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The 5 Years, 2015 – 2020, Development of Geothermal Energy Used in Indonesia: Problems and Solution

Alanda IDRAL

Centre for Geological Resources, Jl. Soekarno-Hatta No,444 Bandung

idral_idral@yahoo.com

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ABSTRACT

As the Country that lies along the ring of fire, Indonesia is blessed with a huge of geothermal energy resources, which is account of 23.9 GW or the second after USA. Currently, the total installing capacity of Indonesian Geothermal Power Plant (IGPP/PLTP) is about 2,130.6 MW, or 8.9 % of the total resources per December 2019, derived from 14 IGPP . This value gives Indonesia as the second country (replace the Philippine) as a geothermal energy producer after USA (3,591 MW). The development of geothermal energy in the country, however, is relatively slow, in which, the installing geothermal capacity increase is about 692 MW or in average about 138 MW/years from 2015 to 2020, so the government target to reach 7,241 MW geothermal installing capacity in the years of 2025 is hard to be reached.. There are several problems that caused the slowly development of geothermal energy in the Country, in which the most important are uncertainties in regulations and price (PLN/State Electrical Enterprise buying price is below economic value), therefore the Government of Indonesia has to work harder to solve the problem nicely as soon as possible in order to gain the Country target for the year of 2025. However on November 2020 GoI cut of the target to 50%.

1. INTRODUCTION

Geographically, Indonesia lies along the Pacific Ring of Fire (figure 1), in which the volcanoes and earthquekes common to this geological zone can be highly destructive, however, the condition also have a positive side such as gives a big potential of geothermal energy.

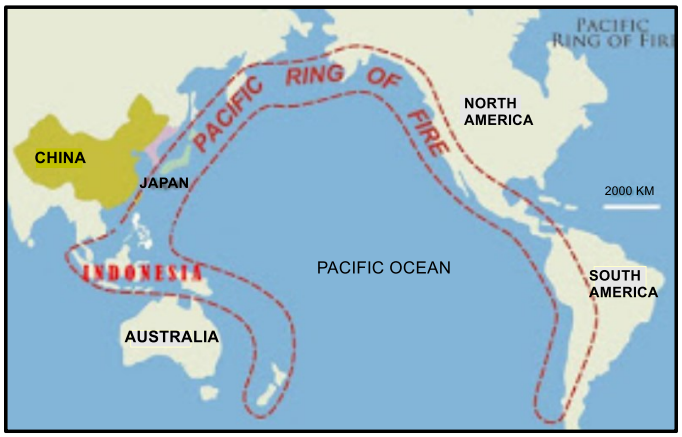


Figure 1: Pacific ring of fire (source:Tamboraku.Blogspot.com 2015)

Currently, the potency of geothermal energy that are starting from the northern tip of Sumatra and passing through Java, Bali, Nusatenggara, Sulawesi and Moluccas Islands are account of 23,9 GW, (Pabum News,2020), the second after USA, that derived from 331 geothermal spot (Badan Geologi, 2018, Kata data.co.id 2019).

At present, the installing Indonesian Geothermal Power Plant (IGPP) is approximately 2,130.5 or equal to 8.9 percent of the total resources, and its derived from 14 IGPP. (Direktorat panasbumi, 2019, Finance.detik.com 2018). However, the progress on its rate of production is occurring at a very slow pace, even though as the largest geothermal electricity producer in Asia or the second in the world after USA, has one of the lowest electrification rate (66%) in Asia (MEMR and NCCCL 2011, Jarman 2012). Henceforth, based on geothermal road map the electrical install capacity target for 2020 is 3,109.5 MWe, unfortunately, the country can not gain the target or in other word the Country can increase the electric capacity for 692 (41.41 %) MWe for the past 5 years or deficit for 979 MWe (58.56) of the target.

Meanwhile, the Country Planning up to the year of 2025, is to develop and increasing the geothermal electric capacity for 30% of the present geothermal resources or equal to 7,241 MWe.(Dit Panasbumi,2018) Henceforth, in the next 5 years the Government of Indonesia (GoI) has to increase the geothermal electric capacity more than 5000 MWe or in average 1000 MWe/year

To support the target, GoI/Ministry of Energy and Mineral Resources (MEMR) has prepared 75 Geothermal area (Geothermal Working Area/GWA and Geothermal Task Force Area/GTA, that spread all over the country from the west to the east

Learning from the past experience in which the target almost never been reach as there are some problem that caused the slowly development of geothermal energy in the Country, among them are uncertainties in regulations, price and social. To solved the problem the government have to commit with the regulations in order to get trust from the investors and make new innovation rules

2. GEOTHERMAL RESOURCES PRESENT CONDITION

Indonesia, as the country that is located along the Pacific Ring of Fire, at present has the geothermal resources potential that is account of 23.9 GWe, the second after USA (30 GWe), and its derived from 331 location that spread out along the Country, see figure 2. Compared to the past 5 years the geothermal potential resources are decreased for 5.1 GWe (17.6%), as the result of more detail intensive exploration especially in the western part and some in the eastern part of Indonesia using more precision method and equipment such Magnetotelluric (MT), Time Domain Electro Magnetic (TDEM) methods and drilling in some prospect areas.

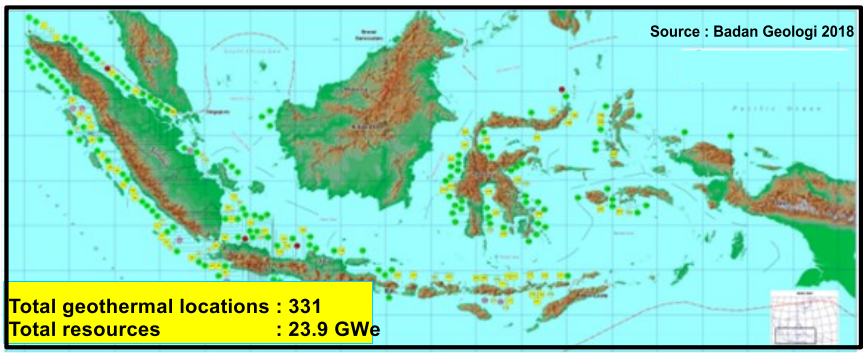


Figure 2: Geothermal Resources Location Map

3. GEOTHERMAL INSTALLING CAPACITY PRESENT CONDITION (2015-2020)

At present, Indonesia even though as the second largest Country in geothermal resources and the second electricity producer in the world after USA, (Direktorat Panasbumi 2018), see table 1 , unfortunately, has one of the lowest electrifications rate (66%) in Asia, as mention previously. Henceforth, to increase the electricity rate the GoI plan is to increase installing electricity capacity by developing several new power plants in which one of them are geothermal resources despite fossil energy that cause global warming, and also a non renewable energy. To support the plan in 2018 the GoI/MEMR has offered 10 GWA through tender process and at a later date offered another 16 GTA, and then is continued by drilling another 5 areas. The total potency of the 26 prospect areas are counted of 2,506 MWe, and the first capacity development plan is 350 MWe., (Dit.Panasbumi 2018). See figure 3,. Unfortunately the plan is not working properly as planning as the 2020 electrical capacity target is failed.

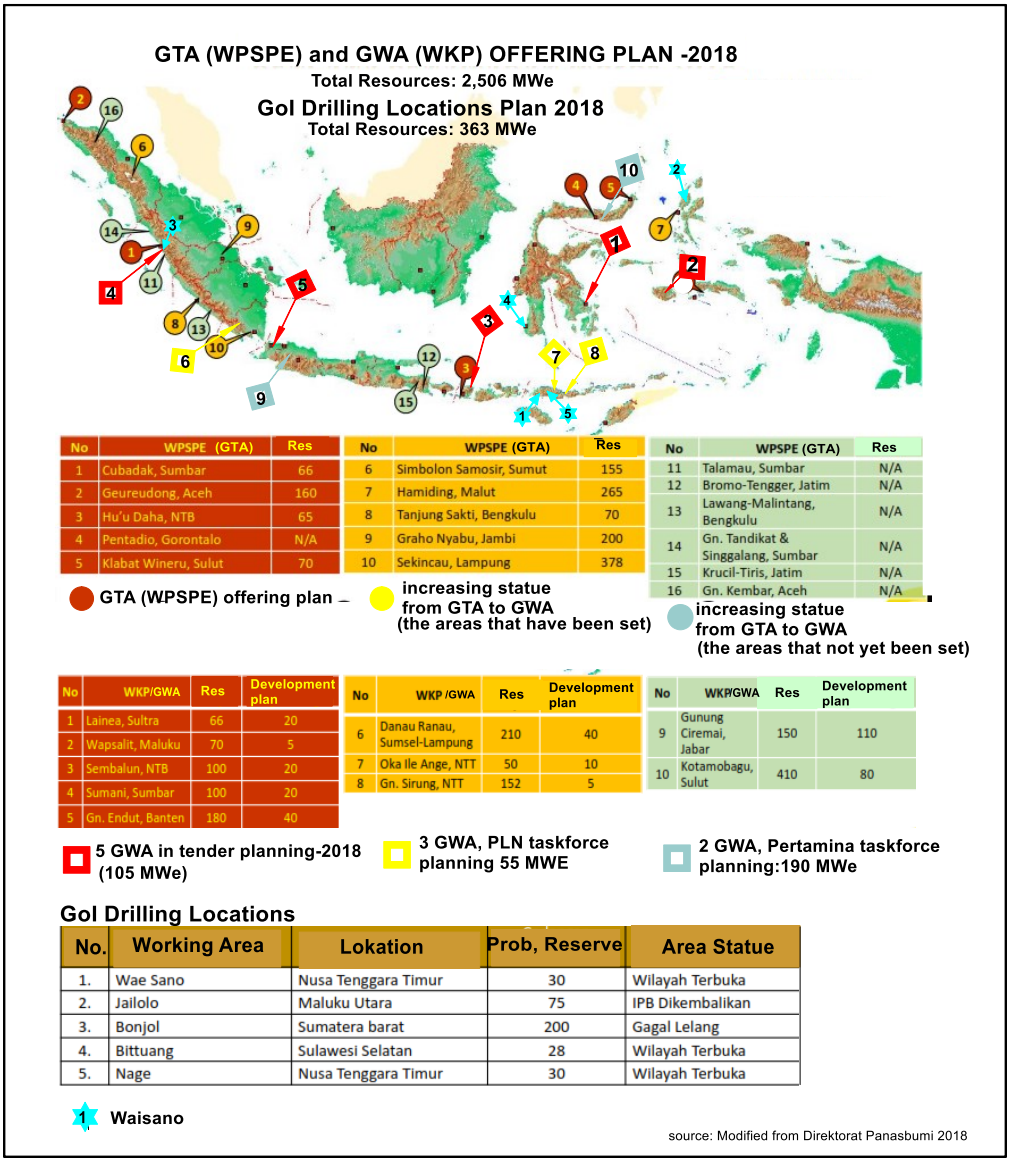
Table 1: Global Geothermal Installing Capacity

No	COUNTRY	RESOURCES (MWe) - %	INSTALLING CAPACITY (MWe)/%	COUNTRY RATIOS %	GLOBAL RATIOS %
1	USA	30,000 – 25.40	3,591 – 26.53	11.97	3.04
2	INDONESIA	23,900 – 20.23	2,130.6 – 15.74	8.9	1.812
3	FILIPINA	4,000 – 3.40	1,916 – 14.15	47.9	1.622
4	KENYIA	15,000 – 12.70	1,116 – 8.25	7.44	0.945
5	NEW ZEALAND	3,650 – 3.10	986 – 7.28	27.01	0.835
6	MEXIC0	4,600 – 3.9	951 – 7.03	20.67	0.805
7	ITALIA	3,270 – 2.8	824 – 6.08	25.20	0.70
8	TURKI	4,500 – 3.8	821 – 6.07	18.24	0.695
9	ISLANDIA	5.800 – 4.9	665 – 4.91	11.46	0.563
10	JAPAN	23,400 – 19.8	533 – 3.94	2.28	0.451
	TOTAL	118,120 – 100 %	13,533.6 – 100 %		11.46%

(Modified from Irena 2017 in Direktorat Panasbumi, 2018)

Currently, total installing electrical capacity in the Country, including fossil energy, is account of 69,600 MWe, in which 14.3.% (10.3 MWe) derived from new renewable energy such as geothermal (3.1%), and the rest (11,2%) derived from hydro, wind, solar and bio energy. Whilst the biggest portion, 85.2% (59,260 MWe come from fossil energy such as coal, crude oil, and gas, (Dit.Panasbumi,2018, DEN, 2019), as seen in figure 4. The declining fossil energy production especially crude oil and the global commitment in reducing greenhouse gas emission have encourage the GoI to increase the role of clean and renewable energy continuously to maintain energy security and independence. As stated in Government regulation no 79 of 2014 on National Energy Policy. in which new and renewable energy mix target is at least 23 % by 2025 and 31 % by 2050. (Dit.Panasbumi,2018). The Country has respectable potential of new and renewable energy to meet the primary energy mix target, especially geothermal that has been used for only 8.9 % of its huge energy resources.

In addition, at present ratios of geothermal used globally is account of 11.46% or equal to 13,533.6 MWe as seen in table 1 above. The table 1 shows us that the used of geothermal energy as an electrical power supply is also relatively small (11.46%) compare to its globally resources.



No	WPSPE (GTA)	Res
1	Cubadak, Sumbar	66
2	Geureudong, Aceh	160
3	Hu'u Daha, NTB	65
4	Pentadio, Gorontalo	N/A
5	Klabat Wineru, Sulut	70

No	WPSPE (GTA)	Res
6	Simbolon Samosir, Sumut	155
7	Hamiding, Malut	265
8	Tanjung Sakti, Bengkulu	70
9	Graho Nyabu, Jambi	200
10	Sekincau, Lampung	378

No	WPSPE (GTA)	Res
11	Talamau, Sumbar	N/A
12	Bromo-Tengger, Jatim	N/A
13	Lawang-Malintang, Bengkulu	N/A
14	Gn. Tandikat & Singgalang, Sumbar	N/A
15	Krucil-Tiris, Jatim	N/A
16	Gn. Kembar, Aceh	N/A

No	WKP/GWA	Res	Development plan
1	Lainea, Sultra	66	20
2	Wapsalit, Maluku	70	5
3	Sembalun, NTB	100	20
4	Sumani, Sumbar	100	20
5	Gn. Endut, Banten	180	40

No	WKP /GWA	Res	Development plan
6	Danau Ranau, Sumsel-Lampung	210	40
7	Oka Ile Ange, NTT	50	10
8	Gn. Sirung, NTT	152	5

No	WKP/GWA	Res	Development plan
9	Gunung Ciremai, Jabar	150	110
10	Kotamobagu, Sulut	410	80

No.	Working Area	Lokation	Prob, Reserve	Area Statue
1.	Wae Sano	Nusa Tenggara Timur	30	Wilayah Terbuka
2.	Jailolo	Maluku Utara	75	IPB Dikembalikan
3.	Bonjol	Sumatera barat	200	Gagal Lelang
4.	Bittuang	Sulawesi Selatan	28	Wilayah Terbuka
5.	Nage	Nusa Tenggara Timur	30	Wilayah Terbuka

Figure 3: GWA, GTA areas that are planned to be offered through tender process and GoI drilling locations in 2018

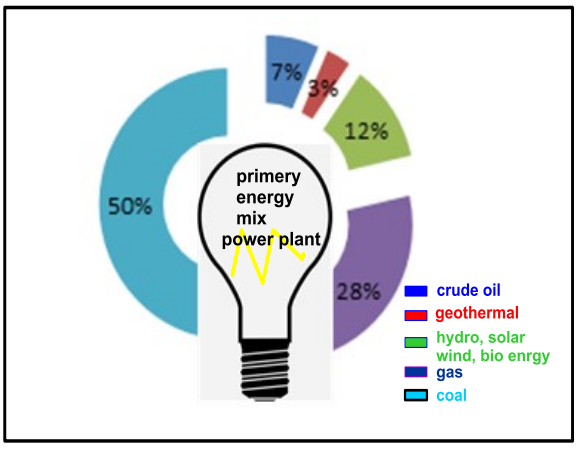


Figure 4: Present Condition Power Plant Energy Mix

4. GEOTHERMAL INSTALLING CAPACITY RATE

The progress of geothermal production rate in 2015 – 2020, however, is occurring at a very slow pace, as based on the geothermal road map the installing capacity target from 2015 to 2020 is 3109.5 MWe, (Dit.Panasbumi,2018) Unfortunately the target can not yet be gain, in which, up to the end of 2020 the installing electrical capacity is account of 2,130.6 MWe that derived from 14 Geothermal Power Plant (GPP), (Katadata.co.id, 2019, Pabumnews, 2020) as seen figure 5 , where 3 GPP are postpone as the effect of Covid -19 that attack Indonesia and the world globally.

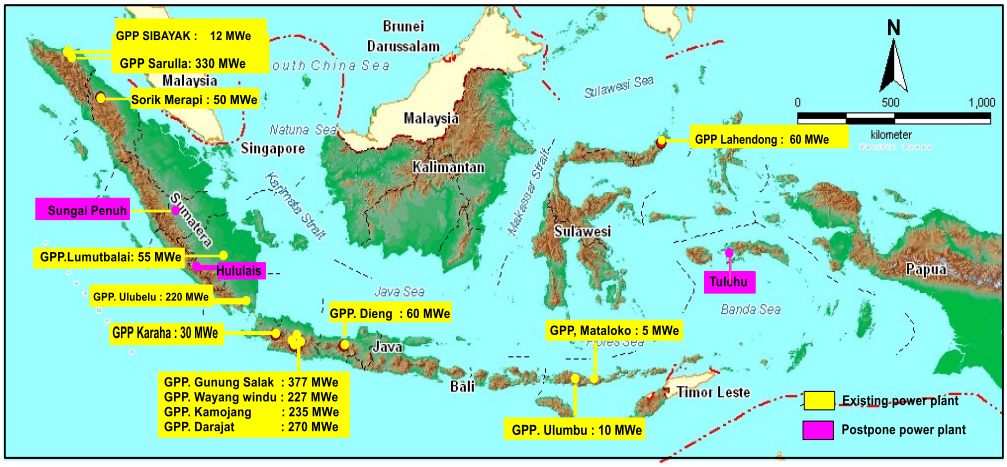


Figure 5: Existing Geothermal Power Plant, (modified from Idral 2015, Dit.Panasbumi, 2018)

During 2015 to 2020, the installing electrical capacity increase by 692 MWe (41.41%) from 1,438.5 MWe to 2,130.5 MWe, .(Katadata.co.id.2019). or deficit for 979 MWe (58.59%) of 2020 target, or in average installing capacity increase by 138.4 MWe (8.3%), year of year. Table 2 and figure 6 show the development of installing geothermal electrical capacity rate that is relatively slow from 2016 to 2019, in which the year target can not be reached and stagnant from 2019 to 2020.

Table 2: Installing and Target Capaity

Year	Installing Capacity (MWe)	Capacity Target (MWe)	Increasing capacity YOY/ MWe	Increasing Capacity of 2020 Target (%)
2014-2015	1403.5	-	35	2.1
2015-2016	1438.5	1439	205	12.3
2016-2017	1643.5	1654	165	9.9
2017-2018	1808.5	1909	140	8.4
2018-2019	1948.5	2134	182	10.9
2019-2020	2130.5	2494	0	0
2020	2130.5	3110	?	0
Average				8.3

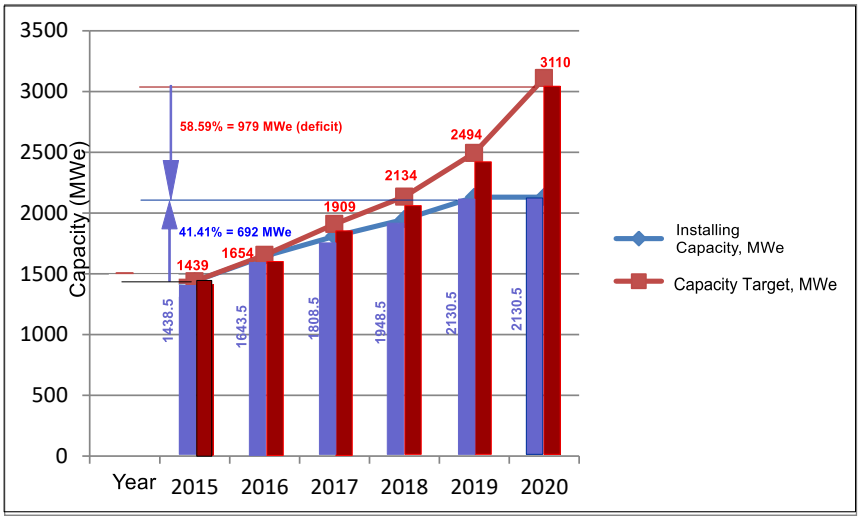


Figure 6: Statistic of increasing geothermal electrical capacity 2015-2020

5. AN OVERVIEW OF GEOTHERMAL DEVELOPMENT PLAN UP TO 2025

In accordance to Strategic plan of the GoI, up to 2025, the Indonesian target is to increase the electrical installing capacity up to 7241 MWe from its present condition, this would account for 30% of the total geothermal resources, as seen in figure 7 Henceforth, to support the target, GoI/MEMR has prepared 75 Geothermal Development Working Area, see figure 8, that consist of 65 region Geothermal Working Area (GWA), that are split into 2 programs, namely, Fast Track Program II (FTP-II) and 35.000 MWe program . Whilst the rest of 10 areas are Government Task force Area (GTA) for Geothermal, or a GoI/MEMR research region.(Dit.Panasbumi 2018)

However, learning from the past experience (2015-2020), in which the 2020 installing capacity target was failed to gain, there for, there is a possibility that the installing capacity target for 2025 can not be reached too, especially after the covid-19 attack Indonesia and the entire country in the world and cause the global economic tend to slowly. This condition, however, on November 17, 2020, Government of Indonesia made a press release in which the geothermal installing target for 2025 is cut off for 50% of previous target or from 7,241MWe to 3500 MWe, (www.panasbumi news,2020) so the target hopefully could be more realistic then before, as seen in figure 7

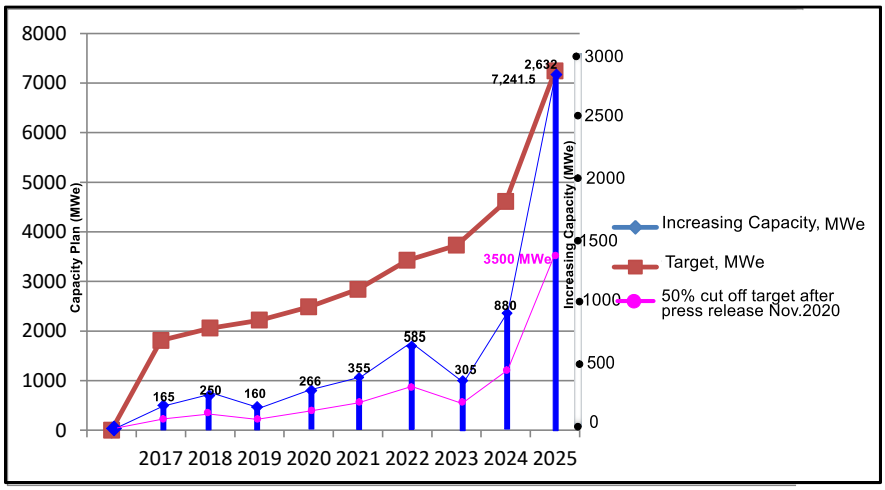


Figure 7: An Illustration of Increasing Electricity Target up to 2025 Before and after 50% Cut Off

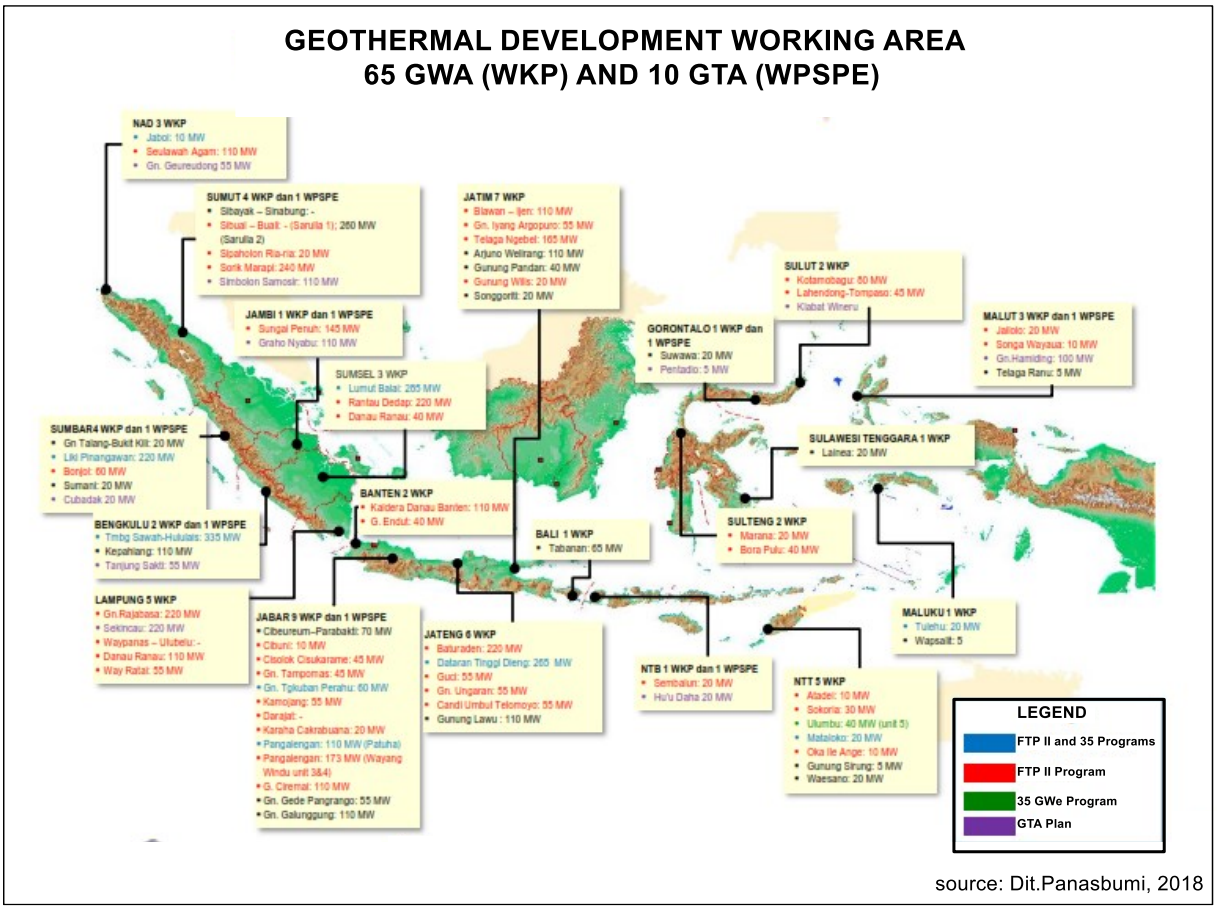


Figure 8: Geothermal Development Working Area

6. GEOTHERMAL TECHNOLOGY POWER PLANT USED IN INDONESIA

As a developing country which has a huge geothermal resources, in which at present Indonesia uses only 8.9% of its huge resources, therefore the country is determined to develop geothermal power plant as the future electrical source, and so the technology used. Currently the geothermal technology used in the Country is depending upon to the characteristic of the reservoir steam type in the area, in which the reservoir steam type in Indonesia are variation, ie vapour dominated, water-vapour dominated, so the conditions are a challenge for the investor to develop new technology. Up to know the technology use to developed the power plant namely single flash steam, double flash steam and binary cycle, as seen in figure 9

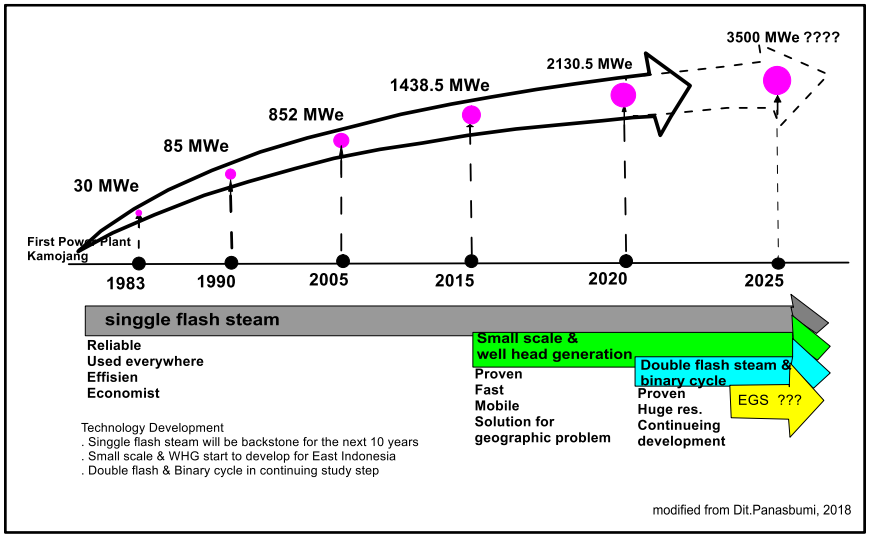


Figure 9: Miles stone technology development used in Indonesia geothermal power plant

7. GEOTHERMAL DEVELOPMENT PROBLEM AND SOLUTION

As mention previously, the progress on geothermal rate of production in the Country is occurring at a very slow pace, as the five year target ,2015-2020 is failed to gain or deficit for 58.6%. The GoI/ MEMR realize that there are several problems that caused the geothermal development acceleration programs are not working properly, namely : (Direktorat Panasbumi-MEMR 2018, DEN, 2019, Pabum news, 2020)

- Almost all geothermal prospects lie in remote area, such conservation forest, national park, protected forest, etc,
- No or bed infrastructure, ie, no road or track only or path way
- Permits/non permits are very complicated or hundreds permit/non pemit
- High interest Fund, such up front risk and huge investation in the beginning
- Uncertainties in regulation
- Price-kwh is very low, below the economics price/PLN (State Enterprice) ceiling price is too low
- Discrepancy between electricity need and geothermal resources in certain area, especially in eastern part the Country
- Social issues, ie, drilling can trigger tectonic activities or earthquake, land problems (customery right) etc

In order to accelerate and to solve the problems of developing utilization geothermal energy in the coming years, GoI makes some new innovations rules such as ((Direktorat Panasbumi-MEMR 2018, DEN, 2019, Pabum news, 2020)

- Simplification in permits and non permits
- Infrastructures for renewable energy (geothermal) will be prioritize and prepared by government
- GoI may give support in the form of fiscal incentive
- Duty free of imported goods
- Electricity purchasing price stipulation from each new and renewable energy sources (geothermal), due to people's purchasing power is low and have to subsidy, and or increasing people income per capita?
- Establishment of business entity to supply electricity to PT.PLN (State electricity Enterprise) and or subsidy
- Reconnaissance survey and exploration will be done by GoI before tender
- Government drilling using Geothermal Energy Upstream Development Project (GEUDP) Fund.

The aim of the GEUDP fund is to reduce the geothermal risk investation in order to drive the geothermal development by private company or government enterprise. The GEUDP fund is a Conditional Grant that is consist of: Clean technology fund (CTF), Global environment facility (GEF) and Government Companion fund (geothermal infrastructure fund). The grant will be pay back by the Company that win the tender of geothermal location, in which the grant is a revolving fund. The time effective for revolving grant is 15 years that is divided into 2 step 5 and 10 years.

8. CONCLUSION

In conclusion, up to the end of 2020 the existing install capacity of geothermal power plant fail to gain the target or in other word deficit of 58.6%. It is caused by several problems, the most important are uncertainties in regulations, price and social. Uncertainties in regulation can cause project economics or economics value of project changes due to time-consumes, whilst price -.kwh in geothermal energy is high due to high geothermal power plant production cost (related to people' purchasing power), that is difficult to compete with fossil power plant especially coal. Furthermore, the difficulty in obtaining low interest-financing have also contributed to the slow development of geothermal energy. Henceforth, social issues are also important, as in some areas the issue can cause the project delayed or failed to be done. Social issues is look like a small thing such as gravel but could thwart the project, the issues occurred because lack of communication, so the GoI or company have to be patient and caution to solve the problem and don't take it lightly..The 2025 target after cut off for 50% of previous target is still in question mark.

As the World second largest of geothermal potential resources with various type of reservoir and accordance to Government plan to develop the resource up to 30% in the future, therefore it is a significant challenges to investor to applied a new geothermal technology.

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REFERENCES

Badan Geologi,: Peta Sebaran Sumber Daya PanasBumi Indonesia, (2018)

Direktorat Panasbumi-KESDM,: Potensi PanasBumi Indonesia, , (2017)

DIrektorat Panasbumi –KESDM, : Doing Business in Geothermal, (2018)

Dewan Energi Nasional,: Indonesia Energi outlook, (2019)

Finance.detik.com,: Ini Sebaran Pembangkit Listrik Panasbumi di Indonesia, (2018)

Idral, A.,: Potency of Non Volcanic Hosted Geothermal Field in Indonesia, Proceedings of the World Geothermal Congress (2010), Bali, Indonesia, (2010), 7 pp.

Jarman, : Geothermal Power Plant Development in Indonesia, Forum for East Asia-Latin America Cooperation (2012),

Mansoer, W.R, Idral, A., : Geothermal Resources Development in Indonesia: A History, Proceedings World Geothermal Congress, Melbourne, Australia, (2015), 11 pp.

Katadata.co.id "Potensi dan Hambatan Pembangkit Tenaga Panas Bumi di Indonesia", (2019)

Katadata.co.id: Capaian Kinerja Kemeneterian ESDM, (2019)

Katadata.co.id, : Potensi Energi Terbarukan Indonesia, Kedua Tertinggi di Dunia (2019)

MEMRI and NCCCI,:Geothermal in Indonesia Low Carbon Development, (2011)

PabumNews : Inilah Permasalahan dan Resiko Pengembangan Panas Bumi di Indonesia (2020)

Tamboraku, Blogspot,com,: Cincin Api Pasifik, (2015)