

Energy Self-Sufficient Village (ESSV) Program: an Opportunity for Coastal Development

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Abstract–Bangka Island has significant potential for development of its local industries through harnessing solar power.. Improved availability of a locally generated and cost-efficient energy source is much needed to boost the local economy. Electricity use and access to fuel drives the main, local industry of fishing. They are vital in powering boats for the fishing process, as well as processing and cold storage and remain the key component in the success of local businesses. Providing a photo-voltaic energy source, both on-board the boats and on shore, would give the local industries a substantial boost, with the knock-on effects being felt throughout the surrounding communities. Furthermore, this innovative and integrated approach; utilizing ‘green boats’ at sea in collaboration with a ‘green village’ on land, could become a focus in the emerging and quickly-growing industry of ecotourism – bringing further revenue into the community. The Energy Self-sufficient Village (ESSV) Program, aims to meet at least 60% of these total energy needs, (electricity and fuel), by harnessing local resources, as well as boosting the production capability of the village economy, through offering an available, sustainable, local energy source. The implementation of an E.I.V.P. on Bangka will provide multiple social, economic and environmental benefits - bringing prosperity to the local economy while offering a shining example of environmental innovation to Indonesians and beyond.

Keywords–*Coastal Development; Energy Self-Sufficient Village; Solar Energy*

I. INTRODUCTION

In 2016, Bangka-Belitung succeeded in becoming the first province in Sumatra with an electrification ratio reaching 100% [1]. That means, 381 villages in the province of Bangka-Belitung already have access to electricity [2]. Although in some areas such as Sumedang island can only enjoy electricity for 12 hours at night [3]. The electricity that flows through Bangka-Belitung Province comes from PLTU and PLTD where it requires coal and diesel to produce electricity. This of course raises a dilemma because the two power plant sources come from resources that cannot be renewed. The risk is that there will be a scarcity of resources which can also have an impact on higher raw material prices. This indicates that the completion of electricity access in the province of Bangka-Belitung does not prioritize sustainability which only resolves for the short term, but

does not account for long-term needs.

Solar energy is one of the resources that can be used to produce electricity. In addition to using natural resources that have never run out, the use of solar energy as an appropriate power plant is applied in island regions such as the Province of Bangka-Belitung. Besides being able to meet the continuing electricity needs for households, the right use of solar energy can make coastal area development. The coastal area is an area that has great potential to be developed, one of which is with ecotourism. Tourism development can be an alternative to local economic resources, especially with the current Bangka conditions that need alternative economies other than tin mining. Beside, Bangka tourism is still lagging behind Belitung. Based on data from the Central Bureau of Statistics, the number of guests staying at Star-rated hotels in Belitung in January 2017, six times greater than guests staying in Bangka at the same month [4]. The establishment of ecotourism villages by showing energy independence is will give environment and economic value to coastal area.

II. THEORETICAL FRAMEWORK

A. Solar Energy

Energy is the ability to do work. This energy itself has various forms, one of which is solar / solar energy which can radiate it in the form of light. Solar energy is emitted in the form of electromagnetic wave radiation with a spectrum of wavelengths between 0.3 - 2.6 μm [5]. Outside of the earth's constant solar atmosphere, the amount of power that befalls one unit of normal area to radiation at an average distance of the earth's sun is 1367 W / m^2 or 1.96 calories / (cm^2 minutes) [6]. On the surface of the earth this lighting (direct radiation and diffusion by the atmosphere) provides a smaller constant of 1000 W / m^2 , or about 73.15% of the solar constant [7]. The intensity of solar radiation is influenced by the cycle time of the earth, weather conditions include the quality and quantity of clouds, changes in seasons and latitude positions. The intensity of sunlight radiation in Indonesia lasts 4-5 hours per day [8].

Photovoltaic (PV) systems convert sunlight directly into electricity. A solar cell or PV consists of semiconductor materials that absorb sunlight. Solar energy hits electrons off the atom, allowing electrons to flow through the material to produce electricity[9]. PV cells are incorporated into modules that hold around 40 cells [10]. About ten of these

modules are installed in PV arrays [11]. PV arrays can be used to generate electricity for a building or in large quantities, for a power plant. A power plant can also utilize concentrated solar power systems, by utilizing solar heat to generate electricity. Sunlight is collected and focused with a mirror to create a high intensity heat source. This heat source produces steam or mechanical power to run a generator that produces electricity.

There are 3 types of solar power plants commonly used in Indonesia [12]. First, solar home system (SHS). This system is individual in its management. Where people directly turn on and turn off the electricity used. This type is often used with solar panel capacity ranging from 50 - 80 wp. Where with the condition of solar panels like that can be installed as many as 3-5 points that can turn on the 3 watt led lights. Second, the hybrid system. Hybrid system is solar power plant that uses 2 or more power generation systems with different energy sources. In general, power plants that are widely used are generators, solar power plant, micro hydro and wind power. This system utilizes renewable energy as the main source combined with generators or other as a backup energy source. The latter is a centralized solar power plantsystem, where all the main components, such as solar modules, regulating devices, inverters, electricity storage, electrical breakers are installed centrally at one location. A centralized solar power plant system is a power plant using medium to large-scale solar energy with pure output equal to PLN's electricity network. Centralized solar power plant with a capacity of 1 kwp to 500 kwp which is capable of serving and meeting the electricity needs of residents' houses as many as 10 to 200 houses.

B. Energy Self-sufficient Village (ESSV) Program

Energy Self-sufficient Village (ESSV) Program is a program to fulfill its own energy needs. This program was first announced by the President of the Republic of Indonesia in 2007. The criteria of Energy Self-sufficient Village are villages that are able to fulfill a minimum of 60% of their total energy needs (electricity and fuel) by empowering local resource potential and the growth of productive activities to improve the village economy as impact of local energy availability. It is expected that with this Energy Self-sufficient Village, people's dependence on the use of non-renewable energy sources and the use of subsidized energy from the government can be minimized [13]. The criteria and requirements run synergistically and continuously are: a) Aimed at creating jobs, reducing poverty and providing energy in rural areas, b) Development of energy in rural areas must involve as far as possible the participation of all communities, from beginning to end [14].

III. RESULT AND DISCUSSION

A. Why ESSV Program important for Bangka Island?

Bangka Island has an area of 11,614,125 km², located next to the East coast of South Sumatra, bordering the South

China Sea to the north, Belitung Island to the east and the Java Sea to the south, namely 1 ° 20' - 3 ° 7 'South Latitude and 105 ° - 107 ° East Longitude [15]. This Bangka return position makes the average regional temperature based on data from the Pangkal Pinang Meteorological Station show variations between 25.70 to 27.70 °C. Whereas air humidity varied between 78 to 87% in 2005. While the intensity of the sun's radiation in 2005 varied between 19.0 to 57.3% and the air pressure between 1008.9 to 1011.4mb [16]. This condition provides a great opportunity for the application of solar power plants.

The island consists of swamps, low land, hills and at the top of the hill there is a dense forest, while in swamp areas there are mangroves. The mainland swamp of the island of Bangka is not much different from the swamp on the island of Sumatra, while the specialty of the coast compared to other areas is the sloping beaches with granite stretches. This natural potential can be used to develop potency in the coastal area of Bangka Island. Tourism with the concept of ecotourism that prioritizes energy independence will be a unique destination and can become a new icon of Bangka tourism.

B. Financial Analysis

In general, the generation costs of solar power plants are more expensive than the cost of generating fossil power plants, hydroelectric power plants, minihydro, and geothermal. But a lot of research states that the investment costs of the solar power plant in the future will decrease, so that the gradual removal of the Fuel subsidy is possible. Solar power plant can be considered as an alternative power plant. IrawanRahardjo and Ira Fitriana's research on investment costs made in 2005 compares the basic price assumptions and PVCOST. This study shows that the investment costs of the solar power plant in the basic case are assumed to be 5,830 US \$ / kW in 2000, 3,190 US \$ / kW in 2005, and 1,650 US \$ / kW in 2010 to the end of the period. While the investment costs of solar power plant in PVCOST cases in 2000, 2005 and 2010 are assumed to be the same as the base case of 1,650 US \$ / kW, then this investment cost decreases to 1,430 US \$ / kW in 2015, 1,210 US \$ / kW in 2020, 1,089 US \$ / kW in 2025, and 968 US \$ / kW in 2030 [17].

Research carried out by USAID through the Indonesia Clean Energy Development (ICED) project in 2017, illustrating the details of the cost of a solar power plant project with a scale of 1 MW capacity and around 5 MW are below [18]:

TABLE 1. COST OF SOLAR POWER PLANT

COST ITEM	1 MW SYSTEM		5 MW SYSTEM	
	\$/WATT	\$/MW	\$/W	\$/5 MW
Developer Costs	\$0.15	\$150,000	\$0.05	\$250,000
Engineering	\$0.50	\$500,000	\$0.20	\$1,000,000
Permitting	\$0.09	\$90,000	\$0.04	\$200,000
Site Preparation / Civil / Fencing	\$0.10	\$100,000	\$0.08	\$400,000
Panel Procurement	\$0.85	\$850,000	\$0.85	\$4,250,000
Inverter / Transformer Procurement	\$0.30	\$300,000	\$0.30	\$1,500,000
Racking Procurement and Installation	\$0.30	\$300,000	\$0.30	\$1,500,000
Electrical Installation (Panel, Inverters/ Transformers, DC and AC Systems, SCADA)	\$0.45	\$450,000	\$0.40	\$2,000,000
Commissioning	\$0.05	\$50,000	\$0.030	\$150,000
Total System*	\$2.79	\$2,790,000	\$2.250	\$11,250,000

Source: USAID-ICED, 2017

In Indonesia, the obstacle faced in the application of solar power plants is the high investment costs, the main tool is solar power plant where photovoltaic modules are still imported from other countries and the efficiency of photovoltaic modules is only 16% which causes the price of Solar Power Plant per watt is still very high.

The case of Bangka Island, to develop coastal ecotourism, we can use centralized solar power plant system.

C. Learn from Other Place

One of the coastal ecotourism by promoting energy independence is the Pantai Baru ecotourism located in Ngentak Village, Srandakan District, Bantul Regency, Yogyakarta. Pantai Baru is a beach developed independently by the residents of Ngentak Village. The new beach offers a variety of tours, ranging from independent energy tourism with the existence of a Hybrid Power Plant that combines Solar and Wind Power, coastal agriculture, to turtle conservation. Interestingly is the active participation of the community in ecotourism at Pantai Baru, starting from making plans to managing. In addition to being able to enjoy free electricity from hybrid power plants, ecotourism successfully contributes to people's income. The contribution of income from the tourism sector to the total income of Poncosari villagers is 59.6 percent [19].

Besides being a power plant, solar energy can also be used for another power. Fishermen in Brondong village Lamongan, East Java took initiative to built solar boat. It can be modeled as a technological development that is combined

with the custom of the community.



Figure 1. Hybrid Power Plant in Pantai Baru



Figure 2. Green Boat from Solar Energy

IV. CONCLUSION

Electrification ratio Bangka-Belitung reaching 100%, but the electricity come from non-renewable energy which not consider the sustainability. Bangka Island has a lot of potential that can be developed, one of them are by developing Energy Self-sufficient Village in coastal area. Energy Self-sufficient Village can use as ecotourism also can attractive the investor. So this ESSV program have environmental and economic value

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