Increasing Energy Efficiency and Conservation Aspects of the Joglo Houses Reviewed from Greenship Home Ver 1.0

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ABSTRACT
Electricity is an extensively used energy source in various sectors today, including the household sector. It facilitates domestic activities such as cooking, cleaning, and entertaining with the use of electric energy tools. Currently, the majority of sources of electrical energy are generated using coal as fuel. Coal is a finite fossil fuel, and its combustion produces carbon emissions. With this consideration in mind, the use of electricity must become more efficient, beginning with the smallest scale, i.e., domestic electricity use. This study was conducted on the traditional Javanese building, namely the *Joglo* house, to determine the score of the Energy Efficiency and Conservation aspects based on Greenship Home Ver 1.0 and how the design can increase the score of those aspects. This study employed Research and Development method. Observations, interviews, and documentation were used to collect data, after which the design of the *Joglo* house was assessed and developed. The development of the *Joglo* was carried out on several criteria, including sub-metering, artificial lighting, air conditioning, heat reduction, energy-saving home appliances, and renewable energy sources. The results of the study showed that *Joglo* house has an existing score of 7 out of 19 main points and 2 bonus points in the Energy Efficiency and Conservation aspects. Afterward, the development of the *Joglo* house raised the score in that area to 15 points and 2 bonus points.

Keywords: *conservation, Efficiency, Energy, Joglo, Redesign.*

1. INTRODUCTION

A house is a functional building as a residence or housing with facilities and environmental infrastructure [1]. The energy crisis has become an increasingly important issue along with the progress of time. Entering the 20th century, The need for energy is increasing in various fields [2]. The environment and energy crisis are global issues facing humanity today. The limited availability of energy available in nature along with the increase in population and utilization of energy sources will lead to an energy crisis [3]. Development greatly influences environmental sustainability and quality because using various types of natural resources. Exploitation of natural resources is not Paying attention to the capabilities and carrying capacity of the environment can result in its decline environmental quality [4]. Sustainability is a concept that today's planners need to understand. To achieve sustainability, these ideas need to be applied to the real world [5]. Global warming is the year-to-year increase in the earth's surface temperature caused by the phenomenon of greenhouse gasses. Whereas, Indonesia's greatest greenhouse gas emissions come from the electricity and heating sectors [6]. Per capita electricity consumption is a comparison of the electricity used to the total population of the country. In 2013, Indonesia's per capita electricity consumption was 0.84 and has increased every year since. Meanwhile, in 2019 Indonesia's per capita electricity consumption reached 1.08 [7]. In light of the rise in electricity consumption, it is evident that electricity production has also increased. The electrical generator with the greatest production, PLTU-B, which utilizes PP steam coal, continues to experience yearly production increases. Increasing energy consumption accelerates the depletion of fossil fuel reserves. This needs to be counterbalanced with energy-saving behaviors beginning with the use of broadly accessible individual scales in the household sector. Energy-saving behavior can contribute to energy conservation, and energy conservation can serve as a resource for the utilization of other forms of electrical energy.

Energy efficiency and conservation are the criteria that must be fulfilled for the green buildings [8]. The assessment of green buildings is conducted on single-family detached houses (single-landed), including new, existing, and redeveloped houses. To those explanations,

A. Kusumastuti et al. (eds.), *5th Vocational Education International Conference (VEIC 2023)*,
Advances in Social Science, Education and Humanities Research 813,
https://doi.org/10.2991/978-2-38476-198-2_121

the subject of green building assessment is a residential house. The traditional Javanese house is one form of a house with a traditional category that is still in use today.

Traditional Javanese architecture is widely known as the *Joglo* house. The traditional Javanese building has stood the test of time and retains its sustainability [9]. Sustainability-maintained buildings are those that have been examined for their compatibility with local environmental and cultural factors. An indication of a building's achievement is the presence of sustainable buildings with efficient energy use. Energy consumption is closely related to energy waste, with ventilation and lighting of the building having the most direct impact. According to previous research, traditional Javanese buildings still prioritize natural ventilation and lighting [10]. Thus, traditional Javanese buildings use electricity less frequently so that its use is more efficient.

This study was conducted on *Joglo* house to determine the existing score of the Energy Efficiency and Conservation category based on Greenship Home Ver 1.0 and how the design can increase the score of those categories [11].

2. RESEARCH METHODS

2.1 *Data Description*

Based on the researchers' observation, the *Joglo* house has a north-facing building orientation. The house is situated directly facing the main road. Its northern boundary is a highway (district road bordering Wonogiri Regency – Sukoharjo), [12] its eastern and southern boundaries are village roads, and its western boundary is the residents' houses separated by approximately 1 meter away. Based on existing measurements, the *Joglo* house has an approximate building area of 472.846 m2.

Figure 1. Existing the *Joglo* House.

In this study, data from observation, interviews, and documentation were summarized to carry out an initial assessment of the existing building, with a score of 7 points out of 19 main points and 2 bonus points on the Energy Efficiency and Conservation criteria.[13]

Table 1. Initial assessment of existing building.

Code	Number	Benchmarks	Max Point	Point
EEC 1	1	Sub-metering lamp, air conditioner, or power plug	1	0
	2	Calculating the house's electricity consumption	1	0
EEC 2	1	30% greater lighting efficiency than SNI 03 6197-2011	2	2
	2	Using LEDs and electrical ballast	1	1
	3	Zoning lighting in the living and dining rooms	1	1
	4	Using automation features in at least one area	1	0
EEC 3	1A	The house can supply comfortable thermal conditions without the use of an air conditioner and has a minimum of three points of IHC 1	2	0
		or		
	1B	Using air conditioner for no more than 50% of the overall floor area	1	1
EEC 4	1	Attempting to design and construct roofing materials that reduce the heat of the entire roof	2	0
	2	Attempting to design and construct materials that reduce heat on walls and floors	2	2
EEC 5	1A	Using energy-saving electrical equipment must account for at least 75% of overall electrical equipment power	3	0
		or		
	1B	Using energy-saving electrical equipment must account for at least 50% of overall electrical equipment power	2	0
EEC 6		BONUS		
	1	There is an alternative power generation feature	2B	0
TOTAL POINTS			19+2B	7

2.2 *Product Development and Testing*

The product was developed using several related sources. After that, the product was assessed by electrical and solar panel experts. The product testing

kept going until the electrical and solar panel experts gave their approval. [14] The researchers used the criticism and recommendations of the experts as a guide to enhance the redesigned product. P was the result of the developed product, as shown in Table 2.

Table 2. Development Results.

No	Redesigned Product	
	Criteria	**Format**
1.	Sub-meter	Calculation of the distribution of the house's MCB
		a. IoT-based kWh image b. Electrical usage monitor card
2.	Artificial Lighting	a. Lamp power calculations per room save 30% more than SNI 6197:2011 b. Image of an energy-saving light
3.	Air Conditioning	Suggestions for using a fan as air conditioning (no more than 50% of the room's overall area)
4.	Heat Reduction	Suggestions for using cool roofs
5.	Energy-saving Home Appliance	Calculation of electronic products that can use energy-saving labels
6.	Renewable Energy Sources	500Wp solar panel design

3. DEVELOPMENT RESULTS

The development of the *Joglo* house was completed and received a total score of 15 points out of 19 main points, and 2 bonus points. The table below shows the assessment results for *Joglo* house from energy efficiency and conservation aspects [15].

Table 3. Initial Existing Assessment.

Code	No	Benchmarks	Max Point	Point
EEC 1	1	Sub-metering lamp, air conditioner, or power plug	1	1
	2	Calculating the house's electricity consumption	1	1
EEC 2	1	30% greater lighting efficiency than SNI 03 6197-2011	2	2
	2	Using LEDs and electrical ballast	1	1
	3	Zoning lighting in the living and dining rooms	1	1
	4	Using automation features in at least one area	1	1
EEC 3	1A	The house can supply comfortable thermal conditions without the use of an air conditioner and has a minimum of three points of IHC 1	2	0
		or		
	1B	Using air conditioner for no more than 50% of the overall floor area	1	1
EEC 4	1	Attempting to design and construct roofing materials that reduce the heat of the entire roof	2	2
	2	Attempting to design and construct materials that reduce heat on walls and floors	2	2
EEC 5	1A	Using energy-saving electrical equipment must account for at least 75% of overall electrical equipment power	3	3
		or		
	1B	Using energy-saving electrical equipment must account for at least 50% of overall electrical equipment power	2	0
EEC 6		BONUS		
	1	There is an alternative power generation feature	2B	2B
TOTAL POINTS			19+2 B	15+2B

4. CONCLUSION

Based on the results of the study and the discussions that were done to develop the efficiency and conservation (EEC) aspects of the *Joglo* house, the following are the conclusions that can be drawn

4.1. Based on the Greenship Homes Ver 1.0 independent assessment of the energy efficiency and conservation (EEC) aspects of the existing *Joglo* house, it has a score of 7 out of 19 main points and 2 bonus points.

4.2. Redesigned products in the form of MCB plans for the house, suggestions on using IoT kWh meters, electrical usage monitor cards, lamp power calculations, suggestions for artificial air conditioning, using cool roofs for the *Joglo* house, calculations for energy-saving electronics, and 500Wp solar panel design.

4.3. After the development, the score for the aspects of Energy Efficiency and Conservation changed from 19 points and 2 bonus points to 15 points and 2 bonus points based on Greenship Homes Ver 1.0

5. RECOMMENDATION

Based on results of the study for the development of the energy efficiency and conservation aspects of the Joglo house, this study presents an insightful implication as below: The redesigning aspects of energy efficiency and

conservation carried out in this study can be used as a consideration by homeowners for the Joglo house repairs.

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