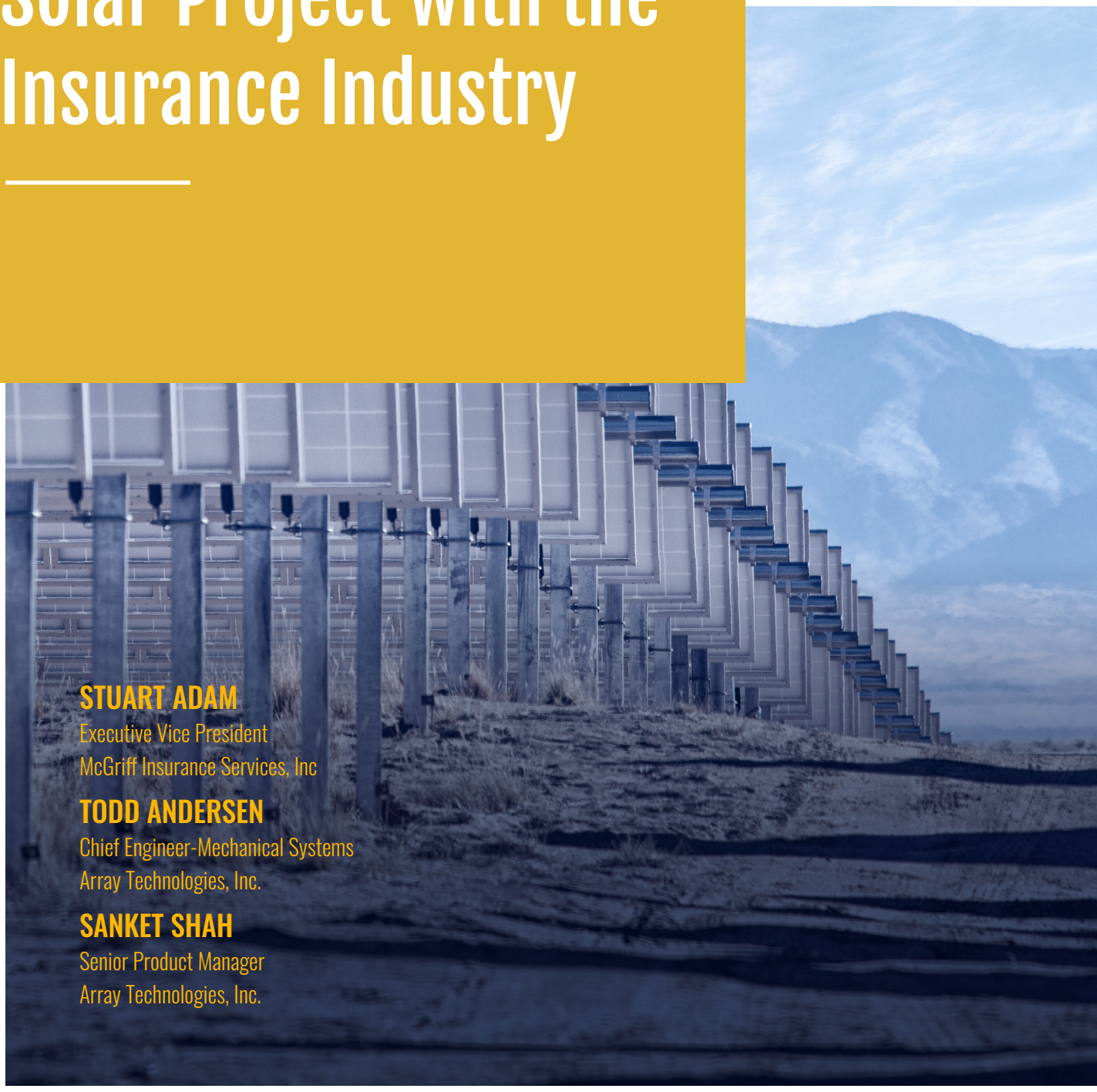
Hail Risk Mitigation to Differentiate your PV Solar Project with the Insurance Industry



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INTRODUCTION

As large-scale photovoltaic (PV) solar sites expand around the globe, insurance underwriters along with site developers, investors, and owners are dealing with the uncertainty of potential catastrophic losses from major weather events; most notably, hail and associated high winds. Recent industry loss data for hail damage indicates an uptick in the frequency of attritional loss and emerging catastrophic losses in the tens of millions of dollars, and a disastrous $75M+ loss at one facility in Texas.

Catastrophic hail is one of the biggest exposure challenges the insurance market is addressing due to its severity. Tools for modeling are limited, probability analysis is insufficient, and the historical data is nonexistent. The existing pool of premium does not support the actual/anticipated losses, so the market is raising premiums, increasing deductibles, lowering limits offered, and even declining to participate on certain projects.

As insurance rates have jumped as much as 400% over 18 months[1], developers and owners find themselves bearing the full weight of damage to assets or paying demonstrably more than project budgets allow.

While the insurance industry is adapting their product to the reality of the loss data, it is important that all stakeholders in the solar chain help establish a credible path toward greater certainty of terms and pricing.

In light of this need for partnership, McGriff believes there are opportunities for greater communication and data sharing to allow underwriters to have tools of differentiation among those owners/developers who are implementing best practices in hail risk management.

McGriff is working with clients and their key vendors to partner with insurance carriers and their engineering teams to build confidence in these best practices and their favorable impact on potential hail damage.

One such example is the inclusion of Array Technologies, a leading provider of tracker technology, in a recent pre-renewal process to help convey critical technical and engineering data for their product. Effective communication and partnerships in this area created a critical path for lead renewable markets to deploy pricing and capacity where they might not have been interested otherwise.

1. *PV Magazine Article: Extreme Weather is causing Solar Insurance Premiums to Explode*

WHY ARE TRACKERS CRITICAL COMPONENTS FOR HAIL RISK MANAGEMENT BEST PRACTICES?

As of now, **any** solar tracker is seen as a favorable feature for a solar site regarding insurance risk. However, not all tracker technology is equal in its structural integrity or its default response to high wind and hail events.

VDE Americas, an independent engineering firm, recently investigated various severe weather scenarios involving hail and PV solar. In this technical memo, VDE examined how different hailstone sizes and wind speeds have varying effects on solar modules and cells.

The transfer of kinetic energy from falling hailstones to the PV panel upon impact is defined as "impact energy." Damage can be obvious to the naked eye when glass is broken from wind torsion or direct hail impact, but it can go undetected when solar cells suffer microcracks that are only discovered with a power test showing diminished output, long-term degradation, or hot spots over time.

As a best practice, VDE recommends tilting away from the wind, reducing the risk of hail damage by decreasing impact energy.

The report notes that in real-world settings, hail events typically occur with severe thunderstorms accompanied by strong winds ranging from 40 to 100 mph. "Thus, a large range of wind speeds should be considered when evaluating mitigation strategies." This is consistent with information provided on wind and hail from the National Weather Service[2].

2. weather.gov

BEST PRACTICES TO MITIGATE HAIL AND WIND DAMAGE

When tilting PV modules **52 degrees away from the wind** is considered across a range of wind speeds, increasing wind speeds actually **result in decreasing hail impact** energy, as shown in the figures below.

This is in line with Array Technologies' centralized single-axis tracker response for hail and high wind events. Array's tracker can be positioned at a high tilt facing into or away from the wind, but as a best practice, away from the wind is recommended during these events.

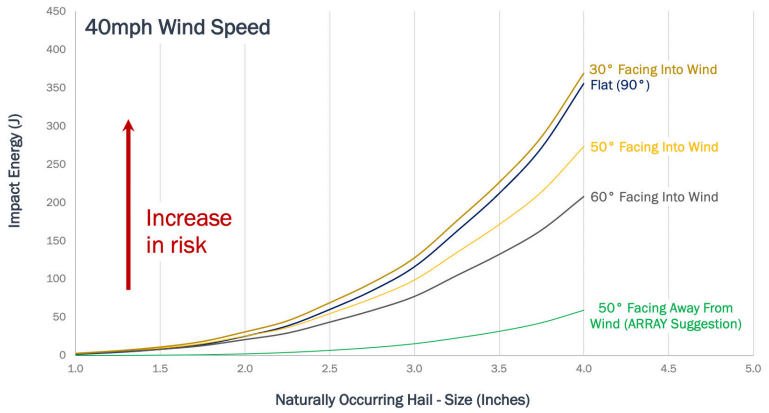
On the other hand, decentralized tracker systems employ a complex series of sensors to actively stow trackers during wind and hail events. This alone can be problematic, as thousands of interconnected components have a higher chance of failing (especially during adverse weather).

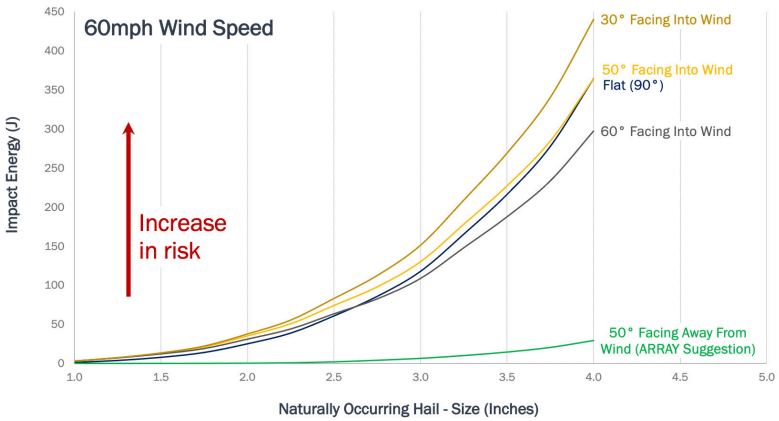
Beyond this, these trackers are stowed facing **toward the wind** to mitigate hail damage. The VDE report clearly shows that smaller, **lighter hailstones are actually more affected by wind** because the wind carries and whips them faster. Consequently, **tilting toward the wind results in greater hail impact energy and more damage.**

It's also important to distinguish between what it means to design for full-site wind speed versus designing for stowing at a low tilt angle. The reason Array's tracker solutions can face away from the wind at 52 degrees is the tracker was designed to handle full-site wind speed at any angle.

Array's trackers are well known for being robust in wind. Array Technologies' engineers test both the downforce and the uplift for site-specific conditions. This is a unique and rigorous testing procedure and comes into play when modules are facing away from the wind and experiencing more uplift wind forces. As such, Array's clamp technology also goes through rigorous testing.

Modules positioned facing in the opposite direction (away) from the wind show significantly reduced impact energy even at larger hail size compared to the one facing into the direction of the wind.





INSURANCE REPRESENTATIVES' PERSPECTIVE ON HAIL RISK

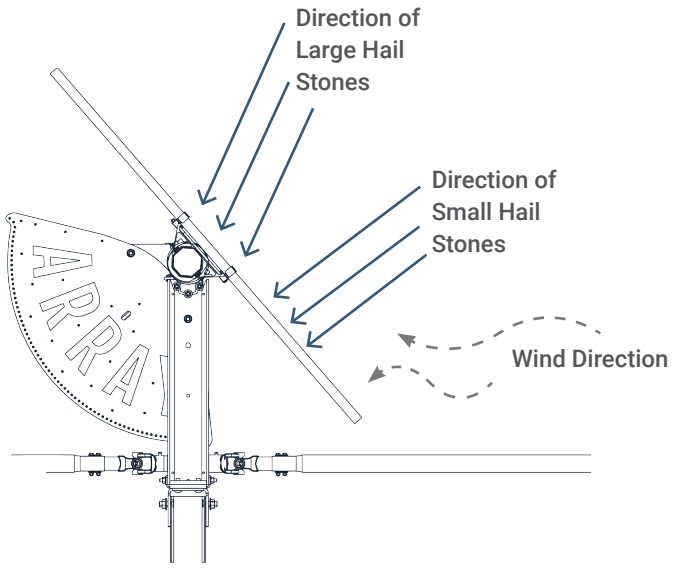
Insurance markets have confirmed to McGriff and their clients that overall hail modeling needs to improve in order for them to better differentiate the cost and terms associated with the exposure for any one project. While in its early stages, insurers and brokers are working with catastrophe modelers to include secondary data, such as tracker utilized, to allow for a more accurate risk profile.

Underwriters remain focused on improvement in their underwriting portfolio and ensuring projects are using best available hail mitigation practices like the Array Technologies' tracker platform.

One lead renewable carrier commented that they were hopeful to plug critical secondary data for a project into modeling systems in time. This would allow for more straightforward equations, e.g., "X technology solutions used in Y location will likely experience Z in terms of hailstone size and recurrence."

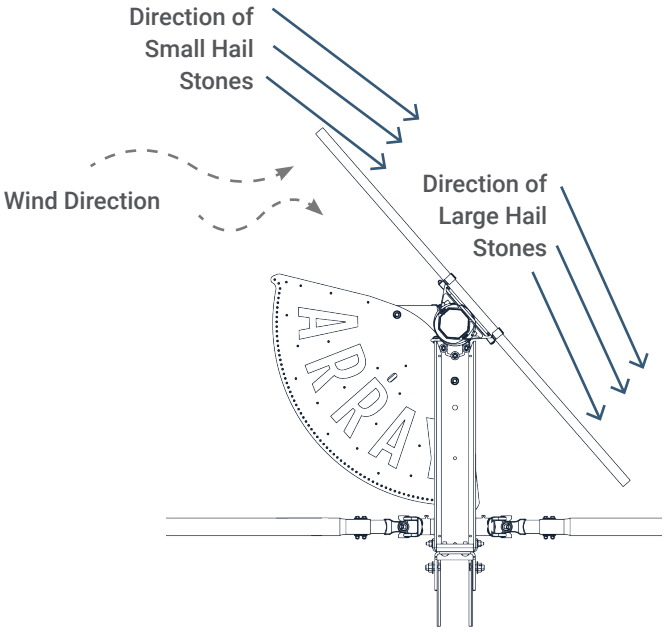
Despite not having the perfect hail model at this time, underwriters remain focused on improvement in their underwriting portfolio and ensuring projects are using best available hail mitigation practices like the Array Technologies' tracker platform.

HAIL & WIND SCENARIOS



TRACKER FACING INTO THE WIND

- Direct impact of hail onto modules
- High risk of damage to modules



TRACKER FACING AWAY FROM THE WIND

- Hail impact mitigated to a glancing blow
- Reduced risk of damage to modules
- Designed to handle full-site wind speed at any angle

CONCLUSION

Insurers are interested in the differences between tracker technology strategies. The only way to establish more accurate baselines is to create more working examples and collect the data. Tracker manufacturers using the best practices detailed above must keep communication lines open between themselves and insurers about these real-world use cases and the information extracted from them.

There is an ability to modify inputs for insurance models with better data via secondary modifiers. Continuing to establish the above tracker best practices will create more specific secondary modifiers. These adjusted modifiers yield more accurate risk results when plugged into modeling systems. This will allow estimates closer to reality, mitigating more risk than using just **any** tracker system, and will help restore equilibrium in the PV insurance dynamic.

More granular input data for these site specifics and the risk mitigation solutions will help insurers build out their knowledge over time. This will result in a more accurate picture of project performance variables with different tracker technologies. As illustrated, **not all trackers are created equal.** These differences in design and risk mitigation execution must be considered for the best operational lifetime of any solar plant. Request the full VDE report on hail risk mitigation here. For more information on Array Technology's risk mitigation or to talk through details for your upcoming PV project, please contact us directly at arraytechinc.com.

> **If you would like to further discuss on-the-ground implications of these concepts for your solar project, Array Technologies has dedicated teams ready to assist. Please reach out to us here to discuss your individual project questions.**

GLOBAL HEADQUARTERS

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Stuart Adam is a client advocate that ensures customers obtain the highest level of service response in all aspects of daily brokerage activities. With over 29 years in the energy insurance industry, Stuart has experience in all aspects of complex program structuring, unique coverage development, alternative marketing strategies, claims advocacy and company collaboration. Stuart has managed programs across the whole energy spectrum for some the largest energy providers in the world and currently helps lead McGriff Energy renewable service platform and account manager development.

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Sanket Shah is responsible at Array Technologies for driving product innovation, with a focus on the development and launch of advanced controls and software products. Sanket's main responsibility is to bring the customer voice into Array's product development. With 10 years' experience in solar industry, the majority of his experience has been in solar plant design and development. He previously was employed at SMA America and Power Electronics, an influential inverter manufacturer, as an applications engineer. Sanket has a Masters in Science from NYU in Power Systems Engineering.

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Todd Anderson is responsible for leading engineering efforts to study the dynamic behavior of single-axis solar tracker systems at Array Technologies while driving the continued reliability of Array' best-in-class solar tracker products. Todd brings over a decade of renewable experience to Array, drawing upon his years of experience in wind turbine support with GE Renewables. Todd holds a Masters Degree in Mechanical Engineering from Brigham Young University, with an emphasis in non-linear finite element simulation and structural dynamics.