Proceedings World Geothermal Congress 2026
Calgary, Canada, June 8 – 11, 2026

Country Update: PHILIPPINES

Rainier M. Halcon, Vanessa S. Lazaro, and Lemuel T. Mangahas
Geothermal Energy Management Division, Renewable Energy Management Bureau, Department of Energy
rhalcon@doe.gov.ph, rainier.halcon@gmail.com

Keywords: Philippines, PGRDF, Department of Energy

ABSTRACT

The Philippines strengthened its geothermal sector with the commissioning of 53.65 MW new geothermal power capacity, enhancing the country's supply of firm, indigenous, low-carbon energy. Developers continued brownfield optimization and step-out drilling, while government-led resource assessments improved understanding of untapped geothermal fields. Development progress remained moderate due to high exploration and drilling costs, prompting the government to initiate a geothermal de-risking facility to reduce financial risks and encourage investment in early-stage projects. The period reflects steady advancement, reaffirming geothermal energy as a critical component of the Philippines' long-term sustainable power strategy.

1 INTRODUCTION

Geothermal energy is a critical component of the Philippines' renewable energy strategy, providing a stable baseload power source that enhances grid reliability and energy security. As of 2025, the country ranks third globally in geothermal capacity, with 2.03 GW of installed capacity, trailing only the United States and Indonesia. Despite this achievement, the sector's growth has been relatively modest: since the enactment of RA 9513 (Renewable Energy Act of 2008), only 197.67 MW of new capacity has been realized, including the recent installations in 2025 such as the Palayan Binary (35.7 MW), Tiwi Binary (17 MW), Tanawon (21.573 MW), and Mahanagdong Brine Optimization (31.294 MW) power plants.

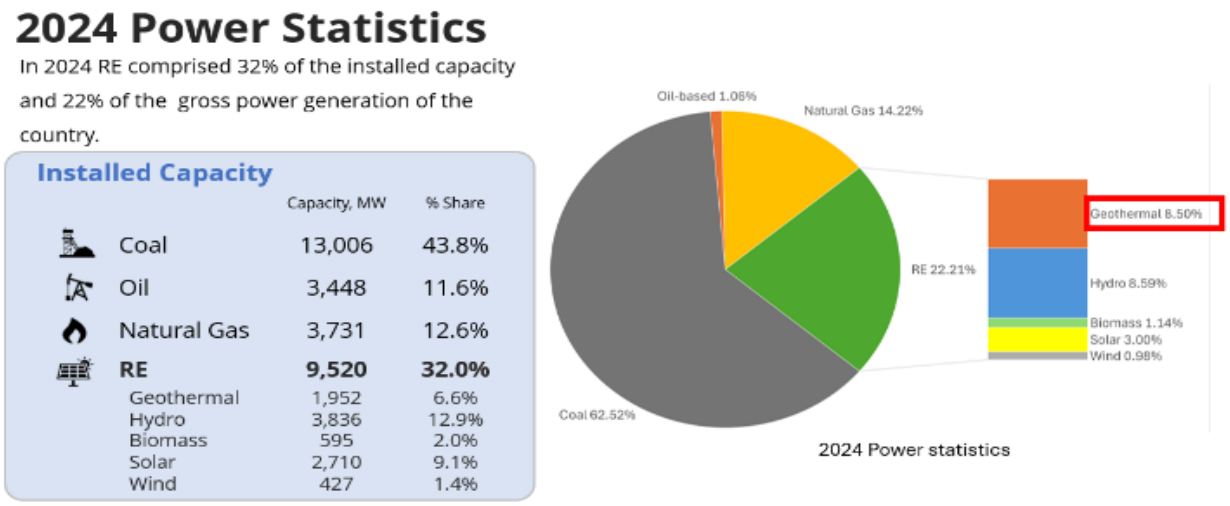

Figure 1: Installed and Generation mix in 2024.

The slower than expected development reflects persistent structural challenges, including high exploration risk, lengthy project lead times, and substantial upfront capital requirements, which constrain the development of greenfield geothermal projects. To address these barriers, the government has started working on the Philippine Geothermal Resource Derisking Facility (PGRDF), sharing exploration costs with private investors to stimulate new development. In 2024, geothermal energy contributed 10,789 GWh, or equivalent to 8.5% of gross power generation and 1,952 MW or equivalent to 6.6% of total installed capacity, highlighting both its strategic significance and the sector's untapped growth potential.

Ongoing developments, policy interventions, and incremental capacity additions illustrate the evolving landscape of geothermal energy in the Philippines, underscoring its role in achieving national renewable energy targets of 35% by 2030 and 50% by 2040, and in supporting the transition toward a sustainable, low-carbon energy system.

2 GEOLOGY BACKGROUND

Philippine geothermal systems are associated with Quaternary to recent volcanism and dense faulting along arc-related volcanic belts (e.g., Bicol–Mindanao Central Cordillera, Negros–Sulu, Santa Ana–Luzon Cordillera). Systems are commonly liquid-dominated with clay-caps mapped by resistivity, and reservoirs occur within volcanic sequences and intrusive bodies.

2.1 Geologic Framework of Philippine Geothermal Resources

The Philippine archipelago is situated within the Philippine Mobile Belt, between opposing subduction systems: west-dipping subduction along the Philippine Trench and East Luzon Trough to the east, and east-dipping subduction along the Manila, Negros, and Cotabato Trenches to the west and southwest. North and south terminations transition into collision belts (e.g., Taiwan; Mindoro–Panay), and the arc–arc interaction occurs in the Moluccas Sea. Pliocene–Holocene volcanic belts correlate with active subduction: (1) the Luzon Volcanic Arc linked to the Manila Trench; (2) the East Philippine Volcanic Arc associated with the Philippine Trench; (3) the Negros–Panay Arc linked to the Negros Trench; (4) the Sulu–Zamboanga Arc formed by the Sulu Trench; and (5) the Cotabato Arc related to the Cotabato Trench. (Mines and Geosciences Bureau (MGB), 2010) Earlier Oligocene–Miocene magmatic belts and Paleogene intrusions (e.g., Agno/Central Cordillera diorite complexes) host widespread hydrothermal alteration and high to moderate-temperature resources (Department of Energy - GEMD, 2024).

The spatial distribution of geothermal fields in the Philippines (Figure 2) reflects the interplay between arc magmatism, intrusive heat sources, and major crustal structures. As synthesized from Malapitan and Reyes (2000) and Troncales (1979), geothermal systems are predominantly situated along Quaternary volcanic arcs, Neogene plutonic belts, and transcurrent fault systems that together define the thermal and permeability architecture of the Philippine Mobile Belt.

Geothermal manifestations along volcanic belts are commonly localized at the flanks and basal regions of young Quaternary volcanoes, where magmatic heat is retained at shallow levels and hydrothermal fluids ascend through deep crustal fractures. Andesite–dacite volcanic terrains are particularly favorable due to their higher magma viscosity, greater potential for shallow magma storage, and enhanced volatile concentration at magma margins, conditions that promote repeated brittle failure and the development of secondary permeability. These characteristics define the major arc systems in the archipelago, including the Luzon Volcanic Arc linked to the Manila Trench, the East Philippine Volcanic Arc parallel to the Philippine Trench, the Negros–Panay and Sulu–Zamboanga arcs associated with west-facing trench systems in the Visayas and Mindanao, and the Central Mindanao–Cotabato arc within the broader arc-collision domain of southern Philippines. Producing fields such as MakBan, Maibarara, Tiwi, Bacon–Manito, Tongonan, Palinpinon, and Mt. Apo are situated along these arcs, highlighting the critical dependence of high-temperature geothermal systems on sustained magmatic heat supply.

Beyond these young arcs, geothermal prospects also occur within Oligocene–Miocene magmatic belts and Neogene plutonic terrains where quartz diorite and granodiorite intrusions form significant crustal heat sources. These intrusive complexes, which occur as batholiths and clustered stocks throughout Luzon, Visayas, and Mindanao, often display multi-phase emplacement and extensive hydrothermal alteration. The thermal contribution of these intrusives, combined with their mechanical contrasts and fracture susceptibility, provides favorable conditions for low- to moderate-temperature geothermal systems where active volcanism is absent.

Structural permeability remains a dominant control on the viability of Philippine geothermal reservoirs. Fault-related deformation along the Philippine Fault Zone (PFZ) and its subsidiary splays governs fluid flow by generating fracture networks, step-overs, relay zones, and terminations that enhance upflow and connectivity (Department of Energy – GEMD, 2024). In many regions, geothermal fields cluster along the easterly convex volcanic front intersected by the PFZ, Structural complexity is particularly pronounced in Mindanao where horsetail splays of the PFZ interact with arc-related volcanic chains, producing zones of enhanced permeability that coincide with solfataric and dormant volcanic centers.

Collectively, these volcanic, plutonic, and structural controls shape the distribution and character of geothermal systems across the Philippines. High-temperature resources track active subduction-related arcs,

whereas low- to medium-temperature systems are more commonly associated with older intrusives and structurally controlled domains within the PFZ corridor. This integrated tectono-magmatic perspective underscores the importance of arc–fault interactions in governing the development, sustainability, and exploitation potential of Philippine geothermal fields.

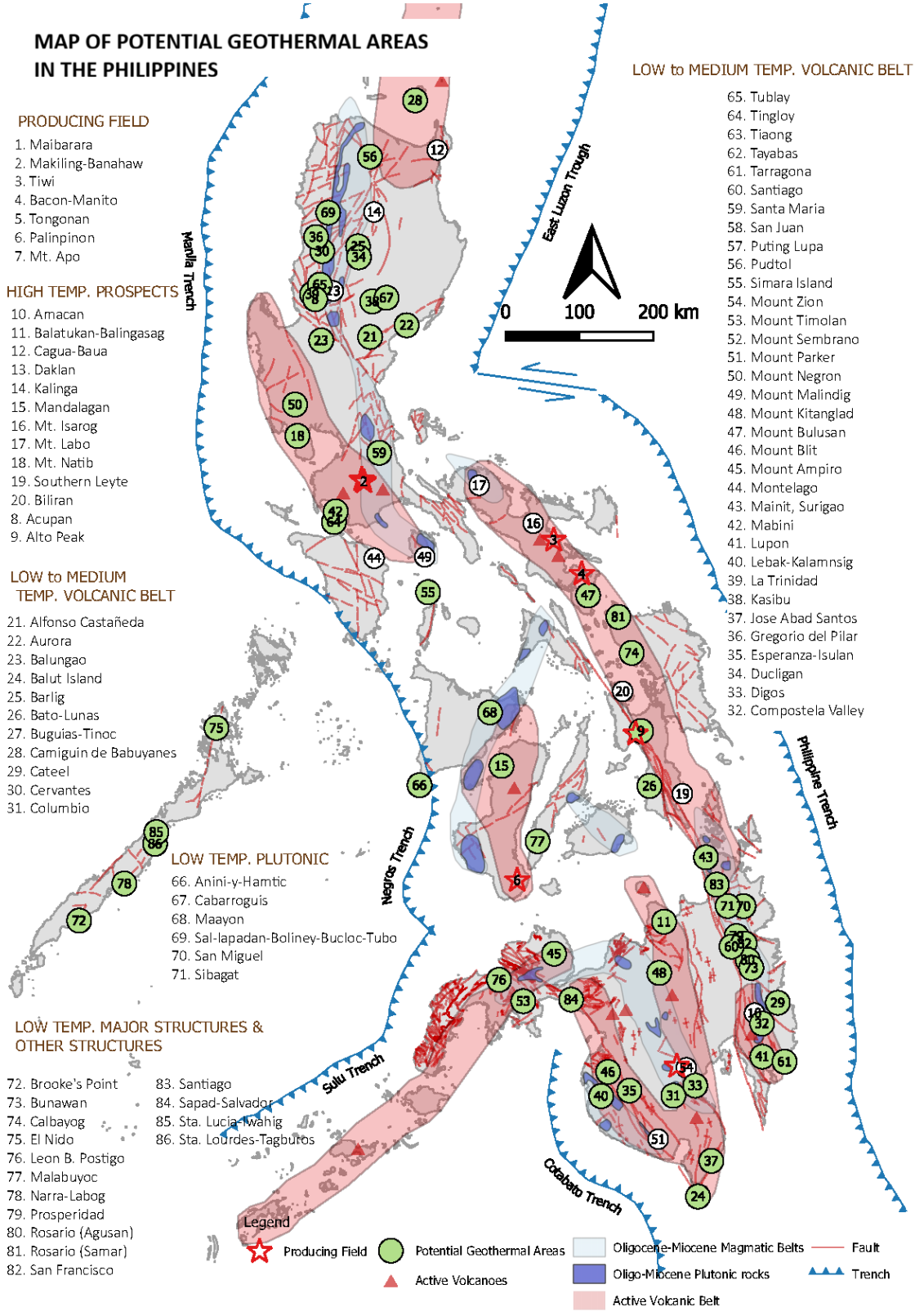

Figure 2. Map of the Distribution of the Philippine geothermal resources. Producing geothermal fields cluster along active volcanic belts.

2.2 Geothermal Resources and Potential

The latest inventory counts 148 geothermal fields scattered all over the Philippines that documents the occurrence of various thermal manifestations. Figure 2 shows the indicative locations and overlapping locations that explain the difference in the counted numbers. The total potential capacity of the Philippines, based mostly on hydrothermal resources is approximately 4,160MW based on P10 probability of the Monte Carlo simulation.

Table 1: Summary of Philippine Geothermal Resources. GSC = Geothermal Service Contract, COA = Certificate of Authority

STATUS	No. of GEOTHERMAL FIELD	INSTALLED CAPACITY (MW)	POTENTIAL CAPACITY (P10, MW)
Commercial Operation	7	2025.94	2197.98
Development stage	2	0	281.92
Pre-development stage	12	0	637.02
Within existing GSC	10	0	319.06
Open area	114	0	724.82
COA	3	0	0.00
Grand Total	148	2025.94	4160.80

Table 1 shows the summary of geothermal fields in various stages of development. The seven (7) geothermal fields under commercial operations are the existing areas with geothermal power plants. The two (2) under development stage are those areas undergoing finalization of development scheme, while those under pre-development stage are in early-stage resource assessment. The areas within existing GSCs are potentially separate geothermal fields or resources from those in commercial operation that remains to be tapped. The geothermal fields under COA are in early-stage acquisition of permits, and the remaining geothermal fields classified as "open area" are those geothermal fields with limited information on its potential for development: these areas are subject to DOE internal resource assessment activities.

The DOE continues to conduct field validation of the geothermal fields identified in the above discussion through locally-funded projects and technical assistance. With technical collaboration from the U.S. Great Basin Center for Geothermal Energy (GBCGE; University of Nevada, Reno), the DOE initiated a regional geothermal Play Fairway Analysis (PFA) to systematically screen the resource potential of northwestern Luzon. The assessment applies an expert-driven, GIS-based workflow that integrates key geologic, geophysical, and geochemical proxies into spatially explicit favorability and predictive models, enabling the identification of areas where heat, permeability, and fluid indicators converge and where "blind" geothermal systems may be present despite limited surface expression (Olvera-García, et al., 2024) . Results from the pilot implementation have already delineated priority zones and prospective hidden targets across Ilocos Norte, Apayao, and Nueva Vizcaya, thereby providing an objective basis for prioritizing reconnaissance, detailed field validation, and subsequent exploration investments. The DOE intends to expand the standardized PFA framework nationwide as regional datasets are completed, quality-controlled, and harmonized to ensure consistent screening, comparability of results across provinces, and iterative refinement of targets as new data become available.

3 GEOTHERMAL UTILIZATION

In line with the National Renewable Energy Program (NREP), several new geothermal power plant facilities were commissioned in 2025 to enhance energy security, reduce carbon emissions, and support the country's long-term renewable energy goals. These projects expand existing geothermal complexes and optimize resource utilization through advanced technologies.

3.1 New Geothermal Power Plants

3.1.1 Tiwi Binary Geothermal Power Plant (17 MW)

The 17-megawatt Tiwi Binary Geothermal Power Plant is an expansion within the existing Tiwi Geothermal Power Plant complex in Albay and is operated by AP Renewables, Inc. The facility employs binary cycle technology to convert residual heat from separated geothermal fluid. This optimization project generates additional value to the overall efficiency and output of the Tiwi complex.

3.1.2 Palayan Binary Geothermal Power Plant (35.70MW)

The Palayan Binary Geothermal Power Plant, developed by Bac-Man Geothermal, Inc., is located in Manito, Albay, within the Bacon-Manito (BacMan) geothermal field. The plant utilizes Organic Rankine Cycle (ORC) technology to generate electricity from the separated geothermal fluid of the existing Palayan Bayan power plants.

3.1.3 Tanawon Geothermal Power Plant (21.573 MW)

The 21.573-megawatt Tanawon Geothermal Power Plant, developed by Bac-Man Geothermal, Inc. and located in Sorsogon City, is a new flash cycle geothermal facility. Tanawon is one of the successful winners of the Third Round of the Green Energy Auction (GEA-3) program which declared commercial operation in August 2025.

3.1.4 Mahanagdong Geothermal Brine Optimization/Binary Power Plant (31.294 MW)

The 31.294-megawatt Mahanagdong Geothermal Brine Optimization/Binary Power Plant is an Energy Development Corporation project situated within the Tongonan Geothermal Service Contract area in Ormoc City, Leyte. The facility applies ORC binary technology to recover thermal energy from the separated geothermal brine.

Table 2: Total installed capacity as of January 2026. O = Operating

Power Plant	No. of Units	Year Commissioned	Status	Total Installed Capacity (MW)
Mahanagdong Geothermal Brine Optimization	1	2025	O	31.294
Palayan Binary	1	2025	O	35.70
Tanawon	1	2025	O	21.57
Tiwi Binary	1	2025	O	17
Mindanao 3 Binary	1	2022	O	3.67
Maibarara 1 and 2	2	2018 / 2014	O	32
Nasulo	1	2014	O	49.38
Mindanao 1 and 2	2	1999 / 1996	O	108.48
Bacman	3	1998 / 1994 / 1993	O	140
Makban	19	2014 / 1995 / 1994 / 1993 / 1984 / 1980 / 1979	O	458.53
Tiwi	4	1982 / 1979	O	234
Tongonan 1	3	1983	O	123
Unified Leyte	19	1998 / 1997 / 1996	O	610.18

Palinpinon 1 and 2	7	1995 / 1994 / 1993 / 1983	O	192.5
TOTAL				2057.30

3.2 Geothermal Power Plant under Construction

The 5.645MW Bago Binary Geothermal Power Plant is being developed by Energy Development Corporation and located in Brgy. Mailum , Bago, Negros Occidental still under construction. Bago Binary is one of the winners of the GEA3. The target commercial operation is by December 2026.

3.3 Cancelled Power Plant Projects

Phase 1 (2MW) of the Biliran Geothermal Project, located in Biliran, Biliran, was cancelled due to technical issues. The 2MW power plant, which was undergoing commissioning phase will no longer pursue full commissioning until further assessment of the powerplant design and resource capability. The proponent, Biliran Geothermal Inc, will conduct additional resource assessment to fully determine sustainable drilling targets.

The Montelago geothermal project, located in Naujan, Oriental Mindoro, was terminated by the Department of Energy. The GSC issued to Mindoro Geothermal Power Corp. was terminated in October 2025 due to their non-compliance with their contractual obligations, especially on the commissioning of the Phase 1 3MW power plant.

3.4 Projects Under Exploration Stage

As of December 2025, there are twelve (12) active Geothermal Service Contracts (GSCs) at the Pre-Development/Exploration Stage. An assessment of their progress reveals substantial variation in how far developers have advanced through the early phases of geothermal project preparation. GSCs awarded prior to 2019 have generally progressed to the Preliminary Conceptual Modeling (PCM) stage, reflecting the longer time available to complete baseline surface investigations. In contrast, among GSCs awarded from 2019 to 2024, only three have reached PCM, suggesting slower advancement among more recently awarded contracts.

A pronounced decrease in the number of GSCs progressing beyond PCM underscores the financial barriers encountered when transitioning from relatively low-cost surface studies to capital-intensive drilling preparation. These constraints limit advancement toward subsurface validation, although three GSCs have successfully reached the exploration drilling stage.

4 ENABLING POLICY SUPPORT

To encourage further geothermal development, the DOE has enacted additional policies that will enable ease of doing business, offtake market, and addressing the early-stage risks brought about by exploration drilling.

4.1 Ease of Doing Business

The DOE's issuance of Department Circular no. DC2024-06-0018 or the "Revised Omnibus Guidelines Governing the Award and Administration of RE Contracts and the Registration of RE Developers" (Revised Omnibus Guidelines) provided an streamlined and transparent processing of applications for RE development and its administration, including that of geothermal resources. This policy introduced the issuance of a "Certificate of Authority" (COA) that provides an RE developer with an additional three (3) years period to acquire the necessary permits and clearances, and even initial resource assessment activities. This is an incentive that provides an additional 3-year period outside the 25 years contract term, so that the developer will have a longer period to take into account to focus in time extensive activities such as drilling and power plant construction. Additional and new investments are also further defined to encourage further development and utilization of geothermal resources.

There is also the Energy Virtual One-Stop Shop (EVOSS) that digitalizes the application and processing of applications for RE projects, that also includes processing of various submissions for the administration of a particular RE project. The EVOSS follows the principle of the Ease of Doing Business law and is the guiding principle where the Revised Omnibus Guidelines is anchored upon. There is also the Greenlane Certification from the Board of Investments and Certificate of Energy Project of National Significance of the DOE to further promote ease of doing business. The combination of the aforementioned policies assures the developers of a

transparent, expedited, and preferential attention in securing all necessary acquisition of permits and clearances from various entities such as the local government units and other government agencies.

4.2 Assured offtake mechanisms

Consistent with the Philippine Energy Plan 2023-2050, geothermal development is supported through a suite of fiscal and non-fiscal incentives and mechanisms including a mandated power offtake, auction-based procurement and voluntary market programs, amongst other. To start off, the Renewable Portfolio Standard compliance from the mandated participants increased from 1% to 2.52% in 2022 and implemented since 2023. Next was the 3rd Green Energy Auction (GEA3) that catered for non-FIT technologies such as geothermal, pumped-storage hydro, and large hydropower development which was completed in 2025. Several new policies were also adopted in 2025 that may further support geothermal development such as voluntary markets, carbon credit framework for energy, and the continuing Green Energy Option Program. Under GEA3, the Tanawon and Palayan Bayan geothermal power plants benefitted from it by taking an assured rate of PhP7.644/kWh for 20 years.

4.3 Philippine Geothermal Derisking Facility (PGRDF)

The PGRDF is the culmination of the ADB-supported technical assistance - "Roadmap to Derisking Geothermal Development in the Philippines" which started in 2021 until 2023. The PGRDF is a cost-sharing mechanism to encourage developers in their exploration drilling. It is designed to support the drilling activities of 12 projects in the amount of 170MUSD. It is a 50:50 cost-sharing mechanism to support developers in their exploration drilling that includes expenses from road and well pad construction, drilling of up-to 3 exploration wells, and the corresponding well testing activities. Its basic concept is if a developer using the PGRDF fund proceeds to a project's declaration of commerciality, the developer is required to pay the loan in 6-years bullet payment. If the project does not apply or if the project is deemed to be not commercially viable to develop, then the developer is required to relinquish the project, then the PGRDF loaned amount will be converted as grant. The PGRDF, since 2024, has been making steady progress towards its implementation by the 2nd half of 2026. As of December 2025, a memorandum of agreement was signed between DOE and the Landbank of the Philippines to manage the PGRDF.

5 WAY FORWARD

The above-mentioned policies are expected to encourage further exploration and development of the country's geothermal resources, especially the implementation of the PGRDF which is anticipated to be approved by the 2nd half of 2026, is expected to drive the development of greenfield geothermal projects. Parallel to this, the DOE is working on other initiatives: such as improvement of various geothermal related databases to make it more accessible, the study to promote direct-use or non-power application of geothermal resources and aligning with the international standards in classifying the country's geothermal resources.

Under the abovementioned initiatives, the amendment of the National RE Plan and the geothermal development roadmap 2025 - 2050, the DOE will work on promoting the direct-use or non-power application of geothermal energy particularly for its balneological application, air conditioning or refrigeration applications, and its most direct - the drying application. The approach will be on policy review to encourage investment in this sector and inventory of candidate areas for various applications. It is envisaged that the promotion of this initiative will provide additional value to the developers or investors and promote better community acceptance.

Next is the parallel review of existing incentives for possible improvement or introduction of additional incentives to promote and encourage further investment in geothermal development. This review will cover measures that can be achieved in the near future such as review and its possible of the RE law's fiscal and non-fiscal incentives, such as the adoption of the FIT scheme similar to other countries to encourage development of low to medium temperature geothermal resources and even acidic resources. For the long term target, the study to introduce support mechanisms that will address the persistent barriers in exploration drilling is being conducted.

Efforts are also being made to actively update the existing geothermal database, along with the intention to adopt the UNFC Classification for Geothermal Resources to align the local classification with international standards. This also includes the introduction of reporting guidelines to streamline the evaluation of the results of geoscientific reports for transparency.

The DOE is also working closely with all relevant stakeholders to discuss and address barriers to geothermal development.

Acknowledgements

The author wishes to acknowledge all contributors to this country report, including the leadership of the Department of Energy, the Renewable Energy Management Bureau, and colleagues at the Geothermal Energy Management Division.

6 REFERENCES

Department of Energy - GEMD. (2024). *Map of Potential Geothermal Areas in the Philippines.* Taguig City: DOE.

Mines and Geosciences Bureau (MGB). (2010). *Geology of the Philippines (2nd edition)*. Quezon City: Department of Environment and Natural Resources (DENR), Philippines.

Olvera-García, E., Simbe, S., Mangahas, L., Marbello, A., Mandig, A., Alcantara, C., . . . Fronda, A. (2024). *Expert-driven geothermal play fairway analysis for low to medium temperature hidden systems in northwestern Luzon Island, Philippines*. Geothermics.

Department of Energy - 2024 Philippine Power Statistics