Proceedings World Geothermal Congress 2010
Bali, Indonesia, 25-29 April 2010

CDM Potential in Geothermal Power Sector in Indonesia

Maritje Hutapea and Gita Lestari

General Secretariat of National Energy Council, Directorate General of Electricity & Energy Utilization

Republic of Indonesia

mhutapea57@yahoo.com, gitalestari@hotmail.com

Keywords: climate change, CDM.

ABSTRACT

Climate change issues have become one of the current issues in the world, including Indonesia. As energy sector is claimed as one of the major sources of greenhouse gasses emission, energy sector pose a potential for emission reduction, particularly through utilization of renewable energy. Renewable energy sources, such as geothermal is considered as a solution to substitute carbon-intensive energy, as it emits almost no greenhouse gasses emission. Indonesia which is located on the volcanoes ring of fire has a huge geothermal potential, approximately 27 GW or about 40% of the world geothermal potential.

The government of Indonesia plans to develop this potential to fulfill Indonesia's energy needs, particularly for electricity. Based on Presidential Regulation No. 5 year 2006 concerning National Energy Policy, it is targeted that at least 5% of national primary energy mix will be based on geothermal. Accordingly, Geothermal Development Roadmap has been set up and it will develop 9500 MW geothermal power plant up to 2025. This implementation will be a great opportunity not only in fulfilling the energy needs, but CDM projects proposal for a huge number of emission reduction could also take place. Since 2006, there are only 6 (six) geothermal projects in the world that have been proposed and registered as CDM projects, one of which is Darajat III in West Java, Indonesia.

This paper will explore the potentials and barriers in developing geothermal power plant projects in Indonesia as CDM projects.1.

1. INTRODUCTION

The climate change issue has been one of the main focuses in the world right now. Climate change is caused by the increase of greenhouse gasses in the atmosphere from anthropogenic activities, such as the combustion of fossil fuel in energy sector. To combat the climate change and its effects, the United Nations has initiated the *United Nations Framework Convention on Climate Change* and its more rigid framework the Kyoto Protocol.

Kyoto Protocol is an international agreement that oblige the Annex 1 countries (developed countries) to reduce global greenhouse gasses emission around 5.2% from the emission of 1990 in the first commitment period year 2008-2012. Kyoto Protocol's flexible mechanisms consist of Joint Implementation (JI), Clean Development Mechanism (CDM) and Emission Trading (ET). CDM is the flexible mechanism between Annex 1 countries and non-Annex 1 countries (developing countries). The CDM will allow the developed countries to fulfill their targets of emission reduction, in the mean time, to assist developing countries, such as Indonesia, achieving their sustainable development, among others by developing clean energy technology, such as renewable energy development and energy efficiency technology implementation.

Indonesia is a member of UNFCCC and has ratified the Kyoto Protocol in July 28th 2004 with the issuance of Law No. 17 year 2004 and assembled the National Commission on Clean Development Mechanism as the Designated National Authority in July 21st 2005 under Ministry of Environment Decision No. 206 year 2005. As the developing country (non Annex 1 country), with no obligation to reduce its greenhouse gases emission, Indonesia is voluntarily involved in emission reduction activities and participating in the CDM.

Indonesia is fortunately blessed with a huge potential of renewable energy, specifically geothermal, that has a potential to be developed as CDM project, which is consider cleaner than using fossil-based power plants, such as oil and coal.

2. GEOTHERMAL POTENTIAL IN INDONESIA

2.1 Geothermal Resources

Indonesia has been known to lie in the "ring of fire", a row of 7,000 km active volcanoes, which provide a geothermal power along the volcanic trail in the Sumatera, Java, Bali, Nusa Tenggara, Sulawesi and Maluku isles. The geothermal resources are harvested in the bottom or old volcanic calderas.

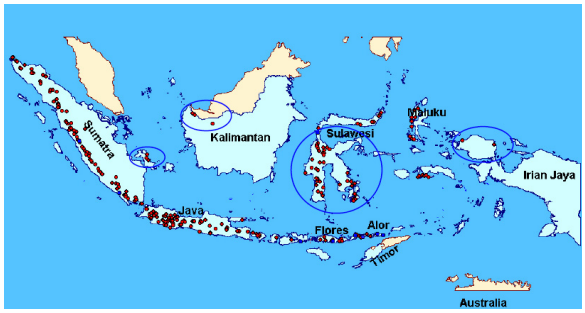

Figure 1: Geothermal Resource in Indonesia.

Based on the National Standard of Geothermal Energy Potential Classification in Indonesia in 1999, there are 15 types of geothermal energy potentials in Indonesia, ranging from resources, speculative and hypothetic, to reserves (probable, possible and proven). Up to 2005, Centre for Geological Resources has recorded 235 geothermal fields in Indonesia, with Sumatera which owns the largest potential of 84 fields, Java with 71 fields, Sulawesi with 51 fields, Bali and the Nusa Tenggara with 27 fields, Maluku and North Maluku with 15 fields, Kalimantan and Papua with 3 and 2 fields respectively. Total geothermal potential in Indonesia is 27,510 MW equivalents, where 10,835 MW can be generated from probable reserves, 1,050 MW from

possible reserves and 2,287 MW from proven reserves. The rest of 13,338 MW will be generated from speculative and hypothetic reserves. The current geothermal power plant installed capacity.

Most of the geothermal areas/fields, around 64.4% or 163 locations, are still in the preliminary survey phase. Small numbers of areas are in detail study (29.6% or 75 locations), exploration study (3.2% or 8 locations) and installed capacity (2.8% or 7 locations). The fields in the preliminary study are mostly small-scale fields or in isolated islands, which require further investigation to improve their exploration statuses.

2.2 Geothermal Development in Power Sector

Realizing the higher dependency on oil, while its reserve is limited, the government commits to gradually reduce its dependency on oil and increase the non-oil energy source to fulfill the energy demand. Therefore, Government of Indonesia issued the Presidential Regulation No. 5 year 2006 on National Energy Policy (NEP). The NEP has 2 (two) targets for 2025, which are energy elasticity less than 1 (one) and optimizing national primary energy mix, which is projected such that geothermal share in year 2025 will be at least 5 % of the total energy demand.

Based on the Presidential Regulation No 5 year 2006, the government has formulated Blueprint of National Energy Management, as implementing guidelines of NEP for energy stakeholders. The Blueprint includes a roadmap of each energy sources development. Based on the Blueprint, the geothermal roadmap shows that in year 2025, the total installed capacity of geothermal power plant will be around 9500 MW.

However, currently, only 7 (seven) fields have been developed for geothermal power plants with total installed capacity of 1.052 MW, namely:

- PLTP Kamojang 200 MW
- PLTP Salak 375 MW
- PLTP Darajat 255 MW
- PLTP Wayang Windu 110 MW
- PLTP Lahendong 40 MW
- PLTP Dieng 60 MW, and
- PLTP Sibayak 12 MW

To push forward the development of renewable energy potential for electricity generation, particularly geothermal, the Government has issued the Power Plant Acceleration Program of 10 000 MW phase 2 as continuation of Power Plant Acceleration Program of 10 000 MW phase 1 which is based on coal power plants. The second phase of 10 000 MW will be developed during period 2012-2014 emphasized on renewable energy power plants, such as hydro and geothermal. In this Acceleration Program Phase 2, there will be additional 4,733 MW installed capacity of geothermal power plants in Indonesia or 48% of the total 9,963 MW power plants built during the year 2012-2014.

3. CDM PROJECT OF GEOTHERMAL POWER PLANT

Based on The Power Plant Acceleration Program Phase 2, there will be a big additional capacity of geothermal power plants with big potential to be proposed as CDM projects, as geothermal emits almost no greenhouse gasses emission. According to CDM's project design document (PDD) of Geothermal Power Plant Darajat Unit III, the geothermal power plant only emits 0.03 ton CO2 equivalent per 1 MWh electricity produced. This is far lower than coal-based power plant or oil-based (diesel) power plant that can emit around 0.9 ton CO2 equivalent/MWh or 0.75 ton CO2 equivalent/MWh respectively.

If we calculated from the electricity generated from geothermal power plant developed based on the Acceleration Program Phase 2 (2012-2014) in Java-Madura-Bali (JAMALI) and non-JAMALI system, the total greenhouse gasses emission reduction per year would be around 24 million ton CO2 equivalent/year. With the average price of certified emission reduction (CER) around US$ 10-15/ton CO2 equivalent, the geothermal development in Indonesia will generate US$ 239.22 -358.84 million per year.

Table 3: Estimated Greenhouse Gasses Emission Reduction from Geothermal Development in Acceleration Program Phase 2 (*Calculated based on average emission factor (roughly) for Indonesian grid = 0.65 tCO2/MWh).

Year	Additional Capacity (MW)	Estimated additional emission reduction per year* (tCO2/yr)
2009	117	591,365
2010	70	353,808
2011	158	798,595
2012	918	4,639,939
2013	685	3,462,264
2014	2,785	14,076,504
Total	**4,733**	**23,922,475**

Up to now, there is only 1 (one) geothermal project that has been registered in Executive Board CDM, namely 110 MW Darajat Unit III Geothermal Project in West Java which reduces 652,173 ton CO2 equivalent per year reduction of greenhouse gasses emission. Currently, there are 4 (four) geothermal power plant projects being proposed for CDM projects, namely 2 x 20 MW Lahendong Unit II and Unit III in North Sulawesi, 60 MW Kamojang in West Java and 11.3 MW Sibayak in North Sumatera. The Lahendong unit II and III, Kamojang and Sibayak projects are estimated to reduce 59.026 ton CO2 equivalent/year, 50.663 ton CO2 equivalent/year, 408.843 ton CO2 equivalent/year and 50.243 ton CO2 equivalent/year respectively.

4. BARRIERS AND SOLUTIONS TO DEVELOP CDM GEOTHERMAL POWER PLANT PROJECT

As mentioned previously, Indonesia has a huge potential of geothermal, however, its utilization (only 1052 MW) is still low compared to its potential. The main barrier facing is its economic viability. Electricity price of a geothermal power plant is considered relatively higher than of other conventional power plants such as a coal power plant. On the other hand, PT.PLN (Persero) has a low purchasing power to buy the electricity from geothermal due to the electricity tariff to consumer being still regulated. With such condition, investors have, therefore, a lack of interest to invest their money to development of geothermal power plants. If geothermal power plant is developed as CDM project, it hopes that the revenue from Certified Emission

Reduction (CER) can be used to improve the viability of a geothermal power plant project that allows geothermal power plants to compete to other power plants.

In addition, to enhance the development of power projects in Indonesia including renewable energy power plants, in 2009, Government c.q Ministry of Energy and Mineral Resources has issued the Ministerial Regulation no. 005 year 2009 on Electrify Purchasing Price Guidelines from Cooperative and Private Company. This regulation mandated that PT. PLN (Persero) provide Self-Estimation Electricity Price for all types of power plants including renewable energy. The Self-Estimation Electricity Price (Harga Perkiraan Sendiri – HPS) is determined based on local content, current exchange rate, fuel price and other economic-macro indicators. This regulation also mandated that PT. PLN (Persero) is obliged to buy electricity from renewable energy power plant with the capacity up to 10 MW with the electricity price standard published by the PT. PLN (Persero). This Ministerial regulation is expected as "win-win" solution for both utility company and power plant developers, including geothermal developers.

REFERENCES

Peraturan Presiden No. 5 Tahun 2006 tentang Kebijakan Energi Nasional. Republic of Indonesia. 2006.

Peraturan Menteri Energi dan Sumber Daya Mineral No. 05 Tahun 2009 tentang Pedoman Harga Pembelian Listrik oleh PT. PLN (Persero) dari Koperasi dan Badan Usaha Lain. Republic of Indonesia. 2009.

Blueprint Pengelolaan Energi Nasional 2006-2025. Ministry of Energy and Mineral Resources – Republic of Indonesia. 2008.

Project Design Document Darajat Unit III Geothermal Project. Chevron Geothermal Indonesia. 2006.

Project Design Document Kamojang Geothermal. PT. PLN (Persero) and PT. Pertamina Geothermal Energy. 2008.

Project Design Document Lahendong III – 20 MW Geothermal Power Plant Project. PT. PLN (Persero) and Japan Bank of International Cooperation (JBIC).2008.

Table 1: Location of Geothermal Resources and Reserves in Indonesia (Source: Geological Agency, 2008)

No	Island	No. of fields	Electricity Generation Potential (MW)					Total
			Resources		Cadangan			
			Speculative	Hypothetic	Probable	Possible	Proven	
1	Sumatera	84	5275	2194	5555	15	380	13419
2	Jawa	71	2235	1446	3175	885	1815	9556
3	Bali & Nusa Tenggara	27	360	359	943		14	
4	Sulawesi	51	925	12	865	150	78	1676
5	Maluku	15	400	37	297			2030
6	Kalimantan	2	45					734
7	Papua	3	50					45
Total		253	9290	4048	10835	1050	2287	27510

Table 2: Geothermal Power Plants in Acceleration Program Phase II in Indonesia (Source: Directorate General of Mineral, Coal and Geothermal, 2009)

Region	Power Plant	Capacity (MW)	Operating Years
JAVA	Bedugul	1 X 10	2012
	Cibuni	1 X 10	2013
	Cisolok-Cisukarame	1 x 50	2014
	Darajat	2 x 55	2012/13
	Dieng	1 x (55 & 60)	2012/14
	Gn. Tangkuban Prahu	2 x 55	2013/14
	Gn. Tangkuban Prahu (small scale)	1 x (5 & 25)	2010/14
	Ijen	2 x 55	2014
	Kamojang	1 x 60	2013
	Karaha Bodas	1 x (30 & 110)	2012/14
	Patuha	3 x 60	2012/13/14
	Salak	1x 40	2013
	Wayang Windu	1 x (117 & 120 & 120)	2009/12/14
	Gn. Papandayan	1 x 55	2014
	Rawa Dano	2 x 55	2014
	Ungaran	1 x 55	2014
	Wilis / Ngebel	3 x 55	2013/14
	Tampomas	1 x 45	2014
	Iyang Argo Puro	1 x 55	2014
	Arjuno Welirang	1 x 55	2014
	Guci	1 x 55	2014
	Baturaden	2 x 110	2013/14
Sub Total Java		**2,137**	
NON JAVA			
Maluku	Tulehu	1 x 20	2012
Maluku Utara	Jailolo	2 x 5	2014
	Songowayauwa	1 x 10	2014
NTB	Huu	1 x 10	2014
	Sembalun	1 x 20	2013
NTT	Mataloko	1 x 10	2014
	Sokoria	2 x 5	2014
	Ulumbu	1 x (5 & 8 & 3)	2010/11/12
	Atadei	1 x 10	2014
South & Southeast Sulawesi	Lainea	1 x 20	2014
North Sulawesi & Gorontalo	Bora	1 x 10	2012
	Kotamobagu	2 x 40	2012/14
	Lahendong IV	1 x 20	2011
	Lahendong (optimasi)	1 x 25	2011
	Lahendong V	1 x 20	2012
	Merana	1 x 20	2014
Southern Sumatera	Ulu Lais	3 x 55	2012/13/14
	Lumut Balai	3 x 55	2012/13/14
	Sungai Penuh	2 x 55	2012/14
	Ulubelu	4 x 55	2011/12/13/14
	Rajabasa	2 x 110	2013/14
	Way Ratai	1 x 55	2014
	Rantau Dadap	1 x 110	2014
	Suohsekincao	2 x 55	2014
	Danau Ranau	2 x 55	2014
Northern Sumatera	Pusuk Bukit	2 x 55	2014
	Sarulla (nil – sil)	1 x (60 & 50 & 220)	2010/11/12
	Sarulla (Sibual-buali)	1 x 110	2014
	Seulawah Agam	1 x 55	2014
	Jabaoi	1 x 10	2014
	Sipaholon	1 x 55	2014
	Gunung Talang	1 x 20	2014
	Muaralaboh	2 x 110	2014
	Bukit Kilik	1 x 55	2014
	Sorikmerapi	1 x 55	2014
Sub Total Outside Java		**2,688**	
Total Indonesia		**4,733**	