

A Review : Important Factors for Performance of Photovoltaic Cell

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Abstract - Energy is one of the requirements for life. There are two main sources of energy: renewable and non-renewable sources. Renewable energy is the energy which comes from natural resources such as sunlight, wind, rain, geothermal heat etc. The Sun is an extremely powerful energy source, and sunlight is by far the largest source of energy received by Earth. Even though, solar power is one of the most promising renewable energy technologies, allowing the generation of electricity from free, inexhaustible sunlight, it still facing a number of hurdles before it can truly replace fossil fuels. A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. The photovoltaic effect is the creation of voltage and electric current in a material upon exposure to light. This paper briefly highlights various factors affecting performance of photovoltaic cell like, PV technology type, operating temperature of PV cell, effect of humidity, effect of shade, effect of dust etc.

Key Words: Renewable energy, photovoltaic effect, photovoltaic cell

1. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them. Energy can be classified as Non-Renewable energy and Renewable energy. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time [1].

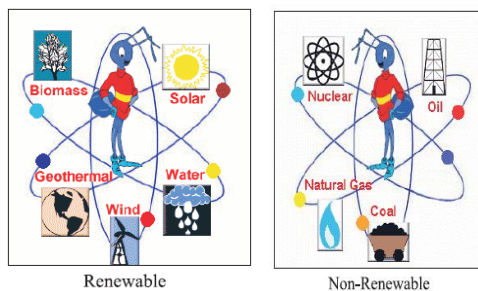


Fig. 1. Renewable and Non-Renewable Energy [1]

Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources

include wind power, solar power, geothermal energy, tidal power and hydroelectric power. The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants [1].

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy etc. The large magnitude of solar energy available makes it a highly appealing source of electricity. The potential solar energy that could be used by humans differs from the amount of solar energy present near the surface of the planet because factors such as geography, time variation, cloud cover, and the land available to humans limit the amount of solar energy that we can acquire [2].

The present population is growing day to day and demand for energy is also increasing accordingly. The scientists and researchers were investigating on the renewable energy sources. One such alternative energy is solar energy. Renewable energy sources came into existence in present days because of increasing oil prices. Solar energy is one of the most popular renewable energy produced (or) generated directly by the sun. Solar energy is the most readily available renewable energy. It does not belong to anybody and is therefore free. Owing to nonpolluting nature, it became most widely used nonconventional energy source [3].

Photovoltaic is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current results that can be used as electricity [4].

The term photovoltaics derive from the Greek word phōs meaning light and the word volt, named by Italian physicist Alessandro Volta (1745-1827). Photovoltaics is a science, which examines light-electricity conversion, respectively, photon energy-electric current conversion. In other words it stands for light-current conversion [5].

2. DISCUSSION

Followings are some important factors which affects performance of photovoltaic cell

- 1) **Shading:** A typical solar module consists of series connection of solar cells to get practically utilisable voltage. A number of such modules are connected together in series and parallel to get the requisite power. From the results, it is concluded that there is a substantial power loss due to non-uniform illumination of a series string. The power generated by highly illuminated cells is wasted as a heat in the poorly illuminated cells. So, care should be taken to see that all the cells connected in series receive the same illumination under different patterns of shading. Such a care will give a better protection to the array and at the same time the total energy output will also be higher [6].

Shading results in mismatches in the generated currents of individual cells of a module. Even partial shading on a single cell can significantly reduce the power output of the entire module as if all the cells were shaded. A shaded cell produces much less current than the unshaded ones [7].

- 2) **Technology :** Many types of PV cells are available today such as monocrystalline, Multicrystalline, multi junction and concentrating. The main advantage of monocrystalline cells is their high efficiency, but the disadvantage of these cells is that a complicated process is required to produce monocrystalline silicon. Multicrystalline cells are cheaper to produce than monocrystalline types because of the simpler manufacturing process required. However, they are slightly less efficient.

Operating temperature: There are various ambient conditions such as irradiance, temperature and dirt/dust that affect the output of a PV power system. An effective way of improving efficiency of a PV module is by reducing the operating temperature of its surface. This can be achieved by cooling the module and reducing the heat stored inside the PV cells during operation [8].

- 3) **Dust:** The dust significantly reduces the efficiency of solar photo voltaic panel. The performance of solar photovoltaic panel subjected to environmental dust was experimentally studied. The effect of dust on the power

reduction and efficient reduction of PV module was quantified. The result shows that dust considerably reduces the power production and efficiency. The electrical parameter of solar panel are sensitive to the dust density so it is very essential to provide auto cleaning mechanism to remove the dust particles from the surface of the panel in order to ensure high performance [9].

- 4) **Solar energy is generated** when sunlight is used to produce electrical energy. Photovoltaic modules use solar cells which converts solar radiation into direct electricity. It is necessary to keep the photovoltaic panels cleaned regularly to gain the maximum power output from the sun. It is inexorable that such things as bird droppings, dust, pollen and mud will collect on the photovoltaic (solar cells) modules. Because of these things the performance and power efficiency of PV panel will decreases rapidly. If the photovoltaic cells not clean properly, so it is unable to collect the maximum sunlight from the sun radiation, then automatically the produced electricity is also reduces. This estimates the power losses up to 30% to 40% of maximum power consumptions. Generally dust on the solar panels quite natural. The dust has a major impact on performance and efficiency of the solar panel. By the observation it is observed that power reduction because of dust accumulated on the panel and it can be improved by using the cleaning method, there is increase in power up to 35% [3].

There are various ambient conditions such as irradiance, temperature and dirt/dust that affect the output of a PV power system. Dirt/dust can accumulate on the PV module surface, blocking some of the sunlight and reducing efficiency [8].

- 5) **Humidity:** Humidity can slow efficiency in two ways.
 1. Tiny water droplets, or water vapor, can collect on solar panels (like beads of sweat) and reflect or refract sunlight away from solar cells. This reduces the amount of sunlight hitting them and producing electricity.
 2. Consistent hot, humid weather can degrade the solar panels themselves over their lifetime..

This mainly applies to areas that are constantly humid [10].

3. CONCLUSIONS

A solar energy is one of the most important sources for renewable energy. Photovoltaic cell is a device which does the direct conversion of light into electricity. After reviewing various literatures related to photovoltaic cell, we can list various factors which can affect performance of photovoltaic cell. Shading, dust, humidity reduces performance of photovoltaic cell. PV technology type, operating temperature of PV cell, are also important consideration for PV cell.

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