

Encouraging Geothermal Investment in Indonesia: Evaluating Government Strategies to Address Exploration Risks and Comparative Insights from Successful Countries

Rahmatyo Gilang Trilaksono^{1,2} & Ali Ashat¹

¹ Geothermal Engineering Master's Program – Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung 40132, Indonesia

² PT PLN (Persero), Jalan Trunojoyo Blok M-1 No. 135, Jakarta, Indonesia
Email: r.gilang.t@gmail.com

Abstract. Exploration is the most expensive and high-risk phase in the geothermal development chain. This condition has resulted in low private sector participation, particularly during the early stages of development. This study aims to evaluate the Indonesian government's policy strategies to address geothermal exploration risks and conduct a comparative analysis with successful approaches implemented in Kenya, the Philippines, and Turkey. Using a qualitative-descriptive method, the study draws on policy literature and actual exploration data to examine regulatory frameworks, fiscal incentives, and public risk-sharing mechanisms. The findings reveal that while Indonesia has initiated exploration through government agencies such as Center for Mineral, Coal, and Geothermal Resources “PSDMBP” and offers fiscal incentives and risk guarantees (via Geothermal Risk Mitigation Facility “GRMF” and PT Penjaminan Infrastruktur Indonesia “PII”), the implementation still faces major challenges, including limited budget, weak inter-agency coordination, bureaucratic inefficiencies, and restricted access to geoscientific data. In contrast, exploration models in Kenya (public exploration via Geothermal Development Company “GDC”), the Philippines (Build-Operate-Transfer “BOT” scheme with feed-in tariffs), and Turkey (cost-sharing with the private sector) show more integrated and investor-friendly approaches. This study concludes with strategic recommendations, including the establishment of a state-owned exploration company, improved data transparency, regulatory reforms, and the implementation of output-based fiscal incentives to enhance geothermal investment attractiveness in Indonesia.

Keywords: *geothermal exploration, energy policy, exploration risk, energy investment, fiscal incentives, international policy comparison.*

1 Introduction

Geothermal energy development in Indonesia began in the early 20th century with the discovery of geothermal manifestations in West Java. Formal exploration activities were first conducted in 1926 by the Dutch colonial government near Kawah Kamojang. The first commercial geothermal power plant (Kamojang Unit 1), with a capacity of 30 MW, began operations in 1983.

Since then, development has continued gradually through partnerships between the government, Pertamina, and other entities.

Despite regulatory progress through the issuance of Law No. 27 of 2003 and its successor, Law No. 21 of 2014—which reclassified geothermal activities as non-mining to enable operations in forest areas—Indonesia still faces significant challenges in the exploration phase. Exploration is widely recognized as the costliest and riskiest phase due to geological uncertainty, high drilling costs, and a lack of guaranteed proven reserves.

Although Indonesia holds the world's second-largest geothermal potential, resource utilization remains suboptimal. Government involvement in risk mitigation is critical to attract private sector investment. This study evaluates the policies that have been implemented and compares them with best practices from other countries.

2 Methodology

This research employs a qualitative-descriptive approach through literature study and comparative public policy analysis. The primary focus is on evaluating Indonesia's geothermal exploration policies and benchmarking them against successful approaches in Kenya, the Philippines, and Turkey.

The analysis compares five key aspects: (1) exploration risk mitigation schemes, (2) government involvement, (3) fiscal and financial support, (4) transparency and accessibility of geoscientific data, and (5) effectiveness in attracting private investment. The evaluation forms the basis for developing responsive policy recommendations.

3 Evaluation of Geothermal Exploration Policies in Indonesia

3.1 Historical Development and Policy Formulation

Since the initial geothermal exploration conducted during the Dutch colonial era in 1926, the development of geothermal energy in Indonesia remained stagnant until a breakthrough occurred in 1983 with the commissioning of the Kamojang Unit 1 geothermal power plant. Following that, the construction of geothermal power plants progressed gradually, but not significantly, due to the absence of regulations that encouraged investment {13}.

A major milestone was the enactment of Law No. 27 of 2003 on Geothermal Energy, which provided a legal foundation for managing WKP. However, this

law still classified geothermal activities as mining, thereby hindering development in forest areas.

In 2014, the government replaced the law with Law No. 21 of 2014, which redefined geothermal activities as non-mining. This change was significant as it opened up opportunities for development in conservation areas under environmental preservation principles. Additionally, the government's role in early-stage exploration through the PSDMBP was further strengthened.

3.2 Geothermal Exploration Policy in Indonesia

Geothermal exploration in Indonesia faces significant challenges, as it represents the most expensive and high-risk stage in the geothermal project development chain. To reduce the burden of risk on private investors, the government, through the Ministry of Energy and Mineral Resources (ESDM), allocates funding from APBN to support early-stage exploration activities, which are implemented by the PSDMBP.

However, the implementation of this policy faces several obstacles. First, budget limitations mean that government-led exploration efforts cannot adequately cover all potential WKP evenly and optimally. Second, inefficient inter-agency coordination hampers the planning and execution of exploration projects. Third, various technical and administrative barriers—such as slow tender processes and delays in procuring survey services—contribute to project implementation setbacks.

Concrete examples of these challenges include project delays due to non-compliance with technical standards, limited availability of qualified geoscience professionals at the regional level (Habibi et al., 2023), and uncertainty regarding the continuity of funding after the initial exploration phase, which is commonly reported as a barrier to private sector confidence in Indonesia's geothermal landscape (Asian Development Bank, 2021; Habibi et al., 2023). These issues indicate that, although the government is involved in the exploration stage, its role has not yet fully succeeded in creating a competitive and attractive investment climate for private developers.

3.3 Fiscal Incentives and Risk Guarantee Schemes

To attract more investors, the Indonesian government also offers a range of fiscal incentives, including tax holidays, import duty exemptions for equipment, and reductions in income tax. In addition, the government established the GRMF under the Ministry of Finance and provides risk guarantee facilities through PII.

However, the implementation of these incentives is considered suboptimal. Utilization of the GRMF, for example, remains very limited due to complex application procedures, a lack of information accessible to developers, and uncertainties surrounding the disbursement process of risk mitigation funds. Moreover, the risk guarantees provided by PII have not yet fully addressed investors' needs for a comprehensive geological risk protection scheme.

3.4 Policy Solutions Implemented in Other Countries

To address the high risks associated with geothermal exploration, several countries have developed innovative policy strategies that have proven successful in attracting investment. These solutions may serve as references for Indonesia in formulating more effective and appealing exploration policies.

First, **Kenya**, through the GDC, implemented a public exploration scheme funded by the government and international donors. GDC conducts geoscientific surveys and initial drilling, and then tenders the proven WKP to private developers for construction and operation. This approach significantly reduces exploration risks for investors and has successfully attracted private sector participation. (Kiplagat, J. K., Wang, R. Z., & Li, T. X. (2011). Kenya's transformation to a geothermal giant: Role of GDC and public risk taking. *Renewable and Sustainable Energy Reviews*, 15(6), 2960–2974)

Second, **the Philippines** applies a BOT approach and provides tariff-based incentives such as feed-in tariffs to guarantee long-term developer revenue. The government also offers open access to early exploration data and accelerates the WKP bidding process through a more transparent and competitive system. (Alcasid, C. A., et al. (2016). Policy support for renewable energy in the Philippines: feed-in tariffs and the Renewable Portfolio Standard. *Renewable Energy Focus*, 17(1), 23–30)

Third, **Turkey** has implemented an exploration subsidy program that is directly granted to private developers, not just state institutions. The Turkish government covers part of the cost of initial exploration drilling and provides additional incentives in the form of resource risk sharing. This approach has proven effective in accelerating geothermal development, making Turkey one of the fastest-growing geothermal markets in the world. (Dincer, I., & Acar, C. (2018). Geothermal energy use in Turkey: Developments and policies. *Energy Policy*, 119, 84–95.)

Fourth, **Iceland** promotes early-stage public-private research collaboration through institutions such as Iceland GeoSurvey (ÍSOR), and offers open access to its national geoscientific database. This enables both investors and research

institutions to reduce technical uncertainties from the outset. (axelsson, G. (2013). Role of research institutions in supporting geothermal development: Case of Iceland. *Proceedings of the World Geothermal Congress 2015.*)

From these practices, key lessons for Indonesia include:

1. The need for a dedicated public exploration entity with sufficient budget and skilled human resources.
2. The importance of transparent and open access to exploration data.
3. The effectiveness of risk-based and result-oriented incentives, rather than solely tax-based incentives.
4. The need to accelerate the permitting and bidding process for projects with proven reserves.

4 Evaluation of Government Policy Strategies and International Comparison

4.1 Evaluation Framework

The evaluation of Indonesia's geothermal exploration policies is conducted using a comparative analysis with strategies implemented in Kenya, the Philippines, and Turkey. The evaluation covers five main aspects:

1. Exploration Risk Mitigation Schemes
2. Government Involvement in Early Stages
3. Fiscal and Financial Support
4. Accessibility and Transparency of Data
5. Effectiveness in Attracting Private Investment

Data for the analysis were obtained from policy documents, international agency reports, case studies, and relevant academic publications.

4.2 Indonesia's Policy Performance

Based on the five evaluation aspects, Indonesia demonstrates strength in state involvement in early-stage exploration through PSDMBP and in the provision of fiscal incentives such as tax holidays. However, several critical challenges remain:

1. Risk mitigation schemes are not yet fully structured and do not comprehensively address geological uncertainties.
2. Exploration funding is highly limited and relies predominantly on (APBN).

3. Weak inter-agency coordination and bureaucratic complexity hinder the procurement and bidding processes for (WKP).
4. Limited availability and transparency of exploration data impede private developers' ability to conduct thorough due diligence.

These findings align with the Asian Development Bank's (2021) conclusion that Indonesia's approach remains overly conservative and insufficiently aggressive in mitigating early-stage risks compared to other countries.

4.3 Comparison of Strategies from Other Countries

A comparison of international strategies provides insights into designing more effective exploration policy frameworks. The table 1. below summarizes exploration policy strategies in Indonesia, Kenya, the Philippines, and Turkey based on the five key evaluation aspects:

Table 1 Comparative Analysis of Geothermal Exploration Policies in Selected Countries

Aspect	Indonesia	Kenya	Philippines	Turkey
Initial Exploration	PSDMBP (government-led)	GDC (government-led)	Government and private	Private with exploration subsidies
Risk Mitigation	GRMF & PII (limited scope)	Fully public funded	Feed-in tariff & early data	Cost-sharing for exploration
Fiscal Incentives	Tax holiday, import relief	Not emphasized	Competitive feed-in tariff	Premium payments for early success
Data Transparency	Limited, not integrated	Public after GDC surveys	Open access via DOE	Highly open through public institutions
Investor Interest	Low	High	Moderate	Very high in the private sector

4.4 Policy Implications and Recommendations

The evaluation reveals that Indonesia's geothermal exploration policy still faces fundamental barriers that need urgent attention. Although the state is present through PSDMBP, there is a lack of strong institutional support, data transparency, and robust risk mitigation mechanisms.

4.4.1 Key Implications

Without concrete intervention to reduce exploration risk, private developers will continue to avoid involvement in early-stage geothermal development.

Limited transparency and access to geoscientific data generate high uncertainty in project feasibility analysis, making investment decisions more difficult.

Complicated licensing and bidding processes increase transaction costs and extend project time-to-market.

4.4.2 Strategic Recommendations:

In the short term (1-2 Years), the government should focus on optimizing existing mechanisms and removing immediate barriers that hinder geothermal exploration. The priority lies in streamlining procedures, enhancing data access, and piloting collaborative models:

1. **Optimize the use of GRMF and PII:** The GRMF and PII have the potential to significantly reduce exploration risk, yet their impact is limited by complicated procedures and narrow risk coverage. Simplifying application processes and expanding eligibility criteria can accelerate fund utilization and boost developer confidence.
2. **Digitalize and open WKP data:** Access to accurate and timely geoscientific data is essential for developers to conduct feasibility assessments. Establishing an integrated geothermal data platform—modeled after successful international systems—would improve transparency and support investment decision-making.
3. **Launch pilot public-private exploration projects:** Demonstration projects involving government and private sector collaboration can serve as a testing ground for new exploration strategies. These pilots will not only validate resource potential but also refine institutional roles and cooperation mechanisms before national scaling.

For long-term sustainability (3-5 Years), structural reforms are necessary to institutionalize geothermal exploration and incentivize risk-taking among private developers. These reforms aim to establish new entities, modernize incentives, and provide legal certainty:

1. **Establish a state-owned geothermal exploration company:** Drawing lessons from Kenya's GDC model, Indonesia could benefit from a dedicated public entity tasked with conducting early exploration and proving reserves. This would significantly reduce private sector exposure to geological risk and attract more players to the development phase.

2. **Reform risk-based fiscal incentive schemes:** Existing incentives primarily focus on taxation, which may not adequately address exploration risk. A shift toward output-based aid—where incentives are tied to the successful discovery of geothermal resources—would reward performance and align government support with tangible results.
3. **Draft implementing regulations under Law No. 21/2014:** Although the law provides a legal foundation, the absence of detailed technical and administrative regulations creates uncertainty. Developing clear operational guidelines will ensure smoother project implementation and strengthen investor confidence in the geothermal sector.

5 Conclusion

5.1 Conclusion

Geothermal exploration is the most crucial yet most high-risk phase in the geothermal project development chain in Indonesia. The high geological uncertainty, substantial upfront costs, and unpredictability of exploration success make this stage less appealing to private investors. Therefore, the strategic role of the government in mitigating these risks is key to the successful development of the sector.

The evaluation shows that Indonesia's exploration policy—implemented through PSDMBP assignments and fiscal incentives such as tax holidays—is a step in the right direction. However, its implementation still faces various challenges, including limited budget, inter-agency bureaucracy, slow WKP tender processes, and limited transparency in geoscientific data.

Comparative analysis with countries such as Kenya, the Philippines, and Turkey demonstrates that their success in attracting investment is largely due to strong government roles in absorbing early exploration risks, providing accurate and accessible data, and applying risk- and performance-based incentive schemes.

5.2 Recommendations

Based on the evaluation, the following are strategic recommendations for the Government of Indonesia to strengthen its geothermal exploration policy:

A. Systemic and Structural Recommendations

- 1) Establishment of a State-Owned Geothermal Exploration Company
A dedicated entity is needed to conduct surveys, initial drilling, and reserve validation before tendering projects to the private sector—similar to Kenya's GDC model.

- 2) Regulatory Reform
Develop implementing regulations under Law No. 21 of 2014 that specifically address exploration governance, land acquisition, risk-based incentives, and institutional frameworks.
- 3) Innovative Financing Schemes
The government can issue green bonds or tap into international climate funds (e.g., the Green Climate Fund) to finance exploration beyond reliance on APBN.

B. Operational and Short-Term Recommendations

- 1) Optimization of GRMF and PII Schemes
Simplify procedures, enhance transparency in criteria, and expand the scope of geological risk coverage.
- 2) Digitalization and Open Access to Data
Establish a national geospatial-based platform for WKP geoscientific data accessible to developers, academics, and policymakers.
- 3) Acceleration of WKP Tenders
Streamline administrative processes through the creation of a One-Stop Licensing Unit that integrates permitting, technical evaluation, and WKP administration.
- 4) Implementation of Output-Based Incentives
Provide fiscal rewards or exclusive operating rights to developers who successfully discover and prove geothermal reserves.

References

- [1] Government of Indonesia. (2014). *Law No. 21 of 2014 on Geothermal Energy*. Jakarta: Secretariat of the Republic of Indonesia.
- [2] Government of Indonesia. (2003). *Law No. 27 of 2003 on Geothermal Energy*. Jakarta: Secretariat of the Republic of Indonesia.
- [3] PwC Indonesia. (2019). *Power in Indonesia: Investment and Taxation Guide*.
- [4] Bappenas. (2020). *Strategic Review on the Development of New and Renewable Energy: Geothermal Energy*. National Development Planning Agency (Bappenas), Indonesia.
- [5] Asian Development Bank. (2021). *Unlocking Indonesia's Geothermal Potential*. Manila: ADB Publications.
- [6] Directorate General of Taxes. (2023). *Regulation on Tax Facilities for Geothermal Activities*. Ministry of Finance, Republic of Indonesia.
- [7] PT Penjaminan Infrastruktur Indonesia (PII). (2022). *Annual Report and Infrastructure Guarantee Mechanism*.

- [8] Kiplagat, J. K., Wang, R. Z., & Li, T. X. (2011). Kenya's transformation to a geothermal giant: Role of GDC and public risk taking. *Renewable and Sustainable Energy Reviews*, 15(6), 2960–2974.
- [9] Department of Energy, Republic of the Philippines. (2022). *Philippine Energy Plan 2020–2040*.
- [10] Dincer, I., & Acar, C. (2018). Geothermal energy use in Turkey: Developments and policies. *Energy Policy*, 119, 84–95.
- [11] Axelsson, G. (2013). Role of research institutions in supporting geothermal development: Case of Iceland. *Proceedings of the World Geothermal Congress 2015*.
- [12] Darwis, H. (2004). *Sejarah Pengembangan Panas Bumi di Indonesia*. Jakarta: Direktorat Jenderal Energi Baru dan Terbarukan, Departemen Energi dan Sumber Daya Mineral.
- [13] Hochstein, M. P., & Sudarman, S. (2008). History of geothermal exploration in Indonesia from 1970 to 2000. *Geothermics*, 37(3), 220–266. <https://doi.org/10.1016/j.geothermics.2008.01.001>
- [14] Habibi, A. H., Perdana, T., Hari, E., & Setyawan, H. (2023). Geothermal Business Outlook in Indonesia. Geothermal Business Outlook Summer Forum.