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Potential Analysis and Regulations of Solar Power Plant Development in Indonesia

Mochamad Tauffauzan Catur Junihartomo[1], Suyono Thamrin[2,] M. Sidik Boedoyo[3]
Department of Energy Security, Faculty of Defense Management
The Republic of Indonesia Defense University
Bogor, Indonesia

Abstract:- Coal energy is still dominantly used as fuel for power plants as a system for meeting the needs of electrical energy in Indonesia. At the end of 2021 the government issued a policy to limit coal exports with the aim of meeting coal needs for general electricity. The government predicts that by 2025 the need for electricity will reach 125 GW, and the government also issues policies with the aim of renewing energy having a role in 2025 by 5% and specifically for solar power plant contributing 800 MW. The method used is a literature study that is used to collect data relating to renewable energy policies, the potential for new and renewable energy in Indonesia, the potential of each province related to the use of solar energy, problems that still exist in the development of PV mini-grid, and analysis of solutions for development. next solar power plant. The potential for solar power plant development in Indonesia where solar energy has a potential of 207,898 MW in all parts of Indonesia, but in practice the use of solar energy is still minimal at 0.04%. The government has the responsibility in managing national energy for the availability of national energy, various policies and regulations are issued for the development of new and renewable energy, especially in the development of solar power plant. Several problems also still arise related to the development of PV mini-grid, especially in remote and outermost areas in Indonesia, such as the high cost of development and the lack of investors in new and renewable energy. The government should also strive to implement policies and regulations in order to achieve the target in the medium term of 2025 by providing flexible policies to investors and also on technical developments that need to be standardized for products.

Keywords:- *National Energy Policy, Solar power plant, Regulation, Development Potential, Indonesia.*

I. INTRODUCTION

Indonesia is one of the four largest coal producers in the world, with a total annual coal production capacity of more than 130 million tonnes [1]. According to PT. PLN's Electricity Supply Business Plan (RUPTL), Indonesia stores coal reserves of 38.80 billion tons in 2019 [2]. It is predicted that coal production in Indonesia in 2020 can reach a total of around 529 million tons. Of the total production, the percentage of coal exports reached 357 million tons (63%) which was mostly exported to meet demand in China and India [3]. The high level of production, coupled with the decline in demand caused by the Covid-19 pandemic virus in 2020 has depressed domestic commodity prices and prompted miners to lower their production targets [4].

At the end of 2021 the central government through the President of Indonesia issued letter number B-1605/MB.05/DJB.B/2021 which is available to fulfill coal needs for general electricity [5]. This policy occurred because of the coal production crisis that occurred in Indonesia, this policy must also be complied with by entrepreneurs with a domestic market obligation (DMO) mechanism, companies that violate will receive strict sanctions. During the coal crisis that occurred in Indonesia, it was also caused by the high price of coal in the market, so mining companies chose to ship coal to PLN. The supply of electricity in Indonesia is predicted to reach around 125GW in 2025, so renewable energy resources are needed to support the supply of electricity. Renewable energy that can provide significant support is geothermal, biomass [6].

The Indonesian government has issued a National Economic Policy (KEN) with the aim of addressing the growing national electricity demand as a result of limited natural resources, namely fossil fuels. The role of electric energy as well as the government to manage energy from KEN has been planned for the development of power plants in 2025 which is estimated at around 5% of the total generating capacity in 2025, the report said. And this solar power plant is predicted to be able to produce 800 MW, with an annual growth rate of around 40 MW [7].

Solar power that is utilized today is one of the most promising energy resources in the 21st century [8]. A clean solar system can reduce CO2 emissions that can cause global warming, besides that solar systems can take advantage of unlimited solar power.

This article examines and reviews the development and regulation of PV mini-grid in Indonesia and also the existing problems related to the development of PV mini-grid in Indonesia.

This article is intended to examine and review the development and regulation of PV mini-grid policies in Indonesia and also the existing problems related to the development of PV mini-grid in Indonesia.

II. METHODOLOGY

In the analysis of the development of solar power plant as an alternative power plant that plays a role in the future, a qualitative analysis method is used by means of a literature study [9]. Where this study is used to collect data relating to renewable energy policies, the potential for new and renewable energy that exists in Indonesia, the potential of each province related to the use of solar energy, problems that still exist in the development of PV mini-grid, and analysis of solutions for further PV mini-grid development.

III. RESULT

A. *Solar power plant Development Policy*

The government has the responsibility for managing national energy, it is very decisive for the availability of safe national energy for every community. This is also stated in Law Number 30 of 2007 concerning energy that energy is managed based on the principles of benefit, rationality, efficiency, justice, increased value added, sustainability, community welfare, preservation of environmental functions, national resilience, and integration by relying on national capabilities. [10].

In Law No. 30 of 2007 it is also explained that renewable energy is energy produced from sustainable energy resources if managed properly, including geothermal, wind, bioenergy, sunlight, water flows and waterfalls, as well as movement and temperature differences. sea layer. In the formulation of the National Energy Policy (KEN), the target in 2025 is that the role of new and renewable energy is at least 23% as long as the economy is fulfilled, oil is less than 25%, coal is at least 30%, and natural gas is at least 22%. And in 2050 the role of new and renewable energy is at least 31% as long as the economy is fulfilled, oil is less than 20%, coal is at least 25% and natural gas is at least 24% [11]. PLN's policy in developing EBT is also supported by government policy in the regulation of the Minister of Energy and Mineral Resources Number 50 of 2017 concerning the use of Renewable Energy Sources for the provision of electricity. PLN is required to purchase electricity from power plants that utilize renewable energy sources. In addition, PLN also has an obligation to operate power plants that utilize renewable energy sources with a capacity of up to 10 MW continuously (must run) [12].

The purchase of renewable energy prices is regulated in a ministerial regulation and it is hoped that the price of BPP will increase as a result of the price of new renewable energy and be handled. The potential for renewable energy generation can be developed to meet electricity needs if requirements such as meeting the balance of supply and demand for local electric power systems, conducting feasibility studies, and conducting research and development, network research, development funding capabilities, and pricing are in accordance with applicable regulations.

In the solar power plant planning project, PLN has a policy to build a centralized PV mini-grid to electrify many off-grid communities in underdeveloped areas, border islands bordering neighboring countries and other outermost islands [2]. The placement of communal PV mini-grid / concentrated community PV mini-grid was chosen after considering technical - economic factors such as the cost of fuel transportation to the location and operation of PV combined with existing diesel power plant, yes, thereby reducing fuel consumption. In addition, PLN also pays attention to alternative sources of primary energy/Renewable Energy available in the local area and the level of service that will be maintained there.

B. *Potential Development of Solar power plants in Indonesia*

Indonesia has the potential of new renewable energy resources to meet the supply to industrial customers by using renewable energy generators owned by PLN or privately owned. The amount of new and renewable energy can be seen in Table 3.1

No	Energy Type	Potency	Installed Capacity	Utilization
1	Geothermal	29.544 MW	1.438,5 MW	4.9 %
2	*Hydro*	75.091 MW	4.826,7 MW	6,4 %
3	*Mini-Micro Hydro*	19.385 MW	197,4 MW	1,0 %
4	Bioenergy	32.654 MW	1.671 MW	5,1 %
5	Solar	207.898 MW (4,80 kWh/m^2/day)	78,5 MW	0,04 %
6	Wind	60.647 MW (≥ 4m/s)	3,1 MW	0.01 %
7	Wave	17.898 MW	0,3 MW	0,002 %

Table 3.1 New and Renewable Energy Potential

Source: Presidential Regulation Number 22 of 2017 concerning the General Plan of National Energy (RUEN) [13]

From the data shown above, it can be seen that the potential for solar energy in Indonesia is very large. In one day the solar energy produced reaches 4.80 kWh/M2/day with a total potential of 207,809 MW, so it has the potential for the development of Solar power plants in every region in

Indonesia [14]. The map of the potential for solar energy can be seen in the following table :

No	Province	Potency	No	Province	Potency
1	DKI Jakarta	225 mw	18	Kalimantan Selatan	6.031 mw
2	Riau	753 mw	19	Sulawesi Tengah	6.187 mw
3	DI Yogyakarta	996 mw	20	Papua Barat	6.307 mw
4	Gorontalo	1.218 mw	21	Nusa tenggara Timur	7.272 mw
5	Bali	1.254 mw	22	Sulawesi Selatan	7.588 mw
6	Sulawesi Barat	1.667 mw	23	Aceh	7.763 mw
7	Maluku	2.020 mw	24	Kepulauan Riau	7.881 mw
8	Papua	2.035 mw	25	Kalimantan Tengah	8.459 mw
9	Sulawesi Barat	2.113 mw	26	Jawa Tengah	8.753 mw
10	Lampung	2.238 mw	27	Jambi	8.847 mw
11	Banten	2.461 mw	28	Jawa Barat	9.099 mw
12	Bangka Belitung	2.810 mw	29	Nusa Tenggara Barat	9.931 mw
13	Maluku Utara	3.036 mw	30	Jawa Timur	10.335 mw
14	Bengkulu	3.475 mw	31	Sumatera Utara	11.851 mw
15	Sulawesi Tenggara	3.917 mw	32	Kalimantan Timur	13.479 mw
16	Kalimantan Utara	4.643 mw	33	Sumatera Selatan	17.233 mw
17	Sumatera Barat	5.898 mw	34	Kalimantan Barat	20.113 mw
TOTAL					207.898 mw

Table 3.2 Solar Technical Potential

The magnitude of the potential of each region in Indonesia for the development of PV mini-grid is not accompanied by its application in the field. Currently, new and renewable energy is still dominated by the use of hydropower, geothermal, and biomass and biodiesel [15]. The constraint on the development of solar power plant is the investment which is quite expensive both in terms of solar power plant development which requires a large area and technically solar power plant which can only absorb energy during the day requires storage units such as batteries or batteries for power at night [16].

In the General Energy Plan (RUEN) (Presidential regulation No. 22 of 2017) concerning the General National Energy Plan, 2017), the reference indication of solar development plans per province based on provincial electricity consumption per capita and solar potential availability per province can be seen in the following table:

No	Province	Total Installed Capacity per Year (MW)					
		2020	2021	2022	2023	2024	2025
1	Nusa Tenggara Timur	40,5	96,8	159,6	238,0	320,7	414,9
2	Kalimantan Barat	43,8	88,3	140,9	209,2	282,4	366,4
3	Gorontalo	19,7	35,7	71,7	114,1	169,3	228,5
4	Sumatera Selatan	35,8	71,7	114,1	169,3	228,5	296,6
5	Nusa Tenggara Barat	90,2	90,2	112,3	167,2	225,4	292,0
6	Sulawesi Barat	23,3	60,5	100,7	150,4	202,6	261,8
7	Jambi	27,1	60,7	98,6	146,7	197,9	256,3
8	Kalimantan Timur	27,7	56,1	89,3	132,5	178,9	232,1
9	Sumatera Utara	57,7	57,7	86,2	128,0	172,2	224,1
10	Sulawesi Tengah	31,4	52,7	86,2	128,4	173,1	224,1
11	Kalimantan Tengah	23,7	52,5	85,0	126,5	170,6	221,1
12	Papua	39,4	50,7	84,2	125,7	169,3	218,8
13	Sulawesi Tenggara	21,6	49,7	81,9	122,1	164,6	212,9
14	Aceh	22,5	50,2	81,3	121,0	163,2	211,4
15	Maluku Utara	18,9	47,3	78,3	116,8	157,3	203,5
16	Jawa Tengah	22,1	44,6	71,7	106,6	143,8	186,4
17	Jawa Timur	23,1	44,9	71,7	106,4	143,6	186,4
18	Sulawesi Selatan	21,2	43,8	70,8	105,2	142,0	184,0
19	Maluku	17,6	41,9	69,6	103,8	139,9	180,8
20	Papua Barat	19,0	39,8	64,6	96,1	129,5	167,8
21	Jawa Barat	20,2	39,3	67,2	93,1	125,6	163,0
22	Kalimantan Selatan	18,1	38,0	61,5	91,5	123,5	160,0
23	Bengkulu	16,5	37,3	61,2	91,3	123,0	159,2
24	Sumatera Barat	17,2	35,9	58,1	86,4	116,6	151,0

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25	Lampung	13,5	31,3	51,6	77,0	103,8	134,3
26	Kepulauan Riau	16,5	31,5	50,2	74,4	100,5	130,4
27	Sulawesi Utara	11,5	26,5	43,7	65,1	87,8	113,6
28	Bangka Belitung	11,7	25,9	42,4	63,2	85,2	110,3
29	Bali	108,2	108,2	108,2	108,2	108,2	108,2
30	Kalimantan Utara	12,0	24,3	39,1	58,1	78,5	101,7
31	Banten	10,0	22,2	36,3	54,0	72,9	94,3
32	Riau	9,0	21,8	36,2	54,1	72,8	94,2
33	D.I. Yogyakarta	8,0	18,9	31,3	46,8	63,0	81,5
34	Jakarta	1,4	3,2	5,3	7,9	10,7	13,8
Total Kapasitas Terpasang		900,1	1.600,1	2.500,2	3.699,8	5.000,2	6.500,2
Total Tambahan/Tahun			700,0	900,1	1.199,6	1.300,4	1.500,0

Table 3.3 Indications of Solar Development Plans per Province in 2020 – 2025

PT. PLN as the only public company responsible for managing electric power, as well as the responsibilities and objectives of PT. PLN regarding electricity services to the community to improve the standard of living and welfare of the community in a fair and equitable manner.

C. Problems In The Development Of Solar power plants

As a technology that is able to produce electricity without using fuel at a relatively high cost, solar power plant is an alternative, especially in remote areas in Indonesia that have no other potential, but the development of solar power plant also encounters obstacles or problems such as:

- Solar power plant is expensive in terms of development and economy.
- Solar power plant requires a very large area, to generate 1000 Wp requires 1 M2.
- Solar power plant requires a power storage supply unit such as a battery / battery because it can only generate during the day.
- There is no production of crystalline silicon ingots in Indonesia, so they have to import from other countries.

In addition to the technical side of implementation, the development of solar power plants also encounters various obstacles in the current policy, so that it is still difficult for entrepreneurs who want to enter the solar power sector. Regulations from the government that apply the BOOT (built operate own and transfer) system where ownership will be transferred when the contract period is over. The regulation is also not transparent regarding BPP (Cost of Generating) which requires renewable energy including solar PV to compete with coal-fired power plants which can result in market confidence will comply with solar power plants.

There are still many who question the policy regarding the use of BPP as a reference because it is considered not transparent in its preparation and determination of percentages. Business entities should again consider developing solar power plant, especially in remote areas in Indonesia, which requires an electrification requirement of 95% and this is burdensome for investment.

The government has the intention to accommodate the public in installing solar PV in their respective homes, but the policies of the government are still far from what the public expects. The government is trying to fence off consumers who intend to become electricity producers where the public only wants to save electricity for their daily needs.

IV. CONCLUSION

The government always strives to develop new renewable power plants including solar power plant by issuing policies and regulations as mentioned above. New policies and regulations related to the development of new and renewable energy are needed to create a more investor-friendly investment environment. This also needs to be done to achieve the targets that have been set for the development of solar power plant in Indonesia and also to be able to compete with power plants that still use coal energy sources.

On the technical side of the implementation of development, the role of solar power plant in the future is to reduce the use of fuel in diesel power plant, and also to increase the ratio of electricity. It is necessary to build a silicon ingot manufacturing plant in Indonesia to cut the cost of developing solar power plant considering that Indonesia has a very large potential for silica sand. The development of PV mini-grid in the future will not only focus on small units, but also on a larger scale in rural and urban areas. There is also a need for government policies to support the growth of micro solar power plant through efforts to standardize products, subsidies, tax policies and others.

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