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A Comparative Analysis of the Influence of Temperature and Wind Speed on the Efficiency of 100 WP Solar Panels of Monocrystalline and Polycrystalline Types at Sriwijaya State Polytechnic

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Abstract: Solar panels in PLTS convert photon energy into electrical energy, where sunlight, which produces light intensity, plays a very important role. In this case, environmental conditions that continue to change can affect the output power of the solar panels. Apart from light intensity, solar panel environmental conditions such as temperature and wind speed greatly affect the efficiency of solar panels. This research looks at the extent of the influence of temperature and wind on the efficiency of solar panels. From the test results and calculations, it was found that the sample temperature of the monocrystalline panel measured on Friday, June 16, 2023, was 31.5°C, and the temperature of the polycrystalline panel was 31°C. From various aspects of the calculations carried out, we can see that the efficiency of monocrystalline panels is 18.07%, while the efficiency of polycrystalline panels is 16.04%. From the calculation results, we can conclude that the efficiency of monocrystalline modules increases significantly.

Keywords: Efficiency, Solar Panels, Temperature, Wind

1. Introduction

Indonesia is a tropical country with lots of sunshine. Therefore, if it has good potential, people can take advantage of sunlight with solar power plants (PLTS). Indonesia's location on the equator is estimated to have solar radiation of 4.8 kWh/m^2/day. In Indonesia, to be precise, the South Sumatra region is between 2° 52' and 3°5' South Latitude and 104°37'-104°52" East Latitude, which has an average temperature of 25.8°C/year. PLTS is a generator that converts solar energy into electrical energy. This generator is an environmentally friendly type of generator. As fossil fuels are depleting over time, there is a need to develop solar power plants as an alternative energy source.

Solar panels in PLTS convert photon energy into electrical energy, where sunlight, which produces light intensity, plays a very important role in this case. Environmental conditions that continue to change can affect the output power of the solar panels [1]. This is because weather factors are very sensitive to the performance of solar panels, such as cloudy, overcast, foggy, and the humidity level at the location where the panels are placed. Apart from light intensity, solar panel environmental conditions such as temperature and wind speed greatly affect the efficiency of solar panels.

If the temperature on the panel rises above the standard, it will cause a decrease in the power produced because the efficiency of the panel also decreases [7]. Wind speed is directly related to the cooling of the PV system, which can affect the performance of the solar panels. When the wind speed is greater, it will cool the outer surface of the panels [2]. The wind speed around the location of the solar panels greatly influences the efficiency of the panels. This can help keep the temperature of the glass in the solar cells low so that the working temperature of the solar cells remains optimal.

Solar panels come in various types and, of course, have different levels of efficiency, such as monocrystalline, polycrystalline, thin film, and compound thin film triple junction. The most commonly used solar panels in Indonesia are the monocrystalline and polycrystalline types of crystalline silicon solar panels; however, the two panels have different types of silicon solar cells used. Monocrystalline solar panels are made from a single crystal of silicon, while polycrystalline solar panels have solar cells made from many silicon fragments melted together. In this case, the silicon found in monocrystalline and polycrystalline solar cells has its own advantages and disadvantages [12].

Many studies have been carried out using parameters that influence the efficiency of solar panels, such as the influence of tilt angle, shadow effects, etc. However, parameters such as the relationship between temperature and wind speed have not been studied much in terms of how they affect the efficiency of solar panels [5]. From the background above, the author wants to examine the extent of the influence of temperature and wind speed on the efficiency of solar panels.

Therefore, the author took the initiative to conduct a "Comparative Analysis of the Effect of Temperature and Wind Speed on the Efficiency of 100 Wp Monocrystalline and Polycrystalline Solar Panels at the Sriwijaya State Polytechnic" in order to compare the efficiency results of the two panels.

2. Methodology

The methods used in this research include observation and a literature study. This research was carried out by direct observation at the Sriwijaya State Polytechnic. Data were taken on 100 WP monocrystalline and polycrystalline solar panels at the Sriwijaya State Polytechnic, namely on June 16 2023, June 17 2023, June 19 2023, June 20 2023, June 21 2023, June 22 2023, June 23 2023, 24 June 2023, 26 June 2023, 27 June 2023, 3 July 2023, 4 July 2023, 5 July 2023, 6 July 2023, and 7 July 2023. Data collection was carried out from 08.00 WIB to 16.00 WIB, with an interval of 1 hour. In this research, the parameters calculated are solar irradiation, solar panel temperature, ambient temperature (surrounding environmental temperature), voltage, current, and wind speed.

2.1. Solar Panel Characteristics

The solar cell parameters that have the most influence on the power curve are short-circuit current and open-circuit voltage for internal parameters, while external parameters include temperature and irradiance. Maximum power and efficiency are also included in the discussion because they are parameters commonly used to compare solar cells.

The electrical properties of a solar module are usually represented by its current-voltage characteristic, which is also called the IV curve. Light causes the diode IV curve to fall from the first quadrant to the fourth quadrant. If a solar module is short-circuited (Vmodul = 0), then short-circuit current (Isc) flows. In an open circuit state (Imodul = 0), the module voltage is called the open voltage (Voc). The power produced by the solar module is equal to the product of the current and voltage produced by the module.

$$P = V \times I \tag{2.1}$$

Information :

P = Module output power (Watts)
V = Module working voltage (Volts)
I = Module working current (Ampere)

The horizontal axis is voltage, the vertical axis is current. Most IV curves are given in Standard Test Conditions (STC) 1000 W/m2 radiation (or called one peak sun hour) and 25 ^{o}C/77 ^{o}F solar panels. For information, STC represents optimal conditions in a laboratory environment. Curve IV consists of 3 important things:

1. *Maximum Power Point (MPP)*

In curve IV, *Maximum Power Point* is the operating point where the maximum output power produced by the solar panel is at maximum conditions. In other words, Vmp and Imp can be measured when the solar panel is loaded at a temperature of 25 ^{0}C and radiation of 1000 W/m ^{2}. On the current curve the voltage is 17.5 volts is Vmp, and Imp is 2.86 amperes. The number of watts at the maximum limit is determined by switching Vmp and Imp, the maximum number of watts at STC is 50.05 watts. The output power decreases as the voltage decreases. The output power of most solar energy decreases as the voltage increases beyond *the maximum power point.*

$$P_{in} = I_r \max \times A \quad (2.2)$$

Information:

P_{in} = Maximum Input Power (watts)
Ir = Maximum Irradiation Value (W/m^2)
A = Panel Area (m^2)

2. *Open Circuit Voltage (Voc)*

Open Circuit Voltage (Voc), is the maximum voltage of the solar cell and this occurs when the cell current is zero. In open circuit conditions, namely the maximum voltage capacity that can be achieved in the absence of current, $V_{OC} = 0$. From this equation it can be seen that the value of V_{oc} depends logarithmically on the ratio $IL_{/} I_o$. This means that at constant temperature, V_{oc} scales logarithmically with I_L and because $_{IL}$ depends linearly on *irradiance*, V_{oc} also scales logarithmically with respect to *irradiance.* This formulation concludes that *irradiance* has more influence on I_L than $V_{oc.}$

3. *Short Circuit Current (Isc)*

Short Circuit Current (Isc), is the current that flows when the solar cell voltage is zero. The maximum current output from the solar panel in the open circuit condition is obtained from the solar cell in the condition of no resistance (R), V= 0. The power in the current condition Isc is 0 watts. *Short circuit current* can be measured when the circuit is short-circuited. In ideal conditions without power loss, I_{SC} is the same as $I_{L.}$ I_{SC} depends linearly on *irradiance* and is influenced by several other things, namely cell area, light spectrum and other optical parameters. Testing under *Standard Test Conditions* (STC), commercial solar cells have I_{SC} which varies between 28 mA/cm ^{2} to 35 mA /cm ^{2}.

4. *Fill Factor (F F)*

Fill Factor (FF) is a price that is close to a constant for a particular solar cell. If the FF value is higher than 0.7, then the solar cell is better. Fill factor is a measure of the quality of a solar cell that can be determined by comparing the theoretical maximum power and output power at open circuit and short circuit voltages. The fill factor is a parameter that states how much $I_{sc} \times V_{oc}$ is the maximum power $V_m \times I_m$ produced by the solar cell.

$$FF = \frac{Vpm \ x \ Ipm}{Voc \ x \ Isc} \quad (2.3)$$

Information:

FF = Fill Factor (%)
Vpm = Voltage at Maximum Working Point (volts)
Ipm = Current at Maximum Working Point (Ampere)
Voc = Open Circuit Voltage (volts)
Isc = Short Circuit Current (Ampere)

5. *Maximum Power Volt (Vmp)*

Maximum Power Point (Vmp) on the IV curve is the operating point which shows the maximum power produced by the solar cell panel.

6. *Maximum Power Current (Imp)*

Maximum Power Current (Imp) is the current at Maximum Power when the power output is greatest.

7. *Maximum System Operating Voltage*

Maximum System Operating Voltage on a solar panel is the maximum voltage at which the solar system must be operated.

8. *Maximum Series Fuse Rating*

The Maximum Series Fuse Rating on a solar panel is the maximum fuse rating in the solar panel array.

9. *Tolerance*

Tolerance in solar panels is a measure of how much electrical power a solar panel can produce above or below its rated capacity at any time.

10. *Nominal Operating Cell Temperature (NOCT)*

Nominal Operating Cell Temperature (NOCT) is a test standard adapted to the operational conditions of solar cells, which is defined as the temperature reached by open circuit cells in the module.

2.2 *Solar Panel Equivalent Circuit*

On generally panel Sun own Suite equivalent like shown in figure 1 and mathematical modeling is very necessary for know-how panel parameters Sun which used.

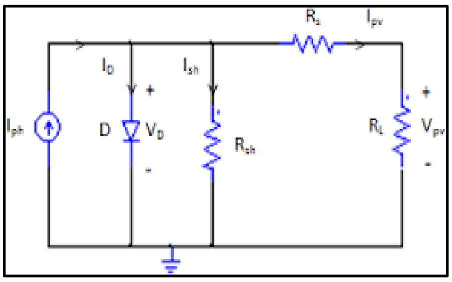

Figure 1. Sequence Equivalent Cell Panel Sun

Light generated current or *photocurrent* (Iph) varies linearly to solar radiation and depends on the applied temperature. Obstacles and Rs denote the parallel and series intrinsic resistance of the cell. Principle simple from Suite equivalent solar cells in on, that is:

$$I_{pv}=I_{ph}-I_{D}-I_{Rs} \qquad (2.4)$$

Information:

Ipv = Photovoltaic current

Iph = Photocurrent

ID = Current in the diode

IRsh = Shunt resistance current

The solar panel current (Iph) is directly proportional to the amount of solar radiationGand temperature T.

2.3 Effect of Irradiance or Sunlight Intensity on Solar Cells

The solar radiation received by the earth is distributed over several ranges of wavelengths, ranging from 3 nm to 4 microns. Some radiation experiences reflection in the atmosphere (diffuse radiation), and the rest can reach the surface of the earth (direct radiation). Second radiation this is used to measure the amount of radiation received by the solar cell. Size is an important quantity. For measure, it is:

a) *Spectral irradiance* I_{λ}: The power received by one unit area in the form differential long waved λ, unit: $W/m^2 \mu m$.

b) *Irradiance*: Integral from *spectral irradiance* For whole Wavelength, units W/m^2.

c) Radiation : The time integral of *irradiance* for a certain period of time.

By because that, its unit the same with unit energy, that is H/m^2 –days, J/m^2 –month or J/m^2-year.

Among these three quantities, the one that will be used in the analysis is W/ m^2 because this unit is usually used in *data sheets*, while the radiation quantity is usually used to calculate the estimated output power in the system installation. *Irradiance* is an energy source for solar cells, so their output is very dependent on changes *in irradiance.*

Judging from the picture, the power output is directly proportional to *the irradiance*. Isc is more affected by changes in irradiances than Voc. This is in accordance with the explanation of light as packets of photons. When the irradiance is high, that is, when the number of photons is large, the current produced is also large. Vice versa, so that the current produced is directly proportional to the number of photons. The following is a characteristic image of the IV curve regarding changes *in irradiance.*

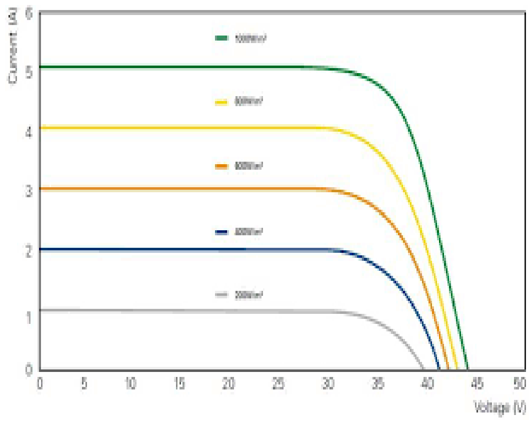

Figure 2. *Curve Characteristics of Irradiance Changes*

Solar model testing on the data sheet is generally carried out at standard test conditions (STC), namely air mass (AM) 1.5, irradiance 1000 W/m^2, and temperature 25 °C. In real conditions, the irradiance value does not reach this value, depending on latitude, position of the sun, and weather conditions. Irradiance values at certain locations also vary from month to month.

Solar radiation is energy emanating from thermonuclear processes that occur in the sun, or it can be said to be the main source for atmospheric physical processes that determine weather and climate conditions in the earth's atmosphere. Solar radiation plays an important role in various other energy sources utilized by humans. Light can be said to be an absolute part of human life. To support correct artificial lighting techniques, of course, you need to know how much light intensity is needed in a particular place. So, to find out how much light intensity there is, you need a light measuring instrument that can be used to measure the amount of light in lux units.

$$1 \text{ lux} = 0.0079 \text{ W/m}^2$$

When the irradiance is high, that is, when the number of photons is large, the current generated is large. On the contrary, the current generated to measure light intensity, a tool called a lux meter is used. A Lux meter is a tool used to measure light intensity or lighting level. Usually used indoors. The lighting needs of each room are sometimes different. Everything depends on and is adjusted to the activities carried out. To measure lighting levels, a tool is needed that can work automatically, capable of measuring light intensity and adjusting to the light needed.

Light intensity is measured using a lux meter, which produces light intensity values in lux units. There is no direct conversion between lux and W/m2, which depends on the wavelength or color of the light. So to get the conversion between lux and W/m2, an experiment needs to be carried out. However, there is an estimated conversion of 0.0079 W/m^2 per lux. So it can be formulated as follows:

1 lux is directly proportional to the number of photons.

Effect of Irradiance on Input Power:

$$P_{in} = I_r \times A \quad (2.5)$$

Information:

P_{in} = Input Power (watts)

I_r = Solar Irradiation Intensity (W/ m^2)

A = Solar Module Area (m^2)

2.4 Solar Panel Efficiency Calculation

The comparison of performance between one solar module and another solar module is generally seen in its efficiency. The amount of solar energy in the form of photons absorbed by a solar cell determines its efficiency. Module efficiency solar power is defined as the ratio of output power to input power. Input power is calculated as the irradiance received by the surface of the solar cell. This efficiency value is always calculated under standard conditions (irradiance = 1000 W/m2, AM = 1.5, and temperature = 250 C). Solar modules made from crystalline materials currently have an efficiency of 14-16%. The influence of materials is dominant in this case. For example, solar cells are made from polymer/organic (η = 4-5%), amorphous silicon (η = 6%), and multifunction (η = 30%).

$$\eta = \frac{P_{out}}{P_{in}} X\ 100\ \% \quad (2.6)$$

Information:

η = Solar cell efficiency (%)

V = Voltage (volts)

I = Current (Ampere)

FF = Fill Factor (%)

3. Discussion

The following are the output power tables of nanocrystal and polycrystalline types, as well as the temperature comparison tables on polycrystalline and nanocrystal types of panels and the environmental influence tables. The samples taken on June 16 2023 are shown in table 1until table 4..

Table 1. *Output Data Monocrystalline*

No	Time	Output Data Monocrystalline		
		V	I	P
1	08.00	18.76	3.62	67.91
2	09.00	19.69	3.82	75.21
3	10.00	15.93	0.59	9.39
4	11.00	19.37	2.91	56.36
5	12.00	19.84	3.36	66.66
6	13.00	19.09	4.03	76.93
7	14.00	19.24	3.61	69.45
8	15.00	19.31	2.96	57.15
9	16.00	19.48	1.37	26.68
Average		19.96	2.91	56.19

Table 2. *Output Data Polycrystalline*

No	Time	Output Data Polycrystalline		
		V	I	P
1	08.00	19.6 3	3.39	66.54
2	09.00	18.95	1.81	34.29
3	10.00	17.99	0.13	2.33
4	11.00	20.27	0.95	69.12
5	12.00	19.63	4.67	46.32
6	13.00	20.30	3.41	94.80
7	14.00	19.82	3.92	77.69
8	15.00	19.80	3.86	76.42
9	16.00	19.47	2.36	46.32
Average		19.54	2.72	54.0

Table 3. *Panel Temperature Sun and Wind*

Time	Wind (m/s)	Panel Temp Sun	
		Monocrystalline (°C)	Polycrystalline (°C)
08.00	1.61	26	25
09.00	1.37	26	26
10.00	1.22	25	25
11.00	1.92	33	31
12.00	1.72	35	37
13.00	2.64	35	36
14.00	1.11	37	34
15.00	0.69	36	35
16.00	1.51	31	30
Average	1.53	31.5	31

Table 4. *Intensity Sun and Temperature Ambient*

Influence Environment		Note
Intensity Sun (W/ m^2)	Temperature Ambient	
173.01	21.5	Cloudy
305.73	32.9	Cloudy
263.07	32.7	Bright
4479.3	33.6	Bright
413.96	31.3	Bright
489.01	40.2	Bright
666.76	39.1	Bright
282.03	37.4	Bright
285.19	29.6	Bright
369.63	33.14	Bright

Based on the data obtained in Table 1, which is a table of measurement results carried out on June 16 2023. From the research table above, to be able to find out a panel's output power, it can be calculated based on equation (2.5).

$P_{in} = I_r$ average × A, the following calculation is obtained

P_{in}(Monocrystalline) = 36.963 W/ m^2 × 0.67802m^2

= 250.61W

P_{in}(Polycrystalline) = 36.963 W/ m^2 × 0.69010m^2

= 255.08 W

As for calculating *the fill factor,* which is one of the quantities that is a parameter for the performance of a solar cell, this fill factor is a dimensionless quantity that states the ratio of the maximum power produced by a solar cell to the product of Voc and Isc. That is, it can be calculated based on equation (2.3).

$FF = \frac{Vmp\ X\ Imp}{Voc\ X\ Isc}$

Please note that the *fill factor parameters* above are obtained from the nameplate of each solar panel.

FF (Monocrystalline) $= \frac{18{,}50\ V\ X\ 5{,}41\ A}{22{,}20\ V\ X\ 5{,}74\ A}$

$= \frac{100{,}08}{127{,}42}$

= 0.78

FF (Polycrystalline) $= \frac{18{,}00\ V\ X\ 5{,}56\ A}{21{,}6\ V\ X\ 6{,}02\ A}$

$= \frac{100{,}08}{130{,}03}$

= 0.77

To calculate the output power, it can be calculated using equation (2.1), namely:

$P_{out} = V_{rata-rata} \times I_{rata-rata} \times$ FF

P_{out} (Monocrystalline) = 19.96 V × 2.91 A × 0.78

= 45.30 W

P_{out} (Polycrystalline) = 19.54 V × 2.72 A × 0.77

= 40.92 W

To calculate the Maximum Power value, it can be calculated using equation (2.2), namely:

$P_m = I_r\text{max} \times A$

P_{in}(Monocrystalline) $= 666.76\ W/m^2 \times 0.67802 m^2$

$= 452.07$ W

P_{in}(Polycrystalline) $= 666.76\ W/m^2 \times 0.69010 m^2$

$= 460.13$ W

The results of the following solar panel output power calculations can be used to calculate the level of efficiency of a solar panel, namely:

$P_{out} = V_{maks} \times I_{maks} \times FF$

P_{out} (Monocrystalline) $= 19.84\ V \times 4.03\ A \times 0.78$

$= 62.36$ watts

P_{out} (Polycrystalline) $= 20.30\ V \times 4.67\ A \times 0.77$

$= 73.94$ watts

So the efficiency value can be calculated using equation (2.6).

$$\eta = \frac{P_{out}}{P_{in}} \times 100\%$$

$$\eta\ (\text{Monocrystalline}) = \frac{45{,}30\ watt}{250{,}61\ watt} \times 100\% = 18.07\%$$

$$\eta\ (\text{Polycrystalline}) = \frac{40{,}92\ watt}{255{,}08\ watt} \times 100\% = 16.04\%$$

The results obtained were that the monocrystalline panel produced an efficiency of 18.07%, while the polycrystalline panel produced an efficiency of 16.04%.

***Table 5**. Panel Input Power Calculation Results on Other Days*

DATE	INPUT POWER	
	MONO	POLY
JUNE 16, 2023	250.61 W	255.08 W
JUNE 17, 2023	301.50 W	306.87 W
JUNE 19, 2023	285.57 W	290.66 W
JUNE 20, 2023	387.14 W	394.04 W
JUNE 21, 2023	496.94 W	505.80 W
JUNE 22, 2023	306.13 W	311.59 W
JUNE 23, 2023	307.77 W	377.38 W
JUNE 24, 2023	355.24 W	361.57 W
JUNE 26, 2023	481.53 W	490.11 W
JUNE 27, 2023	508.67 W	517.73 W
JULY 3, 2023	521.28 W	530.57 W
JULY 4, 2023	372.55 W	379.19 W
JULY 5, 2023	291.48 W	296.67 W
JULY 6, 2023	400.71 W	407.85 W
JULY 7, 2023	409.86 W	417.16 W

***Table 6.** Panel Output Power Calculation Results on Other Days*

DATE	OUTPUT POWER	
	MONO	POLY
JUNE 16, 2023	45.30 W	40.92 W
JUNE 17, 2023	36.39 W	22.05 W
JUNE 19, 2023	48.37 W	50.61 W
JUNE 20, 2023	39.40 W	43.53 W
JUNE 21, 2023	53.09 W	51.79 W
JUNE 22, 2023	38.26 W	29.80 W
JUNE 23, 2023	38.35 W	38.82 W
JUNE 24, 2023	41.02 W	39.85 W
JUNE 26, 2023	9.68 W	31.05 W
JUNE 27, 2023	39.81 W	32.83 W
JULY 3, 2023	52.29 W	40.49 W
JULY 4, 2023	36.29W	54.45 W
JULY 5, 2023	30.42 W	36.49 W
JULY 6, 2023	38.49 W	35.78 W
JULY 7, 2023	38.87 W	38.28 W

From the data above, it can be concluded that the difference in power values between monocrystalline and polycrystalline panels is caused by weather conditions. The brighter the weather, the power value will increase, and vice versa, when the weather conditions are cloudy, the power value will tend to decrease. From the calculations above, a summary of the efficiency results from the research that has been carried out is shown in Table 7.

Table 7. *Comparison of Monocrystalline and Polycrystalline Panel Efficiency*

SAMPLE	EFFICIENCY	
	MONO	POLY
JUNE 16, 2023	18.07 %	16.04 %
JUNE 17, 2023	12.06 %	7.18 %
JUNE 19, 2023	16.93 %	17.41 %
JUNE 20, 2023	10.17 %	11.04 %
JUNE 21, 2023	10.68 %	10.23 %
JUNE 22, 2023	12.49 %	9.39 %
JUNE 23, 2023	10.34 %	10.28 %
JUNE 24, 2023	11.34 %	11.02 %
JUNE 26, 2023	2.01 %	6.33 %
JUNE 27, 2023	7.82 %	6.34 %
JULY 3, 2023	10.03 %	7.63 %
JULY 4, 2023	9.74 %	14.35 %
JULY 5, 2023	10.43 %	12.27 %
JULY 6, 2023	9.59 %	8.77 %
JULY 7, 2023	9.48 %	9.17 %
AVERAGE	10.74 %	10.49 %

Based on Table 7, the overall efficiency of monocrystalline panels is better than that of polycrystalline panels, although on June 19, June 20, June 26, July 4, and July 5, 2023, the efficiency is greater for polycrystalline panels. This is because the weather conditions changed at the time the data was collected.

3.1. Analysis of the Effect of Panel Surface Temperature

The following is data from measurements of the effect of surface temperature of monocrystalline and polycrystalline solar panels on solar panel efficiency.

Table 8. *Results of Solar Cell Surface Temperature Observations for monocrystalline type*

Days to-	Monocrystalline	
	Temperature (°C)	Power (watts)
1	31.5	56.19
2	29.7	47.68
3	37.6	66.64
4	33.1	50.70
5	38.6	68.88
6	34.7	48.72
7	30.3	49.70
8	35.2	52.72
9	36	12.70
10	41.7	34.87
11	35.5	67.57
12	39	43.28
13	34.5	39.44
14	33.6	49.66
15	34.6	50.58

Table 9. *Results of solar cell Surface Temperature Observations for Polycrystalline type*

Days to-	Polycrystalline	
	Temperature (°C)	Power (watts)
1	31	54
2	30.55	28.63
3	36.6	64.88
4	34.2	56.88
5	37.6	67.55
6	35.3	39.29
7	31	51.08
8	34.6	51.88
9	35.2	40.66
10	40.3	33.41
11	34.4	53.67
12	39.1	70.35
13	34.7	48.48
14	33.4	56.71
15	35.4	59.03

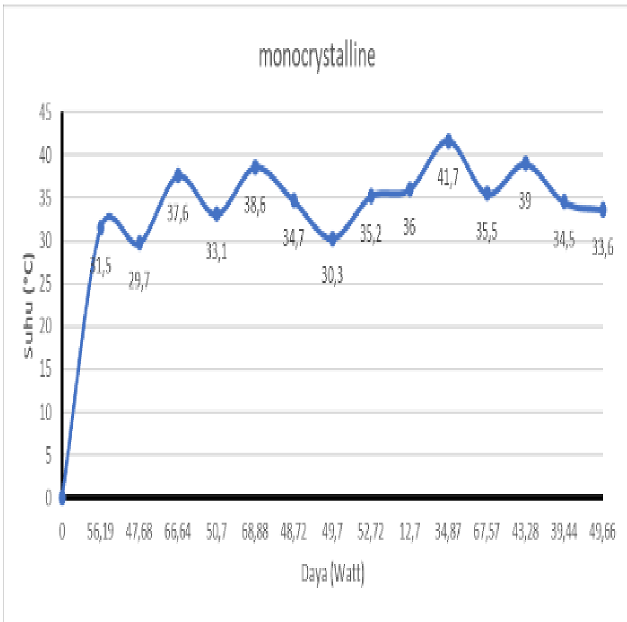

***Figure 3**. Graph of the Effect of Temperature on Monocrystalline Type Solar Panels*

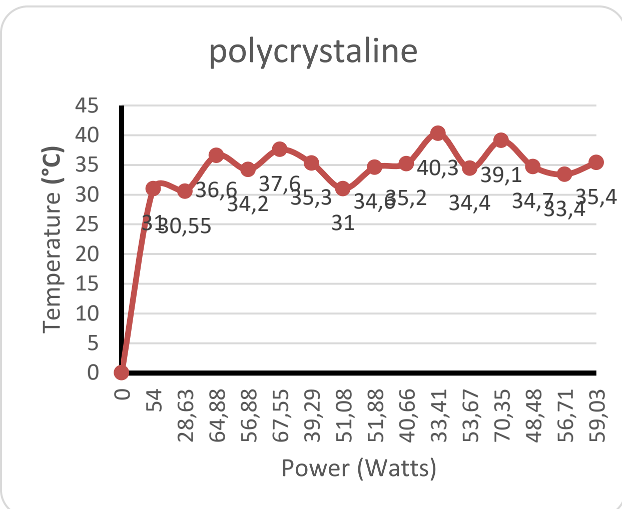

***Figure 4.** Graph of the Effect of Temperature on Polycrystalline Solar Panels*

The relationship between solar panel surface temperature and the resulting efficiency differs from light intensity. The surface temperature of a solar cell is inversely proportional to the power produced. The higher the temperature, the smaller the output power from the solar cells, and vice versa, the lower the panel temperature, the greater the output power from monocrystalline and polycrystalline solar panels. The greater the temperature of the solar panels, the decrease in electricity production, especially in the output voltage.

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3.2. Analysis of the Effect of Wind Speed on Panel Temperature

The following is data from measurements of the effect of wind speed on the efficiency produced by solar panels.

***Table 10.** Results of Wind Speed Observations on Solar Cells*

Days to-	Wind Speed(m/s)	Power (watts)	
		Mono	Poly
1	1.53	56.19	54
2	1.58	47.68	28.63
3	1.93	66.64	64.88
4	0.75	50.70	56.88
5	1.05	68.88	67.55
6	1.02	48.72	39.29
7	1.33	49.70	51.08
8	0.89	52.72	51.88
9	0.28	12.70	40.66
10	0.84	54.87	63.41
11	5.08	67.57	53.67
12	69.8	43.28	70.35
13	0.72	39.44	48.48
14	1.06	49.66	56.71
15	1.17	50.58	59.03

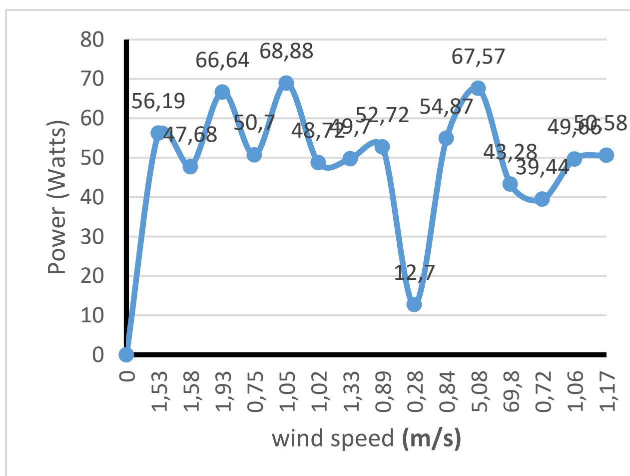

***Figure 5.** Graph of Wind Speed against Monocrystalline Panel*

Temperature

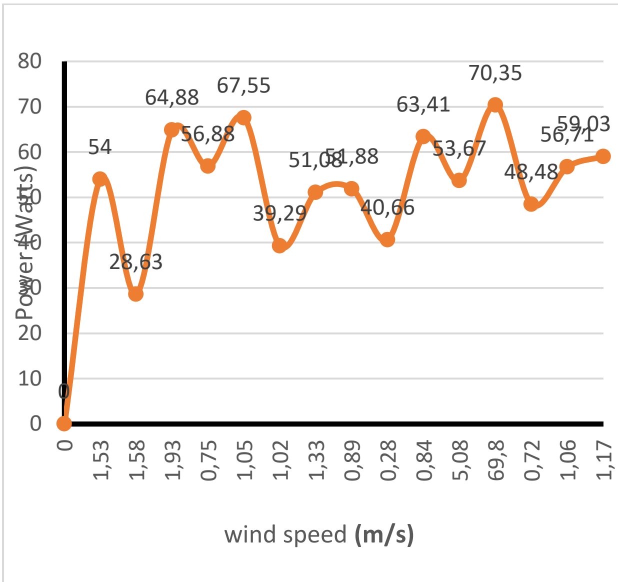

Figure 6. *Graph of Wind Speed against Polycrystalline Panel Temperature*

Based on pictures 3 and 4 above, the change in wind speed in relation to the power produced is the same as the light intensity, where the wind speed is directly proportional to the power produced, but the wind speed is not that significant in terms of the energy produced. The greater the wind speed, the greater the power generated, and vice versa, the smaller the wind speed, the smaller the power produced.

The smallest wind speed was obtained on the 9th day, namely 0.28 m/s with an output power of each panel of 43.28 watts and 70.35 watts, while the highest wind speed on the 12th day was 69.8 m/s with the power of each panel of 43.28 and 70.35 watts. The power produced is small because on that day the weather conditions were raining, so the power released was less than optimal.

4. Conclusion

From the discussion regarding the comparative analysis of the influence of temperature and wind speed on 100 WP monocrystalline and polycrystalline solar panels at the Sriwijaya State Polytechnic, it can be concluded that:

1. Temperature inversely affects power output higher temperatures lead to lower power. Monocrystalline panel reached 41.7°C with 34.87 W, while polycrystalline panels reached 40.3°C with 33.41 W.
2. Wind speed is directly proportional to power production, but its impact is less significant. The smallest wind speed (0.28 m/s) on the 9th day resulted in 43.28 W and 70.35 W for each panel. The highest wind speed (69.8 m/s) on the 12th day showed similar power values.
3. Monocrystalline panels' exhibit better efficiency (10.74 %) compared to polycrystalline panels (10.49 %).
4. Power differences between panel types are attributed to weather conditions, brighter weather increases power values. While coldly conditions decrease power output.

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