

Severe Weather Risk Assessment Preliminary Guidance for Proactive Procurement Strategies

Dominic Cartina and Angad Sachdeva | Apex Clean Energy



I. Introduction

- Severe weather events and their associated risk for operating solar assets has been a trending topic in the industry for several years. The continued rise in concern can be attributed to the rapid increase in recent solar project deployment, especially in regions prone to extreme weather events such as hail, and related reports of substantial property damage and financial loss at multiple facilities.
- In an effort to account for the risk of severe weather, and ensure our projects are properly equipped to mitigate that risk, Apex Clean Energy has developed an actionable methodology for a project's early stage to quantify risks from localized damaging wind, hail, and tornadic events, resulting in recommendations for appropriate technology and design choices.
- While the industry possesses several trusted consultants capable of providing highly detailed severe weather risk assessments during a project's financing or later stages, having the ability to determine this risk during the early-stages of a project is uniquely useful in guiding more accurate engineering and equipment sourcing decision-making.

II. Methodology

- Using publicly available data from NOAA's National Weather Service Storm Prediction Center, a 24-year climatology was developed for the individual severe weather event categories. The data is then processed using the geographic coordinates of the project under consideration, and the events are localized within a 40km radius of the provided coordinates.
- To account for dataset population bias at extremely rural project locations, Apex Clean Energy has established a distance threshold for project coordinate inputs to capture a more representative severe weather threat.
- Following the data localization, distinct severe weather events due to wind, hail, and tornadoes near the project are defined, resulting in the quantification of annually anticipated severe weather event days and a classification for the project's exposure risk.
- Project-specific mitigation recommendations are then provided for both modules and tracking systems. For an indicative process workflow, see Figure 2.1 below.



Figure 2.1

III. Existing Tools and Population Bias

- A commonly used resource for gauging severe weather risk is the National Risk Index (NRI) platform provided by FEMA. While this online, interactive tool is user-friendly and comes at no additional cost, it lacks the level of precision necessary for proactively determining a project's equipment considerations.
- The NRI tool produces risk results for numerous categories on a per county basis and predominantly relies on existing loss claims. The quantity of county-level loss claims are highly correlated with population density; therefore, this approach can be biased against capturing weather-related risk in sparsely populated areas.
- An example of this bias is evident when referencing three Apex Clean Energy solar projects that span across the adjacent Bell, Falls, and Milam counties in central Texas. The population of these counties are 393,193, 17,286, and 25,951, respectively (see Figure 3.1).
- Additional research into the existence of population bias within the FEMA NRI tool was performed through a hail-focused comparative analysis using seven Apex Clean Energy solar project locations across the continental United States possessing a wide variety of county-level population metrics (see Figure 3.2).
- This analysis yielded results confirming that population bias is evident in more rural locations with lower population densities. Furthermore, this comparison also confirmed that the FEMA NRI tool is well-aligned with Apex Clean Energy's approach for project locations nearer to population centers. This is evident in the results for Hinds County, MS (Jackson) and Adams County, CO (Denver).

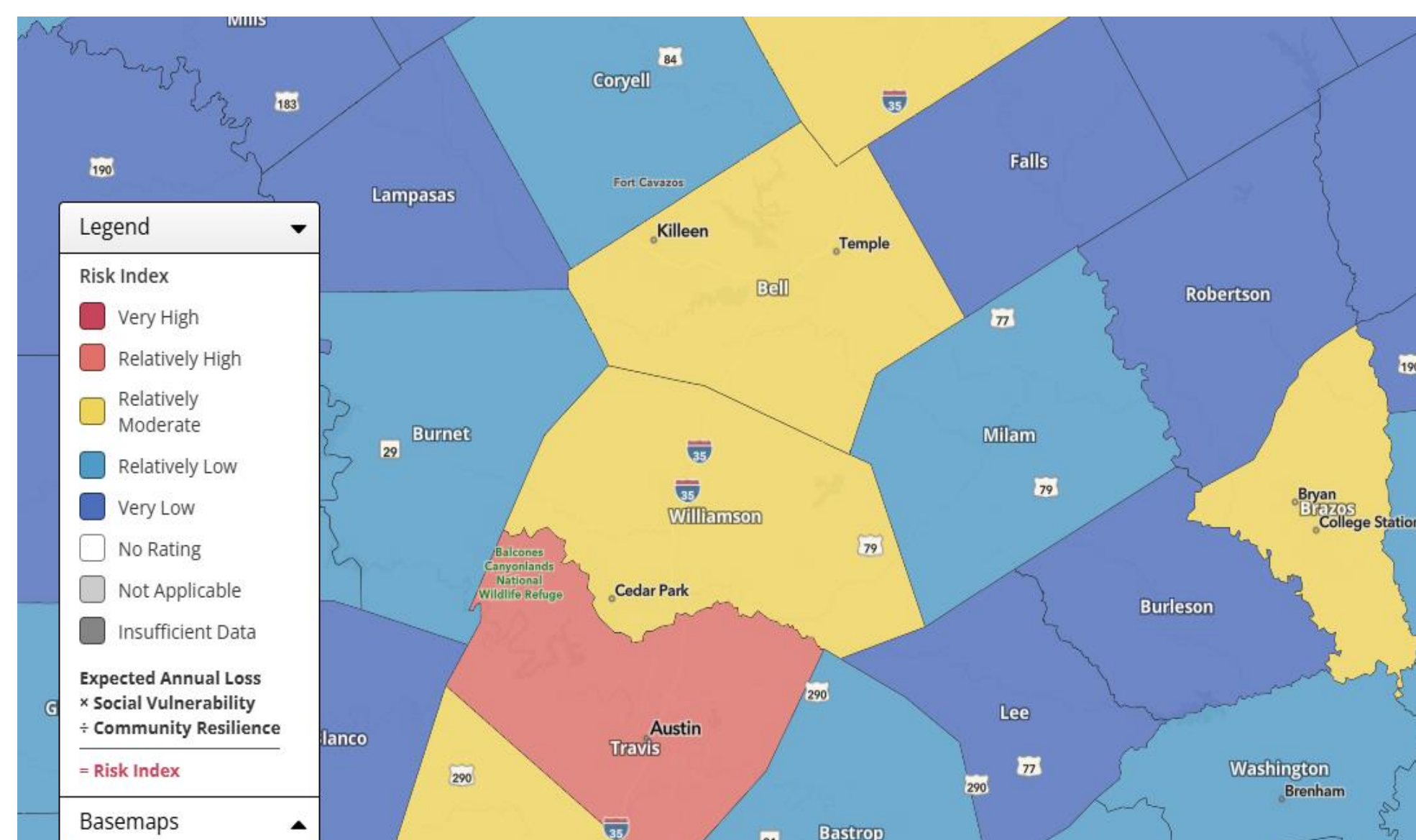


Figure 3.1

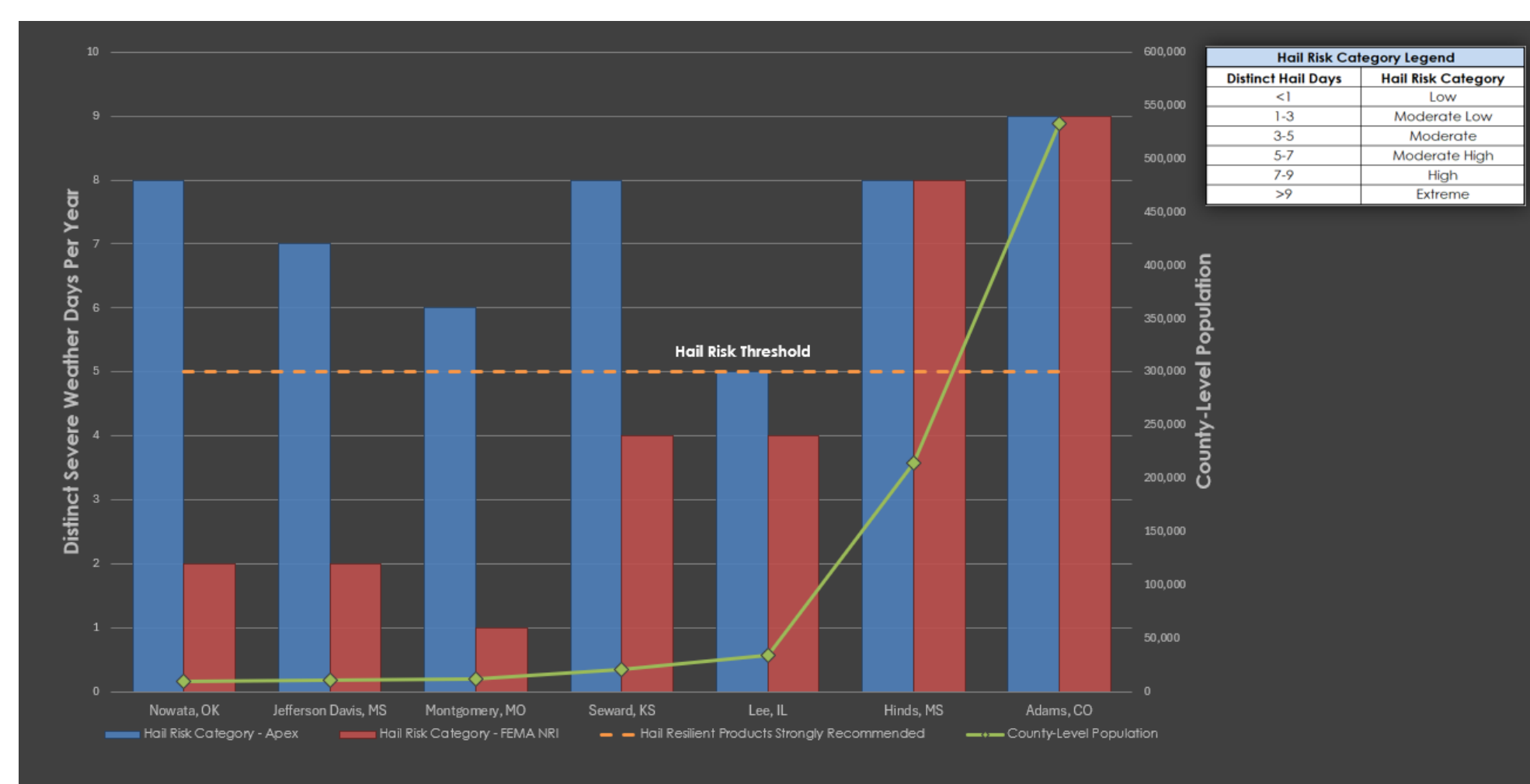


Figure 3.2

IV. Case Study and Results

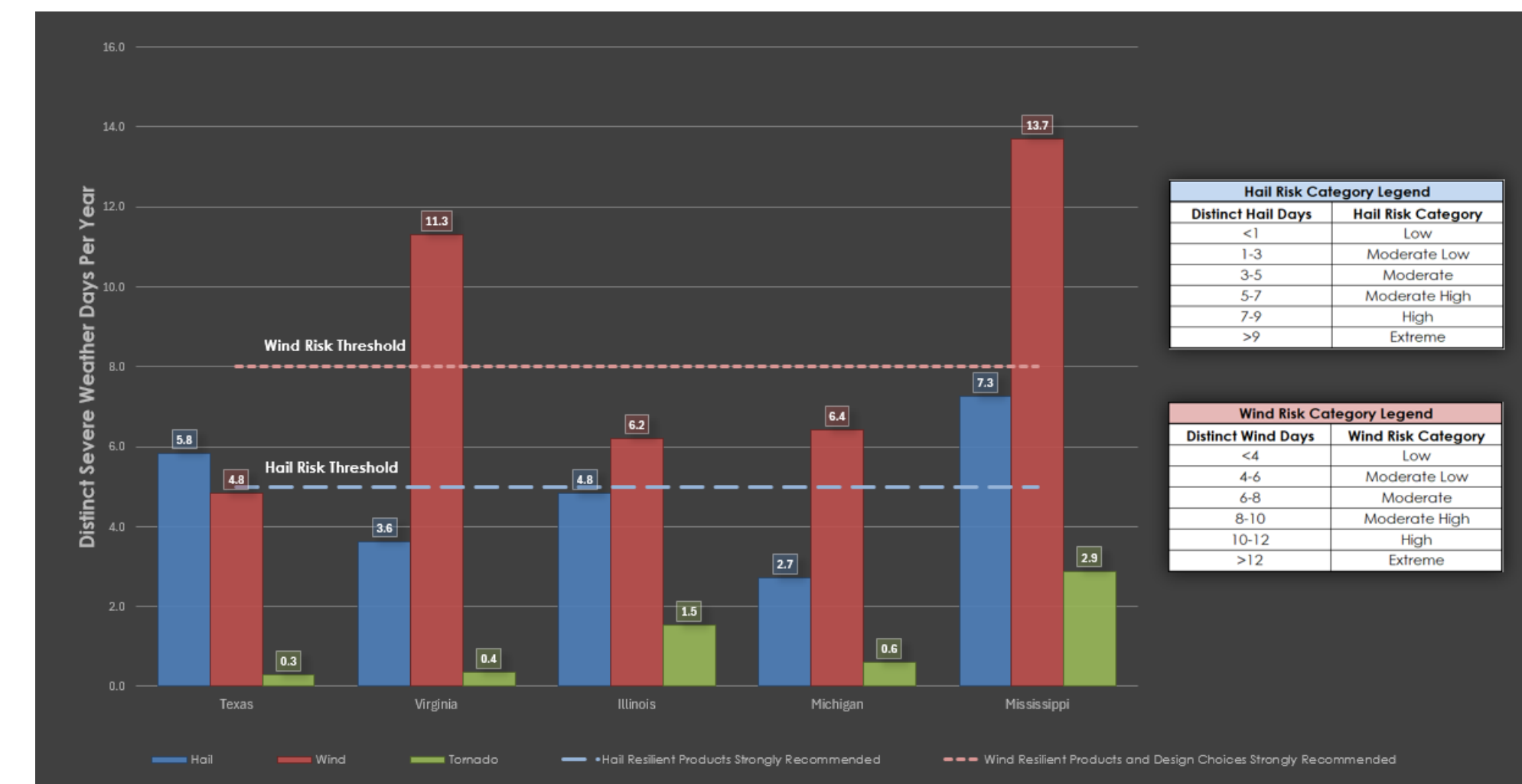


Figure 4.1

- Five Apex Clean Energy solar project locations with varying geographies and climatic conditions were analyzed for severe weather risk using our detailed methodology.
- Two of the five selected projects required input coordinate modifications within the established threshold to properly account for population bias and provide results with a higher level of accuracy (Michigan and Texas in Figure 4.1)
- Following the tool's quantification of annually anticipated severe weather event days and classification for the individual project's exposure risk, mitigation recommendations were provided for both the modules and tracking system; thus, providing insight at an early-stage and recommending risk-specific procurement options to ensure our projects are equipped with the appropriate technology to minimize weather risk.
- Illinois & Michigan:**
 - Minimum Exposure Risk**
 - All modules and tracking systems are approved for consideration.
- Texas:**
 - High Hail Exposure Risk**
 - Smaller format and/or thicker glass modules
 - Hail resilient modules with validated testing
 - Steeper tracker stow angles
 - Hail stow protocols with prompt response times
- Virginia:**
 - High Wind Exposure Risk**
 - Smaller format and/or thicker framed modules
 - More robust clamping systems
 - Wind stow protocols with prompt response times
- Mississippi:**
 - High Hail and Wind Exposure Risk**
 - Smaller format modules
 - Thicker module framing and glass
 - Steeper tracker stow angles
 - Hail and wind stow protocols with prompt response times

V. References

- [1] NOAA/NWS Storm Prediction Center. (2011). Noaa.gov. <https://www.spc.noaa.gov/>
- [2] FEMA. (2023). National Risk Index. Hazards.fema.gov. <https://hazards.fema.gov/nri/map>
- [3] magazine, pv. (2025). The benefits of hail and wind resistant solar modules. Pv Magazine International. <https://www.pv-magazine.com/webinars/the-benefits-of-hail-and-wind-resistant-solar-modules/>
- [4] Nikky V. (2025, April 22). Case Study: Hail Stow Tech Cut Insurance Deductible by 50% - kWh Analytics. kWh Analytics. <https://kwhanalytics.com/case-study-hail-stow-tech-cut-insurance-deductible-by-50/>