

India's PV Manufacturers Shine in Kiwa PVEL Scorecard 2024

Kiwa PVEL Module Reliability Scorecard serves as a globally recognized standard for assessing solar module quality and earning a spot as a Top Performer serves as a validation of the quality and dependability of a manufacturer's offerings.

Today's PV cells are pushing boundaries with materials like silicon, cadmium telluride, and perovskite, boosting their efficiency. Innovations such as bifacial panels, which capture sunlight from both sides, and integration of solar cells into building materials (BIPV) are further advancing solar technology. Meanwhile, large-scale projects benefit from concentrating solar power (CSP), using mirrors or lenses to focus sunlight effectively.

India's solar sector has seen remarkable growth, becoming a profitable venture for businesses and investors alike. By mid-2019, India achieved

the milestone of having the world's cheapest solar power, an achievement recognized by the World Economic Forum. The decreasing costs of Lithium-Ion batteries, dropping from USD 1000/kWh to about USD 150/kWh over the last decade, have accelerated the adoption of solar solutions, with billions of dollars in investments anticipated in the coming years.

This growth hinges significantly on the reliability and performance of PV modules. This is where Kiwa PVEL's PV Module PQP comes into play. Launched in 2012, this testing protocol addresses these concerns, enabling more informed procurement decisions. Their 2024 PV Module Re-

liability Scorecard is considered a gold standard in the industry, setting the bar for reliability and performance. Guided by principles such as empirical data, standardised benchmarking, third-party witnessing, and regular updates, the PQP ensures that modules meet stringent quality and reliability standards.

The PVEL Scorecard 2024

The 2024 PV Module Reliability Scorecard showcased Top Performers across seven key PQP test categories. Determining these standout modules involved averaging the results for every BOM tested under the same model type. To make the cut, modules had



7 Tests of Assessment

Kiwa PVEL’s testing process is exhaustive, encompassing a variety of rigorous tests.

- **Thermal Cycling (TC):** This test extends the IEC/UL certification test to 600 cycles, simulating temperature fluctuations over a module’s lifespan, with less than a two percent power loss required for top ranking.

- **Damp Heat (DH):** This test is conducted for 2000 hours to mimic long-term exposure to high humidity and temperatures, with BOMs needing to degrade by no more than two percent to maintain a top position.

- **Mechanical Stress Sequence (MSS):** It evaluates the module’s ability to withstand mechanical loads, requiring a power loss of no more than two percent for top ranking.

- **Hail Stress Sequence (HSS):** It tests the module’s resistance to impact from hailstones, with the highest scorers having no glass breakage in 40 mm hail testing.

- **Potential-Induced Degradation (PID):** This test assesses the susceptibility of modules to degradation under high voltage stress, with top per-

formers showing less than one percent power degradation.

- **Light-Induced Degradation (LID) and Light- and Elevated Temperature-Induced Degradation (LETID):** This measures power loss due to exposure to light and elevated temperatures, with LETID being more severe in hotter areas and affecting early-generation PERC cells, requiring less than one percent power degradation for excellent performance.

- **PAN Performance test:** It enhances energy yield simulations using empirical data across different conditions, necessary for precise energy modeling, with pan files providing a more accurate depiction of real-world conditions.

These stringent criteria ensure that Top Performers truly stand out in terms of reliability and performance. It’s worth noting that not all products or model types are represented in every test. Manufacturers have the option to opt out of being listed in the Scorecard.

The table below highlights top-performing solar modules from leading manufacturers all around the world like Trina Solar, SEG Solar, Emmvee, and NE Solar, who surpassed all seven rigorous tests of Kiwa PVEL.

to be free from wet leakage failures, major defects during visual inspections, or diode failures. This meticulous process ensured that only the best of the best made it to the top.

To earn a spot on the 2024 Scorecard, PV module manufacturers had to meet a few crucial requirements. First, they needed to have completed the PQP Sample Production Witness after October 1, 2022. This step ensured that the production process was up to par and transparent. They also had to submit at least two factory-witnessed PV module samples to undergo all PQP reliability tests, strictly following Kiwa PVEL’s BOM test requirements. These rigorous prerequisites set a high bar for quality and reliability.

MANUFACTURER	MODEL TYPE							MODULE DESIGN	CELL TECHNOLOGY
	TSM-xxxNEG21C.20	✓	✓	✓	40	✓	✓	bifacial - glass/glass	n-type TOPCon
	SEG-xxx-BTC-BG	✓	✓	✓	40	✓	✓	bifacial - glass/glass	n-type TOPCon
	ExxxHCBG144	✓	✓	✓	40	✓	✓	bifacial - glass/glass	p-type PERC
	NESExxx-72MHB-M10	✓	✓	✓	40	✓	✓	bifacial - glass/glass	p-type PERC

Top Performers: India

India leads in solar energy with manufacturers like Adani Solar, Emmvee, Goldi Solar, Jakson, Premier Energies, Renew, Saatvik, Tata Power Solar, Vikram Solar, and Waaree at the forefront. They innovate and scale production to drive India's renewable energy goals.

1. Emmvee is making waves in the Indian solar energy landscape by passing all seven PV Evolution Labs (PVEL) tests. One of their standout products showcased their innovative approach with advanced bifacial glass/glass technology and p-type PERC cell technology. This ensures top-tier performance and durability, making it a perfect fit for diverse climate conditions. What sets Emmvee apart is its focus on bifacial modules. This feature is especially beneficial for maximizing efficiency in the Indian context, where varying sunlight conditions are a challenge.



On this achievement, **Suhas Donthi, President and CEO of Emmvee Group**, expressed his thoughts and stated, "This marks a significant milestone for both India and Emmvee, reaffirming our position as a leading PV module manufacturer on a global

scale. We take immense pride in being recognized as a top performer in all categories by Kiwa PVEL. This recognition underscores our steadfast dedication to delivering top-quality PV modules worldwide. Looking ahead, we remain committed to pushing the boundaries of solar technology and establishing new benchmarks in the industry."

2. Waaree is setting heat in the Indian solar scene with an achievement, passing all six rigorous tests conducted by PV Evolution Labs (PVEL). This includes Thermal Cycling, Damp Heat, Mechanical Stress Sequence, Hail Stress Sequence, PID, and LID+LETID. Their standout bifacial glass/glass designs and p-type PERC cell technology, offer power class ranges of 580-625W and 530-575W respectively.



Speaking about the recognition by PVEL, **Hitesh C Doshi, Chairman and Managing Director, Waaree Group**, said, "Waaree has long fostered a culture of excellence focused on meeting the high quality standards of global markets, and this recognition further validates our approach. The results of PVEL's extended reliability and performance testing has catalyzed the growth of new markets and buyers for Waaree. As India's largest PV module manufacturer and exporter,

we happily share PVEL's PQP in our conversations with buyers across the globe."

3. Vikram Solar, a key player in the solar sector, specialises in photovoltaic (PV) modules and EPC services. They passed 5 tests, missing just HSS and PAN.



Gyanesh Chaudhary, Chairman & Managing Director, Vikram Solar shared, "Our commitment to creating an abundant and sustainable energy future remains steadfast, driven by an unyielding dedication to quality, performance, and innovation. The stringent standards of Kiwa PVEL's testing protocols underscore the significance of this latest accolade, highlighting the exceptional performance and dependability of Vikram Solar's products. Our consistent leadership in critical solar module testing arenas solidifies our standing in the market. This prestigious recognition fuels our ambition to expand our capacity, break into new markets, and expedite the worldwide adoption of solar energy, reinforcing our role in shaping a greener planet."

4. Adani Solar's ASB-M10-144-AAA solar modules are not far from the race and have successfully passed the PV Evolution Labs (PVEL) testing making place in the top list by passing 4 tests conducted by PVEL.



Commenting on the achievement, **Anil Gupta, CEO of Adani Solar** said, “We are honoured to win the Top Performer position again. This consistent recognition reinforces our commitment to excellence. Our Indian-made solar PV modules embody advanced technology, premium components, and superior design for unmatched reliability and performance. We thank our stakeholders for their continued support as we uphold the industry’s highest standards and strongest quality controls to foster continual advancement and distinguish Adani Solar in the sector.”

5. Jakson Group, known for its integrated solar solutions, also passed 4 tests, missing TC, DH, and PAN. They offer services from manufacturing PV modules to executing turnkey solar power projects, ensuring reliable and efficient solutions.



Sundeep Gupta, Vice Chairman and MD, Jakson Ltd., said, “Kiwa PVEL’s

rigorous PQP testing highlights the reliability and quality of our modules. We are confident that this new listing will support our efforts to penetrate new markets, and accelerate the adoption of solar power.”

6. Goldi Solar is known for competitive pricing and high-efficiency solar panels. They offer EPC services and are an independent power producer (IPP), delivering cost-effective and reliable solutions. Goldi Solar made it to the list by passing 4 tests, missing MSS, HSS, and PAN.



Speaking about the recognition, **Capt Ishver Dholakiya, MD & Founder, Goldi Solar**, said, “We are a quality-driven company, renowned globally for our flawless customer satisfaction, superior products, and substantial investment in R&D and advanced technologies. Achieving the ‘Top Performer’ status in Kiwa PVEL’s Product Qualification Program validates our unwavering commitment to our customers. This accolade underscores our dedication to using cutting-edge technology and rigorous testing to support our contributions to the solar revolution, serving as a testament to Goldi Solar’s ongoing commitment to precision, durability, and customer satisfaction.”

What Does it Mean to Get Listed on the Scorecard?

Inclusion in the PVEL PV Module Reliability Scorecard holds great significance for manufacturers of photovoltaic (PV) modules, indicating that their products have undergone thorough testing and have met or exceeded the stringent performance and reliability criteria set by Kiwa PVEL.

In addition to this, there are other significant factors at play. Firstly, the Kiwa PVEL Module Reliability Scorecard serves as a globally recognized standard for assessing solar module quality, and earning a spot as a Top Performer serves as a validation of the quality and dependability of a manufacturer’s offerings. This recognition can accelerate market expansion and attract international buyers, as it acts as a testimony to the product’s performance, a crucial aspect for potential customers. Many buyers may prioritize manufacturers with PVEL qualifications when making their purchasing decisions.

This is particularly noteworthy for Indian manufacturers, with seven out of ten now featured on the list in recent years, showing the competitiveness of Indian products for the global market. Furthermore, five new entrants from India have emerged as top performers in the latest edition, joining the two from the previous year.