

## Geothermal Deregulation and Energy Policy in Indonesia

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### ABSTRACT

Indonesia is located between the eastern end of Mediterranean Volcanic Belt and western side of Circum Pacific Volcanic Belt, and is blessed with abundant geothermal resources. Trial calculations indicate that forty percent (equivalence of approximately 27 GWe) of geothermal energy in the earth's crust is released in the Indonesian archipelago and neighboring areas, which puts the country as the biggest geothermal energy potential in the world. Today, 807 MW Power Plant from geothermal energy have been developed. The developed geothermal locations are distributed in 7 areas: Kamojang, Darajat, Wayang Windu and Salak in West Java; Dieng in Central Java; Sibayak in North Sumatera and Lahendong in North Sulawesi. It is quite apparent that the geothermal resources in Indonesia have been underdeveloped and neglected in spite of their huge potential.

The growth rate of geothermal development for electricity in Indonesia was relatively slow until the world oil crisis in 1971. Since then the government stresses on a guideline for energy policy, namely intensification on survey and exploration of energy resources including geothermal and coal; diversification of energy by means of reducing on oil depending utilization and promoting through development utilization and customary use of substitute fuel. For geothermal, the government started to issue the President Decree No.16/1974, President Decree No.22/1981, President Decree No.23/1981, President Decree No. 45 in 1991 and President Decree No.49/1991. These decrees appointed the Pertamina, National Oil Company, to conduct exploration and exploitation and to utilized the steam into energy. The decree also introduced a total project that passes through a system. During this period, private sectors have signed 12 contract areas that are mostly big scale geothermal development and are committed to develop and utilize geothermal energy by 3800 MW electric.

Monetary crisis that occurred in mid of 1997 significantly impacted Indonesia economy. Independent Power Producer (IPP) model, that offers a relatively high electricity price and ,thus, giving the private sector high returns, must be reformed. It caused the slow down of geothermal business. To speed up geothermal development, President Decree No. 76 was introduced in 2000. This regulation, however, was unable to invite investors to the geothermal development mainly because Indonesia was still in economic recovery stage at that time.

Recently, the government declared a new Geothermal Law No 27/2003. This Law mainly deregulates the right of

regional autonomy, fiscal reform, sanctity of existing contract, and introduces the transparency process and level of playing field, and regulates the geothermal steam field license. The supporting regulation shows that the government will explore and drill two or three exploration wells, and probably an additional production well in order to have a significant impact on the price. It will take over steam field development risk. Tendering by the government will bring in fair competition. The improvement in efficiency, sustainability and productivity should be performed through technology improvement and optimal utilization. Transparency is one of the new government roles promoted to eliminate anti-competitive practices.

On the other hand, government also deregulated on the down stream sector of energy by declaring the Electricity Law No.22/2002 as a substitute of Law No.15/1985. This law introduced multi buyer and multi seller of electric power generation and distribution, and prioritized the renewable energy especially for the domestic needs. This can bring in a fair competition and improve the efficiency in electricity sector. However, in order to synchronize these two laws, and its workable for the geothermal development, supporting regulation is needed on the behalf of the government.

Since the oil reserve is decreasing, Indonesia needs to balance the energy mix benefits with the clean geothermal energy. The use of renewable geothermal energy would eliminate the dependency on a single source of fossil fuels for the generation of electricity and meet Indonesia's growing energy demand. Therefore, the investment opportunity is present and stands to benefit from developing its abundant and indigenous geothermal resources in order to provide for the country's domestic needs. This geothermal energy of choice will obviously enable Indonesia to export its more portable fuels for much-needed hard currency.

Currently, the government and the parliament are preparing an Energy Law following the 2003 National Energy Policy. This law will regulate the use of energy resources in Indonesia

### 1. INTRODUCTION.

Indonesia is made up of more than 17,000 islands with the population of 210 millions. It is distributed in 62,916 villages. Located between the eastern end of Mediterranean Volcanic Belt and western side of Circum Pacific Volcanic Belt, this country is blessed with abundant geothermal resources. Trial calculations indicate that forty percent (equivalence of approximately 27,189 MWe  $\approx$  11 Billion BOE) of geothermal energy in the earth's crust is released

in the Indonesian archipelago and neighboring areas, which makes this country the biggest geothermal energy potential in the world. This country needs to balance the energy mix benefits, which come from the clean geothermal energy. The use of renewable geothermal energy would eliminate the dependency on a single source of fossil fuels for generation of electricity and would meet Indonesia's growing energy demand. Therefore, there is a possibility for investment opportunity, which will benefit from developing its abundant and indigenous geothermal resources in order to provide for the country's domestic needs. This choice of geothermal energy will obviously enable Indonesia to export its more portable fuels for much-needed hard currency.

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

This paper presents current geothermal deregulation, outlines the resulting geothermal policies of geothermal resources and overviews the energy policy of Indonesia.

## 2. GEOTHERMAL RESOURCES AND THEIR DEVELOPMENT.

Most of the 170 Regions of Indonesia have high temperature geothermal resources, and 21 areas of high temperature geothermal systems with electricity-generating capabilities exist and are being developed. These 21 areas are:

- SIBAYAK, SALAK, WAYANG WINDU, KAMOJANG, DARAJAT, LAHENDONG, and DIENG, which has seven high temperature systems. These are used for electricity generation of 807 MWe operated by PERTAMINA - a state owned oil company, own or with its contractors.
- SARULA, SUNGAIPENUH, HULULAI-SAMBANG SAWAH, LUMUT BALAI, ULU BELU, KAWAH CIBUNI, PATUHA, KARAH, IYANG-ARGOPURO, BEDUGUL, and KOTAMOBAGU, which has eleven high temperature systems, non of which are used for electricity, and currently are under developing by PERTAMINA own or with its contractors for electricity generation.
- TULEHU, MATALOKO, and ULUMBU, which has three high temperature systems outside of Pertamina Geothermal Energy activities, are operated by PLN, National Electricity Company. .

All the high temperature systems are found within the Sumatra, Java, Sulawesi, and Eastern Island Volcanic Zone, which lies over an active subduction zone between the eastern end of Mediterranean Volcanic Belt and western side of Circum Pacific Volcanic Belt (**figure 1**). The plan is to develop electricity generation for 2000 MW by the year 2010, for 4600 MW by 2016, and 6000 MW by the year 2020 (target).

## 3. ENERGY SUPPLY AND DEMAND IN INDONESIA

### 3.1. Energy Supply

Energy supply comes from two sources of energy: fossil energy (oil, natural gas and coal) and renewable energy such as biomass, hydro power and geothermal. However the energy supply mostly comes from fossil energy. In the year 2002, the contribution of fossil energy to the total energy mix was around 709,825.9 BOE (94.8%), which consisted of oil 392,114.4 BOE (52.2%), natural gas 169,892.7 BOE

(22.6%) and coal 147,788.8 BOE (19.7%). The contribution of renewable energy was 41,638.9 BOE (5.6%) which mostly came from hydro power plant 29,843.8 BOE (4.0%) and geothermal 11,795.1 BOE (1.6%).

**Table 1** shows that although the share of oil has gradually decreased, its contribution is still dominant in energy supply. On the other side, the contribution of gas, coal and renewable energy has gradually increased.

### 3.2. Energy demand

Similar to energy supply, the growth demand of energy is also relatively high. During the period 1970-2002, the average growth rate of energy demand was around 7.3% per year. The energy demand by type of energy and users can be seen in **table 2** and **table 3**.

## 4. THE NATIONAL ENERGY POLICY (NEP)

Energy plays an important role in achieving social, economic and environment goals for sustainable development. In most countries including Indonesia, domestic energy demand is met mostly by fossil energy sources, particularly by oil, while the oil reserve is limited. Although contribution of oil has gradually decrease from 87.7% (1969/1970) to 54% (2002), total oil consumption is relatively higher with the growth rate of 6.1% per year followed by natural gas and coal. On the other hand, Indonesia's renewable energy potential is relatively abundant, however, its utilization is still far below its potential.

In addition, during the period of 1990-2002, the average growth of energy demand and supply was about 6% to 7% respectively. This higher growth was particularly due to the economic growth and population growths. However, the per capita energy consumption was relatively low, about 3.37 BOE per capita, while the energy intensity was 3.39 BOE/thousand US\$.

Due to the present energy conditions, government has launched the National Energy Policy (NEP) in order to enable the coordination and synergy of all stakeholders in the energy sector. The vision of the policy is to guarantee the sustainable energy supply in order to support national interest. The missions are: (1) guaranteeing domestic energy supply; (2) improving the added value of energy sources; (3) managing energy ethically and sustainable way and considering preservation of environment function; (4) providing affordable energy for the poor; and (5) developing national capability.

The targets of NEP are: (1) improving the role of energy business toward market mechanism in order to increase added value; (2) achieving electrification ratio of 90% by the year 2020; (3) reaching renewable (non large hydro) energy shares in energy mix of at least 5% by 2020; (4) realizing energy infrastructure, which will maximize 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 making the elasticity to be 1 by 2020; and (7) increasing the local contents and improving the role of national human resources in the energy industries.

To reach the energy targets, strategies have to be taken: (1) restructuring energy sector; (2) implementing market based economy; (3) developing regional empowerment in energy sector; (4) developing energy infrastructures; (5) improving energy efficiency; (6) improving the role of national energy

industry; (7) improving national energy supporting activities (services and industries); and (8) empowering community.

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

In line with the strategies, several action plans have to be done: (1) upstream side (oil, gas, coal, geothermal, hydro power, other renewable energy resources, nuclear energy, other new energy resources); (2) downstream side (petroleum, gas pipeline, gas fuel and LPG, electricity); (3) energy utilization (household and commercial sector, industry sector, transportation sector); (4) human resources development; (5) research development; and (6) community development in supplying energy to empower the local society.

The growth rate of geothermal development for electricity in Indonesia was relatively slow until the world oil crisis in 1971. Since then the government stresses on guidelines for national energy policy, namely intensification on survey and exploration of energy resources including geothermal and coal; diversification of energy by means of reducing the oil depending utilization and promoting development utilization and customary use of substitute fuel. For geothermal, the government started to issue the President Decree No.16/1974, President Decree No.22/1981, President Decree No.23/1981, President Decree No. 45 in 1991 and President Decree No.49/1991. These decrees appointed the Pertamina, National Oil Company, to conduct exploration, exploitation and utilization of steam into energy. The decree also introduced a total project that passes through a system. During this period, private sectors have signed 12 contract areas that are mostly big scale geothermal developments and are committed to develop and utilize geothermal energy by 3800 MW.

The development and utilization of geothermal energy in Indonesia is of the great importance. It is expected to be capable of overcoming the domestic energy problems including those arising from difficult access to the remote areas. It will replace the role of fossil energy, which then can be exported for earning foreign exchange. Secondly, in anticipation of the conditions in Indonesia, where it is going to encounter the ever-increasing need for energy making Indonesia a "net oil importer" nation, endeavors to utilize alternative energy are necessary. Therefore, the utilization of geothermal energy needs to have high priority in the national energy policy.

## 5. INDONESIA GEOTHERMAL LAW

Indonesia has the world-greatest potential geothermal, i.e. approximately 40% of the world's reserve around 20 GWe or 9 billion barrels of equivalent oil for 30 years from successful operations of the potential energy coming from the geothermal resources of high temperature type. The utilization of such energy should be improved in order to reach more than 3-4% of the today's position in the energy mix, in particular for satisfying the supply of energy to the remote areas. 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 affects 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. Furthermore, the implementation of the Indonesian regional autonomy starting January 1, 2001 gave impetus to various energy projects that contribute to regional development.

The issue of commitment and clarity of the Indonesian Government's vision, and the efforts to introduce law reforms for creating a healthy and competitive investment conditions will be an important aspects for discussion in the developing of geothermal industry. The objective condition that has recently been developing indicates the presence of chances for the resurgence of geothermal business in Indonesia. The efforts the Government is making to gradually decrease the subsidy in Oil Fuel and Electricity would make geothermal energy to be competitive against diesel-powered electricity generating stations. The Indonesian Government is fully aware that operators in the energy sector are largely dominated by global and multinational companies, which will not consider good business prospects when investing and support more reliable and stable Government, better security and certainty of law.

In order to support this effort, the legal basis required for geothermal exploitation. Utilization needs to be strengthened with Geothermal Law. The House together with geothermal stakeholders initiated a discussion on the preparation and the draft making of a Geothermal Bill. Fortunately, the initiation of strengthening the legal basis for the exploitation and utilization of geothermal was beginning to appear with the approval of the Geothermal Law since 23 of October 2003.

The formed process of 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 private sector. This is also true in oil/gas and coal mining as well as electricity business.

Academic, education, and comparative geothermal development study brought insights on the national challenges and opportunities in the energy reform that are currently underway in Indonesia.

### 5.1. Do We Need Geothermal Law?

Geothermal Law is need to clarify and answer the conditions such as:

- a. Indonesia has the world largest geothermal potential reserves, yet only 3 - 4% of these reserves have been developed for power generation.
- b. Geothermal energy is a renewable and environmentally clean energy that could substitute depleting fossil energy. Its utilization produces low air emission thereby it is entitled for Clean Development Mechanism.
- c. The 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.

- d. Geothermal energy utilization is side specific, can only be used within its discovery area, either for direct or indirect usage for generating electricity.
- e. The Upstream Geothermal Energy Business undertakings are similar to the upstream oil and gas business: capital and technology intensive with high risk.
- f. Geothermal reserves can be found in certain remote areas that are remote from oil fuel supply facilities; its utilization could give positive impact to remote area development.
- g. Presidential Decrees No. 22/1981 and No. 45/1991 have attracted investment in Geothermal Energy Business for generating electricity amounting to US\$ 1.4 billion for 11 projects prior to the economic and monetary crisis that hit Indonesia in 1997/1998.
- h. No new investment in geothermal business has taken place since the issuance of Presidential Decree No. 76/2000 which substitutes Presidential Decrees No. 21/1984 and No. 45/1991.
- i. Geothermal energy business is different from other energy business whereby it should be managed as an integrated business from upstream to downstream.
- j. To attract this high risk investment and produce usable energy at affordable price certain incentive programs based on law, including tax facilities, are required.
- k. To be competitive with non-renewable fossil energy in the electrical power market, the geothermal business competition should be based on its "level of playing field".
- l. Geothermal Energy is a natural heat energy that is contained in hot water, water vapor, and rocks, together with by-product minerals and other gasses, all of which are genetically inseparable in a Geothermal Energy system. Its utilization requires a mining process.
- m. The geothermal heat and fluid are non-mineral materials. As in the case of crude oil and natural gas which are non-mineral energy resources, it is prudent that geothermal energy business is regulated by its own law to coincide with the implementation of Law No. 22 /1999 and No. 25 /1999.
- n. The final draft of geothermal law, which is the initiative of the Parliament, was approved by the plenary session of the Parliament on 23 September 2003. It became the Geothermal Law starting from 23 of October 2003.

This Law regulates the upstream business of geothermal which consists of 15 Chapters and 44 Articles. The downstream business that engages in electric power generation is subject to prevailing Electric Law No. 20/2002. The 15 Chapters of the Geothermal Law are:

1. General Provisions & Definitions
2. Principles & Objectives
3. Geothermal Energy Mining Right
4. Authority for the Management of Geothermal Energy:
  - a. Authority of the Regional Government
  - b. Authority of the Province
  - c. Authority of the Government
  - d. Authority of Regencies/Cities
5. Work Areas
6. Operational & Business Activities
  - a. Operational Activities
  - b. Business Activities
  - c. Exploration & Exploitation
  - d. Utilization of Byproduct Minerals
7. Land Use
8. Permits
9. Right and Responsibilities of Holders of Geothermal Energy Mining Business Permits
  - a. Right of Holders of GEMB Permits
  - b. Responsibilities of GEMB Permits
10. State Revenues
11. Guidance and Supervision
12. Investigation
13. Criminal Penalties
14. Transitional Provisions
15. Closing Provisions

This regulation provides certainty of the law to the industry because of the huge potentials of Indonesia's geothermal resources and its vital role to ensuring Indonesia's strategic security of energy supply, and its ability to add value as an alternative energy to the fossil fuel for domestic use. In the following paragraphs we present a short note on Vision, Mission, Objective, Mining Right, Operational Activities and Geothermal Business Permit.

## 5.2 Vision

Geothermal Energy plays an important role as a renewable natural resource of choice among the variety of national energy resources. It supports sustainable development and helps to bring about a prosperous society

## 5.3. Mission

The mission is to manage geothermal energy resource development as mandated by the law:

- To encourage and stimulate geothermal energy activities for the sustainable fulfillment that national energy needs.
- To reduce dependence on oil-based fuels, thereby conserving oil reserves

#### 5.4 Objectives

- Control the utilization of Geothermal Energy business activities in order to support sustainable development and provide overall added value
- Increase revenues for the State and the public in order to support national economy growth for the sake of increased public prosperity and welfare

#### 5.5 Mining Right

The government of Indonesia ("Government") carries out the execution of the mining right. In doing so, the Government may delegate its mining right to the Regional Government depending on the extent of the location of the geothermal reservoirs and the utilization of the resource. If it is contained and utilized within the region, the Regional Government is granted the authority to execute the geothermal mining right.

#### 5.6 Operational and Economic Activities

The Government may conduct exploration activities for gathering data and information on geothermal prospects in order to determine the Geothermal Working Area and to prepare for tendering process of the geothermal economic undertaking. It will take over a steam field development risk, hence; will have significant impact on the price. The regulation shows that the government will explore and drill two or three exploration wells. Tendering by the government will bring in a fair competition. The improvement in efficiency, sustainability and productivity should be performed through technology improvement and optimal utilization. Transparency is one of the new government roles promoted to eliminate anti-competitive practices.

#### 5.7 Geothermal Business Permit

The permit is granted to the company upon winning the tendering process to conduct economic activities for exploring and exploiting geothermal energy in 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, for utilization of the geothermal resources.

#### 5.8 Other Key issues on Geothermal Law

- Maximum acreage of Work Area is 200,000 hectares.
- Return of Work Area in stages or Government Regulation will regulate all.
- Geothermal Business Mining activities may not be conducted in certain areas, including nature reserves, etc. except with prior permission of Government agencies and approval of relevant community/individuals.
- IUP may be transferred to an affiliated Business Entity with prior approval of the respective authority.

- IUPholders have the right to obtain tax facilities in accordance with the provisions of applicable tax laws and regulations.
- IUP holders are obliged to pay state revenues in the form of taxes and Non-Tax State Revenues in accordance with provisions of applicable tax laws and regulations.
- Provisions regarding the types and rates of Non-Tax State Revenues to be stipulated in the Government Regulation.
- All cooperation contracts for Geothermal energy business already in existence before this law became effective are declared to remain in effect until the end of the terms of the contracts

#### 5.9 Related Law and regulation

- 1) 1945 Constitution: Article 5 clause (1) and Article 33 clauses (2) and (3).
- 2) Law No. 20/2002 on Electricity.
- 3) Law No. 23/1987 on Management of the Living Environment.
- 4) Law No. 22/1999 on Regional Government.
- 5) Law No. 25/1999 on Distribution of Financial Wealth between Central and Regional Government.
- 6) Law No. 23/1987 on Environmental Protection.
- 7) Law No. 18/2000 on Taxation.
- 8) Law No. 41/2001 on Protective Zone

The geothermal law stipulates that there shall be at least 5 implementing Government Regulations:

- 1) Article 9 (3) – Provisions regarding guidelines, boundaries, coordinates, area extent, procedures and requirements pertaining to offers, procurements and preparation of tender documents, and implementation of tenders
- 2) Article 10 (6) – Provisions on Direct Use in connection with the utilization of Geothermal Energy
- 3) Article 13 (3) – Provisions regarding the extent of a Work Area that may be retained for the Exploration stage and changes to the extent of an IUP area in each stage of Geothermal Energy Mining Business
- 4) Article 30 (4) – Provisions regarding the types and rates of Non-Tax State Revenues
- 5) Article 33 – Provisions regarding guidance and supervision of work and of the execution of business activities with respect to compliance of applicable laws and regulations

### 6. PROBLEMS AND SOLUTIONS OF GEOTHERMAL DEVELOPMENT

It is only for the last thirty years that geothermal potentials have been explored and developed in Indonesia. Half of these potentials are found on Java and Bali, the most densely populated islands of Indonesia, which are in big need of energy resources. The exploration and development activities are projected to solve the problem of increasing

electrical demand and diversification of energy resources from oil to geothermal.

Today, the geothermal electric capacity has increased from 589 MW in 1998 to approximately 807 MW for the last six years. The developed geothermal locations are distributed in 7 areas: Kamojang, Darajat, Wayang Windu and Salak in West Java; Dieng in Central Java; Sibayak in North Sumatra and Lahendong in North Sulawesi (**Table 4 and Fig. 2**). 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 not 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 fast.

The energy business has always been and will always remain capital intensive. It 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 is presently 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-up oil subsidiary. In addition, the government is willing to share the upstream development risk by implementing various geothermal energy-related projects, including surveys of resources, especially for the remote areas. Furthermore, the Electricity Law No. 20/2002 states that it gives a priority to renewable energy sources including geothermal to fulfill the domestic electricity demand. The obligation of electrical companies is to use at least 5% of its production that comes from renewable energy source.

In an effort to accelerate geothermal development, the government has invited private participation, including foreign interest. Recently eight companies have signed Joint Operation Contract with Pertamina. A Memorandum of Understanding (MOU) between Government of Indonesia (GOI) and the Government of the Philippines on energy was also signed in 2001. It was followed-up by MOU between PERTAMINA and PNOC-EDC. PNOC-EDC is interested in geothermal areas like: Lahendong, Kotamobagu, Tompaso (North Sulawesi) and Ulu Belu in South Sumatra. The MOU was also signed by PERTAMINA and MARUBENI in developing Ulu Belu and Lumut Balai. It is followed by MOU between MARUBENI and PLN in 2003.

We should also draw attention to the sustainability of the older generation of the geothermal power plant in Indonesia, because during the many years of operation, it has taught us valuable lesson. The Kamojang plant, the first geothermal power plant in Indonesia, has been operating steadily for 20 years since 1983. Its reliable operation demonstrates the sustainability and renew ability of geothermal resources, if the rate of production is adequate for the reservoir size.

However, the total geothermal power capacity of 807 MWe shares only 3% of the total domestic installed power plant

capacity. Compared to 2,850 MWe in the USA and almost or about 2000 MWe in the Philippines, it must be noted that the geothermal power capacity in Indonesia still remains at a relatively low level.

Regional autonomy starting January 1, 2001 has give significant impact on district infrastructure development. More industries will expect to grow and consequently more energy is needed. Diversification of fuel is a must to ensure a stable and economically priced electric power.

## 7. FUTURE DEVELOPMENT PLANNING

Up to now, energy is solely evaluated by cost competitiveness; however, this criterion will no longer be meaningful in the 21st century. We must evaluate energy by the cleanness to the global environment. From this viewpoint, geothermal energy can be regarded as one of the excellent energy sources. Cleanness of geothermal power in terms of carbon dioxide emissions ranks is second among various energy sources, following medium to small-scale hydropower. Compared to the present energy composition in terms of cost, geothermal power is the most effective energy for reducing the carbon dioxide emissions.

Economic-driven development has solely dominated in the energy production field. However, to solve the global environmental problems, government commitment development must replace it. From this viewpoint, geothermal power development could play a worldwide role in the global environmental issue, so that future development could be expected not only by market force but also by government commitment.

This year, the Government Regulation on Geothermal Development will declare new law. Accordingly, the Geothermal Blueprint and Road-map of Geothermal Development in Indonesia up until the year of 2020 are now being prepared. In short, medium and long-time planning of these two guidance show that government encourages the geothermal industries to explore and develop geothermal fields of Indonesia. We expect contribution of geothermal power plant will become 2000 MWe in 2008, 3400 MWe in 2012 and 6000 MWe in 2020 respectively (**Table 4**).

## 8. INVESTMENT OPPORTUNITIES.

The Government of Indonesia (GOI) considered not building any new big scale hydro power plants. It is not just because it is season dependent but also requires large area. In addition, tick river sediment causes to shallow many water dams that would force the temporary shutdown of the power generators during the dry season. Consequently, GOI should seek for other energy sources like geothermal to fulfill the rapid increasing demand of electricity in many areas.

There are 8 (eight) promising geothermal areas that can be chosen (**Fig. 3**). These areas including Kamojang, Patuha, Wayangwindu geothermal fields in West Java; Dieng geothermal field in Central Java; Ulubelu, Lumutbalai, Sarula Geothermal fields in Sumatra; and Tompaso geothermal field in North Sulawesi. In Ulubelu and Lumutbalai. Three exploration drillings for each field have been done and the surface as well as sub surface data are available. For other six geothermal fields mentioned above, the steams are already in the wellhead. While, Kamojang, Wayangwindu and Dieng geothermal fields are in the expansion stage.

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 businesses such as engineering, testing and other services are also open.

## 9. ENERGY LAW

Currently, the government and the parliament are preparing an Energy Law following the 2003 National Energy Policy. This law will regulate the optimizing use of energy resources in Indonesia. The Law will ensure the security of energy supply by increasing the utilization of the renewable energy.

## CONCLUSIONS

In conclusion, we expect geothermal, the renewable energy resource, to become a significant contributor to the country's energy and livelihood sector. Considering that the bulk of utilization of this particular energy source is still on high-enthalpy fields, much remains for development. In this respect, we invite the private sector to actively participate in geothermal exploration and development activities in Indonesia.

The new Indonesia Energy Policy, Geothermal Law and geothermal development guidance will give impetus to geothermal projects that contribute to regional development such as off-grid rural electrification and geothermal direct uses for agribusiness.

We look forward to a fruitful cooperation on technology transfer and information exchange on exploration, production and development of geothermal energy.

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## REFERENCES

- INAGA, 2003: Comparative Study of Geothermal Development, New Zealand, API in house report.
- MoE, 2003: Indonesian Geothermal Law No.27 Year 2003.
- MoE, 2003: National Energy Policy, Ministry of Energy and Mineral Resources of Indonesia.
- MoE, 2003: Road Map of Indonesian Geothermal Development year 2004-2020, Ministry of Energy and Mineral Resources of Indonesia.
- Pertamina, 2003, Business Profile "PERTAMINA GEOTHERMAL INDONESIA : Publication of Pertamina Geothermal Division.
- Ibrahim,R.F., Fauzi,A., Suryadarma, 2005, The Progress of Geothermal Resources Activities in Indonesia; in Proceedings World Geothermal Congress, 2005, this volume.
- Fauzi, A., Bahri, S., Akuanbatin, H., 2000, Geothermal development in Indonesia : An overview of industry status and future growth; in Proc. World Geothermal Congress.
- Fauzi, A., 1998, Geothermal development in Indonesia: An overview; Geothermia, Rev de Geoenergia, Vol 14(3), pp. 147-152.
- Pratomo, Y, 2004, National Electricity General Plan – A New Direction of Indonesian Electricity Development, Ministry of Energy and Mineral Resources of Indonesia, Jakarta.
- Purwono, J, 2003: Energy Restructuring in order to increase the investment of Energy Sector.

**Table 1**Energy supply in Indonesia (In a thousand BOE)

Year	Oil (avg.)	%	Natural gas (avg.)	%	Coal (avg.)	%	Hydro (avg.)	%	Geothermal (avg.)	%	Total
1969-1973	54,323.9	88.8	3,226.5	5.4	723.2	1.2	2,745.7	4.5	-	-	61,019.2
1974-1978	101,560.3	87.7	10,420.4	8.3	714.1	0.6	3,752.4	3.4	-	-	116,447.2
1979-1983	158,424.5	78.5	35,269.2	17.4	989.1	0.5	7,195.4	3.5	280.4	0.1	202,158.8
1984-1988	175,638.7	65.8	60,993.4	22.8	11,165.1	4.0	18,977.2	7.1	960.8	0.3	267,735.2
1989-1993	244,080.6	64.1	81,330.0	21.4	29,389.7	7.7	23,603.8	6.2	2,136.9	0.6	380,541.0
1994-1997	293,959.2	59.2	127,550.2	26.9	40,511.4	8.3	24,383.2	4.8	3,906.6	0.8	517,753.1
1998-2002	368,885.5	55.8	162,574.6	24.6	94,879.1	13.9	27,444.2	4.2	9,541.2	1.4	663,324.6

**Table 2**Energy demand by type of energy in Indonesia (In a thousand BOE)

Year	Oil fuel (avg.)	%	N. Gas (avg.)	%	Coal (avg.)	%	Electricity (avg.)	%	LPG (Avg.)	%	Total
1969-1973	45,154.2	94.7	520.3	1.1	504.3	1.1	1,434.7	3.0	39.5	0.1	47,653.0
1974-1978	85,309.6	93.3	3,304.8	3.6	467.8	0.5	2,313.7	2.5	297.2	0.3	91,693.1
1979-1983	132,598.5	87.5	11,838.4	7.8	791.0	0.5	5,761.0	3.8	610.4	0.4	151,599.3
1984-1988	137,784.9	78.8	19,410.1	11.1	4,354.4	2.5	11,887.0	6.8	1,594	0.9	175,030.9
1989-1993	190,555.2	76.0	23,937.1	9.5	11,218.8	4.5	21,855.8	8.7	3,234	1.3	250,801.6
1994-1997	245,458.7	74.3	31,752.5	9.7	15,435.6	4.7	31,204.0	9.6	5,420	1.7	348,888.7
1998-2002	309,447.5	71.9	38,890.1	9.0	27,889.2	6.5	46,277.9	10.7	8,458	2.0	430,963.5

**Table 3**Energy demand by sector of energy in Indonesia for year 2001(In a thousand BOE)

	Industry	%	Household	%	Transportation	%	Total
Oil fuel	81,158.7	25.5	72,851.7	22.9	163,746.3	51.5	317,756.7
Natural gas	44,881.6	97.5	871.2	1.9	297.7	0.7	46,050.5
Coal	35,972.8	99.7	124.8	0.3	0.0	0.0	36,097.6
Electricity	22,860.4	25.5	21,051.1	74.4	0.0	0.1	43,911.5
LPG	2,507.9	52.1	73,15.8	47.9	6.9	0.0	9,830.6
Total	187,381.4	41.3	102,214.6	22.5	164,050.9	36.2	453,646.9

**Table 4.** Geothermal Working Areas and Development Planning

No.	Geothermal Field	Developer	Production (2004)	Development Planning Up to 2008	Development Planning Up to 2012
1	Sibayak *	Pertamina	2	10	40
2	Sibual-Buali (Sarula)*	PLN		220	220
3	Sungaipenuh*	Pertamina			55
4	Hululais-Tambang Sawah*	Pertamina			55
5	Lumut Balai*	Pertamina		110	110
6	Waypanas (Ulu Belu)*	Pertamina		110	110
7	Cibeureum-Parabakti* (Salak)	Unocal	330	0	110
8	Pangalengan* - Kawah Cibuni - Gunung Patuha - Wayang Windu	Yala Teknosa Geodipa MNL	110	10 120 110	0 60 110
9	Kamojang-Darajat* - Kamojang - Darajat	Pertamina Amoseas	140 145	60 110	60 75
10	Karaha, Cakrabuana*	KBC		55	55
11	Dtt. Dieng*	Geodipa	60	120	60
12	Iyang, Argopuro*	Pertamina			55
13	Tabanan, Bali (Bedugul)*	Bali Energy		10	110
14	Lahendong*	Pertamina	20	60	40
15	Kotamobagu*	Pertamina			60
16	Tulehu	PLN			16
17	Mataloko	PLN		2	6
18	Ulumbu	PLN		6	0
<b>Total</b>			<b>807</b>	<b>1193</b>	<b>1442</b>

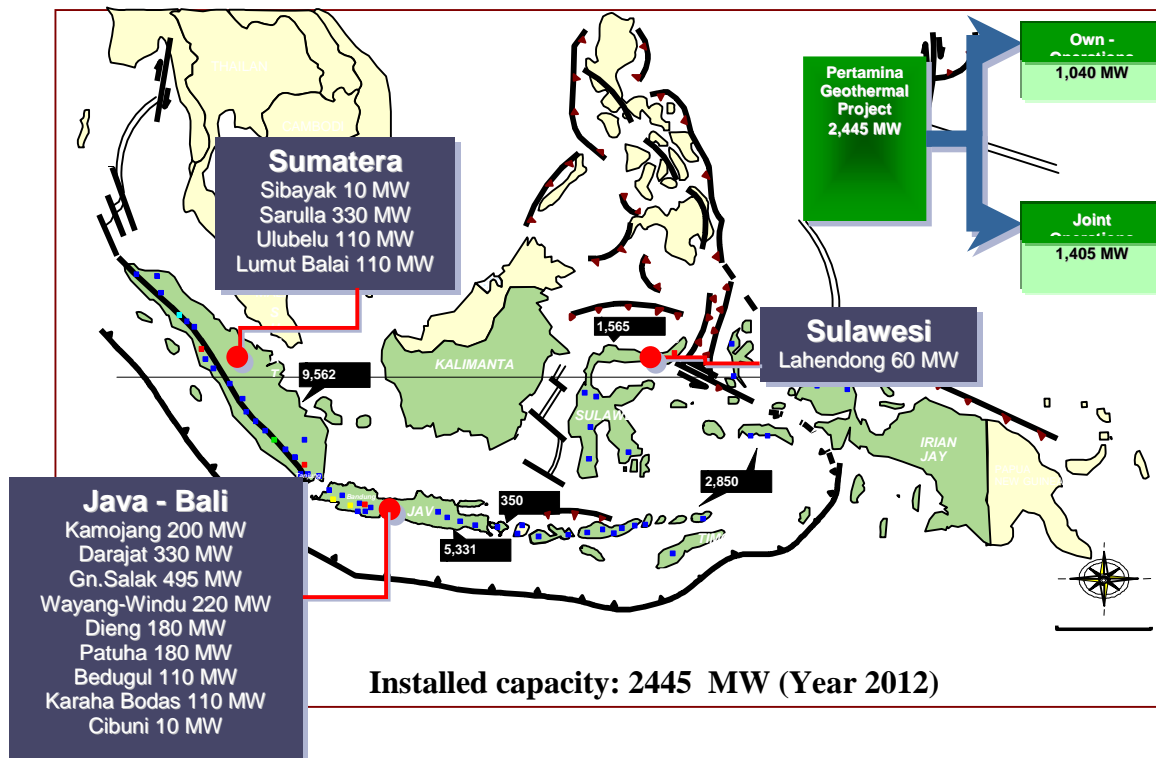


Figure.1: Location map of Indonesian Geothermal Resources and its development

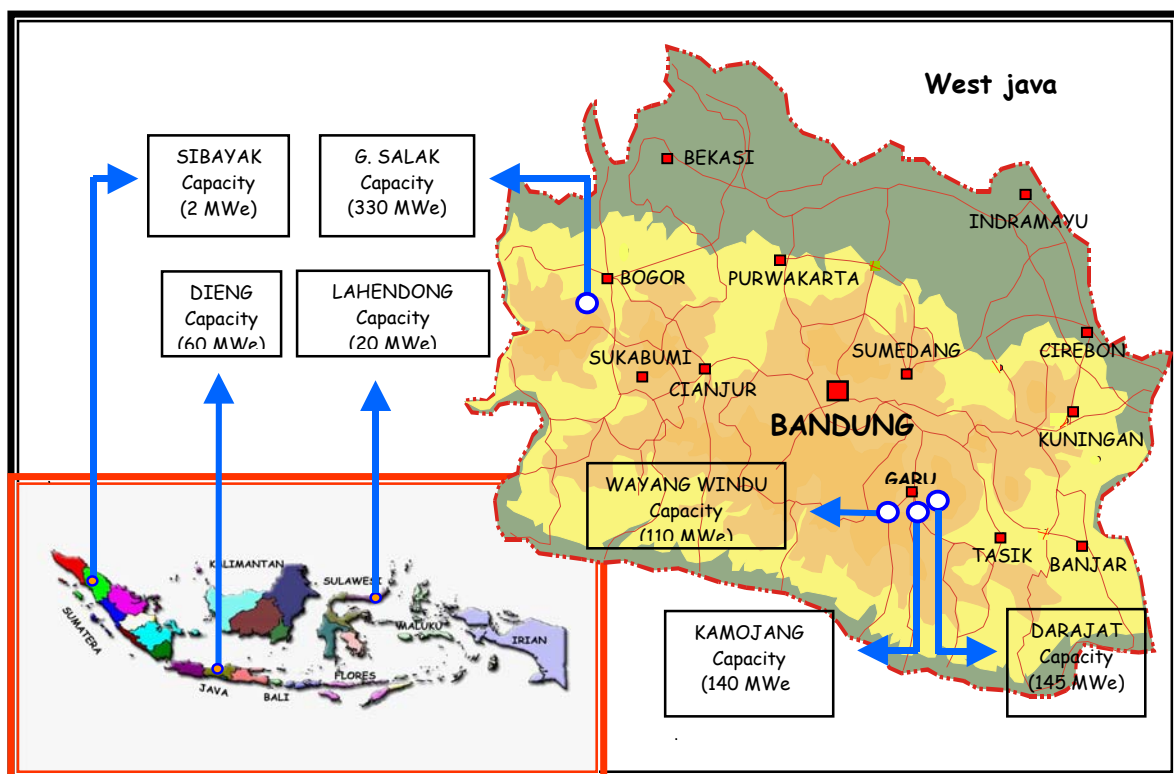


Figure 2. Geothermal installed capacity.

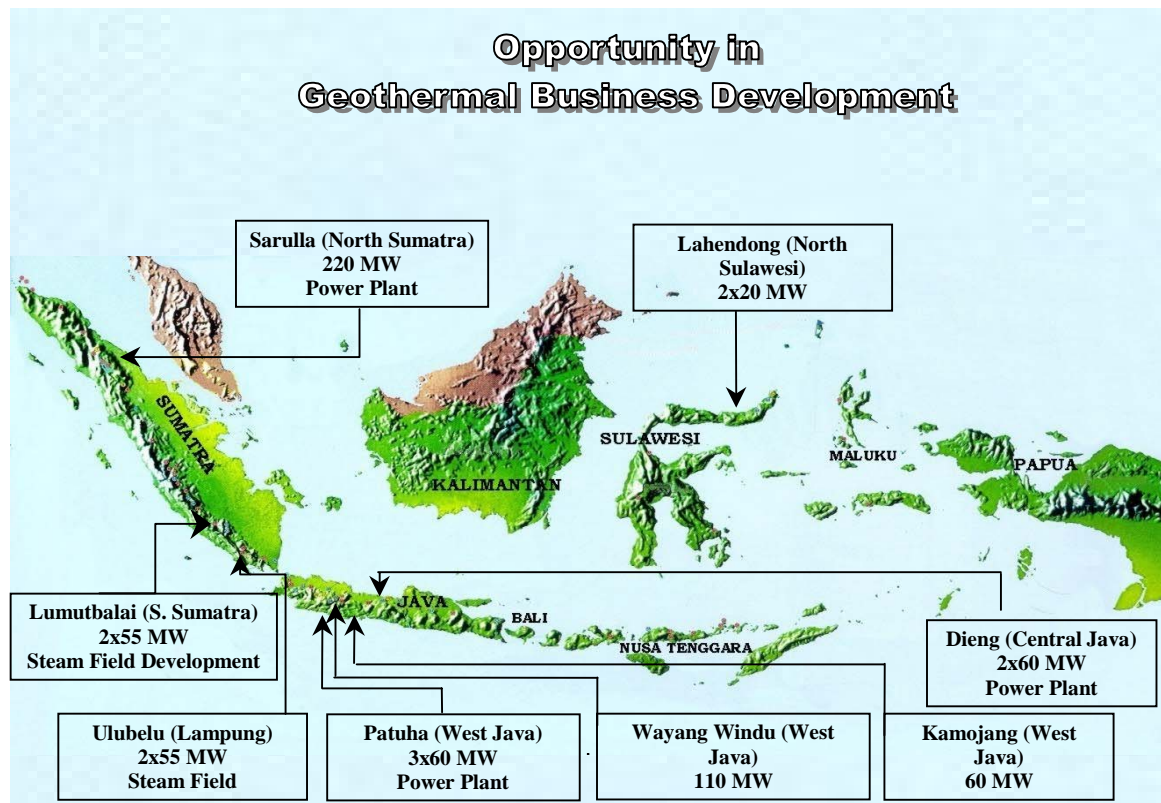


Figure 3. Investment Opportunity in the power sector