



भारत सरकार
विद्युत मंत्रालय
केन्द्रीय विद्युत प्राधिकरण
इमर्जिंग टेक्नोलॉजी एंड इनोवेशन प्रभाग

To,

All stakeholders (Academia, R&D institutions, Solar PV industry and other stakeholders, etc).

Subject: Webinar on R&D Activities in Advanced Photovoltaic Technologies/ Advanced engineering on solar cell-regrating on 17.09.2025 at 2.00 P.M

The Central Electricity Authority (CEA), under Section 73(k) of the Electricity Act, 2003, is mandated to promote research in matters related to power generation, transmission, distribution, and trading of electricity. In line with this, CEA and Ministry of New and Renewable Energy (MNRE) are co-hosting a webinar on **R&D activities in Advanced Photovoltaic (PV) Technologies**, with a focus on **solar cell engineering**. The event will facilitate open discussions among researchers from solar PV industry including stakeholders from government, academia, industry, developers and venture capitalists.

2. The objective is to foster collaborative efforts among stakeholders to drive innovation and support the development and commercialization of next-generation solar technologies such as Perovskite, Tandem, Bifacial, TOPcon and Quantum Dot Solar Cells. These advanced technologies have the potential to significantly enhance efficiency—Tandem Cells, for example, can achieve over 30% efficiency through multi-junction designs. Institutions like NISE, IITs (Bombay, Delhi, Roorkee, Bhilai), National Centre for photovoltaic Research and Education (NCPRE), Chitkara University, and NPL are already engaged in cutting-edge R&D in these areas. The brief background is enclosed at Annexure.
3. The webinar aims to:
 - Explore methods to enhance solar cell efficiency through advanced R&D
 - Promote academia–industry collaboration for technology commercialization
4. All stakeholders are cordially invited to participate and contribute to the national vision of **Atmanirbhar Bharat**.
5. **Registration Link:**
[Click here for Registration for the Webinar](#)
6. **Date & time of the webinar:** 17.09.2025 at 02.00 P.M. onwards.
7. **Link to attend the webinar:** [Click here to Join the Webinar](#).

यह सक्षम अधिकारी के अनुमोदन से जारी किया जाता है।

--sd--

(विजय मेंघानी)
मुख्य अभियंता (ET&I)

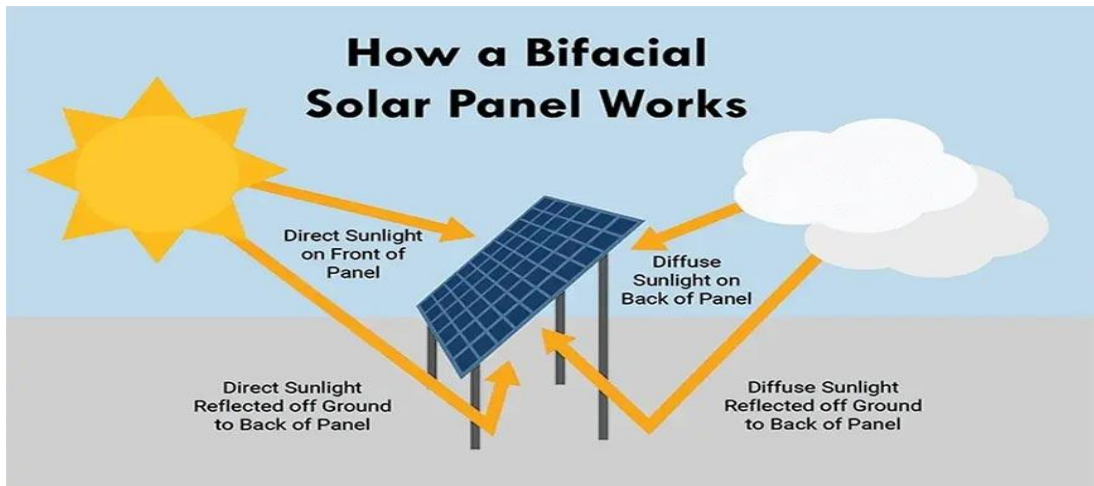
प्रतिलिपि:

1. विशेष सहायक, अध्यक्ष, के.वि.प्रा.
2. विशेष सहायक, सदस्य (योजना), के.वि.प्रा.

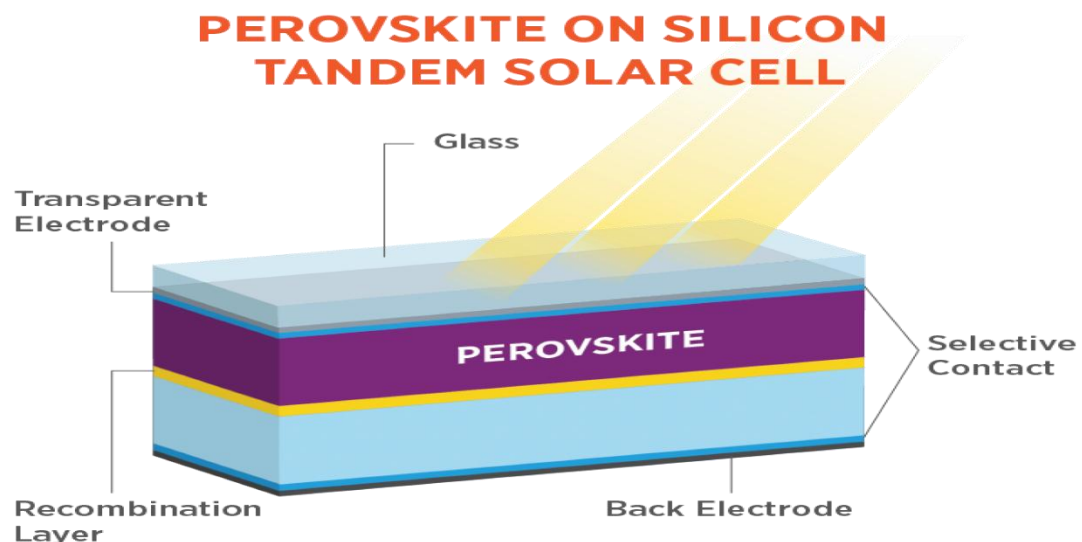
Brief background:

In India, the Government is actively promoting research and development in advanced solar technologies to optimize land use and enhance renewable energy capacity.

2. The National Institute of Solar Energy (NISE) has initiated work on next-generation technologies such as Perovskite Solar Cells and Bifacial Modules, which offer improved efficiency and dual-sided light absorption.
3. Any improvement in solar cell efficiency offers significant advantages, including increased electricity generation, reduced land requirements, and enhanced planning for resource adequacy. For example, a 1% increase in efficiency across 100 GW of solar capacity can generate approximately ₹2,190 crores in additional annual revenue, assuming an electricity generation cost of ₹2.5 per unit.
4. Several premier research institutes are conducting R&D in Tandem Cell Technology. These include the National Centre for Photovoltaic Research and Education (NCPRE) at IIT Bombay. Other institute like IIT Roorkee, IIT Delhi, IIT Bhilai, and Chitkara University are also engaged in the research activity related to advanced solar technologies. Additionally, the National Physical Laboratory (NPL) is also engaged in related research. A team of researchers led by IIT Roorkee has proposed the use of Hybrid Heterojunction Solar Cells (HHSCs) as bottom devices in four-terminal (4T) perovskite-silicon tandem photovoltaic (PV) cells. According to the researchers, this novel architecture could be manufactured at significantly lower costs than conventional perovskite-silicon tandem designs, with an efficiency of 28%.
5. While tandem solar cells remain a global R&D focus, NISE is expected to scale up its efforts in this area as part of its roadmap to foster innovation and enhance global competitiveness. These initiatives align with India's vision of achieving technological self-reliance and leadership in the renewable energy sector.
6. In conventional single-junction solar cells, conversion efficiency is limited by the intrinsic properties of the single absorber material. Currently, commercially available monocrystalline silicon solar cells typically achieve efficiencies in the range of 18–24%.
7. Key Technologies:
 - (i). **Precision in Solar Cell Measurement:** This refers to the accurate and reliable assessment of solar cell performance characteristics such as efficiency, current-voltage (I-V) curves, and spectral response. Precision measurements, using advanced instruments and techniques, are crucial for optimizing solar cell design, improving manufacturing processes, and predicting long-term performance. The goal is to maximize efficiency within the 18–24% range and reduce performance degradation over the cell's lifetime.
 - (ii). **Bifacial Modules:** Bifacial solar cells are capable of generating electricity from sunlight hitting both the front and rear surfaces, unlike traditional monofacial cells that utilize only the front. By capturing reflected light from surfaces like white roofs or ground coverings, bifacial modules can significantly boost overall energy yield, with potential efficiencies around **24%**.



- (iii). **Tandem Solar Cells:** Tandem solar cells represent the forefront of solar technology. These devices stack multiple sub-cells with different bandgaps, enabling better utilization of the solar spectrum. Typically combining **perovskite and silicon layers**, tandem cells can theoretically achieve efficiencies **above 30%**, with some designs approaching **34%**. Each material layer absorbs a specific range of the solar spectrum, thereby maximizing overall conversion efficiency. However, their manufacturing requires precise control over interface properties and the thickness of each layer, making the process more complex than conventional cells.

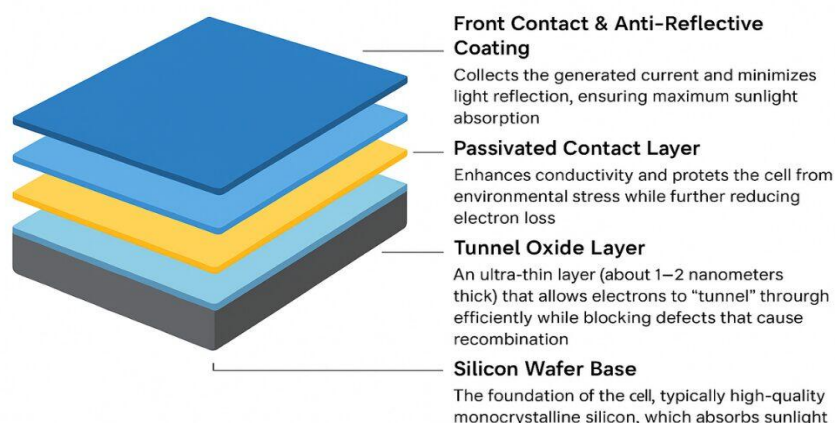


- (iv). **TOPCon Technology in Solar Cells**

Tunnel Oxide Passivated Contact (TOPCon) is one of the most advanced technologies in crystalline silicon solar cells, representing a significant leap beyond the conventional Passivated Emitter and Rear Cell (PERC) architecture. The core principle of TOPCon lies in its rear-side passivation technique. In this structure, an ultra-thin silicon oxide layer, generally around 1–2 nanometers thick, is grown on the silicon wafer. On top of this oxide layer, a thin doped polycrystalline silicon layer is deposited. This design enables two critical advantages: the tunnel oxide minimizes surface defects and thereby reduces electron–hole recombination, while the polycrystalline silicon layer

allows charge carriers to effectively “tunnel” through the oxide and reach the metal contacts with minimal resistance. The result is higher efficiency and improved performance compared to traditional solar cells.

Structure of a TOPCon Solar Cell



- (v). In addition to these few innovations like vertical installation of panel by Renkuba has increased in morning generation, evening generation and every during solar hours.



The critical questions to be answered in the webinar are:

1. What is the current Technology Readiness Level (TRL) of Research & Development (R&D) efforts in tandem solar cells and related technologies?
2. How does the use of hybrid tandem solar cells compare to conventional tandem solar cells in terms of efficiency?
3. What compatibility issues commonly arise during the fabrication process between different layers of tandem solar cells?
4. How cost-effective is the production of tandem solar cells, and what is their potential for large-scale commercialization?

5. Are the materials used in laboratory research for tandem solar cells indigenously developed or primarily imported?
6. Is there any foreign support or technology transfer involved in the development and fabrication of tandem solar cells?
7. What is the current status of collaboration between research institutions, industries, and government organizations in advancing tandem solar cell technology?

Minute- to-Minute program of the webinar:

S.No.	Name of Speaker/ Presenter (Shri/Smt)	Designation/ Organization	Proposed for	Time Frame
INAUGURAL SESSION				
1.	Shri. Vijay Menghani	Chief Engineer (ET&I), CEA	Welcome Speech	5 Minutes
2.	Shri. Ghanshyam Prasad	Chairperson, CEA	Opening remarks	10 Minutes
3.	Dr. Sangita Kasture	Advisor R&D, MNRE	MNRE Insights	5 Minutes
PRESENTATIONS				
4.	Shri. Deepak Choudhry	Deputy Director CEA	Presentation	20 Minutes
5.	Prof. Dinesh Kabra	Associate Professor, IIT Bombay	Presentation	20 Minutes
6.	Prof. Saumitra Satapathi	Professor, IIT Roorkee	Presentation	20 Minutes
7.	Shri. Shubhang Parekh	R&D In-charge, National Solar Energy Federation of India (NSEFI)	Presentation	20 Minutes
8.	Shri. Sooraj Kumar	CEO, P3C Technology and Solution pvt Limited.	Presentation	20 Minutes
9.	Shri. Vaibhav Pareek	Director, Surya Sparks Solutions Pvt. Ltd.	Presentation	20 Minutes
10.	Dr. D.N. Singh,	President, Solar and Semiconductor Technology, SAEL	Presentation	20 Minutes
Q&A session				20 Minutes
