

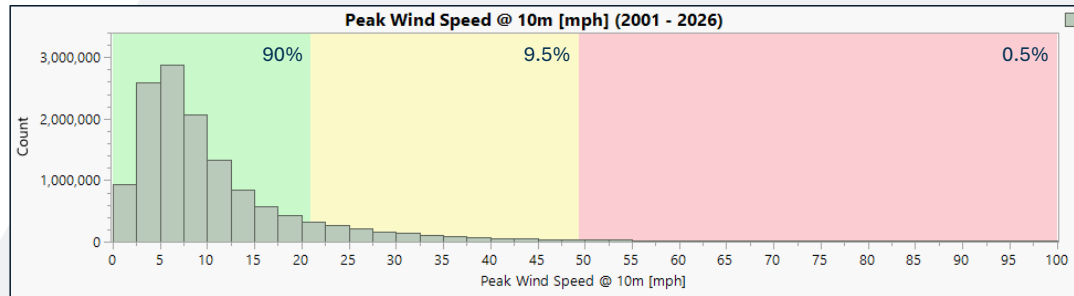
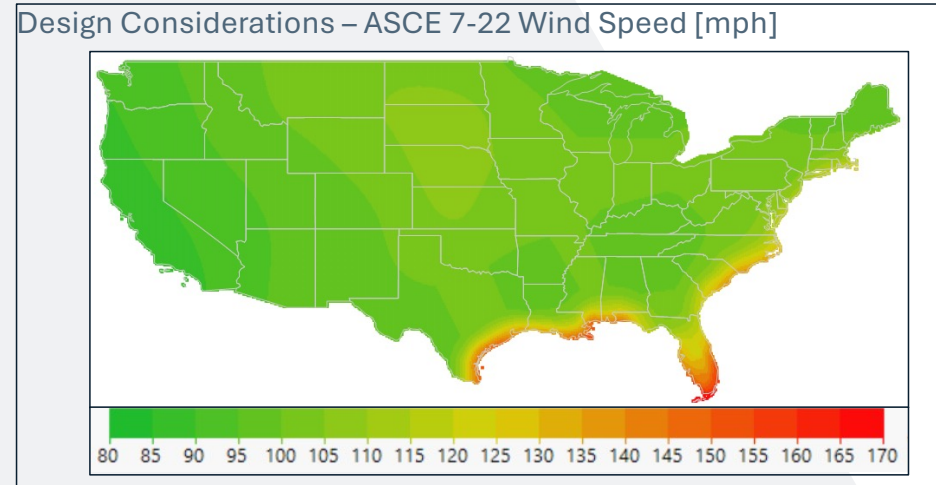
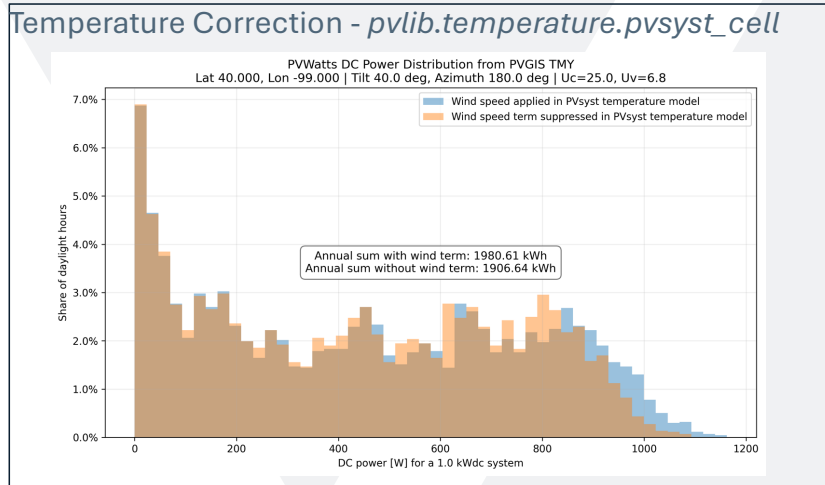


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**A Framework  
for Modeling  
Wind Stow  
Losses**

# How does the solar industry account for wind?

Most common considerations for wind are to temperature correct or design the system



Distribution of NLR Flat Irons 1 minute Peak Wind Speed 10m (2001-2026) – NWTC MIDC

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# On Site Observation of Wind Stow



- ▶ Exterior row stowed at 58mph
- ▶ Second row did not stow
- ▶ No interior row stowing

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# Wind Stow Modeling

# Inputs to Wind Stow Modeling

The Industries Infrastructure for Modeling Wind Stow Losses is Limited in Capability

Wind Data



Stow Algorithm

$$\text{Tilt Angle} = \begin{cases} \text{Stow Angle,} & \text{if } WS > U_{cr} \\ \text{Tilt Angle,} & \text{Otherwise} \end{cases}$$

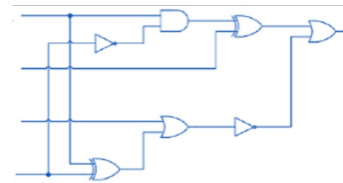
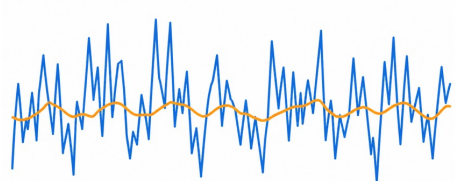
Framework for Analysis

Special Behaviours

- Backtracking ?
- Irradiance optimization
- Wind stow

Wind speed threshold  m/s

Wind stow position  °



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# Comparison of Wind Data

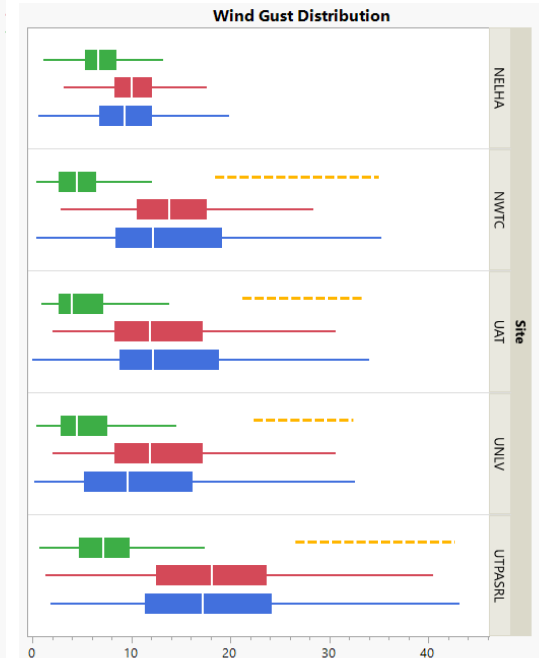
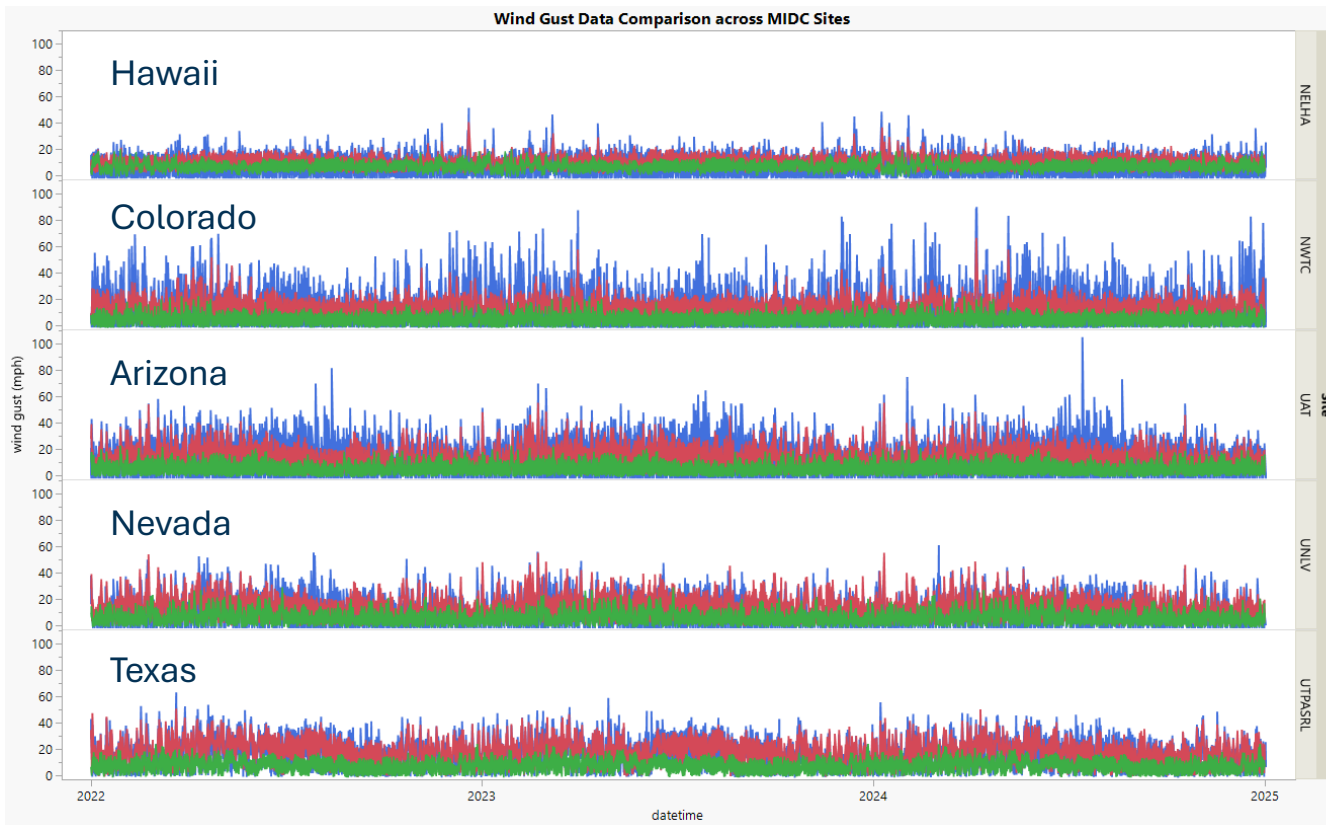
5 MIDC Sites with 1-Minute Actual, 5-Minute Historical, 1-Hour TMY [2022-2025]

source

Actual MIDC

Timeseries

TMY

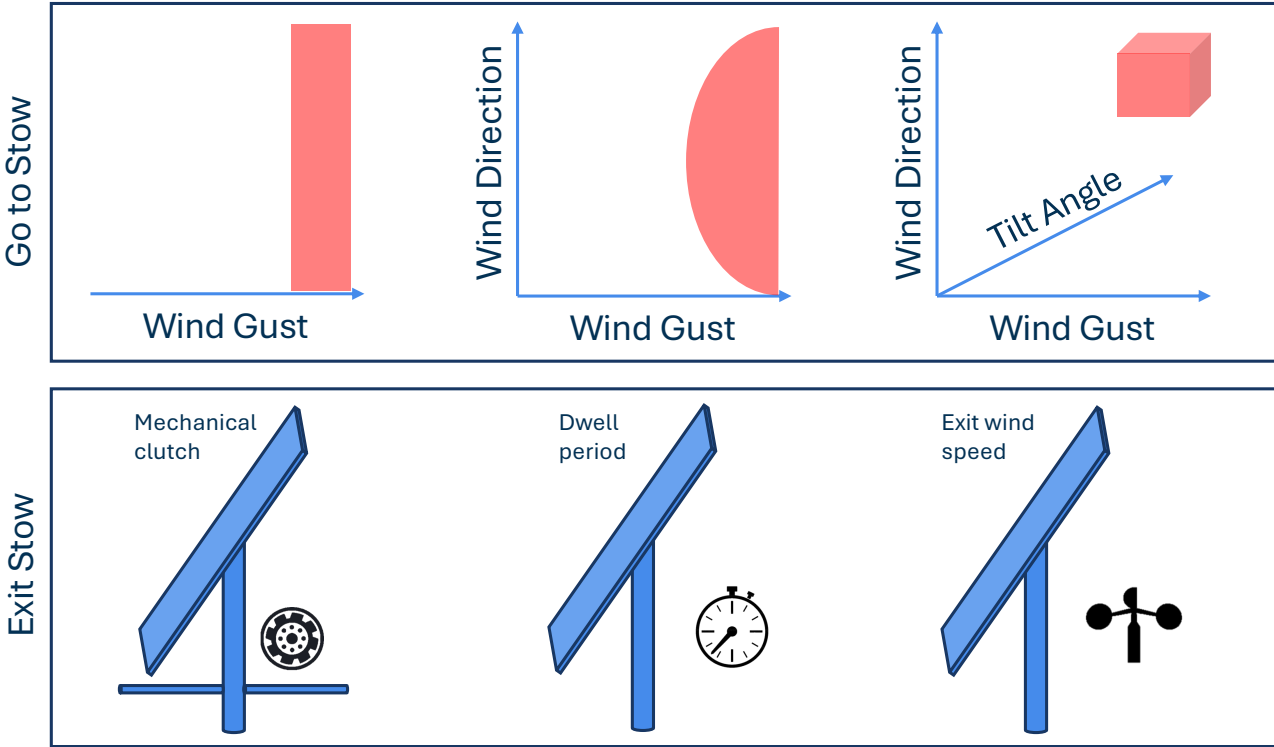


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Stow Trigger

# Wind Stow Algorithmic Landscape

Energy Prediction Software Need to Handle Tracker Stow Logic Complexity



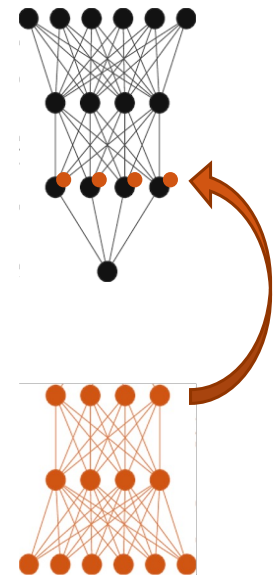
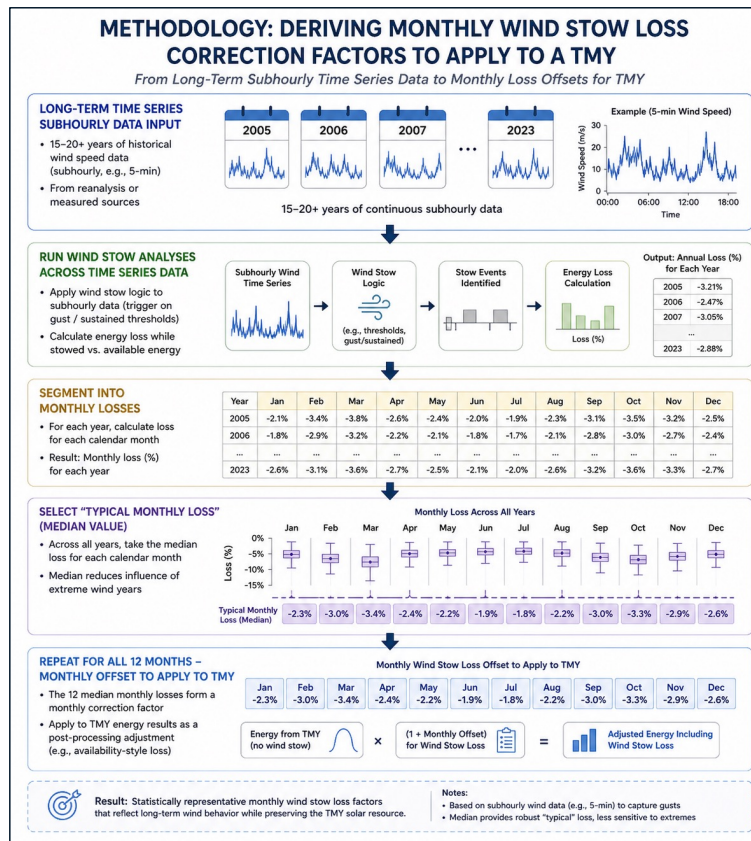
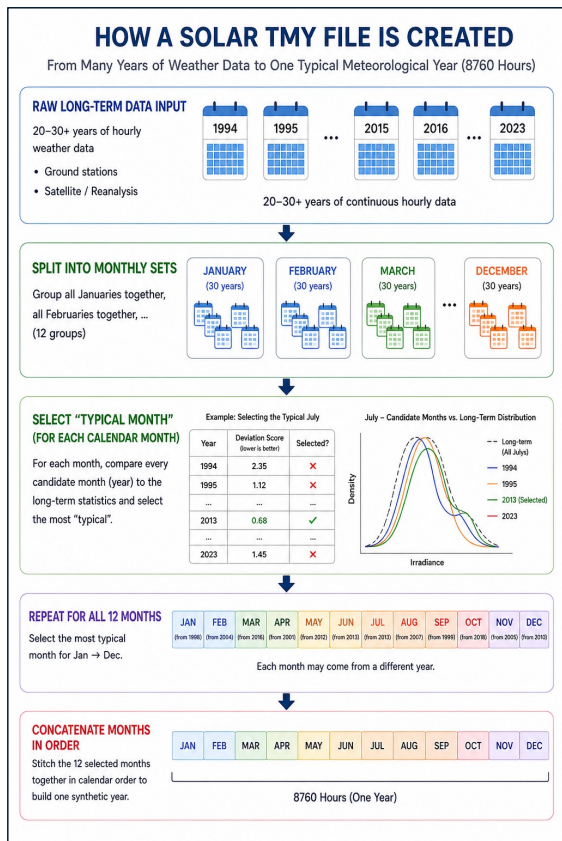
Additional Considerations  
 - Exposure Segmentation  
 - Multi-tiered Stow Triggers

	Wind Stow Functionality	Custom Tracker Import	Sub-Hourly Capability
3E			X
SAM	X	X	X
Plant Predict	X	X	X
Rated Power			X
Pvsyst	X		X
Solar Farmer		X	X
Solargis			X

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# Framework Proposed

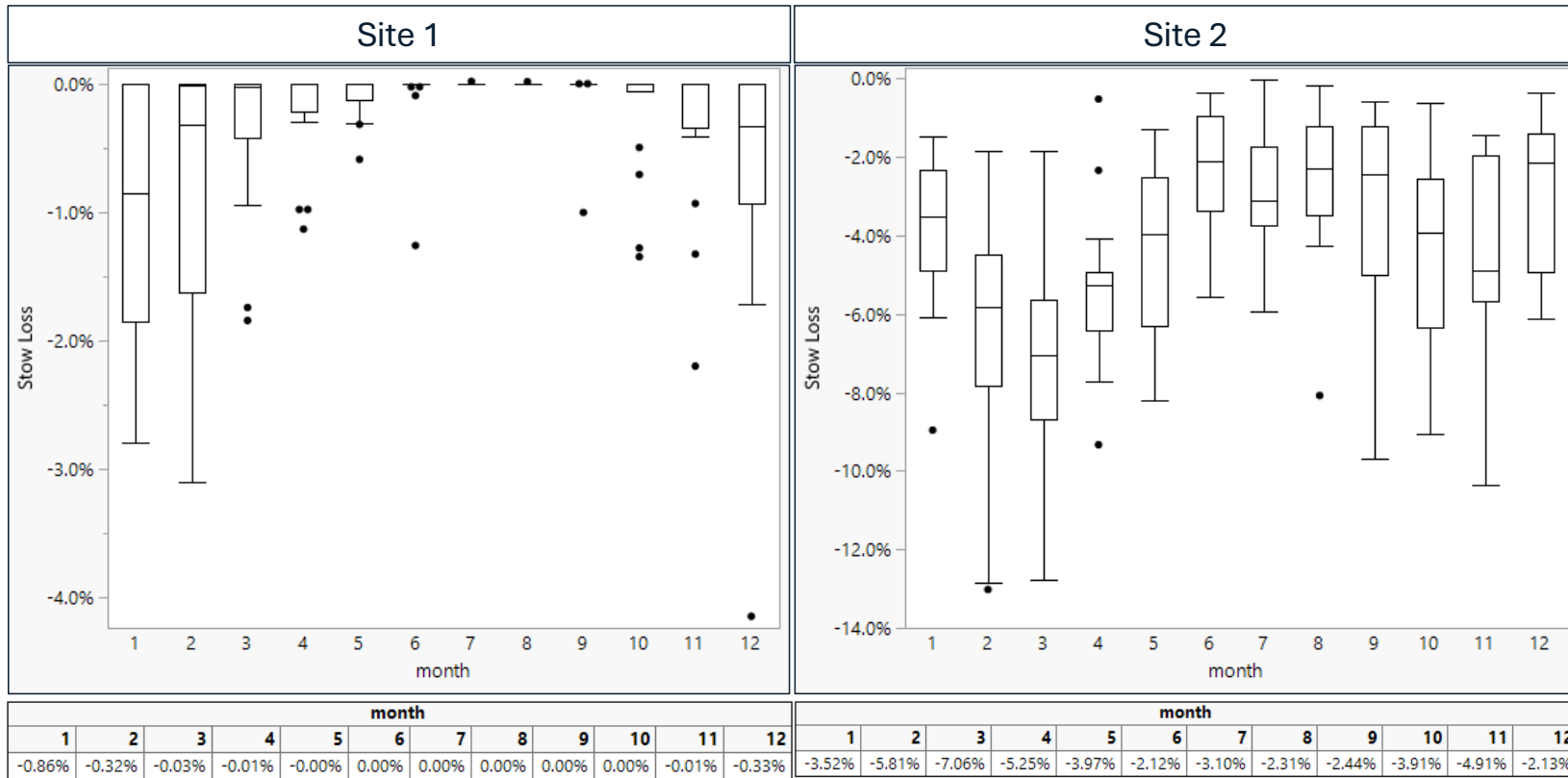
Wind Stow Losses Require a Framework of Processing to Align to TMYs



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# Multi Year Analysis of Test Sites

Multi Year Stow Analyses Expose Annual and Seasonal Variation – 2 Example Sites [2007 – 2025]



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# Loss Modeling Compared to Site Wind Data

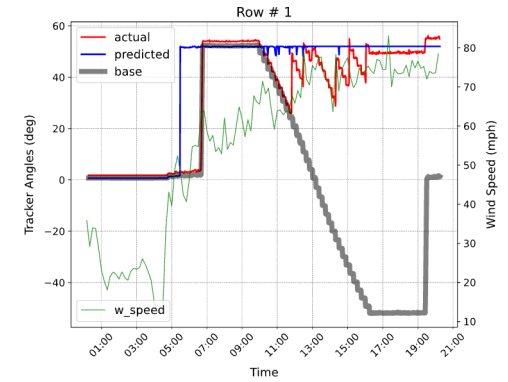
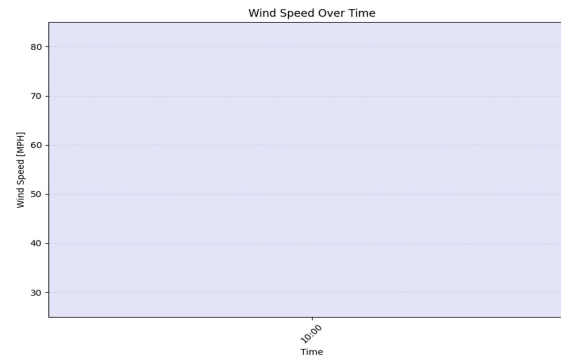
Passive ARRAY	Site Loss	Timeseries Loss	TMY Loss	TMY Durst Loss
Colorado	-0.22%	-0.03%	0.00%	0.00%
Hawaii	0.00%	0.00%	0.00%	0.00%
Arizona	-0.03%	-0.05%	0.00%	0.00%
Nevada	-0.01%	-0.05%	0.00%	-0.02%
Texas	-0.14%	-0.01%	0.00%	0.00%

Active ARRAY	Site Loss	Timeseries Loss	TMY Loss	TMY Durst Loss
Colorado	-0.94%	-0.16%	0.00%	-0.20%
Hawaii	-0.03%	0.00%	0.00%	0.00%
Arizona	-0.66%	-0.10%	0.00%	-0.10%
Nevada	0.00%	-0.11%	0.00%	-1.21%
Texas	-1.19%	-0.49%	0.00%	-0.48%

Active 28mph	Site Loss	Timeseries Loss	TMY Loss	TMY Durst Loss
Colorado	-2.05%	-0.64%	0.00%	-0.10%
Hawaii	-0.24%	-0.15%	0.00%	0.00%
Arizona	-4.00%	-1.29%	0.00%	-0.02%
Nevada	-0.32%	-1.36%	0.00%	-0.70%
Texas	-10.32%	-9.91%	0.00%	-0.19%

Average	Passive	Active	28mph
Site Loss	-0.08%	-0.56%	-3.39%
Solcast Loss	-0.03%	-0.17%	-2.67%
TMY Loss	0.00%	0.00%	0.00%
TMY Durst Loss	-0.00%	-0.40%	-0.20%

	Timeseries to Site	TMY to Site	TMY Durst to Site
MAE	0.48%	1.24%	1.22%

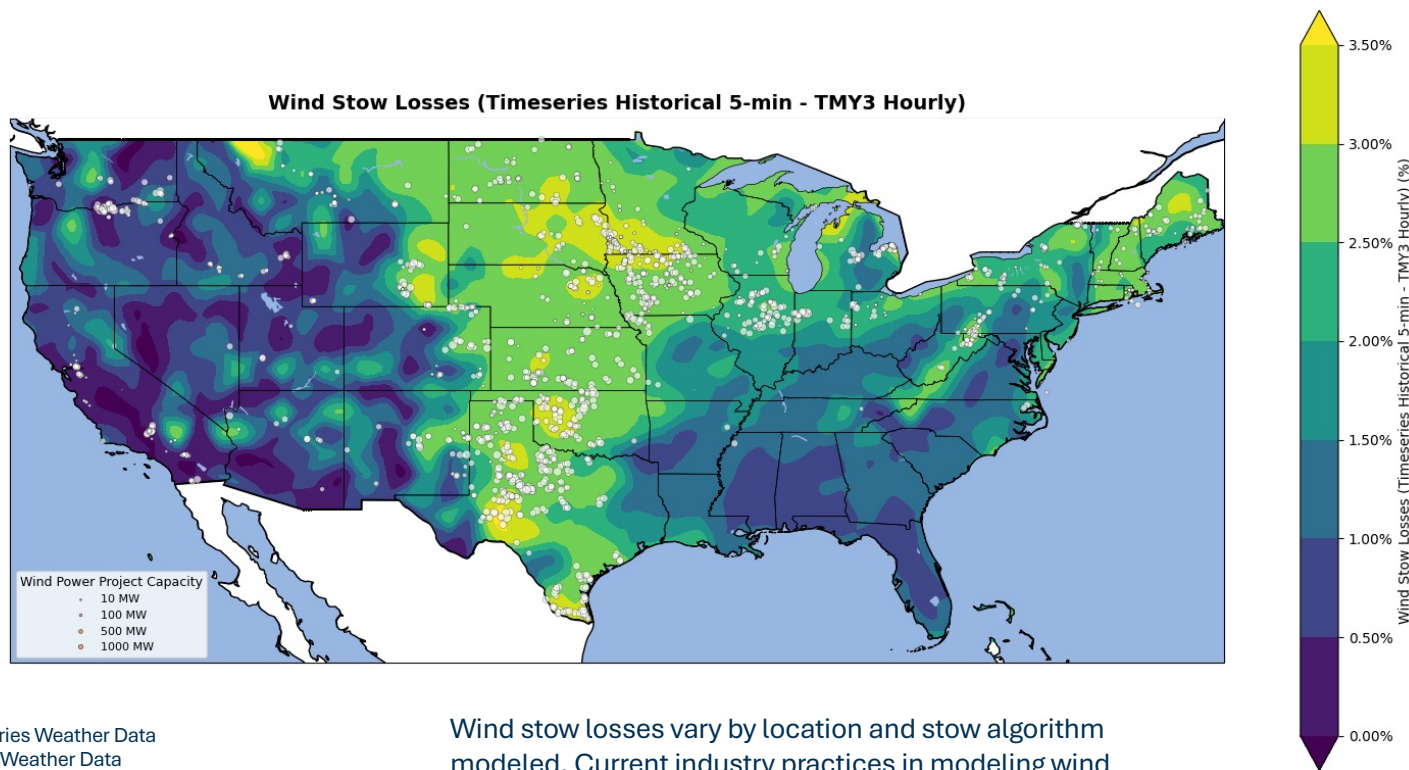


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\*2023 Historical Analysis

# Wind Stow Loss Variance Across the US

Gap Between TMY Hourly Modeling and Sub-hourly Timeseries Wind Gust Data up to 3%



Solcast 5-minute Timeseries Weather Data  
NSRDB 2024 TMY Hourly Weather Data  
28mph Active Stow Threshold  
Operational Wind Projects – Orennia  
1° x 1° resolution data

Wind stow losses vary by location and stow algorithm modeled. Current industry practices in modeling wind stow losses underestimate values up to 3%

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