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Shifting Geothermal Prudence in Law 21/2014 and Job Creation Law for NDC

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Abstract: Indonesia is a country rich in geothermal potential. In the regulations governing geothermal energy, Indonesia has experienced a shift in regulations that have an impact on the application of the principle of prudence in geothermal land use projects. This regulatory shift is very important to realize the Nationally Determined Contribution (NDC). This study analyzes the evolution of the normative framework between Law No. 21/2014 and the Job Creation Law on the principle of prudence by using historical, statute, comparative, and conceptual approaches. Law No. 21/2014, which was previously the legal basis for geothermal energy, has integrated the principle through strict licensing and strict environmental supervision. The law emphasizes proactive risk mitigation. However, on the contrary, the Job Creation Law through the Risk-Based Approach (RBA) and Online Single Submission (OSS) actually prioritizes accelerating investment and simplifying bureaucracy, This has the potential to weaken environmental damage prevention measures because it only relies on predetermined risk standards. This certainly risks eroding the core principle of the precautionary principle: prudent action in the midst of scientific uncertainty. The study evaluated the effectiveness of both regimes in balancing the energy transition with ecological protections for NDC targets.

Keywords: Geothermal Energy; Prudential Principle; Regulatory Shifts.

1. Introduction

Indonesia is endowed with abundant geothermal resources (Fauzia and Makarim 2024). Because Indonesia's strategic location is on the ring of fire line (Hanum, Handayani, and Tegnan 2023; Sari et al. 2024) make it one of the countries with the largest renewable energy potential in the world. The amount of geothermal potential in Indonesia even reaches 40% of the world's geothermal reserves (Wahid et al. 2025). Geothermal utilization can be the key to domestic electricity supply independence (Diyono et al. 2023). The development of the energy sector must be carried out based on the principles of sustainable development and environmental considerations (R. Indonesia 2009). This transition to clean energy with geothermal is expected to reduce carbon emissions (Debriana and Surakusumah 2025). Carbon footprint analysis shows that geothermal has superior emission efficiency over biomass utilization (Idroes et al. 2023), which is supported by an optimal dispatch system that is able to significantly mitigate CO2 emissions (Vertudes et al. 2025).

Geothermal development carries complex ecological risks. The precautionary principle is the main pillar in the formulation of renewable energy management policies to ensure that the acceleration of the transition does not neglect public safety and ecosystem integrity (Damayanti 2025). With many challenges to be faced in geothermal sector development projects. Starting from its unique geological properties, where reservoirs often have to be in active tectonic zones, in addition to this project also involves the exploitation of steam or hot water resources that make their use very vulnerable to environmental and social impacts (Fahmi et al. 2022a). Therefore, the development of NRE (one of which is geothermal) must strictly supervise the potential for water and air pollution to maintain environmental integrity (Alzaben 2025). Because geothermal project locations are often in areas with high ecological value, such as conservation forest areas and

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protected areas, geothermal areas are often adjacent to community settlements (Akhigbe & Info, 2025; Herawan & Redi, 2021a; Pambudi, 2023). Therefore, the precautionary principle is important to take precautions against potential serious or irreparable environmental damage, although scientific evidence regarding the cause and severity of such impacts is not yet fully certain (Sands et al. 2018).

After its passage, Law Number 21 of 2014 concerning Geothermal became the main foundation that regulates the procedures for geothermal exploitation, including provisions regarding work areas, permit applications, and also business procedures (Hessy Oktiarifadah, Charisa Dwi Santika, & Fathia Ariandini Zulhian, 2024; R. Indonesia, 2014). This regulation seeks to integrate how the principle of prudence must be applied in each stage of geothermal development, with the hope of balancing the fulfillment of energy needs needed by humans while still prioritizing the concept of environmental protection (Hessy Oktiarifadah, Charisa Dwi Santika, and Fathia Ariandini Zulhian 2024; M. E. and S. D. M. R. Indonesia 2021; Government Regulation of the Republic of Indonesia 2021).

Over time, along with changes in the government regime, various regulations, especially Law Number 11 of 2020 concerning Job Creation and its implementing regulations issued in 2023, have brought significant changes to various regulatory sectors, including energy and mining (Oktiarifadah, Santika, & Zulhan, 2024). This regulatory transformation has finally changed various licensing mechanisms, investments, and even governance in the geothermal sector (Andayani, Dwiprigitaningtias, and Ikrardini 2024). These changes certainly raise fundamental questions about whether the precautionary principle is still the main foothold in various new legal frameworks, especially in terms of land use management for geothermal projects (Yustika 2024). Where if 2014 was the era of "laying the first stone" for a new geothermal identity, then 2020-2023 is the era of "digitalization and acceleration" which of course has a much more complex rule structure (Fajar et al. 2023).

There is essentially a fundamental conceptual urgency in linking this shift in priorities to NDC targets, which lies in the potential trade-off between the speed of achieving renewable energy targets and the ability to maintain the integrity of environmental protection. Without strong precautionary principles, NDC ambitions through geothermal energy risk creating new ecological impacts that are counterproductive to the overall emissions reduction commitments set out under the UNFCCC. This research aims to ensure that the acceleration of geothermal investment (through the Job Creation Law) does not ultimately paralyze the environmental defense mechanism of the precautionary principle, which is very important to maintain the quality of Indonesia's NDC achievement. Without this link, Indonesia could achieve its proposed renewable energy targets but failed to achieve its ecosystem protection targets, which are also an integral part of its commitment to maintaining global climate balance.

Previous studies have underscored the importance of these aspects. Starting from a study written by Herawan and Redi in 2021 which emphasized the need for the principle of prudence in granting geothermal permits to prevent wider environmental damage. In this study, Herawan and Redi highlighted the conflict of interest in land use for geothermal projects in forest areas (Herawan and Redi 2021a). Furthermore, research written by Fajar and colleagues in 2023 emphasizes the need for legal and policy strategies that can facilitate geothermal energy integration while addressing the complexity of land-use conflicts in forest areas (Fajar et al. 2023). In addition, other researches, including those written by Anggriawan in 2025 and Rahmawanti and Meliala in 2024, also reaffirm the urgency of the clean energy transition, various challenges in the forestry and mining sectors related to land, and how crucial it is to apply the principle of prudence to mitigate various risks arising from geothermal projects (Anggriawan, 2025a; Rahmawanti & Meliala, 2024).

Previously, there have been many studies that discuss various things related to this geothermal project, ranging from research that discusses related regulations, obstacles, obstacles, technical development, economic analysis, to the environmental and social impacts caused (Akhigbe & Info, 2025; Istiqamah & others, 2023; Kalpikajati &

Hermawan, 2022). However, to date, there has been no research that has in-depth discussed a comprehensive comparison of the shift in the normative framework between the regime of Law No. 21 of 2014 and the 2023 Job Creation Law, especially on the principle of prudence in the use of geothermal land, as well as how its implications are for environmental protection (Yustika, 2024; Angriawan, 2025; Kurniawan et al., 2025). Given that Law No. 21 of 2014 focuses on the transformation of juridical status and land accessibility, while the Job Creation Law focuses on accelerating investment and simplifying bureaucracy (through the RBA and OSS systems), which has the potential to raise questions about whether this comes at the expense of strong aspects of environmental protection, including the application of the precautionary principle. This research was prepared with the aim of analyzing how the shift in the principle of prudence in the use of geothermal land has changed, between the regime of Law No. 21 of 2014 and the Job Creation Law. Furthermore, this study will also test the effectiveness of the two regulatory frameworks as legal instruments to meet Indonesia's NDC (Nationally Determined Contribution) target that has been set before the UNFCCC (United Nations Framework Convention on Climate Change) without sacrificing ecological functions.

2. Materials and Methods

This research is a normative legal research. Using four approaches, this study exists to dissect the regulatory text based on the available literature. The four approaches are the historical approach, the statute approach, the comparative approach, and the conceptual approach. First, historical legal analysis and conceptual approach are used to trace how the history of the principle of prudence exists in the international scope until transplanted into the policies that apply in Indonesia, the indicator of the principle of prudence is used as an analysis parameter. The precautionary principle indicator in this study is based on Principle 15 of the 1992 Rio Declaration and the 1998 Wingspread Statement, which includes several criteria; the existence of a threat of serious or irreversible damage, conditions of scientific uncertainty, and shifts in the burden of proof. These existing parameters are then synchronized with Article 2 letter f of Law No. 32 of 2009 as a national normative basis to test the implementation of the principle of prudence in shifting rules in the Geothermal Law and the Job Creation Law. Furthermore, the statute approach, this approach is used to map land use norms and institutional authority in Law Number 21 of 2014 concerning Geothermal and compare it with the Job Creation Law. Finally, the comparative legal method, used to compare the shifting position of the prudential principle in the two geothermal regulatory regimes. This approach is also used in analyzing the division of authority between the two. It should be emphasized that this research only focuses on the analysis of written legal materials and official policy documents, so it does not involve testing of field data, geological technical aspects, or real economic analysis.

The analysis step begins by examining the history of the principle of prudence before examining its specific application in Law No. 21 of 2014. Furthermore, this study will dissect the change in the policy regime towards the Job Creation Law in order to question the position of the prudential principle in the new legal structure, especially in the regulation of geothermal land. The next step is to compare the division of authority of institutions that reflect the principle of prudence in the two periods. This is done to identify transformations that increase or even lower protection standards. In closing, the study evaluates the suitability of the bureaucratic structure of authority in supporting NDC targets to ensure that the acceleration of investment does not sacrifice ecological functions.

3. Results and Discussion

3.1. History and Construction of Prudential Principle Indicators

The history of the precautionary principle dates back to Principle 15 of the Rio Declaration in June 1992 which stipulated that the absence of scientific certainty is not a reason to

delay the prevention of environmental damage, thus creating a global legal standard that requires states to act proactively before permanent impacts occur (Sands et al., 2018; United Nations, 1992). This standard triggered Indonesia to pass Law No. 21 of 2014 which changed the legal status of geothermal activities to indirect use so that access to protected and conservation forest land can be opened for renewable energy projects (Hessy Oktiarifadah et al., 2024; R. Indonesia, 2014). Although access is open, the integration of principles in land acquisition is explicitly mapped in Articles 22 to 24 which require the Forest Area Borrowing Permit (IPPKH) and environmental permits as a legal filter to mitigate the risk of ecosystem damage from the planning stage (Herawan and Redi 2021a; R. Indonesia 2014).

Furthermore, Indonesia ratified the Paris Agreement in December 2015 which requires the preparation of Nationally Determined Contribution (NDC) as a national legal instrument to achieve emission reduction targets through clean energy while still ensuring the protection of the region's ecological function (Yustika, 2024). The impetus for achieving the NDC target then triggered a paradigm shift from layered bureaucratic supervision in Law No. 21 of 2014 to accelerating investment and simplifying licensing in the Job Creation Law (Andayani, Dwiprigitaningtias, and Ikrardini 2024; Hessy Oktiarifadah, Charisa Dwi Santika, and Fathia Ariandini Zulhian 2024). This energy transition planning has even begun to be implemented at the regional level, such as in the electricity sector of North Sumatra, in order to pursue the net zero emission target by 2060 (Sutikno, Suhanan, and Setiawan 2024). This transformation aims to accelerate the realization of geothermal projects as an energy transition strategy, but at the same time questions the consistency of the application of the precautionary principle in the new regulatory structure (Yustika 2024; Anggriawan 2025b).

a. The Evolution of the Prudential Principle in International and National Environmental Law

The principle of prudence is one of the concepts that has developed in response to human limitations in predicting the impact of development activities on the environment in the future (Sands et al. 2018). This principle was born out of the realization that much environmental damage is irreversible, while scientific knowledge about the risks and impacts is often not entirely certain at the time a decision is made. The precautionary principle serves as a normative basis that encourages the taking of preventive actions in development activities that have the potential to pose long-term ecological risks (Sands et al., 2018; Yustika, 2024).

At the national level, the principle of prudence is also adopted into the Indonesian legal system. This principle can be found in natural resource management policies that are oriented towards sustainability (Herawan & Redi, 2021b; Yustika, 2024). One of them is in the regulation of the use of geothermal or geothermal energy which is positioned as a strategic energy source but has a fairly high environmental risk (Fahmi et al. 2022b). Law Number 21 of 2014 concerning Geothermal is one of the proofs of the state's efforts to organize the use of geothermal through a more cautious approach by integrating environmental protection aspects in the regulation of land access and the implementation of geothermal business activities (Hessy Oktiarifadah et al., 2024; R. Indonesia, 2014). The principle of prudence serves as a normative framework to ensure that the development of geothermal energy is not carried out at the expense of environmental sustainability (Yustika 2024).Numbered lists can be added as follows:

b. Figures, Tables and Schemes Prudential Principle Indicator.

Basically, the principle of prudence in general is composed of three main parameters. First, there is a threat of serious or irreversible environmental damage. Second, there is scientific uncertainty regarding the magnitude, form, or probability of potential environmental impacts. Third, the obligation to take preventive measures must be proportionate and effective in mitigating such environmental risks (Sands et al., 2018; United Nations, 1992). These three parameters are objective benchmarks to test the extent to which geothermal regulation reflects the application of the precautionary principle.

3.2 Application of the Principle of Prudence in the Regime of Law No. 21 of 2014

Law No. 21 of 2014 integrates the principle of prudence through strict licensing and supervision mechanisms. Strengthening the prevention function by requiring an evaluation of the compliance of the person in charge of the business through an environmental audit (Minister of Environment 2013). This audit serves to assess the extent to which geothermal operations comply with legal and environmental policy requirements set by the government. The change in geothermal status in Law No. 21 of 2014 allows access to land use in protected forest areas and conservation forests, but is still limited through the obligation of Forest Area Borrowing Permits (IPPKH) accompanied by strict environmental protection requirements. The precautionary principle is applied operationally through the Working Area Determination Procedure (WKP) which requires a preliminary survey and ecological risk assessment before a business license is issued (Herawan & Redi, 2021b; R. Indonesia, 2014; Yustika, 2024). Thus, even though access to land is expanded, Law No. 21 of 2014 places bureaucratic oversight and layered licensing requirements as a form of control to prevent irreversible ecosystem damage (Herawan & Redi, 2021b; Yustika, 2024).

3.3 Land Use and Ecological Protection Norms in Law Number 21 of 2014 concerning Geothermal

Law No. 21 of 2014 integrates the principle of prudence through the transformation of the legal status of geothermal from "mining" to "indirect utilization". This change in terminology is not just a name change, but a legal strategy to open up land accessibility without eliminating the obligation of ecological protection. Based on Article 23 and Article 24, geothermal exploitation is allowed to be carried out in production forest areas, protected forests, and conservation forests, but with strict restrictions in the form of Forest Area Borrowing Permits (IPPKH) and prohibiting open pit mining methods that can damage the landscape (Herawan and Redi 2021a).

The mapping of protection limits in this law is emphasized through the mechanism for determining Geothermal Working Areas (WKP) listed in Articles 10 to 14. Before the area is determined, the government is obliged to conduct a preliminary survey to map the potential as well as environmental risks in the zone (R. Indonesia 2014). This provision serves as an initial filter of the precautionary principle to ensure that geothermal reservoir points do not threaten the existence of protected habitats or the hydrological function of the area (Utomo et al. 2024a). Its implementing regulations, such as Government Regulation No. 7 of 2017, stipulate in more detail that every land use in forest areas must pay attention to the carrying capacity and carrying capacity of the environment to prevent permanent damage (Republic of Indonesia 2017; Yustika 2024). In this context, the application of Life Cycle Assessment (LCA) is crucial to identify environmental hotspots at each stage of geothermal technology development (Rajagukguk and Dahlan 2025). In the hydrological aspect, geothermal exploitation is also obliged to comply with the provisions of river protection, including the determination of river boundary lines to maintain the preservation of streams and aquatic ecosystems (P. R. Indonesia 2011). Before operations begin, developers should ideally conduct an investigation through Environmental Due Diligence (EDD) to map financial, legal, and reputational risks related to environmental impacts (UNEP 2004). These safeguarding standards are in line with exploration risk mitigation implemented by international funding institutions to ensure social and environmental sustainability (International Bank for Reconstruction and Development 2019).

Furthermore, control instruments are integrated through environmental permit obligations and environmental impact analysis (EIA) documents at each stage of activities in accordance with the mandate of Article 38 (R. Indonesia 2014). The precautionary principle in this article is manifested by requiring developers to mitigate risks from the exploration stage to the exploitation of hot water vapor which is prone to causing disturbances to surface water flow and tectonic risks (Fahmi et al. 2022b). This legal dynamic requires synchronization between central and regional regulations so that energy infrastructure development continues to pay attention to sustainability aspects (Jati, 2024)

With a bureaucratic structure that requires multiple permits from the regional to the central level, Law No. 21 of 2014 positions licensing requirements as the main preventive tool so that energy security targets do not neglect ecological functions (Herawan and Redi 2021a; Hessy Oktiarifadah, Charisa Dwi Santika, and Fathia Ariandini Zulhian 2024).

3.4 Paradigm Shift in Geothermal Law in the Job Creation Law Regime

The shift from Law Number 21 of 2014 to the Job Creation Law is not just an administrative technical change, but a philosophical transformation that shifts the legal emphasis from preventive ecological protection to accelerating investment efficiency (Andayani, Dwiprigitaningtias, and Ikrardini 2024; Hessy Oktiarifadah, Charisa Dwi Santika, and Fathia Ariandini Zulhian 2024). If the previous regime placed layered bureaucratic supervision as the main instrument of the precautionary principle, this new legal structure precisely positions the simplification of licensing and digitalization as a fast track to pursue the national energy transition target (Yustika 2024). This change creates a new normative tension: whether the acceleration of the realization of geothermal projects to meet the NDC target still maintains the integrity of the ecosystem, or is the principle of prudence now reduced to a mere administrative formality for the sake of capital absorption (Anggriawan 2025b). In this perspective, a rethinking of foreign direct investment (FDI) policy is needed to provide legal certainty (Putri, Arsalan, and Huang 2024).

a. Land Governance Transformation: Accelerating Investment and Simplifying Licensing

The Job Creation Law overhauls geothermal land governance by replacing the conventional licensing mechanism with a Risk-Based Approach (RBA) (Oktiarifadah et al., 2024) as stipulated in Government Regulation Number 5 of 2021 (Republic of Indonesia 2021). This change is based on the spirit of ease of doing business (Ease of Doing Business) to attract investment in the renewable energy sector (Andayani, Dwiprigitaningtias, and Ikrardini 2024). In this new system, land procurement and use no longer depend on a series of administrative approvals that are sectoral and separate, but are grouped based on the potential hazards or impacts of activities on the environment and safety (Government Regulation Number 96 of 2021 concerning the Implementation of Mineral and Coal Mining Business Activities 2021; Law Number 11 of 2020 concerning Job Creation 2020). This simplification also changes the list of activities that are required to have an EIA, UKL-UPL, or SPPL which is now determined based on technical risk categories (M. L. H. and K. Indonesia 2021). The focus shifts to accelerating the implementation of geothermal projects as the main pillar of Indonesia's long-term low-carbon strategy towards 2050 (Tarigan 2025).

Bureaucratic simplification is implemented through an Online Single Submission (OSS) system that integrates various types of permits into a single digital door (Fajar et al. 2023). Based on Government Regulation No. 5 of 2021, environmental requirements are simplified into technical standard documents whose verification process is carried out faster than the previous regime (Republic of Indonesia 2021). The focus of regulation shifted from strict administrative supervision at the beginning (ex-ante) to supervision of technical standards while activities were ongoing. This transformation aims to accelerate geothermal projects as an energy transition strategy, but at the same time change the way the principle of prudence is applied in mitigating land use risks in areas with high ecological value (Oktiarifadah, Santika, and Zulhan 2024).

Although the bureaucracy is cut, the company still has absolute technical obligations. Based on the Regulation of the Minister of Energy and Mineral Resources Number 33 of 2021, geothermal business actors are required to implement good Engineering Principles as well as Occupational Safety and Health, Environmental Protection and Management (K3LL) STANDARDS (M. E. and S. D. M. R. Indonesia 2021). The implementation of K3LL is an instrument of corporate legal accountability to prevent dan-

gerous events or accidents that can damage the environment (Andayani, Dwiprigitaningtias, and Ikrardini 2024).

b. Centralization of Authority: Transfer of Supervisory Functions from the Regions to the Center

The transformation of the licensing mechanism faster through the digital system is followed by the restructuring of power between government agencies. The Job Creation Law centralizes authority by withdrawing the geothermal licensing and supervision functions from the local government back to the central government (Andayani, Dwiprigitaningtias, and Ikrardini 2024; Hessy Oktiarifadah, Charisa Dwi Santika, and Fathia Ariandini Zulhian 2024) (Andayani, Dwiprigitaningtias, and Ikrardini 2024; Oktiarifadah, Santika, and Zulhan 2024). Based on changes in the articles of authority in the Job Creation Law, the role of provincial and district/city governments in ecological supervision which was previously explicitly regulated in Law No. 21 of 2014 is now eliminated.

This transfer of authority is a normative effort to eliminate regulatory overlap and cut bureaucratic barriers in geothermal investment. However, technically legally, this centralization removes the system of layered supervision (checks and balances) that previously involved local authorities in mitigating environmental risks at the local level (Andayani, Dwiprigitaningtias, and Ikrardini 2024). With this one-stop structure, the central government holds sole control in ensuring that land use operations continue to comply with the principle of prudence without direct administrative control from the regions (Andayani, Dwiprigitaningtias, and Ikrardini 2024).

4. Conclution

In the RBA system, the application of the precautionary principle is highly dependent on the effectiveness of technical standard supervision in accordance with Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management. The focus of supervision shifted from layered checks at the beginning (ex-ante) to compliance with environmental quality standards during the activity. Reducing the role of regional supervision has the potential to reduce the essence of the precautionary principle to simply fulfilling administrative standards. The centralization of authority directly changed the way the three indicators of the precautionary principle were applied in the new licensing structure. In the RBA system, the criteria for threat of serious damage and scientific uncertainty are no longer tested in depth in each case, but have been established in advance through a risk standard (pre-determined risk) in a digital system. This standardization provides certainty for investors, but has the potential to ignore aspects of scientific uncertainty that are local and specific to each geothermal work area.

The essence of Principle 15 of the Rio Declaration, which emphasizes preventive measures amid scientific uncertainty, is in danger of being reduced to mere administrative compliance in pursuit of the target of accelerating clean energy investment. Scientific uncertainty in the digital system directly impacts changes in the land control instruments used. Law No. 21 of 2014 relies on the rigidity of environmental permits and Forest Area Borrowing Permits (IPPKH) as an administrative filter involving inter-agency coordination and the role of local governments (Herawan and Redi 2021a). Environmental permits under this regime are stand-alone documents that must be owned before operational activities begin, thus providing layered oversight of ecological risks at the local level. The instrument ensures that each stage of land use, especially in sensitive areas, has passed rigorous administrative validation to prevent serious environmental impacts.

Instead, the Job Creation Law simplifies the instrument through integration into the centrally managed Risk-Based Approach (RBA) and Online Single Submission (OSS) systems. In this new system, environmental permits are no longer administratively separate documents, but are integrated into a single "Business Permit" that is verified based on risk standards that have been automatically set by the system. This fundamental dif-

ference shows a shift from ex-ante supervision involving many parties, to automatic standardization that prioritizes the speed of the geothermal investment process. This transformation substantially leads to a downgrading of protection because it assumes that all ecological risks can be predicted through low, medium, or high risk categories. The obligation to take proportionate precautions is now more focused on meeting operational technical standards than on critical mitigation of scientifically uncertain threats. Thus, although the RBA system improves time efficiency, it risks neglecting the most basic essence of the precautionary principle, which is to act vigilantly in the absence of absolute scientific evidence. In the end, this research is only limited to normative analysis of the regulatory shifts that have occurred. Therefore, of course, further empirical research is needed to be able to test how the concrete impact of the application of the RBA and OSS systems on the environmental quality in the geothermal work area is factually determined. Future research should focus on monitoring field data related to how water, air, and ecosystem integrity are recorded around geothermal projects after the enactment of the Job Creation Law, as well as evaluating the effectiveness of centralized monitoring in detecting how locally specific ecological risks may not be captured by digital standardization.

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