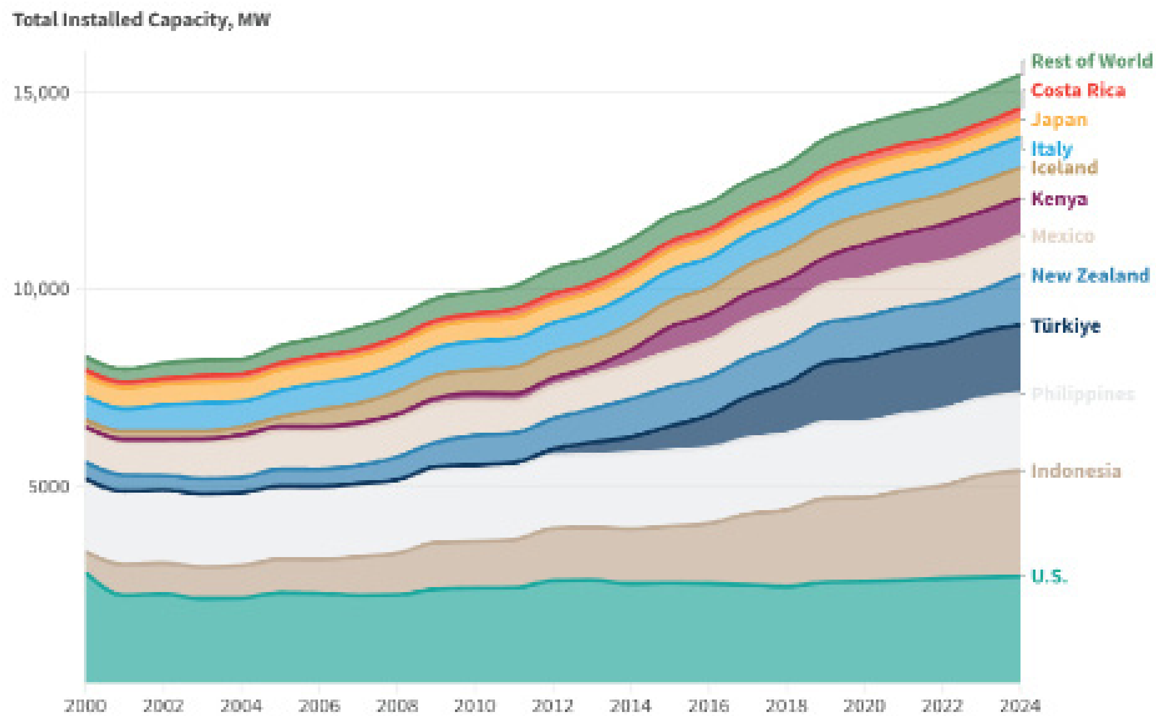
Hydrothermal installations are primarily clustered near active rifts with strong resource potential




Source: Carnegie analysis of Global Energy Monitor data.

**Figure 2. Global Installed Geothermal Generation Capacity**

The United States leads in total capacity, but new installations are driven by Indonesia, Türkiye, and Kenya




Source: Carnegie analysis of IRENA STAT Online Data Query Took, accessed April 2025.

growth has remained stagnant for decades. There are, however, exceptions. The Central American countries of Costa Rica, El Salvador, and Honduras have made comparatively strong capacity gains since 2000.[11] In the past decade, global geothermal growth in sheer volume of installed capacity has been driven by three important actors: Indonesia, Kenya, and Türkiye (see figure 2). These countries have used various policy measures to help domestic industries accelerate, as described later in this paper.

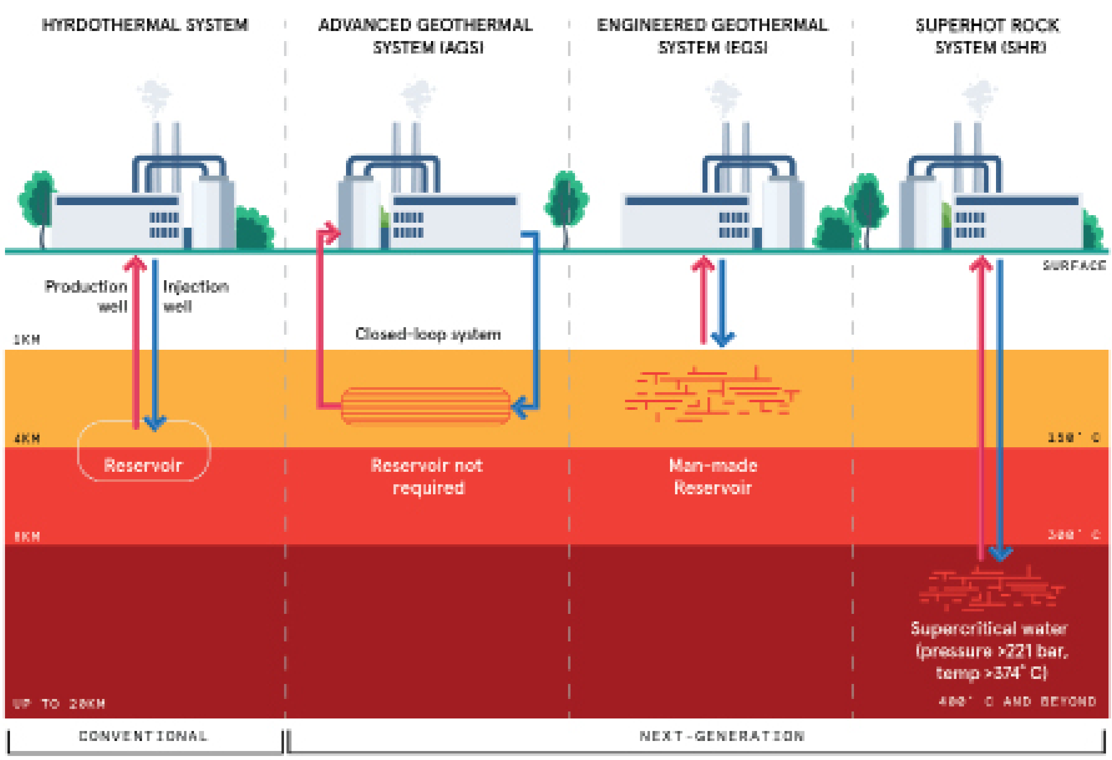
## Hot Dry Rock

Researchers and innovators have long sought the potential of novel geothermal drilling and completion techniques that do not require harder-to-find hydrothermal resources. In the 1970s, American researchers at Los Alamos National Laboratory began to experiment with so-called hot dry rock, a resource that, as the name implies, is privy to heat but lacks the fluid required in a geothermal reservoir.[12] These early experiments sought to fracture the rock to create an artificial reservoir, a process known today as enhanced geothermal systems (EGS) (see figure 3). By the 1980s, researchers in France and Japan also tried to create an artificial reservoir through fracturing the hot dry rock but to no avail. These early

EGS projects failed due to the technical complexity of completing these wells. In the 2000s, others in South Korea and Switzerland tried to stimulate wells with fracturing but triggered seismic activity, essentially stopping the research altogether.[13] But by the 2010s, the U.S. government reignited its support for this technology.[14] Thanks in part to U.S. government research grants and allocation of public land as drilling test beds, the expertise from the American shale revolution helped solve some of EGS's technical challenges in drilling and maintaining the flow of the reservoir.[15] By this time, another solution to the dry rock challenge was emerging: using a closed loop to circulate heat from the earth without the need for external water. Known today as advanced geothermal systems (AGS), or closed-loop systems, these designs started to take off in the late 2010s and quickly entered the scene.[16]

While EGS and closed-loop geothermal are the primary approaches in the next-generation geothermal umbrella, other strategies are being pursued. Some have chosen to tackle sedimentary basins, which are more permeable than those that are typically fractured with EGS and could yield an underappreciated resource that could be tapped more like the incumbent hydrothermal system.[17] Others are looking further into the future—and

**Figure 3. Types of Geothermal Energy Systems**



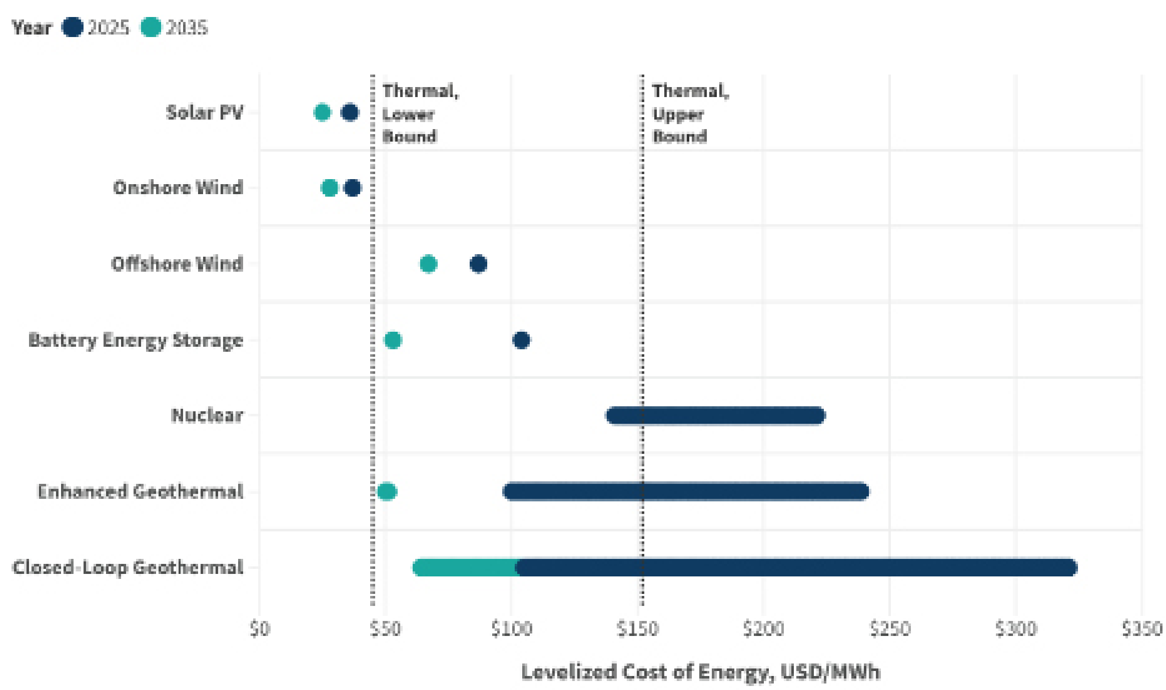

Source: Adapted from "Infographic: Next-Generation Technologies Set the Scene for Accelerated Geothermal Growth," S&P Global Commodity Insights, https://www.spglobal.com/commodity-insights/en/news-research/latest-news/energy-transition/011124-infographic-next-generation-technologies-set-the-scene-for-accelerated-geothermal-growth-energy-transition.

deeper underground. Various researchers and startups are experimenting with supercritical geothermal or superhot rock (SHR) projects by finding and extracting heat above 375 degrees Celsius (707 degrees Fahrenheit).[18] These resources turn water into a supercritical state where it could be used to produce as much as ten times the power from a single well compared to conventional geothermal.[19] But SHR projects remain at the early stages of research and development. While some supercritical resources are near the surface due to extraordinary geological formations, most of the resources and energy at these temperatures are significantly deeper and thus cannot be accessed with incumbent oil and gas drilling technology, instead requiring advanced drilling that can penetrate deeper than the vast majority of existing wells.[20] Other technological challenges arise with SHR, such as the materials required to enclose the well and withstand such high temperatures, as well as completion and stimulation techniques to keep the reservoir flowing.[21]

EGS and closed-loop systems are at approximately the same stage of commercialization, with first-of-a-kind facilities slated to come online by 2026.[22] That said, EGS has garnered more policy support in the United States and remains at the center of ample literature evaluating its potential cost reductions.[23] Although next-generation geothermal may not reach cost

**Figure 4. Cost of Energy Types vs. Next-Generation Geothermal**

By 2035, EGS and closed-loop geothermal system costs could outcompete fossil generation




Sources: Carnegie analysis based on data from "Lazard's Levelized Cost of Energy Analysis, Volume 15.0," Lazard, October 2021; "Enhanced Geothermal Shot Analysis for the Geothermal Technologies Office," NREL, February 2023; "Global Cost of Renewables to Continue Falling in 2025 as China Extends Manufacturing Lead," BNEF, February 6, 2025; "The Future of Geothermal Energy," IEA, December 2024; "Techno-Economic Performance of Eavor Loop 2.0," NREL, 2022.; and "Lazard LCOE," Lazard, April 2023.

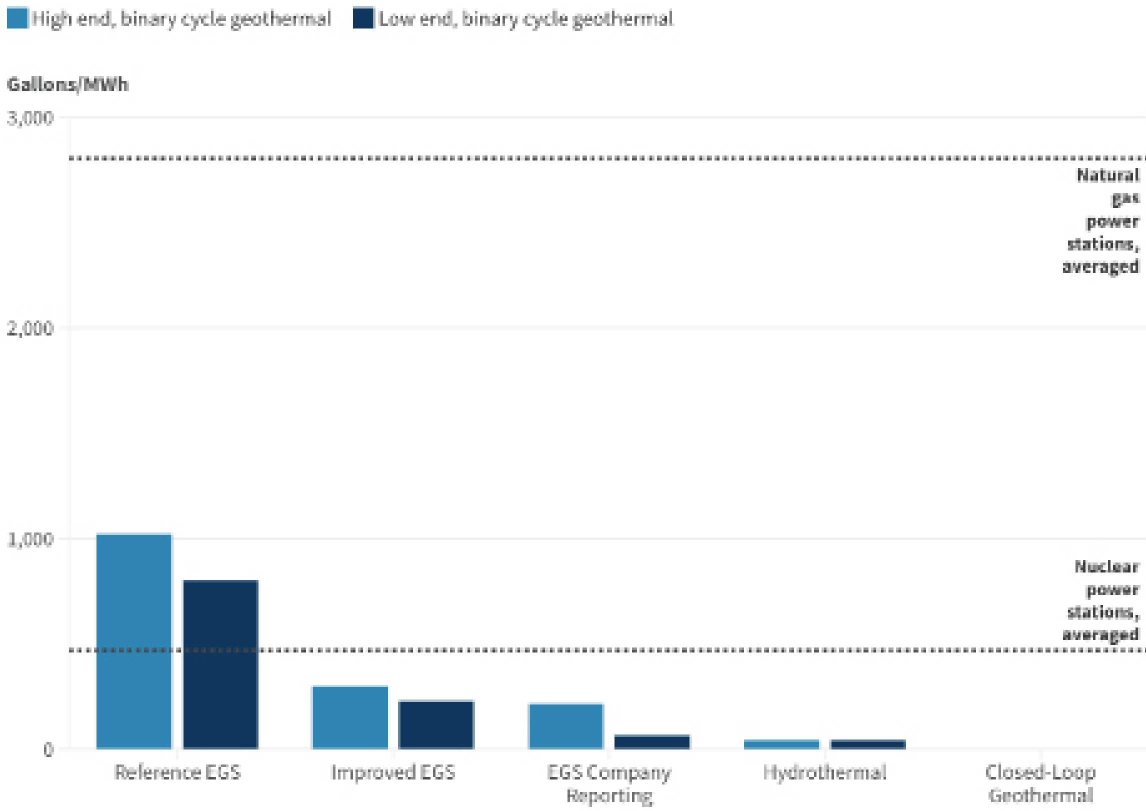
parity with onshore wind or solar in the 2030s on a purely levelized cost basis, it is essential to emphasize that EGS and closed-loop geothermal provide system-wide benefits that levelized cost metrics do not depict: they are flexible power sources that are dispatchable 24/7.[24] Today, EGS price estimates are between about $100 and $240 per megawatt hour—near the cost of new nuclear power.[25] However, recent analysis points to EGS reaching $80 per megawatt hour by the end of the decade and $50 by 2035.[26] This price drop, if actualized, would bring EGS to passing parity with thermal power generation and somewhere between onshore and offshore wind (see figure 4). Some studies show significant promise. The cost reduction of doubling deployment or productivity, known as learning rates, observed in early EGS drilling have reached 35 percent, an astounding number when compared to lithium-ion batteries near 30 percent and solar at 24 percent.[27]

While the cost potential of closed-loop geothermal is less clear, it could yield unforeseen opportunities. At present, it is likely more expensive than its next-generation competitor. By some estimates, the cost of closed-loop systems is $105 per megawatt hour in high heat gradients and as much as $321 per megawatt hour in lower quality resources. This is primarily due to the high costs of drilling of the specific closed-loop systems observed in the analysis (other closed-loop designs may yield different results). Once professionalized, closed-loop geothermal could reduce costs, to between $64 to $160 per megawatt hour.[28] Nonetheless, closed-loop systems still may have a promising pathway to market, particularly in district heating (centralized heat sources that are distributed throughout neighborhoods), which do not require turbines, cutting the cost of the project by about 30–50 percent.[29] This is because of the efficiency in power generation, estimated at about 20 percent, versus heating, which can be as high as 90 percent.[30]

Beyond cost, closed-loop geothermal could yield other positive externalities for geothermal build-out, such as widespread scalability and reduced impact on water resources. As this paper will explore, some markets—particularly in Europe—may be averse to EGS's fracturing process (which is also water intensive), providing a regulatory opening for closed-loop systems.[31] Similarly, EGS resources are not inherently ubiquitous and, although vastly larger than those of the existing hydrothermal systems, may come with their own geologic requirements, such as rock that has low permeability.[32] If geothermal is to become a truly global energy source, closed-loop systems may offer a complimentary value proposition. Also important is that closed-loop geothermal is a unique and sole form of clean firm power generation that requires negligible quantities of water to generate electricity (see figure 5). It should be noted that although EGS does indeed demand water, industry results indicate a reduction of water use that is well below other thermal generation like nuclear and especially natural gas. Over time, as certain regions face increasing drought and stress on water-intensive industries, closed-loop systems could yield a water premium that helps define its long-term value in a sustainable energy mix.

**Figure 5. Water Demand for Next-Generation Geothermal Systems**

Concern regarding water impact are material for EGS systems, but fall beneath nuclear and gas




Sources: "U.S. Electric Power Sector continues Water Efficiency Gains," U.S. Energy Information Agency, June 14, 2023; "Geothermal Mythbusting: Water Use and Impacts," Fervo, March 31, 2025, and "Nuclear Energy Factsheet," University of Michigan Center for Sustainable Systems, 2024; "GeoVision Analysis Supporting Task Force Report: Impacts," U.S. Department of Energy, National Renewable Energy Laboratory, 2019.

Note: Values for the "Reference EGS," "Improved EGS," and "Hydrothermal" scenarios are based on the Binary Cycle 125-160 degree C and 160+ degree C systems in NREL's "GeoVision Analysis Suggesting Task Force Report: Impacts" report. EGS company reporting values represent the higher and lower bounds of Fervo's water consumption reporting, including gallons of water consumed by drilling, stimulation, and operation of EGS wells. Company reporting suggests high recapture rates for operational water demand (>99 percent). Based on available literature, closed-loop geothermal systems are inferred to have insignificat gallon/MWh water consumption. Some water usage for drilling is required, but over a project's lifecycle, water consumption will be marginal.

## Drilling Down to Scale Up

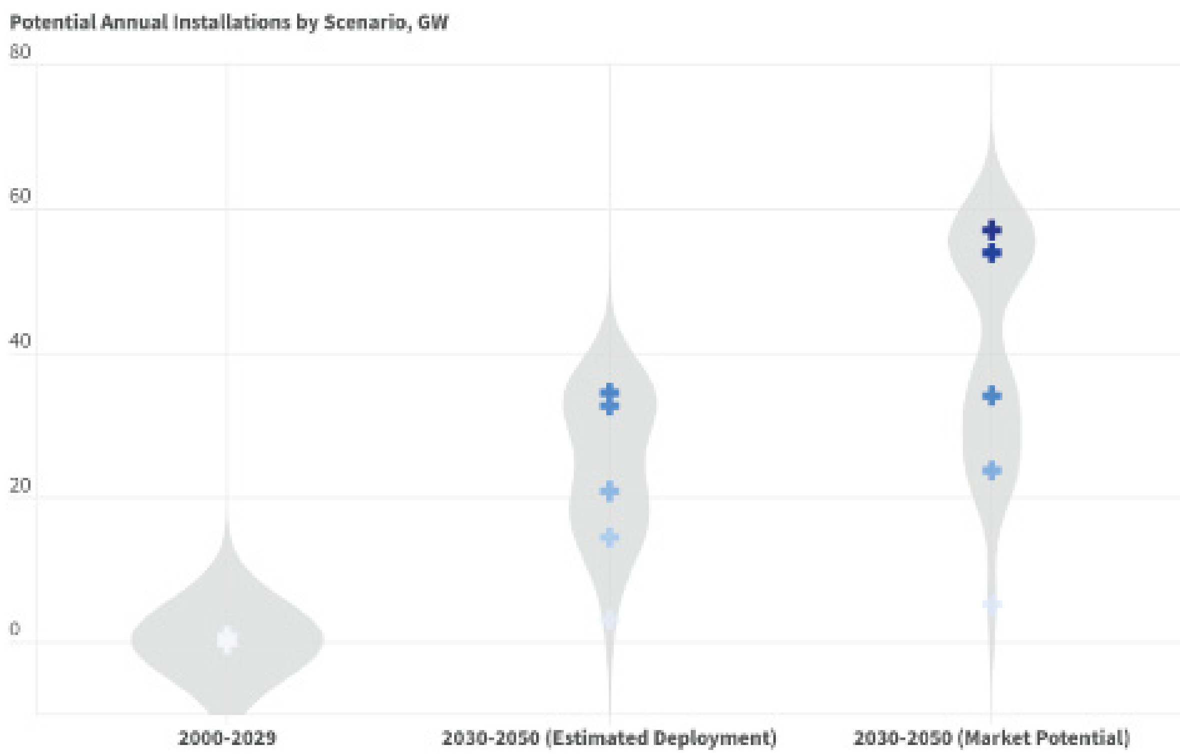
Because of these breakthrough advancements, energy forecasters now expect step changes in geothermal power's potential. Analysis from the U.S. Department of Energy (DOE) asserts that the next-generation geothermal potential from hot dry rock in the United States alone could be 5,500 gigawatts, nearly 140 times its previous estimation from incumbent hydrothermal systems of a mere 40 gigawatts. The DOE's forecast expects U.S. next-generation geothermal power to reach at least 90 gigawatts of installed capacity by 2050 under reasonable economic cost assumptions and over 300 gigawatts based on other factors, such as land availability and the development of competing technologies.[33] Subsequent analysis from the International Energy Agency (IEA) utilizing data from Project InnerSpace's GeoMap™ finds that U.S. capacity could reach 150 gigawatts by 2050. Globally, the IEA expects that over

800 gigawatts of next-generation geothermal could be installed by mid-century, comprising about 15 percent of total power generation, an astounding level of development that the industry has not yet experienced.[34]

The geothermal industry today remains a niche sector compared to multi-gigawatt giants like natural gas, solar, and wind. The modeling completed by the DOE and IEA paints an enormous scale of supply chain build-out. For example, annual geothermal power installations between 2000 and 2029 hovers near 300 megawatts but jumps from anywhere between 100 to 200 times that between 2030 and 2050 (see figure 6). This potential growth is unprecedented for the geothermal industry and an important area to consider if demand is to escalate as anticipated by forecasters. A convenient narrative has emerged amid the present geothermal momentum: the supply chain is entirely transferable from the oil and gas sector and devoid of geopolitical risks endemic to clean tech (specifically, China's accelerating dominance across renewables, batteries, nuclear power, and the minerals these technologies require).[35] Based on discussions with industry and existing literature, this analysis ignores some potential complexities that could emerge and will nonetheless require care and attention to scale at the necessary pace.

**Figure 6. Next-Generation Geothermal Scale Up**

Under a geothermal liftoff, annual installations could jump about hundred-fold from 50 MW to 50 GW




Source: Authors' analysis based on "Future of Geothermal Energy," International Energy Agency, December 2024 and "Pathways to Liftoff: Next Generation Geothermal Power," U.S. Department of Energy, March 2024.

Note: Average annual assumptions are based on five-year benchmarks for global installed capacity including in the International Energy Agency's "Future of Geothermal Energy" report, augmented by U.S. Department of Energy data for the "Estimated Deployment" scenario.

Modern-day geothermal wells and power plants require three essential technology verticals for development: drill rigs to construct the wellbore, tubulars and casings to seal the well, and organic Rankine cycle (ORC) turboexpanders (a specialized class of turbine) to convert the earth's heat into electrons. If geothermal power is to scale, these supply chains could face varying degrees of strain. Some drilling rigs required for EGS and closed-loop systems can be applied from oil and gas, but universal transferability is not possible, as these operations could require accessing depths and environments typical in unconventional production.[36] As a result, specialized so-called heavy drill rigs with heavy hook loads may be needed.[37] Conversely, many of the tubulars and casings required to seal a geothermal well can easily be borrowed from oil and gas production.[38] Close proximity to these components could be beneficial to project development. Lastly, the industry for ORC turbines is ripe for disruption, with just five manufacturers in operation whose factories are split between Italy, Israel, China, and increasingly in Türkiye, as well.[39] If demand increases as the IEA forecasts, it could pose opportunities for gas turbine manufacturers to enter this space or for novel innovations, such as supercritical carbon dioxide turbines that boast higher efficiency and modularity, to seize a burgeoning market.[40]

## The Global Potential of Next-Generation Geothermal

Advancements in geothermal technologies are concentrated in North America, but the potential for global deployment is growing (see figure 7). North America—particularly the Western part of the United States—is the optimal environment for next-generation geothermal commercialization because of strong hot dry rock resources, incumbent geothermal and drilling industries, deep expertise in complex drilling techniques from shale production, proximity to equipment (such as rigs and casings), and a dynamic startup culture and venture capital ecosystem. Meteoric electricity demand growth from data centers and Big Tech's interest in next-generation geothermal only furthers this argument.[41] The world's first commercial scale EGS facility is being finalized in Utah, closed-loop systems are under development in California and New Mexico, and other early-stage projects are beginning in the United States and Canada.[42] The U.S. Air Force has contracted nearly all regional next-generation geothermal firms to develop their technologies on American military installations across Texas and California.[43] Some early developments are also underway for SHR projects in Oregon and Nevada.[44]

This paper envisions a scenario where next-generation geothermal becomes a bankable low-carbon energy source in North America and, due to country-level policy regimes, industrial bases, and hot dry rock resources, can be exported as a global opportunity. Some North American firms are already beginning to develop projects abroad: the first commercial scale closed-loop facility will be online next year in Germany, and other early next-generation

**Figure 7. Mapping Next-Generation Geothermal Sites**

North America leads with notable developments across Europe and Asia


Source: Carnegie analysis of announced projects from company press releases.

Note: Analysis includes projects at varying stages of development, from feasibility study to commercial deployment. Several SHR testbeds are omitted because they did not move forward to commercial scale power generation. For information on SHR testbeds, please reference Clean Air Task Force's SHR map.

geothermal projects are at feasibility study stages in Japan, Kenya, the Philippines, and Romania.[45] The following outlines how well countries outside of North America are positioned to scale these systems once they commercialize. To illustrate which countries are prime opportunities, a rating system uses the following key indicators (see figure 8):

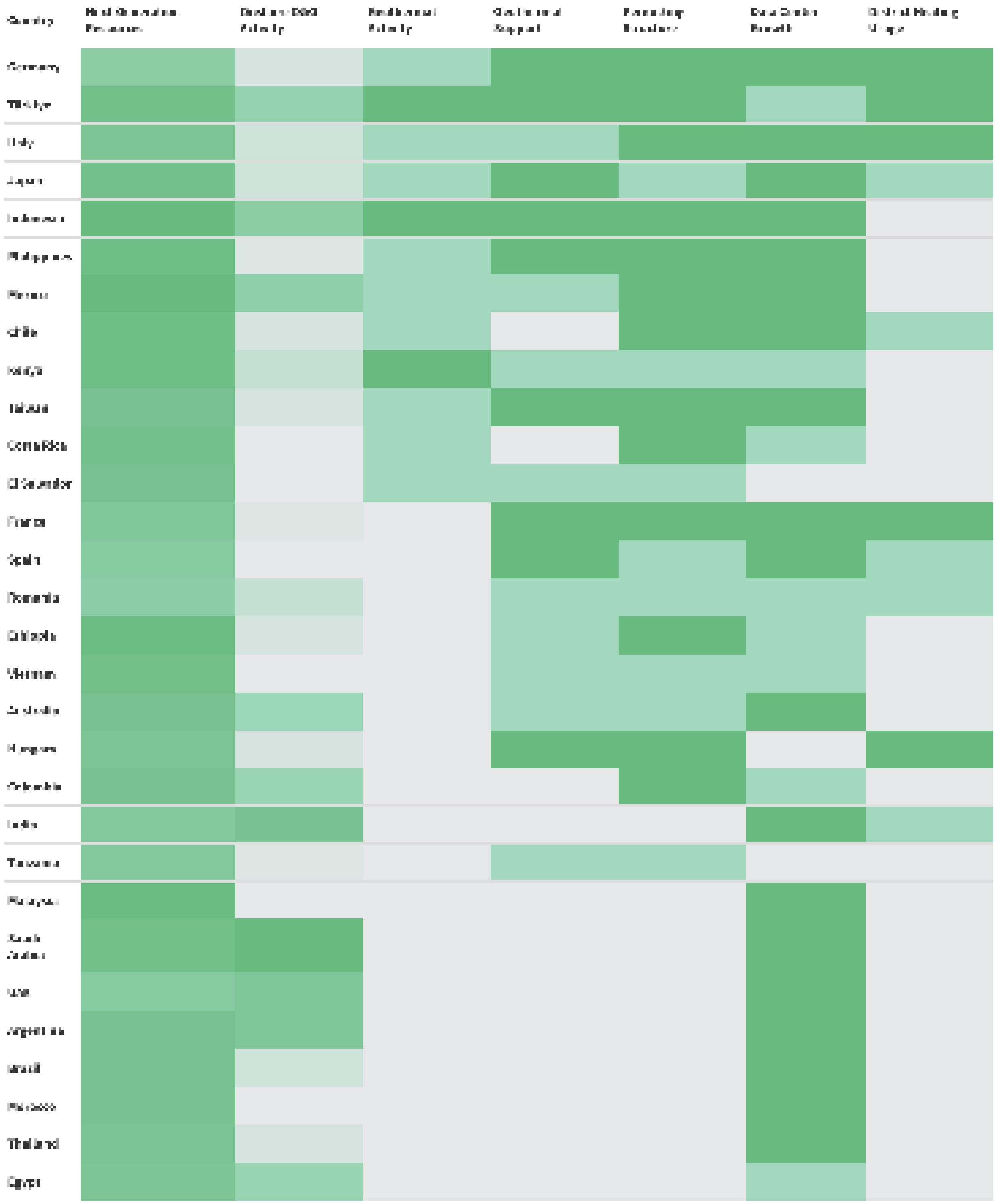
- **Next-generation geothermal potential:** Using Project InnerSpace's GeoMap™, this indicator rates country-level heat gradients at 5,000-meter depths by summing the score of each country's 1) net resource potential, 2) net resource potential per land mass, 3) upper-bound resource potential, and 4) upper-bound resource potential per land mass.

- **Onshore oil and gas activity:** Some countries may not have incumbent geothermal industries, but using Baker Hughes's rig count data, this indicator illustrates where onshore oil and gas production is most present and, with it, regional labor forces and supply chains.

- **Existing geothermal activity:** Based on data from the International Renewable Energy Agency, annual capacity installations over the past twenty-five years are measured to categorize the scale of recent hydrothermal growth, indicating domestic industrial momentum.

**Figure 8. Optimal Countries for Next-Generation Geothermal Deployment**

Measures describe resource potential, existing industry, regulatory and support measures, and demand pull opportunities



Source: Carnegie analysis using next-generation geothermal resource potential from Project Innerspace GeoMap™ data; IRENA Electrostat data; Baker Hughes Global Rig Count; energy market regulations and advisory documents; national regulation on resource exploitation and drilling licensing; corporate announcements and national strategies for data center deployment; and existing district heating networks.

Note: For research methodologies, please see appendix I. For sources, please see appendix III.

- **Geothermal support measures:** Drawing from all publicly available documents, analysis from Carnegie Endowment for International Peace researchers indicates whether countries have support measures in place, such as subsidies (for instance, feed-in tariffs and contracts for differences), or risk mitigation measures for drilling.

- **Geothermal permitting:** Government and legal documents help indicate whether a country has developed a geothermal-specific permitting regime and whether there is an existing framework that could include geothermal or no geothermal framework.

- **Data center growth:** Based on publicly available data, this indicator quantifies the scale of data center build-out—an emerging demand-pull measure for next-generation geothermal—in these respective markets.

- **District heating market:** Based on publicly available data, this indicator maps where existing or developing district heating is prevalent and could function as a first mover in next-generation development. (This excludes low-enthalpy heating and cooling systems that employ heat pumps.)

This high-level framework omits areas that require further investigation. First, the resources identified are based on the best existing data, but some countries may differ in the granularity of resource identification while others may simply not have been sufficiently surveyed. As geothermal exploration continues, new regional discoveries may emerge. Secondly, while this paper creates a framework to evaluate the accessibility and proximity of resources to key industrial hubs, it does not include more granular, community-level dynamics that are essential to equitably developing infrastructure prospects, especially regarding Indigenous communities and water rights. Third, the paper ascribes two demand-pull indicators—data centers and district heating—because those are presently being observed in early next-generation geothermal development. But it does not include medium enthalpy heat applications, such as food processing, textiles, and paper production, where next-generation geothermal could supply residual heat from clean power production. Lastly and similarly, the analysis does not indicate where countries are currently using geothermal for heat—not power—which could be a consideration to note in future research.

## Summary of Results

There is no perfect market, but there are clear leaders. To help visualize the results of this analysis, three broad categories emerge (see table 1). **Power Players** are countries that are either legacy producers of geothermal power or have begun to install geothermal capacity, including Chile, Indonesia, Kenya, Mexico, the Philippines, and Türkiye. These are likely to be optimal markets given the confluence of incumbent industries, subsurface data, and existing policy regimes. **Second Movers** are countries that do not have historical geothermal capacity additions (although some may be preparing to install their first power plants) but possess policy and market indicators that would position them as prime opportunities down the line. Lastly, **Heat on the Horizon** refers to countries with strong resources but no relevant policy regime, positioning them as long-term opportunities where effective support mechanisms and regulatory structures could help incentivize developments.

**Table 1.**

| Power Players | Second Movers | Heat on the Horizon |
|---|---|---|
| Germany, Türkiye, Italy, Japan, Indonesia, Philippines, Mexico, Chile, Kenya, Taiwan | Costa Rica, El Salvador, France, Spain, Romania, Ethiopia, Vietnam, Australia, Hungary, Colombia | India, Tanzania, Malaysia, Saudi Arabia, United Arab Emirates, Argentina, Brazil, Morocco, Thailand, Egypt |

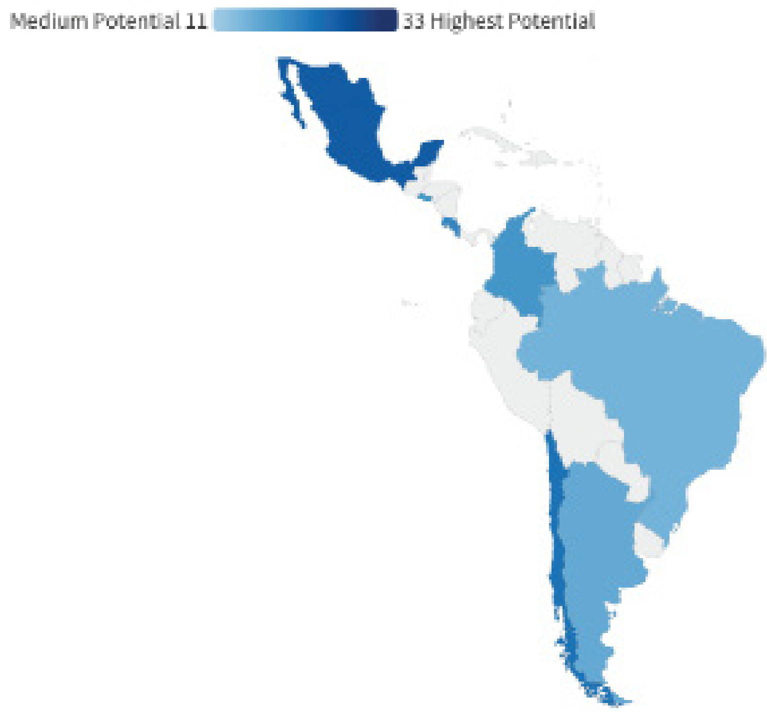
This paper reviews the top thirty countries based on domestic resource potential, excluding those with high political risk and unfavorable investment climates. For instance, countries such as China, Iran, and Venezuela, despite having strong resources, will not engage in joint ventures with U.S. or Canadian firms anytime soon. Others, such as Algeria, Haiti, Sudan, and Yemen, face significant domestic political risks. Additionally, nations such as Jordan and Papua New Guinea lack the long-term demand needed for technology adoption. The United States and Canada are excluded because they are already hotspots of next-generation geothermal incubation, while Iceland and New Zealand are unlikely to need next-generation technologies given their abundant hydrothermal potential.

## Latin America

Across Latin America, Mexico stands out as the most important potential player with near-term opportunities in the region, Chile and Colombia for medium-term considerations, and Argentina and Brazil for long-term potential. Other countries not analyzed should also be considered given their resources, especially the Dominican Republic and Panama. Fuel-poor island nations could also be well positioned to adopt this energy source, albeit with limited long-term growth potential. Bolivia, Ecuador, and Venezuela boast top caliber resources but were omitted from this paper given their varying degrees of political risk. While Latin America does not currently produce significant quantities of geothermal power (barring power plants in Mexico and some Central and South American countries), this unexploited resource could prove a boon for regional energy security, decarbonization, and national energy majors as they build out transition strategies.

**Figure 9. Next-Generation Geothermal Potential in Latin America**

Composite scores combine assessments of heat resources, existing industry, government incentives, and demand pull factors




Source: Carnegie analysis using Project Innerspace GeoMap™ data, Baker Hughes Global Rig Count, IRENA Electrostat data, and assessments of country-level policies and demand drivers. See Appendixes one and two for a complete methodology and the report's footnotes for the full list of references.

## Mexico

**Mexico** is ripe for a geothermal renaissance. The confluence of exceptional hot dry rock resources with an existing incumbent (and expanding) geothermal industry and regulatory regime, as well as rising load growth from industry and data demand, paint a high opportunity scenario.[46] Further, about 70 percent of Mexico's natural gas is imported, accounting for about 60 percent of its power mix.[47] This dynamic creates a strong political argument for reinvesting in geothermal from an energy security lens. Although Mexico has not built any new geothermal power in the past decade, it is home to a legacy industry with about 1,000 megawatts of installed capacity.[48] In recent years, the nation's power market has become increasingly statist, which would imply that state-owned Comisión Federal de Electricidad (CFE) would be an essential player in a geothermal build-out (although there are no indications of the potential geothermal involvement from the country's bloated state-owned oil major, PeMex).[49]

Most strikingly, Mexico's resources are located in ideal regions of economic concentration. Areas primed for next-generation geothermal developments based on resource potential, access to existing transmission, and demand-side developments underway include Monterrey in the Northeast, Tijuana in the Northwest, and a collection of hubs across central Mexico: Querétaro, San Luis Potosí, Guanajuato, Guadalajara, and Mexico City.[50] In 2025, Mexican President Claudia Sheinbaum unveiled new energy laws that include reforms to help streamline geothermal development; future policies from Mexico City are key signposts to consider.[51]

### Central America

Costa Rica and El Salvador rate highly on their resource potential, but they are small nations that are still exploiting their well-endowed hydrothermal resources.[52] **Costa Rica** boasts a growing incumbent geothermal industry, clear domestic regulations, and some data center growth. (The nation is quietly emerging as a manufacturing hub for semiconductors, another power-hungry tech sector.)[53] Although domestic resources do not directly overlap with the primary industrial hub of San José, transmission lines are clearly sufficient to deliver new capacity, especially in the northwest part of the country, which is devoid of national parks.[54]

**El Salvador** has experienced similar growth in geothermal capacity, and the country offers some subsidy support through the Renewable Energy Incentives Law.[55] Resources are notably strong surrounding San Salvador and especially San Miguel.[56] The country's historically unstable security and investment climate is now improving, an important long-term variable.[57] Honduras and Panama were omitted from this analysis, but they both boast strong resources and should be considered in future research.

### South America

South America is more complex, but Chile and Colombia stand out as logical opportunities. **Colombia**'s resources are strongest surrounding urban areas such as Cali, Pereira, Ibagué, and Bogotá (although the potential appears weaker near the port hubs of Barranquilla and Cartagena).[58] Colombia has installed negligible geothermal power and offers no subsidies, but it does have a geothermal regulatory regime through the Ministry of Mines and Energy and is also an emerging tech hub.[59] Colombia could find opportunity for Ecopetrol, its state-owned energy major, in pursuit of its diversification strategy: the firm recently took preliminary measures to develop its first geothermal project.[60]

**Chile** recently installed its first geothermal power plants and could prove an interesting location to explore given its top-tier resources and long-standing climate goals that will require retiring its remaining coal fleet.[61] Chile's hot dry rock resources are conveniently located across the nation's most important economic clusters, including Santiago and Antofagasta (as well as nearby northern industrial hubs).[62] Although Chile lacks geothermal subsidies, it has an accessible and clearly defined permitting regime.[63] All the while, its energy demand growth and proximity to Argentina's oil and gas infrastructure position it as a potential hub for new geothermal development.

Argentina and Brazil both have heat potential, but long-term development remains a question. Notable geothermal resources surround some of **Brazil**'s key economic areas with transmission access, including Rio de Janeiro, Recife, Brasília, Curitiba, and, to a lesser extent, São Paulo.[64] However, geothermal development will likely be constrained by Brazil's lack of existing geothermal industry or policy regime. It is also one of the most important developers of solar and wind and has sizable existing clean firm capacity from hydro.[65] Further, its hydrocarbon production is almost entirely offshore, implying lower potential labor and equipment transferability.[66] That said, Brazil's state-owned oil giant has begun exploring deep geothermal drilling, an important area to watch.[67]

**Argentina** faces the opposite problems. Unlike Brazil, its present economic stature, although potentially improving, may preclude novel infrastructure investment in the near or medium term.[68] Although the country also has a nonexistent geothermal regime, it is home to a unique shale boom that would imply a higher level of transferability than other onshore oil and gas production. Further, the Vaca Muerta region, where Argentine fracking takes place, is located near the nation's optimal geothermal resources. They are, however, on the opposite side of the country's primary economic and industrial clusters, with some transmission access across the nation.[69] In sum, Argentina's potential, while unique and notable, remains a long-term prospect.

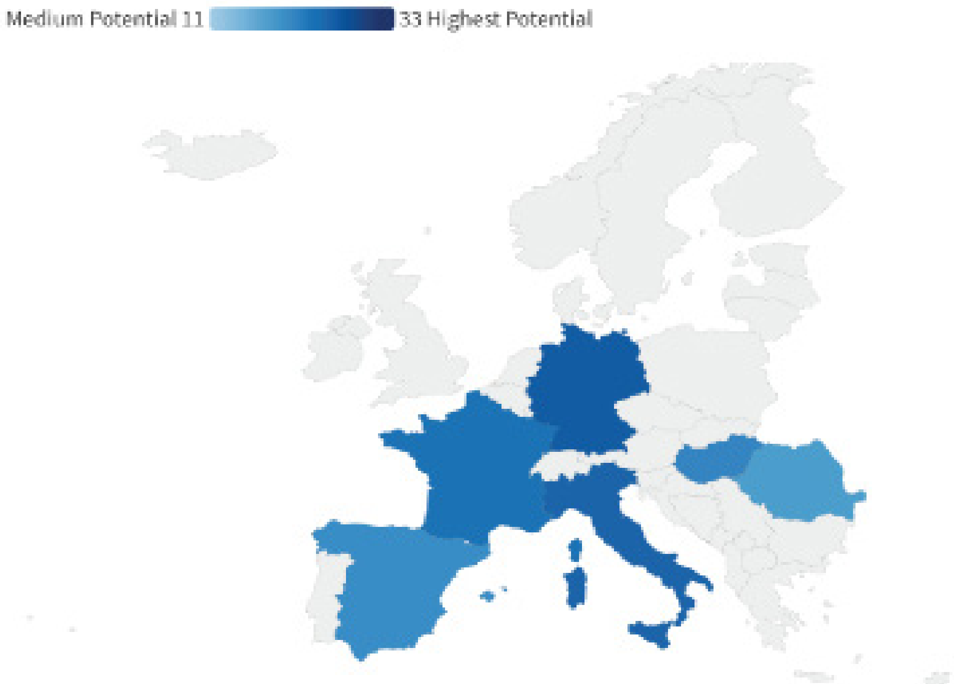
## Europe

Europe is home to clear opportunities across France, Germany, Italy, Hungary, Romania, and Spain, with Germany standing out as a priority. Europe has notable subsurface resources and above surface industry: three of the five specialized geothermal turbine companies are domiciled and operating in Italy.[70] But it is missing a sizable domestic industrial base from both geothermal developers and oil and gas producers. Similarly, because of a lack of hydrocarbon activity, the continent is home to negligible drill rigs, and there would be less accessibility to casings than in locations with ongoing energy production. Some European Union (EU) member states in this paper, such as France, Germany, and Spain, have imposed various restrictions on hydraulic fracturing that could complicate the potential rollout of enhanced geothermal and isolate certain markets to closed-loop systems, barring regulatory changes.[71]

All said, the long-term opportunity for European energy security and decarbonization is enormous. Europe is home to 19,000 district heating units that are almost entirely thermal fired—geothermal systems are well positioned to decarbonize them.[72] While individual member states have enacted geothermal-specific policies, both the European Parliament and the European Council have recently put forth agenda setting items that could prove a signpost to watch for the block's push on the technology writ large.[73]

**Figure 10. Next-Generation Geothermal Potential in Europe**

Composite scores combine assessments of heat resources, existing industry, government incentives, and demand pull factors




Source: Carnegie analysis using Project Innerspace GeoMap™ data, Baker Hughes Global Rig Count, IRENA Electrostat data, and assessments of country-level policies and demand drivers. See Appendixes one and two for a complete methodology and the report's footnotes for the full list of references.

## Germany

**Germany**'s combination of strong resources, market environment, and demand-pull indicators—alongside recent geothermal policy and project developments—position it as a prime next-generation geothermal market in Europe.[74] Germany currently operates forty-two deep geothermal power plants (mostly for heat), with sixteen facilities under construction and an astounding 155 plants in the planning phase; this is a sizeable example of industrial momentum.[75] Alongside federal laws that promote 10 terawatt hours of geothermal energy by 2030, Berlin has initiated support measures—both a feed-in tariff and a loan scheme to de-risk the drilling operations—and legislation to expedite the permitting process.[76]

Germany's hot dry rock resources are well situated near major cities and industrial regions, such as Essen, Frankfurt, Munich, and Stuttgart.[77] On the demand side, both Germany's data center build-out and thermal-fired district heating units are the largest in Europe—roughly double those of Poland, the runner up. (Germany's heating units primarily rely on natural gas, coal, and biomass.)[78] Power market trends would also bode well for geothermal power: the nation plans to retire 30 gigawatts of coal capacity, having already retired its nuclear fleet, while experiencing power price volatility from the so-called *dunkelflaute* (or “dark lull”) when wind and solar resources are not activated.[79] Already, German researchers are investigating deep geothermal projects in coal-heavy regions, likely in anticipation of these dynamics.[80]

### Western Europe

France, Italy, and Spain all stand out as potential areas for consideration—albeit with their own challenges. **France** is home to Europe’s historical EGS research and has notable hot dry rock resources in the central-eastern part of the state between Paris, Lyon, and Limoges.[81] Alongside France’s feed-in tariff and slightly convoluted risk mitigation scheme, the nation’s long-term energy framework specifically calls for the development of deep geothermal resources—albeit entirely for heat.[82]

Conversely, **Italy** could prove a market where next-generation geothermal has opportunity in the power sector. Alongside over 700 megawatts of installed geothermal capacity, new power (and combined heat/power) installations are forthcoming, with billions of euros being pledged by utilities and developers.[83] Italy’s resources are located conveniently near key cities, such as Florence, Genoa, Naples, and Rome, but they are not directly accessible to the industrial clusters in the North. Italy has a specific geothermal permitting regime and high tariff rates (especially for binary cycle) but lacks de-risking mechanisms for drilling or project financing.[84]

Although **Spain** is building its first geothermal power in the Canary Islands, high variable renewables and nuclear phase-out could create market precedent on the mainland.[85] Spain has considerable resources, especially near Valencia, A Coruña, Zaragoza, and south of Madrid.[86] It is also home to notable data demand and clean power subsidies, including a fund to de-risk geothermal drilling.[87] Not listed in this paper are countries with notable resources, such as Greece, which is home to a less favorable investment climate, and the states of Belgium, the Netherlands, and Luxembourg with notable nuclear power. These other member states also pose notable potential that might be explored further.

### Eastern Europe

Eastern Europe is home to important resources that Hungary and Romania are notably positioned to exploit. **Hungary**’s resources are essentially ubiquitous across the country and align nicely near demand hubs such as Budapest, Gyor, Kecskemét, and Szeged.[88] The Hungarian government released a national strategy in April 2024 to double its geothermal use by 2030 and announced a loan scheme from the Ministry of Energy to de-risk projects, with particular goals for district heating.[89] However, market indicators paint a potentially less enticing environment for geothermal power development, in which data center demand growth is bearish and nearly half of the country’s electricity is already supplied by nuclear electrons, with solar comprising an additional 20 percent.[90]

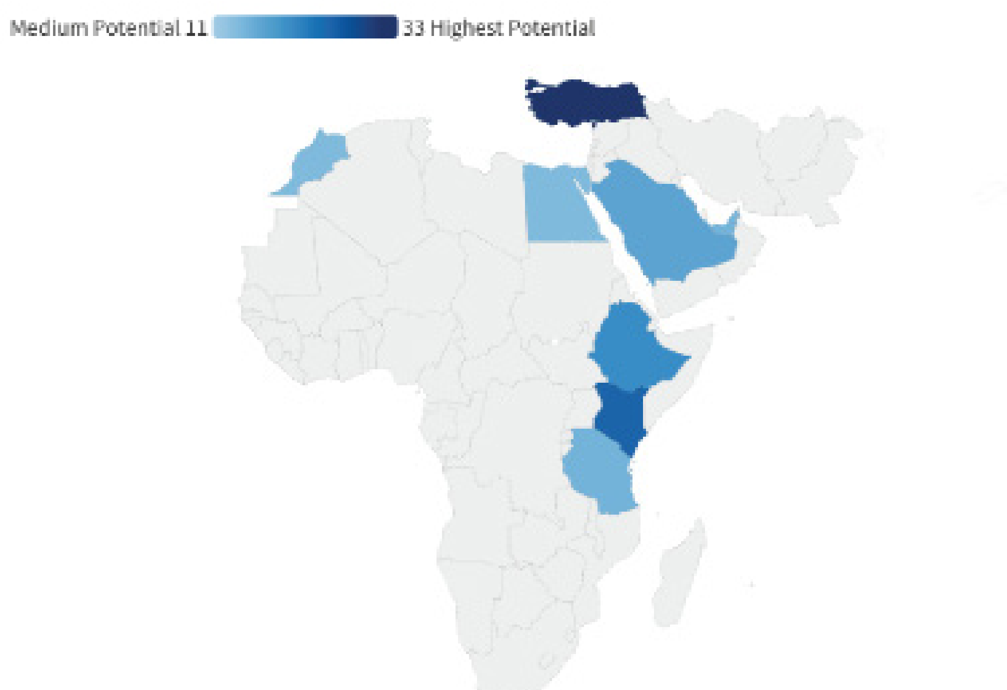
**Romania** also has considerable resources, but they are located in the western part of the country, away from key cities and economic zones, and are compounded with a slightly less enticing environment that includes fewer district heating units, potential contracts for difference as subsidies, and a permitting regime that lacks clarity (as domestic energy companies have called for a geothermal-specific regulatory regime for heat that sits more clearly in either the mining or hydrocarbon sector).[91] Although Romania is building its first geothermal heating project, nearly half of the country's electricity already comes from clean firm resources, such as hydro and nuclear, with notable variable renewable progress.[92] Not listed in this paper are Baltic states that boast significant resources but face weaker investment climates, such as Serbia.

## Africa and the Middle East

Africa and the Middle East hold enormous next-generation geothermal resources, but current political economic realities confine the possibilities to several key players. Kenya, Tanzania, and Ethiopia are well positioned on the African continent, while Türkiye is the standout actor in the Middle East and Saudi Arabia has notable long-term potential. It should be noted that North African resources appear exceptionally strong, especially in Algeria, but Egypt and Morocco are the most viable regional countries where these

**Figure 11. Next-Generation Geothermal Potential in Africa and the Middle East**

Composite scores combine assessments of heat resources, existing industry, government incentives, and demand pull factors




Source: Carnegie analysis using Project Innerspace GeoMap™ data, Baker Hughes Global Rig Count, IRENA Electrostat data, and assessments of country-level policies and demand drivers. See Appendixes one and two for a complete methodology and the report's footnotes for the full list of references.

opportunities could emerge because of political and economic risk factors (although the former presents concerns from an investment perspective). Nigeria has exceptional dry rock resources but is omitted because electricity infrastructure investment is hindered by the country's defunct power grid and market.[93] Multiple African countries, such as Namibia and Senegal, also have some potential and merit further examination.

### Kenya

**Kenya** is perhaps the great, modern geothermal success story, and its prominence could be furthered by next-generation technologies. Geothermal now provides nearly 50 percent of the nation's electricity and is increasingly used across industries.[94] The nation's hot dry rock resources are accessible and consistent across economic zones, including Nairobi, Nakuru, Kisumu, and Eldoret.[95] Further, the nation's incumbent geothermal developer, KenGen, is supported by a strong policy ecosystem that includes a competitive auction system, risk mitigation measures for drilling, and a permitting regime that includes two-year permits and thirty-year licenses for heat extraction.[96] The country is the epicenter of data center growth in Africa and home to the continent's first hyperscalers.[97] Kenya is also the first Global South country to develop a direct air capture facility, which will also be geothermal powered (another potential long-term demand indicator).[98] Although Kenya has at least another 200 megawatts of geothermal power in the pipeline, important questions remain about when a nation with such plentiful hydrothermal resources will need next-generation geothermal.[99] Kenya has faced ongoing drought, and closed-loop systems could find a niche in certain parts of the country—a closed-loop system has already received approval to operate in a brownfield geothermal site.[100]

### East Africa

Kenya serves as an African hub for geothermal development by training the workforce and exporting the technology to its neighbors, including Tanzania and Ethiopia, among others.[101] These countries have notable potential, as observed in this analysis. **Tanzania**'s resources appear potentially under-surveyed, this could be in part because of protected lands. Nonetheless, the data still indicate high heat gradients, especially surrounding cities such as Mbeya, Arusha, and Moshi (and, to a lesser extent, the capital of Dar es Salaam and Morogoro).[102] Tanzania is developing its own domestic geothermal industry, with a goal of generating 200 megawatts in the coming years.[103] Although the national feed-in tariff scheme has ended, geothermal projects are eligible for international drilling risk mitigation funds and are privy to a clear—albeit not geothermal specific—permitting regime.[104]

**Ethiopia**'s comparably positive geothermal resources and unique electrification goals, which require expanding its power generation, create tailwinds for its potential.[105] With access to de-risking funding and a moderately clear permitting structure, the nation has long-term potential.[106] But Ethiopia's regional security risks could complicate this outlook.[107]

### Türkiye

Like Kenya, **Türkiye** is a regional geothermal champion. The nation has installed about 1.7 gigawatts of hydrothermal capacity, and it has strong targets for adding new geothermal power generation. However, geothermal still comprises only a small amount of the national power mix.[108] Türkiye is also home to an exceptionally strong policy regime, including a fifteen-year feed-in tariff authorized under the Renewable Energy Law and a risk sharing mechanism for drilling put forth by the Development and Investment Bank of Türkiye.[109] The nation's Geothermal Resources and Natural Mineral Waters Law is specifically tailored to geothermal licenses.[110]

Alongside the nation's emerging position as a clean tech manufacturing hub for Europe, Türkiye has successfully brought onshore the production of the geothermal supply chain, including turbines, generators, and steam injectors, as a result of its subsidy that prioritizes domestic products.[111] This could provide a template for other geothermal-rich nations keen to attract value-added industry, such as Indonesia, Kenya, and Mexico. Like in the case of Mexico, Türkiye's hot dry rock resources are well placed around key cities and industrial zones, such as Istanbul, Izmir, Kayseri, and Gaziantep.[112] Alongside these compelling indicators, a closed-loop geothermal system in Türkiye is already in the preliminary investigation phase, a potential sign of this low-risk operating environment.[113]

### North Africa and the Gulf

Long-term questions remain about North African countries, such as Egypt and Morocco, while Gulf states, such as Saudi Arabia, boast optimal indicators. **Morocco** is a key manufacturing hub and is significantly dependent on fuel imports for power.[114] In addition to its consistent capacity additions of renewables, it also boasts newly appreciated hot dry rock geothermal resources near Meknes, Fes, and Oujda—albeit with no industrial momentum.[115] **Egypt** has an even greater single source dependence on hydrocarbons for electricity and boasts promising geothermal resources between Cairo and Hurghada, but it remains an unlikely prospect given the current investment climate.[116]

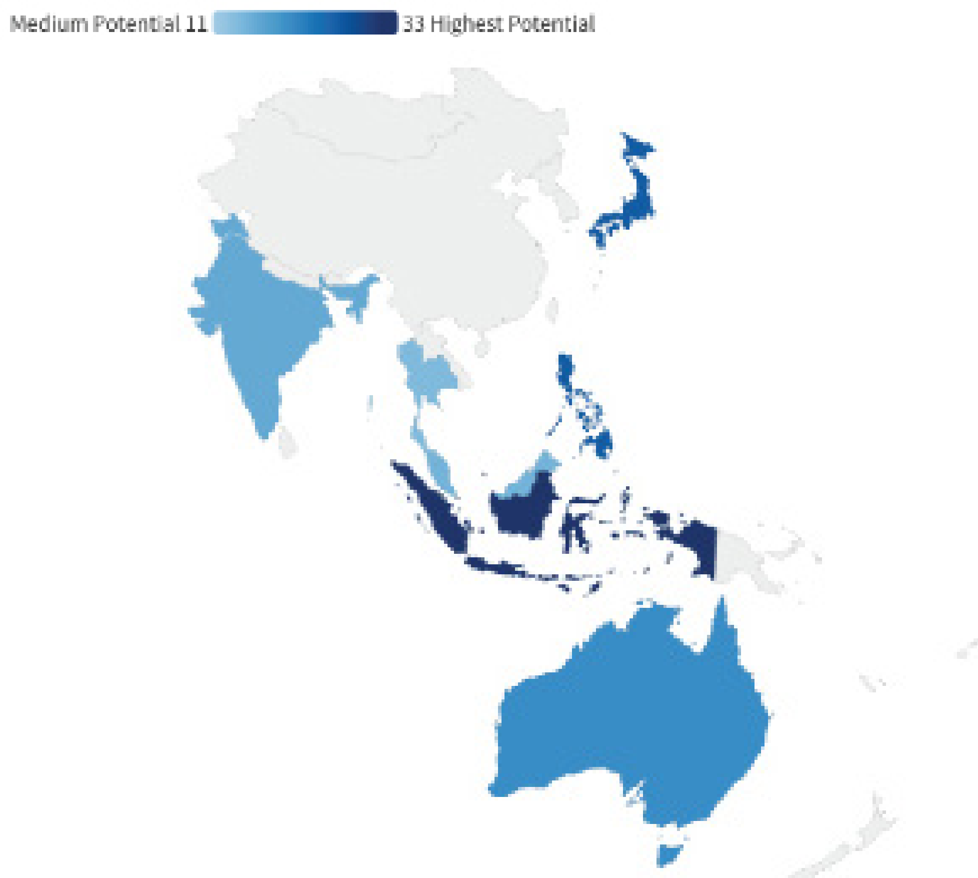
Across the Red Sea, however, **Saudi Arabia** has already begun investigating its well-endowed geothermal resources.[117] Primarily concentrated in the western parts of the country, Saudi Arabia's hot dry rock strongly overlays with key cities, such as Jeddah, Medina, and Yanbu, an emerging industrial hub; additional resources are also located near Riyadh.[118] Although the kingdom currently lacks a subsidy or regulatory regime, its world-renowned oil production and industry, rising data demand, and sovereign wealth funds create a long-term prospect for diversification.[119] As illustrated in table 1, the **United Arab Emirates**' resources are less notable, but the country has analogous indicators of prestigious hydrocarbon development, and data demand. Like Saudi Arabia, the nation has a well capitalized sovereign wealth fund.[120]

## Asia and Oceania

Over the past decade, Asia has emerged as the foremost region for geothermal power development, with over 40 percent of global installed capacity and a robust pipeline of planned investments.[121] Indonesia and the Philippines are the clear front-runners for potential next-generation geothermal adoption, each with established geothermal industries, market subsidies, risk mitigation platforms, and streamlined regulatory frameworks. Japan and Vietnam have strong resources, clear market incentives, permitting structures for private developers, and notable demand signals from the technology sector, but there are sociopolitical and policy trade-offs. Countries like India, Australia, Malaysia, and Thailand are beginning to explore geothermal potential in varying degrees.[122] Together, these countries comprise a significant portion of the regional next-generation geothermal potential, particularly as populations grow, industrial policies accelerate, and load growth continues.

**Figure 12. Next-Generation Geothermal Potential in Asia and Oceania**

Composite scores combine assessments of heat resources, existing industry, government incentives, and demand pull factors




Source: Carnegie analysis using Project Innerspace GeoMap™ data, Baker Hughes Global Rig Count, IRENA Electrostat data, and assessments of country-level policies and demand drivers. See Appendixes one and two for a complete methodology and the report's footnotes for the full list of references.

## Indonesia

In the entirety of this analysis, **Indonesia** is a standout priority for next-generation geothermal production. Besides the United States, Indonesia is the global leader for geothermal power, having installed 2 gigawatts of capacity to its grid over the past two decades.[123] In its 2025–2034 investment plan, Indonesia's state-owned utility announced a new deployment target of 5.1 gigawatts, of which 4.5 gigawatts will be developed by private investors, over the next ten years.[124] Indonesia's geothermal boom is the result of domestic market support and policy regulation, bolstered by funding from multilateral development banks.[125] A 2022 presidential decree restructured the feed-in tariff system introduced by the Ministry of Energy and Mineral Resources (MEMR) in 2017, which is expected to slightly increase the subsidies received by geothermal producers.[126] Additionally, MEMR manages several funds to mitigate drilling risks, with support from the Ministry of Finance and separate funding from the World Bank.[127]

However, well-crafted policies have been historically constrained by Indonesia's geography—nearly all conventional geothermal sites are located on the islands of Java and Sumatra.[128] Despite past geographic hurdles, Indonesia's geothermal stars remain aligned: more ubiquitous resource potential compounded with power demand from data centers and onshoring paint a scenario where Indonesia's subsurface expertise and industrial momentum could be an asset to these technologies.

## The Philippines

Like Indonesia, **the Philippines** is a world leader in geothermal, with around 2 gigawatts of installed capacity in 2024.[129] However, unlike its neighbor in the Ring of Fire, annual capacity additions in the Philippines have stalled since the early 2010s.[130] Growth has been limited predominantly due to the financial burden of geologic exploration, potentially made worse by a highly corrosive volcanic subsurface.[131] To reduce financial pressures and geologic uncertainty, the Philippines launched a series of green energy auctions (GEA) with associated feed-in tariffs and other favorable rate structures to stimulate interest in new geothermal investments. However, the most recent GEA-3 in 2025 saw secure bids for only 31 megawatts, well below the 100 megawatt goal, while most other eligible technologies were oversubscribed.[132]

In attempts to reinvigorate the industry, the Philippine Department of Energy announced new financial incentives, including a $250 million facility in partnership with the Asian Development Bank, which would provide up to half the initial costs for exploration and drilling.[133] The Department of Energy is also conducting additional resource assessments for geothermal sites to assess geologic attributes for private developers.[134] Despite recent difficulties, the Philippines remains invested in geothermal development and has even taken the first steps to develop next-generation systems.[135]

## Japan and Taiwan

Japan and Taiwan both have strong regimes and resources but different limitations. **Japan**'s geothermal growth has been stagnant over the past decade, and it may face challenges going forward. Japan had 460 megawatts of installed geothermal capacity in 2024, down from 533 megawatts in 2000, and its growth is challenged by social license issues, such as *onsens* (culturally coveted natural hot springs that may be affected by geothermal development).[136] However, the Japanese government has maintained support for geothermal through feed-in tariffs since 2012, with the latest adjustment from the Ministry for Economy, Trade, and Industry setting rates between $0.11 and $0.37 per kilowatt hour.[137] Japan's strategy for mitigating risk is uniquely channeled through the state-owned oil and gas company, JOGMEC, which offers financing to cover 50 percent of exploration costs, project development finance if drilling is successful, and debt guarantees for up to 80 percent of loans provided by private financial institutions.[138] The regulatory regime is less comprehensive, favoring permits for production approved at the local level, with no license required for exploration.[139]

The confluence of immense fuel import vulnerability and strong indicators could position **Taiwan** as a potential market for consideration.[140] Like Japan, Taiwan has a feed-in tariff for geothermal and a potentially favorable permitting regime, but the country has installed negligible capacity.[141] However, these winds are changing, as tech giants work with the Taiwanese government to double production.[142] It should be noted that Taiwan's long-term political risks, namely the looming concerns of confrontation with Beijing, could preclude startups with new technology to choose this market.

## Australia

Although **Australia** has no installed geothermal capacity, it holds several promising indicators, and recent developments could position it as long-term player. Despite the nation's lack of hydrothermal resources, its hot dry rock resources are well situated near key urban and industrial areas, such as the Northern Territory near Cairns and especially New South Wales outside Melbourne and near Canberra—all of which have existing transmission access.[143] Australia produces natural gas domestically, implying some of level of existing workforce that could be transferred.[144] Market dynamics create further potential headwinds: the nation has proactively been retiring its coal fleet while not expanding other firm power sources (though nuclear power remains banned).[145]

These factors could create long-term opportunities for clean firm power sources like geothermal, especially if Prime Minister Anthony Albanese's climate agenda continues.[146] Where Australia's geothermal becomes complicated is on policy, as the nation holds a federalist system with various permitting regimes by states and no present incentives (though some drilling subsidies were used in the past for geothermal exploration).[147] Recently, two feasibility studies for EGS were completed on sites in Southern Australia near Adelaide, confirming notable heat potential.[148]

### Vietnam

While **Vietnam** has no operable geothermal power stations, developers have announced several large-scale projects, and the government is developing stronger incentives with streamlined regulations.[149] Vietnam's state-owned utility, EVN, does not offer feed-in tariffs, but 2024 legislation creates a power purchase agreement model for independent power producers to strike a long-term offtake agreement for a fixed cost.[150] Demand drivers could help spur geothermal development, with 2024 legislation permitting full foreign ownership of data centers which are expected to result in large global operators entering the Vietnamese market.[151]

### Malaysia, Thailand, and India

Although Malaysia, Thailand, and India have a combined geothermal power capacity of only 0.3 megawatts, next-generation geothermal systems could open new opportunities. Unlocking this potential will require dedicated effort from both the public and private sectors. Neither **Malaysia** nor **Thailand** offers market incentives for geothermal power or risk mitigation schemes for exploration, and permitting structures are vague—if they even exist. The heat potential, however, is promising. Among the countries analyzed in this paper, Malaysia has the third-highest potential for hot dry rock resources in this analysis, and Thailand's highest heat gradients are located near the largest energy demand clusters of Bangkok and Pattaya.[152] Both countries currently rely heavily on coal and natural gas for electricity generation and have announced significant data center expansion, underscoring the need for clean firm power in the coming decades.[153]

Unlike Malaysia and Thailand, **India** is developing a domestic geothermal strategy. The Ministry of New and Renewable Energy (MNRE) launched the Taskforce to Harness Geothermal Energy in India in August 2024 to review the Indian Geothermal Energy Development Framework and conduct private sector consultations on the global status of geothermal technologies.[154] These findings will inform MNRE's geothermal guidance and subsequent legislation. India's state-owned oil and gas and coal companies are currently developing the nation's first two pilot geothermal projects, a notable first step.[155]

## Policy Recommendations

Although next-generation systems are reaching commercial scale at astounding rates, they are unlikely to be globally deployable until later this decade. As a result, policy regimes might take a "rising tides lift all boats" approach by supporting the continual development of incumbent hydrothermal systems in the near term and seizing that momentum to include EGS and closed-loop geothermal systems once they become more widespread. Doing so will entail a strategy that prioritizes collaboration with the **Power Players** countries (such as Kenya and Mexico) and, as next-generation systems commercialize in the medium term, helps the **Second Movers** ready their policy regimes to attract and incubate next-generation geothermal systems.

An area not observed in this paper, but worth future research, is the creation of optimal business models for technology diffusion abroad. Next-generation geothermal deployment could borrow from overseas investment models for oil and gas or hydrothermal projects. These models broadly fall into three categories: build-own-operate, build-operate-transfer, and technology licensing.

- The first model is standard for legacy geothermal players, which develop, own, and operate geothermal sites around the world. Next-generation firms could pursue sole ownership across the full value chain or enter joint ventures with local partners to share costs and revenues.[156]

- In the build-operate-transfer model, U.S. firms would provide the technological expertise and equipment needed to develop a next-generation geothermal project and transfer it to a local owner after a short operational period.[157] This approach adapts the principles of servicing contracts common in the oil and gas sector to the geothermal industry, which requires surface installations in addition to subsurface services.

- Finally, next-generation firms could pursue a hands-off approach to international deployment, licensing technology on a bilateral basis or among technology consortia. Given early stage intellectual property concerns, this approach is unlikely in the short term but has precedent from established oil field service firms.[158]

The following section outlines domestic and multilateral policy recommendations, including several for the United States to consider when promoting its technology and drilling activity abroad.

## Aligning Domestic Policies to Maximize Geothermal Potential

- **Introduce Policy Support and Regulatory Regimes**
  Countries can begin preparing domestic energy markets for next-generation geothermal by adapting the policy regimes of current industry leaders. Favorable market incentives—including feed-in tariffs, contracts for differences, or long-term fixed pricing—and well-defined regulatory regimes provide crucial support for nascent geothermal development. Additionally, government agencies can reduce risk by providing publicly available geologic data and risk mitigation funds for developers.

- **Set Clear Intentions and Integrate Geothermal Within Existing Government Strategies**
  Policy planning agencies can provide the clear demand indicators required for first-of-a-kind investment by incorporating geothermal into their nationally determined contributions under the Paris Agreement on climate change, energy transition strategies, and state-owned utility resource plans (as well as expanding the value proposition of national energy majors). Setting supply-side indicators on a national level is important for markets facing load growth from data centers, population increases, and industrial policies. In the process of establishing national goals, governments should coordinate with domestic industry and trade organizations to identify bottlenecks.

- **Pursue Partnerships with Geothermal Leaders**
  Geothermal newcomers should be encouraged to request support from established geothermal leaders like Kenya, Türkiye, and Indonesia. Regional cooperation is essential, leveraging expertise from neighboring countries with established geothermal industries, comparable geographies, and similar energy market considerations. Broader international collaboration with legacy players, such as Iceland, could also provide beneficial technical skills and relationships for sustained collaboration.

## Building Global Partnerships and Sharing Knowledge

- **Expand IEA Geothermal Platforms**
  The IEA's Geothermal Technology Collaboration Program should expand beyond its core membership of advanced economies to include non-OECD members through a new forum model. The program could signal its intention to engage emerging markets by establishing regional centers of excellence in recent geothermal leaders, beginning with Indonesia, Kenya, and Türkiye. Broader scientific collaboration would enable early knowledge-sharing and capacity-building with countries that have geothermal potential but limited institutional infrastructure.

- **Strengthen Supply Chain Resilience**
  To avoid overdependence on any single supplier, governments with established manufacturing capacity for the geothermal supply chain should convene regular dialogues with international partners and industry leaders to identify bottlenecks and diversify production of turbine manufacturing and corrosion-resistant materials. Involving countries with specialized inputs, such as Indonesia for ORC turbines and Gulf countries for drilling rigs, could further build resilience.

- **Elevate Dialogue at COP Level**
  Geothermal power has been severely omitted from the global climate dialogue—the Conference of the Parties (COP) to the UN Framework Convention on Climate Change— and leading countries should begin to elevate the technology to working

committee levels with sectoral pledges (as observed recently with COP nuclear dialogues).[159] This group should specifically include petrostates and their national energy companies—many of them mentioned in this paper—into this discussion to leverage subsurface expertise, infrastructure, and capital.

## Renewing Multilateral Financing for Next-Generation Geothermal

- **Launch a New Global Geothermal Development Plan Through ESMAP**
  The World Bank should initiate a successor to its Global Geothermal Development Plan under the Energy Sector Management Assistance Program (ESMAP). This new program could be expanded to include next-generation technologies and its country engagement broadened to markets with untapped potential. A new phase would signal global commitment and provide a structured approach to supporting geothermal scaling.

- **Modernize Risk-Sharing Mechanisms**
  Institutions, including the Clean Technology Fund, the Green Climate Fund, and regional national development banks, should jointly review and update the geothermal support tools developed over the past decade. The review should consider opportunities to integrate recently formed platforms, such as the Multilateral Investment and Guarantee Agency, to increase the pool of available funds and diversify support mechanisms. Many risk-sharing platforms, such as those led by European development agencies in Latin America and the Caribbean, are nearing the end of their operational windows. A joint review enables adaptation to newer technologies while continuing financial availability.

- **Expand the Coalition of Funders**
  Future geothermal development should draw on a broader pool of financial actors beyond traditional development finance institutions. This includes state-owned energy companies—such as Japan's JOGMEC—sovereign wealth funds, and export credit agencies. These actors can help close funding gaps, especially in the later stages of project development, when public-private capital stacking becomes essential.

## Strengthening the U.S. Government's Overseas Geothermal Strategy

- **Expand Early-Stage Support**
  In consultation with national labs and the International Trade Administration, the U.S. Trade and Development Agency should scale up its grant award for geothermal feasibility studies, particularly in emerging markets. These early assessments lower the risk for private firms by determining site viability and creating a foundation for

project bankability. Despite its experience in geothermal, the agency has awarded relatively few geothermal-related grants to date, representing a major opportunity to ramp up support for U.S. developers in underexplored regions.

- **Innovate Risk Mitigation**
  The U.S. International Development Finance Corporation should move beyond traditional commercial loans to create risk-sharing instruments tailored to geothermal power's unique challenges. This includes offering loans that convert to grants if drilling is unsuccessful—a critical tool for managing the uncertainty of exploration. Partnering with agencies like the Millennium Challenge Corporation could make such tools viable and scalable, ensuring public funds unlock rather than follow private investment.

- **Advance Geothermal Diplomacy**
  The United States should incorporate geothermal into existing bilateral and multilateral energy, economic, and security platforms, including the Partnership for Transatlantic Energy and Climate Cooperation and the Luzon Economic Corridor. The Quadrilateral Security Dialogue (the Quad), which brings together the United States, Australia, India, and Japan, offers additional opportunities to pilot novel geothermal solutions, potentially on military installations as part of energy security initiatives. Collaboration with partners can include nonfinancial assistance from agencies such as the Commercial Law and Development Program or International Trade Advisory Committees.

# Appendix I: Methodology for Figure 8

## Geothermal Resource Scoring Methodology

To systematically evaluate national geothermal potential across multiple dimensions, we developed a composite scoring framework that combines both volumetric and spatial quality of geothermal resources. Our analysis is based on raster datasets from Project InnerSpace's GeoMap™ representing geothermal power potential, overlaid with national boundary shapefiles.

The process unfolds in five steps:

1. **Zonal statistics extraction:** Using QGIS tools, we performed zonal statistical analysis to calculate the **total geothermal resource value** (sum) and the **average geothermal intensity** (mean) within each country's borders. This was done separately for the full geothermal dataset and for a filtered upper-bound layer that captures only the highest quality geothermal zones (values above the fiftieth percentile of the global dataset).

2. **Normalization by land area:** To account for differences in national size, we divided each country's total and upper-bound geothermal values by its land area (sourced from the World Bank). This yields **resource density metrics** that reflect geothermal potential per square kilometer.

3. **Scoring by percentile rank:** Each of the four core metrics—**total resources**, **resource density**, **upper-bound total**, and **upper-bound density**—was assigned a score from 1 to 5 based on its percentile rank relative to all countries in the dataset. This standardizes across indicators and ensures comparability.

4. **Composite scoring:** An overall **composite geothermal score** was calculated as the unweighted average of the four normalized component scores, capturing both the quantity and quality of a country's geothermal resources.

5. **Numerical listing:** Countries were ranked based on their total number of these four metrics. The final output is a simple numerical list, reflecting various degrees surveyed subsurface resources.

## Geothermal Activity Scoring Methodology

To assess the maturity and momentum of a country's incumbent geothermal power industry, we developed a traffic-light classification framework based on historical installed capacity and growth trends using data from the International Renewable Energy Agency. This activity-based metric complements geologic resource assessments by evaluating the operational footprint and trajectory of geothermal development over time.

The scoring methodology follows three steps:

- **Installed capacity benchmarking:** For each country, we compiled annual geothermal power capacity data (in megawatts) over a twenty-five-year period. The most recent year of reported capacity (2024) serves as the anchor for assessing the scale of the incumbent industry. Countries with zero capacity were automatically classified as having no active geothermal sector.

- **Growth rate calculation:** We calculated the percentage change in installed capacity over the previous decade (from 2014 to 2024) to evaluate whether the industry is expanding, stable, or declining. This metric serves as a proxy for investment activity, permitting effectiveness, and developer engagement.

- **Tricolor classification:** Countries were assigned a qualitative status—**Green**, **Light green**, or **Gray**—based on a combination of scale and growth:

  – **Green:** Countries with **greater than or equal to 100 megawatts** of installed capacity **and** at least **25 percent growth** over the past ten years, indicating an established and growing industrial base

  – **Light green:** Countries with **greater than or equal to 50 megawatts**, or any measurable growth in the past decade, signaling either moderate-scale legacy development or early-stage growth

  – **Gray:** Countries with **zero installed capacity** or **no meaningful recent growth**, suggesting minimal industrial activity or sectoral dormancy

## Onshore Oil and Gas Activity Scoring Methodology

To estimate the level of industrial activity in the onshore oil and gas sector, we relied on operational rig counts as a proxy for ongoing exploration and production. This method captures active field development and serves as a real-time indicator of sectoral intensity.

The methodology consists of two steps:

1. **Rig count aggregation:** Using country-level data from the **Baker Hughes International Rig Count**, we summed all active **onshore oil**, **gas**, and **miscellaneous** rigs for each country. This provides a snapshot of total drilling activity, regardless of hydrocarbon type.

2. **Numerical listing:** Countries were ranked based on their total number of active onshore rigs. The final output is a simple numerical list, reflecting relative levels of operational intensity in the onshore oil and gas sector.

## Geothermal Support Scoring Methodology

To evaluate the strength of government support for geothermal power, we reviewed national legal frameworks, policy instruments, and subsidy mechanisms targeting geothermal development.

Countries were classified into one of three categories based on observed public support:

- **Green:** Countries offering **both** geothermal-specific **risk mitigation measures**, such as drilling insurance and exploration guarantees, **and direct financial incentives**, such as feed-in tariffs, contracts for difference, renewable energy certificates, or competitive auctions

- **Light green:** Countries offering **either** a geothermal risk mitigation scheme **or** a direct financial support mechanism

- **Gray:** Countries with **no observable support measures** targeting geothermal energy

## Geothermal Permitting Structure Scoring Methodology

To assess the regulatory clarity and accessibility of geothermal project development, we examined the legal and administrative permitting frameworks applicable to geothermal energy in each country. This analysis used best available legal and administrative documents to gauge regulatory regimes.

Countries were categorized based on the specificity and adequacy of their permitting regimes:

- **Green:** A **clear, geothermal-specific permitting regime** exists, established through dedicated legislation or administrative codes

- **Light green:** A permitting system is in place that **includes geothermal energy** but is **not specific** to it (for instance, general mining, energy, or water laws)

- **Gray:** No permitting regime applicable to geothermal energy is observed, or there is **evidence of regulatory inadequacy or obstruction** (such as overlapping jurisdictions, lack of clarity, or excessive delays)

## Data Center Growth Scoring Methodology

To assess the scale and strategic relevance of data center development for geothermal and grid-interactive demand, we evaluated projected electricity demand growth from the digital infrastructure sector.

Countries were categorized based on observed or anticipated data center activity:

- **Green:** Clear evidence of **hyperscaler deployment** (such as Amazon, Google, or Microsoft) and/or **1 gigawatt or more** of cumulative **data center load growt**h anticipated from domestic infrastructure
- **Light green:** Active or planned **data center construction** but primarily by **regional or smaller players**, with total demand growth expected to remain **below 1 gigawatt**
- **Gray:** **No observable** data center development or associated electricity demand growth

## District Heating Applications Scoring Methodology

To evaluate the potential for geothermal direct-use in heating networks, we assessed the presence of existing thermal-based district heating systems that could integrate with or be converted to geothermal supply.

Countries were classified as follows:

- **Green:** Presence of **operating district heating networks** currently served by **thermal generation** (for instance, fossil fuel boilers), indicating high feasibility for geothermal integration
- **Light green:** **Some district heating infrastructure** that is limited in scope, or the country is primarily reliant on **nonthermal sources** (such as waste heat or biomass)
- **Gray:** **No observable district heating systems**, or only minimal installations with limited geographic or thermal relevance.

# Appendix II: Methodology for Figures 9-12

Figures 9–12 map composite scores based on the seven variables listed in Table One and detailed in Annex One.

## Methodology

- **Numeric conversion:** Each variable—next-generation resource potential, onshore oil & gas activity, existing geothermal activity, geothermal support, geothermal permitting, data center growth, and district heating—was assigned numeric values:
  - **High = 3, Medium = 2, Low = 1.**
    For the two inherently quantitative variables (resource potential and oil & gas activity), values were binned into three groups to align with this scale.
- **Weighting:**
  - Existing geothermal activity scores were **multiplied by 3**, reflecting the advantages of established supply chains, expertise, and subsurface data.
  - Geothermal support measures and permitting scores were **multiplied by 2** to emphasize the critical role of policy and regulatory clarity.
  - The remaining four variables were left unweighted. Demand-pull indicators (data centers, district heating) are not geothermal-specific, and while oil & gas activity can support geothermal, it does not drive it without supportive policies. Resource potential was also not weighted, as all countries analyzed already possess significant heat potential (that were not dissimilar in score from Appendix I).
- **Scoring range:** With these weights, composite scores range from a minimum of **11** to a maximum of **33**.

# Appendix III: Sources for Figure 8

## Germany

### *Geothermal Support Measures*


1. "Electricity Market Reform," European Council, May 22, 2024, https://www.consilium.europa.eu/en/policies/electricity-market-reform/.
2. Christian Boissavy, "Report Reviewing Existing Insurance Schemes for Geothermal," GEORISK, n.d., https://www.georisk-project.eu/wp-content/uploads/2020/02/D3.1_Report-reviewing-geothermal-risk-mitigation-schemes-v2.pdf.
3. Carlo Cariaga, "KfW, Munich RE Introduce Risk Protection Mechanism for Geothermal in Germany," ThinkGeoEnergy, October 17, 2024, https://www.thinkgeoenergy.com/kfw-munich-re-introduce-risk-protection-mechanism-for-geothermal-in-germany/.
4. Edoardo Scornajenghi and Francesca Isgrò, "Italian Geothermal Energy: State of the Art and Next Prospects," PWC, March 3, 2025, https://www.pwc.com/it/en/industries/energy-utilities1/geothermal-energy.html.
5. Carolina Kyllmann, "Q&A: How Will Germany Support the Expansion of Renewables in Future?," Clean Energy Wire, November 11, 2024, https://www.cleanenergywire.org/factsheets/qa-how-will-germany-support-expansion-renewables-future.
6. Kerstine Appunn, "Germany Stops Landmark Mechanism that Funded Renewables Expansion Via Power Bills," Clean Energy Wire, June 30, 2022, https://www.cleanenergywire.org/news/germany-stops-landmark-mechanism-funded-renewables-expansion-power-bills.


### *Geothermal Permitting*


1. "Germany," Global Geothermal Alliance, n.d., https://www.globalgeothermalalliance.org/Regions-and-countries/Countries/Germany#framework.
2. Carlo Cariaga, "Germany Approves Legislation Package to Expedite Approval of Geothermal Projects," ThinkGeoEnergy, September 5, 2024, https://www.thinkgeoenergy.com/germany-approves-legislation-package-to-expedite-approval-of-geothermal-projects/.


### *Data Center Growth*


1. "First IBM Quantum Data Center in Europe Opens; Will Include IBM›s Most Performant Quantum Systems," press release, IBM, October 1, 2024, https://newsroom.ibm.com/2024-10-01-first-ibm-quantum-data-center-in-europe-opens-will-include-ibms-most-performant-quantum-systems.
2. "'Hyperscaler': Microsoft Invests Billions in the Rheinische Revier Area," press release, NRW. Global Business, March 13, 2024, https://www.nrwglobalbusiness.com/de/ueber-uns/news/detail/hyperscaler-microsoft-invests-billions-in-the-rheinische-revier-area.
3. "Tishman Speyer to Build Major Data Center Campus in Frankfurt as AI Drives Demand for Significantly Increased Computing Power," press release, PR Newswire, May 13, 2024, https://www.prnewswire.com/news-releases/tishman-speyer-to-build-major-data-center-campus-in-frankfurt-as-ai-drives-demand-for-significantly-increased-computing-power-302143641.html.


### *District Heating Market*


1. "DHC Market Outlook 2024: Executive Summary," Euroheat & Power, n.d., https://api.euroheat.org/uploads/Final_Market_Outlook_2024_0efcdb4b7e.pdf.


## Türkiye

### *Geothermal Support Measures*


1. Olga Rosca, "EBRD and CTF Give Funding Boost to Turkey's Geothermal Energy," European Bank for Reconstruction and Development, January 14, 2016, https://www.ebrd.com/home/news-and-events/news/2016/ebrd-and-ctf-give-funding-boost-to-turkeys-geothermal-energy.html.
2. Gökhan Demirel, "The Feed-in Tariff System in Turkey," Rödl & Partner, April 18, 2024, https://www.roedl.com/insights/turkey-feed-in-tariff-system.
3. Carlo Cariaga, "New YEKDEM Scheme Announced for Renewables in Türkiye," ThinkGeoEnergy, May 3, 2023, https://www.thinkgeoenergy.com/new-yekdem-scheme-announced-for-renewables-in-turkiye/.
4. Carlo Cariaga, "Turkish Geothermal Sector Requests YEKDEM Incentive Scheme to Extend Until 2040," ThinkGeoEnergy, February 5, 2025, https://www.thinkgeoenergy.com/turkish-geothermal-sector-requests-yekdem-incentive-scheme-to-extend-until-2040/.

5. “Turkey to Scale-up Renewable Geothermal Energy Generation with World Bank Support,” press release, World Bank Group, December 16, 2021, https://www.worldbank.org/en/news/press-release/2021/12/16/turkey-to-scale-up-renewable-geothermal-energy-generation-with-world-bank-support?cid.
6. “Türkiye Jeotermal Risk Paylasim Mekanizmasi,” Türkiye Jeotermal Risk Paylasim Mekanizmasi, 2025, https://rpmjeoturkiye.com/en/homepage/.
7. “Türkiye,” Global Geothermal Alliance, n.d., https://www.globalgeothermalalliance.org/Regions-and-Countries/Countries/Turkey.

### *Geothermal Permitting*

1. “Jeotermal Kaynaklar Ve Dogal Mineralli Sular Kanunu,” Resmi Gazete, June 3, 2007, https://www.resmigazete.gov.tr/eskiler/2007/06/20070613-1.htm.

### *Data Center Growth*

1. Jason Ma, “Khazna to Build Data Center Near Ankara, Turkey,” Data Center Dynamics, April 30, 2025, https://www.datacenterdynamics.com/en/news/khazna-to-build-data-center-near-ankara-turkey/.
2. “Turkey Data Center Portfolio Report 2025: Turkey›s Data Center Market to See $200 Million in New Investments by 2026 - ResearchAndMarkets.com,” press release, Businesswire, June 26, 2025, https://www.businesswire.com/news/home/20250626975579/en/Turkey-Data-Center-Portfolio-Report-2025-Turkeys-Data-Center-Market-to-See-%24200-Million-in-New-Investments-by-2026---ResearchAndMarkets.com.

### *District Heating Market*

1. Carlo Cariaga, “Interview with Ufuk Sentürk – Chairman of JESDER, Turkey,” ThinkGeoEnergy, May 17, 2022, https://www.thinkgeoenergy.com/interview-with-ufuk-senturk-chairman-of-jesder-turkey/.
2. EGEC, “2020 EGEC Geothermal Market Report Key Findings,” European Geothermal Energy Council, June 2021, https://bodemenergie.nl/wp-content/uploads/2021/06/Key-Findings-EGEC-Geothermical-Market-Report-2020.pdf.

## Italy

### *Geothermal Support Measures*

1. David Wotherspoon, “The Impact of CfD (Contracts for Difference) on Italy’s FER2 Decree,” OWC, July 2, 2024, https://owcltd.com/media/blog/the-impact-of-cfd-contracts-for-difference-on-italys-fer2-decree/
2. PWC TLS, “EU Commission Approves FER 2 Decree. Some Preliminary Legal and Techno-economic Comments,” PWC, June 13, 2024, https://blog.pwc-tls.it/en/2024/06/13/eu-commission-approves-fer-2-decree-whats-new-for-innovative-or-high-cost-renewable-energy-sources-for-the-energy-transition-race-some-preliminary-legal-and-techno-economic-comments/.
3. Svenja Bartels, “The FER 2-Decree: New Subsidies for Offshore Wind Energy and Other Innovative Renewable Energy Sources,” Rödl & Partner, December 5, 2024, https://www.roedl.com/insights/renewable-energy/2024/october/italy-fer-2-decree-new-subsidies-offshore-wind-energy.
4. “Welcome to GeoElec,” European Geothermal Energy Council, 2025, https://www.geoelec.eu/.
5. “GEORISK Project,” European Geothermal Energy Council, https://www.egec.org/georisk-project/.
6. “Geothermal Energy Potential in Italy: An Untapped Treasure for Driving the Energy Transition,” Exergy, June 13, 2024, https://www.exergy-orc.com/geothermal-energy-potential-in-italy-an-untapped-treasure-for-driving-the-enegy-transition/.
7. Carlo Cariaga, “Italy Starts Consultation on Incentive Scheme for Geothermal Heating,” ThinkGeoEnergy, April 3, 2025, https://www.thinkgeoenergy.com/italy-starts-consultation-in-incentive-scheme-for-geothermal-heating/.

### *Geothermal Permitting*

1. Edoardo Scornajenghi and Francesca Isgrò, “Italian Geothermal Energy: State of the Art and Next Prospects,” PWC, March 3, 2025, https://www.pwc.com/it/en/industries/energy-utilities1/geothermal-energy.html.

### *Data Center Growth*

1. “Microsoft Invests €4.3B to Boost AI Infrastructure and Cloud Capacity in Italy,” press release, Microsoft, October 2, 2024, https://news.microsoft.com/it-it/2024/10/02/microsoft-invests-e4-3b-to-boost-ai-infrastructure-and-cloud-capacity-in-italy/.

2. "Italy Colocation Data Center Portfolio Analysis 2024: Current IT Load Capacity for 2023 and Future Capacity Additions 2024-2028 - ResearchAndMarkets.com," press release, Businesswire, July 16, 2024, https://www.businesswire.com/news/home/20240716360775/en/Italy-Colocation-Data-Center-Portfolio-Analysis-2024-Current-IT-Load-Capacity-for-2023-and-Future-Capacity-Additions-2024-2028---ResearchAndMarkets.com.

### *District Heating Market*

1. Carlo Cariaga, "AGSM AIM invests on geothermal project in Verona, Italy," ThinkGeoEnergy, January 11, 2024, https://www.thinkgeoenergy.com/agsm-aim-invests-on-geothermal-project-in-verona-italy/.
2. Carlo Cariaga, "Italy's National Energy Plan a Missed Opportunity for Geothermal," July 15, 2024, https://www.thinkgeoenergy.com/italys-national-energy-plan-a-missed-opportunity-for-geothermal/.

## Japan

### *Geothermal Support Measures*

1. "METI Sets the Surcharge Rate for FY2024, the Renewable Energy Purchase Prices for FY2024 Onward, and Other Details Relating to the FIT and FIP Schemes," Ministry of Economy, Trade and Industry, March 19, 2024, https://www.meti.go.jp/english/press/2024/0319_001.html.
2. "Japan Sets Feed-in Tariff Levels for Renewable Projects in 2022-2023," Enerdata, February 25, 2022, https://www.enerdata.net/publications/daily-energy-news/japan-sets-feed-tariff-levels-renewable-projects-2022-2023.html.
3. "Financial Support," Japan Organization for Metals and Energy Security, n.d., https://www.jogmec.go.jp/english/geothermal/geothermal_10_000003.html.
4. Carlo Cariaga, "JOGMEC Announces Subsidies for Six Geothermal Power Projects in Japan," ThinkGeoEnergy, June 24, 2024, https://www.thinkgeoenergy.com/jogmec-announces-subsidies-for-six-geothermal-power-projects-in-japan/.
5. Alexander Richter, "Japan's Government Pushing Geothermal Exploration and Development," ThinkGeoEnergy, August 27, 2021, https://www.thinkgeoenergy.com/japans-government-pushing-geothermal-exploration-and-development/.
6. "Japan Geothermal Energy Market Overview," ThinkGeoEnergy, May 2021, https://www.thinkgeoenergy.com/wp-content/uploads/2021/05/Japan-short.pdf.

### *Geothermal Permitting*

1. Joseph Bevash and Hiroki Kobayashi, "Japan," BBA//FJELDCO, May 2, 2018, https://www.geothermal.bba.is/country/japan.
2. Alexander Richter, "Japan Pushes Ahead with Deregulation Efforts for Geothermal," ThinkGeoEnergy, June 2, 2021, https://www.thinkgeoenergy.com/japan-pushes-ahead-with-deregulation-efforts-for-geothermal/.

### *Data Center Growth*

1. Dan Swinhoe, "Colt Launches Data Center in Tokyo, Japan," Data Center Dynamics, February 26, 2025, https://www.datacenterdynamics.com/en/news/colt-launches-data-center-in-tokyo-japan/.
2. "Ares Management Closes Inaugural US$2.4 Billion Data Center Development Fund in Japan," press release, Businesswire, June 11, 2025, https://www.businesswire.com/news/home/20250611308330/en/Ares-Management-Closes-Inaugural-US%242.4-Billion-Data-Center-Development-Fund-in-Japan.
3. Tomoko Nakajima and Kohshi Arnold Itagaki, "Japan Infrastructure Market Update: The Ever-Growing Rise of Data Centers," Freshfields, June 2, 2025, https://www.freshfields.com/en/our-thinking/briefings/2025/05/japan-infrastructure-market-update--the-ever-growing-rise-of-data-centers.

### *District Heating Market*

1. Iida Tetsunari, "The 4th Generation District Heating and Japan's Thermal Policy," Institute for Sustainable Energy Policies, December 1, 2022, https://www.isep.or.jp/en/1377/.

## Indonesia

### *Geothermal Support Measures*

1. Habibi Alhusni, et al., "Geothermal Business Outlook in Indonesia" (paper presented at the 48th Workshop on Geothermal Reservoir Engineering, Stanford, February 6–8, 2023), https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2023/Habibi.pdf.
2. "FP083 Indonesia Geothermal Resource Risk Mitigation Project," Green Climate Fund, n.d., https://www.greenclimate.fund/project/fp083.

3. “Risk Mitigation for Geothermal Development in Indonesia,” Global Infrastructure Hub, November 1, 2021, https://www.gihub.org/innovative-funding-and-financing/case-studies/risk-mitigation-for-geothermal-development-in-indonesia/.
4. “Indonesia Geothermal Electricity Finance (IGEF) Program,” Clean Investment Funds, n.d., https://www.cif.org/sites/cif_enc/files/meeting-documents/indonesia_geothermal_ctf_program_proposal_public.pdf.
5. “Indonesia Geothermal Resource Risk Mitigation Project (GREM),” World Bank, n.d., https://projects.worldbank.org/en/projects-operations/project-detail/P166071.

### *Geothermal Permitting*

1. Matthew Goerke, Dhani Maulana Pattinggi, and Paskalia Deviani Ekaputri, “Indonesia,” BBA//FJELDCO, April 28, 2018, https://www.geothermal.bba.is/country/indonesia.
2. Data Center Growth
3. Zachary Skidmore, “BDx Indonesia Signs 30MVA PPA to Power Indonesian Data Center Portfolio,” Data Center Dynamics, June 19, 2025, https://www.datacenterdynamics.com/en/news/bdx-indonesia-signs-30mva-ppa-to-power-indonesian-data-center-portfolio/.
4. “Equinix Unveils Its First AI-Ready Data Center with Dense Ecosystem in Jakarta,” press release, Equinix, May 15, 2025, https://www.equinix.com/newsroom/press-releases/hongkong/2025/05/equinix-unveils-its-first-ai-ready-data-center-with-dense-ecosystem-in-jakarta-.
5. Jan Yong, “Indonesia – Massive potential if obstacles can be overcome,” W.Media, May 14, 2025, https://w.media/indonesia-massive-potential-if-obstacles-can-be-overcome/.
6. David Chernicoff, “Thailand and Indonesia Look to Become Data Center Hubs For APAC,” Data Center Frontier, April 7, 2025, https://www.datacenterfrontier.com/site-selection/article/55275492/thailand-and-indonesia-look-to-become-data-center-hubs-for-apac.
7. Alissa Shebila, “The Future of Hyperscale Data Centers in Indonesia,” EDGE DC, December 2, 2024, https://edge.id/articles/the-future-of-hyperscale-data-centers-in-indonesia.

### *District Heating Market*

1. “US Firm Plans Geothermal Deep Closed-loop Cooling System in Bali, Indonesia,” International District Energy Agency, March 21, 2022, https://www.districtenergy.org/blogs/district-energy/2022/03/21/us-firm-plans-geothermal-deep-closed-loop-cooling.
2. “District Cooling System in Indonesia” (presentation presented at the 21st APEC Workshop on Energy Statistics, Tokyo, September 12–14, 2023), https://www.egeda.ewg.apec.org/egeda/meeting/21WSpresentations/S3-5.pdf.

## Philippines

### *Geothermal Support Measures*

1. Thess Sula, “Philippines Geothermal Energy,” International Trade Administration, July 26, 2024, https://www.trade.gov/market-intelligence/philippines-geothermal-energy.
2. AMALA Clean Energy Advisors, “Roadmap to Derisking Geothermal in the Philippines,” Asian Development Bank Final Report, May 2024, https://www.adb.org/projects/documents/reg-55140-001-tacr-0.
3. Lisbet K. Esmael, “DOE Eyes $250 Million to Bankroll De-risking Geothermal Facility,” *Philippine Daily Inquirer*, September 26, 2024, https://business.inquirer.net/482185/doe-eyes-250-million-to-bankroll-de-risking-geothermal-facility.
4. Alexander Chipman Koty, “Philippines Opens Renewable Energy to Full Foreign Ownership,” ASEAN Briefing, January 11, 2023, https://www.aseanbriefing.com/news/philippines-opens-renewable-energy-to-full-foreign-ownership/.
5. Carlo Cariaga, “Philippine Government Aims to Secure USD 250 Million for Geothermal Derisking Facility,” ThinkGeoEnergy, September 30, 2024, https://www.thinkgeoenergy.com/philippine-government-aims-to-secure-usd-250m-for-geothermal-derisking-facility/.
6. “Philippines’ Renewable Auction Oversubscribed with More than 7.5 GW of Bids,” Enerdata, February 17, 2025, https://www.enerdata.net/publications/daily-energy-news/philippines-renewable-auction-oversubscribed-more-75-gw-bids.html.

### *Geothermal Permitting*

1. “Republic of the Philippines Spotlight on Environmental, Social, and Governance (ESG) Agenda,” Bangko Sentral ng Pilipinas, May 2024, https://www.bsp.gov.ph/Pages/IRG/ESG%20presentation_%20May%202024.pdf.

2. Thess Sula, "Philippines Geothermal Energy," International Trade Administration, July 26, 2024, https://www.trade.gov/market-intelligence/philippines-geothermal-energy.

3. "Philippines Geothermal Energy Market Overview," ThinkGeoEnergy, May 2021, https://www.thinkgeoenergy.com/wp-content/uploads/2021/05/Philippines-short.pdf.

4. Alexander Chipman Koty, "Philippines Opens Renewable Energy to Full Foreign Ownership," ASEAN Briefing, January 11, 2023, https://www.aseanbriefing.com/news/philippines-opens-renewable-energy-to-full-foreign-ownership/.

### *Data Center Growth*

1. Hazel Moises, "From Paradise to Powerhouse: The Philippines Data Center Industry's Meteoric Rise," W.Media, July 1, 2024, https://w.media/from-paradise-to-powerhouse-the-philippines-data-center-industrys-meteoric-rise/.

2. "Philippines Data Center Market Investment Report 2025-2030: Coverage of 22 Existing and 11 Upcoming Third-party Data Center Facilities Across 7 Cities in the Philippines," press release, Globe Newswire, February 13, 2025, https://www.globenewswire.com/news-release/2025/02/13/3025781/28124/en/Philippines-Data-Center-Market-Investment-Report-2025-2030-Coverage-of-22-Existing-and-11-Upcoming-Third-party-Data-Center-Facilities-Across-7-Cities-in-the-Philippines.html.

3. Amber Jackson, "How Evolution Data Centres & CREC Power Green Data Centres," *Data Centre*, December 9, 2024, https://datacentremagazine.com/hyperscale/how-evolution-data-centres-crec-power-green-data-centres.

### *District Heating Market*

1. Doris Dumlao-Abadilla, "PH's Largest District Cooling System (DCS) Plant Switched On," *Philippine Daily Inquirer*, September 21, 2017, https://business.inquirer.net/237248/phs-largest-district-cooling-system-dcs-switched.

2. "ENGIE South East Asia Your Partner in District Cooling Systems (DCS)" (presentation presented at the APEC Workshop on District Cooling and/or Heating Systems, Hong Kong, September 2020), https://apec.sitefinity.cloud/docs/default-source/satellite/EGEEC/Files/Workshop4/03-2_ENGIE.pdf.

## Mexico

### *Geothermal Support Mechanisms*

1. Sebastian Schierenbeck, "Mexico – Building a Renewable Energy Market Without Conventional Feed-in-tariffs," Apricum GmbH (Berlin), February 27, 2014, https://apricum-group.com/mexico-building-renewable-energy-market-without-conventional-feed-tariffs/.

2. "Cover Page for CTF Project/Program Approval Request (Mexico)," Climate Investment Funds, 2014, https://fifspubprd.azureedge.net/cifdocuments/Project/1789/1789_XCTFMX504A_Mexico_Cover%20Page%20and%20Project%20Document.pdf.

3. "Geothermal Financing and Risk Transfer Program," Inter-American Development Bank (IDB), n.d., https://www.iadb.org/en/who-we-are/topics/financial-markets/financial-markets-initiatives/geothermal-financing-and-risk.

4. Francisco Flores-Espino, Sarah Booth, and Andrew Graves, "Mexico's Geothermal Market Assessment Report," National Renewable Energy Laboratory, Technical Report NREL/TP-6A20-63722, March 2017, https://docs.nrel.gov/docs/fy17o-sti/63722.pdf.

5. Perla Velasco, "Mexico Opens International Tender for Geothermal Well Development," Mexico Business News, October 28, 2024, https://mexicobusiness.news/energy/news/mexico-opens-international-tender-geothermal-well-development.

6. Alberto Campos, "Clean Energy Certificates: Will They Continue to Function Under Mexico's New Reform?," Trio Advisory, March 11, 2025, https://www.trioadvisory.com/resources/clean-energy-certificates-will-they-continue-function-under-mexicos-new-reform.

7. "ICC Mexico Urges Publication of CEL Requirements," Mexico Business News, March 5, 2024, https://mexicobusiness.news/energy/news/icc-mexico-urges-publication-cel-requirements.

8. Gabriela Cosio, "Mexico Reinstates Conditions for Clean Energy Certificates (CELs)," Garrigues, March 14, 2024, https://www.garrigues.com/en_GB/new/mexico-reinstates-conditions-clean-energy-certificates-cels.

### *Geothermal Permitting*

1. Francisco de Rosenzweig, Juan F. Ruenes Rosales, Juan Carlos Llorens Rojas, José Daniel Franco, Alberto De Villa Albarran, and Gustavo Neyra, "New Energy Laws," White & Case, March 21, 2025, https://www.whitecase.com/insight-alert/new-energy-laws.

### *Data Center Growth*

1. "Global Data Center Market Report 2025: Regional Market Overviews — Mexico," Pan American Finance, May 2025, https://panamericanfinance.com/insights/energy-transition/global-datacenter-market-report-2025/regional-market-overviews-gdmr2025/mexico-gdmr2025/.
2. Martin Menski, James Johnson, Amaury de Feydeau, "Data Center Boom in Latin America Calls for Accelerating Infrastructure Investment," White & Case, November 18, 2024, https://www.whitecase.com/insight-our-thinking/latin-america-focus-2024-data-center-infrastructure-investment.
3. Saf Malik, "ODATA Powers up Mexico's Largest Data Centre Campus, Fuelling AI and Cloud Growth," Capacity Media, February 28, 2025, https://www.capacitymedia.com/article/2eh7jnjtmtfpynb6mqiv6/news/odata-powers-up-mexicos-largest-data-centre-campus-fuelling-ai-and-cloud-growth.
4. "ODATA Announces the Launch of Its Largest Data Center in Mexico With 300 MW of IT Capacity," press release, ODATA, May 1, 2025, https://odatacolocation.com/en/blog/imprensa/odata-announces-the-launch-of-its-largest-data-center-in-mexico-with-300mw-of-it-capacity/.

### *District Heating Market*

1. Rhea Mukerjee, "Mexico City: A Case for Cooling Action," E3G, May 19, 2020, https://www.e3g.org/news/mexico-city-a-case-for-cooling-action/.

## Chile

### *Geothermal Support Measures*

1. Andrew Reed, "Geothermal Energy: Unleashing the Earth's Power to Fuel Chile's Future," NRDC, IB: 13-11-A, November 2013, https://www.nrdc.org/sites/default/files/chile-geothermal-IB.pdf.
2. "Geothermal Risk Reduction in Chile," IDB Sustainability, May 10, 2014, https://blogs.iadb.org/sostenibilidad/en/geothermal-risk-reduction-chile/.
3. "Cover Page for CTF Project/Program Approval Request (Chile)," Climate Investment Funds, 2015, https://fifspubprd.azureedge.net/cifdocuments/Project/1791/1791_PCTFCL222A_Chile_Cover%20Page.pdf.
4. "Geothermal Risk Mitigation Program (MiRiG)," Climate Investment Funds, n.d., https://www.cif.org/projects/geothermal-risk-mitigation-program-mirig.

### *Geothermal Permitting*

1. "Concesión de Geotermia (Ley Nº 19.657)," Chile Atiende, April 4, 2024, https://www.chileatiende.gob.cl/fichas/2287-concesion-de-geotermia-ley-n-19-657.
2. Carlo Cariaga, "Chile officially publishes new geothermal law," ThinkGeoEnergy, November 11, 2024, https://www.thinkgeoenergy.com/chile-officially-publishes-new-geothermal-law/.

### *Data Center Growth*

1. "Chile Data Center Portfolio Report 2025, with Coverage of 37 Existing and 14 Upcoming Data Centers Across Chacabuco, Colina, Comuna Valparaiso, Paine, Puerto Montt, Santiago, Temuco and Valparaiso," Globe Newswire, March 17, 2025, https://www.globenewswire.com/news-release/2025/03/17/3043482/28124/en/Chile-Data-Center-Portfolio-Report-2025-with-Coverage-of-37-Existing-and-14-Upcoming-Data-Centers-Across-Chacabuco-Colina-Comuna-Valparaiso-Paine-Puerto-Montt-Santiago-Temuco-and-V.html.
2. Amber Jackson, "Amazon Commits US$4bn to new AWS Infrastructure in Chile," *Data Centre*, May 7, 2025, https://datacentremagazine.com/critical-environments/amazon-commits-us-4bn-to-new-aws-infrastructure-in-chile.
3. Fabian Cambero, "Amazon to Spend $4 Billion on Cloud Infrastructure in Chile," Reuters, May 7, 2025, https://www.reuters.com/business/energy/amazon-spend-4-billion-cloud-infrastructure-chile-2025-05-07/.
4. "National Data Centers Plan 2024–2030," MinCiencia, n.d., https://www.minciencia.gob.cl/uploads/filer_public/29/c7/29c71595-69d1-4b1f-be58-b6946a1967f2/national_data_centers_plan.pdf.

## Kenya

### *Geothermal Support Measures*

1. "Feed-In-Tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity," Ministry of Energy, Government of Kenya, December 2012, https://repository.kippra.or.ke/server/api/core/bitstreams/611992c1-5437-4318-9fbf-808db328e57b/content.
2. "Renewable Energy Auctions Policy," Ministry of Energy, Government of Kenya, January 2021, https://communications.bowmanslaw.com/REACTION/emsdocuments/Renewable%20energy%20auction%20Policy.pdf.

3. Jared Kangwana, Alex Devereux, Lucy Mwaniki, and Andrew Njau, "The Legal Landscape of Renewable Energy in Kenya: Opportunities & Challenges for Global Investors," Clyde & Co., July 24, 2024, https://www.clydeco.com/en/insights/2024/07/the-legal-landscape-of-renewable-energy-in-kenya-o.
4. Carlo Cariaga, "Kenya Leverages Geothermal Supply in Newly Declared Olkaria Special Economic Zone," ThinkGeoEnergy, February 28, 2025, https://www.thinkgeoenergy.com/kenya-leverages-geothermal-supply-in-newly-declared-olkaria-special-economic-zone/.
5. Montel Kamau, "Kenya Ends Specially Discounted Power for Olkaria-Kedong SEZ: Implications for Industrial Investment and Economic Growth," Serrari Group, March 11, 2025, https://serrarigroup.com/kenya-ends-specially-discounted-power-for-olkaria-kedong-sez-implications-for-industrial-investment-and-economic-growth/.
6. "Geothermal Risk Mitigation Facility for Africa," GRMF, 2025, https://grmf-eastafrica.org/.

### *Geothermal Permitting*

1. "The Energy Act, 2019," Kenya Gazette Supplement, March 14, 2019, https://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/2019/EnergyAct__No.1of2019.PDF.

### *Data Center Growth*

1. "Microsoft and G42 Announce $1 Billion Comprehensive Digital Ecosystem Initiative for Kenya," press release, Microsoft, May 22, 2024, https://news.microsoft.com/source/2024/05/22/microsoft-and-g42-announce-1-billion-comprehensive-digital-ecosystem-initiative-for-kenya/.
2. Dina Bass and Farah Elbahrawy, "Microsoft, G42 Announce Geothermal-Powered Data Center in Kenya," Bloomberg, May 22, 2024, https://www.bloomberg.com/news/articles/2024-05-22/microsoft-g42-announce-1-billion-geothermal-data-center-in-kenya.
3. "iXAfrica Launches Kenya's First Hyperscale Data Centre in Partnership with Schneider Electric," press release, Schneider Electric, July 19, 2024, https://www.se.com/za/en/about-us/newsroom/news/press-releases/ixafrica-launches-kenya%E2%80%99s-first-hyperscale-data-centre-in-partnership-with-schneider-electric-669a26245f0a2ec8cf0e3441#.
4. "DFC Disburses $83 Million for Africa Data Centres to Expand ICT Infrastructure in South Africa," U.S. International Development Finance Corporation, August 15, 2022, https://www.dfc.gov/media/press-releases/dfc-disburses-83-million-africa-data-centres-expand-ict-infrastructure-south.
5. "Africa Data Centres Power Up," Energy News Network, June 19, 2025, https://energy-news-network.com/industry-news/africa-data-centres-power-up/.

### *District Heating*

1. "Kenya 2024 Energy Policy Review," International Energy Agency, 2024, https://iea.blob.core.windows.net/assets/98bc7ce1-b22d-48c9-9ca2-b668ffbfcc4b/Kenya2024.pdf.
2. "Africa Cooling Map," Kigali Cooling Efficiency Program, May 2018, https://www.k-cep.org/wp-content/uploads/2018/05/Africa-Cooling-map.pdf.
3. "Chilling Prospects 2022: Catalytic Finance for Energy-efficient, Climate-friendly Cooling for All in 2050," Sustainable Energy for All, April 22, 2022, https://www.seforall.org/data-stories/catalytic-finance-for-cooling.

## Taiwan

### *Geothermal Support Measures*

1. "TASS2024 Geothermal Energy: Taiwan's Hidden Treasure of Green Power," Sustainable Taiwan Expo 2025 and Circular Economy Forum, August 28, 2024, https://tassasiaexpo.com/en/tass2024-geothermal-energy-taiwans-hidden-treasure-of-green-power/.
2. Carlo Cariaga, "Taiwan Announces Incentive Program for Geothermal Projects," ThinkGeoEnergy, May 24, 2022, https://www.thinkgeoenergy.com/taiwan-announced-incentive-program-for-geothermal-projects/.

### *Geothermal Permitting*

1. "The Draft Amendment to Renewable Energy Development Act Passes Third Legislative Reading, Adding Regulations on 'Solar Panel Installation on Buildings' and the 'Chapter for Geothermal Energy'," Ministry of Economic Affairs, July 12, 2023, https://www.moea.gov.tw/MNS/english/news/News.aspx?kind=6&menu_id=176&news_id=110545.
2. "The Geothermal Exploration Development Permit and Management Regulation Has Been Officially Announced," EnergyOMNI, June 3, 2024, https://www.energy-omni.com/en/news/article/C9Dzz98YnFhw9ht0.

### *Data Center Growth*

1. Annie Huang, "Taiwan's AI Data Center Boom Faces Power Bottleneck," *DigiTimes*, September 25, 2024, https://www.digitimes.com/news/a20240924PD207/taiwan-data-center-data-cooling-efficiency.html.
2. "AWS to Launch an Infrastructure Region in Taiwan," press release, Amazon, June 11, 2024, https://press.aboutamazon.com/2024/6/aws-to-launch-an-infrastructure-region-in-taiwan.
3. Keoni Everington, "Apple Reportedly Plans Data Center in Taiwan," *Taiwan News*, June 25, 2024, https://www.taiwannews.com.tw/news/5895338.

### *District Heating Market*

1. Darrell Proctor, "New GE Gas-Fired Plant Part of Taiwan's Energy Transition," *Power Magazine*, August 10, 2021, https://www.powermag.com/new-ge-gas-fired-plant-part-of-taiwans-energy-transition/.

## Costa Rica

### *Geothermal Support Measures*

1. "Costa Rica (REI) Investment Plan," Climate Investment Funds, November 3, 2023, https://www.cif.org/sites/cif_enc/files/2024-02/gcap_tfc.5_04_rev.01_costa_rica_rei_investment_plan_october.pdf.
2. "Taxes and Incentives for Renewable Energy," KPMG, September 2015, https://assets.kpmg.com/content/dam/kpmg/pdf/2015/09/taxes-and-incentives-2015-web-v2.pdf.
3. Magnus Gehringer and Victor Loksha, "Geothermal Handbook: Planning and Financing Power Generation," Energy Sector Management Assistance Program, June 2012, https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/FINAL_Geothermal%20Handbook_TR002-12_Reduced.pdf.

### *Geothermal Permitting*

1. La Asamblea Legislativa de la República de Costa Rica, "Law 5961 - Geothermal Energy," The University of New Mexico Digital Repository, 1976, https://digitalrepository.unm.edu/la_energy_policies/180.
2. Alexander Richter, "Costa Rica Submits Geothermal Direct Use Legislation for Consultation," ThinkGeoEnergy, December 5, 2021, https://www.thinkgeoenergy.com/costa-rica-submits-geothermal-direct-use-legislation-for-consultation/.

### *Data Center Growth*

1. Dan Swinhoe, "Navégalo to Open Data Center in San José, Costa Rica," Data Center Dynamics, July 7, 2023, https://www.datacenterdynamics.com/en/news/nav%C3%A9galo-to-open-data-center-in-san-jos%C3%A9-costa-rica/.

### *District Heating Market*

1. Rodolfo González, "When Coming Together Cools the Environment… and the Economy," Dirección de Gestiéon de Calidad Ambiental, n.d., http://www.digeca.go.cr/when-coming-together-cools-environment-and-economy.

## El Salvador

### *Geothermal Support Measures*

1. "Concept Environmental and Social Review Summary Concept Stage," World Bank, January 17, 2025, https://documents1.worldbank.org/curated/en/099080824130534817/pdf/P50610916d0e5602c1b05810f4414fe7adf.pdf.
2. "El Salvador Geothermal Energy Market Overview," ThinkGeoEnergy, April 2021, https://www.thinkgeoenergy.com/wp-content/uploads/2021/05/El-Salvador-short.pdf.
3. Todd Smith, "Assessing El Salvador's Energy Sector," Center for Energy Science & Policy (CESP), George Mason University, n.d., https://cesp.gmu.edu/assessing-el-salvadors-energy-sector/#_ftn34.
4. "Promotion of Renewable Energies in El Salvador," Zone Environmental Services, May 27, 2022, https://zone-es.com/en/fomento-de-las-energias-renovables-en-el-salvador/.

### *Geothermal Permitting*

1. "Decreto No. 843," Asamblea Legislativa – Republica de el Saldvador, https://www.asamblea.gob.sv/sites/default/files/documents/decretos/171117_072910206_archivo_documento_legislativo.pdf.

### *Data Center Growth*

1. Niva Yadav, "Codisa Data Center Inaugurated in El Salvador," Data Center Dynamics, July 18, 2024, https://www.datacenterdynamics.com/en/news/codisa-data-center-inaugurated-in-el-salvador/.
2. "El Salvador to Expand Digital Infrastructure with IDB Support," Inter-American Development Bank (IADB), n.d., https://www.iadb.org/en/news/el-salvador-expand-digital-infrastructure-idb-support.

### *District Heating Market*

1. Ryan C. Berg, et al., "Turning Up the Heat on Geothermal Energy Development in Latin America," CSIS, March 10, 2023, https://www.csis.org/analysis/turning-heat-geothermal-energy-development-latin-america.
2. "El Salvador and Honduras Advance Energy-efficient and Climate-friendly Air Conditioners Through MVE Mechanisms and Testing Standards," United 4 Efficiency, October 26, 2022, https://united4efficiency.org/el-salvador-and-honduras-advance-energy-efficient-and-climate-friendly-air-conditioners/.

## France

### *Geothermal Support Measures*

1. "Electricity Market Reform," European Council, May 22, 2024, https://www.consilium.europa.eu/en/policies/electricity-market-reform/.
2. Virginie Schmidlé-Bloch, et al., "Geothermal Energy Use, Country Update for France" (paper presented at the European Geothermal Congress 2022, Berlin, October 17–21, 2022), https://www.afpg.asso.fr/wp-content/uploads/2023/02/EGC_2022_FRANCE-country-update.pdf.
3. "France," IEA Geothermal, n.d., https://www.iea-gia.org/our-members/france.
4. "Deep Geothermal Energy in France: Sector study 2024," French Association of Geothermal Energy Professionals, 2024, https://afpg-extranet.s3.amazonaws.com/media/2025/2/18/Sector%20study%202024%20-%20Deep%20geothermal%20energy.pdf.
5. Carlo Cariaga, "EUR 195M Guarantee Fund Approved for Deep Geothermal Projects in France," ThinkGeoEnergy, August 8, 2023, https://www.thinkgeoenergy.com/eur-195m-guarantee-fund-approved-for-deep-geothermal-projects-in-france/.
6. "French Geothermal Know-how," GEODEEP, n.d., https://www.geodeep.fr/geodeep-cluster/the-french-know-how/.
7. "French Strategy for Energy and Climate," Ministere de la Transition Écologique et Solidaire, April 10, 2019, https://www.ecologie.gouv.fr/sites/default/files/documents/0-PPE%20English%20Version%20With%20Annex_0.pdf.
8. Rhys Talbot, "France to Review Role of Renewables in Energy Plan," Argus Media, April 30, 2025, https://www.argusmedia.com/en/news-and-insights/latest-market-news/2683502-france-to-review-role-of-renewables-in-energy-plan.

### *Geothermal Permitting*

1. Romaric Lazerges, Paul Vandecrux, and Pauline Choplin, "France," BBA//FJELDCO, April 28, 2018, https://www.geothermal.bba.is/country/france.

### *Data Center Growth*

1. Dan Swinhoe, "Iliad to Invest €2.5 billion into OpCore Data Center Unit," Data Center Dynamics, May 31, 2024, https://www.datacenterdynamics.com/en/news/iliad-to-invest-25-billion-into-opcore-data-center-unit/.
2. Dan Swinhoe, "Equinix "Actively Seeking" Partners for District Heating Ambitions," Data Center Dynamics, June 6, 2024, https://www.datacenterdynamics.com/en/news/equinix-actively-seeking-partners-for-district-heating-ambitions/.
3. Georgia Butler, "Communes of Ernée to Deploy Two Immersion Cooled Data Centers with Numains-Hyperion in France," Data Center Dynamics, June 12, 2024, https://www.datacenterdynamics.com/en/news/communes-of-ernee-to-deploy-two-immersion-cooled-data-centers-with-numains-hyperion-in-france/.
4. Niva Yadav, "Netsooon.ai Launches Eco Data Center Subsidiary DataGreen," Data Center Dynamics, September 11, 2024, https://www.datacenterdynamics.com/en/news/netsooonai-launches-eco-data-center-subsidiary-datagreen/.
5. Matthew Gooding, "France and UAE to Invest Billions into 1GW European AI data center," Data Center Dynamics, February 7, 2025, https://www.datacenterdynamics.com/en/news/france-and-uae-to-invest-billions-into-1gw-european-ai-data-center/.

### *District Heating Market*

1. "DHC Market Outlook 2024: Executive Summary," Euroheat & Power, n.d., https://api.euroheat.org/uploads/Final_Market_Outlook_2024_0efcdb4b7e.pdf.

2. Dan Swinhoe, “Equinix “Actively Seeking” Partners for District Heating Ambitions,” Data Center Dynamics, June 6, 2024, https://www.datacenterdynamics.com/en/news/equinix-actively-seeking-partners-for-district-heating-ambitions/.

## Spain

### *Geothermal Support Measures*

1. Pedro L. Marín, José Antonio García, and Fernando Bañez, “Spain,” in *The Energy Regulation and Markets Review*, ed. David L. Schwartz (Law Business Research, 2023), https://www.brattle.com/wp-content/uploads/2023/07/The-Energy-Regulation-and-Markets-Review-Spain.pdf.
2. Edoardo Scornajenghi and Francesca Isgrò, “Italian Geothermal Energy: State of the Art and Next Prospects,” PWC, March 3, 2025, https://www.pwc.com/it/en/industries/energy-utilities1/geothermal-energy.html.

### *Geothermal Permitting*

1. “Grid Connection Permit Process,” European Commission Clean Energy for EU islands, n.d., https://clean-energy-islands.ec.europa.eu/countries/spain/legal/permits-and-authorisation-processes/grid-connection-permit-process.
2. Pia V. Kohrs, “Energy Law in Spain (1): New Regulation for Grid Connection and Feed-in Permits,” Mariscal Abogados, n.d., https://www.mariscal-abogados.com/energy-law-in-spain-1-new-regulation-for-grid-connection-and-feed-in-permits/.

### *Data Center Growth*

1. Danielle Myles, “Aragon Primed to Become Europe’s New Data Centre Hub,” FDI Intelligence, July 25, 2024, https://www.fdiintelligence.com/content/5dda38eb-7079-5da6-aa69-f03659222151.
2. Rodrigo Orihuela and Clara Hernanz Lizarraga, “Data Centers Are Becoming a Political Tool for Spain’s Government,” Bloomberg, July 25, 2024, https://www.bloomberg.com/news/articles/2024-07-25/data-centers-are-becoming-a-political-tool-for-spain-s-government.
3. Dan Swinhoe, “Blackstone to Develop 300MW Data Center Campus in Aragon, Spain,” Data Center Dynamics, October 15, 2024, https://www.datacenterdynamics.com/en/news/blackstone-to-develop-300mw-data-center-campus-in-aragon-spain/.
4. Dan Swinhoe, “Edged and Merlin to Develop Two Gigawatt-scale Data Center Campuses in Spain,” Data Center Dynamics, January 14, 2025, https://www.datacenterdynamics.com/en/news/edged-and-merlin-to-develop-two-gigawatt-scale-data-center-campuses-in-spain/.

### *District Heating Market*

1. Martín Balboa-Fernández, et al., “Analysis of District Heating and Cooling Systems in Spain,” *Energy Reports* 6 (December 2020), 532-537, https://www.sciencedirect.com/science/article/pii/S2352484720316280.
2. “EU Tracker – Local Heating and Cooling Plans in Spain,” Energy Cities, 2025, https://energy-cities.eu/countries/spain/.
3. Carlo Cariaga, “Valencia, Spain Offers Subsidies for Geothermal, Other Renewables,” ThinkGeoEnergy, January 15, 2024, https://www.thinkgeoenergy.com/valencia-spain-offers-subsidies-for-geothermal-other-renewables/.

## Romania

### *Geothermal Support Measures*

1. “Integrated National Energy Climate Plan of Romania 2021–2030 Update,” European Commission, November 2023, https://commission.europa.eu/system/files/2023-11/ROMANIA%20-%20DRAFT%20UPDATED%20NECP%202021-2030.pdf.
2. Varinia Radu and Ramona Dulamea, “Romania Enacts CfD Support Scheme with First Auction Launched,” CMS Law-Now, September 11, 2024, https://cms-lawnow.com/en/ealerts/2024/09/romania-enacts-cfd-support-scheme-with-first-auction-launched.
3. Monica Iancu, Ionel Macovei, and Vasile Soltan, “Power Generation, Transmission & Distribution 2024,” July 18, 2024, https://practiceguides.chambers.com/practice-guides/comparison/1244/13800/21766-21767-21768-21769-21770.
4. Christina Baisch, Philipp Wolpert, and Georgie Friederichs, “A Risk Mitigation Framework for Community-Based Financing in Geothermal,” *European Geologist* 54 (2022), https://doi.org/10.5281/zenodo.7602267.
5. Alexander Richter, “Four Areas for Potential Geothermal Power Generation Discovered in Romania,” ThinkGeoEnergy, October 12, 2020, https://www.thinkgeoenergy.com/four-areas-for-potential-geothermal-power-generation-discovered-in-romania/.

6. Mia Kristine Martinussen and Ana-Maria Axenia, "Romania-Iceland Collaboration on Geothermal Energy - Highlights from working visit in Reykjavik," Innovation Norway, November 15, 2024, https://eea.innovationnorway.com/article/romania-iceland-collaboration-on-geothermal-energy.

7. "GENEX- Geothermal Energy Explorer- Capacity Building at the Government Level in the Area of Geothermal," EEA Grants, n.d., https://eeagrants.org/archive/2014-2021/projects/RO-ENERGY-0001.

### *Geothermal Permitting*

1. "FPPG Calls for Updated Legislation to Support Geothermal Energy in Romania," Energynomics, September 12, 2024, https://www.energynomics.ro/en/fppg-calls-for-updated-legislation-to-support-geothermal-energy-in-romania/.

### *Data Center Growth*

1. Dan Swinhoe, "Two Data Center Developments Totaling 45MW Planned in Romania," Data Center Dynamics, February 15, 2024, https://www.datacenterdynamics.com/en/news/two-data-center-developments-totaling-45mw-planned-in-romania/.

2. Petre Barac, "Tema Energy: Romania Could at Least Triple its Data Center Market in the Next Three Years," The Diplomat-Bucharest, April 2, 2024, https://www.thediplomat.ro/2024/04/02/tema-energy-romania-could-at-least-triple-its-data-center-market-in-the-next-three-years/.

### *District Heating Market*

1. Raluca Petcu, "Romania's Fossil Fuel-driven District Heating Plans are Holding Back a Sustainable Energy Transition," CEE Bankwatch Network, August 23, 2023, https://bankwatch.org/blog/romania-s-fossil-fuel-driven-district-heating-plans-are-holding-back-a-sustainable-energy-transition.

2. "Modernising Heating Systems in Romanian Cities," European Investment Bank, June 13, 2022, https://www.eib.org/en/stories/modernising-heating-systems-romanian-cities.

## Ethiopia

### *Geothermal Support Measures*

1. Atkilit Bekele, "The New Geothermal Proclamation No. 981 2016," Simmons & Simmons, April 10, 2017, https://www.simmons-simmons.com/publications/ck0b4flqgnw1t0b36xr3k0w2x/100417-the-new-geothermal-proclamation-4fr1ca.

2. Carlo Cariaga, "MIGA, World Bank Increases Insurance Coverage for Tulu Moye Geothermal, Ethiopia," ThinkGeoEnergy, November 17, 2023, https://www.thinkgeoenergy.com/miga-world-bank-increases-insurance-coverage-for-tulu-moye-geothermal-ethiopia/.

3. "Restructuring Paper on a Proposed Project Restructuring of Ethiopia Geothermal Sector Development Project Approved on May 29, 2014, to Government of Ethiopia," World Bank, RES56710, n.d., https://documents1.worldbank.org/curated/en/099120923195519746/pdf/P13361304f7fc2056080be0de223388e48d.pdf.

4. "Ethiopia: Sustainable Energy Fund for Africa provides $10 million Grant to Support Tulu Moye Geothermal Resource Development," press release, African Development Bank, December 8, 2022, https://www.afdb.org/en/news-and-events/press-releases/ethiopia-sustainable-energy-fund-africa-provides-10-million-grant-support-tulu-moye-geothermal-resource-development-57228.

5. "Geothermal Risk Mitigation Facility for Africa," GRMF, 2025, https://grmf-eastafrica.org/.

### *Geothermal Permitting*

1. Atkilit Bekele, "New Regulation on Geothermal Resource Development," Mesfin Tafesse & Associates, September 24, 2019, https://www.mtalawoffice.com/insights-news/entry/new-regulation-on-geothermal-resource-development.

2. Atkilit Bekele, "The New Geothermal Proclamation No.981/2016," *Legal Update* 10 (October 2016), https://www.mtalawoffice.com/images/upload/OCTOBER_2016.pdf.

3. Atkilit Bekele, "The new Geothermal Proclamation No. 981 2016," Simmons & Simmons, April 10, 2017, https://www.simmons-simmons.com/publications/ck0b4flqgnw1t0b36xr3k0w2x/100417-the-new-geothermal-proclamation-4fr1ca.

### *Data Center Growth*

1. "Ethiopia Data Center Market Investment Analysis & Growth Opportunities Report 2023-2028 Featuring Key DC Investors - Raxio Data Centres, Safaricom, and wingu.africa - ResearchAndMarkets.com," press release, Businesswire, November 16, 2023, https://www.businesswire.com/news/home/20231116139171/en/Ethiopia-Data-Center-Market-Investment-Analysis-Growth-Opportunities-Report-2023-2028-Featuring-Key-DC-Investors---Raxio-Data-Centres-Safaricom-and-wingu.africa---ResearchAndMarkets.com.

2. "Raxio Continues Support of Africa's Digital Transformation and Digital Economy with Launch of New Flagship Data Centre in Ethiopia," press release, Raxio, November 21, 2023, https://www.raxiogroup.com/raxio-continues-support-of-africas-digital-transformation-and-digital-economy-with-launch-of-new-flagship-data-centre-in-ethiopia/.
3. Paula Gilbert, "Raxio Launches Flagship Data Center in Ethiopia," Connecting Africa, November 22, 2023, https://www.connectingafrica.com/data-centers/raxio-launches-flagship-data-center-in-ethiopia.


## Vietnam

### *Geothermal Support Measures*


1. "Vietnam Country Commercial Guide," U.S. International Trade Administration, January 30, 2024, https://www.trade.gov/country-commercial-guides/vietnam-power-generation-transmission-and-distribution.
2. Duc Tran, "Direct PPAs–A New Opportunity in Vietnam," A&O Shearman, July 19, 2024, https://www.aoshearman.com/en/insights/direct-ppas-a-new-opportunity-in-vietnam.
3. Net Le, Thi Thinh Vu, Anh Thu Le, "Project Finance 2024, Vietnam, Trends and Developments," Chambers and Partners, November 5, 2024, https://practiceguides.chambers.com/practice-guides/project-finance-2024/vietnam/trends-and-developments.
4. "Resolution of the Politburo on Orientations of the Viet Nam's National Energy Development Strategy to 2030 and Outlook to 2045," Central Committee of the Communist Party of Vietnam, February 11, 2020, https://vepg.vn/wp-content/uploads/2020/03/CPCs-Resolution-55.NQ-TW-on-Energy-Development-Strategy-to-2030-and-outlook-to-2045.pdf.


### *Geothermal Permitting*


1. "Geothermal Transparency Guide," BBA, 2017, https://www.vnf.com/webfiles/GEOTHERMAL-TRANSPARENCY-GUIDE_WEB.pdf.


### *Data Center Growth*


1. Jason May, "Viettel Breaks Ground on Data Center in Ho Chi Minh City, Vietnam," Data Center Dynamics, April 26, 2025, https://www.datacenterdynamics.com/en/news/viettel-breaks-ground-on-data-center-in-ho-chi-minh-city-vietnam/.
2. Trang Le, "Is Vietnam's Data Center Market Ready for Take-Off?," JLL, accessed June 30, 2025, https://www.jll.com/en-au/guides/is-vietnams-data-centre-market-ready-for-take-off.


## Australia

### *Geothermal Support Measures*


1. Cameron Huddlestone-Holmes, "Geothermal Energy in Australia," CSIRO, July 11, 2014, https://arena.gov.au/assets/2017/02/Geothermal-Energy-in-Australia.pdf.
2. "Exploration Incentive Scheme (EIS)," Government of Western Australia, April 16, 2025, https://www.wa.gov.au/organisation/geological-survey-of-western-australia/exploration-incentive-scheme-eis, https://www.wa.gov.au/organisation/geological-survey-of-western-australia/exploration-incentive-scheme-eis.
3. "Exploration Incentive Scheme," Government of Western Australia, April 2025, https://www.wa.gov.au/system/files/2025-04/drillingprevioussuccessfulapplicants1-30.pdf.


### *Geothermal Permitting*


1. Rosalind Archer, Christine Le Billon, and Adam Stepanoff, "Is the Australian Geothermal Industry 'Gathering Steam'?" (paper presented at the 46th New Zealand Geothermal Workshop, Auckland, November 20-22, 2024), https://www.worldgeothermal.org/pdf/IGAstandard/NZGW/2024/062.pdf.


### *Data Center Growth*


1. Dan Swinhoe, "Microsoft to Invest AU$5 Billion Expanding Australian Data Center Footprint," Data Center Dynamics, October 24, 2023, https://www.datacenterdynamics.com/en/news/microsoft-to-invest-au5-billion-expanding-australian-data-center-footprint/.
2. Niva Yadav, "NextDC Seeks $1.8bn Loan for Asia Expansion," Data Center Dynamics, September 13, 2024, https://www.datacenterdynamics.com/en/news/nextdc-seeks-18bn-loan-for-asia-expansion/.
3. "Earths Energy Initiates Study of Geothermally Powered Data Centres in Queensland," Earths Energy, September 19, 2024, https://clients3.weblink.com.au/pdf/EE1/02854403.pdf.
4. Dan Swinhoe, "Telstra Signs Solar PPA in New South Wales, Australia," Data Center Dynamics, September 11, 2024, https://www.datacenterdynamics.com/en/news/telstra-signs-solar-ppa-in-new-south-wales-australia/.

### *District Heating Market*

1. Joanne Emerson Taqi, "District Energy: Review of International Regulation and the Future of District Heating and Cooling in Australia," White & Case, August 22, 2023, https://www.whitecase.com/insight-alert/district-energy-review-international-regulation-and-future-district-heating-and.

## Hungary

### *Geothermal Support Measures*

1. "Renewables in Hungary," CEE Legal Matters, June 12, 2023, https://ceelegalmatters.com/renewable-energy-2023/renewable-energy-hungary-2023.
2. "Renewable Energy Support Scheme (METAR) - 2021," International Energy Agency, October 29, 2021, https://www.iea.org/policies/13946-renewable-energy-support-scheme-metar-2021.
3. "Hungary Offers Loans to Double Geothermal Energy Use by 2030," Enerdata, April 24, 2024, https://www.enerdata.net/publications/daily-energy-news/hungary-offers-loans-double-geothermal-energy-use-2030.html.
4. Carlo Cariaga, "Hungary Publishes National Strategy to Double Geothermal Output by 2030," ThinkGeoEnergy, April 29, 2024, https://www.thinkgeoenergy.com/hungary-publishes-national-strategy-to-double-geothermal-output-by-2030/.

### *Geothermal Permitting*

1. "Hungary," DARLINGe, n.d., https://www.darlinge.eu/data/licensing_pdfs/Annex4.pdf.

### *Data Center Growth*

1. "Hungary Data Centre Market Landscape Report 2022-2026: Modest Growth Projected with No Plans Identified for Large New Data Centre Facilities," Globe Newswire, December 16, 2022, https://www.globenewswire.com/news-release/2022/12/16/2575348/28124/en/Hungary-Data-Centre-Market-Landscape-Report-2022-2026-Modest-Growth-Projected-with-No-Plans-Identified-for-Large-New-Data-Centre-Facilities.html.

### *District Heating Market*

1. Aniko N. Toth, "Creating a Geothermal Atlas of Hungary," (paper presented at the 42nd Workshop on Geothermal Reservoir Engineering, Stanford, February 13-15, 2017), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2017/Toth.pdf.
2. David Strasszer and George Xydis, "Integrating Geothermal Energy in Hungary: A Case Study on Sustainable Urban Heating and Emissions Mitigation through the District Heating Infrastructure," *Tunnelling and Underground Space Technology* 149 (July 2024), https://doi.org/10.1016/j.tust.2024.105804.
3. "Hungary Aims to Double Geothermal Energy Use by 2030," bne IntelliNews, April 19, 2024, https://www.intellinews.com/hungary-aims-to-double-geothermal-energy-use-by-2030-321839/.
4. Carlo Cariaga, "Hungary Publishes National Strategy to Double Geothermal Output by 2030," ThinkGeoEnergy, April 29, 2024, https://www.thinkgeoenergy.com/hungary-publishes-national-strategy-to-double-geothermal-output-by-2030/.
5. Selene Verri, "The Future is Geothermal: Hungarian City Leads the Way with Renewable Energy," Euronews, April 15, 2024, https://www.euronews.com/my-europe/2024/04/15/hungary-boasts-the-eus-largest-geothermal-system.

## Colombia

### *Geothermal Support Measures*

1. IRENA and USAID, "Renewable Energy Auctions in Colombia: Context, Design and Results," International Renewable Energy Agency, 2021, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/March/IRENA_auctions_in_Colombia_2021.pdf.
2. "Colombia Factsheet: Policy and Market Landscape for Consumer Renewable Energy," BASE, July 2024, https://energy-base.org/wp-content/uploads/2024/07/Colombia-Factsheet.pdf.
3. Joan Prats, et al., "Colombia Investment Grant for the Financing and Risk Transfer Program for Geothermal Power," Climate Investment Funds, n.d., https://cif.org/sites/cif_enc/files/meeting-documents/utility-scale_geothermal-colombia-project_document.pdf.

### *Geothermal Permitting*

1. IRENA and USAID, "Renewable Energy Auctions in Colombia: Context, Design and Results," International Renewable Energy Agency, 2021, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/March/IRENA_auctions_in_Colombia_2021.pdf.

2. Peña Mancero Abogados, "Renewable Energy Investments in Colombia," Alliott Global Alliance, April 2024, https://www.alliottglobal.com/media/7813/teaser-colombia-renewable-energy-investment.pdf.

3. Joan Prats, et al., "Colombia Investment Grant for the Financing and Risk Transfer Program for Geothermal Power," Climate Investment Funds, n.d., https://cif.org/sites/cif_enc/files/meeting-documents/utility-scale_geothermal-colombia-project_document.pdf.

### *Data Center Growth*

1. "Data Centers," Procolombia, n.d., https://investincolombia.com.co/en/sectors/information-technology-and-creative-industries/data-centers.

2. Dan Swinhoe, "V.tal Inaugurates Second Colombian Data Center in Barranquilla," Data Center Dynamics, April 19, 2024, https://www.datacenterdynamics.com/en/news/vtal-inaugurates-second-colombian-data-center-in-barranquilla/.

## India

### *Geothermal Support Measures*

1. Anil Kumar, "Subject: Constitution of Task Force to Harness Geothermal Energy in India," Government of India, Ministry of New and Renewable Energy, August 29, 2024, https://mnre.gov.in/en/notice/constitution-of-task-force-to-harness-geothermal-energy-in-india/.

### *Geothermal Permitting*

1. Rituraj Baruah, "Govt Eyes Finalizing Geothermal Policy, Plans Demonstration Projects of Up to 25 MW," Mint, April 22, 2024, https://www.livemint.com/economy/govt-eyes-finalizing-geothermal-policy-plans-demonstration-projects-of-up-to-25-mw-11713783289513.html.

### *Data Center Growth*

1. Aditi Vij, "India›s Data Centre Revolution: Potential for 5X Capacity Expansion to Fuel Digital Transformation: Cushman & Wakefield," Cushman & Wakefield, July 8, 2024, https://www.cushmanwakefield.com/en/india/news/2024/07/potential-for-5x-capacity-expansion-to-fuel-digital-transformation.

### *District Heating Market*

1. "The District Energy in Cities Initiative in India moves to the next phase," ICLEI South Asia, November 23, 2017, https://southasia.iclei.org/news/the-district-energy-in-cities-initiative-in-india-moves-to-the-next-phase/.

## Tanzania

### *Geothermal Support Measures*

1. "Country Snapshot: Tanzania," Norton Rose Fulbright, October 2015, https://www.nortonrosefulbright.com/en-us/knowledge/publications/4fae8eb4/country-snapshot-tanzania.

2. Matthias Klarl, "Eastern Africa: Electricity Market in Tanzania and latest developments," Rödl & Partner, 2019, https://www.roedl.com/insights/renewable-energy/2019-08/eastern-africa-electricity-market-in-tanzania-and-latest-developments.

3. "Geothermal Risk Mitigation Facility for Africa," GRMF, 2025, https://grmf-eastafrica.org/.

4. United Republic of Tanzania Ministry of Energy and Minerals, "Investment Plan for Tanzania," Scaling-Up Renewable Energy Programme, May 2013, https://www.cif.org/sites/cif_enc/files/srep_tanzania_investment_plan_design.pdf.

5. "National Energy Compact for United Republic of Tanzania," Mission 300 Africa Energy Summit, January 2025, https://mission300africa.org/energysummit/wp-content/uploads/2025/01/Tanzania-National-Energy-Compact.pdf.

### *Geothermal Permitting*

1. "Fact Sheet for Geothermal Development to Promote Public Private Partnerships in East Africa," United Nations Industrial Development Organization, n.d., https://downloads.unido.org/ot/32/09/32096052/Geothermal%20fact%20sheet%20for%20promoting%20PPP%20-Tanzania.pdf.

2. "Tanzania - Renewable Energy," International Trade Administration, 2021, https://www.trade.gov/energy-resource-guide-tanzania-renewable-energy.

### *Data Center Growth*

1. Georgia Butler, "Raxio Invests in Building Tanzania Data Center," Data Center Dynamics, March 23, 2022, https://www.datacenterdynamics.com/en/news/raxio-invests-in-building-tanzania-data-center/.

2. Dan Swinhoe, “Wingu.Africa Breaks Grounds on Data Center Expansion in Dar es Salaam, Tanzania,” Data Center Dynamics, March 20, 2025, https://www.datacenterdynamics.com/en/news/winguafrica-breaks-grounds-on-data-center-expansion-in-dar-es-salaam-tanzania/.

## Malaysia

### Geothermal Support Measures

1. “Feed-in Tariff,” Sustainable Energy Development Authority Malaysia, accessed June 30, 2025, https://www.seda.gov.my/reportal/fit/.
2. Shabrina Nadhila and Dinita Setyawati, “Solar and Grid Flexibility Critical for Malaysia’s Future Electricity Affordability and Security,” Ember, August 7, 2024, https://ember-energy.org/latest-insights/solar-and-grid-flexibility-critical-for-malaysia/#chapter-1-malaysias-electricity-landscape.

### Geothermal Permitting

1. Carlo Cariaga, “Interview, Making the Case for Geothermal Development in Malaysia,” ThinkGeoEnergy, August 26, 2024, https://www.thinkgeoenergy.com/interview-making-the-case-for-geothermal-development-in-malaysia/.
2. Mohd Haris Abdul Rani, et al., “Powering Malaysia’s Future with Geothermal Inspiration from Southeast Asia,” IJRISS, December 22, 2024, https://rsisinternational.org/journals/ijriss/articles/powering-malaysias-future-with-geothermal-inspiration-from-southeast-asia/.

### Data Center Growth

1. Aniruddha Ghosal and Vincent Thian, “Malaysia’s Betting on Data Centers to Boost its Economy. But Experts Warn They Come at a Price,” Associated Press, February 19, 2025, https://apnews.com/article/malaysia-johor-data-centers-energy-electricity-power-cfb087f755d3e203a347463af229e88d.
2. Ralph Jennings, “How Malaysia’s Data Centers Became the Engine Powering China’s AI Ambitions,” South China Morning Post, April 3, 2025, https://www.scmp.com/economy/china-economy/article/3304927/how-malaysias-data-centres-became-engine-powering-chinas-ai-ambitions.
3. “RHB Sees Malaysia to Become the Largest Data Center Hub in ASEAN,” Technode Global, October 2, 2024, https://technode.global/2024/10/02/rhb-sees-malaysia-to-become-the-largest-data-center-hub-in-asean/.

## Saudi Arabia

### Geothermal Support Measures

1. “SPPC Awards 7.2GW Contracts to Consortiums,” Power Technology, November 11, 2024, https://www.power-technology.com/news/sppc-awards-contracts-consortiums/.
2. Eva Levesque, “Saudi Summons Energy to Unearth Geothermal Potential,” Arabian Gulf Business Insight, June 13, 2024, https://www.agbi.com/analysis/renewable-energy/2024/06/saudi-arabia-geothermal-energy/.

### Geothermal Permitting

1. “IADC Geothermal Committee General Meeting” (presentation presented at IADC Geothermal Committee Meeting, Dubai, November 2024), https://iadc.org/wp-content/uploads/2024/12/Presentations-f2f-Geothermal-Cttee-Meeting-Dubai-November-2024.pdf.

### Data Center Growth

1. “AWS to Invest $5.3 to Build Data Centers in Saudi Arabia to Bolster Tech in the Region,” CIO, March 5, 2024, https://www.cio.com/article/1311730/aws-to-invest-5-3-to-build-data-centers-in-saudi-arabia-to-bolster-tech-in-the-region.html.
2. Saf Malik, “What is Driving Saudi Arabia’s $21bn Data Centre Investment Surge?,” Capacity Media, March 10, 2025, https://www.capacitymedia.com/article/2eir2o1uu11xqfdsdwrgg/news/what-is-driving-saudi-arabias-21bn-data-centre-investment-surge.

## United Arab Emirates

### Geothermal Support Measures

1. “ADNOC and Tabreed Advance the First Project in the Region to Harness Geothermal Energy,” press release, ADNOC, August 14, 2023, https://www.adnoc.ae/en/News-and-Media/Press-Releases/2023/ADNOC-and-Tabreed-Advance-the-First-Project-in-the-Region-to-Harness-Geothermal-Energy.

### *Data Center Growth*

1. Elwely Elwelly, “Dubai›s Du Announces 2 Billion Dirhams Hyperscale Data Center Deal with Microsoft,” Reuters, April 22, 2025, https://www.reuters.com/business/media-telecom/dubais-du-announces-2-billion-dirhams-hyperscale-data-center-deal-with-microsoft-2025-04-22/.
2. Niva Yadav, “Microsoft Invests $1.5bn in UAE-based AI Firm G42,” Data Center Dynamics, April 16, 2024, https://www.datacenterdynamics.com/en/news/microsoft-invests-15bn-in-uae-based-ai-firm-g42/.
3. Georgia Butler, “AWS and e& Sign $1bn Cloud Agreement in Middle East,” Data Center Dynamics, October 18, 2024, https://www.datacenterdynamics.com/en/news/aws-and-e-sign-1bn-cloud-agreement-in-middle-east/.

## Argentina

### *Geothermal Support Measures*

1. Miquel Muñoz Cabré, et al., “Renewable Energy Policy Brief Argentina,” International Renewable Energy Agency, June 2015, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Argentina.pdf?la=en&hash=4A7F4CDAB9E00B7739363467AB2B2ADA67C94CDC.
2. “Renewable Energy in Latin America: Argentina,” Norton Rose Fulbright, October 2016, https://www.nortonrosefulbright.com/en-ca/knowledge/publications/963b8f44/renewable-energy-in-latin-america-argentina.
3. Gianluca Bacchiocchi, et al., “RenovAr, Argentina›s Renewable Energy Program,” Clifford Chance, August 2016, https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2016/08/renovar-argentinas-renewable-energy-program.pdf.
4. V. Laguzzi and C. Mercure, “Renewable Energy in Argentina: Are Current Financing Instruments Driving the Energy Transition? An assessment of the implementation status of FODER, FODIS and PERMER,” Fundación Ambiente y Recursos Naturales (FARN), January 2025, https://www.climate-transparency.org/wp-content/uploads/2025/02/Renewable-energy-in-Argentina-financing-instruments-FODER-FODIS-and-PERMER.pdf.
5. “FODER - Argentina Renewable Fund Guarantee,” World Bank, December 19, 2024, https://projects.worldbank.org/en/projects-operations/project-detail/P159901.
6. “Argentina - Fund for the Development of Renewable Energy (FODER) Project (Spanish),” World Bank, Group, February 22, 2018, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/182681528356012036/argentina-fund-for-the-development-of-renewable-energy-foder-project.

### *Data Center Growth*

1. Jorgelina Do Rosario and Spencer Soper, “Amazon Plans $800 Million Data Center in Argentina,” Bloomberg, October 3, 2019, https://www.bloomberg.com/news/articles/2019-10-03/amazon-web-services-poised-to-build-a-data-center-in-argentina?sref=79i9aXlC.
2. Niva Yadav, “Claro Argentina to Build $30m Data Center in Buenos Aires,” Data Center Dynamics, August 22, 2024, https://www.datacenterdynamics.com/en/news/claro-argentina-to-build-30m-data-center-in-buenos-aires/.

## Brazil

### *Geothermal Permitting*

1. Kariny Leal, “Trump’s Push for Fracking Fuels Debate; Brazil Remains Uncertain,” Valor International, November 25, 2024, https://valorinternational.globo.com/environment/news/2024/11/25/trumps-push-for-fracking-fuels-debate-brazil-remains-uncertain.ghtml.

### *Data Center Growth*

1. “Scala Data Centers Secures $500 Million from Coatue and IMCO to Accelerate Growth and Innovation in Latin America,” press release, PR Newswire, September 23, 2024, https://www.prnewswire.com/news-releases/scala-data-centers-secures-500-million-from-coatue-and-imco-to-accelerate-growth-and-innovation-in-latin-america-302255757.html.
2. Georgia Butler, “AWS to Invest $1.8bn Expanding Brazilian Data Center Operations,” Data Center Dynamics, September 12, 2024, https://www.datacenterdynamics.com/en/news/aws-to-invest-18bn-on-expanding-brazilian-data-center-operations/.

## Morocco

### *Geothermal Support Measures*

1. "Incentives and Benefits, Morocco," DLA Piper, accessed June 30, 2025, https://www.dlapiperintelligence.com/corporateppa/countries/index.html?t=incentives-and-benefits&s=02-key-local-advantages&c=MA.

### *Geothermal Permitting*

1. Wacef Bentaibi, Benolt Pape, and Gide Loyrette Nouel, "Electricity Regulation in Morocco: Overview," Thomson Reuters Practical Law, January 21, 2021, https://www.gide.com/sites/default/files/electricity_regulation_in_morocco_overview_w-019-30581.pdf.

### *Data Center Growth*

1. Matthew Gooding, "US AI Startup Plans Massive 386 MW Data Center in Morocco," Data Center Dynamics, May 8, 2024, https://www.datacenterdynamics.com/en/news/us-ai-startup-plans-massive-386mw-data-center-in-morocco/.
2. "Oracle Plans to Open Two Public Cloud Regions in Morocco," Oracle, May 30, 2024, https://www.oracle.com/in/news/announcement/oracle-plans-to-open-two-public-cloud-regions-in-morocco-2024-05-30/.
3. Dan Swinhoe, "Naver Plans 500 MW Data Center Campus in Morocco," Data Center Dynamics, June 13, 2025, https://www.datacenterdynamics.com/en/news/naver-plans-500mw-data-center-campus-in-morocco/.

## Thailand

### *Geothermal Support Measures*

1. "SPP Hybrid Firm and VSPP Semi-Firm Feed-in Tariff Policy," Thailand's Ministry of Energy, Energy Policy and Planning Office, accessed June 30, 2025, https://www.eppo.go.th/images/Infromation_service/NEWS/2017/06Jun/08Jun/PPT-NEPC-hybrid-englishUBM2.pdf.
2. Sonya Kalnin, Dhan Packpongphanchai, and Ramita Visavaythanan, "Thailand Powers Up: New Renewable Energy Incentives and Opportunities in 2024," Watson Farley & Williams, November 5, 2024, https://www.wfw.com/articles/thailand-powers-up-new-renewable-energy-incentives-and-opportunities-in-2024/.
3. Ramita Visavayothanan, "Thailand's 5 GW Renewable PPA FIT Scheme: 2022-2030," Watson Farley & Williams, October 12, 2022, https://www.wfw.com/articles/thailands-5-gw-renewable-ppa-fit-scheme-2022-2030/.
4. Ernst Kuneman, et al., "Electricity Market Designs in Southeast Asia," Agora Energiewende, NewClimate Institute, Energy Research Institute, 2024, https://www.international-climate-initiative.com/fileadmin/iki/Dokumente/Publikationen/Projekte/20_I_380/20250127_Electricity_Market_Designs_SoutheastAsia.pdf.

### *Data Center Growth*

1. "Amazon to Boost Thailand Cloud Infrastructure with $5 Billion Investment," Reuters, October 18, 2022, https://www.reuters.com/technology/amazon-boost-thailand-cloud-infrastructure-with-5-bln-investment-2022-10-18/.
2. "Thailand Approves $2.7 Billion of Investments in Data Centers, Cloud Services," Reuters, March 17, 2025, https://www.reuters.com/technology/thailand-approves-27-billion-investments-data-centres-cloud-services-2025-03-17/.

## Egypt

### *Geothermal Support Measures*

1. "Regulatory Review of the Electricity Market in Egypt: Towards Crowding-in Private Sector Investment," United Nations Economic Commission for Africa, 2023, https://res4africa.org/wp-content/uploads/2023/03/RegulatoryReviewofElectricityMarketinEgypt.pdf.
2. "Egypt Renewable Energy Law, Decree No 2023/2014," International Energy Agency, February 26, 2025, https://www.iea.org/policies/6104-egypt-renewable-energy-law-decree-no-2032014.
3. "Why is Geothermal Energy Yet to Catch on in Egypt Like in Turkey and Kenya," Enterprise, March 17, 2025, https://enterprise.news/egypt/en/news/story/9c56b98f-8884-486f-87d1-55c415f4e2e9/why-is-geothermal-energy-yet-to-catch-on-in-egypt-like-in-turkey-and-kenya%3F.

### *Data Center Growth*

1. "Why is Egypt Falling Behind the Emerging Market Data Center Boom," Enterprise, March 25, 2025, https://enterprise.news/egypt/en/news/story/6a32031b-ef43-454a-bc7f-e01ed904d503/why-is-egypt-falling-behind-the-emerging-market-data-center-boom%3F.

# About the Authors

**Milo McBride** is a fellow in the Sustainability, Climate, and Geopolitics Program at the Carnegie Endowment for International Peace in Washington, DC. His research focuses on the geopolitics of energy transition technologies, critical minerals, and role of next-generation advancements in decarbonization pathways. Alongside his work at Carnegie, Milo is a nonresident fellow at the Center on Global Energy Policy at Columbia University.

**Daniel Helmeci** is a research assistant in the Carnegie Sustainability, Climate, and Geopolitics Program. He was previously a James C. Gaither Junior Fellow in the Carnegie Sustainability, Climate, and Geopolitics Program. Before joining Carnegie, Dan studied Political Science and History at Rice University.

**Debbra Goh** is a James C. Gaither Junior Fellow in the Sustainability, Climate and Geopolitics Program.

**Daevan Mangalmurti** is a James C. Gaither Junior Fellow in the Sustainability, Climate and Geopolitics Program.

# Notes


1 “The Future of Geothermal Energy,” International Energy Agency, 2024, https://www.iea.org/reports/the-future-of-geothermal-energy.

2 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

3 “Geothermal,” International Renewable Energy Agency, 2025, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy; L.C.A. Gutiérrez-Negrín, “Evolution of worldwide geothermal power 2020–2023,” *Geothermal Energy* 12 (2024). https://doi.org/10.1186/s40517-024-00290-w.

4 John W. Lund, “100 Years of Geothermal Power Product” (paper presented at the Thirtieth Workshop on Geothermal Reservoir Engineering, Stanford, January 31-February 2, 2005), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2005/lund.pdf.

5 Ragnheiður Elín Árnadóttir, “A Geothermal Leader: The Case of Iceland,” Atlantic Council, June 1, 2018, https://www.atlanticcouncil.org/blogs/energysource/a-geothermal-leader-the-case-of-iceland/.

6 John W. Lund, “100 Years of Geothermal Power Product” (paper presented at the Thirtieth Workshop on Geothermal Reservoir Engineering, Stanford, January 31-February 2, 2005), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2005/lund.pdf; Peter Muiruri, “‘Our Contribution to a Cleaner World’: How Kenya Found an Extraordinary Power Source Beneath its Feet,” *The Guardian*, January 25, 2024, https://www.theguardian.com/environment/2024/jan/25/our-contribution-to-a-cleaner-world-how-kenya-found-an-extraordinary-power-source-beneath-its-feet.

7 “Iceland, a World Leader in Clean Energy, Supports Africa›s Push for Geothermal Power,” United Nations Environment Programme, June 24, 2020, https://www.unep.org/news-and-stories/story/iceland-world-leader-clean-energy-supports-africas-push-geothermal-power.

8 Lúdvík S. Georgsson, “Forty Years of Geothermal Training in Iceland — History, Status and Future Direction” (paper presented at the UNU-GTP 40th Anniversary Workshop, Reykjavik, April 26, 2018), https://rafhladan.is/bitstream/handle/10802/17507/UNU-GTP-40-0-Ludvik-Georgsson.pdf.

9 Malgorzata Wiatros-Motyka, Nicolas Fulghum, and Dave Jones, “Chapter 3: Global Electricity Trends,” Ember, May 8, 2024, https://ember-energy.org/latest-insights/global-electricity-review-2024/global-electricity-trends/#global-electricity-generation.

10 Sertaç Akar, Chad Augustine, Parthiv Kurup, and Margaret Mann, “Global Value Chain and Manufacturing Analysis on Geothermal Power Plant Turbines,” Clean Energy Manufacturing Analysis Center, NREL/TP-6A20-71128, September 2018, https://docs.nrel.gov/docs/fy18osti/71128.pdf.

11 “Geothermal,” International Renewable Energy Agency, 2025, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy; “IRENASTAT Online Data Query Tool,” International Renewable Energy Agency, accessed May 20, 2025, https://pxweb.irena.org/pxweb/en/IRENASTAT.

12 Donald W. Brown, "A Hot Dry Rock Geothermal Energy Concept Utilizing Supercritical CO2 Instead of Water" (paper presented at the Twenty-Fifth Workshop on Geothermal Reservoir Engineering, Stanford, January 24-26, 2000), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2000/Brown.pdf.

13 Ahinoam Pollack, Roland Horne, and Tapan Mukerji, "What Are the Challenges in Developing Enhanced Geothermal Systems (EGS)? Observations from 64 EGS Sites" (paper presented at the World Geothermal Congress 2020+1, Reykjavik, April-October 2021), https://www.worldgeothermal.org/pdf/IGAstandard/WGC/2020/31027.pdf.

14 The Antares Group, "2010 Geothermal Technology Program Peer Review Report," Department of Energy, Energy Efficiency and Renewable Energy, 2010, https://www.energy.gov/sites/default/files/2014/02/f7/2010_gtp_peer_review_report_final.pdf.

15 "FORGE," U.S. Department of Energy, n.d., https://www.energy.gov/eere/geothermal/forge; Benoît Morenne, "Bill Gates Is Backing This Geothermal Company. Will Trump's Republicans?," *Wall Street Journal*, June 4, 2025, https://www.wsj.com/business/energy-oil/bill-gates-geothermal-fervo-energy-043cf2f3?gaa_at=eafs&gaa_n=ASWzDAgMtTH-GuK-h4Sn_Px-Q_Ou7bvS3cOUrF65OqlDj0EHgLUYwKkkwCt5EmImZGn8=&gaa_ts=68503939&gaa_sig=Ve0GS-R6iCRLP0BKScs_aWmyWIO3hi8bmJO3owsRrekoDr-zFErcstSAoJIiM8OpeHsTqP2ntP5hdRgx5R0NwXQ=%25253; Micheline Maynard, "Geothermal Energy Advances," *Time*, October 30, 2024, https://time.com/7094813/fervo-energy-fervoflex/.

16 Xinglan Hou, et al., "Numerical Simulation Study of Closed-loop Geothermal System Well Pattern Optimisation and Production Potential," *Applied Thermal Engineering* 231 (2023), https://doi.org/10.1016/j.applthermaleng.2023.120864.

17 N Mitha Angelina, et al., "Investigating Enhanced Geothermal Systems Feasibility in a Low-Permeability Sedimentary Formation" (paper presented at the Fiftieth Workshop on Geothermal Reservoir Engineering, Stanford, February 10-12, 2025), https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2025/Angelina.pdf; "DEEP Earth Energy Production Corp.," DEEP Corp, n.d., https://deepcorp.ca/.

18 Trenton T. Cladouhos and Owen A. Callahan, "Bridging the Gaps: A Survey of Methods, Challenges, and Pathways Forward for Superhot Rock Heat Extraction," Clean Air Task Force, n.d., https://cdn.catf.us/wp-content/uploads/2024/05/23155355/shr-bridging-gaps-heat-extraction.pdf.

19 Thomas Reinsch, Patrick Dobson, Hiroshi Asanuma, Ernst Huenges, Flavio Poletto, and Bernard Sanjuan, "Utilizing supercritical geothermal systems: a review of past ventures and ongoing research activities," *Geothermal Energy* 5 (2017), https://doi.org/10.1186/s40517-017-0075-y.

20 Shigemi Naganawa, et al., "Innovative Drilling Technology for Supercritical Geothermal Resources Development" (paper presented at the 42nd Workshop on Geothermal Reservoir Engineering, Stanford, February 13-15, 2017), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2017/Naganawa.pdf.

21 Rebecca Pearce and Tony Pink, "Drilling for Superhot Geothermal Energy: A Technology Gap Analysis," Clean Air Task Force and Cascade Institute, 2024, https://cascadeinstitute.org/wp-content/uploads/2025/01/Drilling-Report-Summary-CI-Version-9Sept2024-RPauthorv1.0.pdf.

22 "Fervo Energy Announces 31 MW Power Purchase Agreement with Shell Energy," press release, Fervo Energy, April 15, 2025, https://fervoenergy.com/fervo-energy-announces-31-mw-power-purchase-agreement-with-shell-energy/. "The EavorLoop at Geretsried, Germany." Innovation Fund – EU Climate Action. European Commission. April 2023, https://climate.ec.europa.eu/system/files/2023-04/if_pf_2023_eavorloop_en.pdf

23 Robert W. Sweeney and Noah Gordon, "Geothermal Energy and U.S. Competitive Advantage: Drill, Baby, Drill," Carnegie Endowment for International Peace, March 13, 2025, https://carnegieendowment.org/research/2025/03/geothermal-energy-and-us-competitive-advantage-drill-baby-drill?lang=en.

24 Wilson Ricks, et al., "The role of flexible geothermal power in decarbonized electricity systems," Nature Energy 10 (2025), https://doi.org/10.1038/s41560-023-01437-y.

25 "Executive summary, The Future of Geothermal Energy," International Energy Agency, December 2024, https://www.iea.org/reports/the-future-of-geothermal-energy/executive-summary; "Geothermal," National Renewable Energy Laboratory, n.d., https://atb.nrel.gov/electricity/2024/geothermal; "Levelized Cost of Energy+ (LCOE+)," Lazard, 2025, https://www.lazard.com/research-insights/levelized-cost-of-energyplus-lcoeplus/.

26 Roland Horne, Albert Genter, Mark McClure, William Ellsworth, Jack Norbeck, and Eva Schill, "Enhanced Geothermal Systems for Clean Firm Energy Generation," *Nature Reviews Clean Technology* 1 (2025), https://doi.org/10.1038/s44359-024-00019-9; International Energy Agency. *The Future of Geothermal Energy* (International Energy Agency, 2024), https://www.iea.org/reports/the-future-of-geothermal-energy.

27 Kareem El-Sadi, et al., "Review of Drilling Performance in a Horizontal EGS Development" (paper presented at the 49th Workshop on Geothermal Reservoir Engineering, Stanford, February 12-14, 2024), https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2024/Elsadi.pdf; Micah S. Ziegler and Jessika E. Trancik, "Re-examining Rates of Lithium-ion Battery Technology Improvement and Cost Decline," *Energy & Environmental Science* 4 (2021), https://doi.org/10.1039/

D0EE02681F; Mark Bolinger, Ryan Wiser, and Eric O'Shaughnessy, "Levelized Cost-based Learning Analysis of Utility-scale Wind and Solar in the United States," *iScience* 25 (2022), https://www.cell.com/iscience/fulltext/S2589-0042(22)00649-6?_returnURL=https://linkinghub.elsevier.com/retrieve/pii/S2589004222006496?showall=true.

28 Koenraad Beckers and Henry Johnston, "Techno-Economic Performance of Eavor Loop 2.0" (paper presented at the 47th Workshop on Geothermal Reservoir Engineering, Stanford, February 7-9, 2022), https://research-hub.nrel.gov/en/publications/techno-economic-performance-of-eavor-loop-20.

29 Mark McClure, "Technical Barriers for Deep Closed-loop Geothermal," ResFrac, March 21, 2023, https://www.resfrac.com/blog/technical-barriers-for-deep-closed-loop-geothermal; International Energy Agency. *The Future of Geothermal Energy* (International Energy Agency, 2024), https://www.iea.org/reports/the-future-of-geothermal-energy.

30 Sadiq J. Zarrouk and Hyungsul Moon, "Efficiency of Geothermal Power Plants: A Worldwide Review," *Geothermics* 51 (2014), https://doi.org/10.1016/j.geothermics.2013.11.001; John Gelegenis, "Rapid Estimation of Geothermal Coverage by District-heating Systems," *Applied Energy* 80 (2005), https://doi.org/10.1016/j.apenergy.2004.04.008.

31 Brigitte Osterath, "Fracking in Europe," Deutsche Welle, July 20, 2015, https://www.dw.com/en/what-ever-happened-with-europes-fracking-boom/a-18589660.

32 "The Future of Geothermal Energy Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century," Idaho National Laboratory, November 2006, https://energy.mit.edu/wp-content/uploads/2006/11/MITEI-The-Future-of-Geothermal-Energy.pdf.

33 "Pathways to Commercial Liftoff Reports," U.S. Department of Energy, n.d., https://www.energy.gov/lpo/pathways-commercial-liftoff-reports; Charles Gertler, Michael O'Connor, et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power," U.S. Department of Energy, 2025, https://12cf57a2.delivery.rocketcdn.me/wp-content/uploads/2025/02/LIFTOFF_DOE_NextGen_Geothermal_v14.pdf.

34 "The Future of Geothermal Energy," International Energy Agency, 2024, https://www.iea.org/reports/the-future-of-geothermal-energy.

35 "China Dominates Clean Technology Manufacturing Investment as Tariffs Begin to Reshape Trade Flows: BloombergNEF," press release, BloombergNEF, April 28, 2025, https://about.bnef.com/insights/finance/china-dominates-clean-technology-manufacturing-investment-as-tariffs-begin-to-reshape-trade-flows-bloombergnef/; Stephen Ezell, "How Innovative Is China in Nuclear Power?," Information Technology & Innovation Foundation, June 17, 2024, https://itif.org/publications/2024/06/17/how-innovative-is-china-in-nuclear-power/; International Energy Agency, *Energy Technology Perspectives 2023* (International Energy Agency, 2023), https://www.iea.org/reports/energy-technology-perspectives-2023.

36 Jason P. Brown, David Rodziewicz, and Colton Tousey, "Drilling Productivity in the United States: What Lies Beneath," Federal Reserve Bank of Kansas City, May 22, 2019, https://www.kansascityfed.org/research/economic-bulletin/drilling-productivity-what-lies-beneath-2019/; Steven Fercho, et al., "Geology, Temperature, Geophysics, Stress Orientations, and Natural Fracturing in the Milford Valley, UT Informed by the Drilling Results of the First Horizontal Wells at the Cape Modern Geothermal Project" (paper presented at the 49th Workshop on Geothermal Reservoir Engineering, Stanford, February 12–14, 2024), https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2024/Fercho.pdf; "Eavor's Milestone in Geretsried Becomes ThinkGeoEnergy's Most-Read Story of 2024," press release, Eavor, February 24, 2025, https://eavor.com/blog/eavors-milestone-in-geretsried-becomes-thinkgeoenergys-most-read-story-of-2024/; Benoit Deville, "Making enhanced geothermal systems an accessible solution," SLB, February 8, 2024, https://www.slb.com/resource-library/insights-articles/making-enhanced-geothermal-systems-an-accessible-solution; Sam Abraham, "Risk mitigation for geothermal projects starts with oilfield tools," Halliburton, December 2024, https://www.halliburton.com/en/resources/power-magazine-risk-mitigation-starts-oil-technology; "IADC Geothermal Well Classification," International Association of Drilling Contractors, February 17, 2025, https://iadc.org/wp-content/uploads/2025/02/IADC-Geothermal-Well-Classification-v1.pdf.

37 Sam Abraham, "Risk mitigation for geothermal projects starts with oilfield tools," Halliburton, December 2024, https://www.halliburton.com/en/resources/power-magazine-risk-mitigation-starts-oil-technology; "IADC Geothermal Well Classification," International Association of Drilling Contractors, February 17, 2025, https://iadc.org/wp-content/uploads/2025/02/IADC-Geothermal-Well-Classification-v1.pdf.

38 Morgan Smith, "Oil and Gas Technology and Geothermal Energy Development," Congressional Research Service, R47405, January 31, 2023, https://www.congress.gov/crs-product/R47405.

39 "Exergy Wins Deal for Two Geothermal Plants in Turkey," press release, Power Engineering International, November 6, 2024, https://www.powerengineeringint.com/renewables/exergy-wins-deal-for-two-geothermal-plants-in-turkey/; "Organic Rankine Cycle – ORC," Ormat, n.d., https://www.ormat.com/en/company/news/view/?ContentID=8819; "2023 Annual Report," Ormat, 2023, https://s1.q4cdn.com/231465352/files/doc_financials/2023/ar/ora006_ar_2023_web.pdf; "Organic Rankine Cycle Solutions for Power Generation with Turbogenerators," Turboden, n.d., https://www.turboden.com/products/2463/orc-system; "ORC Power Generators," Kaishan, n.d., https://kaishanusa.com/orc-power-generators/.

40 "Supercritical CO2: An Expanding Range of Potential Applications," Modern Power Systems, March 12, 2025, https://www.modernpowersystems.com/analysis/supercritical-co2-an-expanding-range-of-potential-applications/?cf-view.

41 Iain Esau, "‹Big Tech›s Energy Demand Could Spark Geothermal Growth, Says Consultancy," Recharge, May 28, 2025, https://www.rechargenews.com/energy-transition/big-tech-energy-demand-could-spark-geothermal-growth-says-consultancy/2-1-1825971.

42 "Fervo Energy Announces 31 MW Power Purchase Agreement with Shell Energy," press release, Fervo Energy, April 15, 2025, https://fervoenergy.com/fervo-energy-announces-31-mw-power-purchase-agreement-with-shell-energy/; Jonathan P. Thompson, "GreenFire Energy Revives Defunct Geothermal Well in California," Canary Media, May 9, 2025, https://www.canarymedia.com/newsletters/greenfire-energy-revives-defunct-geothermal-well-in-california; "New Geothermal Energy Project to Support Our Data Centers," press release, Meta, August 26, 2024, https://about.fb.com/news/2024/08/new-geothermal-energy-project-to-support-our-data-centers/.

43 "Three Additional Next Generation Geothermal Technology Companies Advancing DoD Energy Resilience," press release, Defense Innovation Unit, https://www.diu.mil/latest/three-additional-next-generation-geothermal-technology-companies-advancing.

44 "Newberry Project," Mazama Energy, n.d., https://mazamaenergy.com/newberry/; Sonal Patel, "Quaise Partners with Nevada Gold Mine to Explore Geothermal Retrofit for Coal Power Plant," *POWER Magazine*, December 4, 2024, https://www.powermag.com/quaise-partners-with-nevada-gold-mine-to-explore-geothermal-retrofit-for-coal-power-plant/; Milo McBride and Daniel Helmeci, "Carbon to Clean Tracker: Repurposing Fossil Fuel Power Stations into Clean Energy Hubs," Carnegie Endowment for International Peace, March 2025, https://carnegieendowment.org/features/clean-energy-tracker?lang=en.

45 Jennifer McDermott, "Major Test Case for New Geothermal Technology Launches in Small German Town," Associated Press, February 16, 2025, https://apnews.com/article/energy-transition-gas-geothermal-geretsried-germany-heat-electricity-89a356c70851938963314b3882377247; "Kenya Electricity Generating Company Approves GreenFire Energy Inc. to Commence Implementation of GreenFire's GreenLoop®," press release, GreenFire Energy, n.d., https://www.greenfireenergy.com/kengen2024/; Carlo Cariaga, "GreenFire Closed-loop Technology to Boost Geothermal Power in EDC fields, Philippines," ThinkGeoEnergy, February 7, 2024, https://www.thinkgeoenergy.com/greenfire-closed-loop-technology-to-boost-geothermal-power-in-edc-fields-philippines/; "Sage Geosystems Partners with NREL and Romania's Electrocentrale Bucuresti (ELCEN) to Conduct Feasibility Study on Decarbonizing District Heating System in Bucharest," press release, International District Energy Agency, July 24, 2024, https://www.districtenergy.org/blogs/district-energy/2024/07/24/sage-geosystems-partners-with-nrel-and-romanias-el.

46 "Mexican Electricity Market Operation Year 2023 and 1H 2024," GME, September 2024, https://www.gme-global.com/uploads/archivos/20240917-101415.pdf.

47 "Mexico's Reliance on U.S. Natural Gas to Grow Amid Rising Trade Tensions," press release, Fitch Ratings, February 20, 2025, https://www.fitchratings.com/research/corporate-finance/mexicos-reliance-on-us-natural-gas-to-grow-amid-rising-trade-tensions-20-02-2025.

48 A. Palacios, et al., "A Monte Carlo-based approach for the evaluation of Mexico›s geothermal potential," *Renewable Energy* 223 (2024), https://www.sciencedirect.com/science/article/abs/pii/S0960148124000715.

49 Raquel Bierzwinsky, Hernán González Estrada, and Carlos Campuzano, "Mexico Enacts New Laws for the Power Sector," press release, Norton Rose Fulbright, March 27, 2025, https://www.projectfinance.law/publications/2025/march/mexico-enacts-new-laws-for-the-power-sector/; "Mexico's Pemex Swings to $9 Billion Loss, Management Concedes Challenging Situation," Reuters, February 27, 2025, https://www.reuters.com/business/energy/mexicos-pemex-swings-91-billion-loss-fourth-quarter-2025-02-27/.

50 "Energy Demand Outlook in Mexico," Industronic, January 9, 2025, https://grupoindustronic.com/en/energy-demand-outlook-in-mexico/; "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

51 Luiz Aboim, Gustavo Scheffer da Silveira, et al., "Mexico's New Energy Sector Laws," Mayer Brown, March 26, 2025, https://www.mayerbrown.com/en/insights/publications/2025/03/mexicos-new-energy-sector-laws.

52 Octavio Castillo-Reyes, et al., "Geothermal Resources in Latin-America and their Exploration Using Electromagnetic Methods," *Geothermal Energy* 12 (2024), https://geothermal-energy-journal.springeropen.com/articles/10.1186/s40517-024-00314-5.

53 La Asamblea Legislativa de la República de Costa Rica, "Law 5961 - Geothermal Energy," University of New Mexico Digital Repository, 1976, https://digitalrepository.unm.edu/la_energy_policies/180; Martin Menski, James Johnson, and Amaury de Feydeau, "Data center boom in Latin America calls for accelerating infrastructure investment," White & Case, November 18, 2024, https://www.whitecase.com/insight-our-thinking/latin-america-focus-2024-data-center-infrastructure-investment; Alex Irwin-Hunt, "Costa Rica Newly Buoyant on Local Microchips Industry Prospects," FDI Intelligence, August 14, 2024, https://www.fdiintelligence.com/content/dd49a25b-652a-54e6-a8e8-8d11407902fb.

54 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

55 “Geothermal,” International Renewable Energy Agency, 2025, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy; “El Salvador,” PWC Worldwide Tax Summaries, February 6, 2025, https://taxsummaries.pwc.com/el-salvador/corporate/tax-credits-and-incentives.

56 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

57 “The World Bank In El Salvador,” World Bank Group, April 17, 2025, https://www.worldbank.org/en/country/elsalvador/overview.

58 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

59 “Por el cual se modifica el Decreto 1073 de 2015, en relación con el desarrollo de actividades orientadas a la generación de energía eléctrica a través de geotermia y se establecen otras disposiciones,” Ministry of Mines and Energy, Republic of Colombia, December 27, 2024, https://www.piensageotermia.com/wp-content/uploads/2025/01/Decreto-1598-de-2024-Geotermia-Colombia.pdf; “Data Center Boom in Latin America Calls for Accelerating Infrastructure Investment,” White & Case, November 18, 2024, https://www.whitecase.com/insight-our-thinking/latin-america-focus-2024-data-center-infrastructure-investment.

60 Andrea Jaramillo, “Ecopetrol Signs Deal with AES to Buy Colombia Wind Farm Stake,” Bloomberg, April 14, 2025, https://www.bloomberg.com/news/articles/2025-04-14/ecopetrol-signs-deal-with-aes-to-buy-colombia-wind-farm-stake?sref=79i9aXlC; “Alliance Between Ecopetrol, Baker Hughes and CHEC to Foster the Use of Geothermal Energy in Colombia,” press release, Baker Hughes, March 8, 2023, https://www.bakerhughes.com/company/news/alliance-between-ecopetrol-baker-hughes-and-chec-foster-use-geothermal-energy-colombia; Carlo Cariaga, “Nereidas Geothermal Project Seen to Strengthen Colombia’s Energy Matrix,” ThinkGeoEnergy, October 11, 2024, https://www.thinkgeoenergy.com/nereidas-geothermal-project-seen-to-strengthen-colombias-energy-matrix/.

61 Nick Zelenczuk and Ilsa Weinstein-Wright, “Decarbonizing the Energy Sector in Chile,” Convergence Blended Finance, February 2025, https://idbinvest.org/en/publications/decarbonizing-energy-sector-chile.

62 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

63 “Concesión de Geotermia (Ley Nº 19.657),” Chile Atiende, April 4, 2024, https://www.chileatiende.gob.cl/fichas/2287-concesion-de-geotermia-ley-n-19-657; “Modifica Decreto Supremo Nº 114, de 2012, de Ministerio de Energia, Que Aprueba Nuevo Reglamento Para la Aplicación de la Ley Nº 19.657, Sobre Concesiones de Energía Geotérmica y Deroga Decreto Nº 32, de 2004, del Ministerio de Minería,” Ministerio de Energia, 2019, https://energia.gob.cl/sites/default/files/documentos/consultas_publicas/Modificacion_reglamento_geotermia.pdf.

64 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

65 Natalia Castilhos Rypl, “Latin America’s Clean Energy Build to Peak in 2024,” BloombergNEF, December 2, 2024, https://about.bnef.com/insights/clean-energy/latin-americas-clean-energy-build-to-peak-in-2024/.

66 “ANP – Brazil 2024 Annual Oil & Gas Production,” Brazil Energy Insight, February 3, 2025, https://brazilenergyinsight.com/2025/02/03/anp-brazil-2024-annual-oil-gas-production/.

67 “Petrobras Teams With Geothermal Drilling Company,” *JPT*, August 2, 2024, https://jpt.spe.org/petrobras-teams-with-geothermal-drilling-company.

68 “Argentina’s Energy Sector: A New Chapter for Project Finance and Foreign Investment,” Curtis, April 21, 2025, https://www.curtis.com/our-firm/news/argentinas-energy-sector-a-new-chapter-for-project-finance-and-foreign-investment; “2024 Investment Climate Statements: Argentina,” U.S. Department of State, 2024, https://www.state.gov/reports/2024-investment-climate-statements/argentina/.

69 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

70 Davide Magagna, et al., “Supply chain of renewable energy technologies in Europe: An analysis for wind, geothermal and ocean energy,” European Commission, JRC108106, December 1, 2012, https://publications.jrc.ec.europa.eu/repository/handle/JRC108106.

71 Héctor Herrera, “The legal status of fracking worldwide: An environmental law and human rights perspective,” GNHRE, n.d., https://gnhre.org/?p=10555.

72 “DHC Market Outlook 2024: Executive Summary,” Euroheat & Power, n.d., https://api.euroheat.org/uploads/Final_Market_Outlook_2024_0efcdb4b7e.pdf.

73 "P9_TA(2024)0049 – Geothermal energy – European Parliament Resolution of 18 January 2024 on Geothermal Energy (2023/2111(INI))," EUR-Lex, January 18, 2024, https://eur-lex.europa.eu/eli/C/2024/5738/oj; "Geothermal Energy: Council Calls for Faster Deployment," press release, European Council, December 16, 2024, https://www.consilium.europa.eu/en/press/press-releases/2024/12/16/geothermal-energy-council-calls-for-faster-deployment/.

74 "Germany to Expedite Approval Processes for Geothermal Plants," Reuters, June 28, 2024, https://www.reuters.com/business/energy/germany-expedite-approval-processes-geothermal-plants-2024-06-28/.

75 "Tiefe Geothermie in Deutschland 2025," Bundesverband Geothermie, January 2025, https://www.geothermie.de/fileadmin/user_upload/Aktuelles/Geothermie_in_Zahlen/BVG-TG-Poster-A1-cmyk-2025-01-29-digital.pdf.

76 "Germany to Expedite Approval Processes for Geothermal Plants," Reuters, June 28, 2024, https://www.reuters.com/business/energy/germany-expedite-approval-processes-geothermal-plants-2024-06-28/; Carlo Cariaga, "KfW, Munich RE Introduce Risk Protection Mechanism for Geothermal in Germany," ThinkGeoEnergy, October 17, 2024, https://www.thinkgeoenergy.com/kfw-munich-re-introduce-risk-protection-mechanism-for-geothermal-in-germany/; Carsten Bringmann and Holger Schmitz, "Geothermal Energy Update: Draft Acceleration Law for Heat Transition Presented to Parliament," Noerr, July 5, 2024, https://www.noerr.com/en/insights/geothermal-energy-update-draft-acceleration-law-for-heat-transition-presented-to-parliament.

77 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

78 Michael Emde, "German Information Technology Data Centers," International Trade Administration, May 14, 2025, https://www.trade.gov/market-intelligence/germany-information-technology-data-centers; "DHC Market Outlook 2024: Executive Summary," Euroheat & Power, n.d., https://api.euroheat.org/uploads/Final_Market_Outlook_2024_0efcdb4b7e.pdf.

79 "Germany," Bloomberg Global Coal Countdown, February 2025, https://bloombergcoalcountdown.com/countries/DE; Benjamin Wehrmann, "Germany Looks into Alleged Market Manipulation During Dunkelflaute Power Price Spike," Clean Energy Wire, December 16, 2024, https://www.cleanenergywire.org/news/germany-looks-alleged-market-manipulation-during-dunkelflaute-power-price-spike#; Benjamin Wehrmann, "Q&A - Germany's Nuclear Exit: One Year After," Clean Energy Wire, April 16, 2024, https://www.cleanenergywire.org/factsheets/qa-germanys-nuclear-exit-one-year-after#.

80 Alexander Richter, "EUR 36.5m Funding for Geothermal Research at Coal Plant Site Weisweiler," ThinkGeoEnergy, January 21, 2025, https://www.thinkgeoenergy.com/eur-36-5m-funding-for-geothermal-research-at-coal-plant-site-weisweiler/.

81 Ahinoam Pollack, Roland Horne, Tapan Mukerji, "What Are the Challenges in Developing Enhanced Geothermal Systems (EGS)? Observations from 64 EGS Sites" (paper presented at the World Geothermal Congress 2020+1, Reykjavik, April-October 2021), https://www.worldgeothermal.org/pdf/IGAstandard/WGC/2020/31027.pdf.

82 "French strategy for energy and climate," Government of France, March 2025, https://www.consultations-publiques.developpement-durable.gouv.fr/IMG/pdf/02__projet_de_ppe_3_en.pdf.

83 "Italy›s Tuscany to Extend Enel›s Geothermal Licenses to 2046," Reuters, February 14, 2025, https://www.reuters.com/business/energy/italys-tuscany-extend-enels-geothermal-licences-2046-2025-02-14/; "Zero-emission Geothermal Energy: Fri-El Presents the Pangea Project," Fri-El Geo, March 31, 2023, https://www.f-geo.it/en/zero-emission-geothermal-energy-fri-el-presents-the-pangea-project/.

84 Svenja Bartels, "The FER 2-Decree: New Subsidies for Offshore Wind Energy and Other Innovative Renewable Energy Sources," Rödl & Partner, December 5, 2024, https://www.roedl.com/insights/renewable-energy/2024/october/italy-fer-2-decree-new-subsidies-offshore-wind-energy; Catia Tomasetti, Giovanna Zagaria, and Giulia Pandimiglio, "Italy," BBA//FJELDCO, April 28, 2018, https://www.geothermal.bba.is/country/italy.

85 Carlos Torres Vila and Ann Mettler, "How Spain is Leveraging Industrial Clusters to Lead Europe›s Energy Transition," World Economic Forum, January 16, 2025, https://www.weforum.org/stories/2025/01/spain-energy-hubs-europe-energy-transition/; "Iberian Peninsula Blackout Proves the Need for Grid Resilience," Wind Europe, May 8, 2025, https://windeurope.org/newsroom/news/iberian-peninsula-blackout-proves-the-need-for-grid-resilience/.

86 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

87 Danielle Myles, "Aragon Primed to Become Europe's New Data Centre Hub," FDI Intelligence, July 25, 2024, https://www.fdiintelligence.com/content/5dda38eb-7079-5da6-aa69-f03659222151; Edoardo Scornajenghi and Francesca Isgrò, "Italian Geothermal Energy: State of the Art and Next Prospects," PWC, March 3, 2025, https://www.pwc.com/it/en/industries/energy-utilities1/geothermal-energy.html; Pedro L. Marín, José Antonio García, and Fernando Bañez, "Spain," in *The Energy Regulation and Markets Review*, ed. David L. Schwartz (Law Business Research, 2023), https://www.brattle.com/wp-content/uploads/2023/07/The-Energy-Regulation-and-Markets-Review-Spain.pdf.

88 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

89 “Nemzeti Földhő Stratégia,” Energiaügyi Minisztérium, 2024, https://cdn.kormany.hu/uploads/document/f/f0/f08/f08b172e0ee39eac96f6f4dc2e1515a3e1fe881a.pdf; “Hungary Offers Loans to Double Geothermal Energy Use by 2030,” Enerdata, April 24, 2024, https://www.enerdata.net/publications/daily-energy-news/hungary-offers-loans-double-geothermal-energy-use-2030.html.

90 “Hungary,” International Energy Agency, n.d., https://www.iea.org/countries/hungary.

91 Varinia Radu and Ramona Dulamea, “Romania Enacts CfD Support Scheme with First Auction Launched,” CMS Law-Now, September 11, 2024, https://cms-lawnow.com/en/ealerts/2024/09/romania-enacts-cfd-support-scheme-with-first-auction-launched; “FPPG Calls for Updated Legislation to Support Geothermal Energy in Romania,” Energynomics, September 12, 2024, https://www.energynomics.ro/en/fppg-calls-for-updated-legislation-to-support-geothermal-energy-in-romania/.

92 Carlo Cariaga, “Oradea, Romania inaugurates first geothermal heating plant,” Think GeoEnergy, June 2, 2025, https://www.thinkgeoenergy.com/oradea-romania-inaugurates-first-geothermal-heating-plant/; “Romania,” International Energy Agency, n.d., https://www.iea.org/countries/romania.

93 Yunus Kemp, “Nigeria: Electricity Sector – Slow Growth Amid System Challenges,” ESI Africa, March 26, 2025, https://www.esi-africa.com/industry-sectors/generation/nigeria-electricity-sector-slow-growth-amid-system-challenges/; Isaac Anyaogu, “Explainer: Why Nigeria›s Power Grid is Failing,” Reuters, December 11, 2024, https://www.reuters.com/world/africa/why-nigerias-power-grid-is-failing-2024-12-11/.

94 “Kenya,” International Energy Agency, n.d., https://www.iea.org/countries/kenya; Ben Payton, “Can Kenya’s Geothermal Riches Drive an Industrial Revolution?,” FDI Intelligence, February 18, 2025, https://www.fdiintelligence.com/content/1d0c9745-4c10-5264-9f42-69c44fede7ee.

95 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

96 “Renewable Energy Auctions Policy,” Ministry of Energy, Kenya, January 2021, https://communications.bowmanslaw.com/REACTION/emsdocuments/Renewable%20energy%20auction%20Policy.pdf; “Geothermal Risk Mitigation Facility for Africa,” GRMF, 2025, https://grmf-eastafrica.org/; “The Energy Act, 2019,” Kenya Gazette Supplement, March 14, 2019, https://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/2019/EnergyAct__No.1of2019.PDF.

97 “iXAfrica Launches Kenya’s First Hyperscale Data Centre in Partnership with Schneider Electric,” press release, Schneider Electric, July 19, 2024, https://www.se.com/za/en/about-us/newsroom/news/press-releases/ixafrica-launches-kenya%E2%80%99s-first-hyperscale-data-centre-in-partnership-with-schneider-electric-669a26245f0a2ec8cf0e3441#.

98 Geoffrey Kamadi, “Can Kenya Become a Direct-air-capture Hub?,” C&EN, January 5, 2024, https://cen.acs.org/environment/climate-change/Kenya-become-direct-air-capture/102/i1.

99 Yunus Kemp, “Kenya: Geothermal Energy to Add More Megawatts to the Grid,” ESI Africa, April 16, 2024, https://www.esi-africa.com/news/kenya-geothermal-energy-to-add-more-megawatts-to-the-grid/.

100 “Kenya Drought Response Dashboard (January to December 2023),” United Nations Office for the Coordination of Humanitarian Affairs, March 15, 2024, https://www.unocha.org/publications/report/kenya/kenya-drought-response-dashboard-january-december-2023; “Kenya Electricity Generating Company Approves GreenFire Energy Inc. to Commence Implementation of GreenFire’s GreenLoop®,” press release, GreenFire Energy, n.d., https://www.greenfireenergy.com/kengen2024/.

101 “KenGen-GTC,” KenGen, 2025, https://www.kengen.co.ke/index.php/geothermal-center-of-excellence/kengen-gtc.html; “Home,” Geothermal Training and Research Institute (GETRI), 2025, https://getri.dkut.ac.ke/; Carlo Cariaga, “KenGen Secures Geothermal Exploration Rights in Zambia and Tanzania,” ThinkGeoEnergy, March 26, 2025, https://www.thinkgeoenergy.com/kengen-secures-geothermal-exploration-rights-in-zambia-and-tanzania/; “Ethiopia: KenGen Completes First Drilling at Tulu Moye Geothermal Site,” Africa Energy Portal, April 15, 2021, https://africa-energy-portal.org/news/ethiopia-kengen-completes-first-drilling-tulu-moye-geothermal-site.

102 “The Geothermal Exploration Opportunities Map Beta (GeoMap™),” Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

103 “Tanzania: Govt Vows to Generate 200mw From Geothermal,” Africa Energy Portal, April 18, 2022, https://africa-energy-portal.org/news/tanzania-govt-vows-generate-200mw-geothermal.

104 Matthias Klarl, “Eastern Africa: Electricity Market in Tanzania and Latest Developments,” Rödl & Partner, 2019, https://www.roedl.com/insights/renewable-energy/2019-08/eastern-africa-electricity-market-in-tanzania-and-latest-developments; “Home,” Geothermal Training and Research Institute (GETRI), 2025, https://getri.dkut.ac.ke/; “Fact Sheet for Geothermal Development to Promote Public Private Partnerships in East Africa,” United Nations Industrial Development Organization, n.d., https://downloads.unido.org/ot/32/09/32096052/Geothermal%20fact%20sheet%20for%20promoting%20PPP%20-Tanzania.pdf.

105 "Ethiopia Harnessing EV Potential to Reap Maximum Benefit From Clean Energy," Africa Energy Portal, September 20, 2024, https://africa-energy-portal.org/news/ethiopia-harnessing-ev-potential-reap-maximum-benefit-clean-energy; Martins Eze, "Ethiopia Targets 13,000 MW Electricity Generation by 2028," The Electricity Hub, January 31, 2025, https://theelectricityhub.com/ethiopia-targets-13000-mw-electricity-generation-by-2028/.

106 "Home," Geothermal Training and Research Institute (GETRI), 2025, https://getri.dkut.ac.ke/; Atkilit Bekele, "The New Geothermal Proclamation No.981/2016," *Legal Update* 10 (October 2016), https://www.mtalawoffice.com/images/upload/OCTOBER_2016.pdf.

107 "Conflict in Ethiopia," Center for Preventative Action, Council on Foreign Relations, March 20, 2025, https://www.cfr.org/global-conflict-tracker/conflict/conflict-ethiopia.

108 "2025 Yili Bütçe Gerekçesi," Government of Turkey, 2024, https://www.sbb.gov.tr/wp-content/uploads/2024/10/2025-Yili-Butce-Gerekcesi.pdf; "Türkiye," International Energy Agency, n.d., https://www.iea.org/countries/turkiye.

109 Gökhan Demirel, "The Feed-in Tariff System in Turkey," Rödl & Partner, April 18, 2024, https://www.roedl.com/insights/turkey-feed-in-tariff-system; "Türkiye Jeotermal Risk Paylasim Mekanizmasi," Türkiye Jeotermal Risk Paylasim Mekanizmasi, 2025, https://rpmjeoturkiye.com/en/homepage/.

110 "Jeotermal Kaynaklar Ve Dogal Mineralli Sular Kanunu," Resmi Gazete, June 3, 2007, https://www.resmigazete.gov.tr/eskiler/2007/06/20070613-1.htm.

111 "Türkiye," International Energy Agency Photovoltaic Power Systems Programme, 2024, https://iea-pvps.org/about-iea-pvps/members/turkey/; "The Turkish Wind Supply Chain Keeps Getting Stronger," Wind Europe, November 23, 2023, https://windeurope.org/newsroom/news/the-turkish-wind-supply-chain-keeps-getting-stronger/; Igor Todorović, "Turkey Reaches 55% Rate of Domestic Geothermal Power Equipment," Balkan Green Energy News, February 19, 2025, https://balkangreenenergynews.com/turkey-reaches-55-rate-of-domestic-geothermal-power-equipment/; "Turkey Keeps on Investing in Renewables: 5.5 MWe Power-only ORC Biomass Plant with Air-cooled Condenser for AGT Factory Supplied by Turboden," Turboden, March 29, 2018, https://www.turboden.com/company/media/press/press-releases/2142/turkey-keeps-on-investing-in-renewables.

112 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

113 Carlo Cariaga, "GMK Energy, Novus Earth Partner for Advanced Geothermal Solutions in Türkiye," ThinkGeoEnergy, October 24, 2024, https://www.thinkgeoenergy.com/gmk-energy-novus-earth-partner-for-advanced-geothermal-solutions-in-turkiye/.

114 Hassan Jivraj, "Morocco's EVs Tread Fine Geopolitical Line," FDI Intelligence, February 21, 2025, https://www.fdiintelligence.com/content/16166d86-e9f0-5ee8-9eb2-0ff883e81221; "Morocco Emerging as Key Global Production Hub," Business Sweden, April 19, 2023, https://www.business-sweden.com/insights/blogs/all-blogs/morocco-emerging-as-key-global-production-hub/; "Morocco Country Commercial Guide," International Trade Administration, January 1, 2024, https://www.trade.gov/country-commercial-guides/morocco-energy.

115 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/; "New Report Spotlights Morocco's Solar Investment Potential," press release, SolarPower Europe, March 18, 2025, https://www.solarpowereurope.org/press-releases/new-report-spotlights-morocco-s-solar-investment-potential.

116 "Egypt," International Energy Agency, n.d., https://www.iea.org/countries/egypt.

117 "TAQA, KAUST Starts Studies for Geothermal Energy Potential in Saudi Arabia," Saudi Gulf Projects, February 20, 2024, https://www.saudigulfprojects.com/2024/02/taqa-kaust-starts-to-study-geothermal-energy-potential-in-saudi-arabia/; Carlo Cariaga, "KAUST and TAQA Break Ground on Geothermal Research Well in Saudi Arabia," Think GeoEnergy, February 20, 2024, https://www.thinkgeoenergy.com/kaust-and-taqa-break-ground-on-geothermal-research-well-in-saudi-arabia/.

118 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

119 Jenny Spalding, "The Deal That Keeps the Oil Flowing," Epicenter, June 1, 2023, https://epicenter.wcfia.harvard.edu/blog/deal-keeps-oil-flowing; Elizabeth Montalbano, "AWS to Invest $5.3 to Build Data Centers in Saudi Arabia to Bolster Tech in the Region," CIO, March 5, 2024, https://www.cio.com/article/1311730/aws-to-invest-5-3-to-build-data-centers-in-saudi-arabia-to-bolster-tech-in-the-region.html; Matthew Martin, "Saudi Arabia's Nearly $1 Trillion Wealth Fund Swings to Profit," Bloomberg, July 2, 2024, https://www.bloomberg.com/news/articles/2024-07-02/saudi-arabia-s-nearly-1-trillion-wealth-fund-pif-swings-to-profit?sref=79i9aXlC.

120 Michael Hilton, Andrea C. Spadacini, Cheree King, and Ali Alahmad, "Sovereign Wealth Funds and Liberalized Rules Are Driving the Growth of Middle Eastern Business Hubs," Skadden, January 14, 2025, https://www.skadden.com/insights/publications/2025/01/2025-insights-sections/the-deal-landscape/sovereign-wealth-funds-and-liberalized-rules.

121 “Geothermal,” International Renewable Energy Agency, 2025, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy; “IRENASTAT Online Data Query Tool,” International Renewable Energy Agency, 2025, https://pxweb.irena.org/pxweb/en/IRENASTAT; “Global Geothermal Power Tracker,” Global Energy Monitor, 2025, https://globalenergymonitor.org/projects/global-geothermal-power-tracker/.

122 Carlo Cariaga, “Malaysia Reinvigorating Interest in Geothermal with 1st Geothermal Conference,” ThinkGeoEnergy, September 30, 2024, https://www.thinkgeoenergy.com/malaysia-reinvigorating-interest-in-geothermal-with-1st-geothermal-conference/; “Is Net-Zero in Thailand Possible? These Climate Startups are Proving it is,” New Energy Nexus, May 29, 2025, https://www.newenergynexus.com/blog/is-net-zero-in-thailand-possible-these-climate-startups-are-proving-it-is/; Carlo Cariaga, “India State-owned Oil Firm Establishes Green Energy Subsidiary,” ThinkGeoEnergy, February 3, 2025, https://www.thinkgeoenergy.com/india-state-owned-oil-firm-establishes-green-energy-subsidiary/.

123 “Geothermal,” International Renewable Energy Agency, 2025, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy.

124 Cepi Satiadi, “Private Investors to Develop 89% of Geothermal Capacity in PLN›s New RUPTL,” Petromindo.com, May 15, 2025, https://www.petromindo.com/news/article/private-investors-to-develop-89-of-geothermal-capacity-in-pln-s-new-ruptl; “ADB Supports Indonesia’s Green Energy Transition with Geothermal Expansion Project,” ADB, January 14, 2025, https://www.adb.org/news/adb-supports-indonesia-green-energy-transition-geothermal-expansion-project; “Risk Mitigation for Geothermal Development in Indonesia,” Global Infrastructure Hub, November 1, 2021, https://www.gihub.org/innovative-funding-and-financing/case-studies/risk-mitigation-for-geothermal-development-in-indonesia/; “Indonesia Will Keep State Utility›s Monopoly on Electricity, President›s Aide Says,” Reuters, February 26, 2025, https://www.reuters.com/business/energy/indonesia-will-keep-state-utilitys-monopoly-electricity-presidents-aide-says-2025-02-26/; Carlo Cariaga, “Indonesia Invites Investment in 12 Geothermal Power Projects,” ThinkGeoEnergy, November 18, 2024, https://www.thinkgeoenergy.com/indonesia-invites-investment-in-12-geothermal-power-projects/.

125 “ADB Supports Indonesia’s Green Energy Transition with Geothermal Expansion Project,” ADB, January 14, 2025, https://www.adb.org/news/adb-supports-indonesia-green-energy-transition-geothermal-expansion-project; “Risk Mitigation for Geothermal Development in Indonesia,” Global Infrastructure Hub, November 1, 2021, https://www.gihub.org/innovative-funding-and-financing/case-studies/risk-mitigation-for-geothermal-development-in-indonesia/.

126 Habibi Alhusni, et al., “Geothermal Business Outlook in Indonesia” (paper presented at the 48th Workshop on Geothermal Reservoir Engineering, Stanford, February 6–8, 2023), https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2023/Habibi.pdf.

127 “Risk Mitigation for Geothermal Development in Indonesia,” Global Infrastructure Hub, November 1, 2021, https://www.gihub.org/innovative-funding-and-financing/case-studies/risk-mitigation-for-geothermal-development-in-indonesia/.; “FP083,” Green Climate Fund, n.d., https://www.greenclimate.fund/project/fp083; “Indonesia Geothermal Resource Risk Mitigation Project (GREM),” World Bank Group, https://projects.worldbank.org/en/projects-operations/project-detail/P166071.

128 “Global Geothermal Power Tracker,” Global Energy Monitor, https://globalenergymonitor.org/projects/global-geothermal-power-tracker/.

129 “IRENASTAT Online Data Query Tool,” International Renewable Energy Agency, 2025, https://pxweb.irena.org/pxweb/en/IRENASTAT.

130 “Geothermal,” International Renewable Energy Agency, October 30, 2024, https://www.irena.org/Energy-Transition/Technology/Geothermal-energy.

131 Victoria Milko, “Financial and Community Hurdles Slow Geothermal Energy Development in Southeast Asia,” Associated Press, December 2, 2024, https://apnews.com/article/geothermal-energy-indonesia-philippines-climate-finance-6de912a0a2911f3cb96a875aac3c6c95; Ed Davies and Karen Lema, “Feature - Geothermal-rich SE Asia Struggles to Tap Earth’s Power,” Reuters, June 28, 2008, https://www.reuters.com/article/economy/feature-geothermal-rich-se-asia-struggles-to-tap-earths-power-idUSJAK144175/.

132 “Philippines’ Renewable Auction Oversubscribed with More than 7.5 GW of Bids,” Enerdata, February 17, 2025, https://www.enerdata.net/publications/daily-energy-news/philippines-renewable-auction-oversubscribed-more-75-gw-bids.html.

133 “Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility, Phase 2: Roadmap to Derisking Geothermal in the Philippines - Final Report,” ADB, May 2024, www.adb.org/projects/documents/reg-55140-001-tacr-0; Carlo Cariaga, “Philippine Government Aims to Secure USD 250m for Geothermal Derisking Facility,” Think GeoEnergy, September 30, 2024, https://www.thinkgeoenergy.com/philippine-government-aims-to-secure-usd-250m-for-geothermal-derisking-facility/.

134 Thess Sula, “Philippines Geothermal Energy,” International Trade Administration, July 26, 2024, https://www.trade.gov/market-intelligence/philippines-geothermal-energy.

135 Hollis Chin, "GreenFire Energy Inc. Retains a Representative for Geothermal Projects in the Philippines," press release, GreenFire Energy, February 13, 2024, https://www.greenfireenergy.com/bert-dalusung/; "USTDA Supports Innovative Geothermal Technology in the Philippines," press release, U.S. Trade and Development Agency, November 13, 2023, https://www.ustda.gov/ustda-supports-innovative-geothermal-technology-in-the-philippines/

136 "IRENASTAT Online Data Query Tool," International Renewable Energy Agency, 2025, https://pxweb.irena.org/pxweb/en/IRENASTAT; "Hot Spring Baths Block Japan›s Geothermal Potential," RFI, March 14, 2023, https://www.rfi.fr/en/business-and-tech/20230314-hot-spring-baths-block-japan-s-geothermal-potential.

137 "METI Sets the Surcharge Rate for FY2024, the Renewable Energy Purchase Prices for FY2024 Onward, and Other Details Relating to the FIT and FIP Schemes," METI, March 19, 2024, https://www.meti.go.jp/english/press/2024/0319_001.html; "Japan: Geothermal Energy Market Overview," Think GeoEnergy, May 2021, https://www.thinkgeoenergy.com/wp-content/uploads/2021/05/Japan-short.pdf.

138 "Financial Support," JOGMEC, https://www.jogmec.go.jp/english/geothermal/geothermal_10_000003.html; Carlo Cariaga, "JOGMEC Announces Subsidies for Six Geothermal Power Projects in Japan," Think GeoEnergy, June 24, 2024, https://www.thinkgeoenergy.com/jogmec-announces-subsidies-for-six-geothermal-power-projects-in-japan/.

139 Atkilit Bekele, "New Regulation on Geothermal Resource Development," Mesfin Tafesse & Associates, September 24, 2019, https://www.mtalawoffice.com/insights-news/entry/new-regulation-on-geothermal-resource-development.

140 Jane Rickards, "Taiwan Worsens its Vulnerability to a Chinese Energy Blockade," Australian Strategic Policy Institute, May 13, 2025, https://www.aspi.org.au/strategist-posts/taiwan-worsens-its-vulnerability-to-a-chinese-energy-blockade/.

141 "TASS2024 Geothermal Energy: Taiwan's Hidden Treasure of Green Power," Sustainable Taiwan Expo 2025 and Circular Economy Forum, August 28, 2024, https://tassasiaexpo.com/en/tass2024-geothermal-energy-taiwans-hidden-treasure-of-green-power/; "The Draft Amendment to Renewable Energy Development Act Passes Third Legislative Reading, Adding Regulations on 'Solar Panel Installation on Buildings' and the 'Chapter for Geothermal Energy'," Ministry of Economic Affairs, July 12, 2023, https://www.moea.gov.tw/MNS/english/news/News.aspx?kind=6&menu_id=176&news_id=110545; "The Geothermal Exploration Development Permit and Management Regulation Has Been Officially Announced," EnergyOMNI, June 3, 2024, https://www.energy-omni.com/en/news/article/C9Dzz98YnFhw9ht0.

142 "Google Commits to Taiwanese Geothermal Energy with Historic Baseload Capital Deal," energynews, April 16, 2025, https://energynews.pro/en/google-commits-to-taiwanese-geothermal-energy-with-historic-baseload-capital-deal/#google_vignette.

143 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

144 "Australia's Energy Commodity Resources 2024: Gas," Australian Government Geoscience Australia, July 15, 2024, https://www.ga.gov.au/aecr2024/gas.

145 "Solar Puts Australia in Fast Lane to 100% Renewables," *pv magazine*, May 29, 2025, https://www.pv-magazine.com/2025/05/29/solar-puts-australia-in-fast-lane-to-100-renewables; Tom Crowley and Tom Lowrey, "Nuclear Power in Australia — A Silver Bullet or White Elephant?," March 15, 2024, https://www.abc.net.au/news/2024-03-16/nuclear-power-in-australia-silver-bullet-white-elephant/103571824.

146 Debra Kahn, "Biden Fumbled the Energy Debate. But Another World Leader Won on Clean Power," Politico, May 22, 2025, https://www.politico.com/news/magazine/2025/05/22/australia-climate-change-policies-elections-column-00344370.

147 Rosalind Archer, Christine Le Billon, and Adam Stepanoff, "Is the Australian Geothermal Industry "Gathering Steam"?," (paper presented at the Proceedings 46th New Zealand Geothermal Workshop, Auckland, New Zealand, November 20-22, 2024), https://www.worldgeothermal.org/pdf/IGAstandard/NZGW/2024/062.pdf.

148 "Red Flag Assessment Confirms Paralana's Geothermal Attractiveness," press release, Earths Energy (ASX: EE1), https://clients3.weblink.com.au/pdf/EE1/02877312.pdf.

149 "Geothermal Projects Proposed for Vietnam's Power Development Plan 8," *Power Line*, May 16, 2025, https://powerline.net.in/2025/05/16/geothermal-projects-proposed-for-vietnams-power-development-plan-8/.

150 Duc Tran, "Direct PPAs – A New opportunity in Vietnam?," A&O Shearman, July 19, 2024, https://www.aoshearman.com/en/insights/direct-ppas-a-new-opportunity-in-vietnam.

151 Lien Hoang, "Vietnam Opens Cloud, Data Center Market to Foreign Companies," Nikkei Asia, July 10, 2024, https://asia.nikkei.com/Business/Technology/Vietnam-opens-cloud-data-center-market-to-foreign-companies.

152 "The Geothermal Exploration Opportunities Map Beta (GeoMap™)," Project InnerSpace, 2025, https://geomap.projectinnerspace.org/map-selection/.

153 Teh Kian Yeong, “Tenaga Nasional,” Kenaga, August 30, 2024, https://www.kenanga.com.my/wp-content/uploads/2024/08/TENAGA-240830-2Q24-RN-Kenanga.pdf; “Thailand approves $2.7 billion of investments in data centres, cloud services,” Reuters, March 17, 2025, https://www.reuters.com/technology/thailand-approves-27-billion-investments-data-centres-cloud-services-2025-03-17/; “Malaysia,” International Energy Agency, https://www.iea.org/countries/malaysia/electricity; “Thailand,” International Energy Agency, https://www.iea.org/countries/thailand/electricity.

154 Anil Kumar, “Subject: Constitution of Task Force to Harness Geothermal Energy in India,” Ministry of New and Renewable Energy, Government of India, August 29, 2024, https://mnre.gov.in/en/notice/constitution-of-task-force-to-harness-geothermal-energy-in-india/.

155 “India Breaks New Ground With Geothermal Pilot Plant,” Outlook Planet, August 7, 2024, https://www.outlookbusiness.com/planet/industry/india-breaks-new-ground-with-geothermal-pilot-plant; Suhail Bhat and Sameer Mushtaq, “Prospects and Challenges of India’s First Geothermal Plant,” Dialogue Earth, November 7, 2023, https://dialogue.earth/en/energy/prospects-and-challenges-of-indias-first-geothermal-plant/.

156 “Ormat›s Olkaria III Plant 1 Expansion Reaches Commercial Operation, Increasing Complex Capacity to 150 MW,” press release, Ormat Technologies, Inc., June 27, 2018, https://investor.ormat.com/news-events/news/news-details/2018/Ormats-Olkaria-III-Plant-1-Expansion-Reaches-Commercial-Operation-Increasing-Complex-Capacity-to-150-MW/default.aspx.

157 “Ormat Technologies Awarded BOT Agreement for 45 MW Geothermal Power Project in New Zealand,” press release, Ormat Technologies Inc., June 21, 2011, https://investor.ormat.com/news-events/news/news-details/2011/Ormat-Technologies-Awarded-BOT-Agreement-for-45-MW-Geothermal-Power-Project-in-New-Zealand/default.aspx.

158 Yousef Saba, “ADNOC Drilling buys into SLB›s Oman and Kuwait rig business,” Reuters, May 29, 2025, https://www.reuters.com/business/energy/adnoc-drilling-buys-into-slbs-oman-kuwait-rig-business-2025-05-29/; “SLB and Nabors Announce Collaboration to Scale Adoption of Drilling Automation Solutions,” press release, SLB, January 11, 2024, https://investorcenter.slb.com/news-releases/news-release-details/slb-and-nabors-announce-collaboration-scale-adoption-drilling; Tim Martin, John Gilbert, and Martin Gusy, “A Global Review of Joint Operating Agreement Disputes,” *The Journal of World Energy Law & Business* 13 (2020), https://timmartin.ca/wp-content/uploads/2021/12/Global-Review-of-JOA-Disputes-JWELB.pdf.

159 “COP28 Agreement Recognizes Accelerating Nuclear Energy as Part of the Solution,” World Nuclear Association, May 13, 2024, https://world-nuclear.org/news-and-media/press-statements/cop28-agreement-recognizes-accelerating-nuclear-as.

# Carnegie Endowment for International Peace

In a complex, changing, and increasingly contested world, the Carnegie Endowment generates strategic ideas, supports diplomacy, and trains the next generation of international scholar-practitioners to help countries and institutions take on the most difficult global problems and advance peace. With a global network of more than 170 scholars across twenty countries, Carnegie is renowned for its independent analysis of major global problems and understanding of regional contexts.

## Sustainability, Climate, and Geopolitics

The Sustainability, Climate, and Geopolitics Program explores how climate change and the responses to it are changing international politics, global governance, and world security. Our work covers topics from the geopolitical implications of decarbonization and environmental breakdown to the challenge of building out clean energy supply chains, alternative protein options, and other challenges of a warming planet.

CarnegieEndowment.org