THE GEOTHERMAL ENERGY POLICY PERSPECTIVE: CASE STUDIES AND FUTURE DEVELOPMENT IN INDONESIA

I.A. TAKHYAN

PERTAMINA Corporate Senior Vice President, Upstream, Jakarta, Indonesia

SUMMARY –With Indonesia's abundant geothermal resources, and being renewable and environmentally ftiendly, geothermal energy could contribute significantly to the Government's energy diversification policy. Government policies and economic situation have strongly determined geothermal development in Indonesia. Before economic turmoil hit the country in 1997, around 15 geothermal projects with a total contract capacity of 3,500 MWe were in various stages of rapid development, and the future seemed to be promising. The majority of these projects were then postponed, and development has not advanced significantly due in large part to depreciation of the Indonesian currency. As the Government's subsidy on fossil fuel consumption has been reduced recently, geothermal energy has now become more competitive compared to other energy sources with regard to the optimisation of the available energy resources in the most cost effective and productive manner. Constructing a strong legal base for taxes and economic incentives for geothermal developers as well as promoting development schemes based on the best engineering practice will enhance future development. Small scale modular or staged development is suitable to meet the demand in off-grid rural areas in Indonesia for the future development.

1. INTRODUCTION

Possessing potential geothermal energy of about 20,000 MW, or 40% of the world's resources, Indonesia may well be the nation with the largest geothermal potential in the world. However, utilization of the potential geothermal energy is still far from optimal. For electricity generation, the installed geothermal capacity was only 789.5 MWe by August 2001 (Table 1). This contributes only 2.7% of Indonesia's total energy mix. The rest of the energy *mix* is still dominated by fossil fuels.

Despite its enormous geothermal energy potential, Indonesia seems slow to harness it. Geothermal energy has to compete with the other energy sources such as hydro and fossil fuels. The price of geothermal energy in Indonesia is relatively high compared with the price of energy produced by hydro and fossil fuels. The Government's price subsidy policy on petroleum products, especially for IDO (Industrial Diesel Oil) has made the development of geothennal energy even harder. These facts show that government policies in the energy sector play an important role for geothermal energy development in Indonesia.

When the subsidy for Industrial Diesel Oil was reduced in June 2001, the price of diesel oil rose, and consequently so too did the cost of electricity produced using the diesel oil ($/kW). The reduction of diesel oil subsidy will certainly enhance the competitiveness of geothermal energy. This paper discusses opportunities for geothermal energy in the Indonesian energy policy perspective, based on the latest conditions.

2. SUPPLY AND DEMAND

Two major factors influencing energy demand are population and economic growth. The economic turmoil that hit Indonesia in 1997 has affected economic growth very badly. However, as a country with a population exceeding 200 million people, the demand for electricity has still grown about 10% per year for the last three years. As a result., new power plants need to be built to meet the demand. Without new power plants, an energy crisis could occur. As reported recently, 24 regions outside Java have already suffered rolling blackouts. 11 of these regions possess geothermal resources.

Java Island as the center of economic activities is also heading towards a similar problem. Assuming electricity growth of only 9% per year with no additional power supply ftom new power plants, the generating capacity will be in danger of not being able to meet demand by the year 2003. At this point of time, the reserve of supply (the difference between the total installed capacity and the peak load) will only be about 22%. Whereas, the safe supply reserve margin is 30%. When higher electricity growth is assumed, the danger point will happen sooner (Table 2). To date, it is also reported that about 4 million consumers are on waiting lists to get electricity connected to their homes. As a result, investment in new power plants is needed urgently. However, investment in new power

plants is difficult for the Indonesian National Electric Company (PLN) at this point of time. Consequently, the threat of an electricity crisis is just around the comer.

Since the economic turmoil in 1997, PLN has suffered major losses due to depreciation of the Indonesian Rupiah. It should be noted that PLN buys electricity ftom Independent Power Producers (IPPs) using American dollars (US$) and sells it to consumers using the Indonesian Rupiah (Rp.). As an illustration, the exchange in 1997 for US$ 1 was about Rp. 2,500 but dropped until recently now to a level of Rp. 10,000. This has caused a great impact on the national economy including the power industry. If the average production or purchase cost per kWh is US$ 0.05, so the Rupiah cost to PLN has more than trebled (from Rp.125 to Rp.440), while the selling price to the consumers has remained at the average level of Rp.223 per kWh.

Table 1. Installed capacity of geothermal power plant in Indonesia. PERTAMINA 2001.

Field	In Operation (MW)	Idle (MW)
Kamojang	140	-
Sibayak	2	-
Lahendong	20	-
Gunung Salak	330	-
Darajat	125	-
Dieng	-	60
Wayang Windu	110	-
Total	727	60

In terms of US dollar currency, the electricity price has been almost the same before and after the economic turmoil. Before the turmoil, the exchange rate for US$ 1 was about Rp.2,500 and the selling price for the electricity was Rp.175/kWh. So, it was USD 7 cents/kWh. Currently, when USD 1 equals Rp.10,000 the selling price of US$ 7 cents/kWh becomes Rp700/kWh, 4 times higher than before. Certainly, it is beyond peoples' capability to afford it in the economic crisis situation.

To raise the price of electricity is another problem for PLN. In order to raise the electricity price, PLN has to get approval from Parliament. For social reasons or in terms of political support, such approval will be an unpopular policy. It will be a burden on people and possibly trigger chaos or civil unrest. However, a raise of 17.47% on electricity price could not be avoided to keep PLN away from further loss. The raise has gone into effect since July 2001.

A scheme to gradually raise the price up to US$0.07 per kWh by the year 2005 is also being proposed. The increase will come into effect every three months starting in 2002. At this stage, the electricity price in Indonesia will no longer be the cheapest among the South East Asia countries.

Regardless of the complexity of electricity pricing, investment in new power plants is urgently needed to increase the electricity supply to meet the demand.

3. GEOTHERMAL ENERGY

Given an abundant potential geothermal energy resource, it could be one of the important energy resources in Indonesia, as it is regarded as renewable and environmentally friendly. Moreover, it is non-exportable, and hence a suitable domestic energy source and a substitute for fossil fuel energy sources. Replacement of fossil fuels will reduce domestic fbel consumption. Government revenue from oil sectors will increase as oil export increases. Government expense will be less as subsidy on IDO to generate electricity is reduced. In terms of government policy, geothermal energy utilisation will enhance an energy diversification policy.

Latest development progress of geothermal energy in Indonesia was reviewed by Sudarman et al (2000). By August 2001, installed capacity of geothermal power plants was 787 MWe fkom which 727 MWe was in production. This production figure was only 45% of the target set in 1995. By the year 2005, it is expected that the generation capacity will be 1,907.5 MWe. Fauzi et al (2000) overviewed the industrial status of geothermal development in Indonesia. Many geothermal developments in various stages have been postponed by Presidential Decree No. 5/1998 due to the economic turmoil that hit Indonesia since 1997.

The cancellation of Dieng and Patuha geothermal power plants has resulted in the Indonesia government being required to pay a US$260 million claim by OPIC (the US Overseas Private Investment Corporation). The cancellation of the geothermal power plants is mainly due to the complexity of the power-purchasing scheme between the IPPs, PLN and consumers. PLN buys electricity ftom IPPs using American dollars (US $) and sells it to consumers using the Indonesia Rupiah (Rp.). As a result, the buying price is higher than the selling price. This condition is economically not feasible and has caused a Rp. 25 trillions loss to PLN in the year 2000.

The cancellation has prevented PLN from incurring further losses, but has caused the IPPs to lose their opportunity costs when their power plants are not operated. As a result, the problem has come into dispute and needs to be solved by an arbitrator. The same problem is also faced by other non-geothermal IPPs such as the gas power plant of Paiton in East Jawa.

Regarding these conditions, a win-win solution scheme is needed for the future of geothermal development in Indonesia. It means a challenge for all parties; geothermal experts, developers, PLN, funding agencies and the government. Cooperation of the all parties needs a real transparency in conducting geothermal business to produce a reasonable electricity price.

4. THE ROLE OF GOVERNMENT

Grant (1996) described the geothermal industry as a fascinating mixture of entrepreneurs, government officials, technical experts with differing opinions, technical uncertainty, and anxious would-be customers. Similar to other world's energy industry, geothermal energy is heavily regulated or controlled by government. Bureaucratic imperatives and politics were often crucial beside financial profitability. So, details of the development process frequently reflected these non-financial objectives. Nowadays, higher priority has been shifted to financial concerns.

The Indonesia government has also played an important role in geothermal development. PERTAMINA's (Indonesia state owned Oil and Gas Company) venture into geothermal energy was based on Presidential Decree No.22/1981, which bestowed on PERTAMINA the right to explore and exploit geothermal resources for electricity, with the obligation to sell the product to the State Electricity Company (PLN). Presidential Decree No.45/1991 amended the Presidential Decree No.22/1981 in order to expedite the development of geothemal energy as an alternative energy source, the management of which is now being carried out by PERTAMINA for the sake of the electricity business through the participation of state-owned and national companies as well as cooperatives.

The amendment covers the first, second and sixth dictums, which permitted the above geothermal business players to play a role in developing small scale geothermal business operations. Apart from that, the amendment to the second dictum entitled PERTAMINA to sell the geothermal energy in the form of either steam or electricity not only to PLN but also to other business ventures as well.

In carrying on the geothermal business, PERTAMINA operates either on its own by producing steam or through Joint Operation Contracts (JOCs) by producing steam/electricity, to be sold to PLN under an Energy Sales Contract (ESC).

Since 1982, PERTAMINA has been selling steam to supply the 140 MW Kamojang geothermal power plant which is operated by PLN. Steam supply for 20 MW Lahendong power plant was started in August 2001. In addition, contract with PLN to sell electricity from 2 MW monoblock Sibayak power plant started commercial operation in June 2000.

The Joint Operation Contract between PERTAMINA and Unocal Geothermal of Indonesia Ltd. for the Gunung Salak contract area and an Energy Sales Contract with PLN were signed in 1982. The JOC between PERTAMINA and Amoseas Indonesia for the Darajat contract area and Energy Sales Contract with PLN were signed in 1984.

Until the 1997 economic turmoil, government regulation successfully promoted geothermal development. However, Presidential Decree No.5/1998 was then issued to reconsider the on-going geothermal developments due to the economic turmoil in 1997. As a result, several developments were postponed (Table 3).

The core problem is the pricing of electricity. So, the government should provide integrated policies on energy to revive geothermal development and attract new investment, by recognizing and rewarding some of the intangible benefits of geothermal power; its indigenous nature and environmental friendliness. The policies should assist the industry to produce a competitive electricity price, which not only economically satisfies PLN and the geothermal IPPs in meeting their obligations to lender but also, most importantly, the consumers.

5. FUTURE DEVELOPMENT

Integrated government policies on energy for future geothermal development should concern two basic aspects i.e. constructing a strong legal base and promoting development scheme based on the principle of "best engineering practice",

Firstly, it is should be realized that without strong and certain legalities on geothermal development, investors will be reluctant to come. In this context, the government is now improving regulation of the electricity sector by presenting a Bill on Electricity to the Parliament in February 2001, which is expected to be

Table 2. Java-Bali grid system 1999-2004 (Mer Sudarsono, 2001)

Year	1999	2000	2001	2002	2003	2004
Installed capacity (MW)	15817.7	15510.9	18140.9	18140.9	18140.9	19460.9
Additional capacity. (MW)	-306.8	2630.0	0.0	0.0	1320.0	0.0
(MW)						
Peak Load (MW) 1)	11032.0	12231.0	13332.0	14532.0	15839.0	17565.0
2)	11032.0	12231.0	13699.0	15343.0	17184.0	19246.0
Reserve capacity (%)	40.6	48.3	36.1	24.8	22.9	12.7
	40.6	48.3	32.3	18.2	13.3	1.1

Notes:
1). Lower bound scenario at growth of 9% per year (2001-2004).
2). Upper bound scenario at growth of 12% per year (2001-2004).

Table 3. Geothermal development contracts in Indonesia (PERTAMINA, 2001)

No.	Project Year of contract signing	Contract capacity (MW)	Operator	Current Status
1	Kamojang (Unit 1,2 and 3) / 1984	140	—PERT—	On-line
2	Gunung Salak / 1982 amended 1994	495	JOC PERTAMINA-Unocal	On-line
3	Darajat / 1984 and 1994	330	JOC PERTAMINA-Amoseas	125 MW on-line
4	Sarulla / 1993	330	JOC PERTAMINA-Unocal	postponed
5	Dieng (Unit 1-4) / 1994	400	JOC PERTAMINA-CalEnergy	Taken over by the Government.
6	Kamojang (Unit 4, 5 and 6) / 1994	60	SSC PERTAMINA-Latoka	Under restructuring
7	Karaha / 1994	400	JOC PERTAMINA-Caithness	Postponed
8	Patuha / 1994	400	JOC PERTAMINA-CalEnergy	Taken over by the Government
9	Wayang Windu / 1994	400	JOC PERTAMINA-Asia Power/Magna Mandala	Continued
10	Bedugul (Unit 1-4) / 1995	400	JOC PERTAMINA-CalEnergy	Unit 1-2 reviewed Unit 3-4 postponed
11	Cibuni / 1995	10	Yala Teknosa	Postponed
12	Sibayak / 1996	44	SSC PERTAMINA-Dizamatra	Under restructuring
13	Lahendong / 1999	20	PERTAMINA	On-line
Total		3429		

Notes:
1. Continued : Allowed to proceed the development.
2. Postponed : Development delayed until PD No. 5/1998 revoked

ratified into Law by January 2002. The Bill proposes the establishment of a Regulating Body to mange and control the electricity supply business in Indonesia. The constraint is on guaranteeing fair competition, inducing efficient electricity supply, promoting sustainable new investment, ensuring reasonable profits for market players, and protecting the community interest. The Bill also provides for a Social Electricity Development Fund managed by a separate body to channel subsidies to less capable consumers, less developed and remote areas, and to rural electricity development.

In accordance with the legal manner, policies on 34 percent tax of the. net operating income as the Government's take and subsidies on fossil fuels have to be reconsidered. Political will from the Government and support from geothermal professionals is needed. Reducing tax will certainly reduce the electricity price. Reducing subsidies on the subsidized energy prices will eliminate one of the principal barriers to raising energy efficiency and make geothermal energy more competitive.

Reconsidering the tax policies can be adopted to solve the problem of the idle existing geothermal power plant. In this case, the plan of PLN to raise the electricity selling price up to US$7 cents/kWh by 2005 could be an important starting point. Government role is therefore important in providing specific policies. Two alternatives are considered. If the two schemes are implemented together, both PLN and IPPs can recalculate their economic price. Hopefully, the two parties could possibly reach a good price deal and solve the dispute.

a). Progressive Power Purchase Agreement (PPA) scheme: In this case, the IPPs sell electricity at a lower price in the early production stages. The price is then raised gradually as the increase of PLN's selling price comes into effect and meets a desirable level. In this case a PPA can be divided into several terms or phases, which enables both parties to rationalize the contract.

b). Staged tax scheme: In conjunction with the first scheme, the IPPs should be subjected to a lower tax when the selling price is low. The tax is then raised gradually as the selling price goes up.

Technically, raising the power plant capacity factor enables power plant *to* generate some additional electricity with regard to the power plant manufacturer's design specification. The additional electricity generated will add more income to the overall project cash flow hence possible to reduce the electricity price. So, the geothermal IPPs and PLN are urged to conduct their best engineering practice performances to get the most efficient electricity generation.

Best maintenances on the whole production facilities are the other technical aspects that could bring up a competitive geothermal electricity price. The best maintenance will prolong the lifetime of the production facilities hence the overall project lifetime. Economical geothennal electricity price is determined by the project lifetime. Since the project lifetime is commonly accounted for 25 to 30 years, so any project lifetime longer than those will be such a bonus to yield a cheaper electricity price in the future time. This will depend upon the Government policy to extend the contract area.

Policies on other levies that have been given for geothermal developer such as facility of import duty for operational requirements constitute economic incentives, should also have resulted in a competitive price of electricity.

In terms of energy policy, geothermal energy could take advantage from The 1997 Kyoto Protocol for the reduction of greenhouse gas emissions. Preliminary mechanisms are being developed to attribute a value to investments made in greenhouse gas reducing technologies such as geothermal power, which only produces less than one-tenth of the carbon dioxide of burning coal. The mechanism would be the creation of a market, which allows the trading of "certified emission credits". These will make the geothermal energy more attractive and competitive.

Secondly, the 1997 economic turmoil has indicated that the development is very sensitive to electricity price hence to the change of currency exchange that somewhat related to political situation. Therefore risk should be minimized. Modular or staged development scheme is probably the single most important choice (Grant,1996). It will reduce the initial investment and the risk of total failure. Although modular development requires a higher pre-production investment compared to conventional centralized power plants, it is economically more attractive due to the shorter pre-production period (Danar, 1993).

Modular geothermal development is suitable for rural and isolated communities, which have not had electricity or totally depend on imported fuel to generate power. These kinds of communities are commonly found in the regions outside Jawa Island. Many of the regions possess geothermal resources or are located near *to* geothermal resources. Electricity is important to boost their economic activities, which is vital for human development.

In conjunction with the implementation of the Law on Regional Autonomy, small scale modular development provide greater opportunities to Regional Governments to be self-reliant in managing geothermal energy. This will provide new opportunities for the development of geothermal energy through a strategic alliance of "total project pattern", which involving all geothermal business players; PERTAMINA, PLN, the Regional Government and the developers. Basically, geothermal resources throughout Indonesia have been well inventoried and so the Regional Government could make use of the database for geothermal development to meet the regional needs.

Based on development experience in the USA, Portugal, China and Thailand, Schochet (2000) shows that small-scale geothermal power plants for rural areas are technically and economically feasible. The power plants can produce reliable and cost effective electricity. Many cases even demonstrate that the power plants can be owned and operated by privately financed companies or well-motivated infrastructure agencies. Regarding the facts, it is a big chance for the Regional Governments to get involved in geothermal development and determine their own basic tariff of electricity based on the regional specific conditions. In this case, the Indonesian government should provide policies to encourage geothermal IPPs to conduct such development by offering economic incentive policy.

Brotheridge et al (2000) have established baseline data to assess the potential environmental and social impacts of small scale rural geothermal development. The data is based on studies and exploration in Eastern Indonesia, which are Ulumbu and Sokoria prospects of Flores Island, also Hu'u of Sumbawa Island. The most important environmental issues relate to the abstraction of water from streams and rivers, and reassignment of land. Sociological impacts are related to the lack of opportunity for involvement of the local communities. Employing local people on the project can lessen the two impacts and using an air cooled cooling tower.

6. CONCLUSIONS

The role of geothermal energy is expected to grow for the upcoming years. Reduction of subsidy on fossil fuels has made geothermal energy more competitive with other energy sources. The growth of geothermal energy utilisation will ensure that the available energy resources are used in the most cost effective and productive manner to meet the demand. However, economic situation and government policies have had a great impact on the geothermal development, as they always will. Geothermal developers are challenged to produce a reasonable and competitive electricity price

Reconsidering the energy policies on tax and economic incentives will revive on-going geothermal developments as well as future development. Small-scale modular or staged development that is technically and economically feasible could minimize risk. The model of development is also suitable for many off-grid rural areas in Indonesia.

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