

# Geothermal as a Treasure of Indonesia's Energy Resistance

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## *Abstract.*

Indonesia has the potential of total geothermal resources of around 25,386.5 Mwe and in 2018 it is number 2 with the largest level of geothermal production in the world after the United States, namely 1,948.5 Megawatt (MW). Indonesia has great potential for geothermal energy as renewable energy resources. Geothermal energy is an alternative energy because its energy is cleaner pollution-free than coal energy which has an output of carbon pollution and greenhouse gases. Indonesia's potential for high geothermal energy production can be a treasure for the country's energy security and replace coal as a nonrenewable energy resources fossil fuel. Geothermal is chosen as an alternative energy generator by considering economic, environmental, social and regulatory aspects. The development of the Geothermal Power Plant (PLTP) faces the challenge that requires sufficient careful attention and analysis because of the country's energy security that must be fought for and the environment that must be maintained in balance. The government prepares several solutions with the existence of renewable energy programs and policies that exist as a boundary and supervision.

## **I. Introduction**

Indonesia's dependency on using fossil energy in fulfilling domestic energy needs still tends to be high. Fossil energy contributes 94.3% of the total national energy needs and only 5.7% is fulfilled from new renewable energy. Based on this amount, petroleum contributed 49.7%, natural gas 20.1% and coal 24.5% [1]. Coal is the most important energy source for electricity power plants in Indonesia [2].

The utilization of coal as fuel for electricity generation in Indonesia has been running for decades. Based on information presented by the Indonesian Ministry of Energy and Mineral Resources, Indonesia's coal reserves are estimated to run out in the next 83 years if

the current production level is continued [2]. This ongoing exploitation will cause an energy crisis in fossil resources, especially coal. This is dangerous for the sustainability of development and can result in the failure to meet domestic energy that has an increasing population every year.

The dependency on fossil energy needs to be terminated by utilizing the potential of alternative energy in all parts of Indonesia such as hydropower, wind, geothermal and biomass. The government has actually prepared various regulations to reduce dependence on fossil fuels (for example: General Policy on Energy (KUBE) in 1980

and Decree of the Minister of Mines and Energy No. 996.K / 43 / MPE / 1999 concerning the use of renewable fuels for electricity production PLN wants to buy). But unfortunately, at the level of implementation there has not been a serious and systematic effort to implement renewable energy to substitute fossil fuels [3].

## II. Literature Review

### 2.1 Potential of Renewable Energy Sources

The wealth of Indonesia's natural resources is very abundant, both renewable and non-renewable, and by the existence of these natural resources, Indonesia has the potential of a large number of renewable energy sources, one of which is geothermal energy [4]. Indonesia is a country surrounded by volcanoes or ring of fire which has the largest geothermal energy capacity and is followed by America, Japan and the Philippines. About 40% of all geothermal potential in the world is embedded in the bowels of the Indonesian earth and in other words Indonesia is a geothermal superpower country [5]. The use of geothermal energy can also be said to be efficient and economical and environmentally friendly compared to fossil energy.

The potential for renewable energy in Indonesia is quite large, yet its utilization is still not optimal. Due to the more expensive initial investment and operational costs, energy prices become expensive and cannot compete with conventional energy prices that are still subsidized by the government [3]. Indonesia is estimated to have geothermal power reserves of no less than 27 GigaWatt[6]. This amount is not far from the total national electricity generation which currently reaches 39.5 Giga Watt. In addition, geothermal energy in Indonesia is relatively

high, making it ideal for geothermal power plants (PLTP). The National Energy Policy has targeted that geothermal energy can support 5% of the national energy mix by 2025. New geothermal energy contributes 1% of the potential electricity that can be produced, with a potential reserve of 14,172 MWe[7].

## III. Research Method

The research methodology used in journal writing is a literature study methodology from various sources. The preparation of research is based on information and data obtained with views from the point of view of environmental economics.

## IV. Discussion

### 4.1 Geothermal

Geothermal is a source of heat energy found and formed in the earth's crust. Geothermal is a source of heat energy contained in hot water, water vapor and rocks. These rocks are shared with minerals and gases which are genetically all inseparable in a geothermal system and the mining process is needed. Geothermal energy can be used to substitute electricity. In Indonesia there are 3% of electricity that uses temporary geothermal energy such as BBM 20.6%, coal 32.7% and natural gas 32.7%. The use of alternative energy sources to replace electricity is needed for preliminary exploration by determining the mineral content of rocks in geothermal areas and the use of geothermal energy [8].

Geothermal sources in Indonesia are in highland or mountainous areas, geographically far from the center of users of electric loads. The capacity of production wells is relatively small and is located far

from one another. If this energy is exploited then to distribute electricity that is generated up to the load center requires a long transmission line. The consequences are high costs [9]. The forms of new and renewable energy (EBT) available in Indonesia are

geothermal, hydropower, biomass, solar energy and marine energy. Based on the Directorate General of EBTKE, the Ministry of Energy and Mineral Resources, the potential and utilization of renewable energy can be seen in the following table:

Table 1. Potential and Utilization of Renewable Energy (Ministry of Energy and Mineral Resources).

No.	Non FossilEnergy	Resource	Installed Capacity	Ratio
1.	Hydro	75670 MW	6654.29 MW	8.8
2.	Geothermal	29038 MW	1226 MW	4.2
3.	Mini-micro hydro	769.69 MW	1618.4 MW	29.75
4.	Biomass	49810 MW	22.45 MW	3.25
5.	Solar energy	4.8 kWh/m <sup>2</sup> / day	1.87 MW	-
6.	Wind energy	3-6 m/s	30 MW**)	-
7.	Uranium	3000 MW*)		1

The Indonesian archipelago is located in one of the most active tectonic frameworks in the world, located between the Indo-Australian, Pacific, Philippine and Eurasian tectonic borders. This strategic position makes Indonesia the richest country with geothermal energy spread across 285 regional points along the volcanic arc with a total potential of 29,215 Gwe. Indonesia has the greatest potential for geothermal energy in the world, with at least 29 Giga Watt of total geothermal potential. Of this amount, only about 1.2 Giga Watts have been utilized.

#### 4.2 Existing Policies Regarding Geothermal Energy

The government through the Ministry of Finance has provided various fiscal incentives to encourage geothermal development, starting from taxation facilities, import duty and excise, and geothermal fund facilities. Tax incentives, import duties and excise provided for geothermal electricity developers as stipulated in the Minister of Finance / PMK Regulation Number 21/2010.

The exploitation of geothermal energy is regulated in Law Act Number 21 of 2014 concerning Geothermal Energy. This regulation was promulgated by revoking Law Number 27 of 2003 concerning Geothermal Energy. As a norm basis in terms of utilization of geothermal energy, a number of laws and regulations were issued. Namely:

Presidential Decree Number 22 Year 1981 concerning Provision of Concessionary Concession for Exploration and Exploitation of Geothermal Resources for Energy / Electricity Generation to Pertamina in Indonesia.

Presidential Decree No. 45 of 1991 concerning Amendment to Presidential Decree Number 22 of 1981 concerning Provision of Concessionary Concession for Exploration and Exploitation of Geothermal Resources for Energy / Electricity Generation to Pertamina in Indonesia.

Presidential Decree Number 76 of 2000 concerning Exploitation of Geothermal Resources for Power Generation.

Law Number 27 of 2003 concerning Geothermal Energy.

Law Number 21 of 2014 concerning Geothermal Energy.

#### **4.3 Linkage of Policy to Existing Geothermal Facts**

Law Number 21 Year 2014 concerning Geothermal is issued to replace Law Number 27 of 2003. The birth of the Law, especially article 5 paragraph (1) is motivated by several things. First, the development interests of the forestry sector. In the 2011-2030 national park-based plantation and forestry development map it is written that geothermal energy will be projected as one of the contributors to the forestry sector's national gross domestic product (GDP). Second, the importance of conserving natural resources. the production of electricity from geothermal energy does not produce waste so it does not damage the environment. Forests as the largest store of carbon and habitat for biodiversity will have a positive impact from the use of geothermal resources, because the use of geothermal energy will automatically replace the position of coal, natural gas and petroleum which have contributed the largest carbon emissions. Third, the development interests of the energy sector. The development of geothermal resources as a source of energy, national energy security will be achieved soon. With a potential mastery of 40% of the world's geothermal potential, and with a reserve potential of 14,172 MW, consisting of proven reserves of 2,287 MW, possible reserves of 1,050 MW and estimated reserves of 10,835 MW, utilization of geothermal resources will create national energy independence. Fourth, the interests of regional development. Law Number 23 of 2014 concerning Regional Government also expressly authorizes the regions to deal

with the potential of geothermal resources in their regions. Utilization of geothermal energy can provide a significant contribution to increasing regional original income such as exploitation of petroleum, natural gas and coal. Regional original income from the use of geothermal energy can be used for the welfare of the community. Fifth, business interests. A business activity certainly requires a clear legal rule to ensure profit and loss calculations, on the side of employer regulation encouraging clarity of the legal status of geothermal working areas in conservation forest areas, smooth procedures for obtaining permits, clarity on rights and obligations accepted and must be fulfilled by business people, and other matters directly related to the interests of geothermal energy business. This situation encourages the issuance of a rule that guarantees that the implementation of geothermal energy can be carried out without limitation of places and regions. Finally, the interests of local communities. In terms of community welfare, the majority of utilization in the forest area will provide multiple benefits from the local community itself. in addition to the guarantee of smooth flow of electricity, direct use can also be carried out by local communities, such as in the field of agribusiness, geothermal can be used to dry the results of fighting. In the tourism sector, usually hot water released can be used for bathing pools and many other benefits. On the other hand, Law No. 41 of 1999 concerning Forestry was born in the early days of reform and amidst extraordinary conditions of forest destruction. So as in the opinion of Mahfud MD, Law Number 41 of 1999 concerning Forestry tends to be democratic and responsive.

#### **4.4 Geothermal as an Alternative to Coal in Electric Energy Production**

Coal is an energy source that comes from fossil fuels that function as a power plant. Coal as a source of electricity has a negative impact that is more than geothermal, as the carbon pollution produced is quite high. Indonesia, according to data from the Ministry of Energy and Mineral Resources (2018), is the second highest coal production country in 2018, which is 1,948.5 megawatt (MW). A research that using Indonesia and Malaysia as their sample found that the consumption of all energy sources are produce carbon emission [10]. The high level of production and with a note that there is no use of alternative sources of replacement, then the coal energy reserves in Indonesia will run out. The use of alternative energy sources from renewable resorces is very necessary to overcome the country's dependence on supplying electricity only from coal fuel. Alternative energy sources of renewable resorces are geothermal energy. Geothermal energy is used as an alternative energy generation because it is relatively environmentally friendly. Geothermal energy is also a renewable energy that is relatively not exhausted if it is used wisely, compared to coal energy which is non-renewable energy which will run out when used continuously. Exploration costs and capital costs for geothermal power plants are higher than for electricity generation with coal fossil fuels. However, after operating, the production costs are lower compared to coal-fired fossil power plants.

The real condition of coal and geothermal prices is a new obstacle, where the price of coal source production is cheaper than the price of geothermal production, so this is a big cause causing the price of electricity produced by geothermal power plants to be higher than the price electricity produced by a coal-fired Steam

Power Plant (PLTU). The prospect of geothermal energy compared to the Ministry of Energy and Mineral Resources road map, it can be said that geothermal energy in Indonesia is lagging behind. One obstacle is that the government (Ministry of Energy and Mineral Resources) has not been able to reduce the risk of geothermal exploration and increase the Domestic Component Level (TKDN) inviting turbine / generator manufacturing located in Indonesia.

The Indonesian government is intensifying Geothermal Power Plants (PLTP) by looking at the enormous potential that Indonesia has and reducing the impact that is continually produced by coal as fuel for electricity generation in Indonesia. This is related to the country's economy in the future both environmental economics and large investments in PLTP development. Several breakthrough geothermal development efforts were carried out by the Indonesian government to create the country's energy security, namely geothermal development in the eastern region, assignments to SOEs, simplification of licensing, assignment of preliminary surveys and exploration, and geothermal funds and government drilling.

#### **4.5 Linkages to Environmental Economics**

The construction of Geothermal Power Plants (PLTP) always intersects with various aspects, these aspects are the economic, environmental, social and regulatory aspects that apply. The location of geothermal resources in addition to being in the highlands is mostly also in protected forest areas, where this can become a new obstacle that requires analysis in order to achieve strong energy security and the environment is maintained. While there are government policies or regulations that must be



considered as in the context of this problem Law Number 27 of 2003, which states that geothermal utilization is included in the mining group, thus limiting the utilization of geothermal potential, while in the Draft Government Regulation on Management of Regions New Nature Reserves and Nature Conservation Areas will include a rule that prohibits all mining activities in protected forest areas and nature reserves.

Thus the situation of the PLTP development plan is threatened, in this case the licensing of the location of the operation. But from the other side it has been understood, that the forest area is an area that must be preserved, so that the environment can be maintained. So this connection makes the problem between the construction of geothermal power plants and environmental sustainability. So that those related to the environment will always follow in every development of energy utilization, including EBT. Thus, there are collisions on existing regulations with regulations that will be made. These collisions are a waste of energy and time, so licensing for PLTP construction takes a long time and can even fail.

Geothermal Power Plants (PLTP) is a risk or consequence that must be ready to be accepted by various parties, this is to get electricity that is cleaner, environmentally friendly and its reality up to now has not been fully utilized. Therefore, if both IPP and PLN are willing to build PLTP, the Government provides infrastructure in the form of a transmission line from the PLTP center to the electric load center [9].

## V. Conclusion

Geothermal is a source of heat energy found and formed in the earth's crust. Geothermal is a source of heat energy contained in hot water, water vapor, and rocks. Geothermal can be an

alternative coal fuel as a power plant, considering coal is a nonrenewable energy resource that will run out when used continuously. Indonesia has great potential for geothermal energy, so for now the government is trying to build and continue to develop Geothermal Power Plants (PLTP) that are spread across several regions of Indonesia. The policies of the government have been prepared as a limitation in the management of geothermal energy in Indonesia in order to maintain a sustainable state energy security.

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