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UPDATE ON GEOTHERMAL DEVELOPMENT IN INDONESIA

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SUMMARY – In 2004, the government of Indonesia set up a progressive geothermal target of 2000 MW by 2008 and 6000 MW by 2020. Another target is directed toward local capacity building. It is expected that the country will become a centre of excellence for geothermal industries, and local universities will provide the geothermal education program and the research facilities, to meet man power needs for supporting geothermal exploration and development in Indonesia.

Despite the efforts, progress towards the generation target is not quite as expected. Out of 1193 MW additional power capacity to be commissioned by 2008, most likely only around 340 MW can be realized. To establish local capacity building, in 2005 an MOU to pursue geothermal training has been signed among three Universities, namely ITB, UGM and UI, with PT PERTAMINA (Persero) and PT Rekayasa Industri. Moreover, ITB. Since 1995 they have had active geothermal programs, and a Masters Program in Geothermal Technology will start in 2007.

Future geothermal development in Indonesia will be dependent upon a number of factors, but mainly by the implementing regulations of the Geothermal Law to be issued by the government and electricity pricing.

1. INTRODUCTION

The economic crisis that started at the end of 1997 has negatively affected geothermal energy development in Indonesia. There was a great concern that the factor of five decline of the Indonesian currency relative to the US$ would result in the State-owned power company PLN, who control the whole electricity production, transmission and distribution in Indonesia, being unable to fulfil its agreement to purchase electricity under Power Purchase Agreements at prices ranging from US 6-8 cents per kilowatt hour for 30 years. In 1998, PLN reached total losses of almost 9.1 trillion Rupiah (US$1.4 billion). If the existing contracts remain unchanged, the losses will be extremely high and beyond the company capability. For this reason, restructuring of the Indonesian power sector is one of the main targets of economic reform. As part of the restructuring the power sector, the government suspended eleven geothermal projects and urged PLN to renegotiate the contracts.

In the middle of 2002, after a lengthy process, PLN, Pertamina and several Independent Power Producers (IPPs) completed the renegotiation process for electricity generated from Kamojang (unit-4), Darajat, Salak, Sibayak and Bedugul plants. They agreed to bring down electricity prices from US$ 6-8 cents per kilowatt hour to around US$ 4.5 cents per kilowatt hour. Geothermal contracts were refreshed and the projects were continued with a new pricing scheme.

The disputes were all settled with the single exception of the Karaha Bodas Co (KBC). Energy Sales Contract of Patuha and Dieng geothermal projects were taken over by the government. The The Patuha and Dieng project is operated by PT Geo Dipa Energy, a joint venture company of Pertamina and PLN, which was established to meet the prerequisite of the settlement. In 2003, Unocal Geothermal North Sumatra (UNSG) sold the Sarulla project rights and interests to PLN. The Cibuni project, which was a small scale development, was taken over by PLN. Wayang Windu project was acquired by Star Energy from a Deutsche Bank-led consortium in November 2004.

To provide a legal framework for geothermal energy development in the future, the Indonesian House of Representatives passed a Law on Geothermal in 2003 (UU No. 27/2003). The following year, a road map for geothermal energy was developed, establishing a progressive target of geothermal development from 2004 to 2020.

Suryantoro et al. (2005), Ibrahim et al. (2005) and Fauzi et al. (2005) presented the road map at the World Geothermal Conference 2005. They also updated the progress on geothermal developments in Indonesia until early 2005. Early this year, at a geothermal seminar in Bali, the Department of Energy and PLN discussed the target set for each geothermal project to be developed until 2012.

The outlook has been optimistic. Until today, however, the target set for 2006 has not been achieved. Based on the achievement reach today, it is supposed that the incremental capacity by 2008 will be short of the incremental target set by the government.

This paper provides a brief update on geothermal development in Indonesia, covering road map for geothermal development up to the year 2020, the current status, the local capacity building and the barriers facing geothermal development in Indonesia.

2. ROAD MAP FOR GEOTHERMAL DEVELOPMENT 2004 - 2020

In 2004 the Department of Energy and Mineral Resources of Indonesia issued a Blue Print for Geothermal Development in Indonesia from 2004 up to 2020. Since 2005, the road map has become part of the 'Blueprint for National Energy Management 2005-2025'. For geothermal development, the government set a progressive target of 2000 MW by 2008 and 6000 MW by 2020 (Table 1), representing about 3.8 % of the total electricity generated in Indonesia. The low cost and plentiful supply of coal dominates the new electricity generation in Indonesia. For comparison, over the next three years, PLN plans to add 10000 MW electricity generated using coal-fired plants.

Table-1 Geothermal Development

Year	Capacity (MWe)	Incremental Capacity (MWe)
2004	807	
2008	2000	1193
2012	3442	1442
2016	4600	1158
2020	6000	1400

Another government target is directed toward local capacity building. It is expected that the country will become a centre of excellence for geothermal industries, and local universities will provide geothermal education program and research facilities, to meet man power needs for supporting geothermal exploration and development.

3. PLAN OF DEVEVELOPMENT 2004-2008

The government set up a target of 2000 MW electricity generated using geothermal energy by 2008. Hence, the installed geothermal power capacity will increase to 1193 MW. To achieve this target, the capacity of the existing geothermal power plants will be increased along with development of a number of existing geothermal areas where the resources have been proven by drilling. The geothermal areas are listed in Table 2.

A new geothermal plant (Unit-4), with power generating capacity of 60 MW, is currently being constructed at the Kamojang geothermal field. The plant, which is owned by Pertamina, is to be commissioned by 2008. Pertamina awarded the construction contract to an Indonesian company, PT Rekayasa Industri in February 2006.

The Salak Geothermal Project, which has the largest geothermal plant in Indonesia (6 x 55 MW), has been acquired from Unocal Geothermal Indonesia (UGI) by Chevron Geothermal Indonesia Ltd, which has also operated the Darajat geothermal area. The capacity of the Salak power plant remains the same until 2008, but the one at Darajat will expand with unit 3 of 110 MW.

Table-2 Geothermal Development 2004-2008

AREAS	EXISTING CAPACITY (MW)	INCREMENTAL CAPACITY BY 2008 (MW)	PROJECTED BY 2008 (MW)
Kamojang	140	60	60
Salak	330	-	
Darajat	145	190	110
W-Windu	110	110	110
Lahendong	20	60	40
Dieng	60	120	
Sibayak	2	10	10
Bedugul	-	10	10
Patuha	-	120	
Sarulla	-	220	
Lumut Balai	-	110	
Ulubelu	-	110	
Cibuni	-	10	
Karaha	-	55	
Mataloko	-	2	
Ulumbu	-	6	
	807	**1193**	**340**
TOTAL		**2000**	**1147**

The Wayang Windu project, which was acquired by Star Energy from a Deutsche Bank-led consortium in November 2004, will be expanded to double its capacity by 2008. PLN and Star Energy agreed to a price of US$ 4.94 cents per kilowatt hour. The drilling of development wells to support the unit-2 power generation has started. Star Energy plans to drill 12 development wells in stage

The Lahendong power plant will be expanded with 2 x 20 MW. In October 2006, PLN signed a contract with Japan's Sumitomo Corporation to construct unit-2, valued at USD 28.5 million. Sumitomo has taken on Japan's Fuji Electric and PT Rekayasa Industri as partners in the project. Construction of unit-2 will take approximately 20 months.

At the Sibayak geothermal field, a small generating unit with a capacity of 2 MW has been in operation since October 2000. Pertamina has drilled ten wells in the area, several of them will

supply steam to a power generating unit of 10 MW to be built by an Indonesian private company, PT. Dizamatra. The plant is projected to be commissioned in 2008.

A geothermal power plant of 10 MW will be built by Bali Energi Limited at the Bedugul field. Two out three deep wells, drilled in the 1990s, have successfully produced geothermal fluid. Concerns about the project, however, have been raised by various Balinese communities, religious leaders and environmental groups. The Bedugul area is considered holy and sacred. Resistance to the project results from concern that the utilisation of geothermal energy will destroy the forest and also will have negative impact on Lake Beratan, Lake Balian and Lake Tamblengan.

Continuing efforts are being made by Bali Energi Limited and also by the government to convince Balinese communities, religious leaders and environmental groups about the benefits of a geothermal power plant for Bali, which until today still highly depends on electricity generated on Java. Efforts made by Bali Energi and the government include educating the public about the advantages of geothermal energy over other means of electricity generation, and its minimal environmental and operational impacts and high capacity factor.

At Dieng geothermal area, a power plant with an installed capacity of 60 MW is operated by PT Geo Dipa Energi. The expansion of Dieng (2 x 60 MW) and the development of Patuha (3 x 60 MW), which was planned to be commissioned in 2008, most likely will be delayed by a year or two. Legal issues related to asset relinquishment from the Ministry of Finance of Indonesia to PT Geo Dipa Energi remains unsettled. There is growing concern that due to uncertainties of this matter, the financier of the Dieng and Patuha geothermal projects will lose its interest.

The Sarulla project has been released by Unocal Geothermal North Sumatra (UNSG) to PLN. In August 2006, a consortium consisting of Medco Energi Internasional Tbk, Ormat International, Inc., and Itochu Corp. of Japan, were declared the winner of a tender issued by PLN for the development of Sarulla project. The Sarulla power plant will be constructed over the next five years in 3 phases, of 2x110 MW and 1x120 MW. The first power generating unit is projected to be operational in 2009, while the second and the third unit in 2010.

Apart from expanding Kamojang, Lahendong and Sibayak fields, Pertamina plans to develop Ulubelu (Lampung) and Lumut Balai (South Sumatra) geothermal fields. Exploration wells drilled at Ulubelu have proved the resource. The wells encountered a steam cap overlying a liquid dominated resource with temperatures from 210° C to 230° C. To cover the increasing electricity demand in the southern part of Sumatra a two-unit geothermal power plant with a capacity of 2x55 MW will be built at Ulubelu. Pertamina will operate the steam field and sell the steam for electricity generation to PLN. JBIC is committed to finance the power plant project. Recent estimates suggest that agreement on steam prices between Pertamina and PLN will not be reached within a short period of time. The plant, which is projected to be commissioned in 2008, will probably be commissioned in 2010.

To prove the resource at Lumut Balai geothermal area, Pertamina planned to drill two exploration wells this year, however, no drilling rigs are available. As at Ulubelu, Pertamina plans to build a two-unit geothermal power plant with a capacity of 2x55 MW at Lumut Balai. As for Ulubelu, Pertamina will operate the steam field and sell the steam for electricity generation to PLN. It is reported that PLN is seeking a soft loan from JBIC to finance the power plant project. The plant, which is projected to be commissioned in 2008, will probably be commissioned in 2011.

Mataloko (Nusatenggara) & Tulehu (Maluku) projects are being developed by PLN. Exploration well has proven the resources. To meet electricity demand in the surrounding region, PLN plans to build a small scale power plant of 2 MW at Mataloko and of 6 MW at Ulumbu.

If all the developments planned for Kamojang, Darajat, Wayang Windu, Lahendong, Sibayak and Bedugul come on-line by 2008, the installed geothermal power capacity will increase only by 340 MW, about 70% short of the incremental target, and total capacity in 2008 will only reach 1147 MW, about 50% short of the target set by the government.

4. PLAN OF DEVELOPMENT 2008 – 2012

For the year 2012, the government set up a target of 3442 MW electricity generated using geothermal energy. To achieve this target, the strategy remains on increasing the capacity of the geothermal power plants that have come on-line by 2008 and developing a number of geothermal areas whose rights have been awarded to PLN (Tulehu at Ambon Island) and to Pertamina (Kotamobagu at Sulawesi, Iyang-Argopuro at Yogyakarta Region, Sungai Penuh at Sumatra and Hulu Lais at Sumatra).

Achieving this target will be dependent upon a number of factors. The barriers that have hindered the development of geothermal resources by Pertamina can be classified into two, internal and external. Within Pertamina, for the past few years, geothermal projects have been treated as second priority, as oil and gas project offer more attractive rates of return. Certainly, this barrier

will no longer exist after the share holder of Pertamina agrees to separate the management of geothermal from those of oil and gas as requested by the Law, by establishing PT. Pertamina Geothermal Energi, a wholly owned subsidiary company of Pertamina.

The external factor that may hinder the development of geothermal resources by Pertamina is in achieving agreement on steam price with PLN. Low steam and electricity prices are obviously the main target of PLN. For Pertamina, on the other hand, steam and or electricity prices should offer Pertamina an attractive rate of return.

Table-3 Development Target 2008-2012

AREA	INCREMENTAL CAPACITY BY 2008, MWe	INCREMENTAL CAPACITY BY 2012, MWe
Kamojang	60	60
Salak	0	110
Darajat	190	110
W-Windu	110	110
Lahendong	60	40
Dieng	120	60
Sibayak	10	40
Bedugul	10	110
Patuha	120	60
Sarulla	220	220
Lumut Balai	110	110
Ulubelu	110	110
Cibuni	10	-
Karaha	55	55
Mataloko	2	6
Ulumbu	6	-
Tulehu	0	16
Kotamubagu	0	60
I-Argopuro	0	55
Sungai Penuh	0	55
Hulu Lais	0	55
	1193	**1442**
TOTAL	**2000**	**3442**

The target set by Pertamina for Lahendong, Sibayak, Ulubelu and Lumut Balai is rational and achievable. Pertamina, however, may face barriers in developing Unit-5 at Kamojang, as the expansion area is overlapping with protected forest.

Geological, geochemical and geophysical exploration indicated that Kotamobagu (Sulawesi), Sungai Penuh (Sumatra), Hulu Lais (Sumatra) and Iyang-Argopuro (Yogyakarta Region) have promising geothermal potential. It is estimated that Kotamubagu has a possible reserve of 185 MW, Sungai Penuh of 160 MW, Hulu Lais of 500 MW and Iyang-Argopuro of 185 MW. Unproven reserve availability, however, implies a high degree of uncertainty.

Based on projected achievement of geothermal development in Indonesia by 2008, it is suggested that Indonesia's geothermal power capacity by 2012, will also be short of the incremental target set by Government.

5. PLAN OF DEVELOPMENT 2012 – 2020

The total installed capacity of geothermal power plants in Indonesia is expected to progressively increase to reach 4600 MW by 2016 and 6,000 MW by 2020. To achieve these targets, the government will offer in the near future a number of new work areas. In accordance with the Geothermal Law (Law No. 27/2003), the central or local government authorities will define the work areas and then tender them to business entities.

The areas that may be offered include Seulawah Agam, Gunung Sekincau, Suoh Antatai, Rawa Dano, Gunung Karang, Cisolok Cisukarame, Tangkuban Perahu, Ijen and Sorik Merapi (Atmojo, J.P., 2006).

Some of the incremental capacity by 2016 may also be obtained from the expansion of several power plants (Table-4).

Table-4 Incremental Target by 2016

AREA	INCREMENTAL CAPACITY BY 2016 (MW)
Lahendong	20
Dieng	60
Sibayak	20
Sarulla	110
Lumut Balai	110
Ulubelu	55
Kotamubagu	60
Iyang Argopuro	55
Sungai penuh	55
Hulu Lais	55
TOTAL	**600**

A number of companies have shown interest in mining rights and permits for exploring and or for developing new geothermal work areas. The absence of regulations to implement the Geothermal Law has held up the central or local government authorities to offer new work areas. Early this year the Department of Energy and Mineral Resources submitted the draft of the implementing rules and regulations to the State Secretary, the President's approval has not been awarded yet.

One of the barriers that may hinder the development of new geothermal work areas is related to bureaucracy and uncertainties. Investors may experience these problems if the central and local government authorities do not have standard procedures for tendering projects, issuing permits and supervision. Other barriers that may discourage investment in geothermal projects among others are pricing, unstable political

environment, ineffective regulatory framework and limited availability to data about geothermal systems in Indonesia.

To reduce barrier and to speed up approval processes for exploration and resources development, it is important that the staff of the local government authorities have a comprehensive knowledge about geothermal activities, from upstream to downstream, and also have a good understanding about legal, technical and economics aspects of geothermal development.

6. LOCAL CAPACITY BUILDING

According to Geothermal Law, the use of local products, services, technology, equipment manufacturing and construction of geothermal energy facilities should be increased to its maximum level.

In the Road Map of Geothermal Development from 2004-2020, local capacity building has been one of the targets set by the government. It includes the establishment of a centre of excellence for geothermal industries and the utilisation of local man power for supporting geothermal exploration and development in Indonesia. It is expected that local universities will provide geothermal education program and research facilities for supporting geothermal activities in Indonesia. In achieving this target in 2005, a Memorandum of Understanding (MOU) to pursue geothermal training has been signed among three Universities, namely ITB, UGM and UI, with PT PERTAMINA (Persero) and PT Rekayasa Industri. Moreover, Institut Teknologi Bandung (ITB), which since 1995 has had active geothermal programs, will start a Masters Program in Geothermal Technology in 2007.

To support geothermal development in Indonesia, the Geothermal Laboratory of ITB developed Geothermal Management Information System in 1998 a data base for Geothermal Resources in Indonesia. These data, however, have not been updated.

Other software developed by the Geothermal Laboratory of ITB is SAR-Geothermal, which stands for *Sistem Analisa Resiko* Geothermal. This software was developed in 1999 to provide a tool for users to determine the price of generated electricity, rates of return and other economic parameters of the invested capital of the proposed geothermal projects. The software program is designed to have eight categories of information and function, namely general project information, geothermal resource data, exploration data, plan of development, including power plant and steam field, cost, project scheduling and economic analysis.

For engineering applications, the Geothermal Laboratory of ITB developed GES in 1997, which stands for Geothermal Engineering Software, to facilitate (i) the storage of data and the calculation of output from geothermal wells, from production tests (lip pressure, calorimeter and separator tests) (ii) the calculation of pressure drop in a well and in transmission lines (steam-water line and steam line), (iii) the prediction of the output from geothermal wells, (iv) the analysis of data resulting from transient tests (pressure build-up, pressure draw down) and (v) the calculation of power output and steam consumption.

To help the engineers work more effectively and efficiently in conducting various analyses, a the Laboratory of Geothermal developed GeTools, which stands for Geothermal Engineering Tools, and consists of four tool boxes: (1) drilling toolbox, (2) reservoir engineering toolbox, (3) production engineering toolbox and (4) fluid properties & geochemistry toolbox (Saptadji, N.M et al., 2005).

Apart from developing software, the geothermal laboratory of ITB has been active in providing educational materials, developing short courses and responding to inquiries from the industries and government.

7. CONCLUSION

1. The target set by the government for the year 2008 is difficult to achieve. By 2008, the installed geothermal power capacity will increase only by 340 MW, about 70% short of the incremental target.
2. The future of geothermal in Indonesia will be dependent on the implementing regulations of the Geothermal Law.
3. Business players expect the implementing regulations of the Geothermal Law will soon be issued by the government.
4. Pricing remains the core problem for future geothermal development in Indonesia.

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