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DESIGN OF ENERGY EDUCATION MEDIA FOR SOLAR AND WIND POWER PLANTS AT BOMO BEACH, BANYUWANGI REGENCY

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Abstract. Bomo Beach, which is managed by community groups to become a tourist attraction, has the potential for renewable energy in the form of solar and wind energy. This potential can be harnessed and converted into electrical energy. This study aims to design energy education media for solar power plants and wind power plants at Bomo beach, Banyuwangi regency. The design is carried out by the natural management of the tourist beach. The power plant designed is the integration of the solar power plant system (PLTS) and the wind power plant system (PLTB). Solar power plants use solar panels while PLTB uses horizontal shaft wind turbines and vertical shafts. The energy housing is made as a power store with a 12 volts battery. The design results show that the integration design of solar power plants and PLTB can be applied as an energy education media.

Keywords: PLTS, PLTB, media, education, energy.

1. INTRODUCTION

Bomo Beach which is located in Rogojampi district, Banyuwangi regency is a tourist beach managed by the Fisheries Supervisory Community Group (Kelompok Masyarakat Pengawas Perikanan - Pokmaswas) namely Benteng Samudra. The atmosphere in the morning, afternoon, and evening the beach looks very good but at night this beach looks scary because there is no electric lighting, there is lighting from oil lamps. The beach is only enjoyed in the morning, afternoon, and evening. The provision of free energy that can be synchronized with Bomo Beach will result in the formation of independent energy education and beach tourism at night. Pokmaswas Benteng Samudra as a manager supported by many partners, want beach tourism that is different from the others and can always be remembered by the community, especially tourists.

The management of this tourism potential has constraints in terms of electrical energy supply because the location of the beach is quite far from settlements. The absence of a power source causes the development of beach tourism potential cannot be carried out optimally. Alternative solutions to energy supply are indispensable. Coastal areas are generally known to have alternative energy potentials including solar energy and wind energy. These two types of energy are renewable energy. This energy potential can be used to overcome problems on the Bomo tourist beach.

Solar power generation has a simple concept that is to convert sunlight into electrical energy. Solar cells can produce an unlimited amount of electrical energy directly taken from the sun, with no rotating parts and no need for fuel [1]. The intensity of solar radiation and ambient temperature has an influence on the electrical power produced, the greater the value of the intensity of solar radiation the electrical power produced is also the greater and the temperature influences the electrical power generated by solar panels [2]. According to data from the National Energy Council in 2019, the potential for solar energy in Indonesia is 207.8 GWP [3], with realization reaching 0.15 GWP [4]. The greater the intensity of light received by the solar panels, the greater the current and voltage produced [5]. As a renewable and clean energy, solar energy will not cause environmental pollution like pollution produced by traditional energy e.g. coal, oil, and other fossil fuels [6]. Some new ideas can still be approached with the practical implementation of solar photovoltaic energy applied [7].

Research on solar power plant (PLTS) prototypes resulted in an efficiency of 16.42% [8]. The profit of electrical energy generated from solar power plants is 93,533 (3.3 %) kWh/year [9]. An array of about 10 - 20 or more solar panels will be able to produce sufficient high currents and voltages for daily needs [10]. The energy produced can be utilized as much as possible as electrical energy which in turn can reduce the cost of using electrical energy [11]. To use solar energy continuously both at night and during the day, the electrical energy generated is stored first to a battery controlled by a regulator. The output of the regulator is directly connected with the inverter from DC current AC. While the main technical obstacle of implementing slot power plants is battery damage [13].

Planning of solar power generation systems has been carried out among others for analysis and design for building needs [14], design and evaluation of solar power systems [15], design analysis of solar power generation systems with a capacity of 50 WP [16], development of research results of solar power generation tools [17], installation of information technology-based solar power plants for the formation of energy independent building [18], utilization of solar power plants as a source of electrical energy reserves for quail cultivation [19], planning solar power plants to meet the electricity needs of fishing ponds [20], design and build solar panels for simple home lighting installation [21], economic design and analysis [22], solar panels as power generation for lighting systems on fishing boats [23], pool water pump power requirement [24], designing portable solar power plant [25], implementing solar panels as a source of electrical energy for monitoring corn shift of agricultural land [26], experimental architectural design [27] and grid solar energy system [28].

Wind also includes renewable energy. The utilization of wind energy in Indonesia for the time being is still relatively low but has enormous potential. One of the reasons is that the average wind speed in Indonesia is classified as a l wind speed, which ranges from 3 m/s to 5 m/s, making it difficult to produce electrical energy on a large scale [29]. Wind energy can be harvested to convert wind energy into electrical energy by using wind turbines [30]. The construction and dimensions of hardware in wind energy conversion systems vary widely, depending on usage, capacity, and placement [31]. Generating installations are not only built in flat and windy areas but also in hi and the mountainous regions. The success story of wind energy is inextricably linked to its long history in research and development in many aspects. This includes ongoing efforts spent on improving the reliability of wind turbine designs and site assessments [33]. The design of wind power plants (PLTB) has among others been carried out for the Savonius vertical axis wind turbine type [29]-[32],[34] - [37] and horizontal axis wind turbine [31][36] - [42].

So far, independent energy facility in tourist attractions is only for a tourist area, not how the flow, installation, control systems, and processes of PLTS and PLTB produce energy. So with energy self-education, all visitors, especially elementary, middle and high school children, are expected to be able to instill insight from an early age about how easy it is to produce electrical energy, or for students, it can be used as a reference for lectures and practicums. The main urgency in this design is to provide an understanding so that the wider community can see how simple a power plant is so that it can attract them if they want to create an environmentally friendly energy system at home, place of business, or other things.

The concept of Bomo beach management is natural and educational. The natural concept is represented in the form of maintaining the beauty of the environment. The infrastructure building is made of wood and bamboo. The educational aspect is shown by the breeding of hatchlings (turtle cubs). New educational facilities are created by utilizing the potential of solar and wind energy. Small-scale solar and wind power plants are integrated and created in the concept of energy houses. On the other hand, this educational facility will also supply daily electricity needs. The merger of solar and wind systems is known as a hybrid system and has been studied for campus needs [43] and small-scale irrigation systems [44]. This study aims to design energy education media for solar power plants and wind power plants on Bomo beach, Banyuwangi regency.

2. METHODS

The design of energy education media is carried out by the stages of site surveys, discussions with partners (Pokmaswas), planning, and manufacturing. Site surveys are conducted to obtain site feasibility, especially on convertible energy potential. Discussions with partners are conducted as information and design considerations. The planning stage is part of the design of the system, the devices, and the installations. The manufacturing stage is the construction of a system that has been designed.

The design of energy houses in general is based on natural concepts according to the management of tourist beaches. Initial information and design were obtained from discussions with Pokmaswas. The design and manufacture of energy education houses are designed with consideration and advice from Pokmaswas. This is related to the design of educational house facilities and infrastructure. Design discussions are generally carried out so that the addition of energy education house facilities does not conflict with existing conditions or tourism development plans that will be carried out in the future.

The design of solar power plant (PLTS) and wind power plant (PLTB) systems is based on the potential availability of energy on the Bomo beach. As with other coastal areas, this location has a relatively large potential for sunlight. This is the case with the potential for wind energy where winds throughout the year are relatively constant flow, both from the sea direction and the land direction. The components of the plant used are components that are easily available in the market.

3. RESULTS AND DISCUSSION

Houses at Bomo beach are made with wood base materials. The energy house is positioned next to the beach tourism office. This is done to facilitate maintenance and supervision. In addition, this location is also adjacent to the hatchling breeding site so it will add educational facilities for visitors. The selection of this location is also based on the space of a relatively open area so that sunlight can directly hit the solar panels. In addition, although the coastline is planted with spruce, the wind blows at a speed of 2 – 6 m/s. The measurement results using a digital anemometer show that the measurement results on the coastline range from 4-6 m/s. The measurement results at the energy house location produce an average speed of 2 m/s at the measurement point with a height of 1 meter above the ground and more than 3 m/s at an altitude of 2 meters and above. This is by reference [29] which states that wind speed in Indonesia is 3 – 5 m/s. The Energy House Location Plan Design can be seen in Figure 1

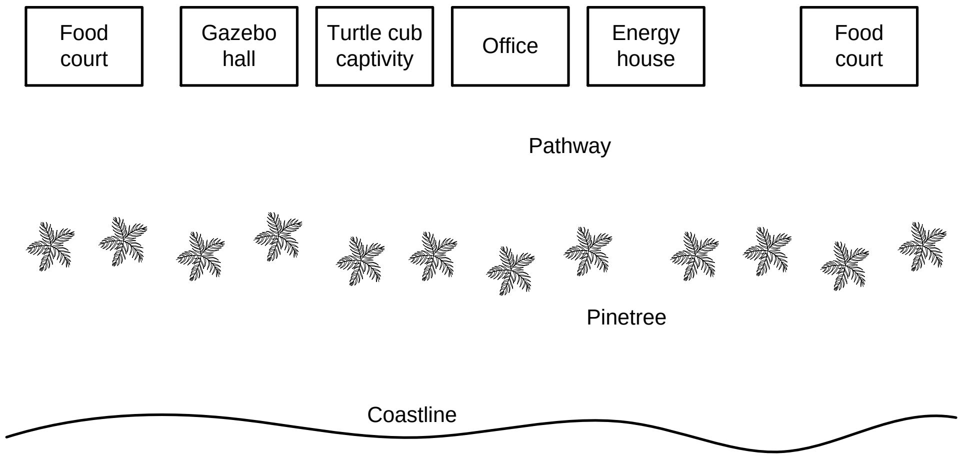

Figure 1. Energy house location plan design

The solar power plant is designed using solar panels. The wind power plant is designed using horizontal axis windmills and Savonius-type vertical axes. The selection of these two types of turbines is by the general types that are widely studied and used in the field. Solar panels are positioned as rooftop energy houses. Two types of wind turbines are installed next to the energy housing. Electrical energy storage is carried out using batteries which will then be distributed for surrounding needs.

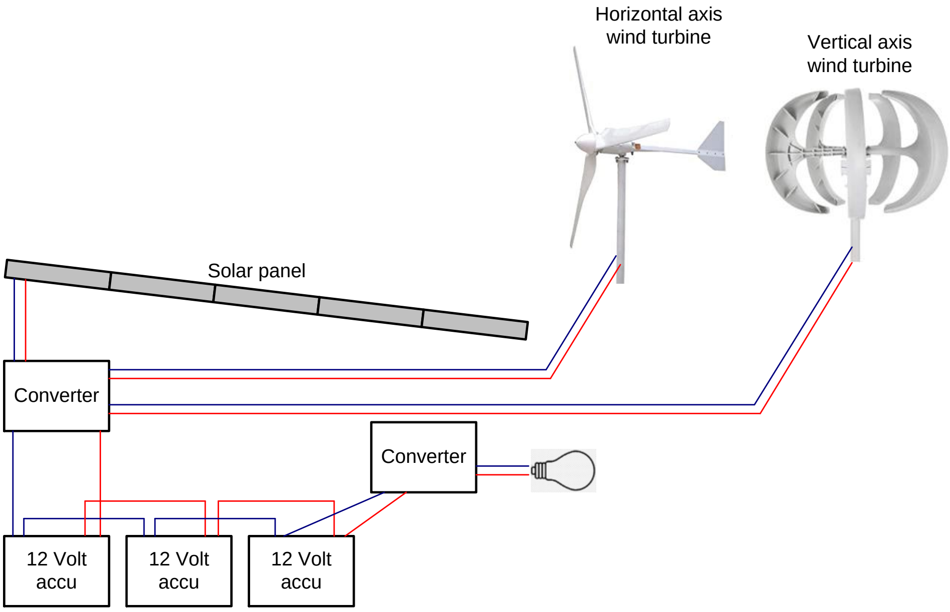

Figure 2. Basic concepts of solar and wind power plants

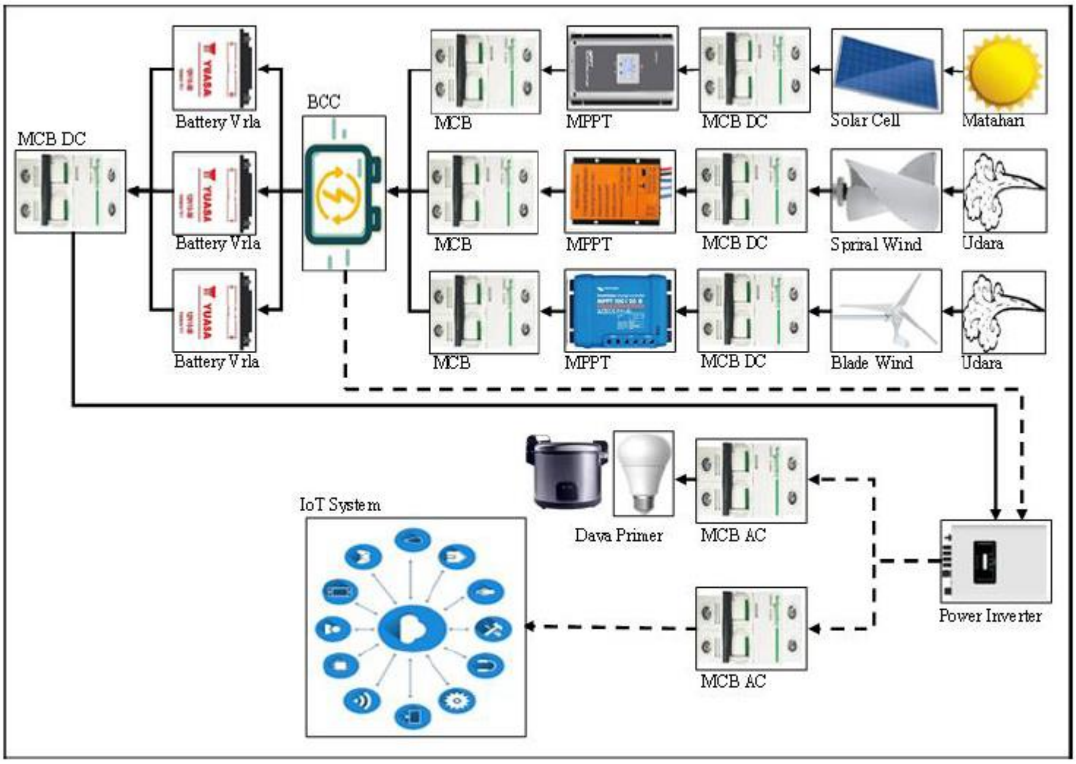

Figure 3. Design of solar and wind power plants

From the above system design from solar power → MCB → MPPT panel → BCC → Battery → Power Inverter 10,000 watt LF PSW → MCB AC 2 x 20 A → output to stalls, umm, audio and lighting. With this system, it can supply electricity to all activities in Bomo Beach in 24 hours, because the system uses solar energy and energy wind that has been carefully calculated, during the day solar energy can supply electricity, but at night can not afford, it will fix the system if the second energy is combined. Integration or merging of these 2 energy sources will have an impact on meeting the needs of Bomo Beach.

The monitoring results showed that the trial results of the system design were able to turn on four lamps, each lamp is a 25 watt LED lights, for a full day (24 hours). This shows that the system that has been built is relatively stable in performance. The integration of solar power plants and solar power plants can be an innovation in the use of energy sources in coastal areas where solar energy and wind energy are highly available. Quite simple equipment can be optimally applied.

The energy education media aspect is a separate medium for tourist beach management partners and their members. Pokmaswas members run businesses, the majority in culinary form. The creation of a power generation system is a very useful learning material for partner activities. In addition, future development is possible as the need for electrical power increases. Partners also learn simple maintenance and repair aspects of the power plants.

Energy education media is also a special attraction for visitors to tourist attractions. Visitors can see up close the installation of solar power plants and PLTB. This attraction can be seen in the increase in the number of visitors where the number of visitors increases by ± 10% on weekdays (Monday to Friday) and increases by ± 20 - 25% at the end of the week (Saturday and Sunday). This shows that educational media provides economic benefits.

The increase in tourist attraction and visits can also be seen in the increase in the number of culinary entrepreneurs. Before the implementation of the power plant, 5 culinary business actors managed permanent stalls. After implementation, the number increased to 6 entrepreneurs. In addition, 12 food and beverage sellers are active on weekends. After implementation, this number increased to 18 people.

In general, the design of energy education media implemented on Bomo beach provides positive benefits for community partners. The generated electrical energy can be used for lighting needs and other needs. The attractiveness of educational media increases the number of tourist visits, opens up new business opportunities for local communities, and provides financial benefits. These positive benefits indicate that the design of energy education media can be applied to improve people's welfare.

The design of energy education media in the form of solar and wind power generators is relatively simple. Applications directly in the community can be implemented easily. Installation and maintenance of this generator installation are also relatively simple. This educational media can be applied in other places that have renewable potential energy. The development of tourist attractions that are managed by the local community can apply this educational media to increase the attractiveness of these tourist attractions.

Figure 4. Energy house and installation

On the other hand, the managing community and users need education regarding the maintenance and repair of this power plant installation. Managers also need to plan the cost of components that have a service life. Electrical storage batteries and various other components can be damaged due to use. Financial planning is required to ensure the sustainability of this installation.

4. CONCLUSION

Solar power plants and wind power plants have been integrated and applied at the Bomo beach of Banyuwangi regency as a medium for energy education. A relatively simple system design can bring benefits in terms of needs for daily activities and as an educational medium. Improvements still need to be made about the monitoring system of electrical power generated by the system.

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