

Opportunities and Challenges in Development of the Floating Solar Power Plant Project at the Adi Soemarmo Airport

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Abstract

Electrical energy is the most critical need in the defense sector to maintain state sovereignty. The floating PLTS in Cengklik Reservoir can be used as the main electricity source in the Adi Soemarmo Air Base building to support energy security and avoid black outs. Cengklik Reservoir has a total surface area of 253 ha. This research aims to find out what opportunities and challenges there are in developing a floating solar power plant project at Adi Soemarmo Air Base so that it can reduce dependence on fossil energy as a primary energy source. The research method used is descriptive qualitative. The research results show that if the utilization of floating PLTS is assumed to be 5% by the Minister of PUPR's regulations, the area of the Cengklik Reservoir where PLTS is installed is 12.65 ha, then a potential for floating PLTS of 14.80 MWp can be identified. This potential can support more reliable military operations. The challenge in building the floating PLTS project in Adi Soemarmo is that the distance between Cengklik Reservoir and Adi Soemarmo Air Base is 2.6 km, and regulations still need to be perfected in terms of permits.

Keywords: *Adi Soemarmo Airport, Solar Energy, Floating Solar Power Plant, Opportunities, Challenges*

INTRODUCTION

Energy is one of the most basic things in human life, especially electrical energy which is the most critical need in the protection sector, especially to maintain the upholding of state sovereignty. To meet the need for electricity in line with the Government Regulation of the Republic of Indonesia Number 76 of 2014 concerning National Energy Policy, it is necessary to diversify from renewable energy sources such as geothermal, wind, bioenergy, sunlight, air flows, and waterfalls, as well as movements and differences. The target sea layer temperature is at least 23% in 2025 and 31% in 2050 as long as the economy is met.

Indonesia itself is still dominated by the use of fossil energy (coal, petroleum, and natural gas) which is the main energy source for electricity generation (Rahman *et al.*, 2022). The use of fossil energy is considered to hurt the environment, such as global warming, even though Indonesia is rich in solar energy. It is very necessary to develop large-scale renewable energy in the country by considering environmental safety (Ainou *et al.*, 2022). This is in line with the National Energy Council (2020) which explains that Indonesia has quite large and relatively stable solar energy potential throughout the year. This good potential can be used as a source of electricity at the Adi Soemarmo Air Base military base to support energy security and avoid blackouts considering that radar and telecommunications operations cannot be turned off. Airports around the world have started to implement solar power plants, for example, Cochin International Airport in India and Incheon International Airport in South Korea (Rozi *et al.*, 2020).

The position of Adi Soemarmo Air Base is quite close to the Cengklik Reservoir which is believed to have the potential to develop floating solar power plants and can be used as the main power source in the Adi Soemarmo Air Base building, while electricity sourced from PT PLN (Persero) is used as a backup or supporting power source. Floating solar power plant is installed in water areas using a type of bifacial solar panel, so it is hoped that it can produce greater energy because it has two sides of solar cells that can receive sunlight. The front side of

the solar panel can receive direct sunlight, while the reverse side receives sunlight from water reflections. This is in line with research by Diniardi *et al.*, (2022) who explained that bifacial floating PLTS is very supportive if built on dams and reservoirs.

In developing a floating solar power plant project, you will be faced with various opportunities and challenges. The opportunity to build a floating solar power plant as the main source of electricity at the Adi Soemarmo Air Base building is that it can increase the reliability of radar and telecommunications. Cengklik Reservoir, which was built in 1923-1928, has a surface area of 253 ha. If 5% of the surface area, namely 12.65 ha, is built with floating solar power plant, it will produce a floating solar power plant potential of 14.80 MWp (Supriadi, 2022). Challenges that may be experienced in the construction of a floating solar power plant project are electricity distribution which must pass through people's homes, the Semarang-Solo toll road, and the impact of the construction of a floating solar power plant on reservoir water quality.

This research aims to find out what opportunities and challenges there are in developing a floating solar power plant project at Adi Soemarmo Air Base so that it can reduce dependence on fossil energy as a primary energy source.

RESEARCH METHODS

This research is a type of qualitative research using descriptive methods according to the condition of the object. Data collection in this research used literature study, interviews, and documentation methods. Library study data collection techniques come from previous research. Interviews were conducted with sources, namely the Adi Soemarmo Air Base installation facilities section regarding electricity needs at Adi Soemarmo Air Base in one month. Meanwhile, documentation was obtained via Google Maps screenshots to determine the distance from Cengklik Reservoir to Adi Soemarmo Air Base.

RESULT AND DISCUSSION

Opportunities for Building a Floating Solar Power Plant at Adi Soemarmo Airport

The construction of a floating solar power plant project in the Cengklik Reservoir as the main source of electricity for the Adi Soemarmo Air Base building is considered to have many opportunities. Adi Soemarmo Air Base, which is located 11 km west of Surakarta City, is quite close to the Cengklik Reservoir which is located in Gunungparan, Ngargorejo, Ngemplak District, Boyolali, Central Java. The distance between the two is 2.6 km which can be traveled in 9 minutes, so it is very possible to build a floating solar power plant as the main electricity source at the Adi Soemarmo Air Base building for defense purposes. Fulfillment of energy is an important element in supporting military operations. A study from the Institute of Essential Services Reform (IESR) in 2021 shows that Central Java province has the potential to develop floating solar power plants of 727.25 MWp from 42 artificial reservoirs that have been surveyed. Cengklik Reservoir has a total surface area of 253 ha. Assuming that 5% (according to the PUPR Ministerial Regulation) of the Cengklik Reservoir area where solar power plants are installed is 12.65 ha, the potential for a floating solar power plant of 14.80 MWp can be identified. According to the Installation Facilities section, the electricity demand for Adi Soemarmo Air Base in one month is 463,113,167 kWh.

Floating solar power plants are one of the uses of space in reservoir inundation areas that is permitted in the Regulation of the Minister of Public Works and Public Housing (PUPR Ministerial Regulation Number 6 of 2020 Pasal 105). The construction of a floating solar power

plant could become a new tourist attraction that can increase the income of the local community. By building a floating solar power plant project, it can reduce greenhouse gas emissions, encourage the use of domestic components and technology transfer, increase foreign investment, and at the same time open up job opportunities, and support the government in achieving the NRE mix target of 23% by 2025. This is in line with the statement of Hidayat & Romadhoni (2022) which explains that technically, floating solar power plants have many advantages over rooftop solar power plants, including:

- (1) Able to optimize reservoir utilization
- (2) There are no obstacles related to large land requirements
- (3) Can operate in a hybrid manner with the hydroelectric power plant built in the Cengklik Reservoir
- (4) Availability of an interconnection network for reservoirs which function as hydroelectric power plants
- (5) The existence of floating solar power plants can reduce evaporation
- (6) Increases energy yield by up to 10% due to lower environmental temperatures compared to rooftop or ground solar power plants

With the presence of a floating solar power plant as the main source of electricity, Adi Soemarmo Airport is believed to be able to reduce dependence on fossil energy. Guaranteed energy needs at military bases can support national defense in carrying out monitoring radars, smooth communications, internet network connections, and other important defense operations. The use of floating solar power plants is also considered to have minimal shadows, unlike rooftop solar power plants because if there is a shadow (building or tree) covering just one solar cell (photovoltaic cell) it will cause the entire series circuit to be disconnected so that the photovoltaic power will be lost. This is because the solar cells that make up the panel are arranged in series, so most of the power will be lost even if only one cell is covered by a shadow.

The construction of a floating solar power plant project which is used for military installations such as Adi Soemarmo Airport shows that the military is contributing to reducing emissions to the environment by the Green Defense concept. This is in line with the Paris Agreement which is an agreement within the framework of the UNFCCC (United Nations Framework Convention on Climate Change) in overseeing CO₂ reduction. The Paris Agreement was created at the UN Climate Change Conference in Paris in 2015. The Indonesian Ministry of Energy and Mineral Resources (2018) in its book entitled "Solar Power Plant Installations" explains that this new and renewable energy power plant is the most widely developed in the world. This is because it has several advantages that are recognized internationally. These advantages include:

- (1) There are quite a lot of manufacturers who can provide both large-scale and small-scale quality products ranging from solar panels, inverters, electrical balance systems, monitoring systems, and tennis construction services to procurement.
- (2) Product lines related to Solar Power Plants continue to develop
- (3) There has been the development of sustainable testing protocols and international standards
- (4) Tendency to decrease the prices of main components, both solar panels and inverters
- (5) There is an increase in technical understanding from service providers
- (6) Development of reliable modeling and the number of solar energy data sources
- (7) Increased trust of international financial services institutions in the bankability of Solar Power Plant projects

Challenges in Building a Floating Solar Power Plant Project at Adi Soemarmo Airport

Even though it has positive prospects, the construction of Solar Power Plant projects is still faced with various challenges. Chairman of the Board of Trustees of the Indonesian Solar Energy Association (AESI) Andhika Prastawa (2021), as reported on the Kontan.co.id page, explained that the trend of using solar energy will continue, although it cannot yet be said to be massive. This is due to limited utilization in certain sectors. Examples include large industries, commercial buildings, and large housing complexes. There are several industrial challenges in increasing the use of solar panels in Indonesia. One of them is regulations that still need to be perfected in terms of licensing. Not only that, it is very necessary to have affordable funding available to reduce the user's initial investment burden. This is because investment in solar power plants is still considered relatively expensive. After all, they must be equipped with batteries.

Minister of Energy and Mineral Resources (ESDM) Arifin Tasrif (2021) assessed that the lack of development of the solar panel industry in the country is a challenge in accelerating the development of solar power plants. To attract investment in the upstream solar panel sector, significant market creation is required. Therefore, the Indonesian government is trying to build a solar power generation market that is attractive to investors. Now, the Ministry of Energy and Mineral Resources (ESDM) is trying to design how the regulations will be prepared in line with the market opportunities that are to be created.

The challenge experienced during the construction of the floating solar power plant project as the main source of electricity for the Adi Soemarmo Air Base building was that electricity distribution had to pass through people's houses and the Semarang-Solo toll road. The distance between Cengklik Reservoir and Adi Soemarmo Air Base can be seen in Figure 1 below.



Figure 1. Distance between Cengklik Reservoir and Adi Soemarmo Airport
Source: Google Maps (2022)

This is an obstacle because the distance is quite far plus having to pass through rice fields, people's houses, and the Semarang-Solo toll road which of course will increase production costs and the availability of the community to support the distribution of floating solar electricity sources from the Cengklik Reservoir. So it is necessary to consider aspects of operation, maintenance, and the need to find land to free up this obstacle. Apart from that, several areas of the Cengklik Reservoir area are used by residents as fish ponds in cages, and the water is used to irrigate plantations.

Based on PUPR Ministerial Regulation Number 6 of 2020 Pasal 105 states that the location and design of a floating solar power plant must support the management of water quality and the surface area of the reservoir inundation area which can be used for a floating solar power plant. It is hoped that the layout of the floating solar power plant will not interfere with the function of the spillway building, and intake building, and pay attention to the reservoir bathymetry measurement route. The impact that may be faced in the construction of a floating solar power plant project at Adi Soemarmo Airport on the quality of reservoir water, namely the occurrence of non-uniform heating in the reservoir due to the water surface being covered by solar panels, resulting in a decrease in reservoir efficiency and degradation of flora growth due to reduced Sun exposure, during maintenance, can pose a risk of detergent, oil and lubricant leaks from motorized boats which can pollute the reservoir water, including disrupting the life of aquatic fauna and flora in the Cengklik Reservoir.

Based on Supriadi Legino's presentation in the Webinar held on December 13, 2022, he explained that various challenges that might be faced in developing a floating solar power plant project include:

- (1) There is still little experience to use as a reference regarding costs, environmental impacts that have occurred, technical complexity faced in terms of designing buildings and operating them in reservoir waters, especially related to aspects of electricity safety (K2), anchoring and mooring problems, operation and maintenance
Based on K2 according to Law 30 of 2009 concerning energy, there are electricity safety provisions aimed at realizing Reliable and Safe (A2) conditions for Installations (Installation Safety), safe from danger to humans and other living creatures (Workforce and the general public), and friendly environment.
- (2) Problems in permits, licenses, certification, and various requirements needed to build a floating solar power plant because it involves cross-functions and cross-ministerial matters, in addition to the fact that there are still many relevant officers who do not understand floating solar power plants.
- (3) As an illustration, land solar power plants are only related to the Ministry of Energy and Mineral Resources and PLN, but floating solar power plants must obtain permits from the Ministry of PUPR, KLHK, and the Ministry of Home Affairs so that development requires a relatively long time in the licensing process.
- (4) The government's push to develop renewable energy, including solar power plants, is still not supported by regulations that simplify the process of developing floating solar power plants.
- (5) In some cases, allowing hybrid operation with hydroelectric power generation is economically more feasible

At the initial stage of a development project, you must have an understanding of both environmental and social risk aspects during the project cycle.

CONCLUSION

Electrical energy is a need that must be met in defense to support the operations of military installations and the resilience of the energy sector. The location of Adi Soemarmo Airport is considered quite close to the Cengklik Reservoir which is believed to have the potential to develop a floating solar power plant and can be used as the main electricity source for buildings at Adi Soemarmo Airport. This can increase the reliability of radar and telecommunications, while electricity sourced from PT PLN (Persero) becomes a backup or supporting electricity

source. The potential of a floating solar power plant from the Cengklik Reservoir can meet the electrical energy needs of military installations at Adi Soemarmo Air Base.

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