TECHNOLOGICAL REVIEW IN PHOTOVOLTAIC DEVELOPMENTS

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ABSTRACT -The abundance availability of solar radiation energy deserves a suitable device which can utilize that energy (photon energy i.e. electromagnetic energy and thermal energy) serves the nation by providing electricity as a result. Solar photovoltaic technology shows one of the progressive advancement in renewable energy technology and this technology is very much suitable for producing electrical power in return of solar energy. This paper presents the overall study and review on the present status of photovoltaic technology. Also, the present study is discussed with broad minded view and concluded systematically.

Keywords: *Photovoltaic cell, Photovoltaic technology, Efficiency.*

I. INTRODUCTION

Solar energy is available in plenty of amount that's why various researchers are involved in studying, analyzing and developing theoretical and analytical models of photovoltaic. Photovoltaic exchanges the direct sunlight into electrical power without any power consuming device in it. Photovoltaic devices are robust and simple in physical design requires less maintenance. It provides electrical output from few mill watts to many megawatts having a standalone constructed system which is the greatest benefit of it. The produced electrical power can be consumed by various power sources as water pumps, remote building lightning, home appliances, communication systems, satellites and space vehicles, water filtration plants etc. As electrical energy is required by vast variety of appliances and solar systems, so the demand of photovoltaic is keep increasing day by day.

Essentially a photovoltaic cell is used to produce electrical energy which can be magnified by the application of power grid. A photovoltaic electrical power production system has multiple components like cells, mechanical and electrical connections, mountings and elements for regulating and modifying the electrical output in suitable mode. These systems are rated in peak it represents the amount of electrical energy that a system is expected to produce when the sun shine is directly appeared overhead on a particular clear day.

Photovoltaic history starts in 1839 and was observed by Alexandre-Edmund Becquerel (physicist) as some electrical currents appeared after receiving certain light on solid due to induced chemical reactions in it. In late 1940s, the similar kind of effect was noticed by various scientists in the similar conditions on a solid like selenium and after that the very first solid state device called photovoltaic cell or silicon solar cell was developed having 6% efficiency [1]. The first ever proposed prospect for grid connected electrical power generation system by the methodology of experience curves at the different levels of cumulative world photovoltaic was introduced by Poponi [2]. In the present work, the overall study and review on the present status of photovoltaic technology have been done also it is discussed with broad minded view and concluded systematically.

II. PHOTOVOLTAIC TECHNOLOGY

We use photovoltaic technology mostly for power generation purpose. In general, it consists mainly of cells for energy absorption, mechanical and electrical components for amplification and transmission purposes. Unit used for rating these systems is peak kilowatts (kWp) which is an amount of electrical power that a system is expected to deliver when the sun is at the most of its intensity on a clear day. The photovoltaic (PV) effect is the basis of the conversion of light to electricity in photovoltaic or solar cells. When a light beam of specific Threshold frequency for a material strikes, it emits electron through excitation this electron through particular setup is directed from cathode to anode which causes electricity as shown in Fig. 1.

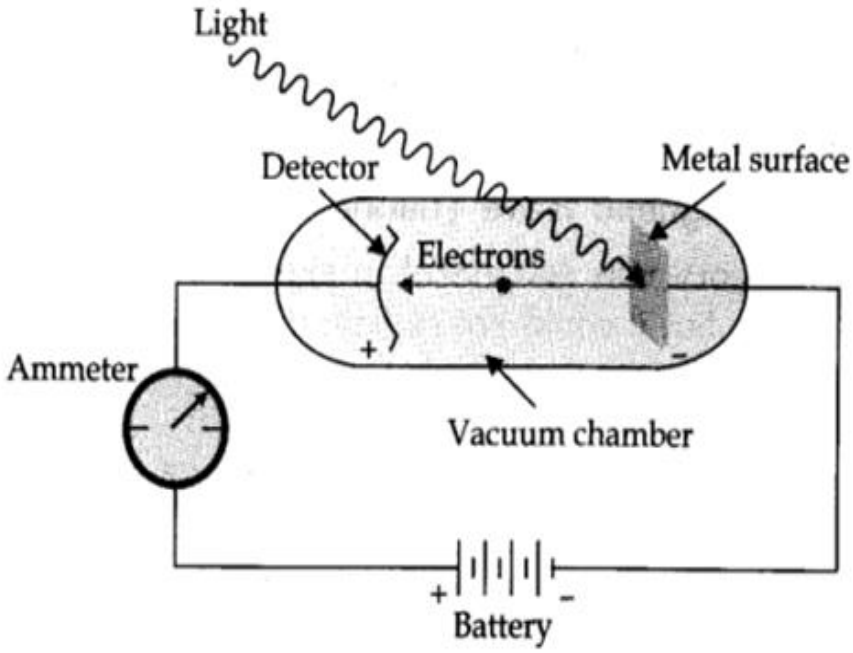

Fig. 1 Schematic view representing the principle of photoelectric effect

For photoelectric effect phenomenon, it needs a light absorbing material in the structure which has less threshold frequency requirement and greater electron emission ability. Few materials which are widely preferred based on their research study are as follows:

Silicon technology has been the dominant one for the supply of power modules into photovoltaic applications and the likely changes are an increasing proportion of multi-crystalline silicon and monocrystalline silicon being used for high-efficiency solar cells while thinner wafers and ribbon silicon technology continue to grow [3]. In comparison with amorphous silicon, crystalline silicon confers increased efficiency even when used in small quantity. The commercially available multi-crystalline silicon solar cells have efficiency around 14–19%.

Thin film solar cells are basically thin layers of semiconductor materials applied to a solid backing material. Thin films greatly reduce the amount of semiconductor material required for each cell when compared to silicon wafers and hence lowers the cost of production of photovoltaic cells. Gallium arsenide (GaAs), copper, cadmium telluride (CdTe) indium diselenide (CuInSe2) and titanium dioxide (TiO2) are materials that have been mostly used for thin film PV cells. Thin film solar cells made out of amorphous silicon are traditionally used for smaller-scale applications, including things like pocket calculators, travel lights, and camping gear used in remote locations. A new process called “stacking” that involves creating multiple layers of amorphous silicon cells have resulted in higher rates of efficiency (up to 8%) for these technologies; however, it’s still fairly expensive.

Cadmium Telluride is the only of the thin film materials that have been cost-competitive with crystalline silicon models. In fact, in recent years, some cadmium models have surpassed them in terms of their cost-effectiveness. Efficiency levels result in a range of 11%

As electrochemical battery is the most commonly used power storage unit such as valve regulated lead acid batteries and these batteries display good cycle life and could be successfully used for standalone photovoltaic application in northwest areas of China [4].

III. APPLICATIONS OF PHOTOVOLTAIC TECHNOLOGY

Photovoltaic Cell has tremendous application and still in process to be applicable for more. Few of the most common application of photovoltaic cell are as follows:

3.1. Desalination plant

It was discussed that electricity price at which solar energy can be considered economical to be used for RO (Reverse Osmosis) desalination as shown in Fig. 2 that is independent of RO plant capacity and proposed expressions for analyzing the unit production costs of RO desalination plants that can be used to find out unit production costs for desalinated water using photovoltaic (PV) solar energy based on current and future PV module prices [5].

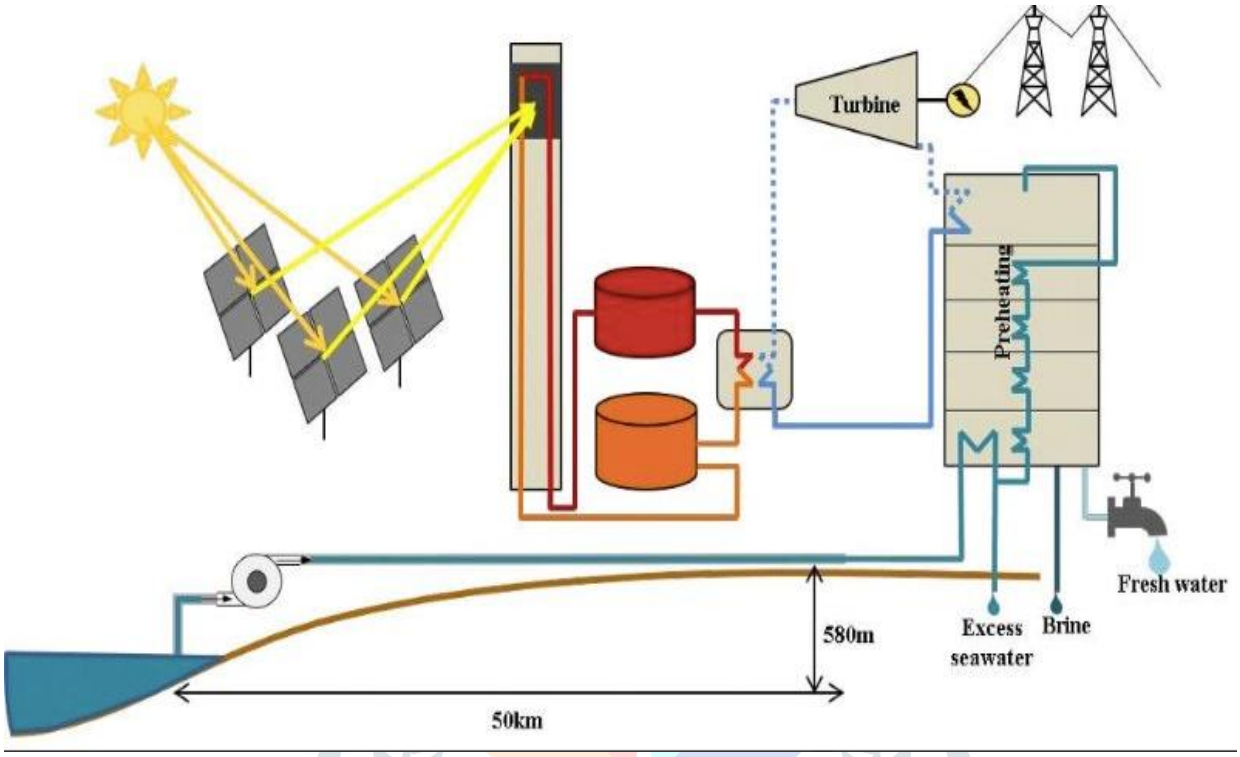

Fig. 2 Sequential establishment of photovoltaic technology in desalination process [5]

3.2. Solar home systems

It was described about the current experience and trials in East Timor with solar photovoltaic (PV) technology by introduction of solar home systems (SHS). Solar home system is integration of solar system with home power supply unit for the purpose of efficient and sustainable use of energy resources which are non-renewable [6].

Solar powered pump is great innovations in the field of irrigation which can help farmers cope up with the draught situation and also to reduce the electricity consumption which subsequently reduces the cost of crop production as shown in Fig. 3. Also, there are some policies to make solar photovoltaic water pumping system, an appropriate technology for the respective application region as it has proved its aspects technically, economically, and environmentally in developed countries [7].

3.3. Space

The presentation of trade-off study in the field of space solar arrays and concentration that defines the parameters to evaluate a concept (cell type, concentrator) becomes appropriate as two different concentrators, and a linear Fresnel lens concentrator is compared to rigid arrays and thermal and optical behaviors are analyzed for space applications [8].

3.4. Other Uses

The integration of solar photovoltaic of 25kWp capacity for an existing building of the cafeteria on the campus of the Indian Institute of Technology, Delhi by creating a solar roof covering with the photovoltaic array inclined at an angle of 15° from the horizontal and faces due south which shows the extensive utilization of photovoltaic energy source [9].

The procedure for optimizing the size of integrated wind, photovoltaic system with battery backup, the design of optimal size of the systems being based on the calculated values of life cycle unit cost of power generation or relative excess power generated or unutilized energy probability for a specified deficiency of power supply probability [10].

IV. DISCUSSION

The transparent solar cell is a highly desirable invention, applicable to more than 5 applications used in our daily lives, such as buildings, car windows, trains, cell phones, laptops, etc. Solar cell has so many other applications and immense scope of innovation.

It has been found that the efficiency of power generation of solar cell is about 20% but can be integrated with renewable energy driven power system, usually a conventional generator powered by diesel or even another renewable form of energy like wind to increase efficiency of power generation such system are called Hybrid power generation system. Such hybrid systems serve to reduce the consumption of non renewable fuel.

V. CONCLUSION

In the present study of work, it has been observed that photovoltaic technology is very much applicable for producing electrical energy and further this energy can be utilized in many areas and the following conclusions have been made based on the study.

- Photovoltaic electrical efficiencies are obtained up to 14–19% and rest is dissipated in the form of heat.
- The transparent solar cell is a highly desirable invention and applicable in various applications such as buildings, car windows, trains, cell phones, laptops, etc.
- The process of synthesizing the transparent material in buildings with same efficiency is big challenge.
- In general, 80% of the solutions of photovoltaic technology are still under development or at the pre commercializing stage.

REFERENCES

[1] Chapin D.M., Fuller C.S., Pearson G.L., A new p–n junction photo cell for converting solar radiation into electrical power. J. Appl Physics 1954; 25:676–7.

[2] Poponi D. Analysis of diffusion paths for photovoltaic technology based on experience curves. Solar Energy 2003; 74:331–40.

[3] Bruton T.M. General trends about photovoltaic based on crystalline silicon. Solar Energy Materials & Solar Cells 2002; 72:3–10.

[4] Hua S, Zhou Q, Kong D, Ma J. Application of valve-regulated lead-acid batteries for storage of solar electricity in stand-alone photovoltaic systems in the northwest areas of China. Journal of Power Sources 2006; 158:1178–85.

[5] Lamei A, Van der Zaag P, Von Munch E. Impact of solar energy cost on water production cost of seawater desalination plants in Egypt. Energy Policy 2008; 36:1748–56.

[6] Bond M, Fuller R.J., Lu Aye. A policy proposal for the introduction of solar home systems in East Timor. Energy Policy 2007; 35:6535–45.

[7] Meah Ka, Ula S, Barrett S. Solar photovoltaic water pumping—opportunities and challenges. Renewable and Sustainable Energy Reviews 2008; 12:1162–75.

[8] Habraken S, Defise J.M., Collete J.P., Rochus P, Dodemont P.A., Hogge M. Space solar arrays and concentrators. Acta Astronautica 2001; 48:421–9.

[9] Bansal N.K., Sandeep G. Integration of photovoltaic technology in cafeteria building, at Indian Institute of Technology, New Delhi. Renewable Energy 2000; 19:65–70.

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