

Empowering Housewives in Overcoming Global Warming through Household-Scale Solar Energy Utilization

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How to Cite: Nur, M.D., & Hartati. (2023). Empowering Housewives in Overcoming Global Warming through Household-Scale Solar Energy Utilization. *JSEAIS*, 2(5), 77-90. <https://doi.org/10.30631/jseais.v2i2.1598>

Abstract

The purpose of this activity is to increase the role of housewives of Pombewe Village, Biromaru District, Sigi Regency, to be able to play a role in tackling global warming through household-scale solar energy. The use of a series of solar panels to save electricity payments, as well as reduce dependence on electrical energy from fossil materials can minimize global warming. The method used is through training and mentoring for housewives by making a simple series of solar cells to generate electricity from home-scale solar energy. The result of a series of training processes is (1) the increasing ability of housewives to make simple circuits of solar cells that produce 443,134 watt-hours of electrical energy during 8 hours of solar irradiation. (2) the more significant active role of housewives in tackling global warming through the use of household-scale solar energy.

Keywords: housewives; global warming; solar energy

Introduction

According to the Big Dictionary of Indonesian, a housewife is a woman who is in charge of managing all household chores, or it can be said that a housewife is a wife (mother) who only takes care of various household chores (not working in the office) (Setiawan, 2019). A mother has a role that cannot be underestimated in taking care of the family. A housewife has six important roles that cannot be replaced by a husband, namely: Mother as a manager, a teacher, a chef, a doctor, an accountant, and an interior designer (Lufthiani et al., 2021).

Energy has become a vital need of the community that is urgently needed to sustain its life and support its daily activities. Among them to cook food, humans need heat energy

or to meet water needs in urban areas, people need electrical energy to turn on and run water pumps.

The sun is a source of energy that is large in quantity and is continuous (inexhaustible), in particular, the electromagnetic energy emitted by the sun (Irawati et al., 2021). The use of solar power does not require combustion so it does not produce exhaust gases in the form of greenhouse gases. The utilization of solar energy is carried out by converting sunlight into thermal or electrical energy to meet human energy needs (Widayana, 2012).

Pombewe Village is located in Biromaru District, Sigi Regency, Central Sulawesi Province, astronomically located at 119°55'21,211"BT- 120°3'58,454"BT and 0°57'13,184"LS - 0°59'48,575" LS, with an altitude of 125 meters above sea level (MASL) (Yusuf, 2016). It is at the equator that makes the village illuminated by sunlight for 10 to 12 hours per day. Therefore, the use of solar energy sources is very supportive in Pombewe village, it's just that in 10 or 12 hours not everything is in a sunny state, sometimes the weather is often unstable in the sense of cloudy, cloudy, and rainy conditions. Because of conditions like this optimal energy absorption in one day will not even reach 10 full hours, therefore it takes data on the average and how long the optimal absorption of solar energy is optimal in each day for planning the load to be installed so that the use of electricity is optimal and there is no outage or battery discharge that is too fast due to the installed load that is too excessive.

As with other regions, the problems that exist in Pombewe Village are that the community still uses fossil fuel electrical energy (Ramadhan et al., 2021). Two fundamental things that burden the utilization of fossil-based energy sources are that the availability of these natural resources is very limited and the weakness of using fossil fuels is that their combustion produces greenhouse gases, thereby increasing the concentration of greenhouse gases on the earth causing an increase in the earth's temperature and global warming (Sulistiyono, 2012). The energy utilization sector is the largest contributor to the concentration of greenhouse gases at 68%. Once identified, carbon dioxide (CO₂) gas is the largest pollutant of such greenhouse gases, with a percentage of 90% (Widodo et al., 2017). Based on the total CO₂ emissions released, there are 3 components that most influence the high emissions, namely the electricity sector (42%), transportation (23%), and housing (6%). Carbon dioxide emissions will increase directly proportional to energy consumption. Meanwhile, the high energy consumption itself is influenced by the large number of households.

The earth is already getting hotter, so humans already have to think about switching from environmentally unfriendly fuels to environmentally friendly fuels (Aziz et al., 2020).

The role of housewives takes care of the family and carry out the responsibility of taking care of the needs at home, so it is very appropriate to be involved in tackling global warming through the use of household-scale solar energy.

Literature Review/Analytical Framework

The Domestic Role of Housewives

Sex differences have an impact on differences in the functions and roles of men and women. Basically, this is not a problem if it is based on conscious choice and not compulsion or discrimination. However, when studied more deeply this difference in male and female sexes can be the cause of the emergence of gender discrimination. Namely injustice, backwardness, neglect of basic rights, and even discrimination that occurs a lot to women.



Men and women have differences in nature and non-nature (Gultom, 2021). In contrast to nature differences, non-natural differences are very likely to change both due to cultural and structural factors. In Indonesia, women generally have dual roles, where almost all non-natural roles are delegated to women (wives). Unlike the male, the female cannot leave her domestic role. So that the strength of women in the domestic sector, makes people believe that the domestic role is entirely the responsibility of the wife.

The role of women in the domestic sphere includes the role of wife (husband's companion), household manager, and mother (giving birth, breastfeeding, raising her child). The role of the wife for example is like giving birth and breastfeeding children, while household management, additional livelihood, continuity of education for children in the household, cooking, and washing clothes are non-natural roles that can be done either by husband or wife together, or alone as a single parent, either male or female (Harun AR, 2015).

The role of the mother in the household is so central, then it will be a great potential in participating as an agent in tackling global warming through the use of household-scale solar energy.

Global Warming

Global warming is a form of ecosystem imbalance on earth due to the process of increasing the average temperature of the atmosphere, sea, and land on earth (Satriani & Asngadi, 2020: 27). The global average on Earth's surface has soared by 0.74 ± 0.18 °C (1.33 ± 0.32 °F) in the last hundred years (Yuliasmara, 2016).

Carbon dioxide or CO₂ is produced by activities on this earth such as breathing, the result of burning fuel enveloping the earth, electricity generation that uses fossil fuels, and the results of activities from residents' homes (Roshintha & Mangkoedihardjo, 2016). Because the levels are excessive, CO₂ seems to be like glass covering the earth's surface. In addition to carbon dioxide, sulfur dioxide and methane are the same as CO₂ enveloping the earth. Like the nature of glass, the gases that coat it will reflect infrared from the sun which should be returned to space, but Infrared is trapped on earth.

The impacts of global warming include an unstable climate. In some areas, drought hits hard because of the drought. The existence of global warming causes the Northern Hemisphere to heat up more than other regions of the Earth. As a result, the icebergs are now starting to melt so that the land will narrow.

Areas that used to experience light snow are now no longer experiencing it. In the mountains of the subtropics, the snow-capped part will be less and will melt faster. The growing season will be longer in some areas. Temperatures in winter and at night will tend to increase.

Warm areas will become more humid as more water becomes steam and escapes from the ocean. Rainfall worldwide has risen by 1% in the past hundred years or so. Storms will turn out to hit more often. In addition, water will more quickly release steam from the ground. As a result, some areas will become drier than before.

The wind will blow stronger and have a different pattern than before. Hurricane cyclones that get their strength from the evaporation of water, will become more violent. Weather patterns become difficult to predict and more extreme.

Here are some steps that can be taken to participate in minimizing the impact of global warming:

1. Environmental conservation such as reforestation, tree planting, and reforestation of critical lands.
2. Using energy sourced from alternative energy (water, solar, wind, bioenergy) energy to reduce the energy use of fossil fuels (petroleum and coal).
3. Recycling and energy efficiency.
4. Education efforts to the wider community by providing understanding and application to prevent global warming.

Solar Panels

A solar cell is a solar device arranged in series, which will produce a voltage of about 16V. This voltage is sufficient to be used to supply a 12V battery. To get an even greater output voltage, more solar cells are needed. The combination of these several solar cells is called Solar Panels or solar modules. An array of about 10 - 20 or more Solar Panels will be able to produce enough high current and voltage for daily needs, which converts the energy of sunlight into electrical energy by the process of photovoltaic effects, hence the name photovoltaic cell (Photovoltaic cell – abbreviated as PV). The mains voltage generated by a solar cell is very small, about 0.6V with no load or 0.45V with load. To get a large electrical voltage as desired requires several solar cells arranged in series. If 36 pieces of solar cells are arranged in series, it will produce a voltage of about 16V. This voltage is sufficient to be used to supply a 12V battery. To get an even greater output voltage, more solar cells are needed. The combination of these several solar cells is called Solar Panels or solar modules. An array of about 10 - 20 or more Solar Panels will be able to produce enough high current and voltage for daily needs.

Home Scale Solar Energy Utilization

The utilization of solar energy is carried out by converting sunlight into thermal or electrical energy to meet human energy needs. The utilization of solar power is carried out by converting direct sunlight into heat or electrical energy. The two basic types of solar energy are sunlight and photovoltaic, which is solar energy.

The basic material for capturing sunlight and converting it into energy is semi-conductor materials. Generally, the material used is silicone material. Black. This silicone base material is made into slabs and installed with poles so that they can be directed directly at the sun. Silicone is a material that can reflect the sun like glass.

Research Method

In preliminary observations, it was obtained: (1) Masyarakat Pombewe Village has not utilized the sunlight that shines abundantly for up to 10 full hours a day as a source of electricity. (2) Looking at the role of housewives who take care of the family and carry out the responsibility of taking care of the needs at home, so it is very appropriate that they are



involved in tackling global warming. (3) Support in the form of counseling and training from various related parties. To answer the above, it is carried out through several methods, namely observation, planning, training, and evaluation. The observation method is carried out to find out the problems experienced by the Pombewe Village Community, especially for housewives, planning methods related to the use of solar energy by using a series of home-scale 100 WP solar panels, training methods are training housewives in networking and utilizing solar energy with home-scale 100 WP solar panels, while the evaluation method is used to find out the advantages and disadvantages regarding the program being run. The following is a table of activities for housewives of Pombewe Village:

Table 1. Implementation of activities

No	Method	Steps	Activities
1.	Observation	Conducting on-site observations	Finding the subject matter
		<ul style="list-style-type: none"> • Permission on Dean FTIK UIN Datokarama Palu 	1. Make a permit letter to the Dean of FTIK UIN Datokarama Palu
2.	Planning	<ul style="list-style-type: none"> • Coordination with the Head of Pombewe Village 	2. Determining the location
			3. Specifying the time and date of the implementation
			<ul style="list-style-type: none"> • Counseling on the use of solar energy using a series of home-scale 100 WP solar panels
3.	Implementation	Counseling and training on the use of solar energy using a series of home-scale 100 WP solar panels	<ul style="list-style-type: none"> • Home-scale 100 WP solar panel stringing training • Training on calculating the energy generated by home-scale 100 WP solar panels
			Discuss obstacles, challenges, and positive things obtained during the implementation of counseling and training in order to launch the next activity.
4.	Evaluation	Organizing Housewives	

Analysis

This program is carried out in Pombewe Village, Sigi Regency, Central Sulawesi Province with observation, planning, training, and evaluation methods. Housewives received enlightenment and training on the use of solar energy by using home-scale 100 WP solar panels. This program involves housewives participating in Tackling Global Warming Through the Use of Household-Scale Solar Energy. The program received a positive response, this is shown by the enthusiasm and involvement of housewives in the following activities that have been carried out:

a) Observation and Planning

At the observation stage, finding out about problems generally occurs in Pombewe Village, Sigi Regency. Thus, it was found that there was a lack of public knowledge about global warming and the Utilization of Household-Scale Solar Energy. While the sunlight in Pombewe Village is very abundant, it shines about 10 hours per day. Meanwhile, at the planning stage, discussing the solution to the existing problems. At the planning stage, counseling is given to housewives about the tools and materials that must be prepared. In addition, training is given on how to assemble, measure, and utilize solar energy with home-scale 100 WP solar panels.

b) Implementation

At the implementation stage, housewives carry out the following activities:

1) Prepare the tools, namely:

- Solar panels 100 Wp type Mono Crystalline
- Solar Charge Controller PWM 20 Ampere
- Inverter pure sine wave 2000 Watt
- Accu/baterai charger
- Multimeter
- Laptop
- Light intensity gauge
- Terminals/cable
- Other supporting equipment

2) How to assemble, measure and utilize tools:

- Connect the tools as in figure 1
- Measuring light intensity, electric current strength and mains voltage
- Calculating battery capacity

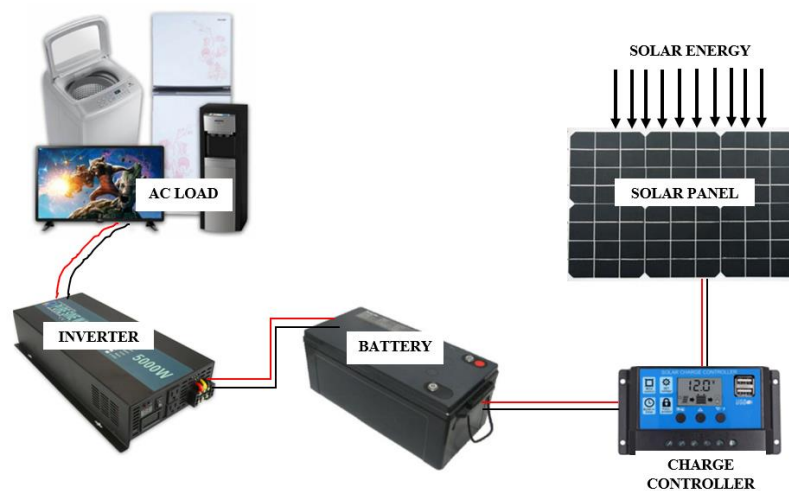


Figure 1. Designing a simple circuit design of a home-scale solar cell

Measurement results

This light intensity measurement is carried out using a Lux Meter which is displayed in digital form on the measuring instrument on November 1, 2022, which can be seen in table 1.

Tabel 1. Measurement results

No	Time	Intensity Light(lux)	Voltage (V)	Current (I)	Power (W)
1	07.30	172810	15.22	3.22	49.0084
2	08.00	174215	15.43	3.20	49.3760
3	08.30	178320	15.55	3.50	54.4250
4	09.00	181121	15.67	3.76	58.9192
5	09.30	186075	15.71	3.92	61.5832
6	10.00	196715	15.75	3.94	62.0550
7	10.30	235420	15.31	4.36	66.7516
8	11.00	245620	15.71	4.32	67.8672
9	11.30	259840	15.77	4.19	66.0763
10	12.00	195425	15.39	4.22	64.9458
11	12.30	267040	15.60	4.08	63.6480
12	13.00	196030	15.51	3.97	61.5747
13	13.30	292340	15.23	3.88	59.0924
14	14.00	272030	15.43	3.50	54.0050
15	14.30	249830	15.44	2.70	41.6880
16	15.00	295630	15.27	2.11	32.2197
17	15.30	199750	15.51	2.11	32.7261
18	16.00	179025	15.46	2.08	32.1568
19	16.30	101480	15.44	2.05	31.6520
20	17.00	99230	15.20	2.05	31.1600
Tegangan Rata-rata					15.48
Arus Rata-rata					3.36
Average Power					52.0465

Table 1 above shows the measurement data on solar panels during clear weather with an average power output of 52.0465 Watts. Since the average power that for 10 hours of measurement is obtained 52.0465 watts then the power generated by the solar panels for 10 hours it is (10 hours \times 52.0465 watts = 520.465 watt hours). From the amount of power generated by solar panels, we can determine the magnitude of what is the maximum power that can be used for loads.

The Value of Current Against Light Intensity

Current measurements are carried out using a digital multimeter that is connected in series to the measurement circuit, below will be displayed a graph of current changes to changes in measured light intensity on November 1, 2022.

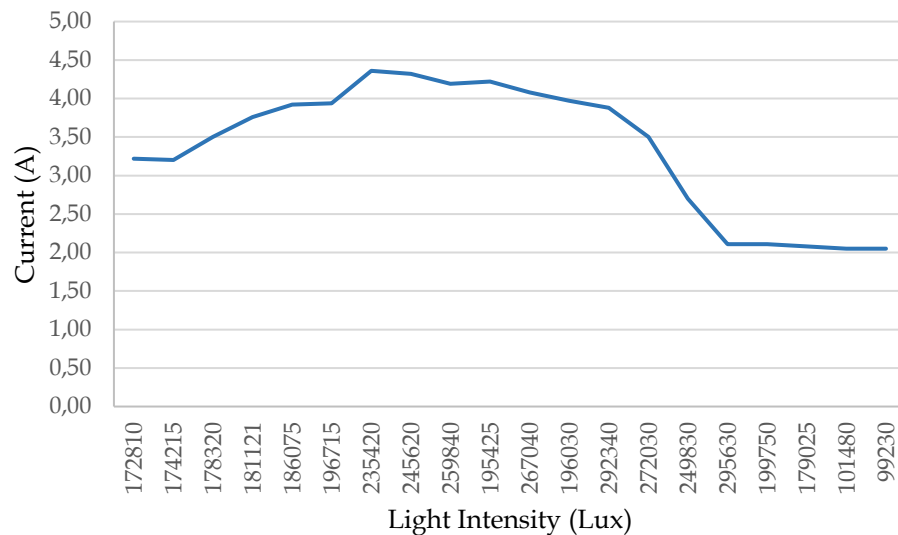


Figure 2. Current to Light Intensity

Battery Capacity Analysis

The power generated by the solar panels for 10 hours is (10 hours x 52.0465 watts = 520.465 watt hours). From the amount of power generated by solar panels, we can determine the capacity of the batteries needed in the solar panel circuit. But first we calculate the losses of the solar panel circuit. We assume the solar panel circuit losses are 15% (Chotimah et al., 2012).

$$E_B = E_P - E_{\text{losses}}$$

$$E_B = E_P - (15\% \times E_P)$$

$$= 520.465 - (15\% \times 520.465)$$

$$= 443.134 - 78.06975$$

$$= 442.3953 \text{ watt/hours}$$

The battery capacity required in Watt/hour energy units is converted into Amperes/Hours corresponding to the unit capacity of the battery, so that the battery capacity can be calculated:

$$AH = E_B / V_s$$

$$= (442.3953 / 12)$$

$$= 36.87 \text{ Ampere Hours}$$

Therefore, the capacity of the battery or battery that must be installed is 36.87 AH, because in the market there is no value for a battery with a capacity of 36.87 AH 12V, then the value used is a value that is close to 35 AH 12V. So the battery or accumulator can store power of:

$$\text{Battery Power} = \text{Current} \times \text{Voltage}$$

$$= 35 \text{ AH} \times 12 \text{ V}$$

$$= 420 \text{ Watt Hours}$$



Then you get a power that can be used for 420 Watts. If it is used to supply a load of 100 Watts, it will be able to serve electricity as long as:

$$T (\text{time}) = (420 \text{ Watt Hour}) / 100 \text{ Watt} = 4.2 \text{ Hours}$$

Empowering housewives to tackle global warming

Empowerment is the action and step to do a structured productivity to see people who do not understand a problem (Aslati et al., 2018). Community empowerment is an effort to provide power or strength for the community to be able to get out of the problems it faces (Kusiawati, 2017). Empowerment is a series of activities to strengthen the power or empowerment of weak groups in society, including individuals experiencing poverty problems (Mahendra, 2021).

Housewives are women who spend a lot of time at home and dedicate their time to nurturing and taking care of their children according to the pattern given by the general public (Korry, 2017). In another sense, it is understood that a housewife is a woman whose majority of her time is used to teach and care for her child with good and correct parenting (Fadlillah & Husniati, 2021).

Housewives have activities to develop themselves, namely through domestic activities, productive economic activities and social activities in the household. Women's participation today is not just demanding equal rights, but also stating the meaning for development in society in Indonesia. Therefore, it is very appropriate for housewives to be involved in environmental problems, especially global warming.

In 2020 the total population of Pombewe Village was 2,803, consisting of 1,408 men and 1,395 women. About 683 people as housewives (Satriani & Asngadi, 2020). From this population data, it is very potential to involve housewives to Overcome Global Warming through the Use of Household-Scale Solar Energy.

Housewives are very enthusiastic in training for home-scale solar energy utilization, by maximizing the supporting factors including the sun shining in pombewe village for about 10 hours per day. After carrying out the training, the housewives know to assemble and calculate a simple series of household-scale Solar Energy Utilization. From the data, it can be calculated that the electrical power generated in Solar panels 100 Wp is 420 Watt hours. In addition to generating electricity that can save PLN bills, another benefit is that housewives help overcome global warming.

Conclusions

The training program on the use of solar energy using home-scale 100 WP solar panels for housewives of Pombewe Village, Sigi Regency, has a positive influence. This program provides new experiences for housewives and opens their horizons to further activities. The use of solar energy has made housewives aware to explore all their undeveloped potentials and play a role in tackling global warming.

Another benefit of this training is that the power generated after the calculation of 420-Watt Hours. The power can be used for household electricity purposes, so it can reduce the use of electricity from fossil energy and of course, can save PLN bills.

There are many housewives have good potential that requires a touch from various parties to develop, then it is suggested to the village government to hold small activities that can add insight to housewives. The involvement of housewives can be focused on environmental, social issues even to the point of improving the family economy.

Acknowledgement

In conducting research with the title Empowering Housewives in Overcoming Global Warming through Household-Scale Solar Energy Utilization. I would like to thank all to parties involved in assisting with this research. More specifically the Dean of FTIK UIN Datokarama Palu who has provided recommendations with letter number 5025/Un.24/F.1/PP.00.9/9/2022.

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