Hailstorms & Solar Farms

A Holistic Framework to Assess the Risk Potential to Emerging Renewable Assets

Contributions from

Harsh Mistry[1], Tim Johnson[2], Sarah Bobby[2], and Karthik Ramanathan[2]

[1]Verisk Catastrophe and Risk Solutions, London, United Kingdom

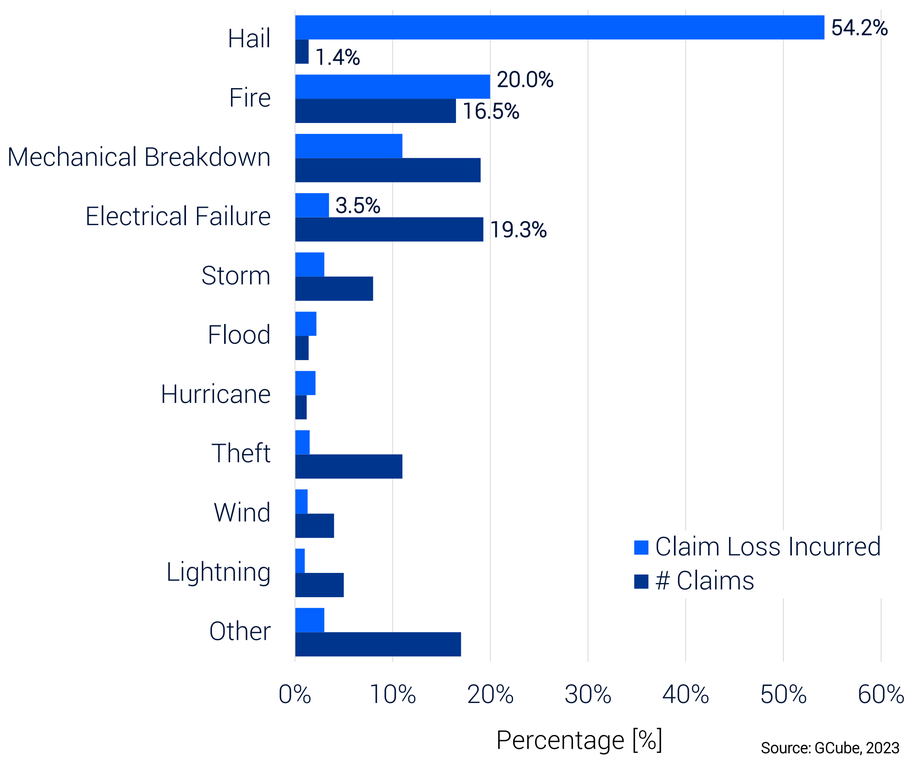
[2]Verisk Catastrophe and Risk Solutions, Boston, United States

Harsh Mistry
Research Associate
Model Product Management
hmistry@verisk.com

Hail Risk to Solar Farms in United States

Solar Farm Losses (between 2018-2023)

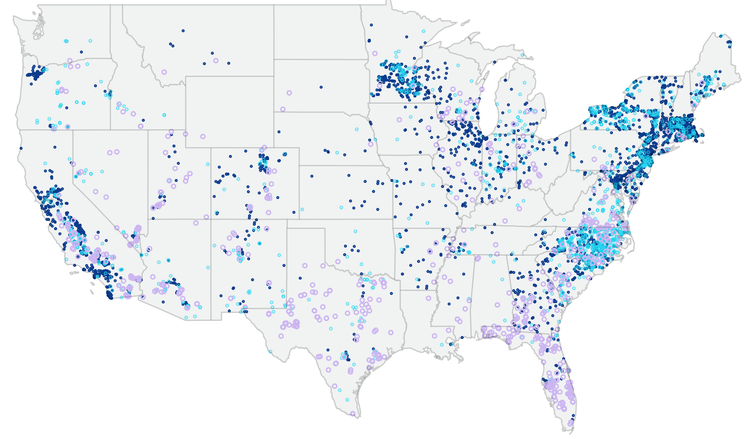
- Utility-scale solar projects are increasingly being sited in the Southern Great Plains and Upper Midwest—regions frequently impacted by severe convective storms and large hail—introducing a heightened risk to solar farms.
- While hail-related claims are less frequent than other sources of losses to solar farms, they accounted for nearly 50% of total claim severity for U.S. solar assets between 2018 and 2023.
- As solar capacity expands rapidly in hail-prone regions, understanding and quantifying hail risk has become critical for developers, investors, and (re)insurers to ensure project resilience and financial sustainability.



Source: GCube, 2023

Utility Scale Solar Farms Across United States

- Utility Solar Small Energy Risk
- Utility Solar Medium Energy Risk
- Utility Solar Large Energy Risk

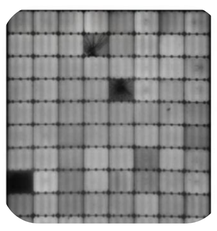


Source: EIA, 2024

Verisk Hail Simulation Framework: A Component-based Approach

Typical Hail Damage to Solar Panels

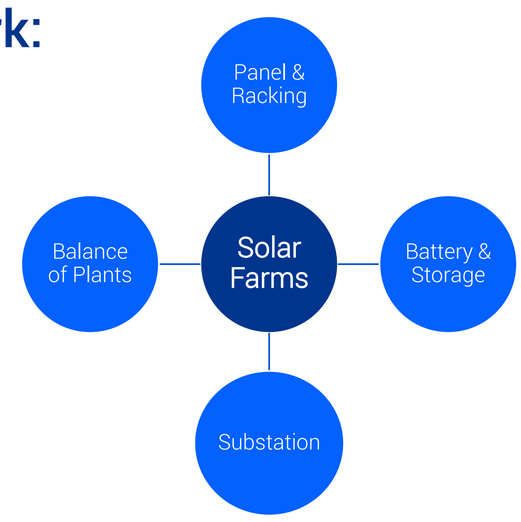
Micro-cacking of solar cells (invisible damage)



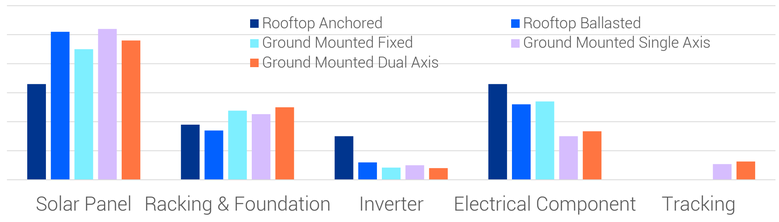
Glass cracking due to hail impact (visible damage)

Glass breakage due to hail impact (visible damage)

Source: Core Energy Works (left and centre); The Drone Life (right)

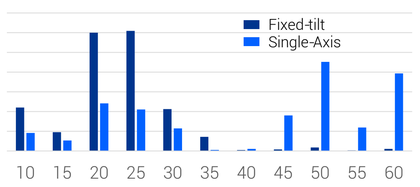


Component-Cost Distributions



Source: NREL, 2023

Farm-specific Tilt Angle Distributions



Source: EIA, 2023

Verisk's Hail Simulation Engine

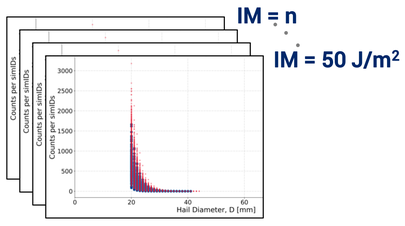
Synthetic Event Set Generation

Hail stones size and count **x** Duration

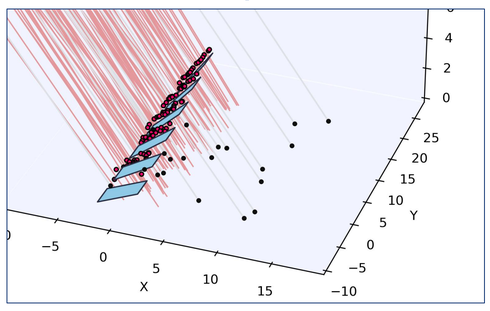
Pool of events with varying intensity

Sample event for each intensity level

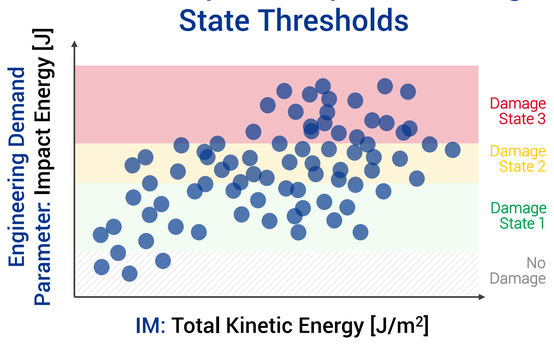
Synthetic event reflecting a specific intensity level



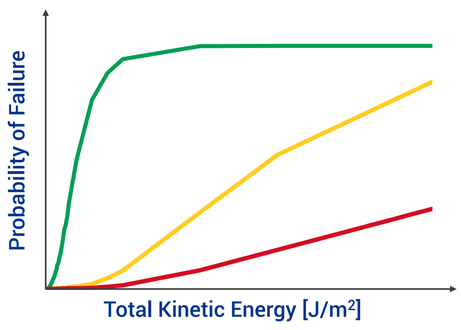
Assess Hail Impact from each



Define Component-specific Damage State Thresholds



Component-Level Fragility Functions



Account Impact from vertical and horizontal kinetic energy

Account Impact from all directions

Accounts wind speeds that have observed in US

Farm-Level Damage Functions

$$Farm\ Damage\ Function = \sum_{component_i,}^{n=all\ farm\ components} \frac{C_i}{\sum_j C_j}\left(\sum_{k=1}^{K_i}(P[DS \geq k|\ IM] - P[DS \geq k+1\ |\ IM])\right)$$

Key Takeaways

- Verisk's holistic framework delivers a more physically representative and granular understanding of hail risk for solar farms.
- By integrating engineering, cost, and observational data, the framework provides (re)insurers, asset managers, and solar farms developers with an effective tool for assessing and managing hail-related exposures in the growing U.S. solar market.
- Advances traditional modeling by integrating component-level resistance, component-specific damage mechanisms, configuration-specific tilt angle effects, and total kinetic energy to represent impacts from a realistic distribution of hail sizes.
- Verisk incorporates the use of total kinetic energy for quantifying the hail intensity experienced by the structures. This enables modelling of explicit impact dynamics as observed during real hailstorms.

References

1. GCube. (2023). Hail no! Defending solar from nature's cold assault: Q4 2023 GCube report.
2. Ramasamy, V., et al. (2023). Q1 2023 U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks With Minimum Sustainable Price Analysis Data File - National Renewable Energy Laboratory.
3. Energy Information Administration (EIA): Solar Utility Report 2024

©2025 Verisk Analytics, Inc. All rights reserved.

Verisk™