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Research Article

A Review of Geothermal Potential of the World

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Abstract

Geothermal energy is a reliable and sustainable source of renewable energy. This source of energy makes use of the Earth's natural heat that is largely continuous under the surface, as opposed to solar or wind energy, which are intermittent and reliant on the weather. Although geothermal energy resources of many regions of the world can satisfy their energy demands, their potentials are not well-known and not fully utilized. This study is an investigation of the world's geothermal potential. The study aimed to review recent works on the world's geothermal energy capacity, specifically, in the geothermally active regions. Secondary data were used for the study and were collected from international energy agency reports, specialized research, and geological surveys. The key sources of data include the International Energy Agency (IEA), International Geothermal Association (IGA), and regional databases like the U.S. Energy Information Administration (EIA) geothermal potential maps. The study revealed that the world's installed geothermal capacity has been growing over the years and reached 17.173 GW at the end of 2025. The study also revealed that currently, six continents (North America, Europe, Asia, South America, Africa, and Australia) have high geothermal energy potentials. While Indonesia has the highest geothermal potential in the world, the U.S. remains the world's largest geothermal power producer. It was recommended that the world's geothermally promising areas, as revealed in this work, opt for proper harvesting and maximum utilization of their geothermal energy.

Keywords	*Geothermal Energy; Active Regions; Renewable Energy; Wind Energy*
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Introduction

The soaring cost of petroleum resources and the critical need to battle climate change have led to broad acceptance that various countries of the world need to adopt new strategies, such as the use of renewable energy resources, to satisfy their energy demands. The geothermally active areas of the world have great potential to provide these vital energy resources. Geothermal energy is heat within the earth (U.S. Energy Information Administration, 2022a), and it is considered to be clean, virtually inexhaustible, and with much less negative environmental impact compared to hydrocarbons (Noorollahi et al., 2019; World Energy Council, 2016).

Geothermal resources are widespread and complex, with many different types of systems for harvesting them. Geothermal energy can be captured and used directly for heating (geothermal heating) and cooling, or in the form of steam to generate electricity. The geothermal systems include geothermal heat pumps for heating and cooling, and geothermal power plants (Australia's Energy Commodity Resources [AECR], 2024). Moreover, the world's installed geothermal capacity has been growing over the years, reaching 17.173 GW at the end of 2025 (Richter, 2026). Geothermal power generation was active in 35 countries worldwide, and the total installed capacity increased by 223 MW during 2025. It is expected that the world's geothermal energy resources will help in satisfying the world's energy demand when properly and fully harvested. *Craig and Gavin (2018*) revealed that geothermal energy has the potential to meet 3 to 5% of global demand for both power and heating by 2050.

Furthermore, energy remains a major driving force for the economic growth of any country, and associated energy commodities promote economic development through an increase in productivity and income, as well as the creation of employment. In order to provide long-term energy security, it is now widely acknowledged that the energy mix must be diversified and dependency on fossil fuels reduced. Most countries of the world are exploring other sustainable and alternative energy sources, including geothermal energy. Moreover, investment in geothermal energy production in any country or region relies on its geothermal energy potential. While countries specifically, those located in the most active geothermal areas in the world (called the Ring of Fire) have greater geothermal energy potentials (U.S. Energy Information Administration, 2022b), other countries have little potential. It is therefore necessary to investigate the world's geothermally promising areas in order to know their energy resources and capacity, and harvesting methods for maximum utilization of geothermal energy.

This study aims to investigate the geothermal potential of the world, specifically, the six continents that hold high potential for geothermal resources.

Geothermal Energy

Geothermal energy is heat generated within Earth (thermal energy extracted from the Earth's crust). The word geothermal comes from the Greek words *geo* (earth) and *therme* (heat). Geothermal energy is a renewable energy source that can be harvested for human use. Geothermal energy combines energy from the formation of the planet and from radioactive decay. The Earth has an internal heat content of 10^{31} joules (J), and about 20% of this is residual heat from planetary accretion, while the remainder is attributed to past and current radioactive decay of naturally occurring isotopes (Turcotte & Schubert, 2002). The hottest part of our planet (the core) is about 2,900 km (1,800 miles) below Earth's crust, or surface. A small portion of the core's heat comes from the friction and gravitational pull formed when Earth was created more than four billion years ago (National Geographic Society, 2025). The vast majority of Earth's heat is constantly generated by the decay of radioactive isotopes (forms of an element that have a different number of neutrons than the most common versions of the element's atom), such as potassium-40 and thorium-232.

Radioactive decay is a continual process in the Earth's core. The Earth has four major parts, or layers (inner core of solid iron, outer core of hot molten rock, mantle of magma and rock and crust of solid rock). The U.S. Energy Information Administration (2022a) stated that the inner core of solid iron is about 2414 km (1,500 miles) in diameter, while the outer core of hot molten rock, called *magma,* is about 2414 km thick. The mantle of magma and rock surrounds the outer core, which is about 2896.81km thick, while the crust of solid rock forms the continents and ocean floors. The Earth's interior temperature and pressure are high enough to cause some rock to melt and the solid mantle to behave plastically. The temperature of the Earth's inner core is about 5982.22°C **(**10,800°), which is as hot as the surface of the sun. Heat from the core is constantly radiating outward and warming rocks, water, gas, and other geological material. On the other hand, the temperatures in the mantle range from about 200°C near the mantle-crust boundary to about 4,000°C near the mantle-core boundary (Lay et al., 2008).

The Earth's internal thermal energy flows to the surface by conduction and is replenished by radioactive decay of minerals (Rybach, 2007). The Earth’s temperature rises with depth from the surface to the core. This gradual temperature change is referred to as the geothermal gradient. Despite seasonal variations, the geothermal gradient of temperatures through the crust is 25–30°C per km of depth in most of the world (Pollack et al., 1993). The top layer of the surface to a depth of 10m (33 ft) is heated by solar energy during the summer in addition to the internal heat flows and cools during the winter.

Geothermal Resources

Geothermal energy finds its way to the earth's surface through volcanoes and fumaroles, hot springs and geysers (U.S. Energy Information Administration, 2022b). Volcanoes are located in gaps or holes in the tectonic plates (broken pieces of earth's crust). Geothermal energy is generated in the form of hydrothermal energy via heating of nearby rocks and underground aquifers by magma. The magma comes close to the Earth's surface near the edges of the tectonic plates and can move to the surface of the Earth through gaps in the plates. Magma is molten (partly melted) rock permeated by gas and gas bubbles and is formed when underground rock formations are heated to about 700 -1,300°C (National Geographic Society, 2025). Magma exists in the mantle and lower crust and sometimes bubbles to the surface as lava (magma that reaches the Earth's surface). In order to generate hydrothermal energy, magma heats nearby rocks and underground aquifers. The heated or hot water can be released through geysers, hot springs, steam vents, underwater hydrothermal vents, and mud pots. The rocks and water found deeper underground have the highest temperatures.

The most active geothermal resources are near the boundaries of the earth’s tectonic plates, where most volcanoes are located. One of the most active geothermal areas in the world is called the Ring of Fire (U.S. Energy Information Administration, 2022b). This area encircles the Pacific Ocean as shown in figure I.

Figure I: Ring of Fire (most active geothermal areas in the world). Source: U.S. Energy Information Administration, 2022b

Geothermally promising areas are identified through deep investigation and can be estimated via a geothermal potential map. The geothermal potential map is generated by integrating geological thematic layers (rock units and faults), geophysical layers (heat flow derived from aeromagnetic data and seismicity), and geothermal layers (hot springs and volcanoes) within the Geographic Information System (GIS) database and applying a weighted overlay technique within the GIS environment to the data (Cariaga, 2025). The world’s largest users of geothermal energy, such as the U.S., Iceland, and the Philippines, have applied geophysical, geological, and geochemical datasets in selecting the sites suitable for geothermal analysis (Tester et al., 2021). Other datasets, such as environmental and reservoir datasets, have been used in addition to geophysical, geochemical, and geological datasets for site selection (Muñoz et al, 2010; Muther et al., 2022).

Geothermal Energy Harvesting

Geothermal energy or heat within the Earth can be captured and used directly for heating (geothermal heating) or in the form of steam to generate electricity. Geothermal heating is the use of geothermal energy for heating buildings and water for human use (*Richter, 2020)*. The type of geothermal heat used for heating is dry geothermal heat, and it can be accessed by drilling and enhanced with injected water to create steam.

Geothermal energy harvested for heating and cooling includes low-temperature geothermal energy and co-produced geothermal energy. Low-temperature geothermal energy can be accessed almost anywhere in the world and used immediately as a source of heat, and is obtained from pockets of heat about 150°C (Hennings & Lynch, 2020). Most of the pockets of heat are found just a few meters below ground. Low-temperature geothermal energy can be used for heating greenhouses, homes, fisheries, and industrial processes as well as generating electricity. On the other hand, co-produced geothermal energy technology relies on other energy sources. This form of geothermal energy uses water that has been heated as a byproduct in oil and gas wells (Ibrahim et al., 2025). Their steam can be used to generate electricity. Geothermal energy can be captured through geothermal heat pumps (GHPs) and geothermal power plants.

Geothermal Heat Pumps

Geothermal heat pumps tap into heat close to the Earth's surface to heat water or provide heat for buildings. The GHPs transfer heat by pumping water or a refrigerant (a special type of fluid) through pipes just below the Earth's surface, where the temperature is a constant 10 – 15.55°C. The GHPs are closed-loop geothermal systems; types of engineered geothermal systems containing subsurface working fluid that is heated in the hot rock reservoir without direct contact with rock pores and fractures (*Toews, 2020)*. During the winter, the water or refrigerant absorbs heat from the Earth, and the pump carries the heat upward to the building above. In the summer, some heat pumps can run in reverse and help cool buildings. Geothermal heat pumps do not require fracturing bedrock to reach their energy source, nor require a geofluid for accessing heat.

Geothermal Power Plants

Geothermal power plants use heat from deep inside the Earth to generate steam used for generating electricity. Geothermal power is an electrical power generated from geothermal energy. In some areas, the heat can naturally exist underground as pockets of steam or hot water, whereas most areas need enhancement with injected water to create steam. Geothermal power plants are found in areas that have a lot of hot springs, geysers, or volcanic activity, where the Earth is particularly hot just below the surface.

Geothermal energy harvesting systems for electricity or power plants include:

1. **Dry-steam power plants.** Dry steam stations or power plants are the simplest and oldest design, but the most efficient. Natural underground steam is piped directly to a power plant, where it is used to fuel turbines and generate electricity. A dry steam power plant directly uses geothermal steam of 150 °C or greater to turn turbines. The rotation of the turbine powers a generator that produces electricity (*National Geographic Society,* 2012). Then the steam is emitted to a condenser, transforming it into liquid and cooling it. The cool water flows down a pipe that conducts the condensate back into deep wells where it can be reheated and produced again. The Geysers in California is the only place where a dry-steam power plant is in use in the U.S., and it is one of the largest geothermal energy complexes in the world (*Scientific American Editors, 2013)*.
2. **Flash-steam power plant.** These power plants use naturally occurring sources of underground hot water and steam. Water of temperature above 180°C is pumped into a low-pressure area. Some quantity of the water “flashes,” or evaporates rapidly into steam, and is funneled out to power a turbine and generate

electricity. The remaining quantity of water and condensed steam may be injected back into the reservoir, making this a potentially sustainable resource (U.S. Department of Energy, 2010). Flash-steam power plants are the most common type of geothermal power plants (*Gudni* et al., 2005).

3. **Binary cycle power plants.** The binary cycle power plants use a unique process to conserve water and generate heat. Binary cycle power plants are the most recent development, and can accept fluid temperatures as low as 57°C (*Erkan et al., 2008*). Water contained in a pipe underground is heated to about 107°-182°C by Earth and cycles above ground (*Gudni* et al., 2005). The hot water heats a liquid organic compound such as tetrafluoroethane (an industrial refrigerant) that has a lower boiling point than water. The organic liquid creates steam, which flows through a turbine and powers a generator to generate electricity. The water in the pipe is recycled to the ground, reheated by Earth to provide heat for the organic compound again (*Tomarov & Shipkov, 2017)*. Steam is the only emission in this process. The binary cycle power plant is the most common type of geothermal electricity station being constructed today (*DiPippo, 2016).*
4. **Enhanced geothermal systems.** An enhanced geothermal system (EGS) uses drilling, fracturing, and injection to provide fluid and permeability in areas of Earth that have hot, dry underground rock (Moore & Simmons, 2013). EGS technology involves creating artificial reservoirs by injecting water into hot dry rocks (HDR) at depth, which are then hydraulically fractured to increase permeability (Syed, 2024). Water vapor from the evaporated liquid is the only gaseous emission in this process**.** The disadvantage of EGSs is that the injection process can cause seismic activity, or small earthquakes (National Geographic Society, 2025).

World’s Geothermal Energy Potential

The world’s installed geothermal capacity has been growing over the years, reaching 17.173 GW at the end of 2025 (Richter, 2026). Geothermal power generation was active in 35 countries worldwide, and the total installed capacity increased by 223 MW during 2025. Global geothermal power capacity reached 14.8 GW in 2023 (International Renewable Energy Agency, 2024). The global geothermal power plants produced approximately 95 tera watt per hour (TWh) of electricity in 2021, which was about 0.33% of the world’s electricity generation. Geographically, the highest percentage (72%) of installed generation capacity resides along tectonic plate boundaries or ‘hot spot’ features of the Pacific Rim (World Energy Council, 2016). These resources are igneous convective resources. Geothermal energy has the potential to meet 3 to 5% of global demand for both power and heating by 2050, and with economic incentives, it will be possible to meet 10% of global demand with geothermal power by 2100 (*Craig & Gavin, 2018*). The world’s geothermal energy reviewed in this work is based on continents that contribute significantly to the world’s total installed capacity.

Geothermal Energy in North America

The North American geothermal energy is dominated by the United States (U.S.), which remains the world’s largest geothermal power producer. Geothermal power capacity reached 3,953 MW in 2025 (Richter, 2026). In 2020, the U.S. remained the leader in installed geothermal capacity with approximately 3.673 gigawatts (GW). This geothermal capacity represented close to 25% of the world’s total online capacity and more than 90% of this capacity was generated from California and Nevada (International Energy Agency’s [IEA], 2020). However, the geothermal contribution to U.S. energy capacity was less than 1%. Geothermal heat pumps (GHPs) maintained approximately 3% annual growth in the U.S., with new installations in 2020 exceeding 1.7 million units. The total installed capacity for geothermal direct use was 485 megawatts thermal (MWt); total installed capacity for GHPs was 20.7 GW. The leading geothermal energy in the U.S. is the Geysers geothermal field in California. The geothermal contribution to U.S. energy capacity has been estimated to be more than 8% by 2050; the estimated potential for direct use is 231 GW, including as many as 17,500 district heating and cooling systems (IEA, 2020).

Mexico has significant potential for geothermal energy due to its location on the Ring of Fire. The geothermal energy potential of México stems from its large number of active volcanoes and thermal springs. Mexico remained the second in geothermal energy in the region with an installed geothermal electricity capacity of 976 MW in 2025 (Richter, 2026). Mexico’s installed geothermal electricity capacity was 963 MW in 2024 and ranked sixth among the top 10 geothermal electricity-producing countries globally **(**Reyes et al., 2024**)**. Geothermal power plants such as Cerro Prieto and Los Azufres have been in operation for over 40 years in México. The majority of the installed capacity utilizes high-temperature volcano-hosted hydrothermal resources. Despite its potential, México is still in the early stages of the exploitation of geothermal energy.

Canada has enormous geothermal energy resources including hydrothermal reservoirs. Geothermal power systems have been in operation since 1911 while direct heat use projects are few in Canada to date (Natural Resources Canada, 2025). Geothermal energy in Canada is primarily located at *Canadian Cordillera, sedimentary basins*, and the *Canadian Shield*. The Canadian Cordillera stretches across British Columbia, the Yukon, and parts of Alberta and holds the highest potential for high-temperature geothermal resources, particularly in volcanic belts (Syed, 2024). Geothermal power generation potential in this region range from 1.550 GW to 5.000 GW (*Morphet, 2012*). Sedimentary basins, which underlie vast regions of Alberta, Saskatchewan, and the Northwest territories hold significant geothermal potential; the resources can be utilized for direct heating or small-scale electricity generation (Adjei, 2025; Natural Resources Canada, 2025).

Geothermal Energy in South America

South America, Mexico, Central America, and the islands of the Caribbean (Latin American countries) have abundant geothermal energy resources. The active volcanism along the Pacific Rim fuels the significant geo-thermal potential in Latin-American countries (Reyes et al., 2024). Despite the abundant geothermal energy resources of Latin America, only a fraction of its potential has been harnessed **(**International Renewable Energy Agency [IRENA], 2023). South American countries such as Argentina, Peru, Colombia, Chile and Brazil have geothermal energy potentials corresponding to 1200 GW, 400 GW, 300 GW, 200 GW and over 2000 GW (Cariaga, 2025)**.** There are dozens of high-potential geothermal power production zones along the Andean volcanic belt with resources capable of generating tens of gigawatts of firm electricity. The Brazil's geothermal resource holds exceptional potential for power generation, energy storage, cooling, and industrial heating. While areas in the northeast part are ideal for renewables-integrated subsurface energy storage systems, the Amazonas Basin could support cooling.

Geothermal Energy in Europe

Geothermal energy is already being used in Iceland, Italy, Germany, Croatia, Hungary, Turkey, and France, for electricity generation, heating, and cooling (Government of Iceland, 2022), with other European countries and cities joining in its use. In 2025, Iceland, Italy and Turkey had installed geothermal electricity capacity corresponding to 808 MW, 916 MW and 1.797 GW (Richter, 2026). Turkey remains Europe's largest geothermal power producer. In 2025, Turkey completed and commissioned three new power plants (Emir, Hez Morali and Nezihe Beren Unit 2) in 2025 (Richter, 2026). Italy was the second largest geothermal power producer while Iceland was the third largest producer in the region.

In 2023, there were 143 operational geothermal plants, 401 geothermal district heating and cooling (DHC) systems and 298 in EU Member States (Cariaga, 2024). This heating and cooling systems correspond to 6 GW of total installed geothermal heating and cooling capacity across 29 countries. During this period, eight new systems were commissioned in the EU, adding 33.9 MW of capacity and new geothermal systems were installed in Finland, Romania, Germany, the Netherlands, and Slovakia. France remained the leader in geothermal district heating capacity in the EU. The European 143 plants had 3.5 GW geothermal electricity generation capacity and collectively generated approximately 20 TWh/year. Geothermal energy has the potential to cover 25% of heating and cooling and around 10% of electricity in Europe by 2030 (Cariaga, 2023).

Geothermal Energy in Australia

There has been solid growth in terms of direct-use of geothermal energy in Australia. Large-scale direct-use hot sedimentary aquifer (HAS) systems, such as those used for heating swimming pools or providing hydronic heating systems and commercial-scale geoexchange systems, are increasing in number in Australia (Beardsmore et al., 2023). Main examples of direct-use geothermal systems include Robarra (Robe, South Australia) and Mainstream Aquaculture (Werribee, Victoria), both using 28–29°C bore water. As of January 2023, Australia had over 36 MW of installed capacity for direct use of geothermal heat from hot aquifers (Beardsmore et al., 2023), an increase of 3 MW (9%) since 2020. Ground source heat pump capacity was estimated to be 71 MW, an increase of 9 MW (14.5%) since

2020. In 2016 to 2017, 0.5 gigawatt hours (GWh) of electricity was generated from geothermal sources, and this accounted for a very small percentage of the country's total renewable generation (ThinkGeoEnergy, 2018).

There are many geothermal energy projects that are ongoing in Australia. In Western Australia, Strike Energy is advancing an HSA geothermal prospect with an estimate of over 200 MW of geothermal power located 300 km north of Perth within the Permian Kingia Sandstone (Strike Energy, 2022; Ballesteros et al., 2020). There has been a large take-up of geothermal tenements across the country and installations exploiting shallower and lower-temperature HSA geothermal and geoexchange resources are increasing in number (Beardsmore et al., 2023). Ground source heat pumps and other direct-use or geoexchange technologies have also been installed.

Geothermal Energy in Asia

The Asia-Pacific geothermal energy market is segmented by type of geothermal power plant (dry steam, flash plants and binary plants) and geography consisting of Indonesia, Philippines, Japan and rest of Asia-Pacific (Mordor Intelligence, 2025). Indonesia is reported to have the greatest amount of geothermal potential in the world (around 28.5 GW) due to its tilting on the "ring of fire" formed by the confluence of three tectonic plates (Fourteau, 2022). Currently, Indonesia is the world's second largest geothermal power producer after U.S. with installed capacity of 2.742 GW (Richter, 2026). Indonesia added new power plants (Ijen Unit 1 project, Lumut Balai Unit 2, and a binary unit at Salak); the largest recorded capacity additions in 2025. In 2020, Indonesia had a total installed capacity of approximately 2.1 GW and four of the world's top ten geothermal projects including the 375 MW Gunung Salak facility and the 330 MW Sarulla facility (NS Energy, 2021).

The Philippines is the world's third largest geothermal electricity producer after the USA and Indonesia as at the end of 2025. The island country had a total installed capacity of approximately 2.034GW (Richter, 2026). The Philippines added Tanawon binary plant at the BacMan II complex in 2025. Project (120 MW Kalinga facility) under development in 2020 is expected to become operational in 2026 (Fourteau, 2022).

New Zealand is the world's fifth largest geothermal electricity producer in 2025. New Zealand's installed geothermal power capacity was approximately 1.259 GW in 2025 (Richter, 2026) and it was achieved through her old power plants and the new Te Huka Unit 3 plant. New Zealand's geothermal energy accounted for approximately 18% of the national electricity supply (which is more than wind and solar combined) in 2020 (NS Energy, 2020). The country's largest geothermal facility, Wairakei plant has capacity of 181 MW (NS Energy, 2021) while the largest singular binary power plant in the world, Ngatamariki facility in New Zealand, completed by Ormat Technologies in 2013 has capacity of 100 MW (Australia Records Institute, 2020). A 32MW geothermal power system is expected to be added to the 28MW Northland facility in 2026 (Ministry of Business, Innovation and Employment, 2020).

Other Asian countries have geothermal energy potentials but in smaller scale. Japan had installed geothermal power capacity of 607 MW as of 2025 (Richter, 2026). China has more than 3,200 thermal features including thermal springs, wells and mine outflows (Zhang & Zhao, 2020). More than 225 high-temperature geothermal systems have also been identified in China and, of these, more than 50 have been studied and assessed.

Geothermal Energy in Africa

Africa is bordered on the east by the Indian Ocean and Red Sea, on the west by the Atlantic Ocean, to the north by the Mediterranean Sea, and to the south by the meeting of Indian and Atlantic Oceans. Africa is composed of a crystalline, precambrian basement where granitic-gneissic greenstone belts of Archean cratons (fragments of ancient crust) are surrounded by Proterozoic orogenic provinces (Stellae Energy, 2026). The surrounding mountainous orogenic belts are where higher heat flow signatures have been found. The geothermal exploration done in Africa using GIS database showed 14 regions with a high geothermal favorability index (Elbarbary et al., 2022). These regions are shown in geothermal potential map of Africa (figure 2) derived from analysis of a number of thematic layers of evidence.

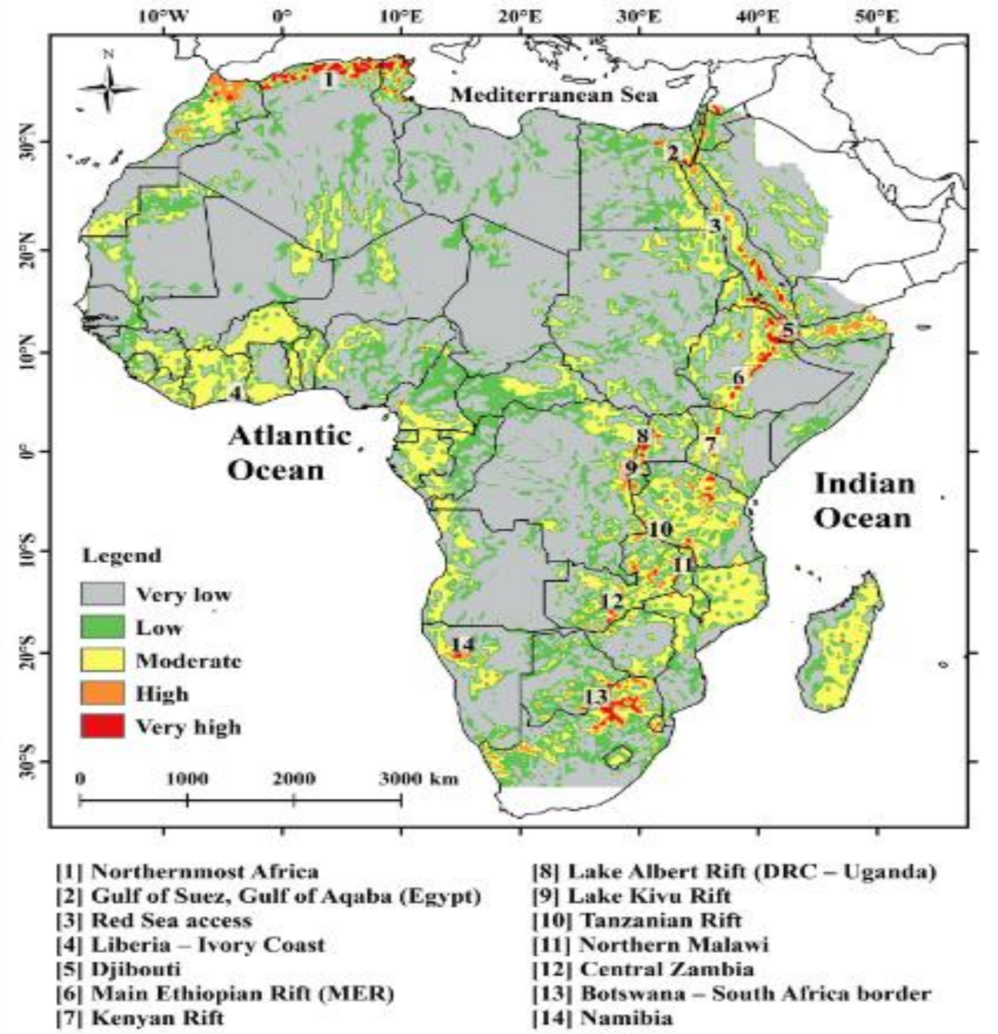

Figure 2: Geothermal potential map of Africa derived from analysis of a number of thematic layers of evidence. Source: Elbarbary et al., 2022

The geothermal potential map of Africa shows that the Africa's geothermal energy is mainly associated with the East African Rift System (EARS) that extend through Tanzania, Burundi, Rwanda, Uganda, Kenya, Ethiopia, Djibouti, and Eritrea. The EARS or East African Rift (EAR) is an active continental rift zone in Africa; a developing divergent tectonic plate boundary (*Fernandes et al., 2004*). The Rift zone includes a number of active and dormant volcanoes such as Mount Kilimanjaro, Mount Kenya and Crater Highlands in Tanzania (*Saemundsson, 2009*). Currently, Kenya is the Africa's leader in installed geothermal capacity with approximately 1 GW; nearly half of the country's electricity mix (IGA, 2025). The geothermal energy is generated from projects like Olkaria V, Olkaria VI, and Menengai. Kenya's installed geothermal power capacity was 980 MW in 2025 (Richter, 2026). The counries's geothermal power production contributed more than 40% of the country's total electricity production in 2022 (Elbarbary et al., 2022). Since 2019, Kenya has operational geothermal plants where high enthalpy fields are situated inside the axis of the Kenya rift (Kombe & Muguthu, 2019). The East Africa has potential of delivering up to 17 GW of installed geothermal capacity by 2045 for powering industry, cities, and communities with clean, indigenous energy (IGA, 2025).

Other African countries that have significant geothermal energy potentials include West African countries like Chad, Cameroon, Nigeria, Ghana, Ivory Coast, Liberia, Sierra Leone, Guinea, Senegal, Mauritania and Algeria. Nigeria's geothermal energy resources are currently not developed due to the unquantified potential and resource data for geothermal energy (Sakinat, 2024). South African countries such as Gabon (West Congolian Belt), Congo, Cabinda, and Angola have granitoids with thermal anomalies; an indication of geothermal potential while Namibia and South

Africa have orogenic belts with good geothermal heat flow signatures (Stellae Energy, 2026) which can be explored for geothermal energy.

Conclusion

This study revealed that the world's installed geothermal capacity has been growing over the years, reaching 17.173 GW at the end of 2025 with 35 countries worldwide being active in geothermal power generation. The study also revealed that U.S. and Mexico (North American), Iceland, Italy and Turkey (Europe), Indonesia, Philippines, New Zealand and Japan (Asia), Argentina, Peru and Colombia, Chile and Brazil (South America), Kenya (Africa) and Australian countries have high geothermal energy potential.

The study also revealed that U.S. remains the world's largest geothermal power producer, with geothermal power capacity of 3.953 GW in 2025 while Indonesia and Philippines remain the second and third world's largest with geothermal power capacity of 2.742 GW and 2.034 GW respectively.

It is therefore, necessary for the world's geothermally promising areas as revealed in this work to opt for proper harvesting and maximum utilization of their geothermal energy.

References

Adjei, A. (2025, May 29). Geothermal: The next North American goldrush? *Wood Mackenzie*. https://www.woodmac.com/news/opinion/geothermal-the-next-north-american-goldrush/

AECR. (2024, July 15). *Australia's Energy Commodity Resources (AECR) 2024 Geothermal*. https://www.ga.gov.au/aecr2024/geothermal

Australia Records Institute. (2020, September 4). Ngatamariki power station: World's largest singular binary power plant. *WorldKings*. https://worldkings.org/news/australia-records-institute/worldkings-worldkings-news-australia-records-institute-auri-ngatamariki-power-station-world-s-largest-singular-binary-power-plant

Ballesteros, M., Pujol, M., Aymard, D., & Marshall, R. (2020). Hot sedimentary aquifer geothermal resource potential of the early Permian Kingia Sandstone, North Perth Basin, Western Australia. *Geothermal Resources Council Transactions*, 44, 477–503.

Beardsmore, G., Ballesteros, M., Davidson, C., Larking, A., & Pujol, M. (2023). Australia country update. In *Proceedings of the World Geothermal Congress 2023*, Beijing, China.

Cariaga, C. (2023, July 14). European Geothermal Energy Council (EGEC) 2022 geothermal market report. *ThinkGeoEnergy*. https://www.egec.org/media-publications/egec-geothermal-market-report-2022/

Cariaga, C. (2024, August 9). European Geothermal Energy Council (EGEC) 2023 geothermal market report. *ThinkGeoEnergy*. https://www.thinkgeoenergy.com/egec-2023-geothermal-market-report-highlights-active-project-pipeline-in-europe/

Cariaga, C. (2025, October 16). GeoMap highlights geothermal in South America as one of the highest quality in the world. *ThinkGeoEnergy*. https://www.thinkgeoenergy.com/geomap-highlights-geothermal-in-south-america-as-one-of-the-highest-quality-in-the-world/

Craig, W., & Gavin, K. (2018). *Geothermal energy, heat exchange systems and energy piles* (pp. 41–42). ICE Publishing.

DiPippo, R. (2016). *Geothermal power plants* (4th ed., p. 203). Butterworth-Heinemann.

Elbarbary, S., Abdel Zaher, M., Saibi, H., Fowler, A., & Saibi, K. (2022). Geothermal renewable energy prospects of the African continent using GIS. *Geothermal Energy, 10*(8), 1–19. https://doi.org/10.1186/s40517-022-00219-1

Erkan, K., Holdmann, G., Benoit, W., & Blackwell, D. (2008). Understanding the Chena hot springs, Alaska, geothermal system using temperature and pressure data. *Geothermics, 37*(6), 565–585. https://doi.org/10.1016/j.geothermics.2008.09.001

Fernandes, R. M. S., Ambrosius, B. A. C., Noomen, R., Bastos, L., Combrinck, L., Miranda, J. M., & Spakman, W. (2004). Angular velocities of Nubia and Somalia from continuous GPS data: Implications on present-day relative kinematics. *Earth and Planetary Science Letters, 222*(1), 197–208. https://doi.org/10.1016/j.epsl.2004.02.008

Fourteau, T. (2022, February 2). The sun beneath our feet – geothermal power development in Asia Pacific. *White & Case*. https://www.whitecase.com/insight-our-thinking/sun-beneath-our-feet-geothermal-power-development-asia-pacific

Government of Iceland. (2022). *Energy*. https://www.government.is/topics/business-and-industry/energy/

Gudni, A., Valgardur, S., Grímur, B., & Jiurong, L. (2005). Sustainable management of geothermal resources and utilization for 100–300 years. In *Proceedings of the World Geothermal Congress 2005*, International Geothermal Association.

Hennings, J., & Lynch, H. (2020, May 21). Low temperature geothermal. *EarthDate*. https://www.earthdate.org/episodes/low-temperature-geothermal

Ibrahim, M. A., Seham, N. T., & Ahmed, M. (2025). Geothermal energy utilization of co-production water from oilfields for electric power generation. *Solar Energy and Sustainable Development, 14*, 87–109. https://doi.org/10.51646/jsesd.v14iFICTS-2024.445

IEA. (2020). *International Energy Agency's (IEA) 2020 U.S. geothermal report*. https://www.energy.gov/eere/geothermal/articles/now-available-iea-2020-us-geothermal-report

IGA. (2025). *Africa is rising: The geothermal moment is now*. International Geothermal Association. https://worldgeothermal.org/africa-is-rising-the-geothermal-moment-is-now

International Renewable Energy Agency. (2024, April 18). *Energy transition technology: Geothermal energy*. https://www.irena.org/Energy-Transition/Technology/Geothermal-energy

IRENA. (2023, February 19). *Global geothermal market and technology assessment*. International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/Feb/IRENA_Global_geothermal_market_technology_assessment_2023.pdf

Kombe, E. Y., & Muguthu, J. (2019). Geothermal energy development in East Africa: Barriers and strategies. *J Energy Res Rev, 2*, 1–6.

Lay, T., Hernlund, J., & Buffett, B. A. (2008). Core–mantle boundary heat flow. *Nature Geoscience, 1*(1), 25–32. https://doi.org/10.1038/ngeo.2007.44

Ministry of Business, Innovation and Employment. (2020, August). *Energy in New Zealand 2020*. https://www.mbie.govt.nz/dmsdocument/11679-energy-in-new-zealand-2020

Moore, J. N., & Simmons, S. F. (2013). More power from below. *Science, 340*(6135), 933–934. https://doi.org/10.1126/science.1235640

Mordor Intelligence. (2025, April 16). Asia-Pacific geothermal energy market size & share analysis – growth trends & forecasts (2025–2030). https://www.mordorintelligence.com/industry-reports/asia-pacific-geothermal-energy-market

Morphet, S. (2012). Exploring BC's geothermal potential. https://suzannemorphet.com/wordpress/wp-content/uploads/2012/01/Exploring-BCs-Geothermal-Potential1.pdf

Muñoz, G., Bauer, K., Moeck, I., Schulze, A., & Ritter, O. (2010). Exploring the Groß Schönebeck (Germany) geothermal site using a statistical joint interpretation of magnetotelluric and seismic tomography models. *Geothermics, 39*, 35–45.

Muther, T., Syed, F. I., Lancaster, A. T., Salsabila, F. D., Dahaghi, A. K., & Negahban, S. (2022). Geothermal 4.0: AI-enabled geothermal reservoir development – current status, potentials, limitations, and ways forward. *Geothermics, 100*, 102348.

National Geographic Society. (2012, November 20). Geothermal energy. https://education.nationalgeographic.org/resource/geothermal-energy/

National Geographic Society. (2025). Geothermal energy. https://education.nationalgeographic.org/resource/geothermal-energy/

Natural Resources Canada. (2025, January 3). Advancing the development of conventional and enhanced geothermal energy. https://natural-resources.canada.ca/science-data/science-research/research-centres/advancing-development-conventional-enhanced-geothermal-energy

Noorollahi, Y., Shabbir, M. S., Siddiqi, A. F., Ilyashenko, L. K., & Ahmadi, E. (2019). Review of two decade geothermal energy development in Iran, benefits, challenges, and future policy. *Geothermics, 77*, 257–266.

NS Energy. (2020, January 8). Profiling the top geothermal power producing countries in the world. *NS Energy*. https://www.nsenergybusiness.com/features/top-geothermal-power-producing-countries/

NS Energy. (2021, April 16). Profiling the top five largest geothermal power stations in New Zealand. *NS Energy*. https://www.nsenergybusiness.com/news/geothermal-power-stations-new-zealand/

Pollack, H. N., Hurter, S. J., & Johnson, J. R. (1993). Heat flow from the earth's interior: Analysis of the global data set. *Reviews of Geophysics, 30*(3), 267–280. https://doi.org/10.1029/93RG01249

Reyes, O. C., Prol-Ledesma, R. M., Corbo-Camargo, F., & Rojas, O. (2024). Geothermal resources in Latin-America and their exploration using electromagnetic methods. *Geothermal Energy, 2*(1), 1–28. https://doi.org/10.1186/s40517-024-00314-5

Richter, A. (2020, January 27). The top 10 geothermal countries 2019 – based on installed generation capacity (MWe). *ThinkGeoEnergy*. https://www.thinkgeoenergy.com/the-top-10-geothermal-countries-2019-based-on-installed-generation-capacity-mwe/

Richter, A. (2026, January 12). Global top 10 geothermal power countries at year-end 2025. *ThinkGeoEnergy*. https://www.thinkgeoenergy.com/global-top-10-geothermal-power-countries-at-year-end-2025/

Rybach, L. (2007). Geothermal sustainability. *Geo-Heat Centre Quarterly Bulletin, 28*(3), 2–7. Oregon Institute of Technology.

Saemundsson, K. (2009). *East African Rift System – An overview*. Reykjavik: United Nations University, Iceland GeoSurvey.

Sakinat, D. A. (2024, July 15). Geothermal energy's potentials in Nigeria's renewable energy portfolio. https://www.verivafrica.com/insights/geothermal-energys-potentials-in-nigerias-renewable-energy-portfolio

Scientific American Editors. (2013). The future of energy: Earth, wind and fire. *Scientific American*.

Stellae Energy. (2026). Geothermal locations, Africa. https://stellaeenergy.com/geothermal-energy/geothermal-locations/africa

Strike Energy Limited. (2022, May 5). Mid-West geothermal power project inferred resource statement, announcement to the Australian Securities Exchange (p. 5). https://app.sharelinktechnologies.com/announcement/asx/4433192d7ec32d47ca68944613a30869

Syed, M. (2024, December 20). Canada’s geothermal potential: Pathway to global leadership. https://climateinsider.com/2024/10/18/canadas-geothermal-potential-pathway-to-global-leadership/

Tester, J. W., Beckers, K. F., Hawkins, A. J., & Lukawski, M. Z. (2021). The evolving role of geothermal energy for decarbonizing the United States. *Energy & Environmental Science, 14*, 6211–6241.

ThinkGeoEnergy. (2018). Birdsville in Australia abandons plans for renewal of geothermal plant. https://www.thinkgeoenergy.com/birdsville-in-australia-abandons-plans-for-renewal-of-geothermal-plant/

Toews, M. (2020, January 11). Eavor-Lite demonstration project. *Eavor Technologies Inc.* https://albertainnovates.ca/wp-content/uploads/2022/08/2506-G2019000423-Eavor-Final-Public-Report-Jan-2021.pdf

Tomarov, G. V., & Shipkov, A. A. (2017). Modern geothermal power: Binary cycle geothermal power plants. *Thermal Engineering, 64*(4), 243–250. https://doi.org/10.1134/S0040601517040097

Turcotte, D. L., & Schubert, G. (2002). *Geodynamics* (2nd ed., pp. 7–8). Cambridge University Press.

U.S. Department of Energy. (2010, December 6). Hydrothermal power systems. https://web.archive.org/web/20101206192842/http://www1.eere.energy.gov/geothermal/powerplants.html

U.S. Energy Information Administration. (2022a). Geothermal explained: What is geothermal energy? https://www.eia.gov/energyexplained/geothermal/

U.S. Energy Information Administration. (2022b). Geothermal explained: Where geothermal energy is found. https://www.eia.gov/energyexplained/geothermal/where-geothermal-energy-is-found.php

World Energy Council. (2016). *World energy resources: Geothermal 2016*. https://www.worldenergy.org/assets/images/imported/2016/10/World-Energy-Resources-Full-report-2016.10.03.pdf

Zhang, Y., & Zhao, G. (2020). A global review of deep geothermal energy exploration from a review of rock mechanics and engineering. *Geomechanics and Geophysics for Geo-Energy and Geo-Resources, 6*(4), 1–26. https://doi.org/10.1007/s40948-019-00126-z