

Why Hail-Resistant PV Modules are Critical for Mitigating Increasing Hail Risks

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For any hailstone aficionados out there, it must be an exciting time. For everyone else, though, the increasing frequency and severity of hailstorms with larger and denser hailstones are causing concern and re-evaluation of PV product offerings.

Since the solar sector often bears the brunt of hail-damage-related costs, PV module manufacturers have been hard at work integrating advanced technologies and subjecting panels to rigorous testing to ensure stronger glass and frames, significantly reducing hail-related cracks, defects, and other damages.

Let's dig into what the *hail* is going on with the weather, how it's affected the solar industry, and the latest hail-resistant PV advancements available for utility-scale project developers and engineering, procurement, and construction (EPC) firms.

Bigger Hailstorms Bring Bigger Solar Damages

You might have seen the flood of recent news reports, videos, and pictures online chronicling devastating hailstorms and hailstones' growing size and thickness. There's a reason for that sudden uptick.

The 2023 summer hail season reported 540 hailstorms in June and 305 in July – both surpassing previous records by more than 200%.

This year has kept pace. A single day in mid-March broke the daily record with 106 hail reports. As of May, the country had already notched 317 storm spotters reporting hail larger than 2 inches, just over 50mm, in diameter.

These new record-setting events have severe financial consequences for the solar industry. The latest data shows that hail damage now accounts for 54% of solar's loss claims and averages about \$58.4 million per claim – despite representing a mere 1.4% of total claims filed.

This trend follows the trajectory of rising costs due to hail damage, which accounts for as much as three-fourths of total severe storm damage in any given year. Between 1980 and 1989, the National Oceanic and Atmospheric Administration (NOAA) reported only eight severe storms that each caused damages of \$1 billion or more (adjusted for inflation). In 2023, 19 severe storms causing \$1 billion or more in damages touched down in the country. Since 2019, there have been 67.

Expanding Prime Hail Conditions Overlapping Population Growth

Scientists have detected that the prime conditions for creating large hail are expanding out of the traditional hail-prone regions of the south and central Great Plains and spreading northward and eastward.

At the same time, populations spreading into formerly undeveloped areas are overlapping with these expanding prime conditions. This means that a hailstorm that touched down 20 or 30 years ago in a largely undeveloped area is now battering new communities, many with solar deployed.

As solar PV capacity increases and utility-scale solar installations expand their cumulative geographical footprint, the collective bullseye they make for hailstorms will grow.

Insurance Companies Reevaluating Hail Risks

The insurance industry is now reevaluating hail risk following 2023's record-setting destruction, which could lead to more stringent component procurement requirements, higher policy rates, or even a lack of coverage in hail-prone areas. Some insurance companies have even started conducting their own solar panel hail testing to evaluate performance and reliability.

While utility-scale project developers and EPCs have reason to be alarmed about hail's long-term impacts, they don't have to worry about finding PV modules that can withstand larger, denser, and faster hailstones.

Mitigating Utility Solar Climate Risks with Hail-Resistant PV Modules

At Trina Solar, we take hail risks to PV modules and the solar industry as a whole extremely seriously. Trina uses the most advanced PV manufacturing technology and conducts extensive in-house quality control and mechanical testing, including hail tests.

Trina also worked closely with VDE Americas, an industry leader in hail-impact analysis for PV modules. Using meteorological data and module hail test information, VDE's model calculates the expected hail damage to PV modules in an area to estimate the expected average annual loss (AAL) over the system's lifetime for replaced modules, added labor costs, truck rolls, etc.

VDE and Trina conducted studies modeling the expected AAL for projects in high, medium, and low hail zones with 2/2mm modules (industry standard) and 3.2mm/backsheet modules (our hail-resistant solution). Based on internal testing and to ensure the most value possible for customers by avoiding overbuilt products, Trina chose 3.2 mm/backsheet modules instead of other options. The 3.2mm/backsheet module is lighter than standard 2/2mm modules, providing additional logistics and shipping benefits and avoiding making life harder for installers or increasing labor costs. The 3.2mm/backsheet modules are also more robust than 2/2mm modules, allowing for higher design pressures that better withstand wind and snow loads without overbuilt racking.

With model assumptions using 100 MWdc and a \$0.51/W replacement cost (all-in cost: modules, in/out, disposal), Trina's 3.2mm/backsheet modules at a 60deg stow angle **saved more than \$1 million in AAL** compared to 2/2mm modules.

Additionally, all module models undergo rigorous third-party mechanical testing by leading global authorities like RETC and Kiwa PVEL to confirm their high reliability and performance.

Trina's 2/2mm Vertex modules showed **no defects** in tests with hailstone sizes:

- 45mm at a 50deg tracker stow angle
- 55mm at a 65deg tracker stow angle

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Hail risks aren't going away, but Trina is here to stay and aims to ensure your modules are, too.