# Extreme event forecasting for wildfires, storms, snow

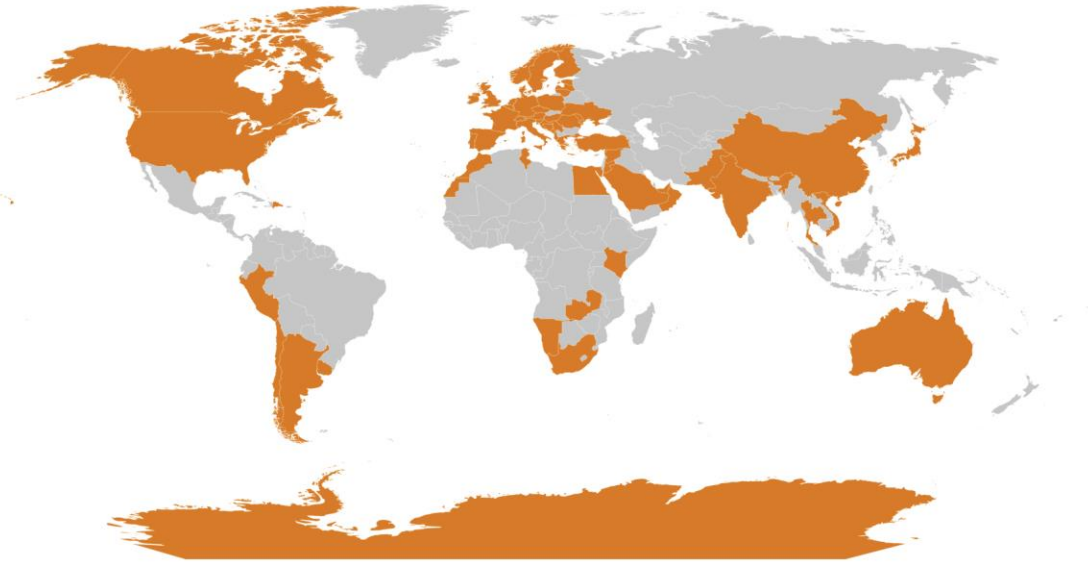
**Peter Zadow**

ESIG — Emerging Issues in Solar Forecasting

Denver, June 15th 2026

# Three companies, one goal: 100% renewable energy!

- Headquarters in Oldenburg, Germany
- Approx. 250 employees
- Operations on all continents
- Over 20 years of experience
- Forecasts for nearly 1TW of installed capacity in solar and wind



## emsys grid services

- Grid Operation
- Network Platform

## emsys vpp

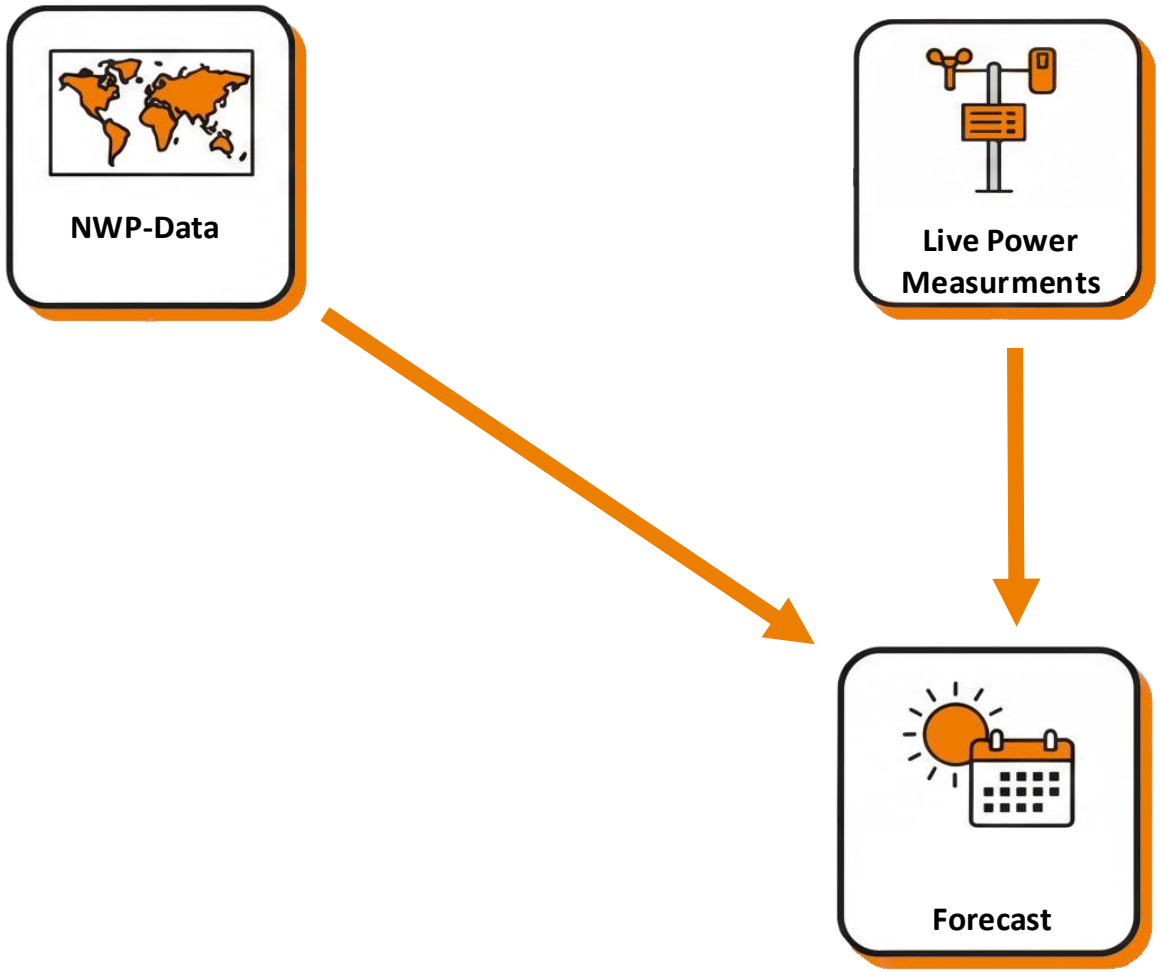
- Virtual Power Plant
- Balancing Power Services

## energy & meteo systems

- Wind & Solar Forecasts
- Consulting

# How do we calculate different scenarios for extreme events

- Power forecast are derived from various parameters from Numerical Weather Prediction Models (NWPs)
- Combined with **additional data sources** (e.g. sattelite data, live production measurments)
- Further parameters from some NWPs are used to derive extreme weather corrections
- Scenarios are calculated individually with and without correction using **site specific** trainings and standing data



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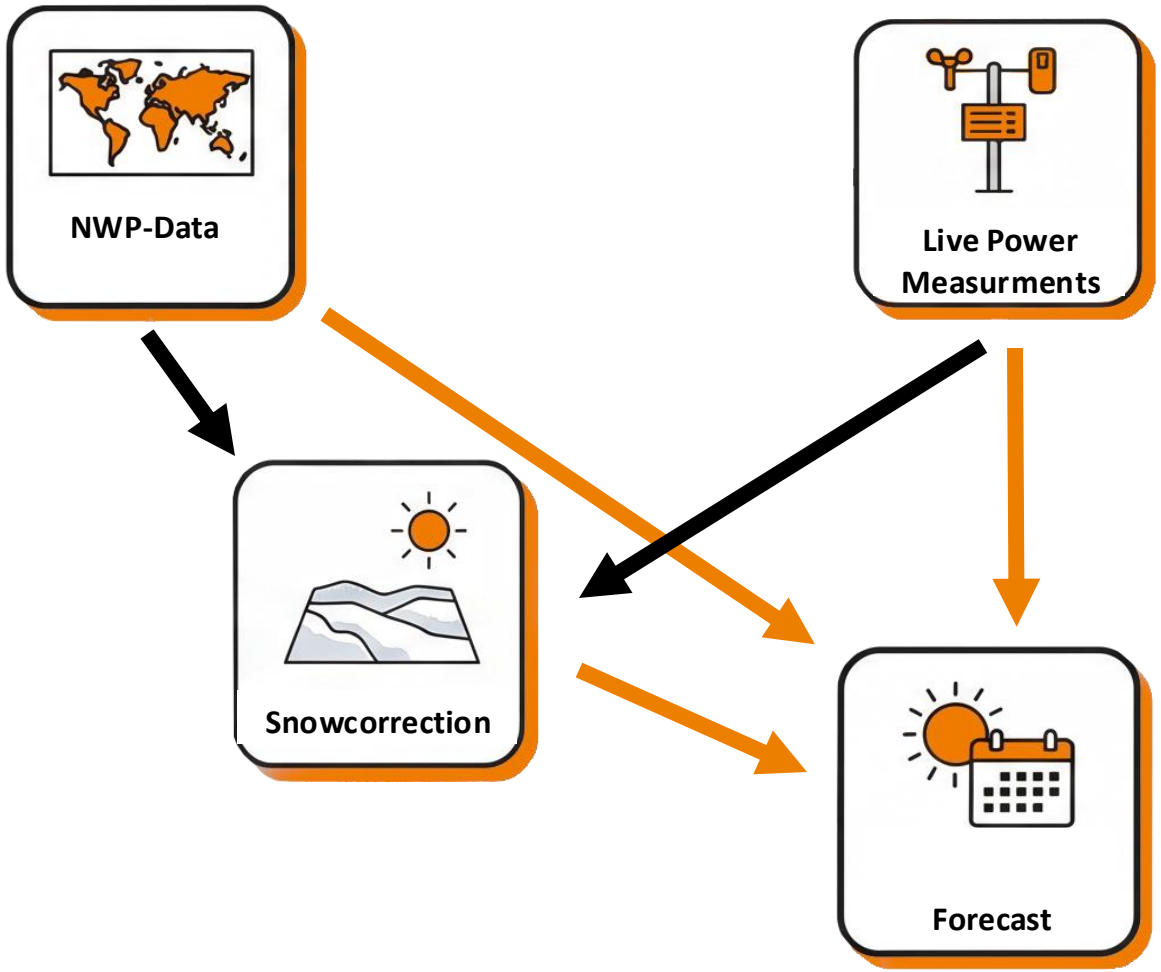
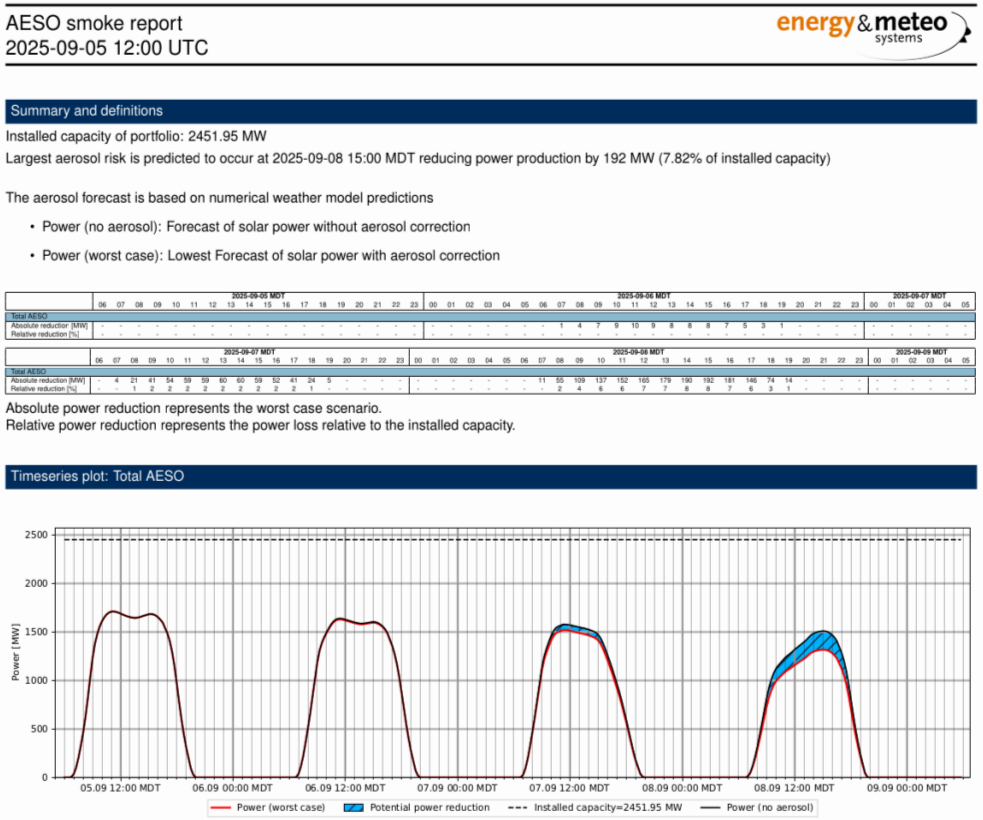


# Why are additional Situational Awarness products nessecary

- Situational Awareness Reports allow for a condensed overview of possible **extrem events**
- Give information about the **worst case** scenario
- Apart from possible power reduction also the temporal evolution of the event is visualised
- Reports are triggered based on customizable thresholds on the predicted power loss



AESO smoke report
2025-09-05 12:00 UTC

energy & meteo systems

**Summary and definitions**

Installed capacity of portfolio: 2451.95 MW

Largest aerosol risk is predicted to occur at 2025-09-08 15:00 MDT reducing power production by 192 MW (7.82% of installed capacity)

The aerosol forecast is based on numerical weather model predictions

- Power (no aerosol): Forecast of solar power without aerosol correction
- Power (worst case): Lowest Forecast of solar power with aerosol correction

Absolute power reduction represents the worst case scenario.
Relative power reduction represents the power loss relative to the installed capacity.

**Timeseries plot: Total AESO**

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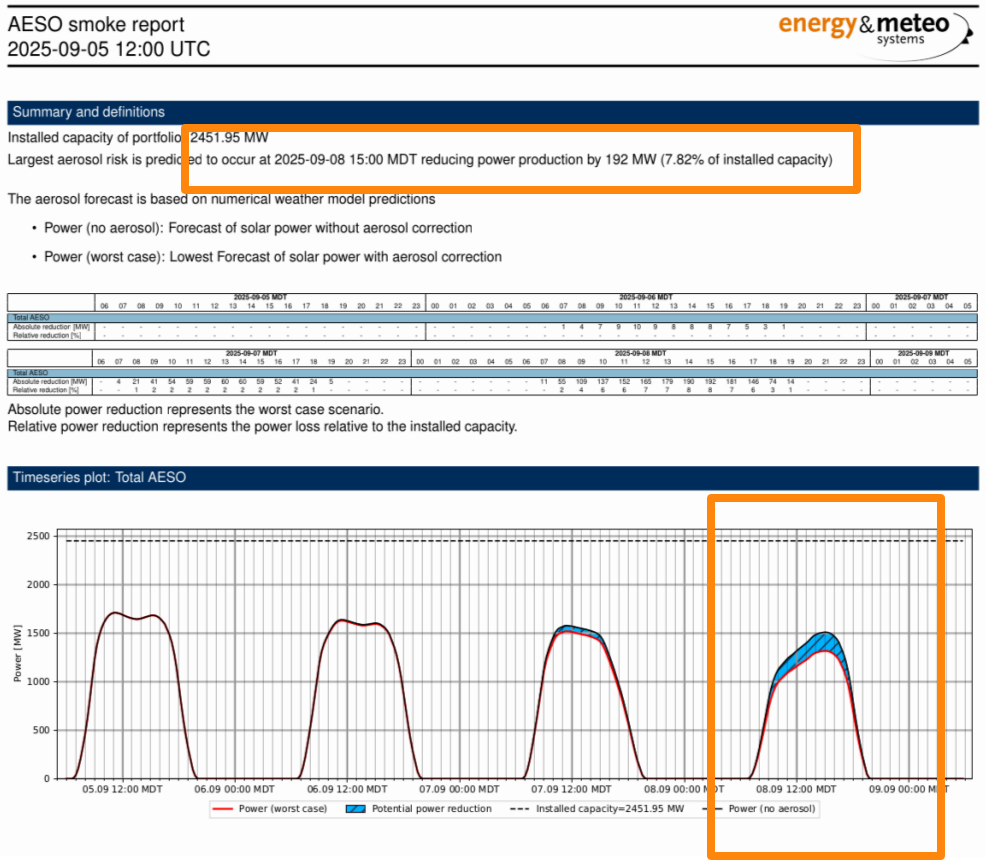

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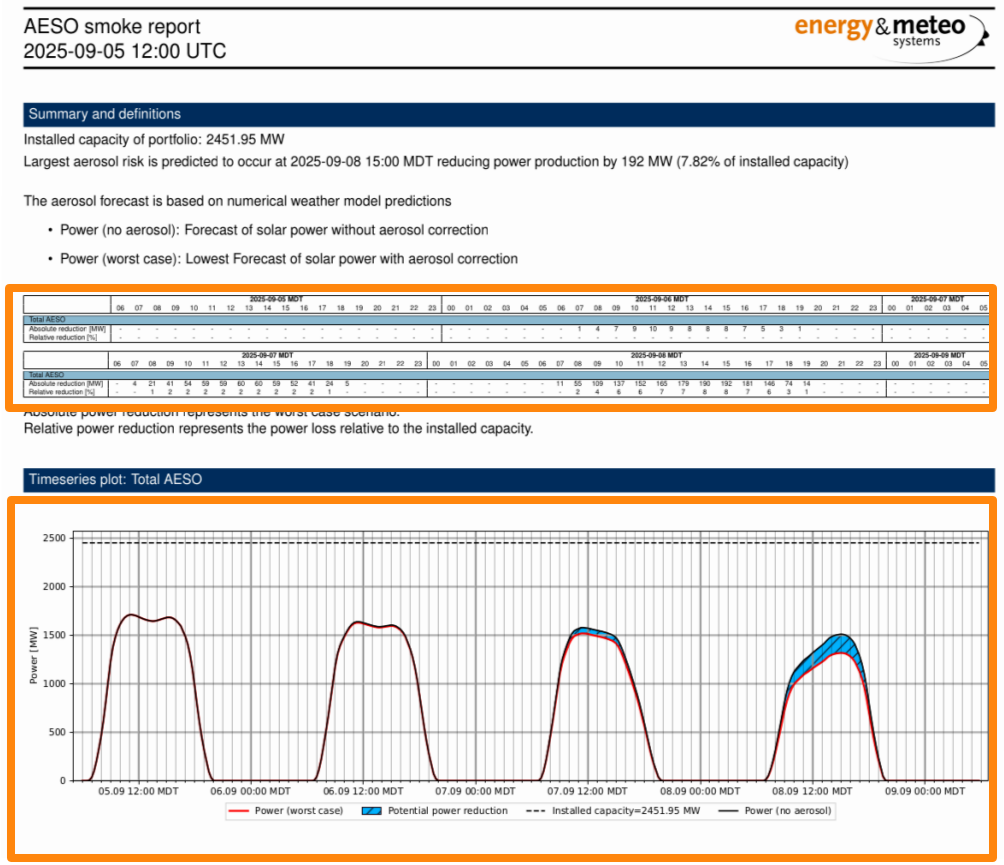
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# Situational Awarness: Smoke

- Automatically triggered report up to four day ahead
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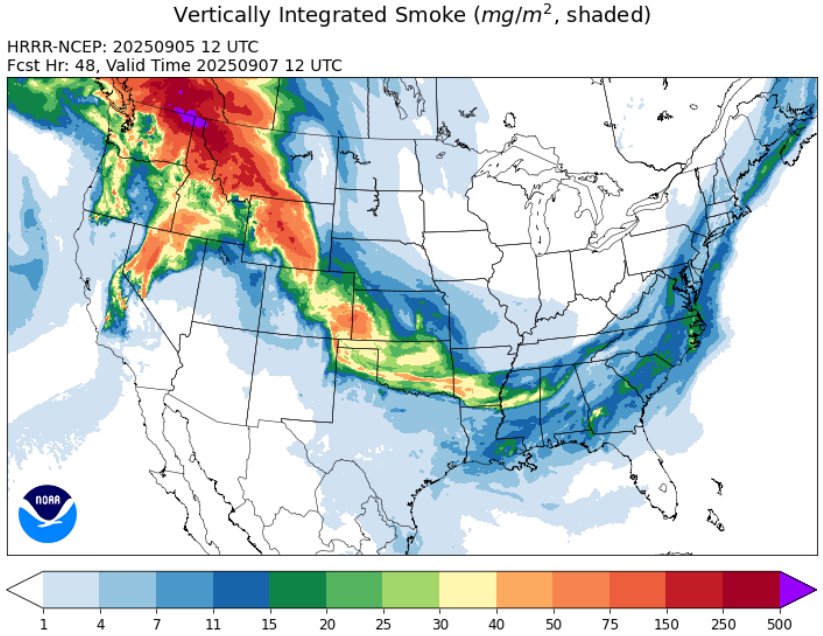


Taken from: https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/

AESO smoke report
2025-09-05 12:00 UTC

energy & meteo systems

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| | 2025-09-05 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-06 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-07 MDT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 00 | 01 | 02 | 03 | 04 | 05 |
| Total AESO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Absolute reduction [MW] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 4 | 7 | 9 | 10 | 9 | 8 | 8 | 8 | 7 | 5 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Relative reduction [%] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| | 2025-09-07 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-08 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-09 MDT | | | | | |
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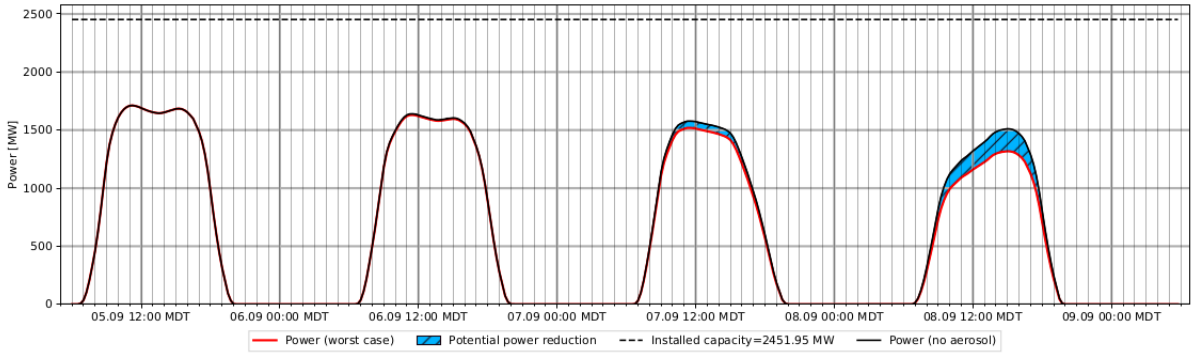
| Absolute reduction [MW] | - | 4 | 21 | 41 | 54 | 59 | 59 | 60 | 60 | 59 | 52 | 41 | 24 | 5 | - | - | - | - | - | - | - | - | - | - | 11 | 55 | 109 | 137 | 152 | 165 | 179 | 190 | 192 | 181 | 146 | 74 | 14 | - | - | - | - | - | - | - | - | - | - | - | - |
| Relative reduction [%] | - | - | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 4 | 6 | 6 | 7 | 7 | 8 | 8 | 7 | 6 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |

Absolute power reduction represents the worst case scenario.
Relative power reduction represents the power loss relative to the installed capacity.

**Timeseries plot: Total AESO**



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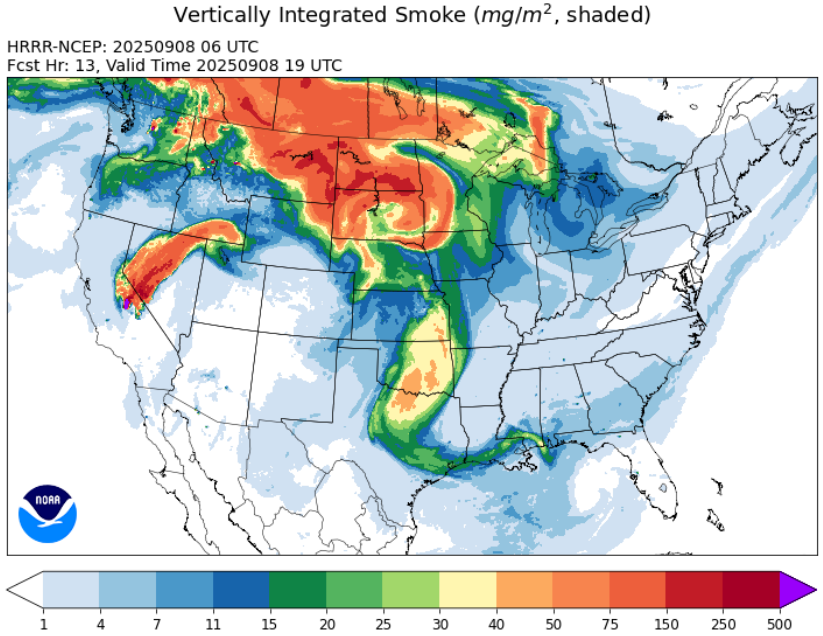


Taken from: https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/

AESO smoke report
2025-09-08 12:00 UTC

energy & meteo systems

## Summary and definitions

Installed capacity of portfolio: 2451.95 MW

Largest aerosol risk is predicted to occur at 2025-09-08 13:00 MDT reducing power production by 246 MW (10.02% of installed capacity)

The aerosol forecast is based on numerical weather model predictions

- Power (no aerosol): Forecast of solar power without aerosol correction
- Power (worst case): Lowest Forecast of solar power with aerosol correction

| | 2025-09-08 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-09 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-10 MDT | | | | | |
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| | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 00 | 01 | 02 | 03 | 04 | 05 |
| Total AESO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Absolute reduction [MW] | - | 15 | 79 | 153 | 198 | 227 | 245 | 246 | 242 | 233 | 201 | 158 | 79 | 15 | - | - | - | - | - | - | - | - | - | - | - | - | 10 | 40 | 63 | 59 | 48 | 36 | 26 | 19 | 14 | 9 | 6 | 3 | - | - | - | - | - | - | - | - | - | - |
| Relative reduction [%] | - | 1 | 3 | 6 | 8 | 9 | 10 | 10 | 10 | 9 | 8 | 6 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| | 2025-09-10 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-11 MDT | | | | | | | | | | | | | | | | | | | | | | | 2025-09-12 MDT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| Total AESO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Absolute reduction [MW] | - | 1 | 8 | 17 | 24 | 26 | 28 | 26 | 21 | 19 | 18 | 14 | 7 | 1 | - | - | - | - | - | - | - | - | - | - | 4 | 22 | 47 | 57 | 60 | 60 | 59 | 58 | 55 | 50 | 39 | 18 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| Relative reduction [%] | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |

Absolute power reduction represents the worst case scenario.
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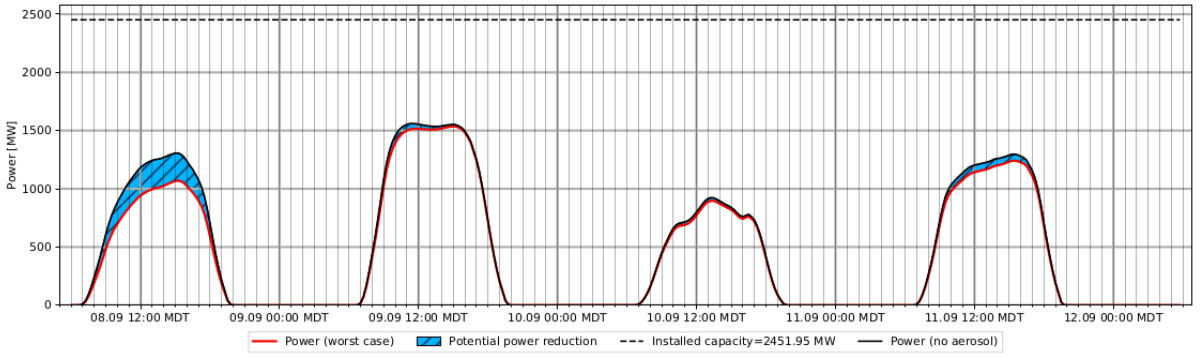
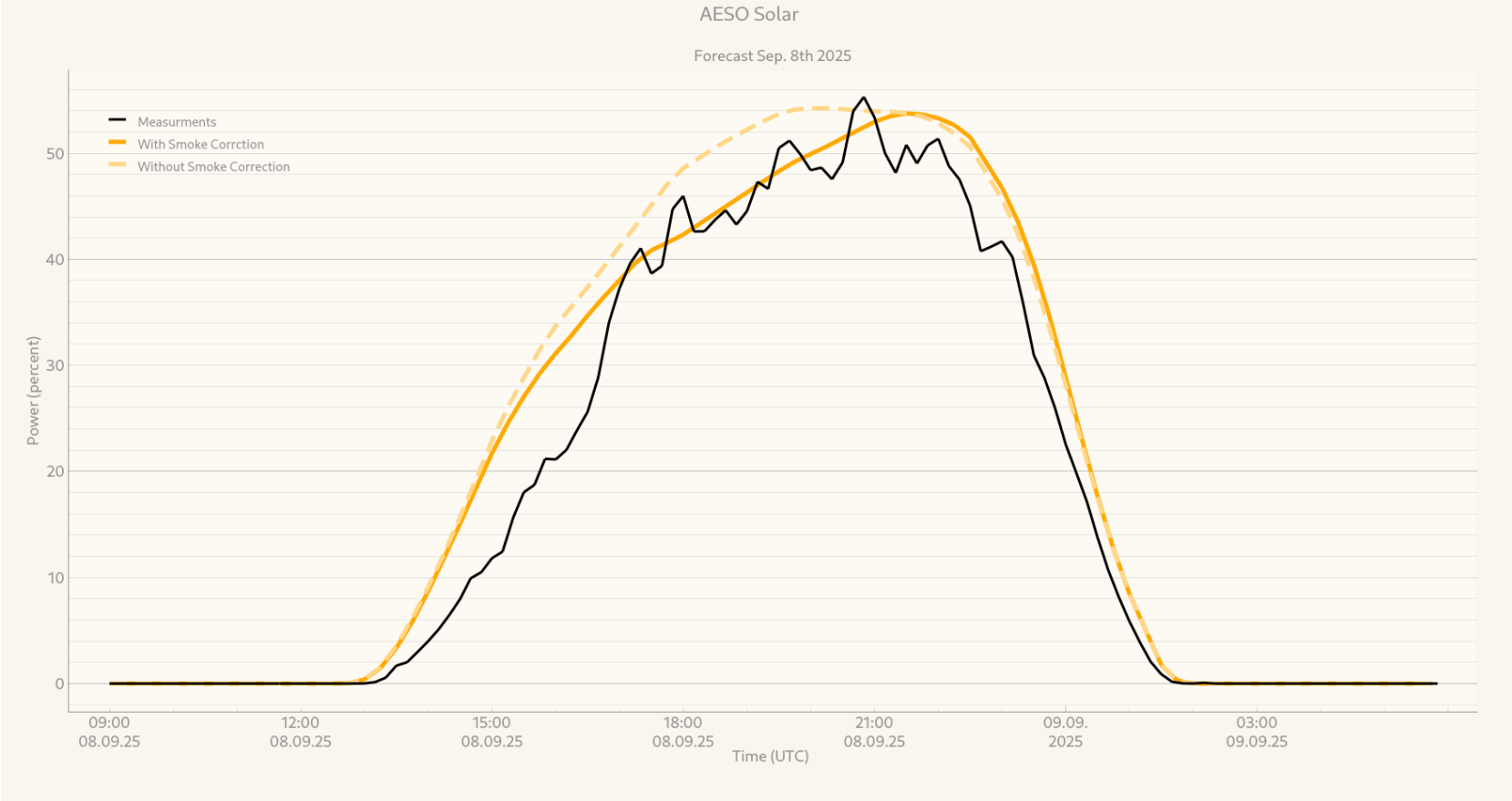
## Timeseries plot: Total AESO



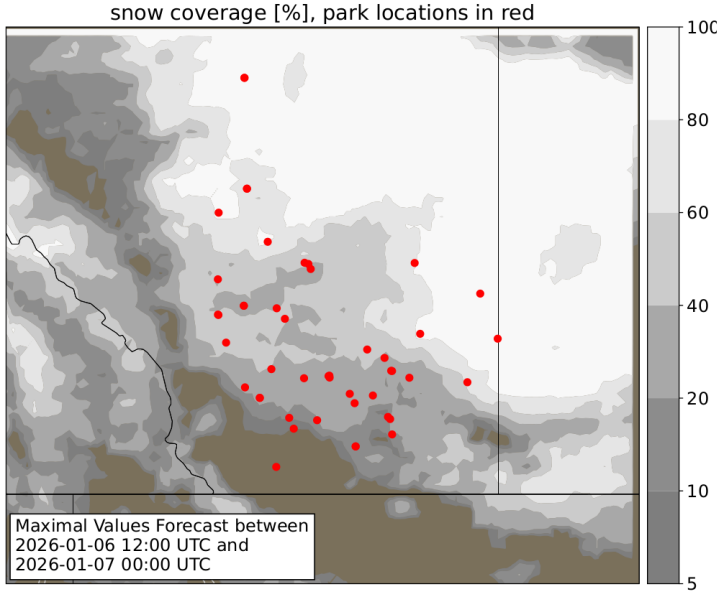
# Forecast Correction: Smoke

- Correction based on **aerosol concentration**
- Reduction up to **8%** of the **installed capacity**
- Tuned to be conservative in the down corrections
- Already operative in the US



# Situational Awarness: Snow

- Automatically triggered report for day ahead and intraday
- Based on internal snow correction
- Designed to give a worst case estimation




AESO snow report
2026-01-06 07:00 MST

energy & meteo systems

## Summary and definitions

Installed capacity of portfolio Total AESO: 2489.65 MW

Largest snow risk in Total AESO is predicted to occur at 2026-01-07 13:00 MST reducing power production by 535.87 MW (84.23% of forecasted power)

The snow forecast is based on numerical weather model predictions

- Power (no snow): Forecast of solar power without snow correction
- Power (worst case): Lowest Forecast of solar power with snow correction

| | 2026-01-06 MST | | | | | | | | | | | | | | | | 2026-01-07 MST | | | | | | | | | | | | | | |
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| Total AESO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Absolute reduction [MW] | - | 11 | 179 | 393 | 458 | 445 | 425 | 357 | 162 | 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 11 | 147 | 323 | 421 | 483 | 536 | 522 | 279 |
| Relative reduction [%] | - | - | 7 | 16 | 18 | 18 | 17 | 14 | 6 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 | 13 | 17 | 19 | 22 | 21 | 11 |

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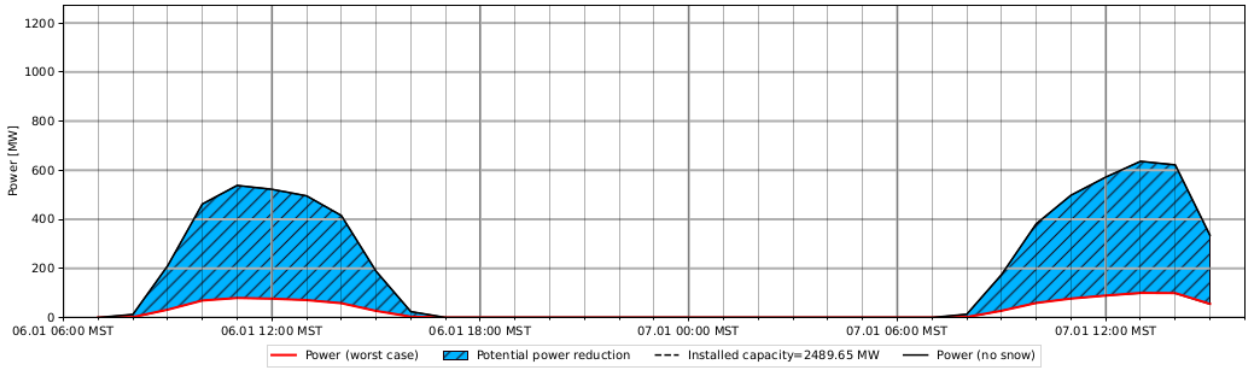
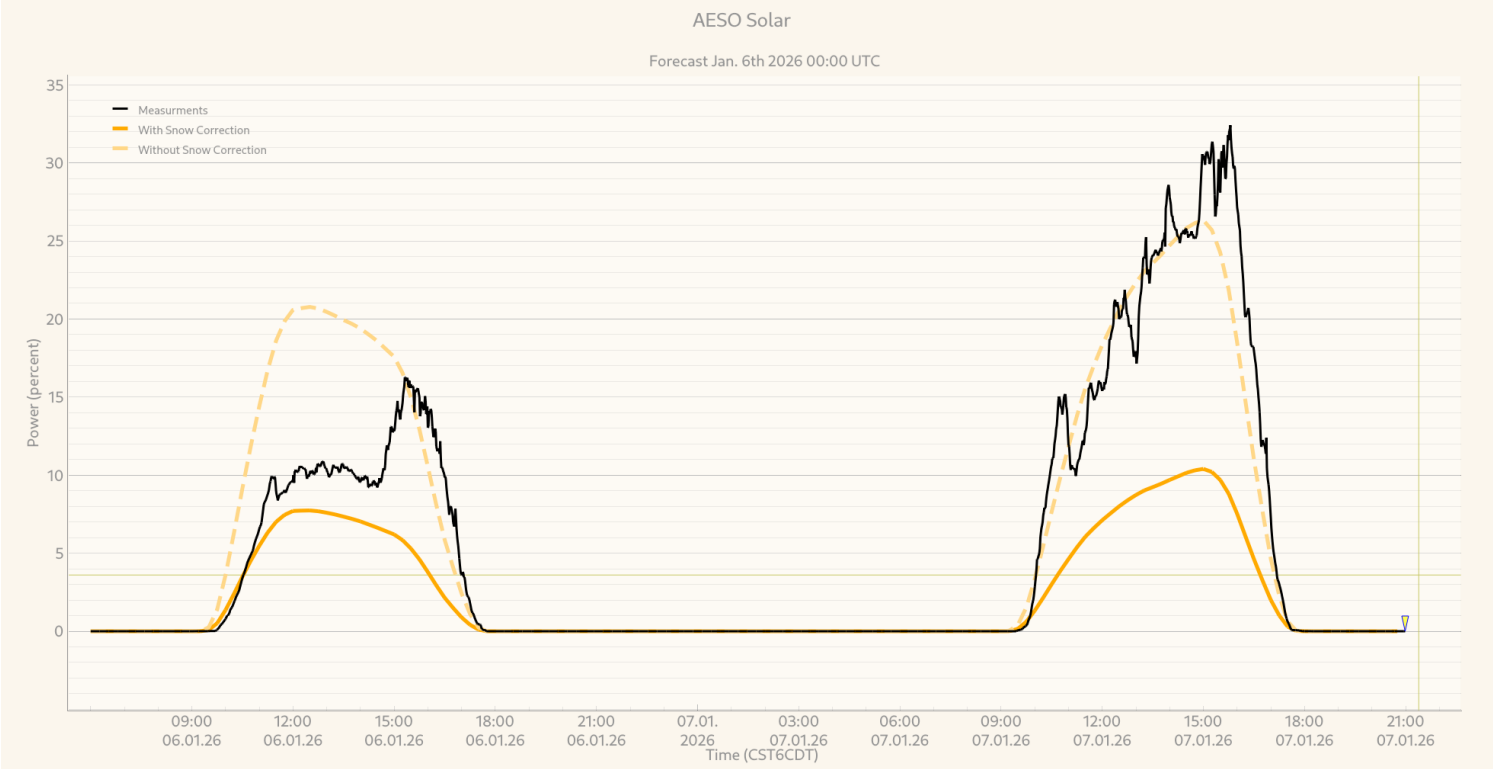


# Forecast Correcion: Snow

- Correction based on predicted **snow cover**
- Forecasted reduction of up to **16% of installed capacity**
- Good fit during snowfall
- Problems with snow-free conditions on tracked panels
- Live data is used to detect snowfree panels and adjust snow correction



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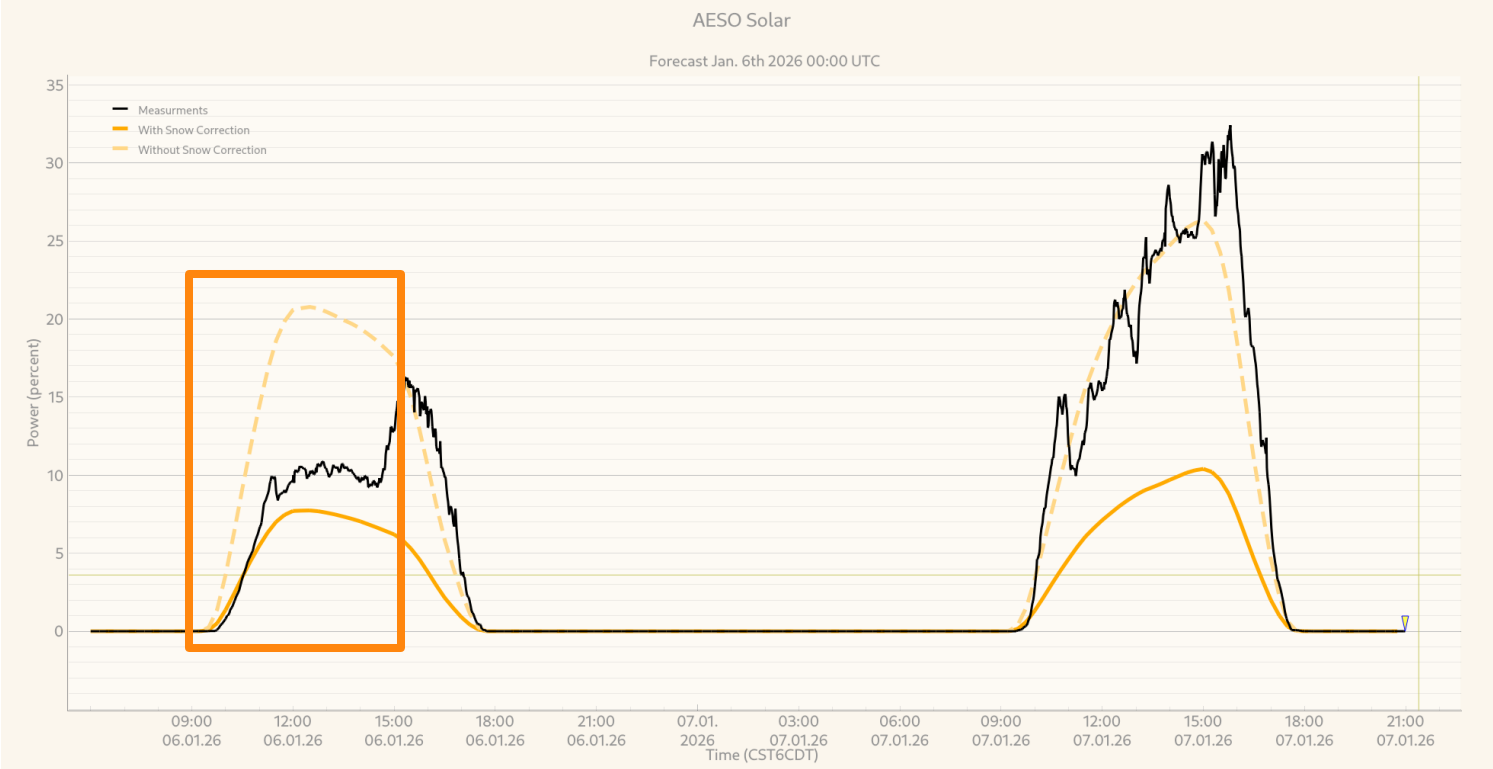

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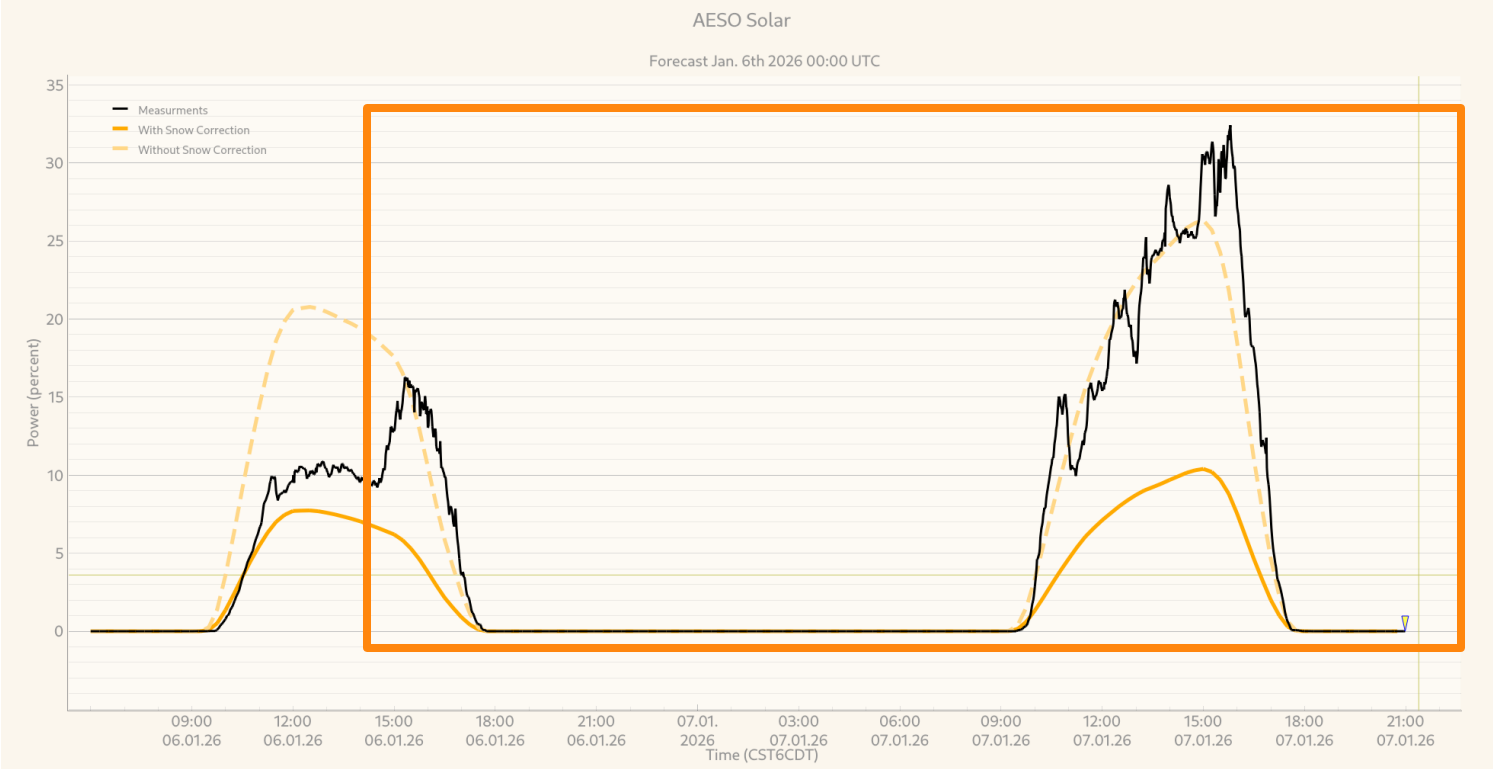
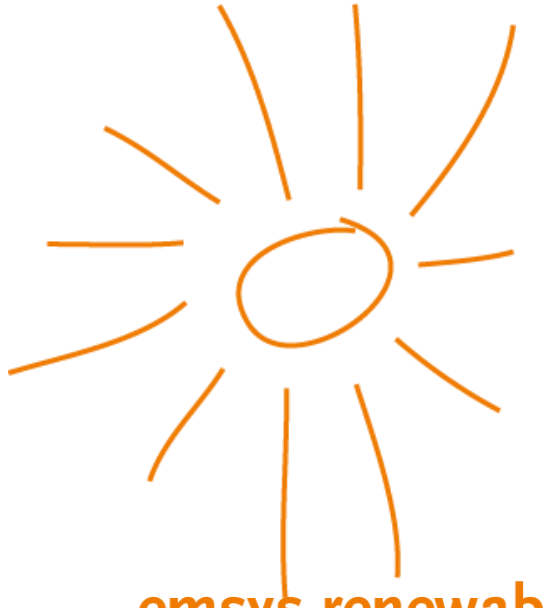


## What is coming next?

- Rising importance of solar energy across the US leading to possibly higher production losses caused by:
  - Wildfires
  - Snowstorms
- Further tuning of our scenarios to the US market for automatic inclusion of all corrections
  - Specific correction for tracked panels
  - Usage of new regional weather models
- Inclusion of Machine Learning for enhanced forecast accuracy
  - Pattern recognition based on past events
  - Data driven correction coefficients



# Thank your for your attention

Peter Zadow
peter.zadow@energymeteo.de