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An Energy Cost Efficiency in a Platinum-Ranked Green Home

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***Abstract*—An eco-friendly home, well known as green home, is a home building that pays attention to sustainability aspects of the environment, both in the construction process and in the use of the building. This article reviews the efficiency of energy costs according to building utilization. A green home designed was developed with a focus on energy efficiency. The draft of home design developed was validated by several experts before submitted to get an assessment from Green Building Council Indonesia (GBCI). The analytical paper was then used to calculate the energy requirements and energy costs of green home design which has gained a platinum rank according to green ship home from GBCI. The result shows that the platinum-ranked green home concept produces 48% energy savings compared to the non-green home concept. The highest cost savings come from electrical appliances for thermal conditioning, whereas a green home does not use electrical air conditioner for thermal conditioning. Energy savings from the building utilization will sustain an increase in energy needs in this disruptive era where almost all human activities require electricity.**

Keywords—energy efficiency, cost, green home, greenship home, home design

I. Introduction

Electric energy consumption has increased from time to time along with the increase in population, increasing the economic capacity of the community, and the rapid development of technology. Indonesia's electricity consumption throughout 2018 was recorded at 1,064 kWh per capita, showing an increase from 2017 which was at 1,012 kWh, while in 2016 it was at 956 kWh [1].

The supply of electricity in Indonesia is currently still dominated by fossil fuels. With the limited reserves of fossil fuels, it is necessary to save on their utilization. Various ways can be done in energy saving. The Government of Indonesia through Government Regulation No. 70/2009 formulates efforts to deal with the energy crisis in Indonesia through conservation of energy [2]. Energy conservation at the national level aims to reduce energy subsidies, the gap between energy supply and demand, greenhouse gases that affect global warming and climate change, and to increase national energy competitiveness [3].

Energy efficiency is defined as all methods, techniques, and principles that make it possible to produce more efficient use of energy and help reduce global energy demand. Energy efficiency must be implied in a multidimensional level to get the best effect. This means that Indonesian society must strive to improve energy efficiency as much as possible, in all sectors (houses, buildings, vehicles, and industry).

Based on the explanation above, conservation and energy efficiency have an interrelated relationship, where energy efficiency is one of the energy conservation efforts in its implementation at a multidimensional level by not disrupting energy use that is needed and done rationally. The main purpose of energy conservation is to save energy. Energy saving also means saving money and reducing the dependence of the people on fossil fuels because they are still the dominant ones.

One of the conservation and energy efficiency efforts can be implemented through the green home building. Green homes are homes which exploit land appropriately, effectively and efficiently in using both energy and water, consider conservation of natural resources, and are healthy and safe for residents of the house. Eco-friendly and safe home care are also an important factor because the sustainability of eco-friendly home must be accompanied by environmentally friendly behaviors of its residents. The concept of green homes should fit the habitability by meeting building safety requirements and the minimum adequacy of spatial dimension and the health of its occupants [4]. The growth and development of communities impact on the increasing human needs for buildings, and further will increase the buildings' effects on the environment. Green building concept is the answer to minimize the adverse effects that may arise from buildings during the manufacturing, design, construction and operation of the buildings.

In Indonesia, there is only one independent and non-profit institution that is fully committed to community education in applying environmental best practices and in facilitating the transformation of the sustainable global building industry, namely "Green Building Council Indonesia (GBCI)". GBCI has formulated the value standards for green homes compiled in "GREENSHIP HOMES". Greenship Homes is a scoring system that is used as a tool in order to implement best practices and strive to achieve measurable standards that can be understood by the general public and residents. The application of Greenship Homes aims to realize the concept of green homes since the beginning of the planning, implementation, and operation. There are six categories in the assessment for green home or eco-friendly homes, namely Appropriate Site Development/ASD, Energy Efficiency and Conservation/EEC, Water Conservation/WAC), Material

Resources and Cycle/MRC), Indoor Health and Comfort/IHC, and Building and Environment Management/BEM. Meanwhile, in relation to aspects of conservation and energy efficiency, the assessment criteria include Electricity Metering, Passive Design Analysis, Sub Metering, Artificial Lighting, Thermal Condition, Heat Reduction, Energy Saving Homes Appliances, and Renewable Energy Source [4].

Research on buildings' energy efficiency has been carried out in several countries such as India [5], Malaysia [6], Saudi Arabia [7], and Brazil [8] . In Indonesia, research on energy efficiency has been carried out with a focus on attention to energy savings in industry [9]; or in transportation infrastructure [10], and on the study of energy economy efficiency from the government side [11]. Meanwhile research on cost efficiency in residential buildings designed to follow the green building concept by considering space needs based on the activities of the majority of Indonesian people has not been found.

Energy efficiency in the everyday use of buildings will certainly have an impact on the efficiency of the energy costs. Therefore, this article discusses the efficiency value of the energy cost generated by the eco-friendly home. The eco-friendly home building design was obtained from a series of product development activities to produce a design of house buildings that are ranked platinum, the highest ranking class, according to GBCI's Greenship Homes.

II. Literature Review

Energy conservation is the use of energy with efficiency and rational by reducing energy consumption through lower quality of energy services but without reducing energy use which is really needed. Meanwhile energy efficiency is how to get the most out of every unit of energy input, and simply stated as the ratio of energy services out to energy input. Energy efficiency is a process caused by stock turnover where old equipment is replaced by the newer and more efficient ones [12].

The assessment criteria of conservation and energy efficiency from Greenship homes GBCI include Electricity Metering, Passive Design Analysis, Sub Metering, Artificial Lighting, Thermal Condition, Heat Reduction, Energy Saving Homes Appliances, and Renewable Energy Source. Electricity metering, and now it has developed smart energy meter, provides energy consumption information to understand how and where energy is being used in order to measure and to control the energy consumption [13]. Passive Design Analysis is conducted to improve understanding of the passive design concept in an effort to reduce energy consumption [14]. Installing sub metering in some special device with high energy consumption such as air conditioner and refrigerator aims to monitor the use of energy resources and to facilitate the calculation of resource consumption [15]. Energy savings from artificial lighting systems, namely through the use of artificial lighting sources that are energy efficient such as LED and electronic ballast. Thermal Condition means that the house is able to provide comfortable thermal conditions for the residents without using air conditioning. Recommended thermal conditions in a room refer to the concept of Hetreed, Ross, & Baden-powell [6]. A green home has an effort to reduce the heat of the house that is received from the house cover. Energy Saving Homes Appliances encourage the use of energy-efficient electrical equipment that gives at least 75% of energy efficiency. And the last, a green home has an effort to reduce the use of non-renewable energy, by installing features of alternative power plants for electricity such as solar panels [17] and wind turbine [18].

III. Methodology

The energy cost analysis study was carried out on a green home design developed with a focus on energy efficiency. The development of the home design was carried out based on the green home criteria ranked platinum from GBCI. The draft home design developed was validated by several experts from the fields of Civil Engineering, Architecture, Environmental Engineering, and Electronic Engineering. The results of the development were then submitted to get an assessment from GBCI. When the design had not reached the platinum criteria, the design would be revised until it reached the platinum rank. Home designs that had achieved platinum criteria were then used as a basis in calculating energy requirements and energy costs. The value of energy cost efficiency was calculated based on the difference between the energy costs of green home and those of non-green home.

IV. Results & Analysis

A. The improvement of house designs

The improvement of eco-friendly house designs was carried out through the following stages:

1. The Arrangement of Residence Concept

The residence concept is the main idea according to the needs of the residents with needed space adjustments. This part discusses concepts and reasons of space arrangement and spatial form. The planned residential concepts are eco-friendly. The analyses of assumptions on residents and of morning-to-evening resident activities were conducted. The overview of the assumptions on residents is shown in Table 1, while the results of the analysis of resident activities are depicted in Table 2.

TABLE I. THE ANALYSIS OF ASSUMPTIONS ON RESIDENTS

No	*Residents*	*Characteristics*
1.	Father	A 45-year-old civil servant in category IV
2.	Mother	43-year-old housewife
3.	The first child	Male & grade 10 student
4.	The second child	Female & grade 8 student

TABLE II. THE ANALYSIS OF RESIDENT ACTIVITIES

Time	**Activities**			
	Father	**Mother**	**The 1st child**	**The 2nd child**
04:00 AM	gets up	gets up	gets up	gets up
04:15 AM	----------performs Fajr pray and read the Holy Quran-------------			
05:00 AM	washes car	Cooks	helps washes car	helps the mother
05:15 AM				takes a bath and dresses up
05:30 AM	takes a bath and dresses up	prepares breakfast	takes a bath and dresses up	helps prepare breakfast

Time	Activities			
	Father	**Mother**	**The 1st child**	**The 2nd child**
05:45 AM	prepares to go to work		prepares to go to school	prepares to go to school
06:00 AM	has breakfast	has to breakfast	has to breakfast	has to breakfast
06:30 AM	warms up car	washes the dishes	goes to school	goes to school
07:00 AM	goes to office	washes clothes		
07:30 AM		Tidies up the house		
08:00 AM		hangs clothes to dry		
08:30 AM		takes a bath and dresses up		
09:00 AM		goes to market		
09:30 AM		Watches TV		
11:15 AM		Cooks		
12:00 PM		performs Dhuhr prayer		
12:30 PM		has lunch		
13:00 PM		Washes dishes		
13:15 PM		takes a nap		
14:00 PM		gets up	goes home	goes home
14:15 PM		picks up clothes		
14:30 PM		Irons	arrives home	arrives home
15:00 PM		performs Asr prayer	performs Asr prayer	performs Asr prayer
15:15 PM			relaxes	Relaxes
16:00 PM	arrives home	Cooks		
16:30 PM	chats with the children	chats with the children	chats with father	chats with mother
17:00 PM		takes a bath		takes a bath
17:30 PM	takes a bath	relaxes	takes a bath	
18:00 PM	---------performs Maghrib prayer and reads the Holy Quran----			
18:30 PM	has dinner	has dinner	has dinner	has dinner
18:45 PM	------------------watches TV--			
19:00 PM	-----------------performs Isha prayer---------------------------------			
19:15 PM	---------------- family time ---			
20:00 PM	does office work	watches TV	does homework	does homework
21:00 PM	watches TV	watches TV	watches TV	watches TV
22:00 PM	goes to sleep	goes to sleep	goes to sleep	goes to sleep

2. *The Determination of Space Needs*

In reference to the results of the analysis, space needs were then determined. The procedures include:

a. Determining functions of rooms
   It aims at finding out the conformity between activities and room used. The results are demonstrated in table 3.
b. Determining spatial zonation
   Spatial zonation was obtained after analysis of activities at rooms had been carried out. Therefore, such zonation as public, semi-public, service, and private, as described in table 4 were obtained.

TABLE III. FUNCTIONS OF ROOM

Room	*Function*
Terrace	Residents can receive guests. There is a park equipped with shade systems regarding the west-facing building orientation.
Living room	Residents can receive guests.
Worship space	Residents can perform prayer in two rows.
Secondary bathroom	Residents can urinate and defecate.
Family room	Four or more members of the family can gather.
Dining room	Four members of a family can have meal together.
Main bedroom	Residents can sleep and locate a wardrobe. There is a toilet.
Children's bedroom	Residents can sleep, study, and locate a wardrobe.
Kitchen	Residents can cook, do the washing-up and other kitchen activities.
Laundry room	Residents can do the washing. The room has a washing machine and some buckets.
Ablution space	Residents can store unused household items.
Main bathroom	Residents can urinate and defecate.
Carport	Residents can keep a car and a motorcycle.

TABLE IV. SPATIAL ZONATION

Room	*Zone*
Terrace	Public
Living Room	Semi-public
Family Room	
Park	
Worship Space	
Ablution Space	
Secondary Bathroom	
Dining Room	Service
Kitchen	
Laundry Room	
Carport	
Back Park	
Main Bathroom	Private
Main Bedroom	
The First Child's Bedroom	
The Second Child's Bedroom	

3. *The Analysis of Space Requirements*

The analysis of space requirements aims at obtaining spatial requirements used as a residential building plan guideline in such processes like planning and designing. Several conditions that need to be considered, include:

a. Air Circulation: Rooms which accommodate the resident activities require clear circulation to create a comfortable atmosphere in each room.
b. Natural Lighting: Rooms which accommodate the residents' activities require natural lighting to save electricity.
c. Artificial Lighting: Rooms which accommodate the residents' activities require artificial lighting since the rooms will get dark at night.
d. Natural Vaporization: Rooms which accommodate the residents' activities require natural vaporization to avoid stuffiness of each room.
e. View from Site: Kitchen and dining room do not require a view from the site since both rooms accommodate focused activities. The residents will not get distracted by the outer view.

TABLE V. SPACE REQUIREMENTS

Space Requirements	***Sunlight***	***Wind***	***View to site***	***View from site***	***Clean Water***	***Dirty Water***	***Fragrance***	***Electricity***	***Sanitation***
Carport	✓	✓	✓					✓	
Park	✓	✓	✓					✓	
Terrace	✓	✓	✓					✓	
Living Room	✓	✓					✓	✓	
Family Room	✓	✓					✓	✓	
Main Bedroom	✓	✓	✓				✓	✓	
The First Child's Bedroom	✓	✓	✓				✓	✓	
The Second Child's Bedroom	✓	✓	✓					✓	
Main Bathroom	✓	✓	✓		✓			✓	✓
Secondary Bathroom	✓	✓					✓	✓	✓
Kitchen	✓	✓	✓				✓	✓	✓
Dining Room	✓	✓	✓				✓	✓	
Worship Space	✓	✓	✓					✓	
Ablution Space	✓	✓	✓		✓			✓	

4. *The Need for Spatial Dimension*

The need for spatial dimension was determined based on several aspects related to the residents' activities and furniture, namely:

a. Spatial magnitude = the number of residents x coefficient
   In order to calculate the required spatial magnitude, it is important to determine the number of residents doing activities in the room. The residents have a coefficient of 0.8 m^2.
b. The need for the spatial dimension = dimension of furniture x the amount of furniture.
   To calculate the need for spatial dimension, it is important to determine furniture which will be placed in the room.
c. Space for activities = Spatial magnitude + the need for spatial dimension

Table 6 describes the calculation results of the required spatial dimension according to the number of the residents per room. Meanwhile, table 7 figures out the calculation results of the spatial dimension according to the required types and amount of furniture in each room. The summation of spatial magnitude according to residents and that is according to furniture will determine the spatial dimension for activities, namely 20% of the summation. The final calculation for the need for spatial dimension is obtained by totalizing the three components: spatial dimension according to residents, that is to furniture and that is according to activities, as explained in table 8.

TABLE VI. SPATIAL MAGNITUDE

No.	***Room***	***The number of residents doing activities @ 0,8 m2***	***Dimension (m2)***
1.	Terrace	Mother and guest (2)	2 X 0.8 = 1.6
2.	Carport	Father and child (2)	2 X 0.8 = 1.6
3.	Living Room	Father, mother, child, and two guests (5)	5 X 0.8 = 4.0
4.	Family Room	Father, mother, and two children (4)	4 X 0.8 = 3.2
5.	Main Bedroom	Father and mother (2)	2 X 0.8 = 1.6
6.	The First Child's Bedroom	Child (1)	1 X 0.8 = 0.8
7.	The Second Child's Bedroom	Child (1)	1 X 0.8 = 0.8
8.	Dining Room	Father, mother, and two children (4)	4 X 0.8 = 3.2
9.	Kitchen	Mother/father/child (1)	1 X 0.8 = 0.8
10.	Laundry Room	Mother/father/child (1)	1 X 0.8 = 0.8
12.	Bathroom	Mother/father/child/guest (1)	1 X 0.8 = 0.8
13.	Worship Space	Father, mother, two children (4)	4 X 0.8 = 3.2
14.	Ablution Space	Mother/father/child/guest (1)	1 X 0.8 = 0.8

TABLE VII. SPATIAL DIMENSION FOR FURNITURE

No.	*Room*	*The amount of furniture*	*Dimension (m2)*	*Total*
1.	Terrace	1. Chairs (2) 2. Table	1. 2 X 0.5 X 0.5 = 0.25 2. 1 X 0.5 X 0.5 = 0.5	0.75
2.	Carport	1. Car 2. Motorcycle	1. 6 X 3 = 18 2. 1 X 2 = 2	20
3	Living Room	1. Chairs 2. Table	1. (2.1 X 0.95) + (1.5 X 0.95) = 3.42 2. 1 X 0.5 = 0.5	3.92
4	Family Room	1. Cabinet (1) 2. Sofa (1)	1. 1 X 0.2 X 2 = 4.8 2. 1 X 0.95 X 2.1 = 1.9	6.7
5	Main Bedroom	1. Bed (1) 2. Wardrobe (1) 3. Dressing table (1) 4. Work table	1. 1 X 2 X 1.5 = 3 2. 1 X 1.8 X 0.5 = 0.9 3. 1 X 0.75 X 0.65 = 0.48 4. 1 X 0.75 X 0.65 = 0.48	4.86
6.	The First Child's Bedroom	Bed (1) Wardrobe (1) Study table (1)	1. 1 X 1.9 X 0.75 = 1.42 2. 1 X 1 X 0.5 = 0.5 3. 1 X 0.75 X 0.65 = 0.48	2.4
7.	The Second Child's Bedroom	Bed (1) Wardrobe (1) Study table (1)	4. 1 X 1.9 X 0.75 = 1.42 5. 1 X 1 X 0.5 = 0.5 6. 1 X 0.75 X 0.65 = 0.48	2.4
	Dining Room	Dining table (1) Dining chairs (4)	1 X 0.9 X 0.9 = 0.81 4 X 0.5 X 0.5 = 1	1.81
9.	Kitchen	Kitchen sink (1) Dish rack (1) Stove (1)	1 X 0.5 X 1 = 0.5 1 X 0.5 X 0.5 = 0.25 1 X 0.25 X 0.5 = 0.125	0.875
10.	Laundry Room	Washing machine	1 X 0.5 X 0.6 = 0.3	0.3
12.	Bathroom	Shower Set (1) Closet (1)	1 X 0.75 X 0.75 = 0.56 1 X 0.5 X 1 = 0.5	1.06
13.	Worship Space	Prayer rug (4)	4 X 0.65 x 1.10 = 2.86	2.145
14.	Ablution Space		-	

TABLE VIII. THE CALCULATION FOR THE MINIMUM NEED FOR THE SPATIAL DIMENSION

No.	*Room*	*Furniture + Residents doing acitivities (A) (m2)*	*Activity Dimension= 20% x A (m2)*	*Required spatial dimension (m2)*
1.	Terrace	0.75 + 1.6 = 2.35	0.47	2.82
2.	Carport	20 + 1.6 = 21.6	4.32	25.92
3	Living Room	3.92 + 4 = 4.92	0.984	8.904
4	Family Room	6.7 + 3.2 = 9.9	1.98	11.88
5	Main Bedroom	4.86 + 1.6 = 6.46	1.292	7.752
6.	The First Child's Bedroom	2.4 + 0.8 = 3.2	0.64	3.84
7.	The Second Child's Bedroom	2.4 + 0.8 = 3.2	0.64	3.84
8	Dining Room	1.81 + 3.2 = 5.01	1.002	6.012
9.	Kitchen	0.875 + 0.8 = 1.675	0.335	2.01
10	Laundry Room	0.3 + 0.8 = 1.1	0.22	1.32
11	Bathroom (at main bedroom)	1.06 + 1.6 = 2.66	0.532	3.192
12	Bathroom	1.06 + 0.8 = 1.86	0.372	2.232
13	Worship Space	2.86 + 3.2 = 6.06	1.212	7.272
14	Ablution Space	0 + 0.8 = 0.8	0.16	0.96

In addition to the minimum need for spatial dimension, the relation among the rooms is found out, as illustrated in Figure 1.

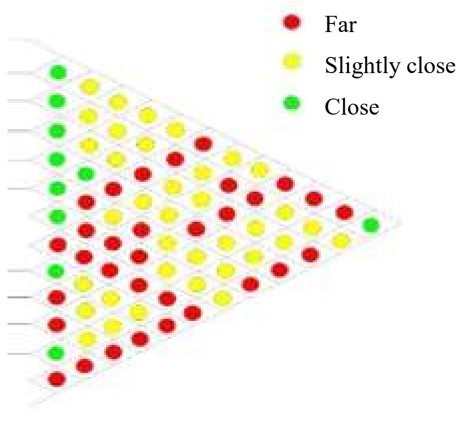

Fig. 1. The Relation among Rooms

In reference to the data of dimension and relation among rooms, a design is made (Figure 2). Such design is the final result after the validation from related experts. Assessment by GBCI on the design resulted in platinum rank based on a version of Greenship Homes.

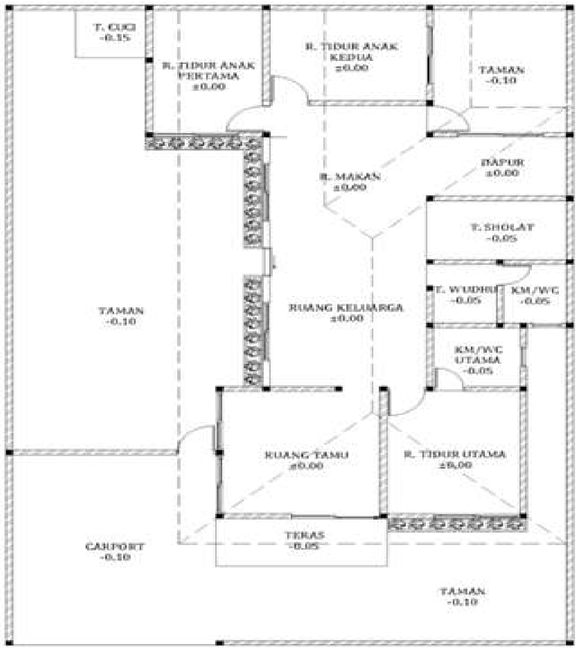

Fig. 2. Eco-friendly home design

B. The Attempts for Energy Efficiency

Several attempts for energy efficiency at the eco-friendly house according to the design include:

1. *Calculating the number of points of light*

In order to determine the number of points of light based on the guideline of SNI 03-6197-2000, in which standardized lux required in each room vailable, the following formula can be used:

Total Lumens = Lux x spatial dimension

The amount of light = $\frac{Total\ Lumens}{Lumens\ of\ light}$

(Lumens of light are listed on the package)

2. Artificial lighting

Saving is obtained from artificial lighting. Using the light with electrical power is 30% more efficient than using lighting power listed in SNI 03 6197-2011. Using LED as indoor lighting is expected to reduce electrical power consumption. Lighting zonation which fits the residents' activities is required for family room and dining room. Using such automatic features as a motion sensor, timer, and light sensor in a certain room is important.

Energy-saving light includes CFL lamps and LED lamps. LED lamps have more advantages: no mercury content and longer durability [19]. The calculation of the amount of light required and the power of the two kinds of light was carried out in the study. The results of the calculation are summarized in table 9.

3. Energy-saving home appliances

In order to encourage the use of energy-saving home appliances, it is significant to use 'energy efficient'-labeled electrical appliances as much as at least 75% of the total power (watt) of the electrical appliances.

C. The Calculation of Energy Costs

Based on the three attempts for energy efficiency, the energy costs spent in the eco-friendly house was then determined. The building operation time was calculated with regards to the results of the analysis of the residents' activities (Table 2). The calculation was done in two concepts: green home with platinum rank based on a version of Greenship Homes GBCI and non-green home with no application of eco-friendly concepts. The type of light used in green home was LED. Meanwhile, the type of light used in non-green home was CFL, the type of light commonly used by Indonesians. Green home did not have AC to regulate the temperature of rooms, while non-green home did . One criterion of a green home is the use of greywater. Therefore, greywater recycling instrument is required. The use of water pumping systems in the design of green home aimed at increasing the volume of filtered greywater in a tub placed on the top. The calculation results of energy costs for the two concepts are shown in Table 10.

The cost of electricity (per kWh) determined by Indonesian government is IDR 1,467.28. Therefore, the energy cost (per month) for each concept is:

GH = 476.7 x IDR 1,467.28
= IDR 699,452.376

NGH = 922.05 x IDR 1,467.28
= IDR 1,352,906

Efficiency value is obtained by calculating the percentage of the difference between the energy costs of green home and those of non-green home.

Efficiency = 1,352,906 – 699,452.376/1,352,906 x 100% = 48%

The only way to achieve energy efficiency in a building is to optimize energy efficiency from every aspect of the design, from the beginning to the end [20]. Therefore, it is necessary to plan detailed steps as described in the stages of design development of building in this article. There were several different conditions of each criterion the researcher met in developing a greenhouse especially to fulfill the criteria of energy efficiency and conservation according to greenship homes of GBCI. Electricity Metering is a device used in a home electrical installation to determine electricity consumption. Every house that subscribes to energy from the government already has an electricity metering.

Passive Design Analysis is the calculation of the total power and expenses for paying electricity to the home based on the existing passive design concept. It was easily conducted as long as all data needed were available, such as information about electronic equipment power capacity and usage duration. Sub Metering is a device that functions to control electrical power used to meet energy saving. Many people have a lack of related information about the device.

Artificial Lighting is needed to provide lighting supply inside a home at night or when the sky is dark because of cloudy weather. Efforts are made to use energy-efficient LED light but still in accordance with the needs of light in every room. It is difficult to use 30% more efficient light power because of the lack of lamp specifications in the market which is very energy efficient and able to meet the needs of light in a room. Thermal Condition is an important effort in design to regulate the room temperature to remain comfortable. The challenge encountered is to make all parts of the rooms in the house comfortable at a certain temperature in spite of area limitation and space distribution.

Heat Reduction is an effort to design and or to use building materials that can reduce heat so that the room stays comfortable in hot conditions. The obstacle faced is the difficulty of finding material that can have a large heat reduction coefficient value. That material is still in a relatively expensive price range.

The use of energy-saving home appliances strongly supports homes in realizing energy savings. Energy saving standards in the appliances are at least local, meaning that the standards are applied in a particular area. Currently, the price for energy-saving appliances is still relatively expensive and there are not many alternative brands or types of devices that are easy to find. Renewable energy sources are intended so that the home does not depend on energy supplies from the government (fossil fuels) and so that the home can meet its own electricity needs. There are still a few simple residences that use solar panels as an alternative source of electricity. This is mainly due to the high price of solar panel units

The calculation of energy costs from the designed building is based on building utilization in the forms of resident activities. The household sector does absorb energy consumption only 10.2% of the total national energy consumption with an increase in energy consumption of 3.1% in the last 20 years [3]. The highest consumption is still held by the industry sector, amounting to 39.49%. However, energy efficiency efforts must be sought through all sectors. Any number of energy saving contribution of one sector will contribute to the success of efficiency efforts and national energy conservation. The housing sector has become the biggest energy efficiency supplier in Europe, contributing to a total energy savings of 1000 GWh in 2020 [21]. The high energy consumption in the European regions is due to the considerable energy requirements for heating and providing hot water, especially during the winter [21]; [22].

It is necessary to socialize the energy savings through the household sector as well as an effort to educate the public, through the smallest component of society, namely the family, about the benefits and importance of energy efficiency efforts. Socialization of saving energy starting from the family is expected to have an impact on the wise habit of using energy anywhere such as in public facilities, schools, and workplaces. Consequently, it will affect the efforts to save energy nationally. The result of energy cost savings which means reduced household expenditure will indirectly increase people's purchasing power to spend on other needs beside energy. This condition will give positive effect for the national economic improvement.

Wonohardjo [23] states that the impacts on the external environment caused by excessive energy consumption at home include: global warming, an increase in needs for space, a decrease in AC performance, and an increase in artificial heat release. The results of calculation of energy consumption in this article (Table 10) show a very big contribution of air conditioning instruments (AC). HVAC space cooling systems typically account for more than 40% of total energy consumption in the residence [24].

The potential of natural resources in the form of sunlight and abundant wind can be used for energy sources. Indonesia, which is located in a tropical region, has very large solar energy potential with average insulation of 4.5-4.8 kWh/m2/day [25]. If the energy potential of nature is utilized properly, it can produce a zero energy house building, which is a building that can provide its own energy needs [24]

TABLE IX. HE NUMBER OF LIGHT AND THE POWER REQUIRED

Room	LUX (*SNI*)	Spatial Dimension (m2)	Lux Calculation	Lumen	CFL					LED				
					Real power	Lumen of light	The amount of light	Total used	Power of kW	Real power	Lumen of light	The amount of light	Total used	Power of kW
Terrace 1	60	5.47	60	328.2	5	275	1.2	1.0	0.005	3	270	1.2	1	0.003
Terrace 2	60	2	60	120	5	275	0.4	1.0	0.005	3	270	0.4	1	0.003
Carport	60	26.13	60	1567.8	8	440	3.6	4.0	0.008	5	450	3.5	4	0.005
Park 1	60	62.11	60	3726,6	8	440	8.5	9.0	0.008	5	450	8.3	8	0.005
Park 2	60	27.1	60	1626	8	440	3.7	4.0	0.008	5	450	3.6	4	0.005
Park 3	60	10.97	60	658.2	8	440	1.5	2.0	0.008	5	450	1.5	2	0.005
Family Room	120-150	11.67	135	1575.45	12	720	2.2	2.0	0.012	8	720	2.2	2	0.008
Living Room	120-150	12.99	135	1753.65	12	720	2.4	2.0	0.012	8	720	2.4	2	0.008
Dining Room	250	15.05	250	3762.5	12	720	5.2	5.0	0.012	8	720	5.2	5	0.008
Kitchen	250	5.55	250	1387.5	12	720	1.9	2.0	0.012	8	720	1.9	2	0.008
Main Bedroom	120-250	11.01	130	1431.3	12	720	2.0	2.0	0.012	8	720	2.0	2	0.008
The First Child's Bedroom	120-250	9.05	130	1176.5	12	720	1.6	2.0	0.012	8	720	1.6	2	0.008
The Second Child's Bedroom	120-250	9.55	130	1241.5	12	720	1.7	2.0	0.012	8	720	1.7	2	0.008
Worship Space	120-250	5.55	130	721.5	8	440	1.6	2.0	0.008	5	450	1.6	2	0.005
Ablution Space	60	2.79	60	167.4	5	275	0.6	1,0	0.005	3	270	0.6	1	0.003
Laundry Room	60	2.25	60	135	5	275	0.5	1.0	0.005	3	270	0.5	1	0.003
Main Bathroom	250	3.44	250	860	8	440	2.0	2.0	0.008	5	450	1.9	2	0.005
Secondary Bathroom	250	2.5	250	625	8	440	1.4	1.0	0.008	5	450	1.4	1	0.005

TABLE X. THE CALCULATION OF ENERGY COSTS

No	Name of Electrical equipment	Operation Time (h/d)	Eco-friendly house (LED light, Electrical appliances with an energy saving of 75%)			Conventional house (CFL light, Electrical appliances with no energy saving)		
			Amount	Electric energy consumption (kW)	Total electric energy consumption/d (kWH)	Amount	Electric energy consumption (kW)	Total electric energy consumption/d (kWH)
1	Terrace light	12	2	0.003	0.072	2	0.005	0.12
2	Laundry room light	1	1	0.003	0.003	1	0.005	0.005
3	Ablution space light	30	1	0.003	0.09	1	0.005	0.15
4	Carport light	12	4	0.05	2.4	4	0.08	3.84
5	Worship space light	1.25	2	0.05	0.125	2	0.08	0.2
6	Bathroom light	1.5	3	0.05	0.225	3	0.08	0.36
7	Park light	11	14	0.05	7.7	15	0.08	13.2
8	Family room light	5	2	0.08	0.8	2	0.012	0.12
9	Bedroom light	6	6	0.08	2.88	6	0.012	0.432
10	Dining room light	1	5	0.08	0.4	5	0.012	0.06
11	Kitchen light	2	2	0.08	0.32	2	0.012	0.048
12	TV	6	1	0.0025	0.015	1	0.01	0.06
13	Washing machine	1	1	0.0575	0.0575	1	0.23	0.23
14	Iron	1	1	0.1	0.1	1	0.4	0.4
15	Rice cooker	1	1	0.0125	0.0125	1	0.05	0.05
16	Computer	4	1	0.065	0.26	1	0.26	1.04
17	Water pump	4	1	0.03125	0.125	1	0.125	0.5
18	Greywater Recycling Systems	4	1	0.03125	0.125	0		0
19	AC at family room	5	0	0	0	1	0.4	2
20	AC at bedrooms	6	0	0	0	3	0.4	7.2

V. CONCLUSION & RECOMMENDATION

The platinum-ranked green home according to green ship home from GBCI which was designed in this study produces 48% of energy cost efficiency. The electrical equipment that accounts for the highest cost savings is air conditioning which does not exist in a platinum-ranked green home. The more energy efficiency value can be sought through the use of alternative energy such as solar cell and wind turbine.

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