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RESEARCH ARTICLE

DESIGN AND DEVELOPMENT OF BI-FACIAL SOLAR PHOTOVOLTAIC MODULE

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ABSTRACT

Today, in this era we want to produce more energy from various types of energy sources. Bifacial solar panel can be the best alternative to produce more energy because both sides as front and rear will absorb more energy. To make rear surface more absorptive as it is not in direct contact with sunlight we have to use more reflective surface. If we compare mono-facial and bi-facial solar panel, bi-facial solar panel 5% to 20% more output. We need a cheap and useful reflective surface such as plane mirror which will effectively boost up our output. As the name indicates our panel is light dependent from one side and other side takes the reflected rays. The design is optimized in such a way that it will achieve maximum yield from specific site setup. In this article we have taken the readings for both with and without reflector solar panel, for various angles of inclination of solar panel and calculated the values of current.

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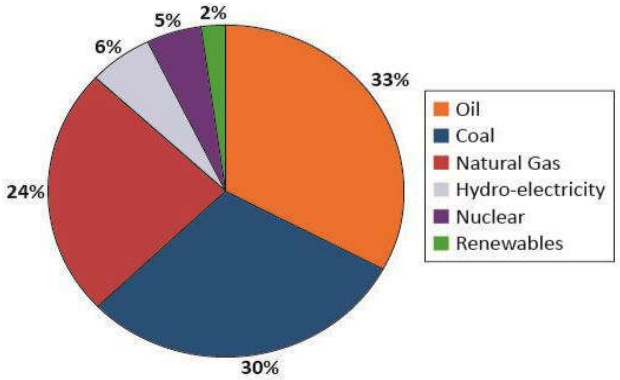
INTRODUCTION

Tackling the energy problem is amongst the biggest challenges for human kind in the 21st century. It is a challenge because of several problems: The first challenge the human kind is facing is a supply-demand problem. The demand is continuously growing. The world population is still rapidly growing, and some studies predict a world population of 9 billion around 2040 in contrast to the 7 billion people living on the planet today. All these people will need energy, which increases the global energy demand. (Frank *et al*., 2012) The Sun is energy source for almost all the processes that happen on the surface of our planet. As the Sun is the only real source we have, we need to move to an era in which we start to utilize the energy provided by the directly to satisfy our energy needs. As we see about 60% of the electricity is generated using fossil fuels, where coal is the dominant contributor. Nuclear is responsible for 6% of the World's electricity generation. With 2% hydroelectricity is by far the largest contributor among the renewable energy sources. Of all the generated electricity, about 40% of the electric energy is used for residential purposes and 47% is used by industry.



Working principle

The working principle of solar cells is based on the photovoltaic effect, i.e. the generation of a potential difference at the junction of two different materials in response to electromagnetic radiation. The photovoltaic effect is closely related to the photoelectric effect, where electrons are emitted from a material that has absorbed light with a frequency above a material-dependent threshold frequency. In 1905, ALBERT EINSTEIN understood that this effect can be explained by assuming that the light consist of well defined energy quanta, photons. The energy of such a photon a photon is given by:

$$E = h*v$$

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Where h is Planck's constant and v is the frequency of light. For his explanation of photoelectric effect EINSTEIN received the Nobel Prize in Physics in 1921.

The photovoltaic effect can be divided into three basic processes:

1. Generation of charge carriers due to the absorption of photons in the materials at junction.
2. Subsequent separation of the photo-generated charged carriers in the junction.
3. Collection of the photo generated charge carriers at the terminals of the junction.

Light entering the solar cell can -

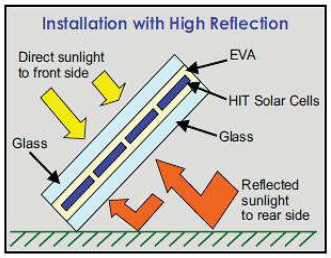
a. Go right through it.
b. Become absorbed, generating hest in the form of atomic vibrations
c. Separate an electron from its atomic bond, producing an electron-hole pair.

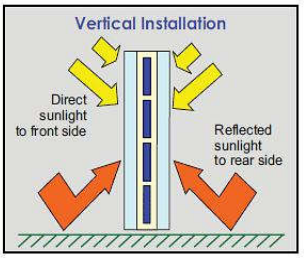
Introduction to bifacial solar cells

Unlike standard mono facial (single side) silicon PV cells, which collect energy only by their front-side (sunny-side), the bifacial cell has an open backside, which enables collection of the substantial amount of reflected light available from the earth, rooftops, clouds and the atmosphere. The bifacial gain is significant in direct solar illumination conditions and locations. This bifacial cell and module back-side collection capability provides additional energy output in regular flat rooftop and ground installations additional energy in vertical installations, such as solar fences and sound barriers in highways and railways. Bifacial solar panels equipped with external reflectors are expected to generate additional electrical energy depending on the materials properties of the reflector and its location. (2)

Reflector's Role

- The use of mirror with bifacial solar panel improves its actual efficiency to 14.42% over 10.70% in mono-crystalline solar panel.
- Therefore, the concentrator and reflector system can be used as an effective solar concentration system for bifacial solar panel with minimum extra material cost.





Testing parameters

The increase in energy generation improves actual efficiency of the bifacial solar cell from 10.7% to at least 14.4%.

Design of bifacial solar panel

Steps involved

Sr. No.	Types of solar panel	Actual Solar Cell Efficiency (% η)
1	Mono crystalline	10.70
2	Bifacial with Plane mirror	14.42
3	Bifacial With Prisms	19.49

1. Laser cutting

The solar cells are cut down into pieces with the help of LASER cutting machine, according to the need of design requirements (which is a manual operation).

2. Tabbing

The solar cells need to be connected electrically with each other. Tabbing is the process of connecting those solar cells with the help of copper conductors coated with lead.

3. Stringing

The solar cells need to be connected in series or parallel with each other in order to design a solar module or panel. For the designed panels, 18 pieces on one side of the panel are connected in series with each other and the rest 18 pieces on other side in parallel to each other with front sided pieces.

4. Lay-up: glass-eva-cell-tedler

It is the sequence of laying the elements of solar panel in the proper standard manner. The mono facial solar panels are laid in the sequence as glass-EVA-cell-tedler, while the bifacial solar panels are laid in sequence as glass-EVA-cell-EVA-glass.

5. Lamination

The layup needs to be set tightly, which is done with the help of EVA. The EVA melts at temperature above 120 degree, so the layup is melted at temperature above 140 degree. The lamination sets the layup together.

Construction details

Solar cell used = 4.3 W
0.5 V
156*156 mm

Capacity of panel = 10 W
540*660 mm

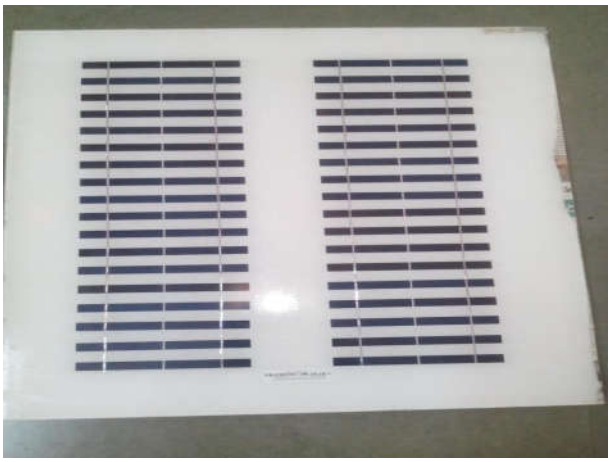
Applications

1. Space application
2. Solar trackers and concentrators
3. Terrestrial applications
4. BIPV (Building Integrated Photo Voltaic)
5. Vertical module

Observations

Without Reflectors

Type	Voltage (Volt)	Current (Ampere)
Mono-facial	20	0.66
Bi-facial	20.5	0.59



Inclination of panel

The inclination with maximum power generation is selected as fixed inclination for the panel.

Angle of panel (Degree)	Current(short circuit) (Ampere)
0	0.84
15	1.03
30	0.93
45	0.80
60	0.73
75	60
90	0.55

With Reflector

Type	Voltage (Volt)	Current(Ampere)
Mono-facial	20	0.66
Bi-facial	20.5	1.03

RESULTS

The Bifacial Solar Panel we have designed shows increased efficiency compared to the mono facial one when tested for the outdoor results.

Conclusion

The parameters like efficiency, inclination of panel, elevation of panel, distance between reflectors and panel are optimally calculated for the given panel through the test results.

Acknowledgment

I first pray at the lotus feet of our divine source of inspiration "Shri Sant Gajanan Maharaj'' who's blessings are always with me. I have no words to express my sincere thanks to my guide Prof. -R.S. Pote.

REFERENCES

Cuevas, A., A. Luque, J Eguren, and J. Del Alamo, 1982. "50 per cent more output power from an Aledo-collecting flat panel using bifacial solar cells,' Sol Energy, vol 29, pp 419-420.

Frank, J., M. Rüdiger, S. Fischer, J.C. Goldschmidt, M. Herml, 2012. Optical simulation of bifacial solar cells. *Energy Proc*., 27, pp. 300–305

Lim, Y.S., C.K. Lo, S.Y. Kee, H.T. Ewe, A.R. Faidz, 2014. Design and evaluation of passive concentrator and reflector systems for bifacial solar panel on a highly cloudy region – a case study in Malaysia Renew Energy, 63, pp. 415–425

Robles-Ocampo, B., E. Ruíz-Vasquez, H. Canseco-Sánchez, R.C. Cornejo-Meza, G. Trápaga-Martínez, F.J. García-Rodriguez, *et al*. 2007. Photovoltaic/thermal solar hybrid system with bifacial PV module and transparent plane collector. *Sol Energy Mater Sol Cells*, 91, pp. 1966– 1971

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