

**Solar Photovoltaic: Overview**¹ Neha Dodia¹ Electrical Engineering Department, Atmiya Institute of Technology & Science

Abstract -This paper briefly discussed about solar cells which is known as photovoltaic. Solar cells are best alternative fossil fuels to generate electricity. This paper gives the information regarding its construction and technology used in whole solar system. Ultimately this system is cost effective as compared to today's power generation system.

Keywords-Renewable energy-solar cells-photovoltaic

I. INTRODUCTION

The rapid increase in use of Non-renewable energies such as fossil fuel, oil, natural gas has created problems of demand & supply. Renewable power generation can help countries meet their sustainable development goals through provision of access to clean, secure, reliable and affordable energy. Renewable energy has gone mainstream, accounting for most capacity additions in power generation today. Tens of Giga watts of wind, hydropower and solar photovoltaic capacity are installed worldwide every year in a renewable energy market that is worth more than a hundred billion USD annually. Among all these RE sources solar photovoltaic provides major contribution because most of the parts of the countries like India having sunny weather.

Today, PV is one of the fastest growing renewable energy technologies and it is expected that it will play a major role in the future global electricity generation as the main source of PV is sunlight and it is easily available everywhere around the earth. A whole solar energy plant is a group of photovoltaic cells and auxiliary components like inverter and controllers. A solar cell which is used to convert sunlight directly into electricity is also called photovoltaic cells. The modern form of the solar cell was invented in 1954 at Bell Telephone Laboratories.

PV Technology offers number of benefits such as

1. This energy source is available everywhere in the globe.
2. It is small and highly modular so it can be used anywhere.
3. The maintenance costs and operation costs are low as compared to conventional power plant.

II. PHOTOVOLTAIC SOLAR CELLS

A single PV device is known as a cell. An individual PV cell is usually small, typically producing about 1 or 2 watts of power. To boost the power output of PV cells, they are connected in chains to form larger units known as modules or panels. Modules can be used individually, or several can be connected to form arrays. One or more arrays is then connected to the electrical grid as part of a complete PV system. Because of this modular structure, PV systems can be built to meet almost any electric power need, small or large. The efficiency of a cell is simply the amount of electrical power coming out of a cell divided by the energy from sunlight coming in. The amount of electricity produced from PV cells depends on the quality (intensity and wavelengths) of the light available and multiple performance characteristics of the cell.

When light shines on a photovoltaic (PV) cell, it may be reflected, absorbed, or pass right through it. The PV cell is composed of semiconductor material, which combines some properties of metals and some properties of insulators. That makes it uniquely capable of converting light into electricity. When light is absorbed by a semiconductor, photons of light can transfer their energy to electrons, allowing the electrons to flow through the material as electrical current. This current flows out of the semiconductor to metal contacts and then makes its way out to power your home and the rest of the electric grid. Based on different semiconductor materials used in solar cells there are different type of cells [3] available in the market which are as follows:

2.1. Silicon:

Silicon is, by far, the most common material used in solar cells, representing approximately 90% of the modules sold today. Crystalline silicon cells are made of silicon atoms connected to one another to form a crystal lattice. This lattice provides an organized structure that makes conversion of light into electricity more efficient. Solar cells made from silicon currently provide a combination of high efficiency, low cost, and long lifetime. Modules are expected to last for 25 years or more, still producing more than 80% of their original power after this time.

2.2. Thin film photovoltaic:

A thin-film solar cell is made by depositing one or more thin layers of PV material on a supporting material such as glass, plastic, or metal. There are two main types of thin-film PV semiconductors available in the market today: cadmium telluride (CdTe) and copper indium gallium selenide (CIGS). CdTe is the second-most common PV material after silicon which provide low-cost. This makes them a cost-effective alternative though their efficiencies still aren't quite as high. Both CdTe and CIGS require more protection than silicon to enable long-lasting operation outdoors.

2.3. Organic Photovoltaic:

Organic PV, or OPV, cells are composed of carbon-rich polymers and can be tailored to enhance a specific function of the cell, such as sensitivity to a certain type of light. This technology has the theoretical potential to provide electricity at a lower cost than silicon or thin-film technologies. OPV cells are only about half as efficient as crystalline silicon and have shorter life but could be less expensive to manufacture in high volumes. They can also be applied to a variety of supporting materials, making OPV able to serve a wide variety of uses.

2.4. Concentration Photovoltaic:

Concentration PV focuses sunlight onto a solar cell by using a mirror or lens. By focusing sunlight onto a small area, less PV material is required. PV materials become more efficient at energy conversion as the light becomes more concentrated, so the highest overall efficiencies are obtained with CPV cells and modules. However, more expensive materials, manufacturing techniques, and tracking are required, so demonstrating the necessary cost advantage over today's high-volume silicon modules has become challenging.

III. SOLAR PHOTOVOLTAIC TECHNOLOGY [1]

There are a wide range of PV cell technologies available in the market using different types of materials, and an even larger number will be available in the future. PV cell technologies are usually classified into three generations, depending on the basic material used and the level of commercial maturity.

3.1. First Generation PV System.

Silicon is one of the most abundant elements in the earth 's crust. It is a semiconductor material suitable for PV applications. Crystalline silicon is the material most commonly used in the PV industry, and wafer-based c-Si PV cells and modules dominate the current market. It is used mainly for commercial purpose. This is a mature technology that utilizes the accumulated knowledge base developed within the electronic industry. This type of solar cell is in mass production and individual companies will soon be producing it at the rate of several hundred MW a year and even at the GW-scale.

3.2. Second Generation PV System.

This is also known as thin film solar cells. After more than 20 years of R&D, thin-film solar cells are beginning to be deployed in significant quantities. Thin-film solar cells could potentially provide lower cost electricity than c-Si wafer-based solar cells. However, this isn't certain, as lower capital costs, due to lower production and materials cost, are offset to some extent by lower efficiencies and very low c-Si module costs make the economics even more challenging. Thin-film solar cells are comprised of successive thin layers, just 1 to 4 μm thick, of solar cells deposited onto a large, inexpensive substrate such as glass, polymer, or metal. Therefore, they require a lot less semiconductor material to manufacture to absorb the same amount of sunlight (up to 99% less material than crystalline solar cells). In addition, thin films can be packaged into flexible and lightweight structures, which can be easily integrated into building components. There are three primary types of solar cells use in this technology [2]

1. Amorphous silicon (a-Si and a-Si/ $\mu\text{c-Si}$)
2. Cadmium Telluride (Cd-Te)
3. Copper-Indium-Selenide (CIS) and Copper Indium-Gallium-Dieseline (CIGS).

3.2. Third Generation PV System.

Third-generation PV technologies are at the pre-commercial stage and vary from technologies under demonstration to novel concepts still in need of basic R&D. Some third-generation PV technologies are beginning to be commercialized, but it remains to be seen how successful they will be in taking market share from existing technologies. There are four types of third generation PV technologies such as

1. Concentrating PV (CPV)
2. Dye-sensitized solar cells (DSSC)
3. Organic solar cells
4. Novel and emerging solar cell concepts.

IV. CONCLUSION

This paper has dealt with the evolution of photovoltaic cells. Due to limited source of fossil fuels it becomes necessary to use natural source to generate power. From the above discussion, it can be said that this is the efficient and cost effective way of power generation as the sunlight is main source which is easily available in many providences of the earth.

REFERENCES

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