Proceedings World Geothermal Congress 2020+1
Reykjavik, Iceland, April - October 2021

Geothermal Development in Aceh, Indonesia: Challenges and Prospect

Teuku Mukhlis and Teuku Athaillah

Department for Energy and Mineral Resources of Aceh Province, Jalan T. Nyak Arief No. 195 Banda Aceh 23114, Indonesia

teuku.mukhlis@acehprov.go.id

Keywords: geothermal, electricity, renewable energy, government role, Government of Aceh.

ABSTRACT

Aceh is a special province in Indonesia which is authorized to regulate and manage its government affairs and the interests of its local community. The Government of Aceh can manage its own natural resources including geothermal development. Geologically, Aceh is located in the boundary zone of the Eurasian plate and the Indo-Australian plate which are parts of the world's so called ring-of-fire. One of the impacts of this tectonic structure; Aceh has a lot of volcanoes and huge renewable (geothermal) energy potential. Geothermal energy potential in Aceh is around 1,357 MWe spread over 15 locations. However, until now, none of geothermal power plants have supplied electricity in Aceh. Nowadays, Aceh have 3 geothermal fields ready to be developed. The areas have been tendered, namely Jaboi and Seulawah Agam. Another area is preparing for the tender namely Geureudong. There are still 12 locations of geothermal resources that can be developed immediately. The peak load of electricity demand in Aceh was around 424 megawatts (MW) in 2018, and it is estimated that in 2028 it will be 1,007 MW (with an average growth of 6.94% / year). To anticipate the increase in electricity peak load, the Government of Aceh is committed to develop clean and renewable energy sources in order to fulfill the electricity needs of the people and industries in Aceh. One of green and renewable energy sources is geothermal development. This paper will review the progress and government regulations of geothermal development in Aceh as well as identify its challenges and future prospects. The methodology used is a qualitative approach with the focus on literature review and secondary data.

1. INTRODUCTION

Aceh is one of provinces in Indonesia located on the western tip of Sumatra Island, with a population of 5,189,466 people and the number of households was 1,231,058 (2017) where its growth rate of 1.83% per year. The number of electricity customers in Aceh in 2017 was 1,200,100, this number will continue to increase every year because it is accompanied by the rate of population growth. The electrification ratio in Aceh in 2017 was 98.59%, while for the national level, the ratio electrification in 2017 was 95.99%. Electricity needs for Aceh are expected to grow rapidly in the upcoming 10 years. While nowadays Aceh is still experiencing an electricity crisis especially when it comes to the problem of electricity supply. To meet these needs, it is planned that additional power plants in Aceh will be 3,522 MW by 2028 including the Sumatera system quota (Table 1). In order to overcome the crisis of providing electricity and efforts to reduce the impact of global warming, renewable energy sources are needed. The development of renewable energy becomes essential given the increasingly limited sources of fossil energy.

Table 1. Planned for additional power plants in Aceh

Developer	Type of Generator	Number of Project	Capacity (MW)
PLN	Gas	3	405
7 Project	Water	3	133
540 MW (15.33%)	Others	1	2
	Coal	2	400
IPP	Geothermal	4	440
25 Project	Gas	3	800
2,982 MW (84.67%)	Water	10	1,118
	Others	6	224
Total		**32**	**3,522**

Source: Minister MEMR Decree No 39 K/20/MEM/2019

The Government of Aceh strongly supports the efforts to provide clean and renewable energy sources in order to meet the electricity needs of the people and industry, as Aceh's commitment to low emissions development. One of the abundant clean and renewable energy sources in Aceh is geothermal energy.

Geologically, Aceh located in an active tectonic region as a result of the convergence of two tectonic plates. The plate is the Eurasian Plate and the Indo-Australian Plate which is part of the world ring of fire. Interaction between these plates causes the Aceh region to be rich in mineral resources and geothermal potential while also having a high risk of geological disasters.

Based on the Law No. 11 of 2006 about Government of Aceh, stated that Aceh is a provincial region which a special legal community unit and has special authority to regulate and manage government affairs and the interests of local communities in accordance with the laws and regulations in the system and principle of the Unitary State of the Republic of Indonesia, led by a governor. There are 26 specificities of Aceh in these rules, one of which is the authority of the Government of Aceh to manage natural resources in Aceh both on land and sea including geothermal potential.

Various obstacles and challenges faced in the development of geothermal energy, both in terms of policies and regulations as well as technical matters such as data, permit and others. This article discusses how the development of geothermal energy in Aceh. The development of geothermal energy as one of the renewable energies is very important to be discussed in relation to fossil energy reserves which are limited and the increasing greenhouse gas emissions due to burning fossil fuels.

2. METHODOLOGY

This research is conducted using a qualitative descriptive method that focus on literature reviews to obtain literature or secondary data. The data used is secondary data obtained from various sources.

3. GEOTHERMAL DEVELOPMENT IN ACEH

The discussion on geothermal development in Aceh includes progress, regulations, challenges and future prospects.

3.1 Geothermal Development Progress

Aceh is the westernmost province in Indonesia with the borders of the North and East bordering the Malacca Strait, adjacent to Provinces of North Sumatra to the South and the West with the Indonesian Ocean, which has an area of 5,677,081 ha. In the West of Aceh is subduction zone resulting from the convergence of the Eurasian Plate and the Indo-Australian Plate which has led to the development of the magmatic and geothermal zones in Aceh. Geothermal potentials in Aceh are spread over 15 locations along volcanic arcs with a total potential of 1,357 MWe (Table 2). The initial survey of inventory of potential geothermal manifestations in these locations was conducted in 1972 and 1978.

Currently, 3 geothermal working areas in Aceh have been established, namely Jaboi Geothermal Working Area in Sabang, Seulawah Agam Geothermal Working Area in Aceh Besar and Pidie and then Geureudong Geothermal Working Area in North Aceh, Bener Meriah and Central Aceh. A detailed geological and geophysical survey has been carried out in the Jaboi geothermal potential in 2005-2006. Later in 2006, a drilling for temperature gradient had been done to prove the geophysical exploration. In 2008, Jaboi was established as a Geothermal Working Area (GWA) and Geothermal Permit was issued in 2015. Nowadays, drilling for exploration is being performed in the Jaboi GWA.

Geological and geophysical surveys of Seulawah Agam geothermal has been done in 1990-1995. Drilling for the temperature gradient was conducted in 1995. In 2007, the geothermal of Seulawah Agam was designated as Geothermal Working Area. Although Geothermal Permit for Seulawah Agam GWA has been published in 2017, but until now there are no drilling activities for exploration held.

For Geureudong geothermal, detailed geological and geophysical surveys were conducted in 2013-2014. The geothermal of Geureudong was determined in 2014 to be a Geureudong Geothermal Working Area and is currently preparing for the tender. Another geothermal potential that have been surveyed in detail for geological and geophysical are Lokop in 2013 and Gunung Kembar in 2016. Both of these geothermal potentials and other geothermal manifestations found in Aceh are still categorized as open areas which are available to be developed.

Table 2. Potential and plans for geothermal development in Aceh

No	Name of Field	Potential (MWe)			Development Plans
		Resources		Reserves	
		Speculative	Hypothetical	Expected	
1.	GWA Seulawah Agam				- Unit 1 in year
	- Ie Seum-Krueng Raya		63		2024: 55 MWe
					- Unit 2 in year
	- Seulawah Agam			282	2025: 55 MWe
2.	GWA Jaboi				- Unit 1 in year
	- Iboih	25			2020: 5 Mwe
	- Lho Pria Laot	50			- Unit 2 in year
	- Jaboi-Keuneukai			50	2023: 5 MWe
3.	GWA Geureudong				- Unit 1 in year
	- Rimba Raya	100			2025: 55 MWe
	- Gunung Geureudong			160	
4.	Alur Canang	25			Open area
5.	Alue Long – Bangga	100			Open area
6.	Tangse	25			Open area
7.	Simpang Balik	100			Open area
8.	Silih Nara	100			Open area
9.	Meranti	25			Open area
10.	Brawang Buaya	25			Open area
11.	Kafi	25			Open area
12.	Gunung Kembar			107	Open area
13.	Dolok Perkirapan	25			Open area
14.	Lokop		45		Open area
15.	Kaloi	10	15		Open area
Total		**1,357 Mwe**			

Source: Kementerian Energi dan Sumber Daya Mineral RI, 2017

Besides geothermal utilization for electricity needs, direct use of geothermal energy has also been developed in Aceh, especially for hot spring pools and tourism. Utilization direct use of geothermal for agriculture, plantations, fisheries and others has not been developed. 32.15% of the land area of Aceh is agricultural and plantation, which is the main mainstay sector for Aceh's economic

growth. Direct use of geothermal energy for this sector is very feasible to be developed which will improve the standard of living and the economy of the people in Aceh.

Two GWA in Aceh have already obtained Geothermal Permits (IPB), namely Jaboi and Seulawah Agam. Both IPB are issued by the Minister of MEMR (Central Government) referring to the Law No. 21 of 2014 about Geothermal Energy. The law stipulates that geothermal energy for indirect use in all regions of Indonesia is the authority of the Central Government. If referring to the Law No. 11 of 2006 about Government of Aceh, states that the Government of Aceh manage natural resources in Aceh including geothermal energy. The issuance of Government Regulation No. 3 of 2015 about the National Authority in Aceh, strengthens the authority of the Government of Aceh to manage its own natural resources including geothermal energy. Until now, there are none of regional regulations in Aceh that further regulate geothermal development.

Based on the Law No. 11 of 2006 about Government of Aceh and Government Regulation No. 3 of 2015 about the National Authority in Aceh, IPB in Aceh should be issued by the Governor of Aceh. But in fact, the two IPB in Aceh were issued by Minister of MEMR because the Government of Aceh was not prepared especially in terms of regulations.

3.2 Challenges of Geothermal Development

There are none of geothermal power plants has supplied electricity in Aceh until now. Some challenges that obstruct of investment in Aceh include issues of conflict and the environment. Aceh has been stricken by a long social conflict for more than 28 years in the past between 1976 to 2005 with a toll of 15,000 people died. The condition of the conflict has caused influence on the investment sector in Aceh. The issuance of the law on the Government of Aceh in 2006 was a series of peace processes in Aceh. The GWA in Aceh was determined after the conflict had come ended.

The forest area in Aceh is 60.83% and most of the geothermal potential resides in the forest area. For examples in Jaboi GWA, the total area of GWA is 6,949 ha, 44.78% of the area is forested. Total area of Seulawah Agam GWA is 45,000 Ha, where 49.79% is a forest area. Geureudong GWA area is 97,440 Ha, 30.30% is forest. In accordance with regulations in the field of forestry, the use of forest areas outside of forestry activities can be employed for strategic development purposes. However, the issue of environmental damage due to the use of forest areas in Aceh is put forward.

Another challenge for the Government of Aceh regarding geothermal management is that there are none geothermal management technical guidelines in Aceh that further elaborate the geothermal law and the Aceh Government law. As the result, geothermal management in Aceh still adheres to national regulations.

3.3 Future Geothermal Development Prospects

The need for power plants in Aceh will still grow rapidly in line with the need to enhance the electrification ratio and the increasing population growth. The peak load of electricity demand in Aceh in 2018 was around 424 megawatts. The projection of electricity demand in Aceh in 2028 is 1,007 MW, with an average growth of 6.94% / year. The total Net Capability of Existing Power Plants in 2018 was 559.3 MW (Table 3). Geothermal development in Aceh is considered completely suitable since it could be developed in stages according to its economy.

Table 3. Existing power plants in Aceh

Owner of Generator	Type of Generator	Number of Unit	Capacity (MW)
PLN 257 Unit 500.8 MW (89.54%)	Coal	2	180
	Gas	19	179.9
	Water	4	2
	Diesel	232	138.9
IPP 7 Unit 25.5 MW (4.56%)	Gas	1	24
	Water	6	1.5
Rent 6 Unit 33 MW (5.90%)	Diesel	6	33
Total		**270**	**559.3**

Source: Minister MEMR Decree No 39 K/20/MEM/2019

The prospects of geothermal development in Aceh in the future is truly decent. The available geothermal potential is quite large, spread in Aceh and mostly associated with volcanoes. The Government of Aceh strongly supports efforts to provide clean environmental energy with programs namely Aceh Green and Aceh Energy. For the fulfillment of electricity for the people of Aceh and industries originating from renewable energy, the Aceh Government will commit strategic agendas to support this program, among others 1) preparation of a comprehensive and integrated Aceh Energy Master Plan (primary data validation and development plan); 2) implementation of Public Private Partnership for the utilization of medium and large-scale energy resources, especially geothermal and hydropower without using foreign debt; 3) ensure PLN commitment to improve the transmission system so there are not frequent power cuts in Aceh; 4) providing licensing facilities for private sectors who are interested in investing in the clean and renewable energy.

At present, the Government of Aceh is discussing regional regulations regarding the Aceh General Energy Plan, where a new and renewable energy mix in Aceh of 33.9% will last until 2025 as planned. The current realization of renewable energy mix in Aceh is 0.66% originating from micro hydro power plants.

4. CONCLUSION

Aceh has a geothermal potential that can be utilized for energy development. Although the current conditions are still very far from the target but with geothermal laws, the Government of Aceh laws and also the commitment of the Central Government and the Government of Aceh to develop green energy, I believe the development of the geothermal industry for electricity in Aceh will be encouraging in the future. To embody the planned development target of geothermal and renewable energy, unyielding commitment from leaders is required to continue supporting geothermal development. Nevertheless, it is necessary to accomplish the derivative regulations for geothermal management in Aceh immediately.

NOMENCLATURE

PLN PT Perusahaan Listrik Negara (Persero)

IPP Independent Power Producer

GWA Geothermal Working Area

IPB Geothermal Permit

MEMR Ministry of Energy and Mineral Resources

REFERENCES

BPS - Statistics Indonesia, Statistical Yearbook of Indonesia 2018, Jakarta, 2018

BPS - Statistics of Aceh Province, Aceh Province in Figures 2018, Banda Aceh, 2018

Kementerian Energi dan Sumber Daya Mineral RI, Kepmen ESDM Nomor 39K/20/MEM/2019 Tentang Pengesahan Rencana Usaha Penyediaan Tenaga Listrik PT. Perusahaan Listrik Negara (Persero) Tahun 2019 sampai dengan Tahun 2028, Jakarta, 2019

Kementerian Energi dan Sumber Daya Mineral RI, Potensi Panas Bumi Indonesia Jilid 1, Jakarta, 2017

Kementerian Energi dan Sumber Daya Mineral RI website, https://www.esdm.go.id/id/media-center/arsip-berita/apresiasi-target-bauran-energi-aceh-sekjen-den-rued-adalah-apa-yang-ingin-dilakukan, online, 2019

Media Indonesia website, available: https://mediaindonesia.com/read/detail/100027-wamen-esdm-janji-atasi-krisis-listrik-di-aceh, online, 2017

Pemerintah Aceh website, available: https://acehprov.go.id/profil/read/2017/07/09/113/visi-dan-misi-gubernur-wakil-gubernur-aceh-periode-2017-2022.html, online, 2017

Pemerintah Aceh website, available: https://acehprov.go.id/profil/read/2018/01/18/117/4-aceh-energi.html, online, 2018

Republik Indonesia, Peraturan Pemerintah Republik Indonesia Nomor 3 Tahun 2015 Tentang Kewenangan Pemerintah Yang Bersifat Nasional Di Aceh, Jakarta, 2015

Republik Indonesia, Undang Undang Republik Indonesia Nomor 11 Tahun 2006 tentang Pemerintah Aceh, Jakarta, 2006

Republik Indonesia, Undang Undang Republik Indonesia Nomor 21 Tahun 2014 tentang Panas Bumi, Jakarta, 2014

Serambinews website, available: https://aceh.tribunnews.com/2016/08/30/kekhususan-aceh-menurut-uupa?page=all, online, 2016

Wikipedia website, available: https://en.wikipedia.org/wiki/Insurgency_in_Aceh, online, 2019