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Sanding Machine Powered By 2 X 150 WP Solar Panels

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ABSTRACT: The depletion of fossil fuel leads in searching renewable energy source. Solar energy, one of many renewable energy sources, is very suitable to be used in Indonesia. Indonesia has about 200 GW solar energy potential. This solar energy has been converted into electrical energy through solar power plant. However, only limited of those solar power plants powers household appliances. Thus, the present work aims to developed 2 x 150 WP solar power plant for sanding machine. The performance of the panel is evaluated in in terms of output voltage, current, power, and conversion efficiency. Data collection is performed for 5 days from 9 am to 3 pm. Data taken are irradiance, output voltage and current of the solar panel. The data are use to calculate output power and conversion efficiency. The result shows that the highest average output power is 235.96 Watts with conversion efficiency of 78.65% which occurs in day-5.

KEYWORDS: Solar, energy, renewable, irradiance, power

I. INTRODUCTION

Shortage of fossil fuel and increasing global warming led the utilization of renewable energy sources. Solar energy is emerging as beneficial renewable energy sources (Hanif & Mi, 2024; Mousavi et al., 2022) and it is considered as the best choice to be implemented to realize net zero carbon emission target. Compare with other renewable energy systems, solar energy system is more proven technology which marking a pivotal shift in global power production technologies (Mousavi et al., 2022; Lepiksaas et al., 2025). Solar electricity generation systems have some merits, such as energy-regeneration, cleanliness, no pollution, and safety (Liu et al., 2024).

Many works on solar energy system have been reported so far. Mostly, the solar power plants have a large capacity. Very limited solar power plants have been utilized for small scale purposes, like for powering household appliances. Extensive research has been dedicated to optimizing solar field design. Field design is closely related to the thermal flux collected on the receiver system and therefore heliostat aiming operations. The aiming strategy should be selected to prevent receiver damage (Hull, 2018) and maximize thermal power output (Sanchez-Gonzalez et al., 2018). Several optimization techniques are available in literature, relying both on meta-heuristic (Cruz et al, 2016) and deterministic approaches (Ashley et al., 2017).

To increase performance of the solar energy system, many optimizations effort have been conducted. Merino et al., 2018 optimized energy distribution in solar panel array configurations by graphs and Minkowski's paths. Zhong & Tong, 2019 performed optimization on spatial layout for solar photovoltaic (PV) panel installation. Wang et al., 2020 worked on optimization of the areas of solar collectors and photovoltaic panels in liquid desiccant air-conditioning systems using solar energy in isolated low-latitude islands. Oon et al., 2020 reported an optimization study of solar farm layout for concentrator photovoltaic system on azimuth-elevation sun-tracker. Other works in enhancing performance of the solar energy system are performed by modification of solar cells with antireflection coatings (El-Khozondar et al., 2021) and by using thermal control water spraying cooling in polycrystalline solar panel (Laseinde & Ramere, 2021).

Many works on solar energy system have been reported so far. Mostly, the solar power plants have a large capacity. Very limited solar power plants have been utilized for powering household appliances. The present work aims to develop small-scale solar power plant for powering 150 watt sanding machine.

II. MATERIAL AND METHOD

Figure 1 displays schematic diagram of a 2x150 wp solar power plant ant its experimental setup. The plant has a component of 2-unit 150 wp polycrystalline solar panel, 1-unit MPPT, 1 unit battery, and 1-unit inverter. Output power of the plant is used to drive a 150 wp sanding machine. Solar irradiance to the panel is converted into electrical energy and stored in the battery. The MPPT is used to control charging condition of the battery. The inventer converts DC current from the battery into AC current.

Figure 1. Schematic diagram of the solar plant

Experimental work is conducted for 5 days from 9 am to 3 pm. Solar irradiance (Ir) is measured above the panel's surface, output voltage (V) and current (I) are measured at panel output. Output power and conversion efficiency are calculated using Eq. (1) and (2) where WP is solar plant capacity, i.e. 300 Wp.

$$P_{out} = V \times I \quad (1)$$

$$\eta = \frac{P_{out}}{WP} \quad (2)$$

III. RESULT AND DISCUSSION

Figure 2 presents solar irradiation during 5 days data collection. Solar irradiance increases from 9 am to 12 am and reaches maximum value. The irradiance decreases after 12 am. The solar irradiance at the location ranges from 489.21 to 703.18 W/m^2. Figure 2 indicates the trend of solar irradiation are similar during 5 days experimental work. Meanwhile, Figure 3 shows average value of solar irradiation per days during the work. It is observed that the highest an average solar irradiance occurs at day-5, i.e. 627.92 W/m^2.

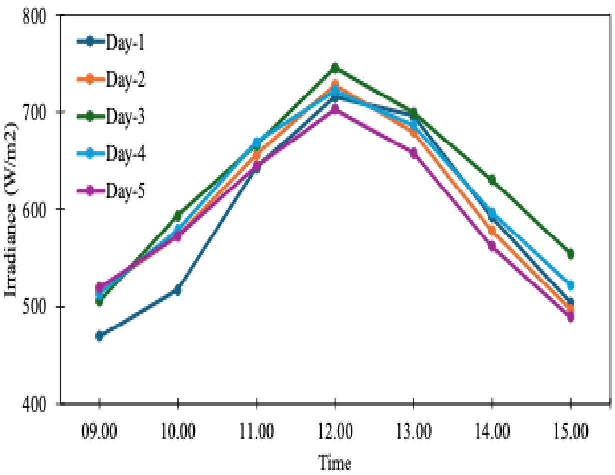

Figure 2. Solar irradiance at data collection site

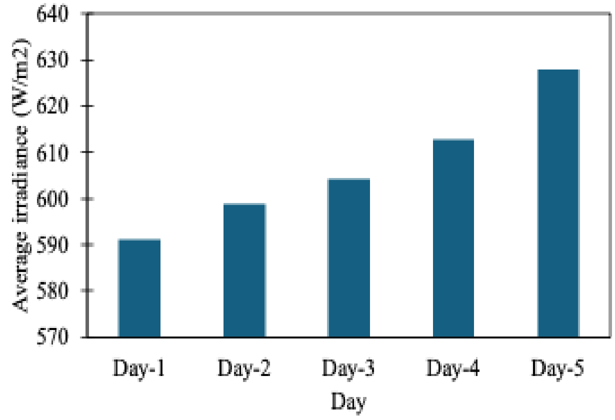

Figure 3. Average irradiance

Figure 4 displays output voltage and output current of the panel. Average output voltage and current show similar trend where increasing solar irradiance impacts on increasing output voltage and output current. The highest output voltage and output current are 48.28 V and 4.68 A which are obtained at the highest an average solar irradiation at day-5.

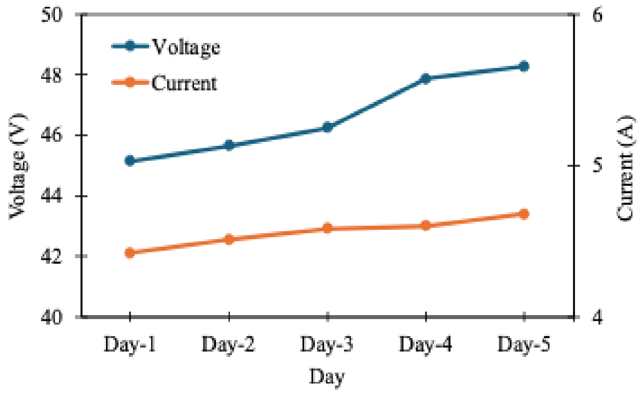

Figure 4. Output voltage and current

Meanwhile, Figure 5 shows output power and conversion efficiency of the panels. Since output power is affected by voltage and current, the highest output power is obtained at the highest voltage and current. The highest output power is 235.96 watt. Thus, the conversion efficiency of 78.65% is obtained for the highest output power.

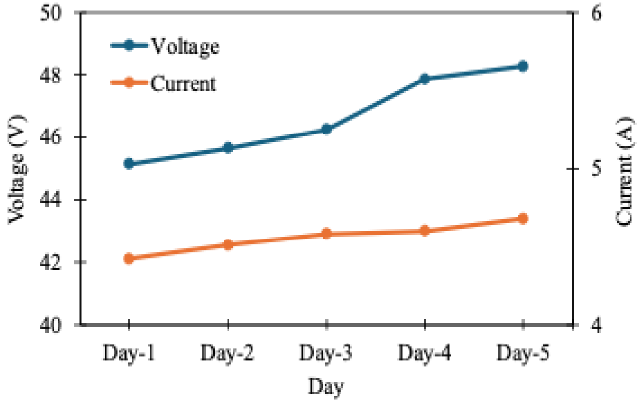

Figure 5 Output power and efficiency

IV. CONCLUSION

A small-scale solar power plant has been developed. The power plant is constructed from 2 x 150 wp polycrystalline sola panel, a MPPT, a battery, and an inventer. It can be concluded that the plant is successfully tested for driving 150 watt sanding machine without any problems. The solar panels have maximum output power of 235.96 Watt and conversion efficiency of 78.65%. It is recommended that the performance of the panels should be evaluated for different inclination angle of the panels.

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