# Desain Implementation of a Photovoltaic for Solar Home System

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**Abstract.** Solar energy is a renewable energy source whose availability is unlimited. To get the electrical energy coming from the sun is required solar panels so that the energy from the sun can turn into electrical energy, Solar technology, also known as photovoltaic (pv) formed in a solar module is formed of a semiconductor material. Semiconductor materials are capable of conducting electric current when there is kinetic energy that drives the electron particles in it to the conduction band. In this case sunlight contains electromagnetic waves or photon energy which is capable of producing kinetic energy to release electron bonds in the semiconductor causing an electric current. This paper describe design and implementing of photovoltaic for solar home system. Keywords. Solar energy, renewable energy, photovoltaic (pv), solar home system.

## 1. Introduction

Energy is one of the main human needs today. Energy to support all the activities we do every day; its existence becomes very important. The energy we use in our daily lives comes from fossil energy, where this fossil energy takes place through a process of millions of years. Massive explorations are made by humans to acquire this fossil energy and are used massively in all places and at all times. Of course, the consequences of this fossil energy will be reduced and one day will be exhausted. Besides there is significant natural and environmental damage due to massive exploration and massive use everywhere. God Creates Fossil Energy Through the Millions of Years, And Human Processes Spend it Only Decades [3]. With the increasing demand of energy in this ever-increasing population, the demand for renewable energy has increased to exponential. Solar energy has come to rescue this demand; Furthermore, solar energy provides zero environmental concerns in this era of global warming and pollution [1]. Solar energy has its own limitation; one such limitation is its efficiency. The efficiency of solar cell is fairly low, only 30-40% of solar energy can be utilized [4]. With the increasing demand of energy in this ever-increasing population, the demand for renewable energy has increased to exponential. Solar energy has come to rescue this demand; Furthermore, solar energy provides zero environmental concerns in this era of global warming and pollution [5]. Solar energy has its own limitation; one such limitation is its efficiency. The efficiency of solar cell is fairly low, only 30-40% of solar energy can be utilized [8]. Renewable Energy was born as the answer to the solution to future energy challenges. Renewable energy is energy derived from nature and can be sustainable, the amount is not limited if managed properly then the resources will not be exhausted. One of them is home system Electricity-based solar cell that utilizes solar energy that converted into electrical energy. Technologies that utilize renewable energy can be said to be relatively new, so that the human resources that master it relatively little. The number of government projects related to electrical energy is not proportional to the number of human resources or technicians who perform maintenance and maintenance of the system. So many of these projects are short-lived than they should and do not work just like fossils. Some The reason why Indonesia needs to apply renewable energy are :

1. Indonesia's huge natural potential, until now still minimal utilization.
2. Encouragement of the Government through the Act to improve the utilization of new and renewable energy.
3. Renewable Energy in all sectors.
4. Prospects for the use of New Renewable Energy-based technology are increasing.

## 2. Characteristic Of Sun Energy

The conversion of sun energy into electrical energy is characterized by a very low efficiency. This is affected by the irregular insolation and also technology used for the conversion of solar radiation. It means that the cost of obtaining electricity from the sun is still the highest in comparison with all other technologies using renewable energy sources [2]. The advantage of the PV installation is its relatively low operating cost including maintenance and minor restoration work.

## 3. Solar Enery System Technologies

### *3.1 Photovoltaic System*

Photovoltaic systems convert the sun's light into electrical energy. The energy is produced by photovoltaic (PV) cells, which are typically made of silicon. The electricity generated by a system travels through an inverter and then into a home or other building to provide for its energy needs. Some systems also have a battery to provide backup electricity. PV modules have no moving parts, typically require little maintenance other than occasional rinsing and can last over 25 years. PV system costs depend on the system's type and size.[6]. There are two common photovoltaic materials: crystalline silicon and amorphous silicon (e.g. thin films).

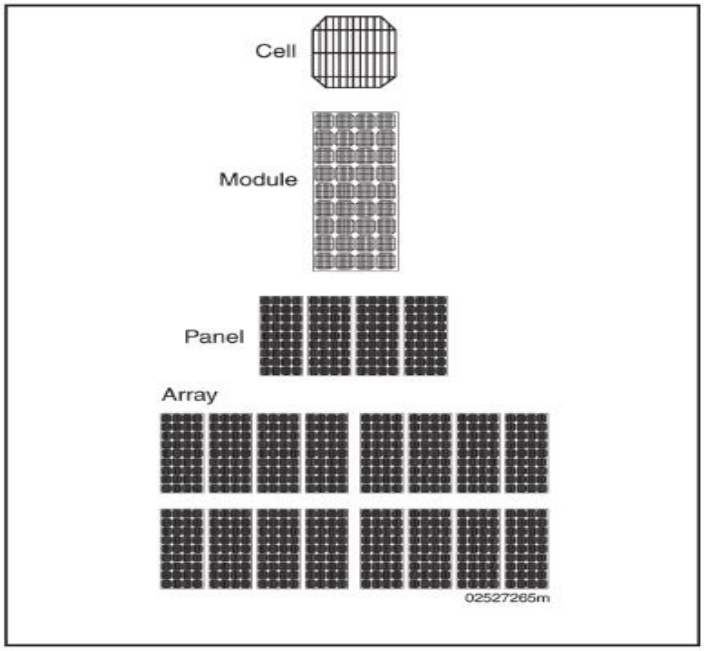


**Figure 1.** Building-Integrated Photovoltaic designs for commercial and Institutional Structures [1]

### *3.2 Crystalline Silicon*

Most solar modules consist of rigid crystalline silicon wafers enclosed in aluminum frames and covered with glass on the top. The modules are typically rectangular, but crystalline silicon modules are also now available in custom shapes such as triangles in order to match the shape of a roof. Crystalline silicon modules come in two types: monocrystalline and polycrystalline. Monocrystalline modules produce more energy per square foot than do polycrystalline modules. The two types have somewhat different appearances due to their different crystalline structures. Crystalline silicon module performance declines when the modules are shaded or exposed to high temperatures.

*3.3 Amorphous Silicon (Thin Films)*

Amorphous silicon modules (e.g. thin films) are made by depositing a very thin layer of PV silicon onto surfaces such as metal, glass or plastic. Thin films are amorphous (flexible) and do not need to be encased in frames or glass. They can be mounted discreetly on roof shingles or standing-seam metal roofs or incorporated into windows. Thin films perform better in hot and shaded conditions than do crystalline silicon modules. However, compared to crystalline silicon modules, thin films are less available commercially and require more surface area to produce the same amount of electricity. They may also not last as long as crystalline silicon modules.

## 4. The Photovoltaic Solar Home System

A photovoltaic system is used for electricity production from solar radiation. The specificity of operation is the production of electricity from photovoltaic blocks in the form of direct current. This energy is transmitted to the control place - electrical panel and next converted by inverters to alternating current parameters of voltage equal 230V. The system consists of 9 of photovoltaic modules with a total capacity of 2340 wp (watt peak) each module consists of 260 Wp.

*4.1 Design Wiring Diagram Solar Home System*

A Solar Home System comprises a solar PV generator (typically one PV module), a battery charge controller and a battery as shown in figure below. These components, as well as the appliances operated by the Solar Home System, are interconnected by the balance-of-system components (cables, switches, plugs and installation material). In some cases, an inverter is also included to enable AC appliances or equipment to be operated. The PV generator or module transforms solar irradiance into electric power. This power is conducted by components to a charge controller. The charge controller assures controlled charge of the battery and operation of appliances. Typically, DC appliances at the nominal voltage of the battery are used. For some appliances, DC–DC converters are necessary as the nominal voltage of the battery does not match their nominal voltage. DC–AC converters are used to supply AC appliances.

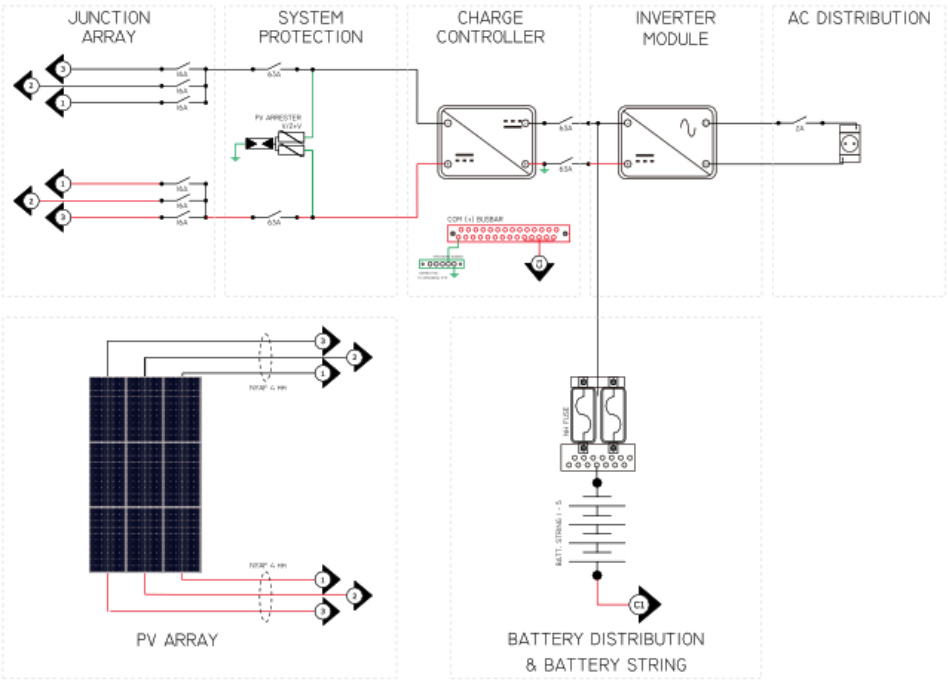


**Figure 2.** Wiring Diagram Solar Home System

*4.2 Design Wiring Charge Controller, Inverter, and Batterie*

The primary function of a Batteries system in a stand-alone (autonomous) renewable energy supply system is to be able to supply electricity during periods of low or zero renewable energy input. However, a batterie system also plays the role of a power transformer. While the sun supplies small amounts of power throughout the day, the storage system needs to be able to supply multiples of these amounts of power to the loads. Design wiring charge controller, inverter, and batterie as shown in Figure 3 below.

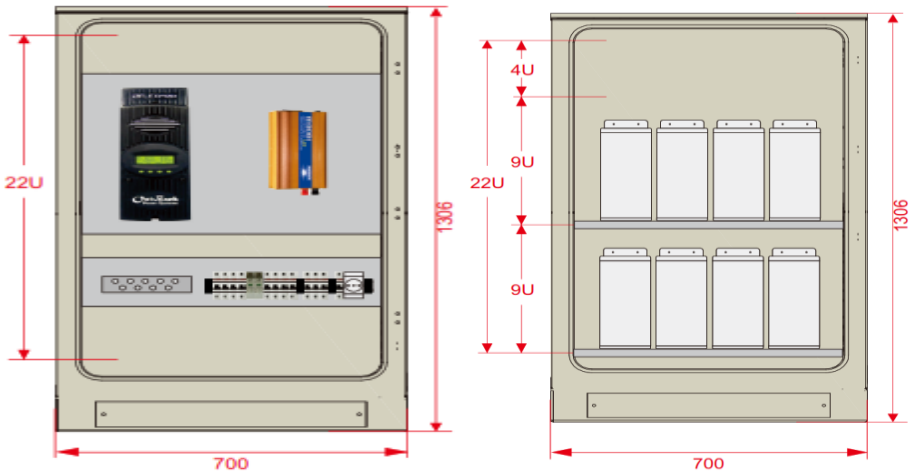


**Figure 3.** Charge Controller, Inverter, & Batteries

The fundamental information on electrochemical cells and batteries can be found in various reference materials, such as [7][8]. An electrochemical cell incorporates a positive and a negative electrode, an electrolyte, electrical connectors to the outside of the cell and a casing for the entire set-up. A battery cell is referred to as the technical implementation of an electrochemical cell, where multiple positive and negative electrodes of a certain design are connected in parallel and where separators are implemented in between the positive and negative electrodes to prevent short-circuiting of the electrodes.

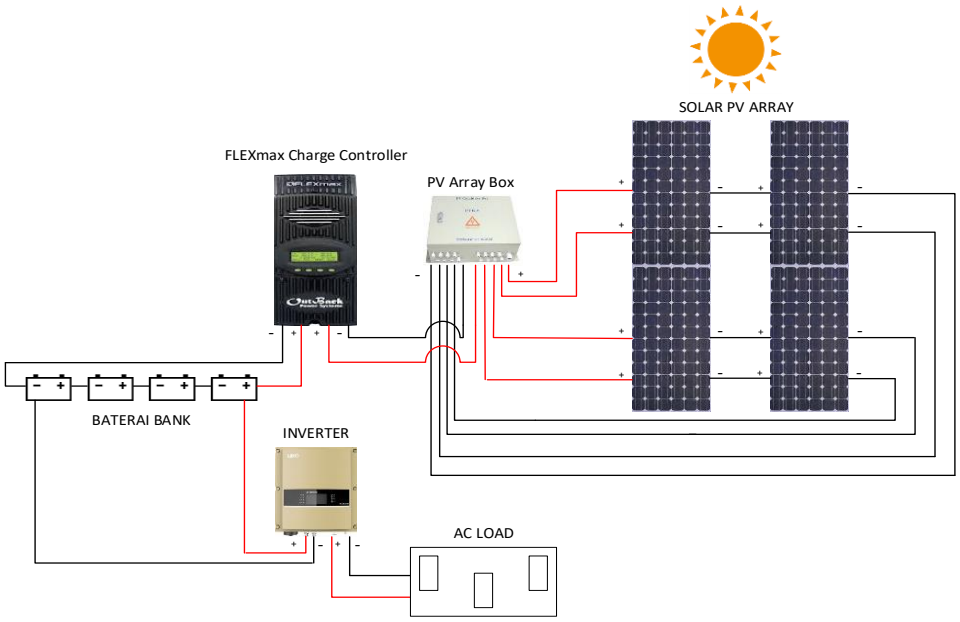


**Figure 4.** Design Solar Home System

The battery, a battery storage unit or even an accumulator is referred to as a set-up with multiple battery cells connected in series to achieve the desired DC system voltage and multiple of these series connections are connected in parallel to achieve a desired ampere-hour capacity. In the context of Solar Home Systems, rechargeable (secondary) batteries are usually used. In the following sections, the term 'battery' refers to 'a rechargeable battery'. Within the literature, rechargeable batteries are often referred to as secondary cells.

Charge Controllers are necessary in order to protect batteries from harmful over-voltage and under voltage. They also protect batteries against unintentional discharge by the PV module. Additionally, charge controllers also protect the appliances in Solar Home System that are connected to the battery via the charge controller. A feature of a charge controller whose importance cannot be underestimated is the information that it provides the user on the Solar Home System condition as shown in Figure 4, and the state of charge of the battery in particular.

Inverter, an inverter is an electrical device used to convert a DC-Direct Current into an AC-Alternating Current. The inverter converts 12/24-volt DC current from a backup current source such as batteries, solar panels / solar cells to AC 220 volts equivalent to PLN. In a Solar Power Plant (PLTS), an inverter is required to provide an AC current source for load, such as lamp, television, an etc.

## 5. Conclusion

This paper presented design and implementation of a photovoltaic for solar home system, Solar Cell technology (Photovoltaic / PV) is a technology that utilizes solar energy to be converted to electrical energy by using equipment made up of semiconductor materials (generally silicon). This PV technology was originally intended to replace the fossil fuel energy that would once run out and for implementation in remote areas.

## 6. Acknowledgment

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## References

[1] Community development department city of santa barbara. "*Solar Energy System Design Guidelines & Solar Recognition Program*", Desember 2006.

[2] Y. Yang, E. Koutroulis, A. Sangwongwanich, and F. Blaabjerg, "*Pursuing Photovoltaic Cost Effectiveness*," IEEE Industry Application Magazine 2017.

[3] J. Herlender, "*Effectiveness of Investigated Photovoltaic System*," Electric Power Networks (EPNet), IEEE 2016.

[4] A. Koushal, R.K Pachauri, Y.K Chauhan, A Gupta. "*Performance Analysis of Photovoltaic System under Thermal Conditions*". 1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES) 2016.

[5] P. Siripatrodom. "*The Biggest Solar Home System.*" IEEE, 2006

[6] S. Ghosh, and S. Rahman. "*Global Deployment of Solar Photovoltaics: Its Opportunities and Challenges*."IEEE 2016.

[7] Reddy TB *Linden's handbook of batteries*, 2011

[8] T. Urmee. "*Photovoltaics for Rural Electrification in Developing Countries*." Green Energy and Technology. Springer International Publishing Switzerland, 2016.