Hybrid Powerplant Using Solar and Wind Energy

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Abstract. Solar and wind energy sources can be used sustainably without worrying about running out. However, both energy sources have a weakness, namely in the rainy or cloudy season the energy produced is not large. So that an alternative is sought, namely by combining them which is usually called a hybrid system. The purpose of developing hybrid technology here is that if one energy source cannot produce energy, the other energy source will replace it as an energy supplier to the load. In the hybrid system, the utilization of solar energy uses a solar cell, while for the utilization of wind energy it uses a turbine generator. From the results of the study, it can be seen that the electrical energy produced by solar power plants is much greater than the electrical energy produced by wind power plants. In addition, solar power plants are still able to produce electrical energy, even though the solar cell is not exposed to sunlight. Meanwhile, in wind power plants, the electrical energy produced depends on the speed of the wind that blows. This means that for areas where the wind speed is unstable, it is better to use solar power plants compared to wind power plants.

Keywords. Hybrid technology, Solar power plan, Wind energy,

1 Introduction

Electrical energy is an important need in everyday life. The longer the need for electrical energy is increasing. However, the availability of electrical energy sources derived from fossil energy is getting less and less. Fossil energy is classified as non-renewable energy and the formation process takes a very long time to millions of years. Therefore, to maintain the availability of fossil energy in the future, alternative energy is needed to reduce the need for fossil energy. Indonesia is a very potential alternative in terms of renewable energy [1].

Alternative energy sources that can be used are solar and wind energy. Solar and wind energy sources can be used sustainably without worrying about running out. In addition, solar energy sources can provide electricity continuously because the energy source is a renewable energy source and is also environmentally friendly energy, as well as to reduce greenhouse gas emissions [2]. Then the territory of Indonesia is surrounded by oceans, the wind speed in various parts of Indonesia is relatively high, so many areas are suitable for wind farm development [3]. Therefore, researchers are interested in exploring alternative energy sources from solar and wind energy.

Solar energy and wind energy actually also have a weakness, namely in the rainy or cloudy season the energy produced is not large, so it is necessary to find an alternative to overcome this problem. One way is to combine the two energy sources, which is commonly referred to as a hybrid system. The purpose of developing hybrid technology is to obtain a more efficient power plant by combining two or more generating sources that work in an integrated manner as a compact system [4]. So if one energy source cannot produce energy, the other energy source will replace it as an energy supplier to the load.

2 Research Methods

2.1 Hybrid Powerplant

Hybrid power plants are made by utilizing solar power and wind power. Utilization of solar energy using a solar cell, while for wind energy using a turbine generator. The two types of electrical energy produced are electrical energy derived from solar cells and also electrical energy from this turbine generator which will then be used for power generation in a hybrid system. Hybrid power plant design is shown in Figure 1. Even though they are made separately, the two power plants are connected by a single box panel. The position of the box panel is integrated into the solar power plant. The design of the box panel contents is shown in Figure 2. Inside the box panel, there are several components needed in a hybrid power plant, including battery/accu, Solar Charger Controller (SCC), Wind Turbine Controller, Battery capacity/voltage, and inverter.

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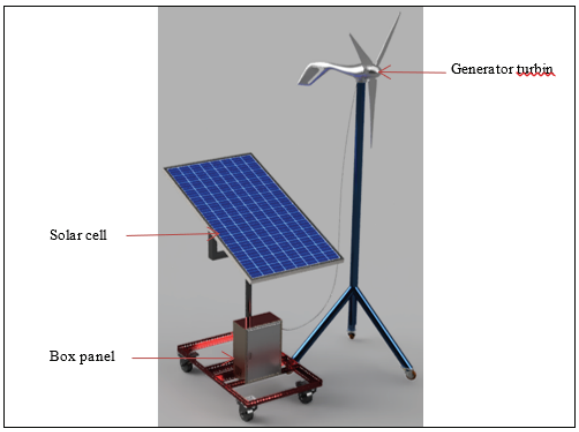

Fig. 1. Hybrid powerplant design

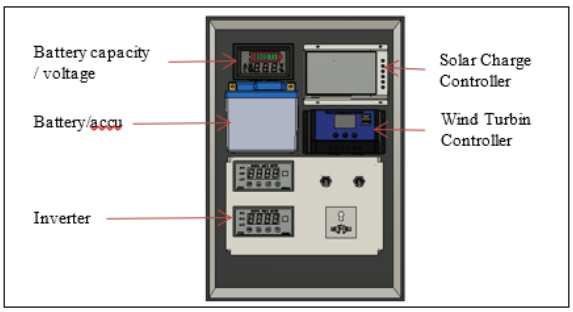

Fig. 2. Box panel design of a hybrid power plant

2.2 Solar Powerplant

Solar power plant using solar cells. Solar cell is a device or component that can be used to convert sunlight energy into electrical energy using the photovoltaic effect principle. The power generated by photovoltaic systems is a proven method with a large number of applications throughout the world [5]. As long as there is sunlight and even in cloudy weather, solar cells can still generate electrical energy. In addition to the flexible process ability to expanded for meeting the growing energy needs furthermore cost effective and minimal maintenance requirements [6]. The type of panel used in this research is 100 WP polycrystalline panel.

2.3 Wind Powerplant

Wind energy is an important energy source, environmentally and economically competitive and expected to have a significant role to meet the global challenges of clean energy and sustainable development under climate change [7-8]. wind power plant using a turbine generator. A wind turbine is a device that converts wind power into mechanical power in the form of a shaft rotation. The rotation of this shaft will generate electricity. In this study the turbine generator used has 3 propeller blades.

The simple concept of a wind power plant is the wind as a source to rotate the blades connected to the generator. The generator has a copper winding so that the emf (electromotive force) occurs. After the emf generates electricity, the electric current is stored through the battery so that it can be used to load.

3 Result and Discussion

The Hybrid power plants using solar and wind energy that have been produced are shown in Figure 3. The battery capacity used in this hybrid power plant is 65 ah. The energy generated from this power plant is DC electrical energy, so if AC electrical energy is needed, an inverter is needed.

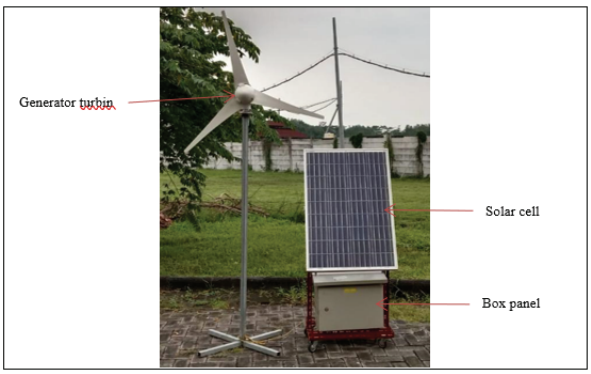

Fig. 3. Yield of hybrid power plants

In solar power plants, trials are carried out outdoors so that the solar cell can be exposed to sunlight. The test results of solar power plants are shown in Table 1. From the data in Table 1, it can be seen that the solar cell has a stable voltage even in cloudy weather conditions. This is because the solar cell still absorbs the existing heat and can still generate sufficient voltage. However, when the weather begins to change in temperature, the solar cell will experience a decrease in voltage so that the resulting voltage also decreases. This is because the nature of the solar cell itself absorbs solar heat and when it rains, the sun's heat begins to refract so that the ambient temperature changes quite significantly.

Table 1. Solar power plant test results

Time (WIB)	Weather Conditions	Solar Cell Voltage (Volt)	Ambient temperature (°)
11:17	Sunny	20.02	32
11:47	Sunny	19.99	31
12:17	Cloudy	19.65	30
12:47	Cloudy	19.50	30
13:17	Drizzling	19.20	29
13:47	Rainy	18.70	28

In wind power plants, trials are also carried out outdoors so that the turbine generator can be exposed to strong wind gusts. The test was carried out in the morning and the test results are shown in Table 2. From Table 2 it can be seen that the average voltage generated is 2.179847 Volts, the average current is 0.174061 Ampere, and the average power is 0.379548 Watts. The test results show that the power generated by the wind power plant is very small. Then the test was carried out again at night and the test results are shown in Table 3. From Table 3 it can be seen that the average voltage generated is 11.22333 Volts, the average current is

0.11667 Ampere, and the average power is 1.32905 Watts. The test results indicate that the power generated by the wind power plant increases compared to the previous test. From the two tests that have been carried out, it shows that the wind speed is unstable, causing the electrical power produced to be unstable.

Table 2. The results of the first test on a wind power plant

Time (WIB)	Turbine Voltage (Volt)	Turbine Flow (Ampere)	Turbine Power (Watt)
08:25	2,09	0,18	0,3762
08:30	2,1	0,18	0,378
08:35	2,11	0,16	0,3376
08:40	2,11	0,18	0,3798
08:45	2,12	0,16	0,3392
08:50	2,14	0,16	0,3424
08:55	2,09	0,18	0,3762
09:00	2,14	0,18	0,3852
09:05	2,13	0,18	0,3834
09:10	2,14	0,16	0,3424
09:15	2,09	0,16	0,3344
09:20	2,09	0,18	0,3762
09:25	2,14	0,13	0,2782
09:30	2,14	0,18	0,3852
09:35	2,09	0,16	0,3344
Average	2,11467	0,16867	0,35659

Table 3. The results of the first test on a wind power plant

Time (WIB)	Turbine Voltage (Volt)	Turbine Flow (Ampere)	Turbine Power (Watt)
00:25	12,51	0,17	2,1267
00:30	12,57	0,21	2,6397
00:35	9,94	0,17	1,6898
00:40	12,29	0,08	0,9832
00:45	13,32	0,11	1,4652
00:50	10,57	0,09	0,9513
00:55	11,89	0,14	1,6646
01:00	12,14	0,12	1,4568
01:05	10,41	0,08	0,8328
01:10	9,56	0,09	0,8604
01:15	11,19	0,09	1,0071
01:20	8,11	0,09	0,7299
01:25	10,7	0,08	0,856
01:30	11,78	0,14	1,6492
01:35	11,37	0,09	1,0233
Average	11,22333	0,11667	1,32905

4 Conclusion

The electrical energy produced by solar power plants is much greater than the electrical energy produced by wind power plants. In addition, solar power plants are still able to produce electrical energy, even though the solar cell is not exposed to sunlight. Even in cloudy or rainy weather conditions, this solar power plant is still capable of producing electrical energy even though it is small. Whereas in wind power plants the electrical energy produced depends on the speed of the wind blowing, which in the test area the wind speed is unstable so that the electrical energy produced is also unstable. This is still capable of producing electrical energy even though it is small. This means that for areas where the wind speed is unstable, it is better to use solar power plants compared to wind power plants.

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