The Geothermal Development Policy on Environmental in Indonesia and the USA

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ARTICLE INFO

Article history
Received: January 10, 2023.
Revised: May 3, 2023.
Accepted: May 8, 2023.

Keywords
Ecology;
Environment;
Community;
Geothermal;
Policy;

ABSTRACT

Geothermal utilization is generally used as clean green energy because of its contribution to gradually eliminating high carbon energy. However, in practice, geothermal damage to the environment, even regulation of its utilization does not guarantee environmental justice. This research study aims to determine environmentally just geothermal regulations to eliminate negative environmental impacts and public rejection of geothermal utilization. This study uses normative legal research. The results of this study indicate that geothermal potential can replace high-carbon energy even though it still has a damaging impact on the environment. Community rejection occurs in various areas where geothermal exploitation occurs in conservation forest areas. Geothermal energy regulation in Indonesia is no more pro-ecological than in the USA. Based on the analysis of the legal gap between the theory of ecological justice and the legal triangle and energy policy, it is found that the principles of geothermal regulation must prioritize ecology, not mere exploitation. The findings of this study are strengthening the principles of geothermal regulation based on ecological justice. Standardization of handling and monitoring of environmental impacts must be carried out in an integrated manner based on area category to avoid the widening of the ecological impact of geothermal utilization which results in rejection of the next project.

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1. Introduction

The utilization of geothermal energy as a power plant is a promising alternative energy choice both for energy security and for dealing with the climate crisis. The energy produced through the use of geothermal energy is clean. The process of geothermal exploration and exploitation can be claimed to be more environmentally friendly and less destructive than oil, gas, and coal mining. However, in general, geothermal utilization remains a high risk for the environment and communities around the project due to possible hazards in its

activities[1] because the exploration and exploitation of the high temperature of the geothermal fluid and its accompanying gas.[2] Thus, exploiting geothermal energy requires high technology and a large amount of investment[3] then arrangements must also be followed that does not only focus on profit exploitation. Geothermal utilization arrangements must be made while taking into account the environmental and societal impacts.

Countries with high emission levels such as the USA, China, EU, Russia, Japan and India have signed the Paris Agreement. While Indonesia has ratified the Paris Agreement through Law no. 16 of 2016 Confirmation of the UNFCCC Paris Agreement as a good faith support for limiting climate change. The ratification of the agreement not only brings Indonesia to reach a balance between CO_2 and the amount that can be absorbed by the environment or the atmosphere.[4] Reconciling geothermal energy with another new and renewable energy (NRE) by the economic facets, geothermal heat is more effective and sustainable in phasing out and replacing fossil energy. Compared to other energies, geothermal is more sustainable in the long term and does not require other major power plants to supply electricity nationally.

It is diverse from the other low-cost NREs, which still depend on each other. Even NREs such as solar and biomass power plants to meet national energy still necessitate power plants using coal. In addition, Indonesia is included in the cohort with base load generating plants with enormous output power and high capital costs. The energy commonly used to carry that base load is coal-fired steam and geothermal power plants. Due to using coal as the most power plant, its effect on energy efficiency has been a crucial problem.[5] In a sense, if we could not use coal as primary power plants so only geothermal energy is adequate to phase out coal energy. Even though other NREs have larger reserves and the price is cheaper than geothermal heat. Electricity production from geothermal heat can reach 90-95% of installed capacity. In addition, the electricity generated is stable (non-intermittent and does not depend on other fuels).

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[1] Guozhu Zhang and others, 'A Promising Technology of Cold Energy Storage Using Phase Change Materials to Cool Tunnels with Geothermal Hazards', *Renewable and Sustainable Energy Reviews*, 163 (2022), 112509 https://doi.org/10.1016/J.RSER.2022.112509

[2] Yu Xu and others, 'Synergetic Mining of Geothermal Energy in Deep Mines: An Innovative Method for Heat Hazard Control', *Applied Thermal Engineering*, 210 (2022), 118398 https://doi.org/10.1016/J.APPLTHERMALENG.2022.118398

[3] Ravita D Prasad and Atul Raturi, 'Techno-Economic Analysis of a Proposed 10 MW Geothermal Power Plant in Fiji', *Sustainable Energy Technologies and Assessments*, 53 (2022), 102374 https://doi.org/10.1016/J.SETA.2022.102374

[4] Rahul Sindhwani and others, 'Modeling the Critical Success Factors of Implementing Net Zero Emission (NZE) and Promoting Resilience and Social Value Creation', *Technological Forecasting and Social Change*, 181 (2022), 121759 https://doi.org/10.1016/J.TECHFORE.2022.121759

[5] Ambarsari Dwi Cahyani and others, 'Between Insufficiency and Efficiency: Unraveling Households' Electricity Usage Characteristics of Urban and Rural Indonesia', *Energy for Sustainable Development*, 69 (2022), 103–17 https://doi.org/10.1016/j.esd.2022.06.005

In forcing other resources to be primary energy, such as solar and wind, those will certainly not be able to withstand the use of existing electricity. Solar and wind are intermittent and unpredictable. Thus, unlike geothermal heat, another energy will depend on another energy to fulfill the needs of the national electricity system. For example, if the use of solar energy takes over the coal power plants, it also needs another energy to support the electricity distribution (by coal) due to Indonesia has no proper batteries for electricity saving (solar energy interferes when the sun goes down). [6] Unfortunately, several previous studies stated that geothermal as clean energy still leaves various negative impacts on the utilization process. Environmental damage can occur if not managed properly. Geothermal development produces B3 waste which can be harmful to the ecosystem. Even inappropriate use can endanger health to the point of killing the soul.[7]

Prior study, wrote by Paulillo et al. (2020), it illustrated that geothermal energy is a renewable baseload resource that can facilitate the decarbonization of the power generation sector. They developed Life Cycle Assessment (LCA) technology that enables rapid yet accurate estimation of the environmental impact of geothermal power.[8] This research tends to discuss technology for assessing ecological impacts according to the environmental category. In line with Paulillo, Gkousis et.al. state that geothermal energy extraction impacts the environment. They also mentioned LCA, where the time component is usually not considered in geothermal LCA, even though time dramatically influences the environmental load.[9] Research on energy transitions was also carried out by Annisa Sekaringtias et al. (2023). The research findings regarding the community acceptance problem are by addressing socially just inclusion and ensuring the adoption and acceptance of all. They also said forming an independent agency for the energy transition was essential. This study is quite linear with the authors but has a different focus.[10] This research uses a socio-political approach, while the author uses a legal approach. The author also only focuses on the energy transition through geothermal energy and its negative impacts, especially in forest areas. Comparison of the study with the USA also differentiates this research.

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[6] Moses Jeremiah Barasa Kabeyi and Oludolapo Akanni Olanrewaju, 'Geothermal Wellhead Technology Power Plants in Grid Electricity Generation: A Review', *Energy Strategy Reviews*, 39 (2022), 100735 https://doi.org/10.1016/J.ESR.2021.100735

[7] Matteo Spada, Emilie Sutra, and Peter Burgherr, 'Comparative Accident Risk Assessment with Focus on Deep Geothermal Energy Systems in the Organization for Economic Co-Operation and Development (OECD) Countries', *Geothermics*, 95 (2021), 102142 https://doi.org/10.1016/j.geothermics.2021.102142

[8] Andrea Paulillo and others, 'Simplified Models for Predicting the Environmental Impacts of Geothermal Power Generation', *Cleaner Environmental Systems*, 6 (2022), 100086 https://doi.org/10.1016/j.cesys.2022.100086

[9] Spiros Gkousis, Kris Welkenhuysen, and Tine Compernolle, 'Deep Geothermal Energy Extraction, a Review on Environmental Hotspots with Focus on Geo-Technical Site Conditions', *Renewable and Sustainable Energy Reviews*, 162 (2022), 112430 https://doi.org/10.1016/j.rser.2022.112430

[10] Annisa Sekaringtias, Brunilde Verrier, and Jennifer Cronin, 'Untangling the Socio-Political Knots: A Systems View on Indonesia's Inclusive Energy Transitions', *Energy Research & Social Science*, 95 (2023), 102911 https://doi.org/10.1016/j.erss.2022.102911

Research on several power plants based on renewable energy sources is widely considered green and clean because of its contribution to the decarbonization of the energy sector. Renewable energy does not produce carbon dioxide, but its significant negative impact on the environment is still found.[11] It cannot be ignored. Although this study has similarities with the authors, the trend of research conducted by Rahman et al. is to compare the negative impacts of several renewable energies. In comparison, the author tends to examine how arrangements should be made to remove obstacles to geothermal utilization, especially in controlling environmental damage by the government and policies that gain public acceptance of geothermal projects. Indonesia and the USA have the vastest geothermal potential in the world; of course, its utilization should be used as a reference. However, environmental and societal impact issues remain unavoidable. Utilization of geothermal is regulated by tending to see what benefits are obtained for realizing net zero emission by minimizing the possibility of environmental damage and community rejection.

Geothermal development, expected to encourage Indonesia to overcome and adapt to climate change, creates new problems. Issues regarding ecological sustainability, not only regarding the environment and human safety but also turbulent social issues—even cultural values that should be respected. Initially, geothermal utilization could positively impact the energy transition target, together with the realization of community welfare, especially for the people around the geothermal field, not the other way around. Referring to the theory of ecological justice, Brian Baxter (2005) argued in his study that there are moral considerations for other living things and a human connection with the earth's biosphere. Therefore, distributive justice is not only given to humans but also other living things and inanimate objects (non-humans). First and foremost, Low and Gleeson (1983) argue that ecological justice differs from environmental justice in that we must here consider moral values. This deeper moral understanding of justice relates to human and non-human relations. Concerning geothermal development, the results of the utilization of natural resources are not only related to human interests alone – anthropocentric, which tend to confuse often human and non-human relations.[12]

The legal gap in this paper will be directed at studying geothermal regulation, which focuses on the principles of geothermal utilization that do not yet reflect ecological justice. It tends to be exploitative and ignores the environment, and receives project rejection by the community. Rejection often occurs due to frequent environmental sustainability problems, especially in projects carried out in

[11] Abidur Rahman, Omar Farrok, and Md Mejbaul Haque, 'Environmental Impact of Renewable Energy Source Based Electrical Power Plants: Solar, Wind, Hydroelectric, Biomass, Geothermal, Tidal, Ocean, and Osmotic', *Renewable and Sustainable Energy Reviews*, 161 (2022), 112279 https://doi.org/10.1016/j.rser.2022.112279

[12] Kamila Pope, Michelle Bonatti, and Stefan Sieber, 'The What, Who and How of Socio-Ecological Justice: Tailoring a New Justice Model for Earth System Law', *Earth System Governance*, 10 (2021), 100124 https://doi.org/10.1016/j. aesg.2021.100124

conservation forest areas. Therefore, it is necessary to change the regulation principles and standardize handling ecological impacts based on the project area. These das sein issues arise because of an imbalance with *das sollen*, that is, the regulation of geothermal utilization which should be based on ecological justice. Ecological justice means justice is not only given to humans and non-humans (plants, animals, and inanimate objects).

No energy utilization technology is without risk. Maximum energy utilization must be carried out thoroughly, considering all aspects. Therefore, geothermal regulation that implements the values of ecological justice is essential to promote. Because conflicts of interest due to regulations that do not provide ecological justice will reduce the value of the benefits of several other "parties".[13] The target of 23% NRE dominance in the mix to encourage the phasing out of fossil energy to non-fossil energy[14] cannot be used as the legality of regulating geothermal utilization which ecologically unfair. Achieving net zero emissions should still be carried out by considering the benefits in all aspects. The urgency of this study is based on the transition from fossil energy to clean energy in Indonesia and the USA, which must be carried out immediately. Geothermal energy plays an essential role in supporting this energy transition. However, the environmental impact and community rejection of the use of geothermal energy have not been adequately resolved because laws and regulations are often not concerned with the environment. It raises a dilemma between realizing energy mix targets or damaging biodiversity. Based on the description above, this paper aims to provide updates regarding the regulation of geothermal utilization, concerned with the environment damage and public acceptance, both in Indonesia and the USA.

2. Research Method

It is a normative legal research article regarding the regulatory concept of realizing geothermal utilization, which eliminates adverse impacts on the environment and leads to community rejection. This research study explains legal facts with inductive logic and interprets and evaluates geothermal utilization policies. This article uses various primary and secondary legal sources, such as laws and regulations, books, and journals. The approach used in this research study is a statutory approach used to find a lawful basis, evaluate, and construct regulatory arrangements for controlling the use of geothermal energy to handle objections to use. A conceptual approach is used to find concepts related to monitoring negative impacts on the environment and conflict resolution against geothermal development in forest areas based on the principles of ecological justice and the triangle of energy law and policy. The flow of writing this article is: finding

[13] Kamia Handayani and others, 'Moving beyond the NDCs: ASEAN Pathways to a Net-Zero Emissions Power Sector in 2050', *Applied Energy*, 311 (2022), 118580 https://doi.org/10.1016/J.APENERGY.2022.118580

[14] Richard Clark, Noah Zucker, and Johannes Urpelainen, 'The Future of Coal-Fired Power Generation in Southeast Asia', *Renewable and Sustainable Energy Reviews*, 121 (2020), 109650 https://doi.org/10.1016/J.RSER.2019.109650

legal facts, identifying legal issues, analyzing problems, building settlement models, and drawing conclusions.

3. Results and Discussion

The Impact of Geothermal Development Policy on Environmental in Indonesia

Basically, Indonesia has massive potential for the NRE by utilizing green energy to realize energy security. In terms of solar energy, it has above 200.000 megawatts (MW) potency; hydro energy has around 75.000 MW; while geothermal energy potential is about 23.000 MW. Following up on the potency of NRE, Indonesia has an ambitious plan to strengthen energy security year by year. In 2025, Indonesia aims to dominate NRE with solar energy power plants. Besides, in 2035 the power plant would be provided by hydro and geothermal power plants. Furthermore, in 2050, solar energy and biomass will be the most preferred power plants. Still, the use of non-renewable energy is the primary energy mix nowadays.[15] In 2020, only 0.02% of the NRE potency had been utilized. Regarding to the Ministry of Energy and Mineral Resources, the energy mix remained to be dominated by fossil energy at 88.8%, coal at 38%, gas at 19.2%, and oil at 31.6%. At the same time, the power generated from NRE was only precisely 11.2%.[16]

Focussing on geothermal heat, Indonesia is known as a host of four of the world's largest power plants due to operating the Gunung Salak unit which is the biggest resource worth around 375 MWE, conducted by PT PGE with Joint Operation Contract (JOC). If the leading sector of geothermal heat is ranked, it would be sorted by the USA, Indonesia, the Philippines, Turkey, New Zealand, and Mexico (in descending order). At the declared rate that Indonesia intends to foster a greater amount of its truly extensive geothermal assets, it very well might be conceivable that they could outperform the USA and become the worldwide market pioneer before 2030.[17] Thus, Indonesia is expected to be the main energy to turn over the using of carbon energy to clean energy.

In fact, geothermal heat has been utilized as electricity by PT PLN only 2.650 MW, or less than 80% compared to its target in 2030 (3.355 MW).[18] Nevertheless, if recalling MEMR's plan, it has targeted at 7.241,5 MW. Appealing to the data, PT PLN only targeted no more than half of MEMR. In this case, we can see the sharp

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[15] Andri D. Setiawan and others, 'Evaluating Feed-in Tariff Policies on Enhancing Geothermal Development in Indonesia', *Energy Policy*, 168.July (2022), 113164 https://doi.org/10.1016/j.enpol.2022.113164

[16] Nugroho Agung Pambudi, 'Geothermal Power Generation in Indonesia, a Country within the Ring of Fire: Current Status, Future Development and Policy', *Renewable and Sustainable Energy Reviews*, 81 (2018), 2893–2901 https://doi.org/10.1016/J.RSER.2017.06.096

[17] John W. Lund, Gerald W. Huttrer, and Aniko N. Toth, 'Characteristics and Trends in Geothermal Development and Use, 1995 to 2020', *Geothermics*, 105 (2022), 102522 https://doi.org/10.1016/J.GEOTHERMICS.2022.102522

[18] Martha Maulidia and others, 'Rethinking Renewable Energy Targets and Electricity Sector Reform in Indonesia: A Private Sector Perspective', *Renewable and Sustainable Energy Reviews*, 101.February 2018 (2019), 231–47 https://doi.org/10.1016/j.rser.2018.11.005

gap in goals within primary institutions in providing electricity from geothermal heat, which could affect the attempting of carrying out to achieve its use. It proves that geothermal power has not been given enough proportion to dominate clean energy in Indonesia. Ultimately, it inflicts a basic question on how the policies that support this geothermal development will be made if the intention targets are not aligned. A mistake has been started at the very beginning-no unite gaze on the national roadmap.

Thus, geothermal energy is a potential power plant. The energy produced through the use of geothermal energy is clean. Likewise, the process of exploration and exploitation of geothermal energy is environmentally friendly and less destructive than oil, gas, and coal mining. However, in the field, geothermal energy utilization still causes various negative impacts. Real impacts occur due to exploitation, utilization of electric power, or even from the land clearing stage for exploration. The government must deal with damage to conservation forest areas. Geothermal potential in Indonesia has been identified as located in 29 (twenty-nine) conservation forest areas and 10.9% are overlapping conservation forests due to the expansion of conservation forest areas.[19]

Pro-environmental sustainability regulations have not supported geothermal utilization in Indonesia. There are still many settings that tend to be exploitative. Several articles in the principle of legislation in Indonesia hinder the use of geothermal in an environmentally just manner. This arrangement is contained in the Law on Geothermal Energy, of which several articles have been amended by the Job Creation Law—the Omnibus Law. The first arrangement that needs to be criticized is Geothermal, which is a national asset controlled by the state and used for the greatest prosperity of the people. In this case, of course, the people's wealth is the most prioritized. Moreover, Indonesia has declared its country as a welfare state. If this article is adopted outright, it tends to be anthropocentric. It is because natural resources are directed at meeting the welfare of society. Welfare is attached to the mere meaning of economics.[20]

They are, furthermore, looking at the regulation of the principles of implementing geothermal utilization based on nine principles. However, the four principles tend to be exploitative-economic, such as benefits, efficiency, economic optimization in utilizing energy resources, and affordability. In comparison, concern for the environment is embodied in only two principles: sustainability and preserving environmental functions. The rest tends to be used to underlie energy security arrangements, namely self-sufficiency, security and safety, and justice. However, this principle regarding environmental sustainability has been removed through the crystallization of regulations in the articles below it. The principle of protecting the environment was ultimately not considered.

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[19] Peter S. Coates and others, 'Geothermal Energy Production Adversely Affects a Sensitive Indicator Species within Sagebrush Ecosystems in Western North America', *Biological Conservation*, 280 (2023), 109889 https://doi.org/10.1016/j.biocon.2022.109889

[20] Kirana Intaniasari, 'Gross Split Contract Framework Regulation on the Caring for People', *Bestuur*, 8.2 (2020), 96 https://doi.org/10.20961/bestuur.v8i2.43141

In utilizing geothermal energy for electricity generation, activities can be carried out in all regions of Indonesia, including production forest areas, protected forest areas, and even conservation forest areas and sea areas. Supervision is stacked on the business license. If the permit process is not standardized, nothing more can be expected in protecting and minimizing negative environmental impacts. Not only in conservation forests but geothermal utilization is also permitted on communal land. Geothermal power projects are often claimed to enhance regional economic development[21] and are sometimes presented as investment opportunities for indigenous communities.[22] Meanwhile, this customary land has unique characteristics that must be protected by cultural customs and its natural preservation, where conflicts are prone to occur with the community, leading to the rejection of human rights violations.

In another article, it is said that in the case of using state land parcels, land rights, communal land, and/or forest areas within the Work Area, the holder of a Business Permit for Direct Utilization or the holder of a Business Permit in the Geothermal sector must first carry out land use settlements with land users on state land or holders of rights or Business Permits in the Geothermal sector in the forestry sector following statutory provisions. If we look closely, it means the business actor already has a business permit before resolving land disputes with the community.[23]

Interestingly, the following article needs to be criticized. It states that Business Permits in the Geothermal sector, initially carrying out Geothermal exploitation on state land, land rights, communal land, and/or Forest Areas, are given the obligation to 1) show Business Permits in the Geothermal field or a legal copy; 2) notify the purpose and place of the activity to be carried out; and 3) carry out settlements or settlement guarantees approved by land users on state land and/or rights holders. However, it is often found that the third obligation is neglected by political lobbying and violence. Practically, the permit holder is happy to complete only the first and second obligations. Unfortunately, sanctions for environmental damage stop at administrative sanctions. Administrative sanctions tend to be light and not remedial for the environment, namely written warnings; temporary suspension of all Exploration, Exploitation, and utilization activities; administrative fines; and/or revocation of Business permits.

These articles open space for geothermal business actors to pay less attention to the sustainability and safety of the surrounding environment. An example of a case that occurred in geothermal utilization was the case of exposure to H2S gas at the

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[21] Julie MacArthur and Steve Matthewman, 'Populist Resistance and Alternative Transitions: Indigenous Ownership of Energy Infrastructure in Aotearoa New Zealand', *Energy Research & Social Science*, 43 (2018), 16–24 https://doi.org/10.1016/j.erss.2018.05.009

[22] *Geothermal Energy and Society*, ed. by Adele Manzella, Agnes Allansdottir, and Anna Pellizzone (Cham: Springer International Publishing, 2019), LXVII https://doi.org/10.1007/978-3-319-78286-7

[23] Hilman S Fathoni, Abidah B Setyowati, and James Prest, 'Is Community Renewable Energy Always Just? Examining Energy Injustices and Inequalities in Rural Indonesia', *Energy Research & Social Science*, 71 (2021), 101825 https://doi.org/10.1016/J.ERSS.2020.101825

Sorik Marapi Geothermal Power Plant (GPP). This incident caused five victims from the residents to die, and 46 people received treatment at the hospital. Three people were outpatients, and one person was treated medically. The results of the investigation show that there has been an operational mall by PT Sorik Marapi Geothermal Power (SMGP) in the Sorik Marapi geothermal field. PT SMGP, as the holder of a Geothermal Permit, is responsible for the geothermal accident. The Directorate General of Renewable Energy and Energy Conservation issued a letter of temporary suspension of all SMGP activities/activities in the Sorik Marapi geothermal field. Without putting aside the existing operational malls, the government, as the permitted provider, is also not firm in dealing with problems in the Sorik Marapi field. Where the community's safety around the geothermal development site is not paid attention to by the government, developers let the pipes pass around the settlements. A gas leak also occurred at the Dieng GPP in the Banjarnegara region, Central Java, in 2022, resulting in a death toll.

In addition, geothermal utilization at the Ulumbu GPP contains non-condensable gas (NCG) substances in the steam discharged into the open air, such as H2S gas, methane, and other gases. The liquid waste generated by the Ulumbu GPP, released into the Waekokor river, is still below the quality standards set by the government. PLN as the owner of the Ulumbu GPP does not exceed the rules set by the government regarding wastewater quality standards for geothermal exploration and production businesses and/or activities. In some locations, the use of geothermal energy even causes a decrease in groundwater.[24] Regarding the operation of GPP Ulumbu, the government needs to carry out supervision considering the potential for pollution from liquid waste disposal. Following Law no. 21 of 2014 concerning Geothermal that the authority to guide and supervise geothermal exploitation in Indonesia is the authority of the central government, but because the location of Ulumbu is relatively remote and difficult to reach, local governments need to be involved. The Regional Government of Manggarai needs to be concerned, considering that the local government is at the location daily, so it is easier to carry out supervision.

The rejection of geothermal development cannot be avoided, for example, the rejection in Padarincang-Banten and the rejection of geothermal development in the Gede-Pangrango area. The rejection of the geothermal development project also occurred in Wae Sano Village, Sano Nggoang District, West Manggarai Regency, NTT. It is because the development is being carried out in a Conservation Forest Area, which the people of Wae Sano Village believe can disrupt ecological sustainability and also affect the vitality of the local community, which also still adheres to noble cultural values. The rejection that occurred, which failed the geothermal project, has also happened in Karanganyar Regency, Central Java. This

[24] Miguel Ángel Marazuela and others, 'Assessment of Geothermal Impacts on Urban Aquifers Using a Polar Coordinates-Based Approach', *Journal of Hydrology*, 612 (2022), 128209 https://doi.org/10.1016/j.jhydrol.2022.128209

project is planned regarding the forest area and cultural heritage of Mount Lawu.[25] GPP Sokaria in East Nusa Tenggara, in 2011, also experienced rejection from the management of the Kelimutu National Park conservation forest area. However, it is currently operating after revising the 2014 Geothermal Law.

According to data from the Geological Agency of the Ministry of Energy and Mineral Resources in 2018, 342 locations of geothermal resources have been found spread across 8 (eight) significant islands. Below is a table of several geothermal utilization locations in Indonesia and the classification of their working areas. Some are included in conservation forest areas and are also experiencing conflict.

Table 1. Indonesia Geothermal Potential Locations in Forest Area

No.	Power Plant	Potential	Industry	Location
2	GPP Sarulla	330 MW	Sarulla Operation Ltd.	Protected Forest Area
3	GPP Salak	337 MW	PT Star Energy Geothermal Salak Ltd.	Conservation Area - National Park
4	GPP Wayang Windu	227 MW	Star Energy Geothermal Wayang Windu	Protected Forest Area
5	GPP Kamojang	235 MW	PT Pertamina Geothermal Energy	Conservation Area - Nature Tourism Park
6	GPP Darajat	270 MW	Star Energy Geothermal Darajat	Conservation Area - Nature Tourism Park
7	GPP Karaha	30 MW	PT Pertamina Geothermal Energy	Protected Forest Area
8	GPP Rantau Dedap	91,2 MW	PT Supreme Energy Rantau Dedap	Protected Forest Area
9	GPP Sokoria	5 MW	PT Sokoria Geothermal Indonesia	Conservation Area - National Park
10	GPP Gunung Lawu	165 MW	PT Pertamina Geothermal Energy (failed)	Protected Forest Area and there are various cultural heritage sites
11	GPP Wae Sano	-	PT Geo Dipa Energi (on progress)	Nunang, Lempe and Dasak Traditional Villages

Based on table 1. Several geothermal utilization projects are located in conservation forest areas, most in protected forest areas. Prior to the revision of the 2014 Geothermal Law, the use of geothermal energy in protected forest areas was also not permitted. It conflicted with protected forest managers and local communities. After the revision, the existing arrangements opened up the most comprehensive possible space for geothermal development. However, with so many environmental impact cases occurring, the government seems not concerned about regulating and imposing sanctions on permit holders in the event of

[25] Abdillah Ibrohim, Rizqi Mahfudz Prasetyo, and Istifari Husna Rekinagara, 'Understanding Social Acceptance of Geothermal Energy: A Case Study from Mt. Lawu, Indonesia', *IOP Conference Series: Earth and Environmental Science*, 254 (2019), 012009 https://doi.org/10.1088/1755-1315/254/1/012009

environmental damage. Therefore, social and legal criticism is essential for making decisions. Support for geothermal utilization can continue to be supported.[26]

The Impact of Geothermal Development Policy on Environmental in USA

In the USA, geothermal energy was first used for electric power production in the United States in 1960. The Geysers in Sonoma and Lake counties, California was developed into the world's largest geothermal steam electrical plant, at 1.517 megawatts. Other geothermal steam fields operate in the western USA and Alaska. In this century, many power plants were built with relatively small capacities. For example, in the six western states that have geothermal power plants, less than 0.5 GW of new geothermal capacity.[27] Geothermal power can be dispatchable to follow the demands of changing loads. Its environmental impact includes hydrogen sulfide emissions, corrosive or saline chemicals discharged in waste water, possible seismic effects from injection into rock formations, waste heat and noise.[28] In the Pacific Northwest, the USA Forest Service is set to open more than 80,000 acres for potential geothermal power development. Companies would then be able to apply for permits to build power plants that would harness the heat beneath the surface to spin turbines and generate electricity. All of this would be taking place in the Mount Baker-Snoqualmie National Forest in Washington state.

In the USA, the use of geothermal energy is regulated in The Geothermal Steam Act of 1970. It is also held in the Geothermal Energy Act of 1980, which concerns loans, programs, the use of geothermal energy, and regulations. The Act provides for the development of domestic geothermal reserves into regionally significant energy sources, promoting the economic health and national security of the Nation. The Federal Government is obligated to encourage private industry by developing and demonstrating practical ways to produce valuable energy from geothermal resources in environmentally friendly processes. Geothermal energy was the first form of renewable energy that the Bureau of Land Management (BLM) approved for production on public lands, with 2018 marking four decades since the first approved geothermal project in 1978.[29]

The increasing demand for renewable energy has resulted in the expansion of energy infrastructure across the scrub ecosystems of western North America. Geothermal power is an increasingly popular renewable energy source, especially in remote areas, but little is known about its impact on the environment, wildlife

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[26] Benjamin K. Sovacool and Michael H. Dworkin, *Global Energy Justice* (Cambridge University Press, 2014) https://doi.org/10.1017/CBO9781107323605

[27] Mark Bolinger and others, 'Mind the Gap: Comparing the Net Value of Geothermal, Wind, Solar, and Solar+storage in the Western United States', *Renewable Energy*, 205 (2023), 999–1009 https://doi.org/10.1016/j.renene.2023.02.023

[28] Guillaume Attard and others, 'A Novel Concept for Managing Thermal Interference between Geothermal Systems in Cities', *Renewable Energy*, 145 (2020), 914–24 https://doi.org/10.1016/j.renene.2019.06.095

[29] Hildigunnur H. Thorsteinsson and Jefferson W. Tester, 'Barriers and Enablers to Geothermal District Heating System Development in the United States', *Energy Policy*, 38.2 (2010), 803–13 https://doi.org/10.1016/j.enpol.2009.10.025

populations, and local communities. Please note that toxic substances such as arsenic and antimony, detrimental to human health, are contained in geothermal water. A report on the Olkaria power plant in Kenya reveals that the geothermal power plant has negatively impacted the nearby Maasai community. Due to the scarcity of skilled workers in some GPPs, many foreign workers must install, operate and decommission these plants. Expanding these factories would require more skilled workers, hindering the indigenous culture observed by the natives. In addition, residents of housing near GPP can be exposed to dust and/or odors, which will eventually cause illnesses such as colds, flu, visual disturbances, and even respiratory ailments.

In addition, GPP requires an excessive amount of land, which may result in large numbers of indigenous people settling elsewhere. Always available in some parts of the world, geothermal energy is used by GPP to heat space and generate electrical energy. They demand large areas of land for their operations, sometimes forcing native people to move. Discharge of toxic chemicals found in wastewater can contaminate nearby water sources. Foul odors, dust, and indirect emissions were observed from this RES. Emissions per kWh can be reduced by increasing the number of boreholes while making them as deep as 90 km. The most threatening threat from this RES-based power plant is a seismic activity which can be a disaster if it is near a densely populated area. This information must be remembered before installing the GPP.[30] Research in Kenya and Iceland by Clemens Greiner et.al (2023), states that geothermal projects can have detrimental impacts such as loss of land and livelihoods. However, the positive impact of the project area is also providing benefits in the form of additional infrastructure development, such as water and roads. Of course, in this study the benefits to humans cannot justify the harm to non-human elements.[31]

It goes without saying that arsenic-rich geothermal fluids are hazardous materials with global impacts, affecting different environments (groundwater, surface water, seawater, sediment, soil, atmosphere) and human and animal health. For the first time, a systematic global assessment of geothermal arsenic in fluids from the six main types of geothermal reservoirs and their environmental impacts (e.g. sources of fresh water used for drinking and irrigation), distinguishing between different uses (if any), was carried out. based on research on geochemical characteristics and geotectonic settings the formation of natural geothermal reservoirs around the world.[32] This will help to further increase the sustainable use of geothermal energy, which can be an excellent source of environmentally friendly

[30] Marco Vaccari and others, 'Rigorous Simulation of Geothermal Power Plants to Evaluate Environmental Performance of Alternative Configurations', *Renewable Energy*, 207 (2023), 471–83 https://doi.org/10.1016/j.renene.2023.03.038

[31] Clemens Greiner, Britta Klagge, and Evelyne Atieno Owino, 'The Political Ecology of Geothermal Development: Green Sacrifice Zones or Energy Landscapes of Value?', *Energy Research & Social Science*, 99 (2023), 103063 https://doi.org/10.1016/j.erss.2023.103063

[32] Alejandro García-Gil and others, 'Nested Shallow Geothermal Systems', *Sustainability*, 12.12 (2020), 5152 https://doi.org/10.3390/su12125152

renewable energy for both electric power production and direct heat use. Arsenic in geothermal fluids (up to several tens of mg/L) originates mainly from deep reservoirs (several kilometers). Proper management of geothermal fluids during exploration, exploitation, use and sustainable disposal of the resulting waste products Due to mitigation strategies is very important.[33]

Similar to the influence of geothermal utilization in Indonesia, the United States also found damage to ecosystems in utilization areas. In the study it was also found that there was a decrease in population sharing to the extinction of animal populations in conservation areas where utilization was carried out. Through demographic models we reveal decreased survival associated with proximity to geothermal infrastructure, reduced surface topographical impedance, as well as found and increased density of nest predators. The model also predicts decreased adult survival with respect to.[34] Therefore, future development of geothermal energy balances the need for domestic energy production with minimizing adverse effects on wildlife populations as well as humans. Assessing the direct and indirect effects of geothermal energy production on sensitive species is an important step to inform the current and future ecological impacts of this fast-growing industry in scrubby ecosystems in the USA[35] Therefore, geothermal utilization in the US cannot be avoided from releasing negative impacts to the environment.

To prevent environmental damage, in addition to regulations regarding geothermal, it is also supported by the Geothermal Resources Operational Orders (GROs), the Environmental Protection Act, the Clean Water Act, the Clean Air Act, the Endangered Species Act, various Acts related to cultural resources and Native American rights and the Public Utilities Regulatory Policy Act. Based on the Geothermal Steam Act of 1970 (30 United States Code Service (USAC.) § 1001), geothermal energy was regarded legally as a groundwater resource. It is also authorized the Secretary of the Interior to issue leases for the development and utilization of geothermal resources on lands managed by the Department of the Interior and the USA Forest Service (see §1002 and §1004 USAC.). "(e) The Secretary of Agriculture shall consider the effects on significant thermal features of those units of the National Park System identified in subsection (a) of this section in determining whether to consent to leasing under the Geothermal Steam Act of 1970, as amended, on national forest or other lands administered by the Department of Agriculture available for leasing under the Geothermal Steam Act of 1970, as amended, including public, withdrawn, and acquired lands.

In the United States, geothermal utilization is also permitted in conservation areas. However, The Secretary shall maintain a list of significant thermal features within units of the National Park System, including but not limited to the following

[33] Nury Morales-Simfors and Jochen Bundschuh, 'Arsenic-Rich Geothermal Fluids as Environmentally Hazardous Materials – A Global Assessment', *Science of The Total Environment*, 817 (2022), 152669 https://doi.org/10.1016/j.scitotenv.2021.152669

[34] Helen Kopnina and Haydn Washington, 'Book Review', *Biological Conservation*, 254 (2021), 108951 https://doi.org/10.1016/j.biocon.2021.108951

[35] Coates and others.

units: Mount Rainier National Park, Crater Lake National Park, Yellowstone National Park, John D. Rockefeller, Jr. Memorial Parkway, Bering Land Bridge National Preserve, Gates of the Arctic National Park and Preserve, Katmai National Park, Aniakchak National Monument and Preserve, Wrangell-St. Elias National Park and Preserve, Lake Clark National Park and Preserve,Hot Springs National Park, Big Bend National Park (including that portion of the Rio Grande National Wild Scenic River within the boundaries of Big Bend National Park), Lassen Volcanic National Park, Hawaii 'i Volcanoes National Park, Haleakalā National Park, Lake Mead National Recreation Area. The mention of the names of these Regions needs to be appreciated. This indicates that the area is guaranteed by law for its conservation protection.

The BLM, which is an agency within the United States Department of the Interior responsible for administering federal lands, is required to manage the impacts of geothermal operations on public lands under the Federal Land Policy and Management Act and the National Environmental Policy Act. The Secretary shall maintain a monitoring program for significant thermal features within units of the National Park System. The Secretary shall establish a research program to collect and assess data on the geothermal resources within units of the National Park System with significant thermal features. Such program shall be carried out by the National Park Service in cooperation with the USA Geological Survey and shall begin with the collection and assessment of data for significant thermal features near current or proposed geothermal development and shall also include such features near areas of potential geothermal development.

Compared to regulations in Indonesia, the USA is more concerned about protecting conservation areas that are used as geothermal utilization areas. Not only delegating it to tenants, but also burdened with the responsibility of managing negative geothermal impacts, monitoring and assessing them. Indirectly, geothermal regulation in the USA shows that the use of geothermal energy has a significant impact on the environment, so that regulation of this negative impact is stated directly in the law. Moreover, the USA directly states which conservation areas must be considered by the Secretary of the Interior if there are areas that are used for the utilization of geothermal resources.

Sharp and pro-environmental arrangements certainly greatly affect the acceptance of a geothermal project at a location. Because, in fact the use of geothermal leaves ecological damage.[36] The social perspective is one of the key considerations, which can speed up the cycle of selection for adoption and support for innovations. Impacts on society and the prosperity of communities and individuals are defined as social impacts. Every activity can have consequences for the community that can change or affect people's lifestyles, business, communication, and so on. These activities can also have a cultural impact by changing people's beliefs, values, standards, and behavior. Social acceptance by

[36] Katherine Mary Luketina, 'Environmental Impacts of Geothermal Energy Use', in *Comprehensive Renewable Energy* (Elsevier, 2022), pp. 72–91 https://doi.org/10.1016/B978-0-12-819727-1.00010-8

local communities is a requirement for the development of renewable energy such as geothermal.

Meanwhile, the social acceptance of geothermal utilization is less than other renewable energies. Koenraad F. Beckers et al. (2021) previously stated that geothermal energy is relatively invisible compared to other renewable energy generators. It has led to a lack of public awareness, which is essential for influencing policies, including the issue of access to land for the use of geothermal energy. Stakeholders are said to be required to communicate the utilization risk evaluation openly.[37] According to the literature, several factors affecting geothermal acceptance are: limited public knowledge about the technology, adverse media coverage, concerns about environmental impacts such as seismic induction, water consumption, and also negative effects on hot springs, low level of community participation in the process. consulting and project development.

Geothermal Regulations based on Ecological Justice in Indonesia and USA

The environmental impact of geothermal utilization is not as damaging as fossil fuel mining, the management and monitoring of the ecological effects are one of the challenges that must be addressed. Direct environmental impacts arise from land use, atmospheric emissions, water consumption, and solid waste. Matter Indirect ecological effects arise from related project activities such as power transmission corridors and construction projects. Geothermal fluids contain compounds of various elements which are potentially hazardous and cannot be used without mitigation. Solid waste is generated during drilling, which includes drilling mud and cuttings. Other contaminants include packaging waste, wood, metals, rubber waste, filters, lubricants, and municipal sewage. Power generation activities such as well operations, cooling towers, construction, and vehicles have disturbed wildlife. In addition, decreasing soil quality and water pollution will damage bio-vegetation and aquatic ecosystems. In contrast, many geothermal resources are located in protected forest areas, even in conservation areas where the development and exploitation of the resources can result in significant ecological effects.[38]

Research on these negative impacts is mainly carried out in the USA openly so that the government can adopt policies and arrangements for mitigation. Thus, the USA has a pattern of exploiting geothermal energy that is more concerned about the environment. Meanwhile, in Indonesia, the government still tends to campaign that geothermal is a completely environmentally friendly project. While the facts of environmental impact research state the opposite. It is important to start giving an overview of ecological damage and people's rejection of the use of geothermal energy.

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[37] Koenraad F. Beckers and others, 'Evaluating the Feasibility of Geothermal Deep Direct-Use in the United States', *Energy Conversion and Management*, 243 (2021), 114335 https://doi.org/10.1016/j.enconman.2021.114335

[38] M. Soltani and others, 'Environmental, Economic, and Social Impacts of Geothermal Energy Systems', *Renewable and Sustainable Energy Reviews*, 140 (2021), 110750 https://doi.org/10.1016/j.rser.2021.110750

A large amount of environmental damage has raised concerns during project implementation. Communities in the utilization area commit a lot of theft to the point where the project termination claims are problematic. The utilization of geothermal energy, which can create net zero emission, has also become shaky. Projects that are supposed to be global solutions have negative impacts locally and regionally. The threat of environmental damage due to the harmful effects of geothermal exploitation cannot be eliminated and must be addressed as a serious threat to ecological destruction. Energy project development requires an in-depth assessment of the broader environmental, social, and cultural impacts on society. Therefore, the government needs to make various efforts to standardize regulations to determine the effect, handling, monitoring, and sanctions that will be given.[39]

The regulation of energy use should broadly consider the impact on the environment and ecology. The Triangle Theory of Energy Law and Policy is formulated to look at energy issues through the perspective of economics, politics, and the environment. Hefron argued that this theory was designed to overcome and fight economic domination in energy utilization issues. This triangle is also known as the 'Energy Trilemma'—supposed to be a vehicle for understanding energy law and policy. Energy law and policy sit in the middle, connected to every aspect. These three points are economics (finance), politics (energy security), and environment (climate change mitigation).[40]

In Indonesia's utilization of geothermal energy, it is still focused on pursuing economic benefits and net zero emission targets. Supposedly, if several new environmental policies occur, it must automatically consider how ecological policies can affect political and economic aspects. Likewise, the government's narrative must also be comprehensive. Not only the narrative of the potential and benefits of environmentally friendly geothermal energy but also the handling of negative impacts. The acceptance of geothermal utilization will be greatly influenced by public perception, participation and social acceptance. Media framing, government spokesperson holds an important key to how geothermal works.[41] For example, in the Philippines, a third country that has significant geothermal potential, it is stated in research that trust through interaction between stakeholders can strengthen public support for geothermal projects; transparent communication can guarantee local people stable and safe operations; Periodic

[39] James T. Weedon and others, 'Community Adaptation to Temperature Explains Abrupt Soil Bacterial Community Shift along a Geothermal Gradient on Iceland', *Soil Biology and Biochemistry*, 177 (2023), 108914 https://doi.org/10.1016/j.soilbio.2022.108914

[40] Simon Marsden, 'The "Triangle" of Australian Energy Law and Policy: Omissions, Connections and Evaluating Environmental Effects', *Journal of Environmental Law*, 29.3 (2017), 475–503 https://doi.org/10.1093/jel/eqx018

[41] Theresa A.K. Knoblauch, Evelina Trutnevyte, and Michael Stauffacher, 'Siting Deep Geothermal Energy: Acceptance of Various Risk and Benefit Scenarios in a Swiss-German Cross-National Study', *Energy Policy*, 128 (2019), 807–16 https://doi.org/10.1016/j.enpol.2019.01.019

information is adequate for seeing meaningful public engagement. Campaignn determines acceptance.[42]

It is because geothermal utilization policies that are widely opened certainly do not only have positive results, and it is also essential to consider the potential negative consequences of policy actions so that public objections can be suppressed.[43] Hefron describes the location of energy law and policy in the middle of a triangle, and there are three triangles surrounding it, namely economics (finance), politics (energy security), and environment (climate change mitigation). These three elements each try to pull energy law and policy towards it so that one can become more dominant. Therefore, effective and efficient energy laws and policies will balance these three elements to provide the best results for society.[44]

In this paper, the author is not only concerned with how humans can enjoy the benefits of using geothermal energy. However, it is broader than just giving pleasure to humans. The whole ecology has the right to benefit. In Brian Baxter's ecological justice, it is argued that the argument for ecological justice and the issue of ecological extinction should alert everyone to the possibility of a worldview in which such moral concerns make sense and the fact that these viewpoints at least attempt to be the most comprehensive moral doctrine possible, rather than limiting moral—consideration for only a subsection of organic life. The goals of ecological justice theory should partly contribute to efforts to prevent major extinctions. But it is clear to all that ideas can have a significant effect only when humans are ready to accept them. Unfortunately, whether they were prepared, is something beyond the power of the idea writer to determine. Still, ideas are always valuable, and in a book devoted to developing and defending ideas, that is probably the best point to end with.

In contrast to environmental justice, environmental justice considers it unfair to transfer environmental risks to parties not involved in their production. Environmental justice advocates may question the ecological implications of such activities but need not; their arguments remain strong even when grounded in political economy that allows some groups to externalize the risks of their practices. Consequently, the issue of environmental justice can be solved without solving environmental problems. On the other hand, ecological justice must address both environmental fairness and the ecological quality of our practices. Ecocentrics argue that environmental justice can be too anthropocentric. In their

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[42] Marnel Arnold Ratio, Jillian Aira Gabo-Ratio, and Yasuhiro Fujimitsu, 'Exploring Public Engagement and Social Acceptability of Geothermal Energy in the Philippines: A Case Study on the Makiling-Banahaw Geothermal Complex', *Geothermics*, 85 (2020), 101774 https://doi.org/10.1016/j.geothermics.2019.101774

[43] Rozanne C. Spijkerboer and others, 'Out of Steam? A Social Science and Humanities Research Agenda for Geothermal Energy', *Energy Research & Social Science*, 92 (2022), 102801 https://doi.org/10.1016/j.erss.2022.102801

[44] Raphael J Heffron and Kim Talus, 'The Development of Energy Law in the 21st Century: A Paradigm Shift?', *The Journal of World Energy Law & Business*, 9.3 (2016), 189–202 https://doi.org/10.1093/jwelb/jww009

view, we need a form of justice that includes non-human elements. In the context of industrialization, the empirical practice of development and investment in the utilization of natural resources tends to pay no attention to the carrying capacity and capacity of environmental sustainability, which will further accelerate the occurrence of ecological disasters such as those currently threatening many regions.[45]

To support the use of geothermal, which provides benefits for the ecology, not only for economic interests and even political narratives, geothermal regulation should be given a regulatory characteristic—energy law. In particular, regulations in Indonesia still do not guarantee ecological safety in the use of geothermal energy in protected and conservation forest areas. In Lihua Qiu's research (2022), states that geothermal utilization will always collide with the expansion of conservation areas and steps to maintain them.[46] At least, geothermal regulation takes into account the principles on which the regulation is based. In this case, it can be proposed the adoption of the following principles: First, the principle of ecological justice and geothermal utilization regulations are based on moral values. It's not just human gain that comes first. But non-humans, such as animals, plants, and inanimate objects, must get their rights. The elements that make up the ecology get the same advantages. Ensuring that the articles in the regulations do not emphasize purely economic values so that ecology becomes an object of exploitation.[47]

Second, the principle of high-level environmental protection and preserving biodiversity, protected forest areas, and conservation forest areas are designated as life support areas and preservation of the diversity of plants, animals, and their ecosystems.[48] However, using forest areas as working areas for geothermal utilization for tens of years can undoubtedly reduce the function of the area. Forest areas cannot be protected like forest areas that are not used as geothermal utilization work areas due to the real negative impact on the environment. This principle can be used as a basis for setting exceptional monitoring standards for protected and conservation forest areas used as utilization areas. Monitoring values and standards for area protection can then be regulated in more detail in collaboration with the Ministry of Forestry.[49]

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[45] Donna Okthalia Setiabudhi, Ahsan Yunus, and Andi Rifky, 'The Role of Land Management Paradigm Towards Certainty and Justice', *Bestuur*, 11.1 (2023), 43–60 https://doi.org/https://doi.org/10.20961/bestuur.v11i1.71710

[46] Eleanor Shoreman-Ouimet and Helen Kopnina, 'Reconciling Ecological and Social Justice to Promote Biodiversity Conservation', *Biological Conservation*, 184 (2015), 320–26 https://doi.org/10.1016/j.biocon.2015.01.030

[47] Muhamad Haris and others, 'Bestuur Governing Indonesia ' s Plan to Halt Bauxite Ore Exports : Is Indonesia Ready to Fight Lawsuit at the WTO ?', *Bestuur*, 11.1 (2023), 26–42 https://doi.org/https://doi.org/10.20961/bestuur.v11i1.69178

[48] A.Tauda and Gunawa, 'Cryptocurrency: Highlighting the Approach, Regulations, and Protection in Indonesia and European Union', *Bestuur*, 11.1 (2023), 1–25 https://doi.org/https://doi.org/10.20961/bestuur.v11i1.67125

[49] Suwari Akhmaddhian, Haris Budiman, and Rahul Bhandari, 'The Strengthening Government Policies on Mineral and Coal Mining to Achieve Environmental Sustainability in Indonesia, Africa

Third, the Principle of Environmental Damage is Corrected at the Source. In some cases, the handling of environmental damage is not resolved at the source. For example, in the case of a gas leak in Sorik Marapi, apart that the gas pipes passing through residential areas, the sanction given by the government was to stop operations and not mention how the security of the community and the surrounding environment is concerned. Indonesia also has the concept of environmental services. Business permit holders in the geothermal sector in conservation forest areas must carry out environmental services. This business service is a requirement for the issuance of a business license. Unfortunately, environmental services are interpreted as efforts to utilize biological resources to gain direct or indirect benefits in the form of nature tourism services, erosion control services, water management, etc. Meanwhile, the main point of the issue of negative impacts on conservation areas is not on how biodiversity is utilized. However, when ecological damage occurs, the source of the damage is handled.

Forth, the Principle of Meaningful Public Participation, community participation in Sherry Arnstein's participation ladder, states that the highest level of participation in society is Citizen Control, in which the community participates in controlling public policy from beginning to end.[50] In meaningful participation, the public has the right to be heard (right to be heard); second, the right to have their opinion considered (right to be considered); and third, the right to receive explanations or answers to opinions given (right to be explained). Rejection of geothermal projects in several locations is often linked to concerns about environmental damage and loss of cultural values attached to a location. Therefore, society needs to be fulfilled the right to participate meaningfully. In utilizing geothermal energy, the community also determines what will be done to the ecology of the area where they live as a form of environmental and cultural protection.[51]

Appropriate arrangements are obtained through the basics of using geothermal, which is pro-ecology. It can be improved in the form of: 1) Granting geothermal utilization permits followed by standardization of handling and monitoring of environmental impacts based on forest area categories; 2) Appointment of government agencies in the law to carry out environmental protection and dealing with environmental damage; 3) mention in laws and regulations that which conservation forest areas need to be monitored and handled strictly to ensure that geothermal utilization in the area does not cause damage to biodiversity; 4) the obligation to settle the land with community involvement—meaningful

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and Germany', *Bestuur*, 11.1 (2023), 95–120 https://doi.org/https://doi.org/10.20961/bestuur.v11i1.71279

[50] Chad Walker and Jamie Baxter, 'Procedural Justice in Canadian Wind Energy Development: A Comparison of Community-Based and Technocratic Siting Processes', *Energy Research & Social Science*, 29 (2017), 160–69 https://doi.org/10.1016/j.erss.2017.05.016

[51] Widiatedja Parikesit and Muhammad Q Shah, 'The Rise of Centralistic Governance in Spatial Planning in Indonesia and Australia: A Comparative Study', *Bestuur*, 11.1 (2023), 121–43 https://doi.org/https://doi.org/10.20961/bestuur.v11i1.70120

participation since before the permit was issued; 5) enforcement of administrative sanctions followed by settlement of damage at its source.

In the end, the development of geothermal energy as a source of electricity must be carried out. Development demands are getting higher as many new projects are being opened, and it often creates environmental and community conflicts. Geothermal development is required to be able to contribute to providing energy sources, protecting the environment, and preserving traditions. A high price needs to be paid to realize net zero emissions. The government must make policies and regulations that balance environmental, economic, and political policy interests. But still, in the development of energy law, it is necessary to protect the rights of ecology because it is most often eliminated in the interest of material gain. Therefore, this paper has explained how the utilization of geothermal energy in Indonesia and America is used as a comparison, which arrangement has previously focused on realizing ecological justice in the utilization of geothermal energy.[52]

4. Conclusion

Geothermal utilization is clean green energy and is more environmentally friendly than coal and gas/petroleum mining. The geothermal potential is said to be able to replace fossil energy to deal with the climate crisis. While the utilization of geothermal is not always the case, geothermal also harms the environment. Public rejection occurs in various areas where geothermal exploitation is carried out in conservation forest areas because the regulation of its utilization has not guaranteed environmental justice. The principle of geothermal energy in Indonesia is no more pro-ecological than the regulation in the US. Geothermal utilization regulations in Indonesia tend to focus on economic aspects. Meanwhile, based on an analysis of ecological justice theory and the triangle of energy law and policy, it was found that the principles of geothermal regulation must be prioritized for the environment, not the mere benefits of exploitation. The principles of geothermal regulation need to be reviewed, where the ecology must be given a safe space to maintain its sustainability. Community rejection will decrease with evidence of pro-ecological arrangements and implementation.

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[52] Jessica L. Hogan and others, 'What Makes Local Energy Projects Acceptable? Probing the Connection between Ownership Structures and Community Acceptance', *Energy Policy*, 171 (2022), 113257 https://doi.org/10.1016/j.enpol.2022.113257

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