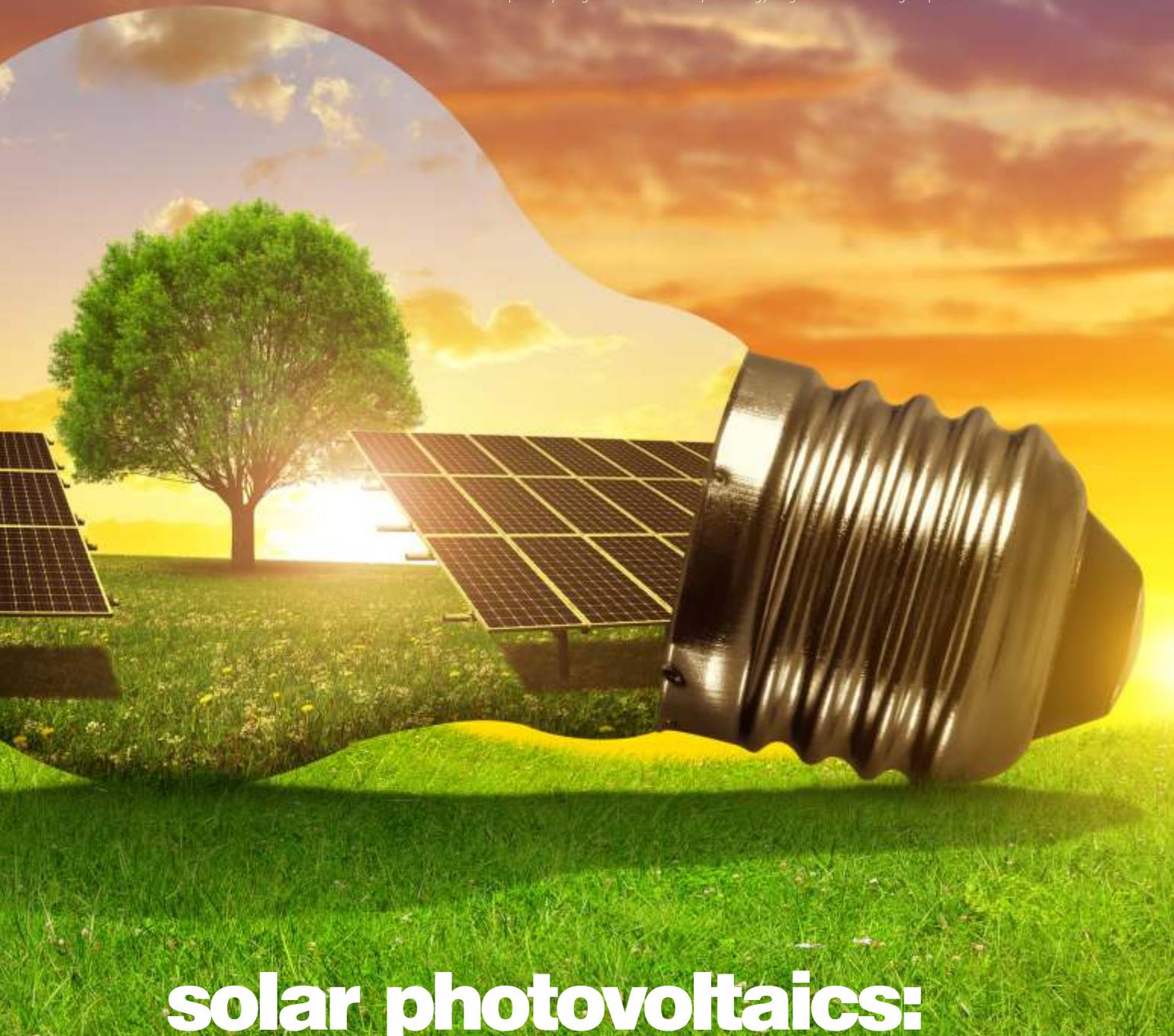


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solar photovoltaics: impact on energy systems

C Palaniappan

This article outlines the energy revolution that we are currently witnessing with Solar Photovoltaics (SPV), which is transforming the energy landscape rather rapidly across the globe, from developed nations to developing nations! Till the last decade, only a handful of companies were engaged in solar power and primarily off-grid (system with battery). People always assumed that solar power could be used only for very small loads like lights and fans but it's now established that any large loads could be run by solar power similar to grid power. From the broad historical perspective of cultural evolution, the fossil-fuel age and the industrial era are, but a brief episode. As rightly pointed out by Fritjof Capra in his famous book 'THE TURNING POINT', this decade will be marked by the transition from the fossil fuel age to a Solar Age, powered by Renewable Energy from the Sun and harnessed through Solar Photovoltaics.





Challenges faced

Earlier the cost of solar panels with battery was earlier very prohibitive and only government agencies and essential services like tele communication, remote monitoring etc could afford it. Energy experts will agree that the Solar Revolution started when there was a significant fall in the price of solar panels and associated electrical components; the cost per kWp of grid-tie system has fallen from around Rs.2 Lakhs on an average to about Rs.50,000 - Rs.60,000/kWp for large systems over the last 3-4 years. This fall in price as well as the government subsidy program available earlier, have opened the flood gates leading to many qualified as well as semi-qualified suppliers providing solar power solutions to the public in the domestic sector. The subsidy, though it helped build the momentum for solar adoption in the domestic sector, has many disadvantages rather than advantages in a long run.

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Presently, different policies are being followed by different States in India which again throw many hurdles in the faster diffusion of the technology - for example in Andhra Pradesh upto 1 MWp roof top solar is eligible for net metering including HT industrial consumers while in Tamil Nadu net meter is not allowed in HT industry. Similarly, different approval mechanisms / procedures are also being followed in different states. Currently, there is a wide talk among the industry as well as government agencies that a huge anti-dumping duty will be imposed on Chinese and Malaysian imported panels. This causes a major uncertainty among large-scale installers in the country.

Despite these challenges, there are many enthusiastic system integrators who are trying to satisfy domestic

needs of a few kW to industrial MW levels. Apart from this, large installations (10 MWp and above) either in the open wasteland or as a solar park for grid export are also being installed using utilities power purchase or similar agreements. There are many large players very actively involved in states like Gujarat, Rajasthan, Tamil-Nadu and Andhra Pradesh in this sector.

Battling and beating these above odds, installed solar power has grown from 513 MW in 2012 to 12288 MW in 2017 which is 2395% of growth. All these issues in renewable energy promotion in India are minuscule compared with the monumental growth expected for Renewable Energy (RE); RE is certainly going to rule the world due to many factors including life-threatening global warming issues and rapidly diminishing fossil fuel.

SPV advancements revolutionizing the energy landscape

Some of the key advancements taking place in the solar power sector to be worth mentioning are:

1. Increase in efficiency of solar panels, which used to be around 11% has been raised to 17-19% and a still further increase in efficiency leads to reduced space requirements for installing the solar panels. The space requirement is a major constraint in the installation of solar panels - for example to install 1 MWp ground mounted system, we may require around 18,000 m² land or for 1 kWp roof top we may require 9 m² space.
2. Apart from these high efficient panels with lesser size, other developments like bi-facial panels, which could collect even the reflected radiation, are coming into the market in a big way. This also aids overcoming the space constraint issues.
3. Smart panels that overcome the hot spot effect in the energy collection are also being introduced. Hot-spots in PV modules represent a broad defect due to shading/soiling, mechanical damage and/or internal module failures.
4. Technological advancements are also occurring across the major critical components of solar power systems like inverters, balance of electrical system and fixed or moving panels supports.
5. As solar power is available only for 30% of a day, to sustain any process fully with solar we need to depend on storages like battery storage, flywheel storage, thermal storage, chemical storage, etc. Lithium batteries are being introduced in large-





scale utility projects replacing lead acid batteries since lead acid has lower life span with limited discharge capacities.

- 6. Tesla and many other companies are introducing electrical vehicles with chargeable lithium batteries which, it is projected, will replace the diesel based vehicles within a decade.
- 7. Novel usage of excess solar power: In one of our 500 kWp roof top project in Tamil Nadu where we needed to have captive power model due to the absence of net-metering, we have adopted a novel concept of diverting the excess solar power not consumed in their machinery to a 200 kW electrical heater fitted in a 10,000 litre insulated water tank and it feeds a 3-ton boiler with preheated water to reduce fuel consumption.

Thus many such new developments including advancements in storage will make solar technology cheaper than the coal based electricity shortly and it will be affordable for the entire human kind.

The Climate Group, an international non-profit organization, has introduced RE 100 initiatives incentivizing RE adoption among corporates across the globe; the concept of 100% renewable energy in business and industries for leading world corporates will ensure significant adoption of RE. In India already 3 large corporates like Infosys, Tata Motors and Dalmia Cement are members of RE 100. Through the author's initiative Hatsun Agro Products has also joined the RE 100 recently.

International Renewable Energy Agency, known as "IRENA", reports that the levelized electricity cost from solar photovoltaic has dropped 69% from 2010 to 2016, reaching the cost of fossil fuels. In developed countries as on today, the solar power is cheaper than nuclear power. We are rapidly approaching a significant confluence at which renewable electricity will simply be the cheapest and most sensible option for business and industries.

The impact

International Renewable Energy Agency, known as "IRENA", reports that the levelized electricity cost from solar photovoltaic has dropped 69% from 2010 to 2016, reaching the cost of fossil fuels. In developed countries as on today the solar power is cheaper than nuclear power. We are rapidly approaching a significant confluence at which renewable electricity will simply be the cheapest and most sensible option for business and industries. Adoption of renewable energy will also lead to higher job creation, which has been proven in the USA.

A word of caution though - like any engineering task, best results will be based on detailed engineering only - hence a successful solar power generating



500 kW captive power for a cattle plant near Palani



3 Ton boiler



200 kW thermal storage synchronized with 500 kW solar power

system will be based on the correct choices of panel, inverter, supports and other balance of materials inclusive of apt installation procedures so that the installed unit could survive for the next 25 years either on the roof or on open ground. This will ensure that the SPV revolution currently underway will not fade away rapidly.

The next ten years, we are going to witness the first phase of Solar Revolution, which will have a tremendous impact on many walks of our life in our planet like phasing out of many technologies dependent on coal or oil. The key bottlenecks in the

faster diffusion of Solar Power are the large space requirement and low efficiency of the panels. It is envisioned that these two issues will be addressed and solved by evolving high efficient panels and usage of all the wasteland and maybe extending to the ocean surface (by floating solar panels now being possible in lakes and ponds) since three-fourths of the earth have sea surface. Coupled with these technological advancements, innovation in storage technology will make the solar SPV technology to make a quantum jump!

Let us welcome "The dawn of Solar Revolution, to save our Planet"



Mr. Palaniappan is the Managing Director at SUN BEST. He has above 36 years of experience in solar power sector. He also served as Reader in Solar Energy at Madurai Kamaraj University.