Monitoring Solar Panel Energy on Spice and Meat Grinding Machines

I Nyoman Sugiarta[1], I Gede Wahyu Antara Kurniawan[2], I Nengah Suparta[3], I Made Aryasa Wiryawan[4], Ni Made Karmiathi[5], and Ni Made Ardhiya Shita Pramesti Dewi[6]

[1,2,3,4,5] Electrical Engineering Department, Politeknik Negeri Bali, Bali, Indonesia
[6] Information Technology Department, Udayana University, Bali, Indonesia
sugiartaelektro@pnb.ac.id

Abstract. For individual or family cooking needs, a manual spice and meat grinder is sufficient. If used for larger purposes, it is certainly not enough. For large cooking needs and used as a business to be sold at SME stalls, the community usually uses PLN electricity sources and fuel oil, such as gasoline, to drive the pulley. The author plans a spice and meat grinder powered by renewable energy from solar panels, serving as an alternative to traditional energy sources for the dynamo motor that drives the pulley. Measurement and monitoring of data are carried out empirically, namely, the motor dynamo is not given a load. A hybrid inverter with the main D3 Solar panel setting carries out the charging and discharging process of energy. If it is lacking, it will be supplied from the battery. If the solar panel and battery are insufficient, then use PLN electricity. Data collection was carried out for 60 minutes. The results at the initial start of the moving dynamo motor used PLN energy supply for 2 minutes with an average power of 283.06 Watts, a current of 1.38 Ampere, and a total energy of 0.01 kWh. Furthermore, energy is supplied by solar panels and accumulators with an average power of 211.02 Watts, a current of 1.04 Ampere, and a total energy of 0.22 kWh. So, it can be concluded that the energy consumption by the grinding machine dynamo motor during the day is mostly 95% supplied by solar panels.

Keywords: Accumulator, Dynamo Motor, Energy, Hybrid Inverter, Solar Panel

1 Introduction

This research began with the desire to help individual businesses and SMEs who want to implement and use solar energy as a substitute for PLN. The demand for spice and meat grinding machines in the community is substantial, particularly during weddings, religious holidays, and for daily cooking needs. People currently use manual spice and meat grinding machines, gasoline motors, and PLN to drive the pulley. For individual or family cooking needs, a manual spice and meat grinding machine is sufficient. If used for larger purposes such as weddings, religious holidays, and businesses, it is certainly not enough. For large cooking needs and to be sold at SME stalls, people use spice and meat grinding machines powered by PLN sources and fuel oil, such as

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gasoline, to drive the pulley. Renewable energy utilization is an alternative to reduce energy demand from the national grid (PLN) and to optimize natural potential (Asy`ari, 2014; Teresna, 2020). One of the natural potentials as a source of electrical energy is solar energy (Partha, 2015; Sugiyanto, 2017; Sapteka, 2018). Solar cells are a technology that converts sunlight into electrical energy (Yuliananda, 2015). The author plans to design a spice and meat grinding machine that utilizes renewable energy from solar panels as an alternative power source for the motor dynamo, thereby driving the pulley.

The study of solar cell characteristics, based on 11-day testing, revealed that the solar panel with a tracking system generated an average current of 0.33 A, whereas the fixed solar panel produced an average current of 0.15 A. The generated current values were stored for further investigation. These test results provide an understanding that solar cells and renewable energy can serve as alternative solutions (Mudhofiroh, 2014). Several published journals contain numerous studies on the use of PLTS to drive dynamo motors. Design and Construction of a Biodigester Mixer with Electric Motor Innovation Using Solar Power. By using a 50 Wp solar panel, a 12 V 18 Ah battery, and a 600 Watt inverter, it can drive a 220 V, 2.6 A, 540 Watt dynamo motor for a maximum of 65 minutes without load (Fatih, 2022; Anoi, 2019). Analysis of a Hybrid Solar Power Generation System and Utility Energy Using a 1500 Watt Inverter in Residential Electricity using batteries with a voltage of 24 Vdc and 75 Ah. Because the system voltage is 220 and the system does not use a transformer to increase or decrease the voltage, 9 batteries will be connected in series so that the voltage approaches 220 Vdc. Based on the results of the 1500-watt bidirectional inverter simulation, the author concludes that this hybrid bidirectional inverter system is suitable for household applications due to its high utility electricity usage efficiency value of 99.9862% (Wardana, 2024).

2 Methodology

This study uses quantitative research methods. The energy produced by solar panels through hybrid inverters will be monitored and measured using an AC wattmeter.

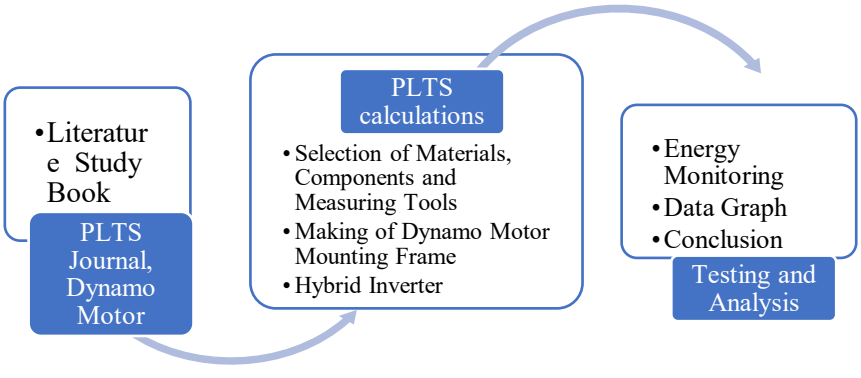

Figure 1. The Research Flow

The Motor Dynamo and Battery Energy Measurement can be seen as shown in Figure 2.

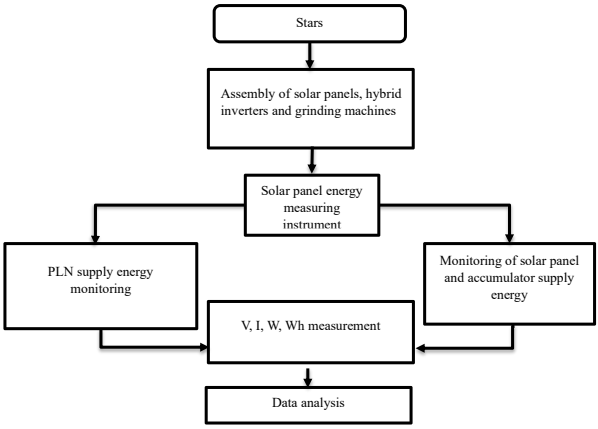

Figure 2. Motor Dynamo and Battery Energy Measurement

The materials and measuring instruments used in this research are shown in Table 1. The Energy Measurement Circuit for the Spice and Meat Grinding Machine is illustrated in Figure 3.

Figure 3. Energy Measurement Circuit for Spice and Meat Grinding Machine

Table 1. Materials and Measuring Instruments

Photo Tools	Tool's name
	Inverter Hybrid 1,2 kW
	Battery meter
	Battery LifeFo4 shoto dan bms (100 Ah 12 V) max charging 50 A, max discharge 100A
	Spice and meat grinder machine
	Digital AC wattmeter
	Dynamo Engine
	Solar Panel

3 Result and Discussion

3.1 Result

Results measurements and data monitoring are carried out empirically, namely, the motor dynamo is not given a load. The charging process of the 12-volt, 100 Ah LiFePo4 battery by 6 x 100 Wp solar panels (3 series and 1 parallel). A hybrid inverter with the main D3 Solar panel setting carries out the charging and discharging process of energy. If it is lacking, it will be supplied from the battery. If the solar panel and battery are insufficient, use PLN electricity. Data collection is carried out without giving a load to the 220 Volt, 370 Watt AC motor dynamo, and is carried out for 60 minutes. Data collection is carried out for 16 days, as seen in Table 2. The average results of the energy required can be seen in Tables 3 and 4 below.

Table 2. Time and Date of Data Collection of No-Load Grinding Machine Usage for 60 Minutes in Denpasar, Bali

Date	Time	Temperature	Weather	Precipitation	Humadity	Wind
29 May 25	10.10	29	Partly Cloudy	26%	78%	5 Km/h
25 May 25	09.50	29	Partly Cloudy	5%	82%	5 Km/h
24 May 25	10.30	29	Cloudy	10%	79%	16 Km/h
23 May 25	11.40	29	Cloudy	20%	82%	11 Km/h
22 May 25	10.30	29	Cloudy Light Rain	40%	81%	16 Km/h
16 May 25	10.15	29	Partly Cloudy	5%	82%	13 Km/h
15 May 25	09.30	29	Mostly Cloudy	20%	87%	6 Km/h
14 May 25	09.00	28	Light Thunder Storm	40%	91%	13 Km/h
13 May 25	09.00	28	Mostly Cloudy	20%	87%	16 Km/h
12 May 25	09.00	28	Partly Cloudy	30%	89%	6 Km/h
11 May 25	09.00	29	Partly Cloudy	5%	86%	6 km/h
30 May 25	12.00	31	Mostly Cloudy	30%	79%	11 Km/h
31 May 25	12.00	30	Thunder Storms	40%	82%	14 Km/h
1 June 25	12.00	31	Partly Cloudy	20%	73%	16 Km/h
4 June 25	11.00	31	Partly Cloudy	0%	73%	8 Km/h
6 June 25	11.00	31	Partly Cloudy	5%	67%	18 Km/h

3.2 Discussion

The average energy consumption that can be used to drive the dynamo motor of the spice and meat grinder machine can be seen in Table 5 and Figure 4 below.

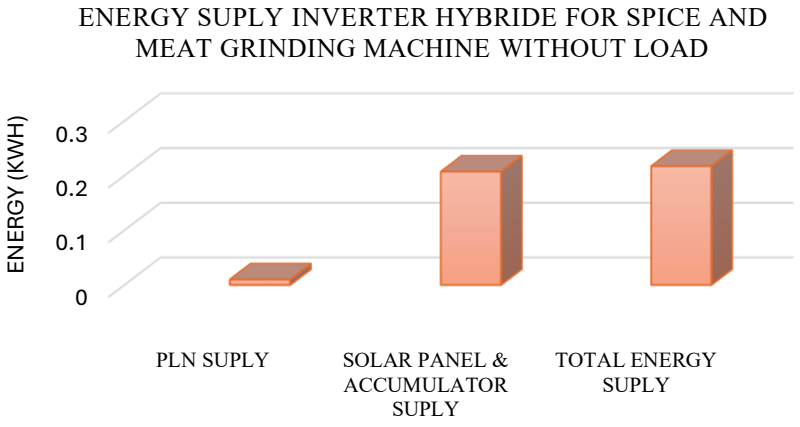

Figure 4. Energy Consumption Graph for Spice and Meat Grinding Machine

Table 3. Energy Required by The Grinding Machine Without Load for 2 Minutes During Initial Start, Supplied From PLN via Hybrid Inverter (AC Out)

Date	Voltage (Volt)	Current (Ampere)	Power (Watt)	Energy (KWh)
29 May 25	229	1.1	231	0.01
25 May 25	229	1.1	231	0.01
24 May 25	229	1.09	230	0.01
23 May 25	226	1.8	366	0.01
22 May 25	227	1.49	309	0.01
16 May 25	227	1.28	266	0.01
15 May 25	227	1.78	364	0.01
14 May 25	222	1.64	331	0.01
13 May 25	230	1.09	227	0.01
12 May 25	231	1.11	232	0.01
11 May 25	228	1.11	233	0.01
30 May 25	225	1.77	357	0.01
31 May 25	228	1.73	352	0.01
1 June 25	224	1.02	210	0.01
4 June 25	229	1.12	231	0.01
6 June 25	225	1.77	359	0.01
Average	227.25	1.38	283.06	0.01

The result at the initial start of the moving dynamo motor uses PLN energy supply for 2 minutes with an average power of 283.06 Watts, Current 1.38 Ampere, and total energy 0.01 kWh. Furthermore, energy is supplied by a Solar Panel and an accumulator with an average power of 211.02 Watts, Current 1.04 Ampere, and Total Energy 0.22 kWh. So, it can be concluded that the energy consumption by the grinding machine dynamo motor during the day is mostly 95% supplied by the Solar Panel.

4 Conclusion

The motor dynamo used to run the grinding machine uses a 220 Volt AC dynamo motor, 1 phase, 2 pole, 2800 rpm, 0.5 Hp, 370 watts. The installed solar panel is 600 Wp (3 pairs of series and parallel). Using a 12 Volt 1.2 kW hybrid inverter and a 12 Volt 100 Ah LiPo4 accumulator. Measurement and monitoring of data are carried out empirically, namely, the motor dynamo is not given a load. A hybrid inverter with the main D3 Solar panel setting carries out the charging and discharging process of energy. If it is lacking, it will be supplied from the battery. If the solar panel and battery are insufficient, then use PLN electricity. Data collection was carried out for 60 minutes. The results at the initial start of the moving dynamo motor used PLN energy supply for

2 minutes with an average power of 283.06 Watts, 1.38 Ampere current, and a total energy of 0.01 kWh. Furthermore, energy is supplied by solar panels and accumulators with an average power of 211.02 Watts, Current 1.04 Ampere, and Total Energy 0.22 kWh. So, it can be concluded that the energy consumption by the dynamo motor of the grinding machine during the day is mostly 95% supplied by solar panels.

Table 4. Energy Required by the Grinding Machine without Load for 60 Minutes via A Hybrid Inverter (AC Out Supplied by Solar Panels and Accumulator)

Date	Voltage (Volt)	Frequency (Hz)	Current (Ampere)	Power Factor (Fp)	Power (Watt)	Total Energy (Kwh)
29 May 25	225.18	50	1.047	0.922	217.92	0.22
25 May 25	224.82	49.96	1.033	0.912	212	0.2
24 May 25	226.2	49.92	1.0494	0.906	214.4	0.21
23 May 25	225.72	50	1.0388	0.904	212.4	0.21
22 May 25	225.54	49.94	1.0348	0.902	207.36	0.24
16 May 25	224.54	49.96	1.0228	0.906	207.26	0.23
15 May 25	225.6	49.94	1.0388	0.902	210.52	0.2
14 May 25	224.5	50	1.0228	0.904	207.96	0.2
13 May 25	225.7	49.94	1.0376	0.902	210.64	0.21
12 May 25	226.52	49.98	1.0474	0.898	212.8	0.23
11 May 25	225.74	49.94	1.039	0.904	211.32	0.21
30 May 25	225.32	49.98	1.031	0.902	209.12	0.24
31 May 25	225.86	49.96	1.0396	0.896	210.76	0.21
1 June 25	225.06	49.98	1.0386	0.898	209.9	0.21
4 June 25	225.82	49.98	1.0502	0.894	211.76	0.24
6 June 25	225.38	49.98	1.0422	0.896	210.16	0.21
Average	225.47	49.97	1.04	0.90	211.02	0.22

Table 5. Energy Required by the Grinding Machine without Load for 60 Minutes Sourced from Solar Panels and Accumulators via A Hybrid Inverter

Date	Energy PLN Supply (KWh)	Energy Solar Panel & Accumulator Supply	Total Energy Supply (KWh)
29 May 25	0.01	0.21	0.22
25 May 25	0.01	0.19	0.2
24 May 25	0.01	0.2	0.21
23 May 25	0.01	0.2	0.21
22 May 25	0.01	0.23	0.24
16 May 25	0.01	0.22	0.23
15 May 25	0.01	0.19	0.2
14 May 25	0.01	0.19	0.2
13 May 25	0.01	0.2	0.21
12 May 25	0.01	0.22	0.23
11 May 25	0.01	0.2	0.21
30 May 25	0.01	0.23	0.24
31 May 25	0.01	0.2	0.21
1 June 25	0.01	0.2	0.21
4 June 25	0.01	0.23	0.24
6 June 25	0.01	0.2	0.21
Average	0.01	0.21	0.22

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