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THE GEOTHERMAL POWER BUSINESS IN JAVA – BALI: TRADING MECHANISM, COMPETITIVENESS WITH FOSSIL FUEL, AND CHALLENGES TO ITS DEVELOPMENT

Firdaus Akmal[1], Herman Darnel[2] and Puguh Sugiharto[3]
[1 & 2]PT. PLN PJ B I, Wisma Aldiron Dirgantara Jl. Jenderal Gatot Subroto Kav, 72 – Jakarta, Indonesia
[3]Indonesian Geothermal Association, Gedung Sarana Jaya, Jl. Budi Kemuliaan I No.1, Jakarta, Indonesia

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ABSTRACT

Although Indonesia has abundant geothermal energy resources, which are known to produce clean and environmentally friendly energy, its development in Indonesia is facing many challenges. The energy market in Java is a single buyer model, so geothermal energy can only be sold to PLN, the state electric company – the only buyer. Under the current energy policy, the average geothermal electricity production cost is higher than the cost of electricity produced by fossil-fuelled generating plants. From a strictly economic stand point; geothermal energy appears to be less competitive. Moreover, the government has set new policies to implement an even more competitive electricity market, which commence by the year 2004. This new policy will add pressure on geothermal energy to compete.

Pertamina, the state oil and gas company, acts as government representative to coordinate and facilitate the geothermal exploration and exploitation. Currently, there are two types of geothermal energy sales: direct sale of steam or sale of electricity. A Geothermal Developer works in cooperation with Pertamina through a joint operating contract to explore for and develop geothermal wells. The developer then either sells the steam to a generation company or uses the steam to generate electricity and sells it to PLN. A generation company, such as PJB-I, buys geothermal steam from developers and sells the electricity to PLN at a regulated price, which may leave no margin for profitable business.

This paper discusses the current geothermal industry structure and business practice in Indonesia. It describes ways to create attractiveness and competitiveness of the geothermal energy business. The ability of geothermal plant to compete with coal, gas and oil fired electric power plants is assessed by evaluating and comparing the production cost for each type of fuel. This comparison also includes the perspective on tax or government production sharing policy in the primary energy businesses. Through this analysis, challenges for the future geothermal development are identified, classified and categorized so that each party in the geothermal business chain can develop specific plans to address their respective challenges.

1. INTRODUCTION

The total installed capacity of geothermal power plants in Indonesia is currently 667 MW, of which 360 MW is owned by PJB I and 307 MW is owned by Independent Power Producers (IPPs). This is just about 3% of the total Indonesia's geothermal energy potential, which is estimated at about 20,000 MW – about 39% of the world geothermal reserves. By 1998 geothermal power plants produced 2.5 billion kWh electricity, which is equal to about 3% of the total generated electricity in Indonesia or about 5% of the electricity sales in Java – Bali market system – the electricity market center in Indonesia.

Considering that geothermal energy resources are abundant in Indonesia and that it can not be exported, stored or transported, then geothermal energy should be a preferred source of domestic energy. Moreover, Indonesia's fossil fuel oil resources are rapidly diminishing and are even predicted to become scarce in the near future. It is therefore vital for Indonesia to make geothermal energy more competitive in the long run. In contradiction to this strategic position, there has been severe economic pressure in Indonesia since mid-1997 due to the drastic depreciation of the Rupiah to the US dollar. The cost of geothermal power, which is paid in the US dollar, became uncompetitive with power produced with other fuels. For this reason, geothermal electrical energy development seems to face an uncertain future.

2. CURRENT GEOTHERMAL INDUSTRY STRUCTURE AND BUSINESS PRACTICES IN INDONESIA.

2.1. Current Java-Bali Electricity Business System

The Java and Bali islands have about 60% of the total population in Indonesia, which is about 200 millions people. Thus most of the economic activities and industries as well as most of the large-capacity power plants are concentrated in these two islands. Java and Bali are interconnected with a sub-marine cable and all the power plants in Java and Bali are interconnected through 150 & 500 kV transmission lines, forming a Java – Bali network system. Total installed capacity and peak load of this network system is currently 16,500 MW and 10,300 MW respectively.

PJB-I and PJB-II (PLN's subsidiaries generating companies) have a capacity of 9,022 and 6,642 MW, respectively. These companies are currently the first and the second biggest electricity suppliers in the Java - Bali system. The remainder of the electricity demand is supplied by Independent Power Producers (IPPs) with a total installed capacity of 3,085 MW. Hopefully, they will play a bigger part in the future.

Most of electricity demand is supplied by thermal power plants such as the Simple Cycle and the Combined Cycle Gas Turbines (OCGT and CCGT), the steam turbine and geothermal power

Plants, followed by Hydroelectric Power Plants (HPP). All these power plants are connected to the transmission and distribution lines, which are operated and owned by PLN. These configurations define the Java-Bali electricity business system as a single buyer multi-supplier system (SBMS-system). As shown by Figure 1, all of the power producers sell their generated electricity to PLN as the only buyer. In this business system, the government, as the owner of PLN, regulates and controls as well as sets the electricity price and views the electricity industry as an infrastructure to support the whole country's activities rather than as the common business practices.

From a strictly economic viewpoint, the transmission lines are allocated to power plants ranked according to their production cost and starting time. The power plant which has cheapest production cost will provide the base load. The lines are then supplied to plants with more expensive production cost and with longer starting time, such as steam power plants. The final power is provided by the most expensive and/or the fastest starting time power plants, such as Gas Turbines, which serve as peak loaders. IPP's sell their electricity based on a signed contract (PPA) with PLN at a certain price and Take or Pay level. It is in this case that excessive TOP level in the electricity contract may contradict sound economic business decisions, if the dispatcher must take the generated electricity even its price is more expensive than other available power plant.

These practices show that the electricity business provides a minimum of competition and efficiency even for the primary energy supplier, electricity production, transmission, distribution and the end user.

2.2. Geothermal Project Investment Procedure

Indirect Investment

Previously, most of the major infrastructure in Indonesia, including electricity, was developed and financed by the government of the Republic of Indonesia (GOI) through its strategic state owned company - PLN. The GOI organized the foreign soft loan and export credit from International Institutions to build the power plant.

Direct Investment

Currently, as the electricity demand increased significantly and the ability of GOI to finance the project is more and more limited, the GOI invites any domestic or foreign company to get involved directly in providing electricity. Specifically, in developing the geothermal power plant, the investor is permitted to get involved in developing the reservoir, the power plant, or even both of them. Therefore there are two types of geothermal energy sales:

a. Steam Direct Sales (SDS): The Developer, through a Joint Operating Contract with Pertamina, explores and develops a geothermal contract area to produce geothermal steam and sells the steam to PLN for electricity generation.
b. Electricity Sales (ES): The Developer explores and develops a geothermal contract area to produce geothermal steam through a Joint Operation Contract with Pertamina, The developer also uses the geothermal steam to generate electricity through its own geothermal power plant, which then sells the generated electricity to PLN.

Mining and Energy Ministerial Decree No. 10/P/M /PERTAMBEN/1981 presents the Term of Reference upon Joint Operation Contract between the Developer and Pertamina, who hold the rights to develop geothermal reserves in Indonesia. The step-by-step procedures for a developer to acquire rights to a contract area and proceed until commercial operation for both types of geothermal energy sales (SDS & ES) are as follows:

1. Based on Site Survey and electricity market demand for the proposed contract area, Developer executes a Memorandum of Understanding (MOU) with Pertamina to start an intensive study of the proposed contract area. The more detailed technical, commercial and legal aspects of the cooperative development of the area are then defined in a Joint Operating Contract (JOC).
2. Electricity sales price and or steam price is then decided through a negotiation process involving PLN, as the buyer. Based on the agreed price and other terms, PLN, Pertamina and Developer then execute an Energy Sales Contract (ESC). This JOC, together with ESC, requires the approval of the Minister of Mining and Energy.
3. The Directorate General of Oil & Gas will evaluate technical aspect of exploration and exploitation, while the Directorate General of Electricity will evaluate the electricity aspect.
4. Based on the advice of the Directorate General of Oil & Gas and Electricity, the Joint Operating Contract between Pertamina and Developer will be approved by Minister of Mining and Energy.
5. The Developer then starts the project activity: accessing the reservoir, environmental impact, financing, bid preparation and tender, construction, commissioning and operation.

Table 1 shows the investment procedure and the role of each institution to get permission on developing geothermal contract area.

2.3. Brief Overview of Selected Energy Sales Contract

Based on the method used in calculating the steam price, there are two ESC models, as shown by Table 2:

a. The steam price is expressed in Rupiah and accounted from generated kWh, which refers to an Oil Fuelled Steam Power Plant. An example of this model is the Power Plant A. Currently this model offers energy cost, which competes with other fuels. It does not have a direct impact to the depreciation changes, as the fuel price is regulated by GOI. Compared to non-subsidized fuel oil, which is expected to increase the fuel price to about twice the current price, this model still gives competitive price to other fuels.
b. Expressed in US Dollars and accounted from generated kWh at a certain base price adjusted by currency fluctuation and inflation index. Examples for this model are Power Plants B and C. In severe depreciation condition this model makes geothermal energy unable to compete with others fuels.

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In those two contract models, the developer receives the monthly payment based on the amount of generated electricity. Like any contract, there are some sensitive contract issues between buyers and sellers, such as: Price, Take-or-Pay (TOP) level, Steam Quality, Metering point, discount price if Capacity Factor (CF) is higher than TOP level and penalties for short fall/load curtailment.

Setting Price and TOP at a too high of a level can guarantee a high return to the developer for its investment, but there is little market risk sharing. Conversely at too low of a Price and TOP level, the project might not attractive for the developer. Therefore cooperation, goodwill and transparent negotiations can yield values acceptable to both parties. As an example, the TOP level will be fair if it is based not only on technical aspects, such as planed outage for both reservoir and generation units; but also commercial aspects such as anticipated demand.

The guarantee of steam quality is also important from technical and commercial aspects, as it has very strong relationship with operational capacity, frequency of maintenance/overhaul, breakdown and de-rating of power plant.

Another approach in reviewing the ESC is by comparing the following categories:

a. Geothermal Plants with positive Net Operating Income (NOI) in which the plant has been fully depreciated
b. Geothermal Plants with negative NOI in which the plant is still heavily recovering its investment.

Geothermal Plant A has been in operation since 1983. Its initial investment was funded by a Government-to-Government grant. The plant should have been sufficiently depreciated and start enjoying net operating income. Consequently, it can offer competitive energy price over fossil fuel plant.

On the other hand, Geothermal Plants B and C have just been in operation since 1994. The development of the geothermal fields was funded from the money market or private investment. They are still heavily recovering their respective investment. The energy price is hardly competitive to fossil fuels but it offers long-term value added benefits because of its clean environmental impact, sustainability, and certainty of the price and multiple effect to developing local economy.

In principle, however, the geothermal energy price will be competitive to any fossil fuels in the long-run, after its relatively heavy investment is recovered. The challenge for the industry is to find the entry to the already competitive energy market and appropriately manage the business toward self-sustaining growth. Involvement of Government through appropriate energy policy, environmental regulations ("right to pollute", worldwide air emission exchange to reduce green house effect, etc.), certain incentives and or tax relief, risk sharing and support in research and technology development will help reduce the front-end burden of geothermal energy development.

3. GEOTHERMAL – OTHER FUEL PRODUCTION COST COMPARISON

3.1. Production Cost Comparison

In general, production cost of a power plant can be divided into two main groups, mainly:

1. Fixed cost component.
   A cost component that is not directly related to the amount of generated electricity. It consists of:
   - Component A: Amount of money that has to be earned through its investment cost over the project life cycle (capital recovery).
   - Component B:
     Fixed maintenance cost, which is a component needed to perform scheduled maintenance.
2. Variable Cost Component.
   A component of cost, which is directly related to the amount of the generated electricity cost. It consists of:
   - Component C: Fuel cost component.
   - Component D: Variable maintenance cost.

Separation of these cost components will make it easier to compare and evaluate the production cost of any power plant in more detail.

An apple–to–apple production cost comparison between geothermal and other fueled power plants must be based on the same assumptions, considering the nature of each power station.

Table 3 indicates the production cost comparison of power plants based on the following assumption:

a. Capacity Factor = 30, 40, 50 and 70 %
b. Life Cycle = 15, 20, 25 and 40 years
   (Point a and b depend on the type of power plant)
c. 1 US Dollar = Rp. 8,000,-
d. Debt Equity Ratio = 100 %
e. Fuel cost component for fuel oil is excluded transportation cost (assumed at 10%), to make fuel oil power plant the comparable the geothermal power plant, which are mostly located in the reservoir area.
f. The environment impact of any power plant must be at an acceptable level according to the localized environmental regulation.
g. According to the current tax regulation:
   - Tax rate for geothermal electricity business is equal to 34% of the net income. This is "all-in" tax rate, there is no other tax applied for even imported machinery.
   - Tax rate for other power plant is at the regular basis, VAT = 10%, Dividend withholding tax = 30%, Tax Income = 6%.

3.2. Discussion

Component A

Investment for geothermal power plant (GPP) able to compete even to coal steam power plant (Coal SPP) and Combine Cycle Power Plant (CCGT). From technical design it is known, that the cycle, auxiliaries and facilities of GPP is much simpler than that of Coal SPP. In GPP, there is no boiler or Heat Recovery Steam Generator (HRSG). GPP mostly uses direct contact condenser, which is more efficient in terms of the heat transfer

compared to shell and tube condenser, which is applied in SPP, then the condenser size and investment cost in GPP become much cheaper than in the SPP.
In Coal SPP, before coal comes into the burning process, it shall be ground and pulverized, which can lead to an increase in its investment cost for handling. Unlike in the GPP, geothermal steam is simply filtrated and separated before it flows into the turbine.

Component B & D
Operating Temperature and Pressure of geothermal steam is much lower than steam generated by boiler or HRSG, then generally speaking by considering the material resistance, the maintenance cost of GPP is much cheaper than that of SPP or CCGT. Moreover, as the number of supporting auxiliaries in GPP is much less than that of in SPP, then number of equipment that should be maintain will much less than that of the SPP.

Component C
Fuel cost component in GPP reflects the total cost of capital, maintenance and operating costs for exploration and exploitation of geothermal steam, which is much more expensive than any other fuel cost. Part 4 will discuss in more detail this cost component.

4. FACTORS THAT AFFECT GEOTHERMAL PRODUCTION COST

In order to be able to identify the major factors affecting production cost of geothermal steam, there are two project stages that should be considered: Investment Stage and Operation Stage.

Investment Stage
At this stage, the investment will be spent for the following activity:

- Feasibility Study (Geological, Geochemical, and Geophysics Surveys)
- Build Roads and Land Purchasing
- Exploration
- Well Drillings
- Builds Infrastructure Facilities
- Installed Steam Lines and Steam Gathering.

Table 4 shows the percentage cost estimation in developing geothermal areas during exploration and reservoir assessment in Indonesia and the order of investment cost for 110 MW capacity in Indonesia. It must be remembered that this data just general estimates of project expenses. The exact project cost may differ with those presented data. Detail calculations based on the technical aspect, local conditions and regulations would be needed for an actual project.

Another factors that effect to the investment cost are: estimation of sustainability of the reservoir capacity, and definition of an exact long-term availability and well drilling successfulness at an economic depth (< 3 km).

Unlike Oil and Gas Reservoir, in which the potential reserves can be measured and estimated more accurately as their presence can be identified and exploited with the current sophisticated technology; in geothermal reservoirs it is more difficult to do. In geothermal reservoirs, there are two major factors that characterize the natural potential of geothermal reserves which are difficult to estimate accurately. Those factors are:

1. The heat source in geothermal energy is generated by a hot rock that receives heat from magma, of which its volume and its heat transfer mechanism are difficult to measure.
2. Estimate permeability of the reservoir area, the parameter that indicates the ability of the rock fractures to transmit the water from one place to another.

Usually the reservoir characteristic can be approached by construction of a reservoir model by means of assumption, while an accurate model can only be found if more wells are drilled, which leads a very expensive investment. It is therefore difficult to define the long-term sustainability of the reservoir, which results a high business risk.

Another risk in the geothermal reservoir is caused by the volcanic activity that may result a hydrothermal eruption or earthquake that may destroy the reservoir and power plant facilities.

Operation Stage
Operation stage may cover the following activities:

- Drill make up wells (this is part of investment cost)
- Reaming of scaled block well.
- Chemical treatment (such as anti-scale agent, if any)
- Well Monitoring.
- Environmental Impact Monitoring.
- Maintenance of steam lines.
- Tax or government production sharing policy.
- Maintenance of access road and other facilities
- Administration cost

In the operation stage, the steam purity is a key parameter that dictates the number of reamed wells, utilization of anti-scale agent, steam line maintenance, etc. which then affect the operation and maintenance cost. Unfortunately, the amount and chemical constituent in the geothermal steam varies widely at every reservoir and it is difficult to control, as it is strongly effected by geological structure, type of reservoir and volcanic activities.

The production steam for some wells might decrease after it has been operated for several years. The possible causes of the decreasing steam production are: unbalance of heat and water recharge into the reservoir and clogging, which occurs in the rock fractures near the well bore or in the well pipe.

If the estimated operation and maintenance cost of a geothermal reservoir is about USD 0.006 – 0.008/kWh, then the investment cost contributes more than 90 % of the total steam production cost.

5. CHALLENGES FOR THE FUTURE GEOTHERMAL DEVELOPMENT

Several advantages in utilizing geothermal energy are :

1. It has a multiplier effect in developing the local economy through usage of domestic resources (local products and

services, labors), building related infrastructures, and opening opportunities for agribusiness.
2. It reduces domestic use of fossil fuel and enhances export or at least minimizes the import of this fuel.
3. Geothermal power plants produce relatively clean energy with minimal air SO_x, NO_x and CO_2 emissions. (A geothermal reservoir, which contains a high H_2S would require extra treatment)
4. It establishes fuel diversity.

Although these advantages exist, geothermal development for electricity generation in Indonesia faces a serious problem, especially with Indonesia's future electricity business coming into a restructured and fully competitive system, which will be launched in the near future.

5.1. Future Electricity Business

The future trend of the electricity business in Indonesia is toward Multi Buyer Multi Seller (MBMS), as shown by Figure 2. In this new business system, there is no guarantee that the electricity generated by any type of power plant will be purchased unless it has a competitive production cost.

The GOI has initiated a Restructuring Program as stated in the Electrical Power Sector Restructuring Policy of the Minister of Mining and Energy, of August 1998. The electricity business will undergo a basic change, i.e. electricity price will follow a supply and demand system through a bidding process. Therefore, there will be an unbundling process applied to the Java-Bali Electricity Industry, which will result in a new company in Generation, Transmission, Distribution and Retail business.

The objectives of this restructuring program, like other restructuring programs in other countries, are to create a competition system, transparency, improved efficiency in all electricity business activities and less reliance on government support.

5.2. Challenges for Geothermal Business.

Through the above description and discussion, it can be identified that the challenges for geothermal businesses are:

1. How to make geothermal energy a primary substitute for oil and gas in domestic electricity usage, as it is available in abundant reserves. In addition, it is more environmentally friendly.
2. How to distribute or reduce the risk in geothermal business.
3. How to reduce the investment cost in developing geothermal reservoirs.
4. How to make the community become more aware of the environment.

5.3. How to Make Geothermal Energy Able to Compete with Other Fuels?

The following discussion is presented to guide a more detailed study to improve the competitiveness of geothermal energy in Indonesia:

1. Reduce the uncertainty of the reservoir condition and sustainability.
   Well drilling costs and exploration success can vary widely. These variations can lead to high investment costs. This is the most difficult part of geothermal energy development to reduce, unless there is a technological development in accessing the reservoir. Therefore research and development in reservoir engineering and technology will play an important role to resolve the problem.
2. Reduce "all-in" tax rate.
   Simulation as shown in Table 5 indicates that the electricity price will decrease at about US cents 0.7 – 0.8 /kWh if all-in tax rate is reduced to 10 %. Such tax relief is not unusual to promote the use of natural resources that would otherwise lie dormant.
3. Management of power plants and reservoirs requires coordination between the two. Therefore it is better to establish the reservoir and power plant under one management rather than separately, as is currently the practice.
4. Prolong the contract period.
   Increasing the contract period by 5 years will decrease the electricity price by US cents 0.4 – 0.5/kWh.
5. The developed infrastructure is accounted as "all-in tax rate compensation.
   Most geothermal areas are mountainous and isolated. The infrastructure, bridges and other facilities that have been provided to access the reservoir can be accounted as a compensation of the all-in tax payment.
6. Promote the use of domestic manufacturing capabilities.
   Increasing domestic manufacturing capabilities through preferential policy, if rightly managed, would lower capital costs compared to those with imported equipment. Therefore, such policies should provide enough incentives for foreign direct investment involved in those activities through strategic alliance with their Indonesian counterpart in order to generate a multiplier effect to the local economy.
7. Distribute the risk on initial development of geothermal areas to the Government.
   An initial reservoir assessment and pre-feasibility study to confirm the potential reserves can be costly even if the reservoir is unsuitable for development. It will more attractive to the developer if this initial cost is covered by government, such as arranging a cross-subsidy with other primary energy such as coal or gas. Another advantage with the application of this scenario is the possibility for the government to manage a cross-subsidy of the promising and unpromising contract area, which leads to a more effective and economic situation compared to the current condition – where each developer must cover its initial development cost.

6. CONCLUSION

The strong potential of geothermal resources in Indonesia gives a great opportunity for geothermal energy to be used as an energy alternative to save and prolong the declining fossil fuels. Moreover geothermal energy has unique advantages compared to other fuels in that if can add value to the energy mix. In the long run, geothermal power plants have a competitive edge over fossil-fuelled power plants once the plants have been fully depreciated. Support is still needed from the Government, research institutions and other parties who are involved in the energy development to reduce geothermal production costs at the front end.

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REFERENCES

1. API – Indonesian Geothermal Association, *Result of API 1999 Work Session*, Jakarta March 1999
2. Anton Wahjosoedibjo, (1999), *Indonesia Geothermal Industry Issues*, Jakarta 1999, 20 pp (unpublished).
3. Prijanto, (1998), *Comments on Structure and Pricing of Future Geothermal Power Projects in Indonesia*, API Geothermal Conference, Bandung, 11 pp.
4. PT. PLN (Persero), (1997), *Laporan Status Proyek Listrik Swasta*, Jakarta, pp 35 – 44.
5. Sub Direktorat Eksplorasi dan Produksi Panasbumi – Dirjen Migas, (1995), *Himpunan Peraturan yang Berkaitan dengan Pengusahaan Sumber Daya Panasbumi*, Jakarta, 210pp.
6. Uum Komarudin, (1999), *"Aspek Teknis dan Ekonomis Dalam Pengembangan Lapangan Panasbumi"*, One Day Seminar – PJB I's Annual Anniversary – Jakarta.

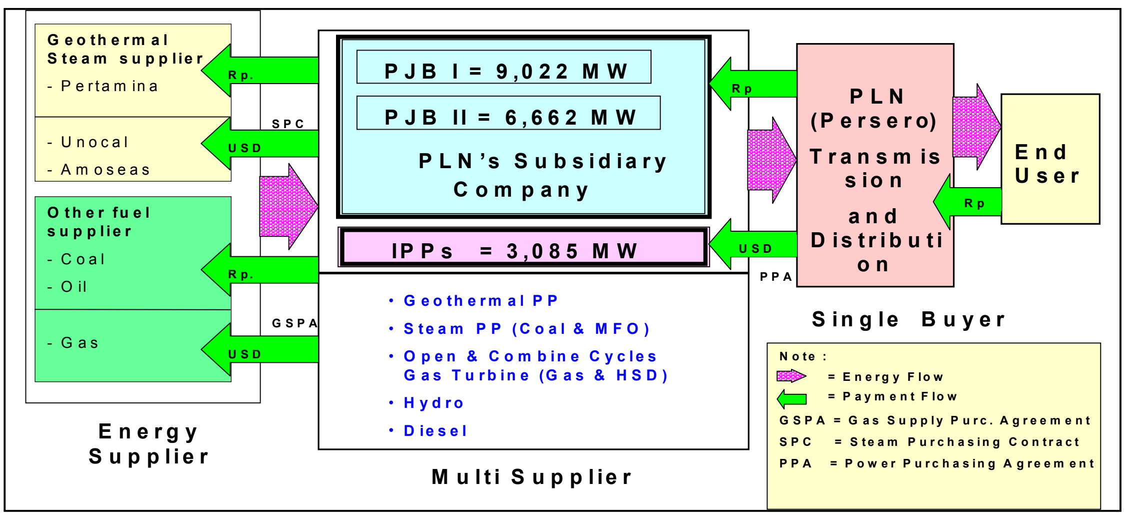

Figure 1: Diagram of Single Buyer Multi Supplier Electricity Business System (SBMS) – the Current Java-Bali Business System

Table 1: Investment Procedure and the Role of Each Institution in Developing Geothermal Electricity Business.

Permission	Activity		Institution
Investment Report	Report the Investment Program: • Volume • Project Information • Source of Financing • Local Partnerships.		**BKPM – Investment Coordinating Agency**
The Right to develop Geothermal Area	• Sign MOU – to start investigation intensively • Sign Joint Operating Contract (JOC) • Feasibility Study		**Pertamina – Oil & Gas State Owned Company**
	• Confirmation of Electricity Demand		**PLN – Electric State Owned Company**
Steam Purchasing Contract (SPC)	• Steam Price Negotiation		**PLN**
	• Evaluate technical and commercial aspects of Exploration and Exploitation of Contract Area		**Directorate General Oil and Gas**
Power Purchasing Agreement (PPA)	• Electricity Price Negotiation		**PLN**
	• Evaluate technical and commercial aspects of Power Plant and Electricity demand		**Directorate General Electricity and New Energy**
	Sign SPC and or PPA		**PLN – Pertamina and Developer**
	Approval SPC, PPA and JOC		**Minister of Mining and Energy**
Approval on Environmental Impact Assessment	• Identify the impact of the project activity to the environment. • Recommend the procedure and technology applied to mitigate the identified impact.		**Bapedal –Controlling on Environmental Impact Agency**
Land Utilization and Assessment	1. Land for forestry Compensation		**Forestry Department** **Local Province Government**
	2. Project Activity :		
	• Resource Assessment (Build Road, Drilling Wells, etc) • Confirms Resources • Financing Plan • Engineering Design	• EPC Bid • Construction • Financial Closing • Commissioning • Commercial Operation	**Developer**

Table 2: Brief Overview of Selected Energy Sales Contract

No	Area	Types	Cap MW	Contract Condition	Remarks
1	Plant A	SDS*)	140	Price in Rp = 0.28 x 0.8 x MFO TOP at CF = 72.33 %, project life 30 years, Steam Quality applied	With current MFO price = USD 0.05 /lt, Steam price = USD 0.0112/kWh
2	Plant C	SDS*)	165	Price (USD/kWh) = kWh x 0.04302 x I TOP Based on CF = 80 % (Gen. Side), Period = 30 years, Steam Quality is not applied	I is inflation index functioning of USD exch. rate, Cons. Index, Oil field Machinery and Tools index and US price index
		ES**)	165	Price USD = Resr. + Gen.comp. Resr.= kWh*0.04302*I Gen.= (0.08467-0.04302 x I) x kWh TOP at CF = 85 %, Period = 30 years, Steam Quality is not applied	I is inflation index functioning of USD exch. rate, Cons. Index, Oil field Machinery and Tools index and US price index
3	Plant B	SDS*)	55	Price (USD/kWh) = kWh x 0.04537x I TOP Based on CF = 80 % (Gen. Side), Period = 30 years, Steam Quality is not applied	I is inflation index functioning of USD exch. rate, Cons. Index, Oil field Machinery and Tools index and US price index
		ES*)	70	Price (USD/kWh) = kWh x 0.0695x I TOP Based on CF = 95 % (Gen. Side), Period = 30 years, Steam Quality is not applied	I is inflation index functioning of USD exchange rate, Indonesian Consumer Index and US producer price index

*) SDS = Steam Direct Sales **) ES = Electricity Sales

Table 3: Geothermal – Other Fuel Production Coat Comparison

Plant type	Fuel	Life	CF	Cap. Cost	O&M Cost	Fuel Cost	Total Cost
		years	%	Cent/kWh	Cent/kWh	Cent/kWh	Cent/kWh
SPP	Coal	25	70	3.027	0.213	0.955	4.195
SPP	MFO	25	70	2.270	0.226	1.248	3.745
CCGT	Gas	20	70	2.084	0.278	1.939	4.303
CCGT	HSD	20	70	2.084	0.283	1.522	3.891
OCGT	Gas	15	30	3.253	0.940	3.040	7.234
OCGT	HSD	15	30	3.253	1.032	2.387	6.673
GSPP	Geo	25	70	2.522	0.65	4.600	7.392
DPP	HSD	15	50	2.342	1.074	2.019	5.436
DPP	MFO	15	50	2.732	1.181	1.323	5.238

Table 4 :% Estimate Cost Components Geothermal Project in Indonesia

No	Project Activity	Estimate Cost (%)	Typical Cost for 110 MW capacity (USD)	Affecting Variable
1	Reservoir Assessment:			
	- Feasibility Study	0.5 – 1,0	0.5 – 1.0 M	Area, Type of Reservoir, Location, etc
	- Build Roads & Land Purchasing	10 – 12	5.0 M	Length, Topography, Soil Condition, Geographic
	- Exploration	6 – 10	~ 2 M per well	Topography, Soil Condition, Geographic, Type of Reservoir, Location,
	- Drill Wells	24 – 30		Depth, Geological Structure, Type of Reservoir, Supporting Facilities, etc
	- Steam Gathering Line	5 – 10		Soil Condition, Topography, Location, Pressure, Chemical Substances, etc
	- General Facilities	1 – 2	~ 0.8 M	
	- Drilling Make up Wells	5 – 10	~ 1.2 M per well	Permeability, Chemical Substances, Reservoir Types, etc
2	Power Plant		1.0 – 1.5 USD per Watt installed capacity	Capacity, Chemical Composition, NCG content, Plant Layout
	- Engineering Design	1 – 2		
	- Civil Works	35 – 40		Topography, Soil Condition, Geographic
	- Mechanical			Technology & Design
	- Electrical			Technology & Design
	- Instrument & Control			Technology & Design
	- Supervision	2 – 4		
	- Start up & Commissioning	1 – 3		
3	Tax Note: there is no other tax applied even for the imported machinery.	34 % net income		Governmental Regulation

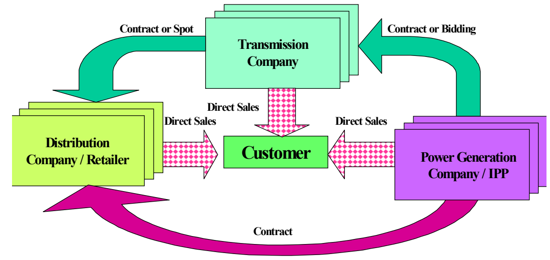

Figure 2: Diagram of Multi Buyer Multi Supplier Electricity Business System (MBMS) – A future business System In Java- Bali.

Table 5 : Effect of Project Time and All in Tax Rate to Steam Price

Project Time (Years)	All in Tax Rate %	Price (US cent/kWh)
15	14	6.155
	19	6.430
	24	6.740
	29	7.100
	34	7.510
20	14	5.904
	19	6.163
	24	6.458
	29	6.795
	34	7.183
25	14	5.796
	19	6.049
	24	6.337
	29	6.665
	34	7.044
30	14	5.748
	19	5.998
	24	6.283
	29	6.607
	34	6.981