

## Energy Security and the Role of Geothermal Development in Indonesia

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**Keywords:** Geothermal resources, energy security, role of geothermal and challenges of development.

### ABSTRACT

Indonesian energy demand grows at 9 percent each year and the growth in electricity demand reaches 14% per year – this requires a strong effort to meet energy supply in Indonesia. The role of oil and gas is in excess of 47% in the national energy mix policy over the years, which is an issue due to the somewhat alarming decline in Indonesia's ability to produce oil in the country. The decline has reached 50% of the peak production. As a result, Indonesia requires the geothermal energy to provide optimum durability.

Indonesia may have 29,000 MWe of geothermal resources, the highest geothermal potential in the world. However, not much additional power plant has come into operation in the last five years, with current production at 1349 MW being only a modest increase from its capacity in 2010 of about 1189MW. Because geothermal development in Indonesia has been expedited by government regulations that allow the participation of the private sector, both local and international, to attract investors to develop geothermal, the installed capacity is still low in comparison to the availability of resources and durability of the development.

Changes in the regulatory environment for the geothermal industry and the resolution of the economic crisis are the major issues affecting the growth of the Indonesian geothermal industry.

In spite of the issues, increasing power demand and electricity tariff in the last five years may indicate that business climate has changed and is becoming more conducive for investment. In addition, the issuance of new National Energy Policy (NEP) updating regulation No.5 Year 2006, keeps opportunities for renewable energy to contribute in supporting the energy security of the country.

In this regard, geothermal will take a very important role in energy supply. The role of geothermal energy in the national energy mix will impact the improvement of the economic and national energy security activities. Therefore, Indonesia is still interested in doing business in energy and to develop mainly geothermal power. Learning from the past, developing geothermal for the energy supply is very challenging. The issuance of new NEP may attract foreign investors to meet the increase of energy demand.

Finally, in regard to investment substance GOI is also expected to be able to maintain Indonesian country risk, to set up competitive basic electricity price, to determine market-demand currency rate, to arrange clear fiscal regulations, and to implement contract sanctity and of course to amend the Geothermal Law.

This paper presents current Indonesian energy condition, power utilities, outlines the national energy policies, geothermal resources, energy security and the role of geothermal development and provides an overview of the challenges in the power sector in Indonesia.

### 1. INTRODUCTION

The high growth of energy demand in Indonesia might alarm the power supply side if it is an imbalance in energy management. For the country, it also may effect the development growth and economic security.

The energy independence and security is an important pillar of economic security, which eventually leads to the national defense. To build the system of energy independence and energy security is very important for a country. Energy security is also important in addition to the ability of national energy supply (as an internal factor) to respond to the changing dynamics of the global energy (external factor) as well as to guarantee the independence of the country.

The role of energy is very high impact for the improvement of the economic and national security activities. Thus, the provision of energy management, utilization and enterprise must be conducted in a fair and level playing field, sustainable, rational, optimum, and integrated. Ensuring the availability of energy, access to energy at achievable prices in the long term, and regard for the environment are conditions that must be developed in energy security.

Energy security and the stability of the energy supply of the present and the future is something that cannot be negotiated. To ensure the achievement of energy security, Indonesia should manage and conduct the energy policy and strategy from its energy resources.

Currently, Indonesia's energy reserves and production are comprised of 56.6 billion barrels of oil resources, 8.4 billion of barrels oil reserves and 348 million barrels/year of oil production. Reserve to production ratio is about 24 year. On the other hand, natural gas resource is about 334.5 TSCF and the reserve is about 165 TSCF. The reserve to production ratio is about 59 production years or about 2.79 TSCF annually.

In addition, the coal resource is about 161 billion tons, and the production is about 391 million tons a year. The reserve to production ratio is about 93 years. Coal Bed Methane (CBM) resource is about 453 TSCF. Furthermore, the resources of renewable

energy range from 75.67 GW of hydropower, 0.45 GW of micro-hydro, 49.81 GW of biomass, 4.8 kWh/m<sup>2</sup>/day of solar power potency, 9.29 GW of wind power and 3 GW uranium for 11 years (only in Kalan, West Kalimantan).

On the other hand, Indonesia is located between the eastern end of Mediterranean Volcanic Belt and western side of the Circum Pacific Volcanic Belt, so is blessed with abundant geothermal resources. The potency is about 29 GWe and places this country as having the biggest geothermal energy potential in the world. This country needs to be balanced in the energy mix to benefit from the clean geothermal energy. The use of renewable geothermal energy would eliminate the dependency on a single source of fossil fuels to generate electricity and meet Indonesia's growing energy demand. Therefore, this geothermal energy of choice will obviously enable Indonesia to export its more portable fuels for much-needed hard currency and increase the energy security of the country.

To speed up geothermal development, a new regulation on the power sector and geothermal development should be introduced. We hope these new regulations will open the opportunities and reduce the challenges and encourage investors to develop geothermal energy in order to fulfill the increasing electricity demand of Indonesia.

In terms of geothermal development and its utilization, the Government of Indonesia (GOI) are committed to utilize the biggest geothermal energy resources to become the largest geothermal producers in the world and a leading user of alternative energy. The increasing use of geothermal energy will substitute fossils that may be fulfilling Indonesia's growing demand for electric power and guarantee the security of the energy supply in the long-term National Energy Policy.

These policies are issued to support a total geothermal power plant installed capacity of 9,500 MWe by the year 2025, as stipulated in the National Energy Mix policy.

We will discuss the current energy policy and the inputs into the implementation of the National Energy Policy (NEP) for national energy resilience, and the role of rules in the management of geothermal energy in Indonesia. A discussion of national energy policy is expected, so that both regulators and investors can interact to reach a common understanding of national energy policy in managing the energy demand and supply.

## 2. NATIONAL ENERGY CONDITION

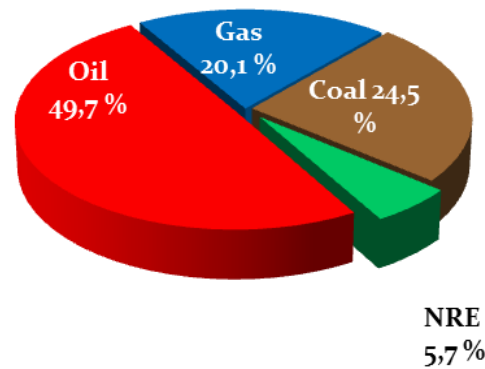
The use of energy in Indonesia is growing rapidly in line with economic growth and a population that has reached over 237 million people in 2014. Energy consumption experienced steady growth of around 7% per annum due to population growth (1.49%) and economic growth (~ 6%).

The Indonesian fossil energy reserve is very small when compared with world energy potential (in terms of natural oil, for example, Indonesia has only 1% of the world energy potential, and in natural gas 3% of the world energy potential, and in coal, 3.6% of the world energy potential).

The condition of national energy consumption and use in Indonesia is indicated by: (1) low energy supply security, (2) fossil energy reserves tend to decrease very rapidly, (3) fossil energy is mainly used as an export commodity, (4) the use of energy is very inefficient and energy management is low on conservation, (5) Indonesia is also facing the global environment issue, (6) energy price is subsidized, (7) NRE utilization is not optimum, (8) R&D capacity of the energy industry and infrastructure is not optimum, (9) there is very low access to energy while on the other hand the demand of energy is very high correlated to the economic growth.

The current energy condition is determined by limited access to energy, with the electrification ratio at about 80% (20% not electrified). The energy infrastructure (remote areas and outer islands) is also low. Among people who do not yet have access to electricity, energy demand growth rate is 7% per annum while the supply growth is less. Across the country, the use of fossil fuel is very high while the fossil reserve is limited and low. The use of renewable energy is low, less than 6% in the energy mix contribution (**Figure 1**). The environmental issues (climate change mitigation, carbon trading and national commitment to emission reduction of 26% by 2020) will be challenge the use of fossil energy which is dominant in the energy sector. In addition, Indonesia has limited funds and human resources to support energy development and guarantee its energy security while the energy elasticity is about 1.63.

Energy supply comes from two sources, namely fossil energy (oil, natural gas and coal) and renewable energy such as biomass, hydropower and geothermal. However the energy supply is mostly from fossil energy. Indonesia possesses a variety of energy resources, but a substantial portion of the country's energy mix continues to rely on oil (**Figure 1**).



**Figure 1: National energy condition (Source: Ministry of Energy, 2013). The figure shows the use of New, Renewable Energy (NRE) and fossil fuel in the National Energy Mix of Indonesia.**

Furthermore, the electricity needs in the year 2011 were about 40 GW and are projected to increase to about 90 GW in the year 2025 and to 400 GW in the year 2050. By using a pessimistic estimate assuming conditions in 2025, 2011 shows that by year 2025 Indonesia needs an additional 70 GW and by year 2050 needs about 200 GW more. This might worsen the energy supply security. It is also targeted by the government that in 2022, Indonesia will reach 100% national electrification ratio. Therefore, there will exist many business opportunities in achieving the electrification ratio target by 2022. Geothermal, as the biggest potential to generate electricity in the country, will play a significant role to achieve this target.

## 2.1. Macro view of energy policy

### 2.1.1. Changing Paradigm in Energy Policy

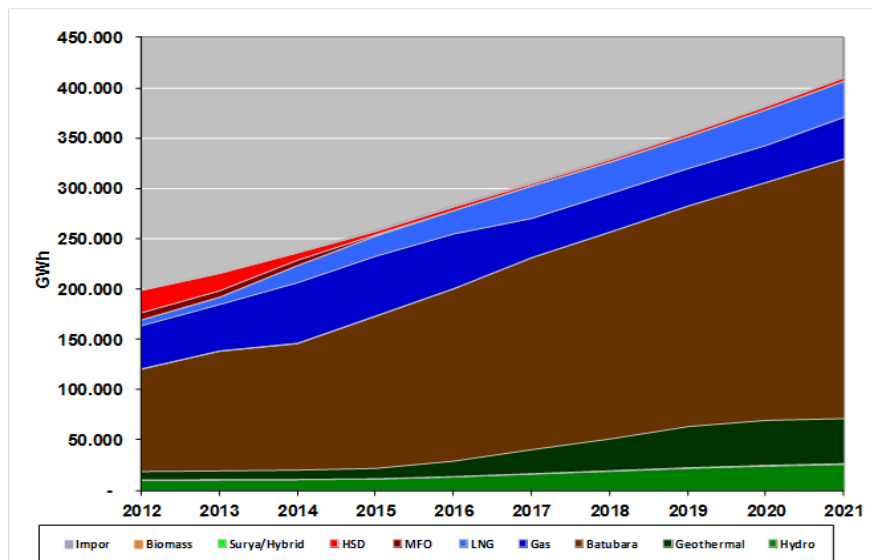
The new paradigm in energy policy should be changed so that natural resources are considered to be national development assets rather than as a commodity. This is expected to result from improving efficiency in energy use, conservation, and special attention for sustainable development in the national energy management policy. To increase the contribution of renewable energy in the national energy mix continuously is among the highest priorities in new paradigm shift. To increase the fossil energy resources and proven reserves is a must. But, reducing fossil energy contribution (percentage) in the national energy mix is also a first priority. There is also an effort to improve independency in the national energy management, accelerating job creation, accelerating the role and participation of domestic industry in the energy sector, boosting research and development in energy sector, and accelerating the opening of energy access for all people to a secure energy supply, especially electricity, oil and gas. Finally, the new paradigm should optimize the usage of natural energy resources for economic development of the nation based on "Economic Added Value Process". On the other hand, government should also socialize, declare and secure the strategic national energy reserves to improve the understanding that the fossil energy must be stored as long as possible to guarantee the security of the nation to the all stake holders.

### 2.1.2. Main policy in renewable energy

Firstly, implement energy conservation to improve energy efficiency in the supply and utilization (demand side), among other sectors of industry, transport, household, and commercial use. Secondly, implement the diversification of energy to increase the share of renewable energy in the national energy mix (supply side), among others. This diversification is reducing the role of fossil energy and improving the role of new and renewable energy such as: Liquefied Coal, Coal Bed Methane (CBM) and other methane, Coal Gasification (CG), Nuclear, Hydrogen (New Energy group), and Renewable energy group such as: Geothermal, Hydro, Bioenergy, Solar, Wind, and Ocean energy

## 2.2. Power Utilities

In the last five years (2009-2014) Indonesia's GDP grew at 6.2% per year, causing the growth of electricity to be 8.65% per year at a tariff of about 7.4 cent USD/kWh. Capacity growth projection from year 2012 to 2021 is as follows: Coal Fired Power Plant, 38 GW; Geothermal Power Plant, 6.3 GW; Combined Cycle Power Plant, 2.5 GW; Gas Turbine Power Plant: 4 GW; Hydro Electric Power Plant: 6.3 GW; and Others about 0.28 GW.

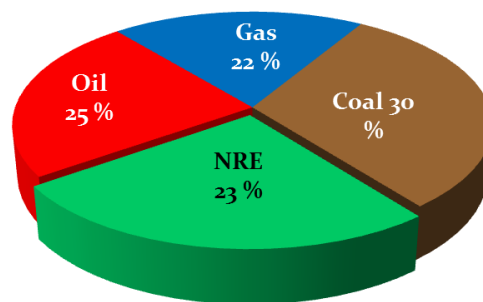


**Figure 2: The use of primary energy for electricity (in percentage of 2012-2021; Source: PLN - 2012)**

In the last five years, the electrification ratio has increased from 72% to 80% in 2013. Total installed capacity is 43 GW. In order to have the basic rules for developing power plants, GOI and PLN have issued National Electricity General Planning and General Planning for Supplying Electricity in 2012-2021 (see Figure 2).

### 3. NATIONAL ENERGY POLICY

At present, in early 2014, the government has issued a new National Energy Policy (NEP) following to the Energy Law No.30 Year 2007 in order to enable the coordination and synergy of all stakeholders in the energy sector. This NEP regulates the optimized use of energy resources in Indonesia. The vision of the policy is guaranteeing the sustainable energy supply to support the national interest. The policy might guarantee the security of energy supply by increasing the utilization of renewable energy such as geothermal. So, the objective of NEP is to guarantee national energy security and domestic energy supply by supporting sustainable development and conserving energy.



**Figure 3: New National Energy Policy (NEP, 2014)**

The targets of NEP are (Figure 3): (1) improving the role of energy business toward a market mechanism to increase added value; (2) achieving electrification ratio of 90% by the year 2020 and 100% by 2022; (3) reaching renewable (excluding large hydro) energy shares in energy mix to at least 23% by 2025; (4) realizing energy infrastructure, which enables maximization of public access to energy and energy use for export; (5) increasing strategic partnership between national and international energy companies in exploring domestic and export energy resources; (6) decreasing energy intensity by 1% per year therefore the elasticity to be 1 by 2020; and (7) increasing the local content and improving the role of national human resources in the energy industries.

To ensure the achievement of the targets, the policy measures to be pursued are: (1) intensification of measures to increase the availability of energy in parallel with the national development and population growth; (2) diversification measures to increase coal and gas shares, which have a larger potential than oil and to increase renewable energy share, which has a huge, potential and clean; and (3) conservation measures to improve energy efficiency by developing and using energy-saving technology both in upstream and downstream sides.

#### 3.1. Energy Policy Direction:

To reach the energy targets, several directions in energy policy have to be pursued: (1) Availability of Energy; (2) Priority of Energy Development; (3) National energy resources utilization; (4) National energy reserve; (5) Conservation and diversification; (6) Environment and Safety; (7) Price, subsidy, and incentive; (8) Energy infrastructure and industry; (9) Energy research and development; and (10) Institution and Financing.

### 3.2. Energy Security

Energy security is defined as “securing the amount of energy required for people’s life, economic and social activities, defense and other purposes for acceptable prices”. We can consider a supply chain (supply side) from obtainment of resources (energy production side) to demand sides (demand side) and how to use energy efficiently (energy efficiency) as a basic component of energy security (Murakami, 2011). On the other hand, APERC in 2007 defined that energy security is “the ability to guarantee the availability of energy resource supply in a sustainable and timely manner, with the energy price being at a level that will not adversely affect the economic performance”. Energy security is not an economic standpoint, but is more of a political and geo-political aspect. Economic imbalances will be resolved with the adjustments in production and consumption, between supply side management and demand side management. Thus, the NEP defines that Energy Security is a condition ensuring the availability of energy, and people's access to energy, at affordable prices in the long term and is not affected by regional and international issues. But there is an important socio-economic aspect of note.

So, energy security will deal with the aspects of: availability, affordability, and price stability. The availability is not only what, where and how it should be produced to fulfill the energy demand, but also how to use energy efficiently. The energy security is also important to analyze the how and what of the affordability for people. What are the indicators of affordability? Should it be in the form of subsidies? How to make the price stable? If the price is too low, it does not encourage investment and innovation. This should be reviewed. From the economic side, price has a big impact. In this case, the role of geothermal as a renewable energy will play a key part in achieving energy security.

## 4. THE ROLE OF GEOTHERMAL DEVELOPMENT AND CHALLENGES

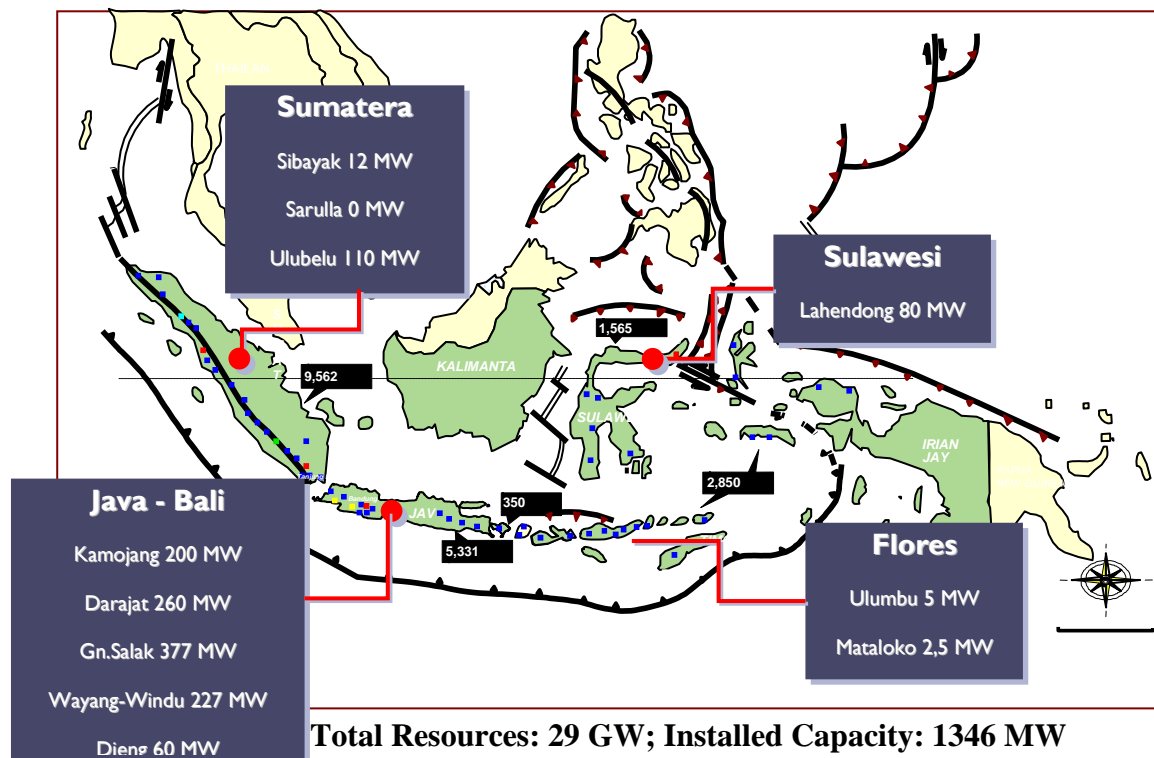
### 4.1. Geothermal potency and its development status

Geothermal power in Indonesia is an increasingly significant source of renewable energy. As a result of its volcanic geology, Indonesia has 40% of the world's potential geothermal resources, estimated at 29,000 MW. Currently Indonesia is the world's third largest geothermal electricity producer after the United States and the Philippines.

At the 2010 World Geothermal Congress in Bali, President Susilo Bambang Yudhoyono announced a plan to build 44 new geothermal plants by 2014, more than tripling capacity to 4,000 MW. By 2025, Indonesia aims to produce more than 9,500 MW of geothermal power, becoming the world's leading geothermal energy producer. This would account for 5% of Indonesia's total energy needs. The utilization of such energy should be potentially improved in order to reach more than 3-4% of today's position in the energy mix, in particular for satisfying the supply of energy to remote areas.

Today, a total of 1346 MW power generation from geothermal energy has been developed as of 2013 (**Figure 4**). It has increased about 159 MW from its installed capacity of 1187 MW in 2009. Currently operating plants are Darajat (260 MW), Dieng (60 MW), Kamojang (200 MW), Gunung Salak (377 MW), Sibayak (12 MW), Lahendong (80 MW), Wayang Windu (227 MW), Ulumbu (5 MW), Mataloko (2.5 MW) and Patuha (60 MW).

The development of geothermal energy in Indonesia has undergone its ups and downs owing to the lack of consistent legal basis, security for the operators that might increase the risks in their investment, and aggravated by the economic crisis that affected the commercial aspect. It is worth noting that the recent political and structural changes in Indonesia have created a business environment that is more conducive than ever before to convincing the stakeholders regarding the value of restructuring the energy sector in support of the national economy.



**Figure 4: Location map of Indonesian geothermal resources and its installed capacity.**

#### 4.2. Government Regulation

The government has tried to promote development of renewable resources but with little success. The government's general policy through Government Regulation No.5 Year 2006 for National Energy Policy (NEP) has clearly advocated diversification of energy sources to increase the use of geothermal to at least 5% of the national energy mix by 2025. This means that 9500 MW of national electricity in 2025 would be supplied by geothermal power plants. But no commitment to implement this policy has been forthcoming (due to the fact PLN as single buyer is not an enforcement of law).

Statistics from the Ministry of Energy and Mineral resources (MEMR) indicate that renewable energy utilization (hydropower and geothermal) accounts for only about 3% of total reserves. The growth of electricity demand has not been enough to drive renewable energy development. Despite the Energy Law No.30 Year 2007 declared to prioritize the use of renewable energy, in fact that the portion and progress of development is still slow.

For geothermal, in order to enhance the role of geothermal in energy use, geothermal law and its implementation regulation have been established since 2003. This Law regulates the upstream business of geothermal. This regulation provides certainty of law to the industry because the huge potentials of Indonesia's geothermal resources and their vital role in ensuring Indonesia's strategic security of energy supply, and their ability to add value as an alternative energy to the fossil fuel for domestic use. The formed process of the geothermal law is aimed at removing any obstructions that will make the competition in this sector more challenging and rewarding. For example, new opportunities for investments will emerge in the geothermal energy sector, underlying vast opening in the upstream activities and the release of the downstream sides to the private sector.

The Indonesian Government is fully aware that operators in the energy sector are largely dominated by global and multinational companies, which will not only consider good business prospects when investing, but also the support of a more reliable and stable Government, and better security and certainty of law.

However, there is no significant progress in projects planned. The major issues are caused by pricing of the energy sold, PPA negotiation, location of the project in the conservation forest and or national park, government guarantee of the project, obligation of PLN to buy the energy from the project company, lack of human resources, etc.

#### 4.3. The Role of geothermal development in Indonesia

Indonesia has the world-greatest potential geothermal, i.e. approximately 40% of the world's reserve or around 29 GWe or 13 billion barrels of equivalent oil for 30 years from geothermal resources of high temperature type. Investment in geothermal development faces substantial uncertainties and continuing challenges. The advantages that geothermal use might be expected to play in the national energy management are as follows: (a) utilization of geothermal energy as a substitute of oil fuel will reduce oil fuel domestic consumption and thus add value through higher export of crude oil and other fossil fuels; (b) geothermal energy utilization is site-specific, can only be used within its discovery area, either for direct usage or indirect usage for generating electricity; (c) the upstream geothermal energy business undertakings are similar to the upstream oil and gas business: capital and technology intensive with high risk; and (d) geothermal reserves can be found in certain remote areas that are far from oil fuel supply facilities, so their utilization could give positive impact to remote area development.

To fulfill the current shortage in electricity supply while anticipating the growing electricity demand and considering reducing use of fossil fuel and greenhouse gas emission, development of new and renewable energy must be accelerated and fully supported by all the stakeholders involved. The National Energy Council (DEN) has made projections of the development of energy including renewable energy. DEN projections for all renewable energy is as follows: 1052 MW (2007), 1260 MW (2010), 4156 MW (2014), 7788 MW (2020) and 12,332 MW (2025). Geothermal will play an important role in the national energy security. Geothermal energy contributes the second greatest portion of renewable energy of 23% of the national energy needs after the supply from hydro power.

However, geothermal development in Indonesia is running very slowly, very far from the target that has been instituted by the Government (12,332 MW by year 2025). Since the Asian financial crisis of 1998 to 2012 there was no significant increase in exploration at all "green field" or exploration in new working areas in Indonesia. Additions that are not large have only happened in the area of work such as the expansion of existing geothermal developments.

Following the issuance of Geothermal Law No.27 of year 2003, regulatory implementation of new exploration areas is also very slow. Until the end of 2013, there is only one private company and PGE to explore new areas. This condition caused the GOI and PLN to agree to speed up development of the electricity sector. Two crash program projects of 10,000MW accelerated development of power plant have been set up that includes the development of approximately 4,000 MW of geothermal power plants in 2014.

The first fast track program of 10,000MW is dominated by coal-fired plant, in which only 10 projects were under construction, 37 projects were in the financing step (out of 76 IPP projects).

The second fast track program is dominated by renewable energy, mainly consisting of geothermal. In this case, the realization is also very slow. From this target only 159 MW has been achieved.

The industry has identified high prices, high capital costs, mining risk, long payback periods for investment, financing mechanisms, a lack of market opportunities, insufficient law and regulation, and regional autonomy as major issues impeding geothermal development.

#### 4.3.1. Geothermal Business Process

The permit is granted to the company upon winning the tendering process to conduct economic activities for exploring and exploiting geothermal energy in a specific working area. Government or Regional Government, depending on the coverage area of geothermal prospect, can issue the permit, namely IUP, whether it covers more than one region, and the utilization of the geothermal resources. The geothermal business activities have been defined clearly in the Government Regulation (GR) No.59 Year 2007 and GR No.70 Year 2010 and in the draft of Ministry Regulation.

#### 4.3.2. Price of energy

The pricing of energy and steam is the main obstacle to the development of geothermal energy in Indonesia. The price needs to be competitive with other energy alternatives, and at the same time offer the contractor or producer an attractive rate of return. The price of the energy is stipulated in Minister Energy Regulation No.14/2008 as revised by regulation No.5 year 2009, with further revision by regulation no.2/2011 and No.22/2012. Now, the World Bank has proposed a new approach to geothermal energy price. The new study from the World Bank (2014) indicates that the price of geothermal energy will vary from 11 to 29 cents/kWh based on avoiding cost of coal and depending on the region of electricity use. The price is also dependent on the year of commission from 2014 to 2025.

#### **4.4. Power sector and geothermal development challenges**

The Government seriously supports decreasing the use of fuel oil by replacement with coal or renewable energy. Since 2006, government issued a regulation to allow support to develop 10,000MW crash program coal power plants. Thus, the use of renewable energy is expected to become 23% in 2025. Therefore, the utilization of geothermal energy needs to have high priority in the national energy policy for sustainability development. In addition, the participation of the private sectors to develop power plant is highly supported by government instead of PLN.

The main challenges of power sector and geothermal use are:

- a. The energy sources are located outside of Java Island in which the highest demand of energy in the country is found, which implies the need to build some additional infrastructure for electricity.
- b. Electricity tariff is not represented as an economic viability due to the subsidy policy
- c. Almost 40% of population is outside of the Java Island which is uneconomic energy supply market.
- d. Affordability of energy to the people is low.
- e. The transmission grid is still unsolicited.
- f. Renewable energy price is uncompetitive with other sources of energy.
- g. Geothermal energy business is different from other energy business in that it should be managed as an integrated business from the upstream to the downstream.

- h. To attract this high risk investment and produce usable energy at affordable price, certain incentive programs based on law, including tax facilities, are required.
- i. To be competitive with non-renewable fossil energy in the electrical power market, the geothermal business competition should be based on its "level playing field".
- j. New regulation allows for a preferred treatment in developing renewable energy projects, such as Ceiling Price.
- k. Improving and harmonizing regulations in the geothermal business.
- l. Fiscal incentive for geothermal developments

#### **4.5. Problems and Solutions of Geothermal Development**

It is quite apparent that the geothermal resources in Indonesia have been underdeveloped and neglected in spite of their huge potential. Our hydrocarbon resources, although quite substantial, are no longer abundant, and there is a limit to the amount of coal that we can burn. Therefore, geothermal energy has become more attractive as an important source of energy for the first decade of this century. Accordingly, we have drawn up plans to further develop these resources, and to develop them quickly.

The energy business has always been and will always remain capital-intensive. The energy business is always associated with high risk anywhere in the world. The economics of resources development is therefore playing a decisive role. Geothermal development in Indonesia is no exception to the rule. As a result of the relatively remote locations and the applicable technology, geothermal steam as an energy resource at the present is relatively more expensive than other sources of energy available in Indonesia. We are currently in the process of improving the economics of geothermal development in order to enable geothermal power to compete with other sources of domestic energy. From the economic side, government has been gradually increasing electricity price and lifting oil subsidies to become market price. Furthermore, the Government Regulation No.5/2006 states that it gives a priority to renewable energy sources including geothermal to fulfill the domestic electricity demand. It is an obligation to the electricity company to use at least 5% of its production from renewable energy sources.

A number of groundbreaking PPA's have been signed that are very likely to allow the projects to reach financial closure on the project financing basis. The Government of Indonesia is starting to establish a method to provide lenders and equity holders with sufficient comfort. Meanwhile, the improvement of the country rating for Indonesia will allow even more funds to invest in Indonesia.

To accelerate geothermal energy development, the overall economic incentives system needs to be improved, which includes further reforming energy prices so that they reflect true market prices. Geothermal energy prices should be bankable to improve its access to fund and consider project risk, which will be different in each location.

Reducing exploration and other early stage development risks should be achieved by improving completeness and reliability of exploration data and implementing risk-mitigation measures.

Government also should stimulate commercial financial institutions to support renewable energy including geothermal and also formulate financial instruments that can reduce resource risk and accelerate Indonesia's geothermal energy development.

In an effort to accelerate geothermal development, the government has proposed to amend the Geothermal Law and revise the pricing of geothermal energy through the new regulation from Ministry of Energy. This new regulation will mandate PLN to buy the energy produced from awarded tender of geothermal working areas. A standard of the PPA has been issued before the tender to convince the investor by having the PPA at a maximum of 6 month after the issuance of the geothermal business permit. This effort is expected to invite more private participation, instead of just PGE, the national geothermal company. To develop 4000 MW within the next five years requires about 15 Billion USD to install the power plants. There are about 48 existing and new geothermal areas in total that are now available to develop. The role of geothermal in supporting the national energy security is very challenging. Investment opportunities in the indicated main businesses mentioned above are very high due to government's limited funds. In addition, opportunities in the field of supporting related business such as engineering, testing and other services are also open.

#### **5. CONCLUSIONS**

In conclusion, we expect geothermal, being a renewable energy resource, to become a significant contributor to the country's energy and livelihood sector for the future. The new Indonesia Energy Policy encourages the role of geothermal development in sustainable energy development and in securing the energy needs of the nation. We look forward to a fruitful cooperation on technology transfer and information exchange on exploration, production and development of geothermal energy.

#### **6. ACKNOWLEDGMENT**

The authors wish to thank the Ministry of Energy and Mineral Resources of Republic of Indonesia, and National Research Council of Indonesia for their permissions to publish the paper.

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