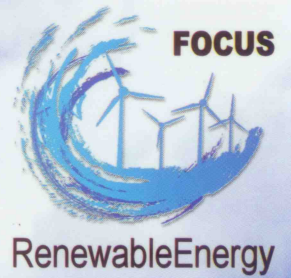


# ELECTRICAL MIRROR

An outlook of the electrical & power industry



## WINDPOWER

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- Grid Connectivity Issues Faced by the German Offshore Wind Industry
- Enhancement of Energy Generation from Two Layer Solar Panels
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Ravi Agrawal  
MD, Inspira Projects Ltd

### Expert Voice



Pratik Chube  
Country GM – products  
Emerson Network Power in India

### In Conversation



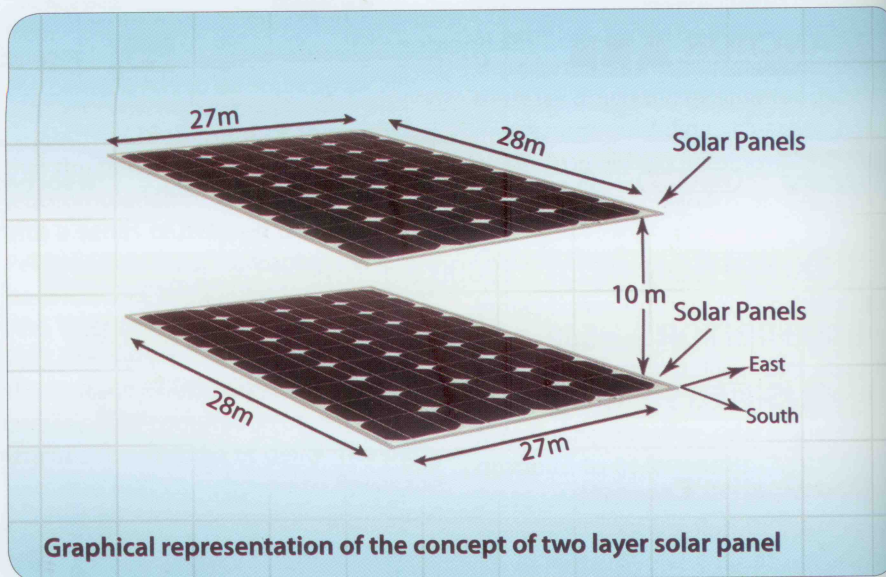
B.Chandrasekhar  
President & CEO  
Access Solar Limited

# Enhancement of energy generation from two layer solar panels

A simpler idea with greater impact by GERMI scientists

Author - Pragma Sharma  
& Prof. T. Harinarayana

**P**hotovoltaic (PV) means direct conversion of solar power in electricity. The technology is growing rapidly and world is adopting the solar photovoltaic power generation in a very faster pace but the technology i.e. the energy generation using solar photovoltaic requires large space. In India, the cost of the land has grown up five to ten times for the last 10 years. Enhancement of energy using solar photovoltaic in a limited space is important in urban areas due to increase in land cost and energy demand in recent years. As cost of the land is growing day by day, there is a strong requirement to use the available space as efficiently as possible. This is true in all the urban and semi urban regions of India. In recent years several methods have been suggested to enhance the energy generation for the limited space availability. For example, like concentrating solar power (CPV) technology which uses lens or mirror for concentration of sunlight is used by refracting the rays and focusing them in a small area solar photovoltaic cell to generate electricity. Another way to save the land cost is to adopt a new methodology to get maximum output from the solar power plant in a limited area. A research survey carried out on solar photovoltaic

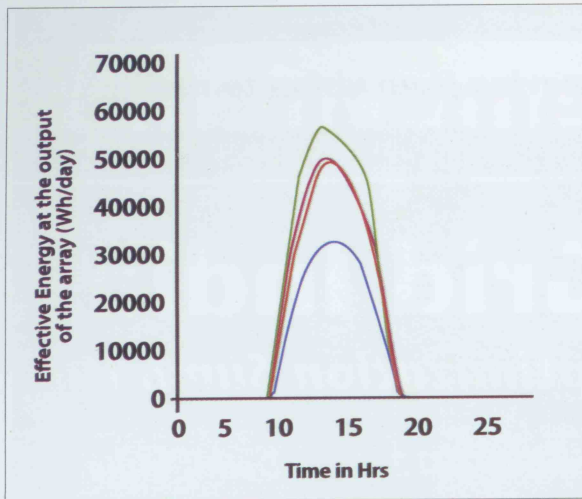


Graphical representation of the concept of two layer solar panel

technology shows that in future this type of study will be highly important with soaring land price cost. Massachusetts Institute of Technology (MIT) in Cambridge has tried to fabricate a new solar design which is called as 3D solar tower, a 3D type of solar panels to build three-dimensional photovoltaic (3DPV) the idea that if you install a 3D photovoltaic surface, the increased energy that is more than compensates for the added expense of the additional PV material and can double the number of peak power generation hours and dramati-

cally reduce the seasonal, latitude and weather variations of solar energy generation compared to a flat panel design. Self-supporting 3D shapes can create new schemes for PV installation and the increased energy density can facilitate the use of cheaper thin film materials in area-limited applications. Also, the initiative taken by the Gujarat government in the development of Gandhinagar Photovoltaic Rooftop Programme and solar panels at the top of Narmada canal for solar energy generation using PV modules has set an example to save the land





cost. Considering all these facts and after several compilation and computation of different models Ms. Pragya Sharma & Prof. T. Harinarayana GERM research team have suggested a new approach to enhance the energy generation from the photovoltaic panels, i.e. by keeping the two layers of photovoltaic panels as collectors of energy one above the other with the same size and orientation. The results of two layer solar panels have shown about 75% increase in efficiency as compared to single layer solar panel. This study can also be extended to n number of photovoltaic layers piled up one above the other. These research findings are being published in an international journal on Energy, Engineering and Environment. The study is aimed to enhance the energy generation for the limited space availability and to investigate the advantages of two layer solar panels with the same dimension and orientation lying one above the other. Additionally, the cost benefit analysis is also described to highlight the advantages of considering the suggested solar panel configuration.

This study on near shade analysis of a single and two layer solar panels through modeling has shown substantial increase in energy generation. For example, energy generation from a single layer solar panel system for a day (Dec 20 as an example shown in the below figure) is observed as 252kWh/day from 756 sq m area around Ahmedabad and Gandhinagar. It increases to nearly 445 kWh/day with a two layer solar panels separated by 10m in the same area. The output varies depending on the separation between the two layers of photovoltaic panels. The result of two layer solar panels, one above the other, with different height separation between them showed enhancement of the energy. The energy generation for no shade over the panels is about 250kWh/day. For a single layer solar panel with shade at 10 m of height, the energy generation is about 190kWh/day. By combining the power from the two panels the net result increases its efficiency by approximately 76% as compared to the power generated by a single layer solar panel without shade. Similarly, one can see that the resultant increase in efficiency is around 56% for 5m height and around 50% for 3m height and 46% for the 1m height between the solar panels. Due to high land cost in urban areas, the present study is significant. The results have shown the increase is over 70% in the output. These results are with two layer opaque PV modules as the solar energy collectors of small dimensions. Our findings suggest that harnessing

solar energy in with this methodology can open new avenues towards Terawatt-scale generation even for the small scale solar power plant claims GERM research team.

The GERM research team is confident and says that the transparent solar panels are on the way to the market and it further enhances the energy generation with this new concept. These results are directly applicable to roof tops of the houses or small scale plants. The study can easily be extended to n layer solar PV panel system. The estimations justify the plant cost with respect to solar panels. As advances in the technology has already brought down the cost of solar photovoltaic technology and is expected to further lower in future. As an example, for a solar photovoltaic single layer solar panel system, if the land cost (e.g. Ahmedabad, Gandhinagar, Rajkot etc. in Gujarat) is large, the module cost is Rs. 40 lakhs and Rs.10 lakhs for other accessories, it provides about 10 kWh of energy per 10 lakhs. For a two layer of solar panel system, as the area remains same the land cost is zero. The only added expenditure are solar panels and other mounting accessories. Thus for 10 m separation one can have 14.8 kWh per 10 Lakhs, which is nearly 50% extra benefit. However, one needs to have an optimal design on the number of solar panel layers through modeling studies. It is necessary to consider the foundations of the site location in deciding on the number of layers. The study need to develop in the form of the actual implementation. Such implementation will need the developers to come and develop pilot model based on the study for small PV power plant and then depending on the results extend it further ■



Pragya Sharma, is Research Scientist in Solar Research Wing and is involved in research and development program of solar energy technology in GERM-Research Innovation and Incubation Centre (GRIIC), Gujarat, India, with more than 4 and half year of experience in the field of solar photovoltaic. She has worked with dedicated unit of Ministry of New and Renewable Energy Government of India, Solar Energy Center on 'Design and Development of 20 kWp roof top PV power plant at SEC, Gurgaon, India.



P. Harinarayana T, Ph.D, Director of GERM-Research Innovation and Incubation Centre (GRIIC), Gujarat earlier as a Head, Magnetotellurics, National Geophysical Research Institute has done outstanding contributions in the field of Deep electromagnetics both on land and also in marine environment. Dr. Harinarayana is one of the top scientist among the geomagnetism and electromagnetic scientists in the world.