Comparative Analysis of the Energy Supply of Poly and Mono Crystalline Solar Panels in the Rooftop On Grid

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Abstract: To support the government program that proclaimed "green energy" and energy savings or energy efficiency, especially the use of electrical energy, the authors need to conduct research on the use of solar renewable energy sources as additional power sources, especially during the day combined with electrical energy sources from State Electricity Company. Solar power plant has several systems such as on grid, off grid and hybrid. Solar power plant rooftop on grid is run in parallel with the State Electricity Company network without batteries. The on-grid solar inverter is connected directly to the State Electricity Company network so that the output generated from the solar panels simultaneously serves the load. The solar panels used for this system are mono crystalline and poly crystalline. The author will conduct testing and measurements for 4 hours from 10.00 – 14.00 for 28 days in Denpasar City, Bali Indonesia is located at coordinates 8.67 south latitude and 115.21 east longitude using empirical methods. The total energy produced by two poly crystalline 100 Wp solar panels in series is 12.84 kWh, two mono crystalline 100 Wp is 12.22 kWh and a combined mono-poly crystalline 200 Wp solar panel is 9.98 kWh. The average electrical energy produced by two poly crystalline 100 Wp solar panels arranged in series in various weather is 0.46 kWh/day, two poly crystalline 100 Wp solar panels is 0.44 kWh/day and combined mono-poly crystalline 200 Wp solar panels by 0.36 kWh/day. It can be concluded that the series circuit two poly crystalline 100 Wp solar panels is able to obtain maximum electrical energy in the on-grid system by using a smart inverter compared to two 100 Wp mono crystalline and mono-poly crystalline 200 Wp solar panels.

1 INTRODUCTION

Solar power plant Rooftop On Grid is run in parallel with the State Electricity Company network without batteries. The On Grid solar inverter is connected directly to the State Electricity Company network so that the output generated from the solar panels simultaneously serves the load. If the load is the same as the solar power plant production, then all solar power plant output is used for the load without assistance from the State Electricity Company network. If the load is less than the solar power plant production, then some of the solar power plant output is used for the load and the rest is channeled to State Electricity Company. If the load is greater than the solar power plant production, then all the solar power plant output is absorbed by the load and the shortage is assisted by State Electricity Company. If there is no solar power plant production, such as at night or on a cloudy and rainy day then all the loads will be served by State Electricity Company. The advantage of the On Grid solar power plant system is that it can carry out the export-import process of electricity to State Electricity Company.

Monocrystalline technology has the best performance compared to polycrystalline while amorphous technology has the latest performance. The station is connected with a total capacity of 5.94 kWp, which is located on the roof of the Tetouan-Morocco science faculty (Ilham, 2017).

Monocrystalline and polycrystalline panels have higher efficiency resulting in better performance than

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thin film panels on a sunny day. Another situation occurs, when the solar panels are blocked by leaves falling from trees or clouds. Monocrystalline and polycrystalline panels cannot generate any electrical energy. Thin film solar panels can produce a greater total amount of energy per year than monocrystalline and polycrystalline panels. These panels can work in partial shade with foreign bodies and indirect sunlight (Michal, 2019).

Increasing light intensity and decreasing relative humidity results in higher efficiency of monocrystalline PV modules when compared to polycrystalline PV modules (Orotoye, 2020).

The efficiency of the solar panel changes when given light with a certain energy, up to the highest intensity of 331.01 W / m2, with the highest temperature occurring resulting in an efficiency of 12.84% on Monocrystalline Panels and 11.95% on Polycrystalline Panels (Sugianto, 2020).

Installation of solar panels on the on grid system can be arranged in series, parallel and a combination of series and parallel. From the results of research that the author did previously on polycrytalline solar panels, it turns out that a series circuit that produces an energy supply of 100 Wh is greater than a parallel circuit (Sugiarta, 2020).

The results of testing the installation of a solar power plant with a capacity of 50 Wp can be concluded that the highest efficiency occurs at a slope angle of 16 ^{0} and at 09:00 hours with a value of 46.076%, then the second occurs at a slope angle of 8 ^{0} and at 09:00 hours with a a value of 45.052%, then the lowest efficiency occurs at a slope angle of 0 ^{0} and at 09:00 with a value of 43,986 % (Yano, 2019).

Based on several existing journals, the author plans a research analysis of the comparative analysis of the energy supply of poly and mono crystalline solar panels in the rooftop on grid solar power plant series. The on grid system was chosen because it is simpler in terms of maintenance and installation. The target is for housing, offices and small industries located in urban and rural areas that already have electricity from State Electricity Company. The results of this study can be used as a reference for the installation of solar panel types for rooftop solar on grid systems in the city of Denpasar, Bali. The greater the supply of energy produced will have an impact on reducing the State Electricity Company bill. This will be useful for households, schools, campuses and small industries that use more electricity during the day.

2 METHOTOLOGY

In this research, the steps involved include research flow diagrams, literature studies, system planning, selection of materials and measuring instruments.

2.1 Research Flow Chart

The research flow chart can be seen as shown in the figure 1.

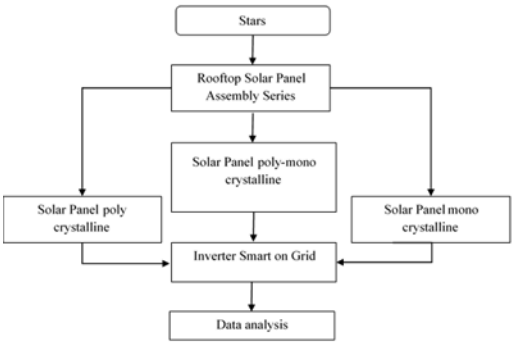

Figure 1: Research Flow chart.

2.2 System Planning

The rooftop solar panel system is installed on the roof of the car garage which has a slope of 17 degrees facing north which has a great potential for sunlight so that the solar panels get the maximum supply of sunlight. The system planning can be seen as shown in the figure 2.

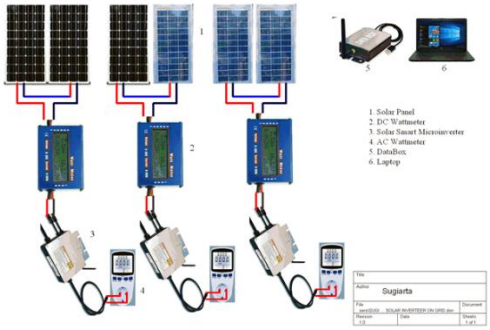

Figure 2: Rooftop On Grid Energy Measurement

2.3 Materials and Instruments

The materials and measuring instruments used in this research are as follows:
1. Solar panels Mono and Polly Crystalline 100 Wp.
2. Solar Smart Microinverter SG 350-600.
3. DataBox – Data Collector (Model DataBox24G).
4. High-precision watt meter.
5. AC Wattmeter digital 0-3680 Watt.
6. DC Wattmeter digital 0-3680 Watt
7. Solar Power Meter
8. MC4 Solar Panel PV Cable Connector
9. 30m 6 mm Solar Cell Red-Black Power Cable.
10. 20m cable 3x2.5 mm state electricity company.
11. Stop contact
12. Switch
13. Aluminum Ladder

Measurement and data collection were carried out empirically at the same time using a data box connected to a computer.

3 RESULTS AND DISCUSSION

3.1 Research Objectives and Location

This research was conducted at Kodya Denpasar, Bali Indonesia. Kodya Denpasar is located at coordinates 8.67 south latitude and 115.21 east longitude.

3.2 Research Data

Tests and measurements for 4 hours from 10.00 – 14.00 for 28 days in Denpasar City, Bali Indonesia is located at coordinates 8.67 south latitude and 115.21 east longitude using empirical methods. The total energy produced by two poly crystalline 100 Wp solar panels assembled in series is 12.84 kWh, two mono crystalline 100 Wp is 12.22 kWh and a combined mono-poly crystalline 200 Wp solar panel is 9.98 kWh as shown in the table 1 and figure 3 below.

Table 1: Energy measurement data (kWh) generated by solar panels.

Weather	Date	Poly	P-M	Mono
Clear	12-Apr-21	0.38	0.31	0.36
Clear	13-Apr-21	0.5	0.35	0.41
Clear	14-Apr-21	0.5	0.38	0.48
Cloudy	15-Apr-21	0.38	0.39	0.4
Cloudy	16-Apr-21	0.51	0.38	0.48
Cloudy	19-Apr-21	0.51	0.36	0.47
Clear	20-Apr-21	0.53	0.36	0.49
Clear	21-Apr-21	0.53	0.37	0.49
Clear	23-Apr-21	0.52	0.37	0.48
Clear	24-Apr-21	0.51	0.37	0.47
Clear	25-Apr-21	0.58	0.46	0.56
Clear	26-Apr-21	0.53	0.37	0.47
Clear	27-Apr-21	0.51	0.35	0.46
Clear	28-Apr-21	0.46	0.33	0.42
Cloudy	29-Apr-21	0.41	0.32	0.41
Clear	30-Apr-21	0.48	0.37	0.45
Clear	3-May-21	0.49	0.37	0.45
Clear	4-May-21	0.38	0.33	0.38
Clear	5-May-21	0.49	0.38	0.44
Clear	7-May-21	0.5	0.36	0.47
Cloudy	8-May-21	0.49	0.35	0.44
Clear	10-May-21	0.39	0.33	0.39
Clear	12-May-21	0.42	0.28	0.38
Clear	14-May-21	0.42	0.37	0.41
Cloudy	20-May-21	0.36	0.36	0.41
Cloudy	21-May-21	0.34	0.31	0.34
Cloudy	22-May-21	0.34	0.32	0.38
Clear	23-May-21	0.38	0.38	0.43
	Total	12.84	9.98	12.22

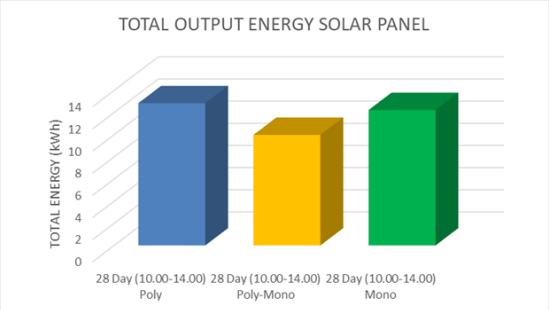

Figure 3: Graph of total energy (kWh) generated by solar panels

4 CONCLUSIONS

The average electrical energy produced by two poly crystalline 100 Wp solar panels arranged in series in various weather is 0.46 kWh/day, two poly crystalline 100 Wp solar panels is 0.44 kWh/day and combined mono-poly crystalline 200 Wp solar panels by 0.36 kWh/day. It can be concluded that the series circuit

two poly crystalline 100 Wp solar panels is able to obtain maximum electrical energy in the on-grid system by using a smart inverter compared to two 100 Wp mono crystalline and mono-poly crystalline 200 Wp solar panels.

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