

## SUSTAINABLE ENERGY HOMES

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### ABSTRACT

Independent energy house become an important for modern housing now a day. Solar energy is one of the renewable and sustainable energy. Optimization Solar energy can be done by considering how long the sun light can directly on solar cells. Optimizing solar cells performance needs to be done, to increase the amount of stored electricity. In addition to the direction of sunlight, the weather also directly affects the performance of solar cells. The result of the direction, it has an effect on the building shape, façade and the room order, so the building will have a shape that according to function. Form follows function is effectively for adjusting room space. This Residential building will be appropriate with urban context, especially in city of Malang. Form follows function, the way to find sustainable house and independent energy house for residential house design. The design plan of Independent energy home with form follows function approach will be done in Malang city.

**Keywords:** homes, independent, modern, sustainable, design, direction, solar cells

### 1. INTRODUCTION

Malang City is located in mountain area, suitable place for stopover. With tropical climate which has a temperature range between 22.2 ° C - 24.5 ° C, humidity levels between 74% - 82% and has a high rainfall in December to April. Malang city have groundwater reserves (CAT) that are good for drinking water. River surface used for the final drainage channel of the city drainage (Pemkot Malang, 2016).

In respond to the effects of climate change, the Indonesian Government participates in dealing with issues on the Sustainable Development Goals (SDG's). In the eleventh point regarding the discussion of Sustainable cities and communities, sustainable development cannot be achieved without significantly transforming the way we build and manage our urban spaces. Making cities safe and sustainable means ensuring access to safe and affordable housing, and upgrading slum settlements. It also involves investment in public transport, creating green public spaces, and improving urban planning and management in a way that is both participatory and inclusive (UNDP Indonesia, 2018).

In the seventh point of SDGs, affordable and clean energy, the need for electrical energy increased from 1990 - 2010 to 1.7 billion and continued to increase, so that it needed cheaper energy. A global economy reliant on fossil

fuels, and the increase of greenhouse gas emissions is creating drastic changes to our climate system. This is impacting every continent, so it requires enthusiasm and effort to create clean energy. In 2011, as much as 20% of global energy used renewable energy, and still needed more. Expanding infrastructure and upgrading technology to provide clean energy in all developing countries is a crucial goal that can both encourage growth and help the environment (UNDP Indonesia, 2018).

On these two issues, a development in renewable energy is needed to have an impact on an urban space, especially a home. One of the renewable energy that will never run out is solar energy. Solar cells are used to capture solar energy directly into electrical energy and this process is also called a photovoltaic process. Researcher continuously experimenting and developing the model and the ability of solar cells to absorb sunlight into electrical energy. Solar cells help homes to become energy-independent buildings, especially electricity.

Until now researchers are still trying to find the best solar cell material, so in the process to invent, it is necessary to optimize the solar panel by observing the direction of the sun and the effect of weather on the solar panel. With the support of optimizing solar energy, the building becomes a sustainable home that is adapted to the city of Malang.

### 1.1. Sustainable Home

In the Republic of Indonesia law no. 32 of 2009 concerning about environmental protection and management, contained in article 1 number 3 defines, "Sustainable development is a conscious and planned effort that integrates environmental, social and economic aspects into development strategies to ensure the integrity of the environment and safety, capability, welfare, and quality of life of present and future generations". So that an independent and sustainable residential house is a house that meets environmental, social and economic aspects.

Sustainability is a long-term plan that meets daily needs without draining or not having a large impact on natural resources. Sustainable development definition from Brundtland Commission perception, Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own. (Brundtland Commission, *Our Common Future*, 1987). A property designated as holding particular status as "environmentally friendly". The term "sustainable" is often applied interchangeably with the green building designation. Sustainable design refers to such characteristics as a lowering of demands on the environment as a result of certain building characteristics: Low energy usage; reduced water usage; carbon neutral (i.e. no carbon dioxide emissions result from property operations – either directly, or indirectly) (Srinivas, 2015).

Several factors are defined in the Greenship Homes program by the Green Building Council Indonesia (GBC Indonesia) by ranking green buildings. Greenship is an environmentally friendly building certification system towards the achievement of the concept of environmentally friendly buildings. Greenship

considers the conditions, nature and rules and standards that apply in Indonesia. The use of renewable energy and efficient energy use are included in the criteria points for developing a "Green" design. The percentage of conservation and energy efficiency criteria in GreenShip is in the first place.

Design planning that takes sustainable elements, especially in the energy sector, will provide support system for quality of life in buildings, so residents can feel the comfort. Sustainable buildings, especially residential houses will be sustain if they take focus on life quality of the occupants, that can reduce the impact on the environment and provide economic results to homeowners.

## 1.2. Solar Energy for Home

Indonesia, a tropical country that has a high potential in solar energy, with average solar radiation of 4,5 kWh/m<sup>2</sup> per day (Solarex, 1996). In Malang city the potential of solar energy has the lowest solar radiation of 3.17kWh / m<sup>2</sup> per day (Utomo, 2012). A good potential energy for a renewable energy source.

In sunny day, solar radiation can reach up to 1kWh / m<sup>2</sup>. If the one square meter semiconductor device has a 10% efficiency, this solar cell module can provide 100 watts of electricity in one hour. Solar modules commercially have efficiency levels ranging from 5% -15% depending on the material (Yuliananda, 2016).

The Photovoltaic Solar Energy System (SESF) is an energy generating system that utilizes solar energy and uses photovoltaic technology. The system is easy to operate, low maintenance, low operating costs and competes with conventional technology in most parts of the Indonesian territory. In Indonesia, SESF technology is used in lighting houses and public facilities. SESF technology is a clean and non-polluting technology that can be used in large urban housing (Yandri, 2012).

In architecture, the revolution of photovoltaic application in architectural buildings take advance in development, ranging from conventional technology to high technology in the 3rd generation, as follows:

### 1. The First Generation (around 1980)

A paneled module with a metal frame is placed (mounting) on the flat roof of the building with a buffer (tracking). For examples of models in figure 1.

### 2. The Second Generation (around 1990)

Photovoltaic cells (PV) are developed more integrated into parts of building materials, example: PV become roofing material (tile, shingle) as in figure 2.

### 3. The Third Generaton (around 1997)

The PV module is developed into an integrated building architecture in various building materials and sophisticated applications. The application of solar modules is applied together with wall elements, shown in figure 3. (Mintorogo, 2004).



*Figure 3. Solar panel module*



*Figure 3. Solar panel module on the roof building*



*Figure 3. Solar panel module applied on the wall of the building*

The application of solar panel modules will be an important factor in design processing and it will become a unity part of residential buildings.

## 2. RESEARCH FRAMEWORK

Data collection from the Meteorology, Climatology and Geophysics Agency (BMKG), Indonesian government agency, relating to the duration of the sun's light, rainfall, and wind are carried out in order to find out how optimal the weather affects solar cells. The research process is carried out according to the seasons in Indonesia, the rainy and dry seasons. From that seasons, take several days as a sampling process. Rainfall is used to see how long the rain falls every day. So the best direction of panel to achieved optimal solar cell is found.

After finding the optimal direction of solar cells, an analysis of the building elements and the imagination process of the building are carried out. From these

two processes, it can be analyzed every part in more depth. After analyzing building elements, a space program process is carried out, to find out the space needed. In the programming process, the spaces that are accommodated are taken from the local space requirements in Malang city and literature study standard. The Result building form will be evaluated with the form follows function approach. The following is a flowchart for creating sustainable energy homes.

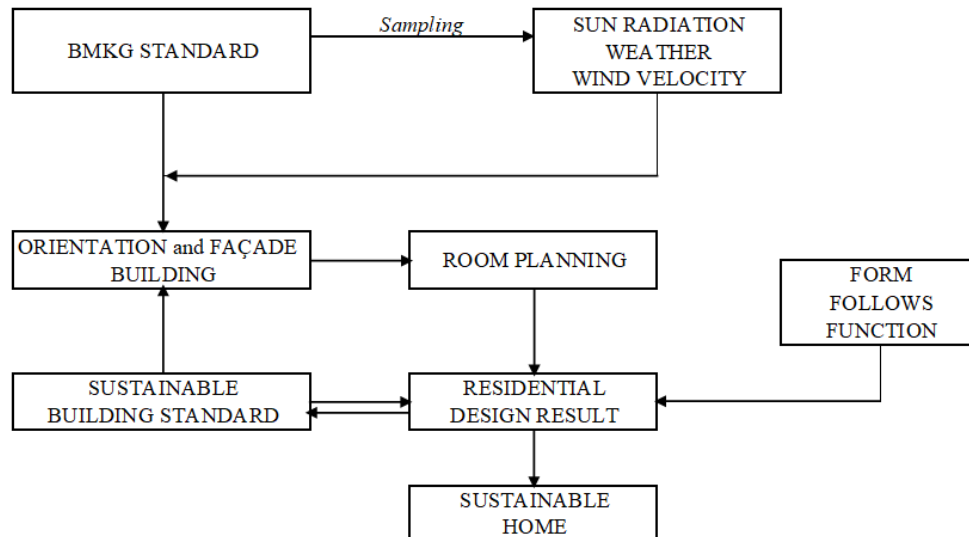


Figure 4. Research Framework

### 3. CONCLUSION

Independent energy homes can be optimized in various ways. Here are some ways to optimize energy, which is to maximize the angle of direction of the solar cell and determine the building material that can reduce thermal and acoustic. The Buildings that responsive to sunlight and focusing on to the comfort factor of occupants is one of the efforts to make the building sustainable. So the residential houses that are responsive to renewable energy needs and optimize the energy that is obtained are sustainable energy homes.

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