EMERGING TECHNOLOGIES TO ENHANCE LARGE SCALE PV PROJECT PERFORMANCE

Prelude

In order to improve the plant performance there could be multiple focus areas, right at the plant design stage to integration stage to achieve optimized plant performance. It is important for developers, EPC Contractors, O&M service providers to consider various options/ strategies to increase their plant yield at a minimal cost. Knowledge about the performance of solar power plants results in correct investment decisions and better regulatory framework, technical enhancement of solar photovoltaic technology. Emerging Technologies are being used to reduce different losses like DC cable layout losses, shadow losses, inverter losses, AC wiring losses and module miss-match losses. Use of AI and ML is being done in performance monitoring and enhancement.

Let's read in details on Emerging Technologies To Enhance Large Scale PV Project Performance

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Emerging Technologies Can Boost Solar 'Power'

On the 75th Independence Day, the Prime Minister spoke about India crossing the milestone of 100 GW of installed renewable energy (RE) capacity. Of this, solar power accounts for 44 GW.

Solar power is a key resource for RE installations, but low efficiency of solar power systems can pose considerable challenges in harnessing its true potential. Employing the emerging innovative technologies in solar panels and solar tracking systems can increase energy production and yield better economic benefits, enhancing the overall efficiency of solar plants. In doing so, the focus should be on large-scale solar plants, as they comprise over 80% of the solar-photovoltaic (PV) installations across the country.

Several solar technologies being explored at the global level are in different stages of development. While India has adopted some of the emerging technologies, it has not done so on a scale large enough to make a difference. To fully actualise India's solar potential, their large-scale adoption is essential. The enabling features of some of these technologies are presented here.

> "GLOBAL RESEARCH SHOWS THAT A SOLAR PLANT WITH BIFACIAL PANELS AND SINGLE-AXIS TRACKERS CAN COST APPROXIMATELY 15% MORE THAN THE CONVENTIONAL SOLAR PLANT WITH MONO-FACIAL MODULES AT A FIXED TILT."

Solar Panels

Presently, polycrystalline Si solar panels—which have an efficiency of 15-17%—are most commonly used in India. However, other current and upcoming solar panel materials, like crystalline Si, thin films, and perovskite solar cells, can offer higher efficiency. Their benefits and development stages are illustrated in Figure 1.

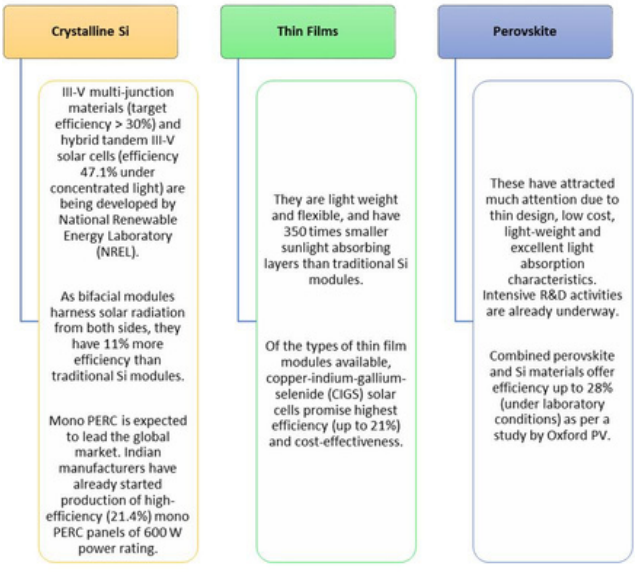

Figure 1: Emerging solar panel materials/technologies

Solar Tracking Systems

The demand for solar trackers is increasing globally (due to rising solar energy demand). According to "Solar Tracker Market, 2021-2028", Fortune Business Insights' latest report, the market size is expected to reach $ 54.23 billion by 2028, with a CAGR of 16.3% between 2021 and 2028.

Tracking systems not only boost sunlight harnessing, but also maximise the overall efficiency of the solar power system. Currently, two types of trackers are available, single-axis and dual axis. Of these, single-axis trackers are expected to dominate the market due to lower cost and longer lifetime.

Global research shows that a solar plant with bifacial panels and single-axis trackers can cost approximately 15% more than the conventional solar plant with mono-facial modules at a fixed tilt. However, the former can generate >20% energy and sometimes even up to 35-39% energy, under optimal conditions.

Comparative Performance Analysis

In order to understand the performance of a large-scale solar plant with and without trackers, the Center for Study of Science, Technology and Policy (CSTEP) conducted an analysis using the PVSyst V6.62 platform. First, a simulation for a 1 MW solar plant was done. Then the performance of an actual power plant with the same capacity was evaluated using emerging trackers and module technologies.

The assumptions and results of the analysis are illustrated in Figure 2 and Figure 3, respectively.

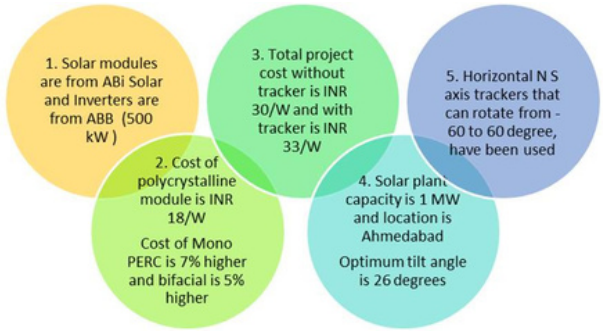

Figure 2: Assumptions considered for PVSyst simulation

Figure 3: Generation and cost of energy profiles for 1 MW solar-PV system with and without single-axis tracking system

As seen in Figure 3, a 1 MW plant with a poly Si solar module without trackers generates the lowest energy (1,772 MWh). However, when trackers are employed, the same plant generates almost 25% more output. The combination of bifacial panel and tracker offers the highest generation (2,308 MWh) and has the lowest cost of energy (INR 2.90/ kWh).

Conclusion

The ability of the emerging technologies to enhance the performance and cost-effectiveness of solar power plants makes a strong business case for their large-scale uptake. The Indian government should consider deploying these to fully harness the country's huge solar resource, and drive the 2030 RE target of 450 GW.