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THE ROLE OF GEOTHERMAL INDUSTRY IN PRIVATE POWER DEVELOPMENT IN INDONESIA

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ABSTRACT

Indonesia is blessed with an abundance of geothermal resources. Over 25 active and hundreds of extinct volcanoes have been charted throughout the 13,000 island archipelago. State Oil and Gas Company (PERTAMINA) has identified at least 70 potential geothermal anomalies and has estimated that the geothermal electric energy potential may approach 20,000 MW, which is the energy equivalent of 6 billion barrels of oil.

Since the 1990's the private power investors have taken part in the development of electricity generation to meet the demand which, accelerated by industry, grew by 6-8% per year until the end of 1996. Unfortunately, starting in July 1997, monetary problems overcame Indonesia and affected the exchange rate of Indonesian currency which fell drastically. The continuing effects affected the industries and some factories have stopped their activities. The collapse of industries, the biggest electricity consumers in Indonesia, has pushed electricity demand into negative growth recently.

The intensive and progressive treatment of the Government of Indonesia on the macro-economical problems, especially on the currency exchange rate, recently showed a positive result. By increasing the stability of the exchange rate, foreign investors have returned to build their industries in Indonesia. This, in turn, will accelerate the growth of electricity demand, and electricity consumption is expected to return to original projected growth in the near future.

1. INTRODUCTION

The government has established ambitious goals for expanding the existing 589.5 MW of on line geothermal electric capacity to over 1000 MWe by year 2000 and to over 5000 MWe by year 2020. Developers and the government will have to work together closely to realize these established goals and to preserve the value of this prolific resource. This spirit of cooperation will require a thorough understanding of the unique features of geothermal energy, the constraints of electricity planning, and the economic and business needs of all parties.

Private investors are gaining a greater role in the development of the electricity sector, including electricity generated using geothermal fuel. The private sector is now in the forefront and a key factor in national development in general. In the latest report, the World Bank suggested that the Indonesian Government reduce the capital participation by state-owned companies especially in the sector of oil and gas, electricity, and telecommunications as the three sectors of fundamental infrastructure have attracted private investors. According to the World Bank, privatization and a greater role of the private sector would improve efficiency and increase the government income that could be used to repay its debts or for reinvestment. This has been proved when foreign investors signed the Energy Sales Contract and built the Geothermal Private Power Company in Indonesia.

Though geothermal privatization has been going on since 1983, a big step began only in 1993, marked by the success of privatization in the geothermal energy development with the participation of private investors, both domestic and foreign, in the development of projects. Big steps have also been made in the development of the electricity sector. Large projects of power generation have been awarded to some joint ventures and the Energy Sales Contracts (Total Projects) have been signed since 1993-1994 and financing closed. The geothermal power projects are Wayang Windu (400 MW), Salak Private Unit-4, 5, 6 (165 MW), Darajat Private (275 MW), Karaha (220 MW), Patuha (220 MW), and Dieng (170 MW), respectively, with a total capacity of 1785 MW.

The World Bank, one of the country's major partners in development, strongly suggests privatization. The Bank said that return on assets and return on equity of private companies could be double those of state owned companies. In general, the benefits of privatization include: 1) Improvement in efficiency, 2) More income available for reinvestment without raising taxes and for reducing dependence on foreign loans, and 3) Additional income to speed up repayment of external debts.

2. UNIQUE ASPECTS OF GEOTHERMAL ENERGY

The following are a few of the attributes realized from utilizing geothermal resources:

- Diversity of energy fuels;
- Preservation of oil, gas and coal for higher use or export;
- Environmentally friendly energy resource;
- Compatibility with multiple land use;
- Good fit with utility growth plans;
- Infrastructure and manpower development;
- Generation of significant tax revenues;
- Positive impact on gross domestic product (GDP).

Some unique aspects of geothermal resources need to be better understood so that the positive attributes can materialize:

1. Geothermal energy is site specific and must be converted to a more user-friendly form of energy (electricity) in the vicinity of where it is found. It cannot be transported long distances. Therefore, the resource is dependent on the power plant and vice versa. The market for geothermal energy is in the form of electricity.
2. Exploration and resource commercialization are costly and there is not an open or competitive market for the resource other than in the form of electricity. The developer must, therefore, have the assurance of a future market and know the value of the electricity at the start of exploration.
3. Exploration and commercialization of geothermal resources can be thought of as two major projects. One is the upstream discovery and commercialization of a major resource, and the other is a down stream power development project. The upstream portion of the project is similar to the discovery and opening of a new coal mine or a giant oil field. However, as is with all natural resource developments, there are risks associated with finding and evaluating the resource.

4. Development can be expedited with reduced business risk if growth takes place in relatively small increments, yet exploration and infrastructure costs can make the first increment of development prohibitively expensive. Contracts should be made as large as possible, to cover the maximum expected potential for each contract area, so that exploration and infrastructure costs can be spread over a larger generation base. The consumer would then enjoy the economic advantage of orderly development and the economies of larger scale projects.
5. Geothermal development should be thought of in terms of long term capacity planning rather than short term. This allows sufficient time to discover and confirm the commercial feasibility of geothermal resources and allows them to be fitted into the system as needed. This plan would also create the flexibility to accommodate failed resources without causing capacity short fall for utility. Better than expected resource success could be brought into the system to replace failed or delayed resources without creating an oversupply to the utility.
6. The longer term approach with large multiple contracts may allow more flexibility for both the utility and the developer, so that a consistent programme can be maintained with minimal mobilization and demobilization of equipment and manpower. Start and stop programmes negatively impact safety, necessitate the requirement for a great deal of training, are inefficient, expensive and thereby deprive the consumer of the most economical power.

3. PRIVATIZATION IN POWER SECTOR

In order to increase the participation of the private sector in the electric power procurement, the government is taking the following steps:

- Increasing the performance of the State Electricity Company (PLN) through restructuring, commercialization and incorporation;
- Improving the structure of electric basic tariff to reflect economical provision cost, if possible a tariff system not standardized all over the country;
- Improving the institutions and management of the electricity sector to create a competitive business climate to maintain efficiency. This is expected to create a healthy competition among the electric power suppliers (PLN and private power generators) and an efficient participation of the private sector;
- Opening a fair opportunity for electric power suppliers (PLN and private sector) to use all primary energy resources based on the work determined by market mechanism;
- Taking steps to popularize the campaign to economize on energy and preserve the environment.

The last policy which was contained in Presidential Decree (PD) No.37/1992 states that private companies are allowed to participate in the supply of electric power through a scheme called Build, Own and Operate (BOO). Later, another scheme was introduced called Build, Operate and Transfer (BOT). In these schemes, the private companies are eligible to the following:

- All facilities are eligible to domestic investment and foreign investment companies;
- Tax exemptions (income tax, value added tax and sales tax for luxury goods);
- Exemptions for import duties;
- An arrangement to secure the supply of primary energy to be used by private power generation plants in line with energy diversification and conservation policy.

The sales price of electric power is determined by the President of the Republic of Indonesia based on the proposal from the Minister for Mines and Energy. The sales price is set up by considering the following:

- People's interest and purchasing power;
- The norms for sound industry and trade;
- Cost of production;

- Technical and economic efficiency;
- Limited supply of primary energy;
- Economy of scale and existing interconnection system;
- Availability of capital.

PLN's power purchasers from private power producers through three different terms:

1. Purchasers for short terms from small scale Individual Power Producer (IPP) with non-firm capacities;
2. Purchasers for medium terms (3 to 15 years), including excess power, from small scale Individual Power Producer (IPP) with firm capacities;
3. Purchasers for long terms (>15 years) from large scale Individual Power Producer (IPP) with firm capacities, under the schemes BOT (Build, Operate and Transfer) or BOO (Build, Own and Operate).

The role of the private sector is supplementary in the electric power procurement by PLN. Therefore, the extent of the role of the private sector will be based on the lease cost expansion programme for supply and demand.

4. BASIC RULES FOR PRIVATIZATION IN ELECTRICITY SECTOR

4.1 General requirements

Under the present electricity setup, it is the government which is supposed to invest in the electric power industry, but as the government budget is limited, private companies, national and foreign as well, are allowed to invest in the industry. To attract private investors, the government has tried to set up a policy to make the rate of return (ROR) attractive and the market secure. Government policy, in inviting the private sector to take part in electric power procurement for public interest, is based on following reasons:

- Growing demand for electric power consumption in the future;
- Large investment is needed to build power generating facilities to meet the growing demand for electric power;
- The government has limited financing capability.

The participation of the private sector in the procurement of electric power for public interest is aimed at

- Assisting PLN meet the public demand for electric power;
- Creating a competitive business climate;
- Encouraging improvement in efficiency and maintaining the continuity of electric power development.

The private sector in geothermal energy, therefore, becomes a joint venture of PERTAMINA and also a partner of PLN, the national electric power development, and constitutes a part of the National Electricity Master Plan (NEMP), which could be implemented harmoniously and in line with the national development phases. In order to ensure the implementation of that programme, the following factors are needed:

- Conducive business climate supported by the government political will;
- A set of transparent, comprehensive and consistent regulations determining the procedure of energy and electric management to be followed by PERTAMINA, PLN and total private electric generating (total project) companies;
- Adequate system of government institutions to implement the regulations, to ensure that the system of electric power procurement is consistently in line with the interests of the public as consumers of electric power.

4.2 Regulation related to privatization of the geothermal industry

The total project (upstream and downstream) of geothermal development is based on the Presidential Decree No. 45/1991; downstream electricity development only is based on the Presidential Decree No. 37/1992, based on Law No. 15/1985 aimed at encouraging business in electric power procurement by the private sector and cooperatives in financing, development, ownership and operation of electric power generators, including business in transmission and distribution. The presidential decrees were issued based on considerations that for meeting growing demand for electric power, it is deemed necessary to encourage business in the electric energy procurement by the private sectors and cooperatives. Therefore, participation of the private sector in the electric power procurement must be taken seriously.

Power purchase agreement for the electricity generated using geothermal fuel is generally included in a long term contract with a duration of 25-30 years. In encouraging electricity generation by private companies, priority is given to the "Build Own and Operation (BOO)" scheme in companies with Presidential Decree No. 45/1991 and No. 37/1992. Power plants are constructed in line with government's policy on the energy sector, taking into account the availability of the required primary energy sources and economic and environmental considerations in compliance with Presidential Decree No. 37/1992.

The cost of power plants set up by private companies is calculated in the same way as in the case of power plants set up by PLN itself. Power purchasing price contains four components; which are:

A: Capacity cost which constitutes a round investment cost in US$/kWh per month during the contract;
B: Fixed cost of operation and maintenance which constitutes monthly cost (in US$/kWh) during the contract;
C: Variable fuel cost (in US$/kWh);
D: Variable operational and maintenance cost based on the types of energy generated (in US$/kWh).

5. PRIVATE POWER PROJECTS IN INDONESIA

Based on the electric power procurement plan (geothermal and non-geothermal) prepared by PLN for IPP in 1996, there are 26 projects to be built by private investors to be completed within 10 years (1996/97 - 2005/06) (Figure 1). The projects have a total capacity of 11,411 MW (Table 1), with an average of 439 MW each and geothermal power generation contributes a total capacity of 2190 MW.

Some projects to be built by the private sector with a total capacity of 1,315 MW are to be completed in National Five Year Plan VI (1994/95 - 1998/99). The projects include Cikarang gas combined cycle power plant (150 MW), Bedugul geothermal power plant (55 MW), Cibuni geothermal power plant (10 MW), Dieng geothermal power plant - two units (95 MW), Kamojang geothermal power plant (60 MW), Patuha geothermal power plant - one of four units (55 MW), Salak-I geothermal power plant (165 MW), Wayang Windu geothermal power plant (110 MW) and Paiton I power plant one of two units (615 MW).

Most of the power generating projects to be built by private investors will be completed in National Five Year Plan VII (1999/2000 - 2003/2004). The projects to be built during that period will have a total capacity of 8,535 MW. They are the Pasuruan gas combined cycle power plant (500 MW), Serpong gas combined cycle power plant (400 MW), Bedugul geothermal power plant - three of four units (165 MW), Darajat geothermal power plant (275 MW), Dieng geothermal power plant - one of three units(55 MW), Karaha geothermal power plant (220 MW), Patuha geothermal power plant - three of four units (165 MW), Wayang Windu geothermal power plant (110 MW), Cilacap coal fired steam power plant (400 MW), Cilacap LSWR steam power plant (400 MW), Paiton I coal fired steam power plant - one of two units (615 MW), Paiton II coal fired steam power plant (1,220 MW), Awar-awar coal fired steam power plant - one of two units, Tanjung Jati A coal fired steam power plant (1,200 MW) and Tanjung Jati B coal fired steam power plant - two units (1,320 MW). Detailed information can be seen in Tables 1, 2 and 3.

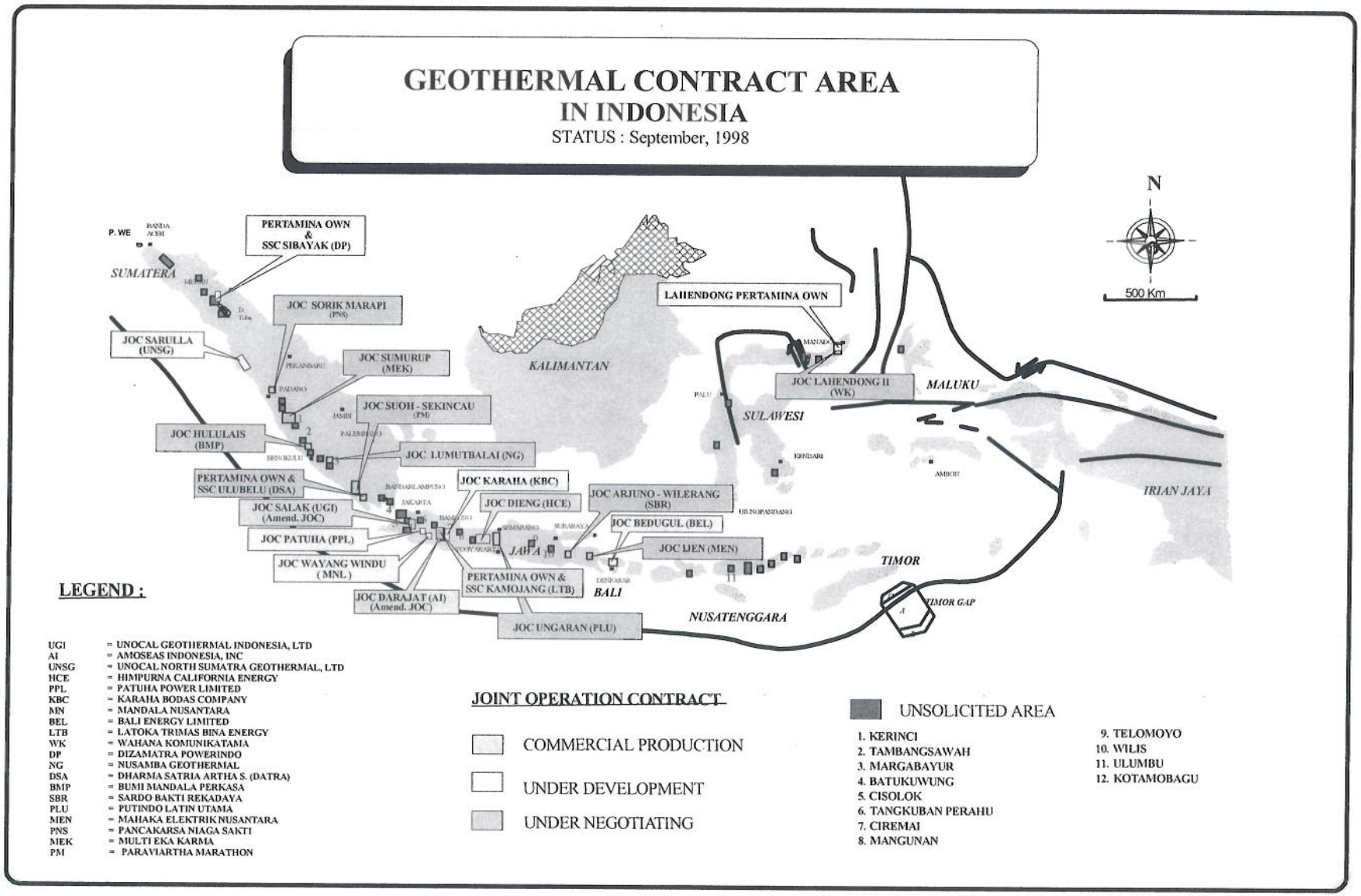

Figure 1: Geothermal areas in Indonesia under production and development

Table 1: Projected electricity generation (data from PLN)

Year	Capacity completed (MW)		
	Private	**PLN**	**Total**
1993/94	-	3,276	3,276
1994/95	-	1,235	1,235
1995/96	-	190	190
1996/97	150	2,552	2,702
1997/98	95	1,390	1,485
1998/99	1,040	1,100	2,140
1999/00	2,900	-	2,900
2000/01	1,960	6	1,966
2001/02	1,895	390	2,085
2002/03	720	611	1,331
2003/04	1,260	433	1693
2004/05	660	1,575	2,235
2005/06	731	848	2,048
Total	11,411	13,606	25,286

The power generating projects to be built by private investors in Indonesia are 26 units with a total capacity of 11, 411 or an average of 556 MW each, consisting of 3 gas combined cycle power plants with a total capacity of 771 MW (average 257 MW), 11 geothermal power plants with a total capacity of 2,190 MW (average 199 MW), 1 diesel power plant of 60 MW, 1 hydro power plant of 180 MW and 1 fired steam power plant with a total capacity of 8,210 MW (average 821 MW). There will be no new diesel power plant in the Java-Bali systems.

PLN divides Sumatera into four management areas with the exception of Batam special area. There are 12 power generating projects to be built by the private sector in Sumatera and Batam with a total capacity of 1,730 MW. They are small, on the average of 144 MW, in capacity. The projects are located in three management areas of PLN namely Area II (North Sumatera) having 6 projects with a total capacity of 1,170 MW, Area IV (Southern Sumatera) 4 projects totaling 380 MW in capacity and Batam having 2 projects with a total capacity of 180 MW.

Twelve power generating projects will be built by the private sector in Eastern Indonesia with a total capacity of 1,323 MW, or an average of only 110 MW each. Geothermal power plants will be included in the Area VII (North Sulawesi and Central Sulawesi) which is having 2 projects totaling 150 MW in capacity consist of 110 MW of coal fired steam power plant and 2 x 20 MW geothermal power plants at Lahendong geothermal field.

Due to the monetary crisis in Indonesia which affected a decrease in electricity demand, on November 1997 the government of Indonesia issued the Minister Decree to suspend the construction of power plants (as seen in Table 3) until economic growth reaches a suitable condition for the business environment to be accelerated and an economic recovery where the exchange rate becomes lower and stable at a reasonable level.

For illustration, the proportion of electricity consumption according to PLN's consumers can be seen in Table 4 below.

Table 2: Independent power producers (IPP) in Indonesia (data from PLN)

No.	Fuel	Project Title	Capacity (MW)	Operation schedule
1234	Coal	Paiton - I	1.32013e+35	1998-1999
5678	Coal	Paiton - II		1999
910	Coal	Tanjung Jati - B		1999
	Coal	Amurang		1999
	Coal	Sibolga - A		1999
	Gas/Combine	Sengkang		1997-1998
	Geothermal	Salak		1997-1998
	Geothermal	Dieng		1998-2000
	Geothermal	Wayang Windu		1998-1999
	Diesel	Pare-pare		1997
		Total		**Under construction**
1112	Coal	Jawa Barat	400	1999
1314	Gas/Combine	Pasuruan	500	2000
1516	Geothermal	Sarulla	330	1998-2001
1719	Geothermal	Patuha	220	1998-2000
2000	Geothermal	Karaha	220	1999-2002
0000	Geothermal	Kamojang Unit-IV	60	1998
0000	Geothermal	Cibuni	10	1998
0000	Geothermal	Bedugul	220	1998-2002
	Geothermal	Darajat	275	1999-2002
	Geothermal	Sibayak	120	1999-2002
	Coal	Tanjung Jati - A	1320	2001
	Coal	Serang	450	2000
	Coal	Cilacap	450	1999
	Gas/Combine	Palembang	136	1998-1999
	Hydro	Asahan	180	2000
	Coal	Tanjung Jati - C	1320	2003
		Total	**6211**	**Being suspended**

Table 3: Private geothermal power projects (data from PERTAMINA)

Geothermal plant	Location	Developer	ESC	Capacity/Year (MW)
Sarulla	North Sumatera	Unocal	Feb 27,1993	330/1999
Salak	West Java	Unocal	Nov 16,1994	165/1997
Dieng	Central Java	Cal Energy/HCE	Dec 2, 1994	170/1998-2000
Wayang	West Java	Asia Power/MNL	Dec 2, 1994	400/1998-2000
Patuha	West Java	Cal Energy/PPL	Dec 2, 1994	220/1998-2000
Karaha	West Java	Caithnes/KBC	Dec 2, 1994	220/1999-2001
Kamojang	West Java	PERTAMINA/LTBE	Dec 2, 1994	60/1996-97
Bedugul	Bali	Cal Energy/BEL	Nov 17, 1995	220/1998-2000
Cibuni	West Java	Yala Teknosa	Nov 17, 1995	10/1999
Sibayak	North Sumatera	PERTAMINA/Dizamatra	Jan 15, 1996	60/1999-2002
Darajat	West Java	Amoseas	Jan 15, 1995	275/1999/2002
Lahendong	North Sulawesi	PERTAMINA/PLN.	Nov 17, 1995	20/1999
				Total 2190 MW

Table 4: Electricity sales (in GWh/y) based on consumers in 1995 (modif. Ganda, 1995a and 1995b)

Area	Household	Industry	Commercial	Public	Total
Java	10,331.53	18,451.62	3,045.13	2,290.51	34,118.79
Indonesia	14,048.10	21,803.24	3,852.89	3,125.72	42,829.95

6. HUMAN RESOURCES

Currently the Indonesian Geothermal Association (INAGA) has a registered number of 369 staff members of various degree and education, being employed by several institutions or companies which are involved in geothermal activities, such as government agencies, PERTAMINA, private companies, consultants/contractors, PLN and university/educational institutions as seen in Table 5. The above members consist of national staff and foreign experts which are hired by the private power companies either as permanent staff or under contract agreement.

Table 5: Manpower in geothermal industry in Indonesia (* retired)

No.	Institution/Company	Manpower	Former UNU Fellows
1234	Amoseas Indonesia, Inc	132	
5678	Bali Energy, Ltd	24	
9101	Government Agencies	59	1*
112	Himpurna Cal Energy, Ltd	100	
	Karaha Bodas, LLC	14	
	Mandala Nusantara, Ltd	224	1
	Patuha Power, Ltd	25	
	PERTAMINA (State Oil & Gas Company)	250	8 + 1*
	PLN (State Electricity Company)	255	
	Universities	10	
	Unocal Geoth. Indonesia, Ltd	182	
	Unocal North Sumatera Geoth, Ltd	14	
	Total	**1289**	

Some national staff members have been trained abroad at several geothermal institutes, 11 students by United Nations University Geothermal Training Programme (UNU) in Iceland, others at the Geothermal Institute, Auckland University in New Zealand, Geothermal Institute at Pisa, Italy and Geothermal Training at Kyushu University in Japan.

Most of the 11 former UNU fellows in Indonesia are still working with PERTAMINA (8 employees) in various positions and 1 employee just finished his service in PERTAMINA last July 1998; 1 employee has retired from the Vulcanological Survey - Ministry of Mines and Energy; and I myself, am working with a joint operation company of PERTAMINA, namely Mandala Nusantara Ltd which has been awarded a total project (BOO) contract of the Wayang Windu area in West Java.

Transferring knowledge, technology and exchanging experiences under a reputable training center, for instance the UNU Geothermal Training Programme of Iceland is very useful for a shortcut upgrading of manpower skill which is required in geothermal development to maintain the efficiency of the project in the long term operation.

7. CONCLUSIONS

The role of power produced by the private geothermal industry is regarded as a supplement to the power produced by PLN, and not as a substitute. Therefore, the involvement of the private sector in electric power industry will be widely opened to meet the gap in power supply and demand, but it will be reduced gradually when the gap declines. The private power sector will supply 45% average of national electricity needs after the year 2000.

The government will enjoy more success in meeting their goals for geothermal development by using a longer term approach to planning. The unique aspects of geothermal energy need to be better understood and applied to advantage in the planning process. The installed capacity of the geothermal power share in national electricity plan until year 2004 will increase from the existing 589.5 MW to 2190 MW.

A long term electricity planning process that can accommodate success as well as failure may provide a more stable business environment which may lend itself to more economical energy pricing. Energy sales contracts should be made as large as possible, to cover the maximum power generation potential for each contract area.

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