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Geothermal Resources Development in Indonesia: A History

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ABSTRACT

This paper describes a history of geothermal resources development in Indonesia. The country which is known as "The Ring of Fire", that starting from the northern tip of Sumatra and passing through Java, Bali, Nusatenggara, Sulawesi and Moluccas islands. Indonesia has 500 volcanic cones and more than 200 volcanoes, in which 129 are active.

The geothermal exploration in Indonesia started in 1918 during the Dutch colonial era, and in 1926 the five test borings were carried out in Kawah Kamojang field-West Java, in which the third being the first that was successful. After that time not much activities were reported and likely cooled down

The new era of exploration started in the beginning of 1970's, in which a prefeasibility study for electricity generation was initiated in 1972 with technical assistance from New Zealand, Italy, USA, and Japan. The result of these studies were used as a basis to issue new policies to accelerate geothermal development and encourage energy diversity in the country and by the end of 2011 299 locations are identified across the Archipelago with estimated resources of 29 GWe or 40% of the world's potential geothermal resources.

Currently Indonesia is the world's third largest geothermal electricity producer with installed production capacity of 1,345.3 MWe. At present, Government of Indonesia/Minister of Energy and Mineral Resources (GoI/MEMR) has tendered 6 locations of geothermal prospect that is ready to be developed, and issued 26 new geothermal working areas (GWA), whilst up to 40 further working areas are expected to be offered at a later date.

1. INTRODUCTION

Indonesia lies along what is known as "the Pacific Ring of Fire", a vast belt of high volcanic activity surrounding the Pacific Ocean (figure 1) and has 500 volcanic cones and more than 200 volcanoes, in which 129 are active (Badan Geology Indonesia/BGI, 2011). Whilst the volcanoes and earthquakes common to this geological zone can be highly destructive, this condition also have a positive side such as gives a big potential of geothermal energy. Currently, the geothermal energy resources that have been confirmed span from Sumatra to East Nusa Tenggara and have the potential to produce up to 29,000 MWe of electricity across 299 locations or equal to 40 percent of the total global potential geothermal energy resources in the world. Half of this potential is found in Sumatra and Java (MEMR and NCCI/National Council on Climate Changing Indonesia, 2011, Jarman, 2012).

Figure 1: Indonesian position in The Ring of Fire

Early geothermal exploration in Indonesia was carried out by Dutch Colonial in 1918-1928 in Kamojang, West Java,. Until the year of 1926, Dutch has made five geothermal exploration drillings, but the one succeeded in producing steam was only wells KMJ-3 with the depth of 66 meters. Until now KMJ-3 still produces natural dry steam (Neuman van Padang, 1960b, www.esdm.go.id).

Sixty eight years later, on January 1983, Kamojang was inaugurated as the first Geothermal Production Field in Indonesia, (Raja, 1995, BGI, 2011, www.esdm.go.id) and then is followed by other geothermal fields that start to produce electricity, such as Mt. Darajat (1994), (Raja, 1995, Fauzi, 1998, 2001, Mawardi et.al, 2010), Mt.Salak (1994), (Mawardi, 2010, Fauzi, 1998, 2001), Mt, Sibayak (1997), (Siregar, 2004), Mt.Dieng (1998), (Fauzi, 2001, 2005), Mt.Wayang Windu (2000), (Fauzi, 2005, Mawardi, et.al, 2010), Lahendong (2001), (Fauzi 2005), Mataloko (2008), (rapit.files.wordpress.com, 2011, BGI,2 011), Ulubelu (2011), (Pertamina, 2008, Purwono, 2010, repit.files.wordpress.com/2013), and Ulumbu (2012), (www.pln.co.id, 2011, 2014). However, while geothermal resources offer the potential of 29,000 MWe of electricity, only 4.6 percent (1,345.3 MWe) has been developed in the past 30 years, since Kamojang was launched as the first geothermal power plant in Indonesia. The progress on its rate of production, however, is occuring at a very slow pace. At present Indonesia, even though as the third largest electricity producer, has one of the lowest elctrifications rate (66 percent) in Asia (MEMR and NCCCI, 2011, Jarman, 2012).

The development of Indonesia's geothermal energy potential is important as the country's electricity demand increases by 7-8 percent annually (Fadillah et.al. 2010, Surya Darma et et al, 2010). In accordance to that, Strategic Plan of the Goverment of Indonesia (GoI), by 2025 Indonesia aims to produce more than 9,000 MWe of geothermal power, this would account for 25 percent of the total geothermal energy (MEMR and NCCCI, 2011, Jarman, 2012). To support the GoI plan, MEMR has tendered 6 locations of geothermal prospect that are ready to be developed, and issued 26 new geothermal working areas (GWA) that have been tendered , whilst up to 40 further working areas are expected to be offered at a later date (Badan Geologi, 2011, Jarman 2012, MEMR and NCCCI, 2011) and together with new policies.

2. HISTORY OF GEOTHERMAL EXPLORATION AND DEVELOPMENT

In 1918, during the Dutch colonial era, JB. Van Dijk proposed to harness geothermal energy in Kawah (crater) Kamojang, West Java. It is the starting point for the geothermal development history in Indonesia. Coincidently, the event coincided with the beginning of harnessing the geothermal steam to generate electricity in Larderello-Italy.

2.1 Years of 1918 – 1928

At the time five test borings were drilled in Kawah Kamojang (West Java) geothermal field, the third well (KMJ-3) being the first that was successful with the depth of 66 meters. Until now KMJ-3 is still discharging superheated dry steam to the atmosphere. Since 1928, Indonesia's geothermal activity practically stopped and only resumed in 1964 (Neuman van Padang, 1960b, www.esdm.go.id).

2.2 Years of 1970's

From 1971 to 1981, investigation of geothermal resources was conducted jointly by Geological Survey of Indonesia, (GSI-Bandung) and New Zealand (NZ) Government, USA, Italy and Japan (Wilson, 1982, Radja, 1995). In 1972, a more comprehensive investigation was carried out in Kamojang involving geological mapping, geochemical, and geophysical. In the same year, six geothermal wells had been drilled in the Dieng Mountains, with depths of 613 meters, (repit.files.wordpress.com. 2013). Unfortunately, none of them had found geothermal steam. In that year, Cisolok, West Java, and the Kawah Ijen, East Java, also had an investigation conducted (www.esdm.go.id). Then in 1974, PT. Pertamina (State Oil Enterprise) and PT. PLN (State Electrical Enterprise) collaboration with NZ Government was more intense to carry-out geothermal surveys in Kamojang for the development of 30 MWe power generation, and completed them in 1977 (Wilson, 1982). In addition, Pertamina was also developing two monoblocks with a total capacity of 2 MWe in the field of Kamojang and Dieng. Inauguration was made on November 27, 1978 for the Kamojang monoblock and on May 14, 1981 for the Dieng monoblock (Wilson, 1982, Fauzi, 1995, Indonesian Power, 2010). Kamojang Geothermal power plant (PLTP) itself was inaugurated 5 years later. The year of 1974 was a significant development year in Kamojang, when Pertamina with PLN (State Electrical Enterprise) developed the geothermal field with geothermal exploration wells with a depth of 600 meters which produces geothermal steam with bursts up.

Outside Java, geothermal resources were investigated in Bedugul-Bali, Lahendong-North Sulawesi, Lampung and Kerinci (Sumatra). Survey teams, GSI-PLN, collaborated with NZ Goverment to visit geothermal fields in Lahendong (1971), Bedugul-Bali (1974), Lampung and Kerinci (1977/1978) (Radja, 1995, Wilson,1982).

2.3 Years of 1980's

In the 1980s, the development of geothermal business discharge characterized by Presidential Decree (PD) No. 22 of 1981 replaced the PD. No. 16 of 1974. According to the provisions of PD. no. 22/1981, Pertamina was appointed to conduct the survey and exploitation of geothermal exploration in Indonesia (BGI, 2011). On that basis, since 1982, activities in Lahendong were continued by Pertamina to conduct a survey of geology, geochemistry, and geophysics.

In 1982, Pertamina also signed a working contract with a geothermal company, Unocal Geothermal of Indonesia (UGI), for geothermal wells in G. Salak, West Java, and started to produce 12 years later. Meanwhile, in February 1983, five years after the first Kamojang mono block was inaugurated, Kamojang Geothermal power plant was started for commercial use with a capacity of 30 MWe, which is then followed by unit 2 and 3 (2X 55 MWe) in 1988 and unit-4 5 years later. (repit.files.wordpress.com, 2011, www.esdm.go.id).

Scientific exploration on the Flores Island was intensified in the 1980's and concentrated effort was directed towards Ulumbu, a geothermal area in Manggarai. Much of the scientific work was conducted by Vulcanological Survey of Indonesia (VSI) Bandung, a GoI institution, in collaboration with PLN, JICA (Japan International cooperation Agency) and NZ Goverment. In 1989, a decision was made to asses the technical and economical feasibility of setting up a smal scale (3 MWe) geothermal plant (Radja, 1995, Kasbani et.al, 1998, Ibrahim, 2008)

In 1985 Pertamina performed geology and geophysic survey to discover Wayang Windu geothermal field and it was then followed by shallow drilling at the site, (Fauzi, 1998, repit.files.wordpress.com. 2013).

2.4 Years of 1990's

In 1991, the Government replaced PD No. 22/1981 to PD No. 45/1991. In PD No. 45/1991 Pertamina get flexibility, along with the contractor, to conduct exploration and exploitation of geothermal. Pertamina was also given more freedom to sell steam or electricity to PLN or to any legal entity licensee to electricity. In addition, in 1991, PD No. 49/1991 also issued to replace PD No. 23/1981 which regulates the geothermal business tax from 46% to 34%. The aim is to stimulate increased use of geothermal energy (BGI, 2011).

In 1993, under bilateral technical cooperation PLN and NZ Goverment carried out drilling activities in Ulumbu geothermal field, whilst production drilling activity commencd in 1994. By 1995, plans were in place for geoscientific studies of seven locations where a mini geothermal plant development was possible. (Radja, 1995, www.pln.co.id 11/11)

In 1994, working contracts were signed between Pertamina's geothermal and four private companies, such Wayang Windu, West Java (P.T. Mandala Nusantara), Karaha, West Java (P.T. Karaha Bodas), Dieng, Central Java (P.T. Himpurna California Energy), and Patuha, West Java (PT Patuha Power Limited). At the same time, 1994, Gunung Salak (unit- 1 and – 2/55 MWe each) and Darajat (unit-1/20 MWe) started to produce the electricity commercially. Three years later, 1997, Gunung Salak unit 3 (55MWe) and 4 (65 MWe) geothermal power plant was inaugurated commercially. Meanwhile, Dieng unit-1 power plant was certified for commercial operation a year later, in July 1998 after 17 years since its first monoblock was inaugurated, (www.esdm.go.id, repit.files.wordpress.com/2011-2013, www.starenergy.co.id)

Henceforth, in 1995, Pertamina and PLN signed a contract (JOC/joint operation contract & ESC/electricity sale contract) for the exploitation and utilization of geothermal in the area of Batukahu, Bali. At the same time Pertamina issued a MOU to PT PLN to build geothermal power plants (1×20 MWe) in Lahendong, North Sulawesi and monoblock (2 MWe) in Sibayak, North Sumatra, which was started to generate elctricity 6 and 2 years later, respectively. Sibayak was investigated by Pertamina between 1989-1999 using various geoscientific methods and drilled 10 holes during 1991-1997 and then a 2 MWe monoblock was built to generate geothermal energy (Fauzi, 1995, 2001, repit.files.wordpress.com/2013). Pertamina committed to develop new power generation using the steam resources from the other wells.

Comprehensive surveys were conducted in Ulubelu Lampung in 1990, (Fauzi,1998, Purwono, 2010) and three years later (1993) three exploration holes had been drilled by Pertamina, while power plant construction was started 14 years later.

Mataloko geothermal fields have been surveyed comprehensively using integrated geoscientific study by VSI (Indonesia), NEDO and Geological Survey of Japan (GSI-Japan) in 1997-2002 and followed by 4 drilled wells. The resource potential was estimated as 63 MWe, (Kasbani 1998, repit.files.wordpress.com/2011).

The severe economic crisis that started in late 1997 has adversely affected the power sector demand and growth in the country. This had resulted in signifant delays to several geothermal projects in the advanced exploration and development stages, (i.e. 9 conventionally power IPP and 7 geothermal project).

Up to the year of 2000, or 3 years after the crisis (1997) no significant development in geothermal activities for new geothermal fields, except the existing geothermal plants was increasing their electricity capacity.

2.5 Years of 2000's

After struggling with the 1997 monetary crisiss that hit Indonesia, Pertamina acquired the privilege to increase the capacity of Kamojang geothermal field from 140 to 200 MWe. During 1989-2002, Pertamina drilled 13 wells to secure a total steam potential of about 74 MWe at the wellheads. And then, after a 2 year costruction period the Kamojang Unit-4 commenced commercial operation in August 2008. At present, Kamojang delivers a total of 200 MWe of electricity, (www.esdm.go.id, Jarman, 2012), MEMR and NCCCI, 2011, Mawardi Agani, 2010)

After financial crisis in 1997, the first unit (110 MWe) at Wayang Windu was completed in 1999, and has been producing at full capacity since 2000, and then 9 years later on 2nd March 2009, Wayang Windu Unit-2 was offically opened with the generation capacity for single turbine of 117 MWe. So, Wayang Windu is now delivering a total of 227 MWe of electricity to PLN, (www.esdm.go.id, Jarman, 2012, MEMR and NCCCI, 2011, Mawardi Agani, 2010, Registered cdm project, 2010). Planning is now to expand Wayang Windu further through an addition of a third unit with generation capacity of 127 MWe, that should be on line by mid-2014, (repit.files.wordpress.com/2013, www.starenergy.co.id).

In Lahendong, the 20 MWe PLTP unit-1 began its commercial operation in 2001, after an extended contruction period following the Asian financial crisis in 1997. The development of Lahendong PLTP unit-2 (20 MWe) began in 2004 and started its comercial operation in 2007. For Lahendong unit-3 (20 MWe), test operation has been carrid out in 2009, and then, 2 years later Lahendong unit-4 began its commercial operation in 2011. That means, up to know Lahendong PLTP is now delivering a total of 82.5 MWe of electricity to PLN, (www.esdm.go.id, Jarman, 2012, MEMR and NCCCI, 2011, Registered cdm project, 2010, repit.files.wordpress.com/2013).

Six years later after Darajat Unit-1 (55MWe) started commercial operation in 1994, the Darajat PLTP Unit-2 was officially open in 2000, with generation capacity of 94 MWe, and then 7 years later in August 2007 Derajat Unit-3 (122 MWe) began its commercial operation. Currently Darajat is now delivering a total of 271 MWe of electricity. (www.esdm.go.id, Jarman, 2012, MEMR and NCCCI/2011, Mawardi Agani, 2010, Registered cdm project, 2010, repit.files.wordpress.com/2011)

In 2002, Gunung Salak unit 5 and 6 began its commercial operation, in which each unit can supply geothermal energy of 65 MWe. In 2005, unit 1-3 had been upgraded to 60 MWe each, that means the total capacity is 375 MWe, (www.esdm.go.id, Jarman, 2012, MEMR and NCCCI, 2011, Mawardi Agani, 2010, Registered cdm project, 2010)

Up to now Dieng PLTP has a capacity of 1x 60 MWe, and currently activities are being conducted to fulfill the target through capability upgrade and development of Dieng Unit 2 and 3 project with the capacity of 60 MWe each, (www.esdm.go.id, Jarman, 2012, MEMR and NCCCI, 2011, Mawardi Agani, 2010, Registered cdm project, 2010, repit.files.wordpress.com/2013)

Currently there is no increasing electrical capacity at Sibayak geothermal power plant, and at present its still deliver of 12 MWe electricity, (Jarman, 2012, www.esdm.go.id , Registered cdm project, 2010).

Mataloko PLTP is a GoI/MRMR pilot project for small scale geothermal power plant in eastern Indonesia , and in 2011 Mataloko delivered a 1.8 MWe of electricity, (www.esdm.go.id, repit.files.wordpress.com/2011)

Intensive exploration and drilling activities in Ulubelu geothermal field was started in 2007, and up to 2009, 8 wells have been drilled to generrate 2 X 55 MWe electric capacity. And then, in 2012, Ulubelu unit 1 and 2 started to operate commercially to deliver 110 MWe of electricity to PLN, (repit.files.wordpress.com/2013, www.pln.co.id/2012)

Trial exploration of the electricity that utilize the geothermal resources in Ulumbu began with drilling the first well in 2003. Drilling resumed later in 2006 for the second and the third wells. Testing of the power supply from Ulumbu geothermal Pawer plant (PLTP) officialy operated in the beginning of November 2011 for 100 kW electricity from the total capacity of 2 x 2.5 MWe to 4 villages. Late November 2 x 2.5 MWe was distributed to the city of Ruteng, and in 2012 the elctricity went to neighboring districts and then starting in 2013 across the mainland Flores, (www.gdereno.co/2014, www.pln.co.id/2011

Table 1 shows the summary of the history of geothermal exploration and development in the country prior or post to the financial crisis (1997 – 2000) in Indonesia (BGI, 2011, Jarman, 2012, MEMR and NCCCI, 2011, Fauzi, 2001, Mawardi Agani, 2010, Registered cdm project,2010, Suryadarma 2010, www.esdm.go.id).

Table 1: Summary of Geothermal Development Scheme and Power Plant in Indonesia (prior or post to Financial Crisis 1997-2000)

NO	Power Plant-Location	Develop. Year/ Commencement Date	Capacity (MW)	Steam field Operator	Power Plant Operator	Potency
1	**Kamojang-West Java**					400
	Unit-1	1980's /1983	30	Pertamina	PLN (S.O.Elct.Comp)	
	Unit-2	1980's /1987	55	Pertamina	PLN (S.O.Elct.Comp)	
	Unit-3	1980's / 1987	55.	Pertamina	PLN (S.O.Elct.Comp)	
	Unit-4	1989-2002/2008	60	Pertamina	Pertamina	
	Total		**200**			
2	**Darajat-West Java**					432
	Unit-1	1984/1994	55	Indon. Pwr/PLN	Chevron	
	Unit-2	1995/2000	94	Chevron	Chevron	
	Unit-3	1995/2007	122	Chevron	Chevron	
	Total		**271**			
3	**G. Salak-West Java**					600
	Unit-1	1990's-/2005 /1994	55/60	Unocal/Chevron	Unocal. Then after 15	
	Unit-2	1990's-2005/1994	55/60	Unocal/Chevron	Years transfer to PLN	
	Unit-3/1990's/2005	1990's-2005/1997	55/60	Unocal/Chevron	Unocal. Then after 15	
	Unit-4/1990's	1990's /1997	65,6	Unocal/Chevron	Years transfer to PLN	
	Unit-5	1994/2002	65,6	Unocal/Chevron	Unocal. Then after 15	
	Unit-6/	1994/2002	65,6	Unocal/Chevron	Years transfer to PLN	
	Total		**377**			
4	**Dieng/Central Java**					580
	Unit-1	1994/1998	60	Cal.Energi to Geodipa	Cal.Energi to Geodipa	
	Total		**60**			
5	**Sibayak/ N.Sumatra**					170
	Phase 1	/1990's /1997	12	Pertamina	PLN	
	Total		**12**			
6	**W.Windu/W.Java**					385
	Unit-1	1994/2000	110	MNL/Star Energy	PLN	
	Unit-2	1997/2008	117	MNL/Star Energy	PLN	
	Total		**227**			
7	**Lahendong/N.Sulawesi**					175
	Unit-1/1990's	2001	20	Pertamina	PLN	
	Unit-2/2004	2007	20	Pertamina	PLN	
	Monoblock binary/2007	2007	2.5	Pertamina	PLN	
	Unit-3/ 2007	2009	20	Pertamina	PLN	

	Unit-4/ 2009	2013	20	Pertamina	PLN	
	Total		**82.5**			
8	**Mataloko/NTT**					63
	Monoblock	1992-2002/2011	1.8	ESDM/MEMR	PLN	
	Total		**1.8**			
9	**Ulubelu/Lampung**					300
	Unit-1	2007/2011	55	Pertamina	PLN	
	Unit-2	2011/2012	55	Pertamina	PLN	
10	**Ulumbu/NTT**		**110**			150
	Unit-1	2000's /2011	2.5	Pertamina	PLN	
	Unit-2	2000's /2012	2.5	Pertamina	PLN	
	Total		**5.0**			
	Total (10 PLTP)		**1345.3**			

(Source :www.esdm.go.id, Jarman 2012, MEMR and NCCCI, 2011, Mawardi Agani 2010, Registered cdm project,2010)

3. GEOTHERMAL RESOURCES DEVELOPMENT

Past regional studies on the total geothermal potential of Indonesia indicated around 16,000 MWe may be present. In 1994, a study by the Department of Mines and Energy concluded the resources potentials were 22,710 MWe (Raja 1994) with 207 locations spread along the Archipelago. Ten years later, in 2005, a study by Ministry of Energy and Mineral Resouces, the geothermal energy resources that have been confirmed span from Sumatra to East Nusa Tenggara have the potential to produce up to 27,000 MW of electricity across 253 locations (Idral,2010, Fauzi 2005). By the end of 2013, the geothermal resourcepotential in the country was 29,000 MWe across 299 locations (see figure 2) as result of an intensive geothermal exploration program that is conducted by Centre for Geological Resources- Geological Agency of Indonesia, (BGI, 2011, MEMR and NCCI, 2011, Jarman, 2012). There was an increase in resources potential along with its locations after 20 years of exploration, however it was decreasing in percentage for the resources, that means no more new potential geothermal resources and locations in the future exploration.

To speed up the crash program Phase II for 10,000 MWe for the year of 2025 the GoI has made a new geothermal policy, and in 2009 had tendered 6 locations of geothermal prospects that are ready to develop, see table 2 and figure 2, and issued 26 new geothermal working areas (GWA) in 2009, see table 3 and figure 3, and later on it had offered through tender process in 2011, whilst up to 40 further working areas are expected to be offered at a later date, see table 4 and figure 3, (BGI 2010, Jarman 2012, MEMR and NCCCI, 2011).

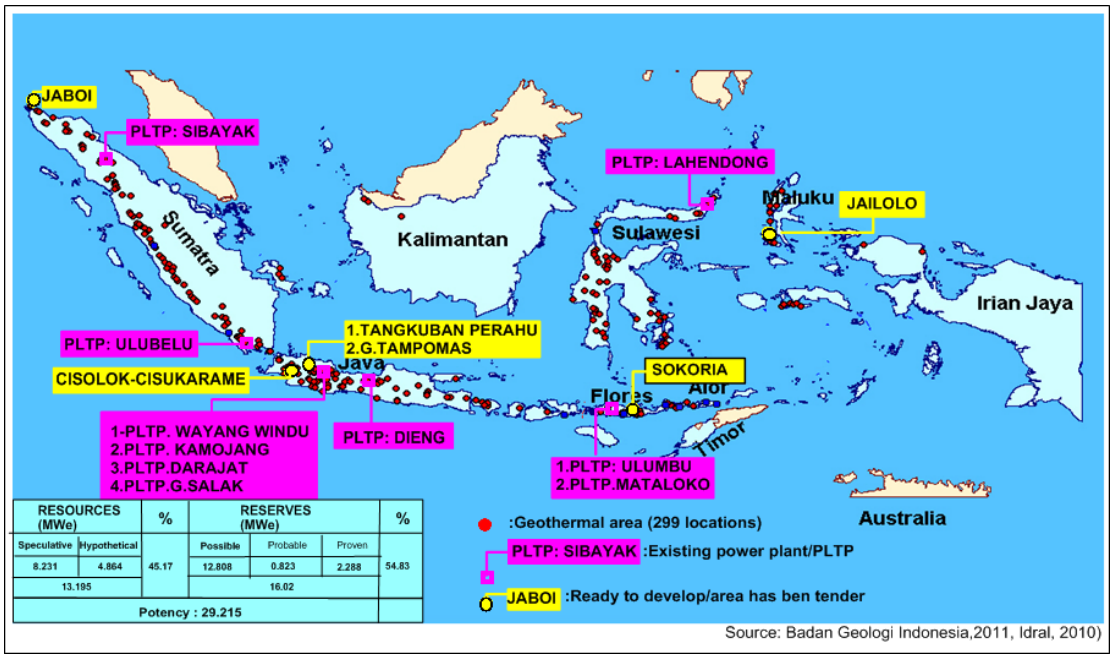

Figure 2: The Disribution of Geothermal Resources, existing Power Plant and GWA ready to develop in Indonesia

Table 2: Six Geothermal Locations have been tender and Ready to Develop

No	GWA's NAME	PROVINCE	POTENCY (MW)	WINNER BIDDING
1	Jailolo	N.Maluku	75	Star Energy Investment
2	G.Tampomas	W.Java	50	Consorcium. PT Wika-Jasa Sarana-Res.Jaya Teknik Mandiri Indonesia

3	Cisolok-Cisukarame	W.Java	45	Jabar Halimun Geothermal
4	Tangkuban Perahu	W.Java	100	PT.Perahu Geothermal Power
5	Jaboi	Aceh N. Sumatra	50	Sabang Energy
6	Sokoria	NTT	30	Bakrie Power Resource- Energy Management Indonesia

(Source :Badan Geologi, 2011, Jarman 2012, MEMR and NCCCI, 2011)

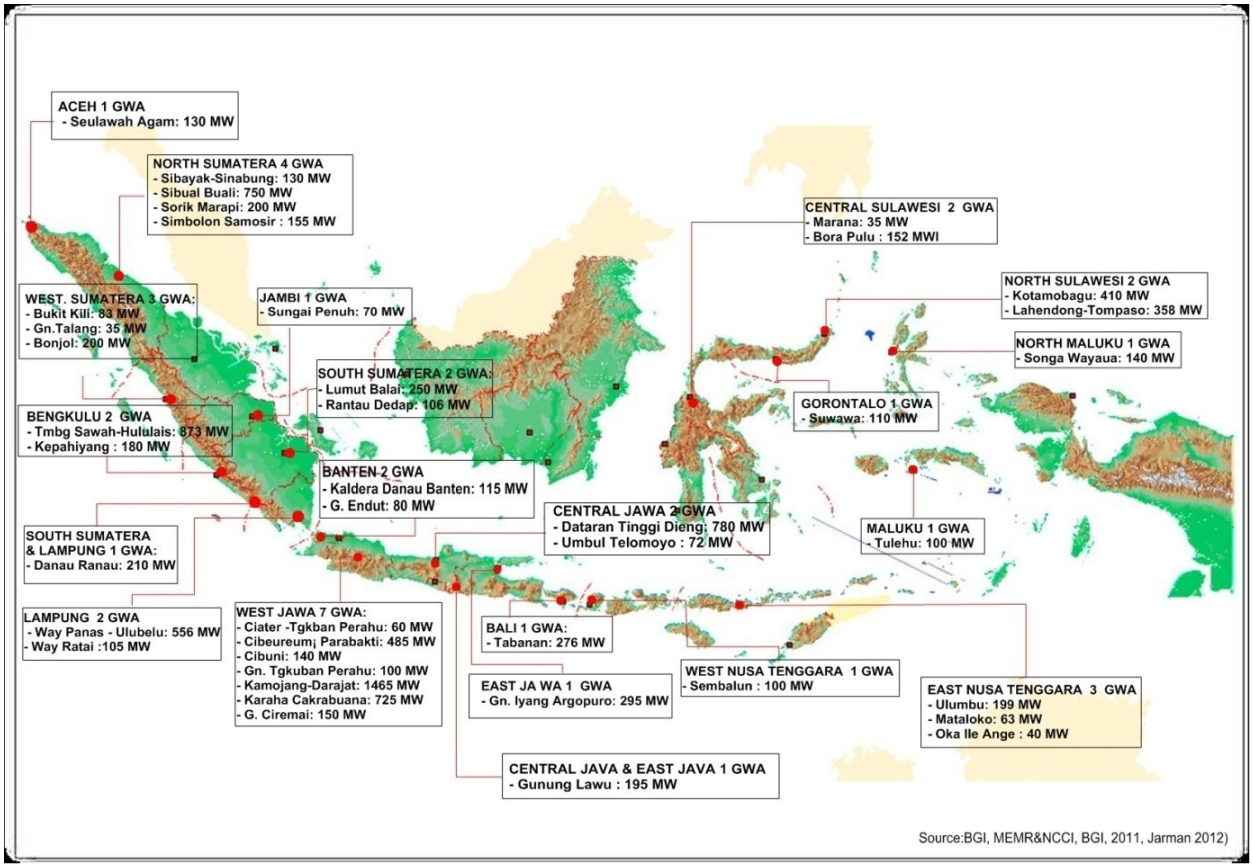

Figure 3: 40 GWA's are ready to offer

Table 3: 26 Geothermal Working Areas (GWA) have been Tender in 2011

NEW GWA'S OFFERED THROUGH TENDER PROCESS - IN 2011					
No	FIELD	REGENCY	PROVINCE	DEVELOPMENT TARGET (MWE)	TENDER STATUS PROCESS
1	Seulawah Agam	Aceh Besar	Nangroe Aceh Darussalam.	160	On Going
2	Jaboi	Sabang	Nangroe Aceh Darussalam.	50	Finished
3	Sorik Merapi	Mandailing Natal	North Sumatra	200	Finished
4	Sipaholon Ria ria	North Tapanuli	North Sumatra	75	Re-Tender
5	Mt.Talang	Solok	West Sumatra	36	Preparation
6	Bukit Kili	Solok	West Sumatra	83	Re-Tender
7	Liki Pinawangan	Ma.Laboh-Solok	West Sumatra	400	Finished
8	Rantau Dadap	Ma.Enim-Lahat-Pagar Alam	South Sumatra	106	Finished
9	Mt.Rajabasa	South Lampung	Lampung	91	Finished

10	Suoh Sekincau	West Lampung	Lampung	230	Finished
11	Kaldera Danau Banten	Serang-Pandeglang	Banten	115	Finished
12	Mt.Tampomas	Sumedang-Subang	W.Java	50	Finished
13	Cisolok-Cisukarame	Sukabumi	W.Java	45	Finished
14	Mt.Tangkubanperahu	Subang-Bandung-Pwk	W.Java	100	Finished
15	Mt.Ungaran	Bondowoso,Banyuwangi	Central.Java	100	Finished
16	Guci	Tegal-Brebes-Pemalang	C.Java	79	Finished
17	Baturaden	Tegal-Brebes-Banyumas	C.Java	175	Finished
18	Telaga Ngebel	Ponorogo-Madiun	East Java	120	Finished
19	Blawan Ijen	Bondowoso,Banyuwangi Situbondo	E.Java	270	Finished
20	Huu Daha	Dompu	West Nusatenggara	65	Finished
21	Sokoria	Ende	East Nusatenggara	30	Finished
22	Atedai	Lembata	East Nusatenggara	40	Finished
23	Merana	Donggala	Central Sulawesi	36	Re-Tender
24	Suwawa	Bonebolango-Gorontalo	Gorontalo	110	Re-Tender
25	Jailolo	West Halmahera	North Maluku	75	Finished
26	Songa	South Halmahera	N.Maluku	140	Preparation

Source: MEMR- NCCI, BGI, 2011

Table 4: 40 GWA's Ready to Offer

40 NEW GWA'S READY TO OFFER				
No	**FIELD**	**POTENCY (MWe)**	**REGENCY**	**REMARK**
1	Seulawah Agam	130	Nangroe Aceh Darusalam	Ready to offer
2	Sibayak-Sinabung	130	North Sumatra	Ready to offer
3	Sibual Buali	750		Ready to offer
4	Sipaholon Ria-Ria	75		Ready to offer
5	Simbolon Samosir	155		
6	Sungai Penuh	75	Jambi	Ready to offer
7	Bukit Kili	83	West Sumatra	Ready to offer
8	G.Talang	35		Ready to offer
9	Bonjol	200		Ready to offer
10	Tambang Sawah-Hululais	873	Bengkulu	Ready to offer
11	Kepahiyang	180		Ready to offer
12	Lumut Balai	250	South Sumatra	Ready to offer
13	Rantau dedap	106		Ready to offer
14	Danau Ranau	210	South Sumatra and Lampung	Ready to offer
15	Way Panas	556	Lampung	Ready to offer
16	Way Ratay	105		Ready to offer
17	G.Endut	80	Banten	Ready to offer
18	Ciater-Tangkuban Perahu	60	West Java	Ready to offer
19	Cibeureum-Parabakti	485		Ready to offer
20	Cibuni	140	West Java	Ready to offer
21	Kamojang-Darajat	1465		Ready to offer
22	Karaha Cakrabuana	725		Ready to offer
23	Pengalengaan	1106		Ready to offer
24	G.Ciremai	150		Ready to offer
25	Dataran Tinggi Dieng	780	Central Java	
26	Umbul Telomoyo	72		Ready to offer

27	G.Lawu	195	Central Java and East Java	
28	G.Iyang Argopuro	295	East Java	Ready to offer
29	Tabanan	276	Bali	Ready to offer
30	Sembalun	100	West Nusatenggara	Ready to offer
31	Ulumbu	199	East Nusatenggara	Ready to offer
32	Mataloko	63		Ready to offer
33	Oka Ile Angie	40		Ready to offer
34	Marana	35	Central Sulawesi	Ready to offer
35	Bora-Pulu	152		Ready to offer
36	Kotamobagu	410	North Sulawesi	Ready to offer
37	Lahendong-Tompaso	358		Ready to offer
38	Suwawa	110	Gorontalo	Ready to offer
39	Songa Wayaua	140	North Maluku	Ready to offer
40	Tulehu	100	Maluku	Ready to offer

(Badan Geologi, 2011, Jarman 2012, MEMR and NCCCI, 2011)

4. DEVELOPMENT OF EXISTING GEOTHERMAL POWER PLANT

After 30 years, since Kamojang PLTP was inaugurated in 1983, the development of existing geothermal power plants in Indonesia seems to be very slow, in which, up to the years of 2000 only 6 geothermal power plants have been developed, whilst the rest of them was developed between the years of 2000 – 2013.

At present, geothermal power plants across the country have a total capacity of 1,345.5 MWe derived from 10 geothermal power plants, see table 5 and figure 4. Currently GoI is targetting 3 PLTP (geothermal power plant) that will start commercialy at the end of 2014 with the capacity of 62 MWe. These plants are Patuha (55 MWe), Cibuni (2 MWe) and Ulumbu unit-2 (2x2.5MWe), (www.antaranews.com).

Figure 4: Existing of power plant by the end of 2013. (Modified from BGI 2011)

Table 5: 30 Years Developing Capacity of Existing Power Plant

NO	Power Plant/PLTP	Capacity	1990's capacity	2000's capacity	2010's capacity	Total capacity MW
1	Kamojang	140 MW	-	60 MW	-	200
2	Darajat	-	55 MW	216 MW	-	271
3	Salak	-	230.6 MW	146.2 MW	-	377
4	Dieng	-	60 MW	-	-	60
5	Sibayak	-	12 MW	-	-	12
6	Wayang Windu	-	-	227 MW	-	227
7	Lahendong	-	-	62.5 MW	20 MW	82.5
8	Mataloko	-	-	-	1,8 MW	1.8
9	Ulubelu	-	-	-	110 MW	110
10	Ulumbu	-	-	-	5	5
	Total (10 PLTP)	**140 MW**	**357.6 MW**	**711.7 MW**	**136.8 MW**	**1,345.3**

(Source :www.esdm.go.id, Jarman 2012, MEMR and NCCCI, 2011, Mawardi Agani 2010, Registered cdm project,2010)

5. OVERVIEW OF CURRENT GOI POLICIES ON GEOTHERMAL

The goverment regulation in Indonesia basically can be divided into 2 categories, namely: regulation before and after regulation No. 27/2003 (UU No 27.2003). The main idea of regulation before UU No. 27/2003 was all geothermal development from up to the steam was carried out by Pertamina and sold the electricity to the PLN, and taxation was set up by PD No.23/1981 and Finance regulation No. 746, PD No.49/1991. Whilst policies after regulation UU No. 27/2003, basically was a replacement of mining concession (KP) to geothermal working area (GWA or IUP/Izin Usaha Pertambangan). Geothermal exploration steps consist of reconnaisance, exploration, feasibility study, exploitation and use, while tax and fiscal followed finance regulation, (BGI, 2010, MEMRI and NCCCI 2011, Jarman 2012)

To speed up a crash program track of Phase II until the year of 2025 that expects geothermal power to account for 5 percent, or 9,500 MWe, the GoI provides some incentives, based on PD No.4 /2010, jo MEMR Regulation No.15/15 of phase II of 10,000 MWe fast track program, namely:

- Low No. 27/2003 on Geothermal
- Government Regulation No. 59/2007 with an Addendum Government regulation
- No. 70/2010 on geothermal enterprice
- Minestrial Regulation
    - No. 005/2007 on the Guidelines for Geothermal Preliminary Survey Assignment.
    - No. 11/2008 on the Mechanism for Determining of Geothermal Working Area
    - No. 2/2011 on Based price for Electricity produced by Geothermal Plant
    - No. 22/2012 on geothermal price structure.
- Fiscal facilities such as :
    - Ministry of Finance (MoF) Decree No. 177/PMK.011/2007 about Dispensation Entry Fee of Imported Goods for Petroleum Upper Course Activity, Gas and Geothermal
    - MoF Decree No. 242/PMK.011/2008 about Value Increment Tax which is charged by the Government for Goods imported for Exploration Effort of Petroleum Upper Course and Petroleum.
    - Government Regulation No. 62/2008 improvement on Government Regulation No. 1/2007 on Income Tax Facilities for Capital Investment on Certain Corporate Works and or in Certain Regions, which gives Income Tax Facilities for Capital Investment such as geothermal sector.
    - MR of MoF No. 22/PMK.011/2011.
    - GoI provide support in reducing down stream geothermal risk (MoF Decree No. 77/PMK.01/2011 and its revision)
- GoI offers preliminary survey assignment to be conducted at investor expense which then GoI will provide "first right refusal" to such investors.

CONCLUSION

In conclusion, currently the potency of Indonesian geothermal resources is approximately 29,000 MWe and to be the largest potential geothermal energy in the world. By the end of 2013 the existing install capaicity is 1,345.3 MWe, in which after 30 years of harnessing geothermal energy after Kamojang was inaugurated in 1983, the use of geothermal energy is relatively small compared to its resources. As the largest geothermal potential resouces in the world, Indonesia has a significant challange to attract private gothermal companies and will be the largest of geothermal energy producer in the world in the future.

In the future, we expect geothermal, being renewable and a clean energy resource, to become a significant contributor to the country's energy and livelihood sector. In this respect, we invite the private sector to actively participate in geothermal exploration activities in Indonesia.

It is worth noting that the political and structural changes in this country have resulted in a situation much more conductive than ever before to convincing the stakeholders of the value of geothermal industry to the national economy and welfare. Furthermore, the implementation of regional autonomy will give impetus to geothermal projects that contribute to regional development such as off-grid rural electrification and geothermal direct uses for agribusiness.

Development of 9,500 MWe electricity from Geothermal Crash Program Stage II requires more than tens of millions of US dollar for the investment. To achieve the targets, international supports is needed in terms of finance, technology, human resources and Technical Assistance.

To our neighboring Asian counties, we look forward to a fruitful cooperation on technology transfer and information exchange on geothermal exploration, development, exploitation and production of geothermal energy.

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