RESEARCH ARTICLE

SOLAR PANEL MODULE OUTPUT ENERGY ANALIYSIS USING FLAT MIRROR

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Manuscript Info

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Abstract

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The tool used to convert sunlight into electrical energy and increase the temperature of solar cells is called a Solar Panel.To convert solar energy into electrical energy, photovoltaic modules are needed. One aspect that effects is the intensity of light. One of the influential aspects of the conversion is the light intensity. The intensity of this light is directly proportional to the value of electrical energy. The greater the light intensity, the greater the energy value produced by the panel and vice versamore light intensity, the more electrical energy the solar panel gets and vice versa. The solar panel will be optimal when exposed to direct sunlight. Optimization of electricity value using flat mirrors as reflector expected directly more sunlight radiation falling on to the surface of the photovoltaic panel flat mirror aims to focus light on the photovoltaic panel. The greather the light received by the flat mirror glass, the higher the output power by the output power obtained by the photovoltaic panel. The calculation of the voltage and current of the solar panels is carried out using a digital is multimeter. The result of the study, the increase in the output power of the solar panel is affected by the sun's temperature which has an impact on the performance of thephotofoltaic panel where the difference in the output, photovoltaic panel without using a reflector is 2.31.

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Introduction:-

A solar panel is a tool used to convert sunlight into electrical energy directly and consists of an arrangement of solar cells as silicon which has properties as an excellent absorber of photovoltaic radiation energy. [11] Photovoltaic panels will be optimal if exposed to direct sunlight. [1] The position of the photovoltaic panel must be perpendicular to the incoming light to produce optimal electrical power. This method uses flat mirror glass as a reflector and is expected to direct more solar radiation onto the surface of the solar panel. The reflector can focus light towards the photovoltaic panel and the more light the mirror glass receives, the higher the output power generated by electrical energy. This indicates that the greater the working temperature surface of the photovoltaic panel, the smaller the voltage generated and the current tends to be constant**.**

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Materials and Methods:-

Solar Panel Materials:-

The type of semiconductor material commonly used to make solar panels is the element silicon, a combination of CadmiumnSulfide and Gallium Arsenide and Cadmium Telluride Solar Cells.[2]

Solar panels (photovoltaic) is a semiconductor device that converts photons (light) into electricity.[1] This conversion is called the photovoltaic effect, in other words photovoltaic can absorb light energy and convert into electrical energy. The photovoltaic effect is defined as a phenomenon of the appearance of an electric voltage due to the contact of two electrodes connected to a solid or liquid system when exposed under light energy. In producing electrical energy on solar panels does not depend on the area of the silicon field of the solar panel. The conversion of solar energy into electricity takes place in semiconductor devices called solar cells.[5]A solar cell is a unit that provides a certain amount of electric power in the form of voltage and current. Because the material that makes up a solar cell is a semiconductor, the process of converting sunlight into electricity is possible. More precisely, the excess charge is negative (n=negative) because it consists of two semiconductors with excess electrons. , it is called (p=positive) because excess positive has too many holes in p-type semiconductors. In this p junction, the process of converting sunlight into electricity, for the purposes of solar cells, the n semiconductor is on the top layer of the p junction facing the direction of sunlight, and is made much thinner than the p semiconductor so that sunlight falling on the surface of the solar cell can continue absorbed and into the depletion region and semiconductors p.[6] The output of the solar panel generates DC voltage. [8]To determine the output power of solar panels, the formula from the following equation can be used

$$P_{out} = V_{out} \text{ x } I_{out} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (1)$$

Where,

P_{out} = power that comes out of the solar panel (W)

V_{out} = solar panel voltage (V)

I_{out} = Current outgoing solar panels (A)

To determine the percentage ratio of the output power generated from solar panels, you can use the equation in calculating the error (Error) as follows[10]

$$|\varepsilon a| = \lceil (xr \text{ new} - xr \text{ old}) : xr \text{ new} \rceil \text{ x } 100 \text{ \%} \dots\dots\dots\dots(2)$$

Where,

εa = error (error)

New xr = current iteration

Old xr = previous iteration

Solar panels can be a sourceuseful energy, then it must: Low production costs, High efficiency and Long operating time/period.

The data used is the measurement data of voltage, current and output power for 7 days. The research started at 10.00-14.00 WIB. The implementation location was in Dusun III Bandar Khalipah, PercutSei Tuan District, DeliSerdang Regency.This research is based on procuring tools and materials, assembling a series of solar panels and then analyzing the working principle of solar panels by collecting them. PLTS Output Power measurement data with a comparison using a flat mirror and without a flat mirror. The tools and materials used in this study are as follows: Digital Lux Meter Serves to measure the intensity of light from 1-200,000 lux, Multimeters Serves to measure voltage, current, resistance The materials used in this study are as follows:[9]

1. Polycrystalline solar panels
2. Reflectors
3. Cable 2.5 meters

Reflection Of Light On a Flat Mirror:-

Plane mirror is a mirror that has a flat and smooth surface. flat mirror blind of glass with the back of the glass coated with a shiny metal so that it is opaque and can reflect light. The light coming towards the mirror will be reflected. This is in accordance with Sinellius' law, where "the incident ray, the normal and the reflected ray lie in a plane and the angle of incidence (i) is equal to the angle of reflection (r)[3].

Results And Discussion:-

Calculating the output power of photovoltaic panels:-

Procedures performed to calculate the output power of photovoltaic panels can be perform as follow,

1. First measure the voltage and current using a digital multimeter and then record the results

2. After measuring the voltage and current, the measurement results are calculated to obtain the output power and determine the output power of the solar panel using the formula.

Stages of calculating the percentage increase in solar panel output power
1. First calculate the output power generated by the solar panel using a reflector and without a reflector
2. After calculating the output power on the solar panel then compare the output power of the solar panel using a reflector and without a reflectorUsing a polycrystalline type solar panel with a capacity of 10 WP. This study uses 2 solar panels, one solar panel without a reflector and one solar panel using reflectors on the right and left sides of the solar panel with a reflector area of 1610 cm2 which aims to compare the percentage increase in output power generated from each each solar panel. To determine the output power (P out) of the solar panel, the formula from equation (1) is used with the average measurement results of the voltage, current and output power of the panel in table 1.

Table 1:- Solar Panel using a flat mirror.

Solar Panel Using a flat mirror (Reflection)				
Measurement	Time	Voltage average (volts)	Current average (amperes)	Power average (watts)
Day 1	Tuesday August 9, 2022	13,31	0,32	4,47
Day 2	Wednesday August 10, 2022	14,19	0,37	5,49
Day 3	Thursday August 11,2022	13,33	0,29	4,09
Day 4	Saturday August 13, 2022	11,45	0,23	2,96
Day 5	Sunday August 14, 2022	12,40	0,31	4,27
Day 6	Monday August 15, 2022	13,91	0,32	4,90
Day 7	Tuesday August 16, 2022	12,78	0,30	4,01
Amount		91,37	2,14	30,19
Average		13,05	0,30	4,31

Table 2:- Flat Mirroles Solar Panel.

Flat Mirrorless Solar Panel (Reflection)				
Measurement	Time	Voltage average (volt)	Current average (amperes)	Power average (watt)
Day 1	Tuesday August 9, 2022	10,04	0,21	2,14
Day 2	Wednesday August 10, 2022	11,69	0,20	2,39
Day 3	Thursday August 11,2022	11,48	0,21	2,11
Day 4	Saturday August 13, 2022	8,69	0,16	1,48
Day 5	Sunday August 14, 2022	9,33	0,19	1,91
Day 6	Monday August 15, 2022	9,43	0,22	1,75
Day 7	Tuesday August 16, 2022	10,34	0,21	2,26
Amount		71	1,40	14,04
Average		10,14	0,20	2,0
Flat Mirrorless Solar Panel (Reflection)				
Measurement	Time	Voltage average (volt)	Current average (amperes)	Power average (watt)
Day 1	Tuesday August 9, 2022	10,04	0,21	2,14
Day 2	Wednesday August 10, 2022	11,69	0,20	2,39
Day 3	Thursday August 11,2022	11,48	0,21	2,11
Day 4	Saturday August 13, 2022	8,69	0,16	1,48
Day 5	Sunday August 14, 2022	9,33	0,19	1,91
Day 6	Monday August 15, 2022	9,43	0,22	1,75
Day 7	Tuesday August 16, 2022	10,34	0,21	2,26
Amount		71	1,40	14,04
Average		10,14	0,20	2,0

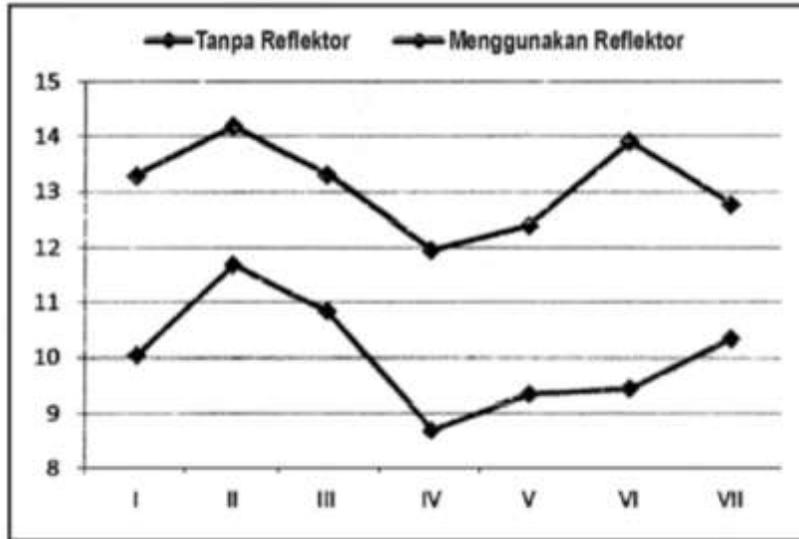The table 1 and 2 can be seen in a graphic implementatin as Picture 1 and 2 and 3as follow:
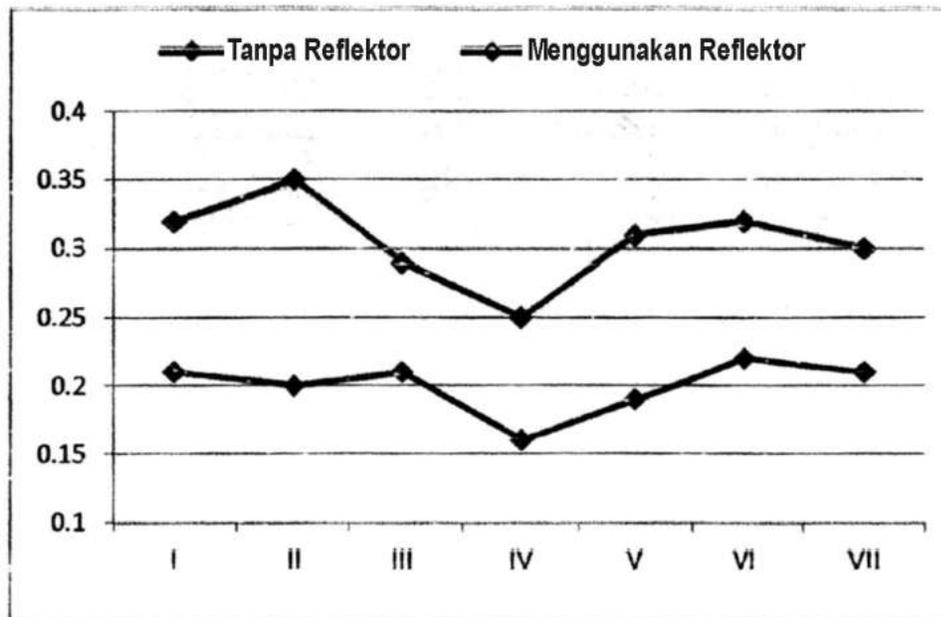
Fig.1:- Output Voltage of Photovoltaic Panel.

Fig. 2:- Output Current of Photovoltaic Panel.

From the results of measurements made on solar panels by using flat mirrors for 7 days, the total output voltage is 91.37 Volts and the output power is 30.19 Watt. The average votageobtained from the measurement results of solar panels without reflectors for 7 days is 10.14 Volts, For the output voltage of 71 Voltsand for the output current 1.4 Amperesand 14.04 Watts for the output power of the solar panels.

Conclusion:-
The results of this study can be concluded as,
1. The results of the average measurement for 7 days show that the solar panel without using a reflector produces an output voltage of 10.14 volts, an output current of 0.20 Amperes and an output power of 2.0 watts. The solar panel using a 1610 cm^2 reflector produces an output voltage of 13.05 volts, an output current of 0.30 Amperes and an output power of 4.31 watts.

2. The percentage increase in the output power of solar panels with the addition of a reflector surface area of 1.88 times the surface area of a solar panel with an area of 1610 cm2 experienced an increase in output voltage of 22.29%, output current of 33.33% and output power of 53.59%

3. The thing that affects the increase in output power is the reflection of light from a flat mirror. The reflector can focus the light around the panel and focus it on the solar panel so that it can increase the output power produced by the solar panel, but the reflection of a flat mirror cannot reflect 100% of the light coming towards the solar panel.

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