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APPLICATION OF GREEN ENERGY FOR BATIK PRODUCTION PROCESS

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ABSTRACT

Batik is a piece of cloth applied by means of a dye-resist technique using "batik-wax" as the resisting medium. Batik has been named as the cultural heritage of Indonesia, which has been recognized by the world. As generally in Indonesia, batik industry is currently still a class of small and medium enterprises (SMEs). One of the quite popular in Indonesia is Yogyakarta batik. There are some Batik SMEs in Yogyakarta. The issue of the SMEs is that the production process is still using kerosene stoves, while the price of kerosene is very expensive. In addition, the use of kerosene means using fossil fuels that produce environmental pollution. Therefore, in this paper described the application of environmentally friendly green energy sources for the production process of batik. The energy source is the installation of solar home system. The system is used to distribute electrical power to the batik electric stove. The use of solar home system and batik electric stoves is more practical and economical than kerosene stove. Another advantage is to reduce dependence on fossil fuels and help preserve the environment with the use of green technology. Applications of green technology in Yogyakarta Batik SMEs help continuity of batik production. This is in accordance with the needs of both SMEs who have often experienced a power outage that disrupts batik production process, especially if using an electric stove for batik. Solar home systems installation and procurement of electric stoves for batik has managed to increase both production capacity and gross profit of the SMEs.

Keywords: *Green Energy, Solar Home Systems, Smes Batik, Batik Electric Stove, Community Development.*

1. INTRODUCTION

The use of renewable energy and energy efficiency, which is a part of the green energy technologies, is very important to reduce global warming and protect the ecosystem. Green technology will be able to reduce carbon emissions [1]-[6]. Green energy technologies by utilizing alternative energy sources such as wind, solar, hydroelectric, and others reduce CO_2 emissions by improving energy efficiency [7]-[10]. Climate change is now occurring due to uncontrolled carbon emissions that affect the world economy. Because of temperature increases, agricultural products will fall, damage from floods and storms will increase, tropical diseases will become more common and access to water will become more of a problem for more and more people. Costs incurred for our environment is greater and the loss could not be changed. Earth's flora and fauna will suffer both directly from the higher temperatures and indirectly through the destruction of their habitat. Even a small increase in temperature will lead to coral bleaching and threatening some amphibians. Temperature rises of 3°C or 4°C and more will lead to major extinctions around the globe [11]-[13].

A popular one in green energy technologies is solar energy. Solar energy has shifted impressive technology. Early solar technology consists of small-scale photovoltaic cells. The latest technology of large-scale PV systems has been fed into the

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power grid. Technology costs have fallen substantially over the last 30 years [14]-[17]. The rapid expansion of the solar energy market is the result of government policies that support instruments, increased price volatility and environmental externalities of fossil fuels, especially greenhouse gas emissions.

Basically the solar energy resource potential that far exceed the entire global energy demand [18]-[19]. Although the technical potential is very large and the recent growth of the market, the contribution of solar energy for the global energy supply mix is still negligible. Numerous studies, have been discussing various issues related to solar energy [20]-[24]. The study provides an overview of the synthesis of existing literature and presents an economic analysis to look at the competitiveness of solar energy compared with fossil energy [25]-[26]. Although the presence of the clean development mechanism of the Kyoto Protocol has been contributed to assist the implementation of several projects of solar energy, its role in promoting solar energy is very small compared to that of other renewable energy technologies as cost competitiveness [27]-[28]. An existing study has shown that the share of solar energy in the world energy supply mix could exceed 10% in 2050 [29]-[34]. This share would still be a small part of the total world energy supply. This share is also a small fraction of renewable supply.

In this study, application of green energy and eco-friendly batik production process is described. The green energy is the use of solar home system in batik industry for processing of batik production. The solar home system is used to supply the electric batik stove for batik processing. In this work, the testing of electric batik stove as a burden of solar home system is done. Also, the analysis of loading of solar home system is described, whether the application of green energy is really able to help resolve problems in the production process of batik?

2. BATIK INDUSTRIES AND THEIR PROBLEMS

Batik is a fabric sheet made by drawing designs on fabric using dots and lines of hot wax. This wax is used to reject dye by soaking a cloth in one color. Once the color is applied, the wax is removed using boiling water and repeat if some of the desired color. Batik has been known to the world community that comes from Java [35]. Custom pattern often have a symbolic meaning that is used in certain ceremonies, while the coastal pattern draws inspiration from various cultures. Batik has been used as everyday clothing since ancient times, and is still used and very loved by many Indonesian people today in events ranging from formal to casual. In October 2009, UNESCO has set Indonesian batik as a Masterpiece of the Oral and Intangible Heritage of Man. As part of the recognition, UNESCO asserted that Indonesia preserve their cultural heritage [36].

In this study, to test the application of solar home systems are burdened with an electric stove in two SMEs batik industries. The existing conditions of the two SMEs are described as follows:

1) The Batik SMEs capable of producing batik from 200 to 400 pieces of batik cloth per month. Low productivity in the SMEs is not on the ability of the human resources and the difficulty of obtaining raw materials and wax batik cloth, but rather:

   a. A number of constraints in producing batik is because only rely on kerosene stoves and firewood and even use coconut fiber burnt. Since the government of Indonesia has implemented a program for kerosene to gas in 2008, then one of the sectors that are directly affected by the program is batik industry. In Yogyakarta, kerosene prices trending up from time to time (i.e. current prices in April 2015 reached Rp 11,000 per litre), and often there is a shortage of kerosene.

   b. The SMEs actually have a electric stove for batik, but not reliable. In addition to the amount that is only one piece, another issue is the continuity of the electricity. Electric stove used in the SMEs is not equipped with a battery, so it's really just rely on commercial power. If commercial power is lost, the stove could not operate. The flow of electricity in the location of these SMEs often experience blackouts, both in weather conditions of rain and sunny weather, because of the low level of reliability.

   c. The SMEs relatively low productivity is caused by: only rely on kerosene stoves and even using firewood and coconut fibers are burned, the high price of kerosene and kerosene shortages often occur. Actually the SMEs still rely kerosene stove in the production of batik and batik yet have an electric stove.

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2) Both SMEs uses electrical energy derived from the PLN. The SMEs subscription with a power capacity of 450 VA and Batik Arjo Munir subscription with the same power capacity. However, during the frequent power outages that at times can not be estimated, in the rain and sunny weather at the time either day or night. This situation will be very difficult if they want to use an electric stove in the process of batik production.

3. METHODOLOGY

The problem-solving step in the batik industry in this research is shown in Fig. 1.

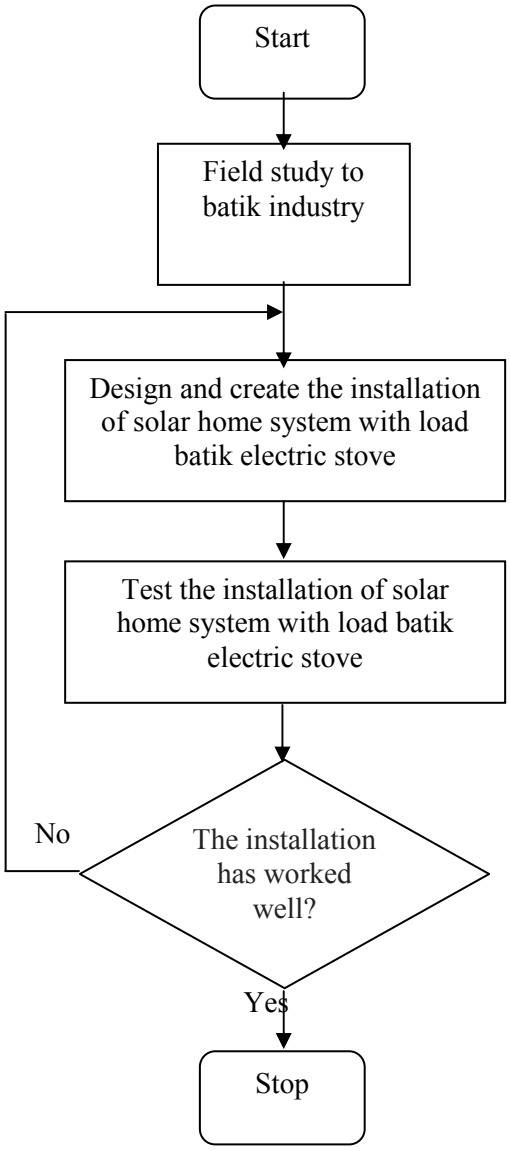

Fig. 1. The Problem-Solving Steps In The Batik Industry In This Research

In order to increase production capacity, market expansion, and capacity building activities in The Yogyakarta Batik SMEs, then in the programs carried out the following activities:

1) Batik production capacity of the SMEs can be improved:
   a. Provide an electric stove specifically for batik SMEs.
   b. Provide and install solar cell home systems to ensure continuity of the flow of electrical power to distribute electrical power to the stove and also home lighting batik production. Provision the solar cell home system is also useful to overcome the problems in both SMEs because it has a low power capacity installed and frequent power outages, while each SMEs will use electrical power continuously for 2 pieces of 125 watts electric stoves.
2) Improving human resource capacity in the respective SMEs.

4. TEST RESULTS

The geographical condition of Indonesia which is located in the tropical region is traversed equator particular gift for the people of Indonesia if it is associated with potential sources of electrical energy derived from sunlight [6]. On the bright midday sun radiation is able to reach 1000 Watt/m^2. If a semiconductor device with area of 1m^2 has an efficiency of 10 % then the solar cell module is capable of delivering 100 watts of power [7]. Currently commercial module efficiency solar cells ranged from 5 to 15% depending on the constituent materials [8]. On a national scale, the government of Indonesia has a serious program in renewable energy, one of which is the solar energy [8]-[9]. The government of Indonesia has targeted that power generator from renewable energy resources will be on-grid for up to 5% by the year 2025 [5].

In this work, the create-design of solar home system with loading of batik electric stove is done. The scheme of solar home system in this work is shown in Fig. 2. Solar cell home systems installation for each SME to ensure the availability of electric current for batik electric stove and lighting the batik production houses. The power capacity of solar cell in the installation is 100 Wp. The technical specifications of 100 Wp solar cell panel for batik industry has described in Table 1. The main burden of solar home systems is batik

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electric stove of 125 W, 220 volts, as shown in Fig. 3

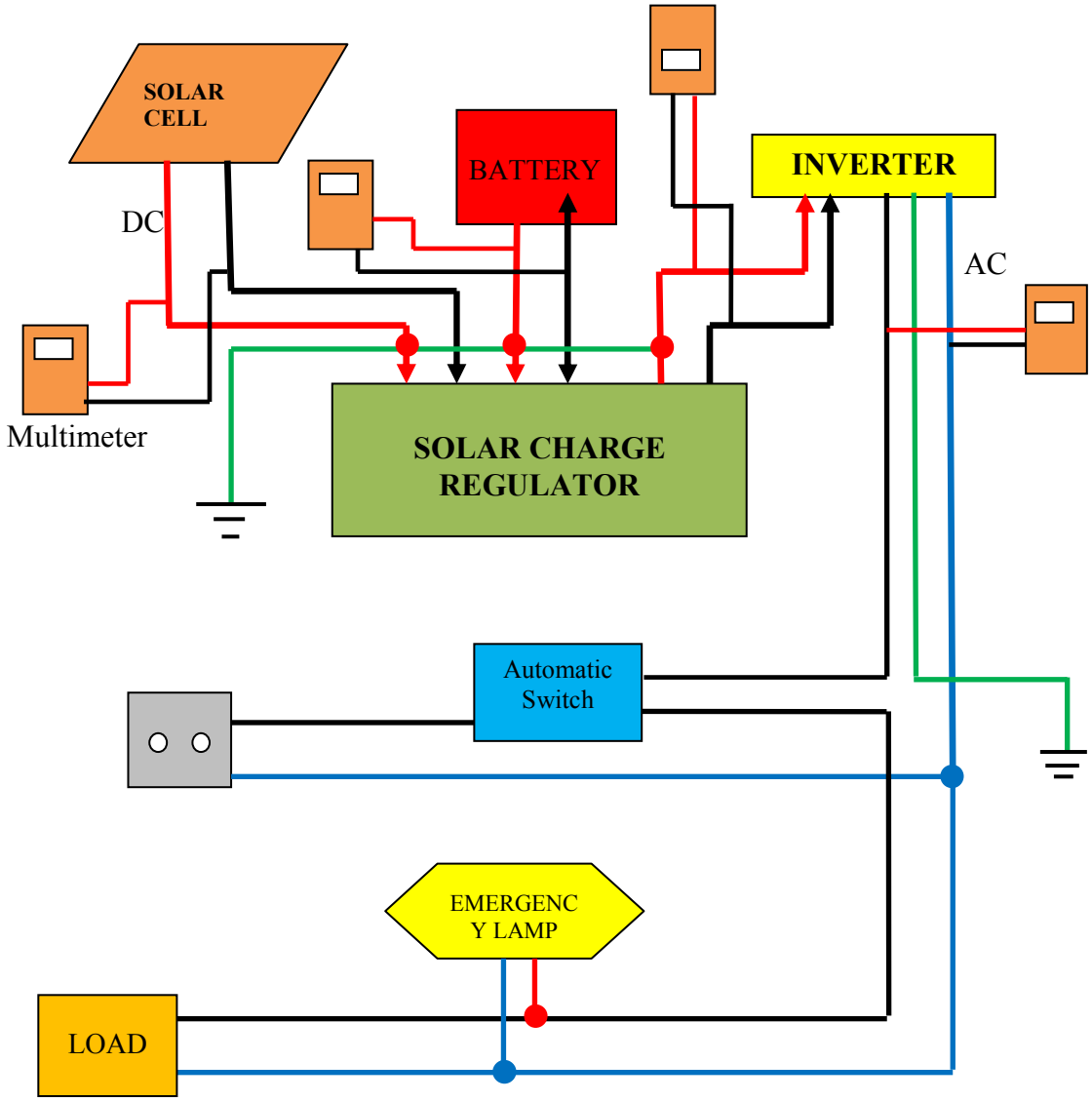

Fig. 2. The Scheme Of Solar Home System In Our Work

The main function of solar home systems are the electrical power supply to the load on the batik electric stove with a power capacity of 125 watts each burner. Production of electric energy solar home systems is highly dependent on sunlight. In one day, the most effective sunlight to generate electrical energy in just over 5 hours, as shown in Fig. 4.

Solar insulation (Fig. 4) can be determined as follows:

1) Insulation sunlight can be estimated from that of predicted weather conditions.

2) Weather forecast data in the form of long sun emits rays can be obtained from meteorological and geophysics agency.

3) The length of time the sun radiates its light is converted into the peak sun hours

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Table 1. Technical Specifications Of 100 Wp Solar Cell Panel For Batik Industry

Parameters	Values	Units
Maximum power	100	watts
Open circuit voltage	21.6	volts
Short circuit current	5.70	amperes
Maximum system voltage	1000	volts
Dimension	835 x 540 x 28	mm
Test conditions	AM1.5 1000W/m225 ° C	-

Fig. 3. Batik Electric Stove Of 125 W, 220 Volts

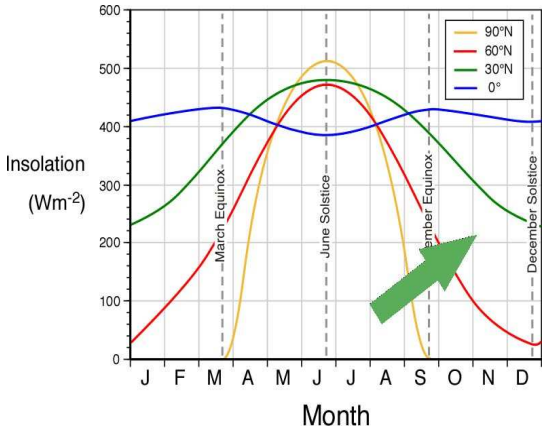


Fig. 4. Daily Solar Insulation Characteristics [2]

Testing of solar home systems with a single load electric stove for batik described as shown in Table 2 and Table 3.

Table 2. Technical Specifications Of Solar Home System Load

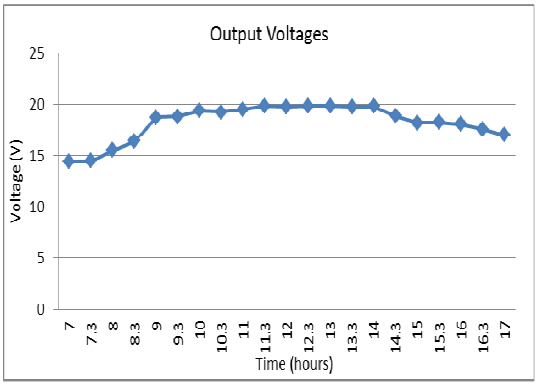
Parameters	Values	Units
Maximum power	125	watts
Nominal voltage	220	volts
Nominal current	0.60	amperes
Frequency	50	Hz

Load type : Electric stove for batik
Place of Testing : Yogyakarta batik SMEs

After the sunlit solar cells for 5 hours, then the solar cells can be used with a load power of 125 watts for 2 hours, which is described in Table 3.

Table 3. Test Results Of Solar Home System Installation.

Parameters	Values	Units
Maximum power	100	watts
Nominal voltage	220	volts
Maximum drying time	5	hours
Frequency	50	Hz
Energy produced	100 x 5 = 500	watt-hours
Long duration usage load	500/125 = 4	hours



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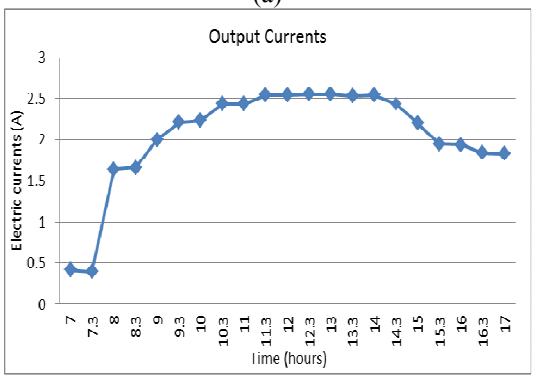
(a)



(b)

Fig. 5. (A) Solar Cell Output Voltage, (B) Solar Cell Output Currents.

Fig. 5(a) and Fig. 5(b) show the output voltages and the output currents of solar cell under study, respectively. Testing of the solar cell with loading of 125 W batik electric stove is start from 7.00 AM to 17.00 PM. As shown in Fig. 5(a) that output voltage of solar cell has varied from 14.45 volts to 19.88 volts. Magnitude of the voltage dependent on sunlight, where the maximum voltage occurs at 12.00 AM and the minimum voltage occurs at 7.00 PM.

Thus, applications of solar home systems in Yogyakarta Batik SMEs help continuity of batik production. This is in accordance with the needs of both SMEs who have often experienced a power outage that disrupts batik production process, especially if using an electric stove for batik.

In this research, application of green technology in the production process of batik. The green technology is a solar home system. The novelty of this research is the application of green technology specific to the batik industry, where solar home systems used to distribute electrical power to the load of the batik electric stove. The author's knowledge there is no article that discusses this issue.

The impact and benefits have been felt through service activities are:

1) Batik production capacity of Yogyakarta Batik SMEs has increased with the following details: The Yogyakarta Batik SMEs, if prior to the work only capable of producing combination stamp and write batik and pure batik with a total capacity of approximately 200 pieces of cloth batik per month, then after our activity is able to increase its production up to 250 pieces of cloth batik per month. The increase in productivity has been accompanied by an increase in gross profit of an average SME Rp 5 million per month to an average of Rp 6 million per month.
2) Expansion of each SME market has increased. Both SME market has dared not only to supply the batik cloth batik shops around Malioboro street and Beringharjo mart, Yogyakarta, but also through exhibitions in several cities such as Jakarta and Bandung are often sponsored by the Department of Industry and Local Government of Yogakarta.
3) Human resources capacity in each SME has increased in quality, mastery of which operating and maintenance of solar home systems installation and electric stoves for batik.

5. CONCLUSION

This work has proved to be very beneficial for Yogyakarta Batik SMEs. Applications of solar home systems in Yogyakarta Batik SMEs help continuity of batik production. This is in accordance with the needs of both SMEs who have often experienced a power outage that disrupts batik production process, especially if using an electric stove for batik. Solar home systems installation and procurement of electric stoves for batik has managed to increase both production capacity and gross profit of the SMEs. In a period of ten months the Yogyakarta Batik SMEs productivity increased from an average of 200 pieces of batik cloth to an average of 250 pieces per month. The increase in productivity has been accompanied by an increase in gross profit of the SMEs.

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