



SUPERNOVA

Assessing Tracker Availability in Utility-Scale Solar Power Plants

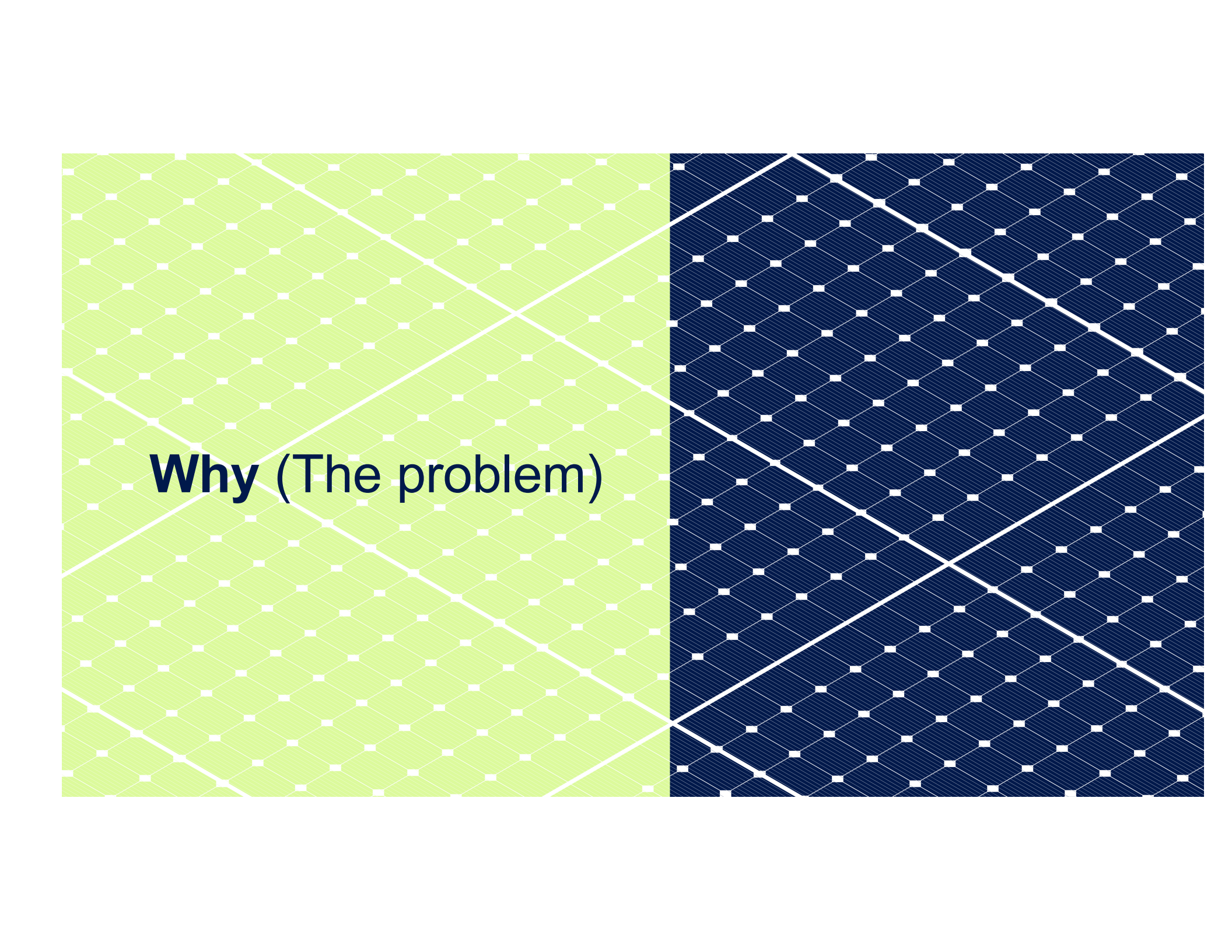
PVPMC Workshop – May 2025

Gofran Chowdhury



- **Why** (The Problem)
- **What** (The Purpose)
- **How** (The Method)





Why (The problem)

Statkraft – a leading international renewable energy company

Installed capacity

21,4 GW

2024 Production

66.3 TWh

96% renewable

Employees

7 000

in 20+ countries

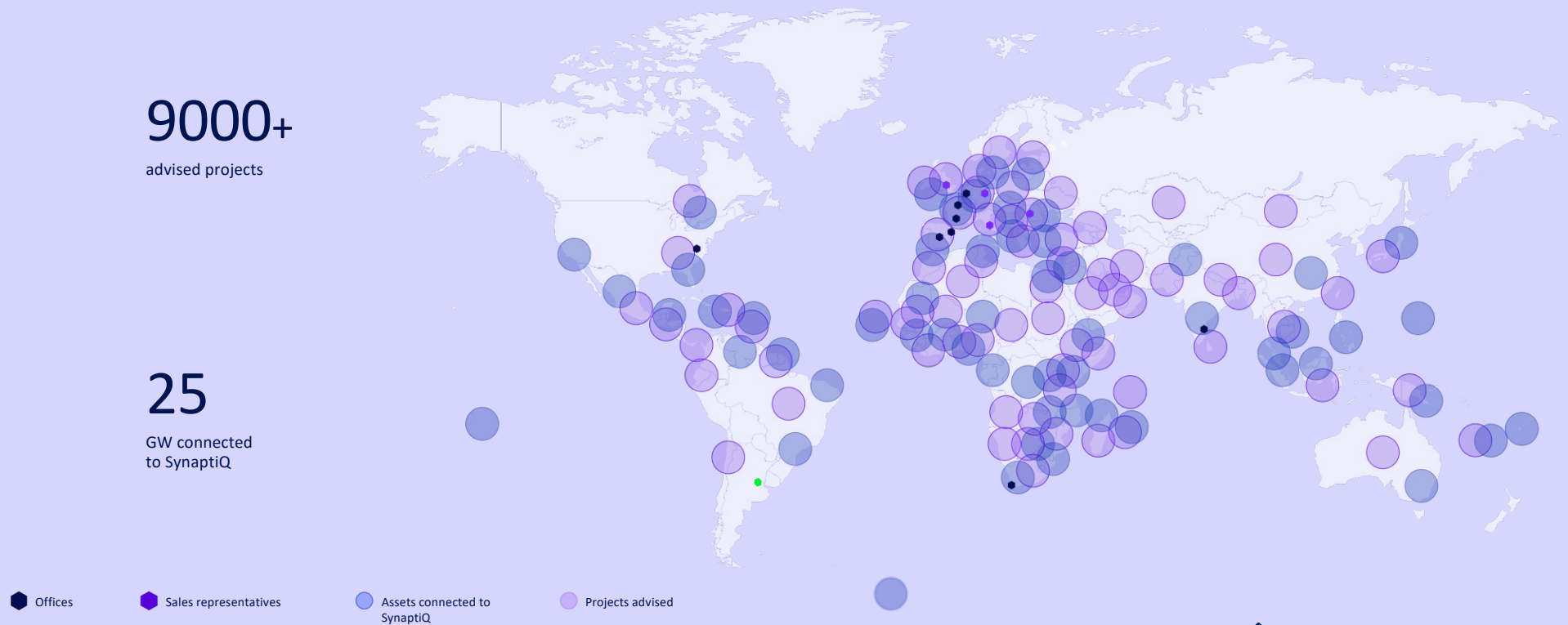
Fully owned by the
Norwegian state



Global presence in solar, wind, storage and green hydrogen

9000+
advised projects

25
GW connected
to SynaptiQ



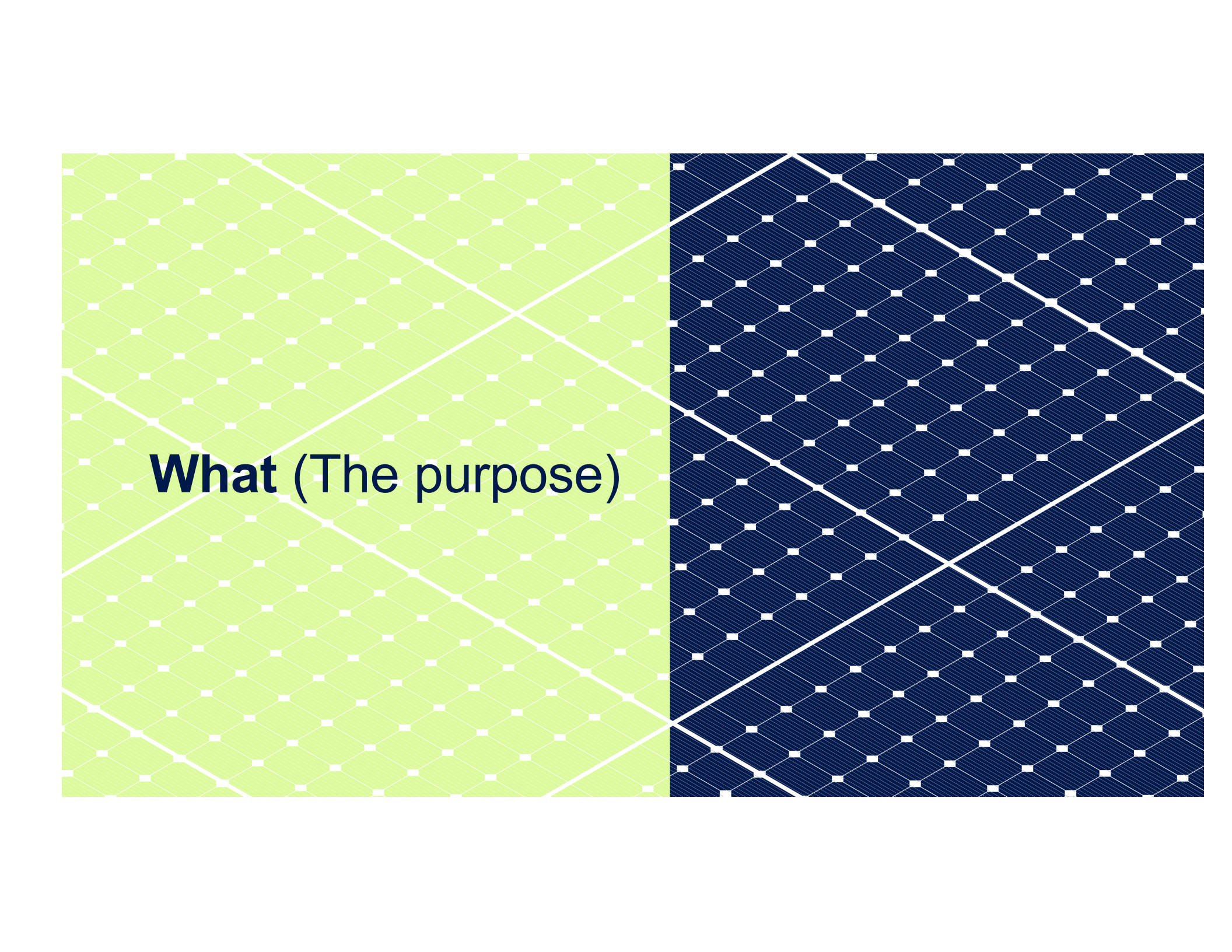
3E document confidentiality classification: 3E internal only

Tracking



Back Tracking





What (The purpose)

Motivation

- Single-Axis Tracker is a key equipment in PV installations
 - 725 GW new tracker installations are forecasted between 2024-2030¹
- Tracker operation can heavily influence performance guarantees
 - P50s not always consider tracker malfunctions
 - Manufacturers claim optimisation tracking algorithm can increase energy yield by around 6%²
- Tracker KPI guarantees are not common
 - Neither in Industry nor in Literature
 - Tracker manufacturers may claim over 99% availability (or uptime)³
 - Does operational PV plant data sustains it?



¹ [Innovation driving change in solar tracker market – pv magazine International](#)

² [Nextracker WhitePaper_OptimizingYourEnergyYield_FINAL_061318.pdf](#) 6.2% gain with TeamTrack backtracking algorithm | Soltec Lab, TrinaTracker | Trina Solar

³ [Suntrack - The most bankable PV Solar Tracker Controller, Boost Solar Energy Output with Single-Axis Solar Trackers, GameChange Solar Demonstrates Best in Class Availability of 99.6% for its Genius Tracker](#)



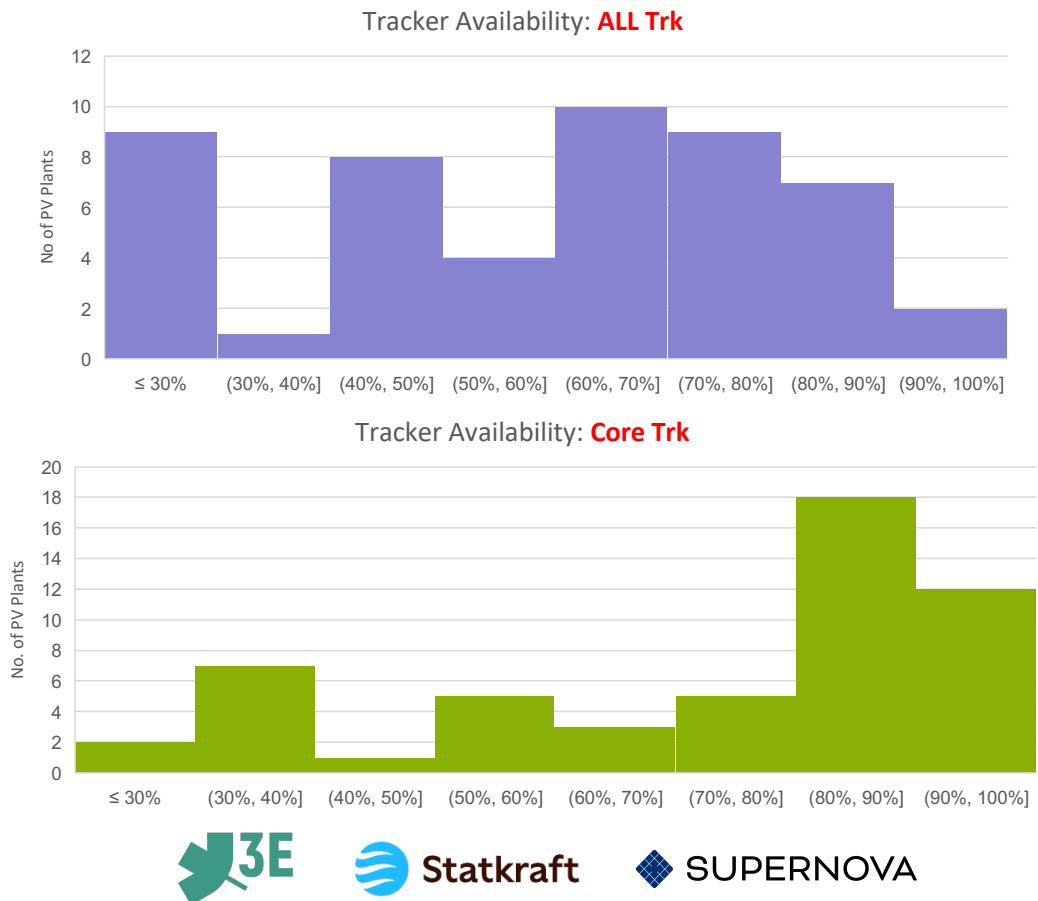
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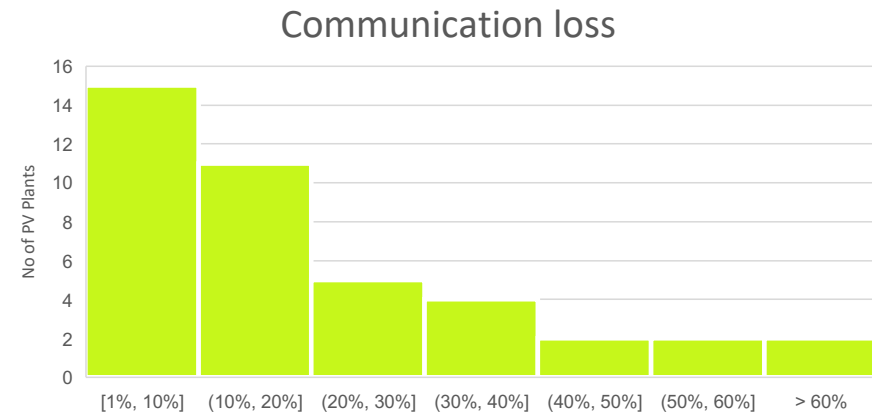
Portfolio Overview (SK+ 3E)

- > 50 Utility-scale PV plants
- ~ 2 GWp
- Plants generally Operational >5 years
- ~1 year dataset used
- Comms gaps are a major issue
- Backtracking
 - Harder to model
 - Tracker issues recurrently



Comms Gaps (SK+ 3E)

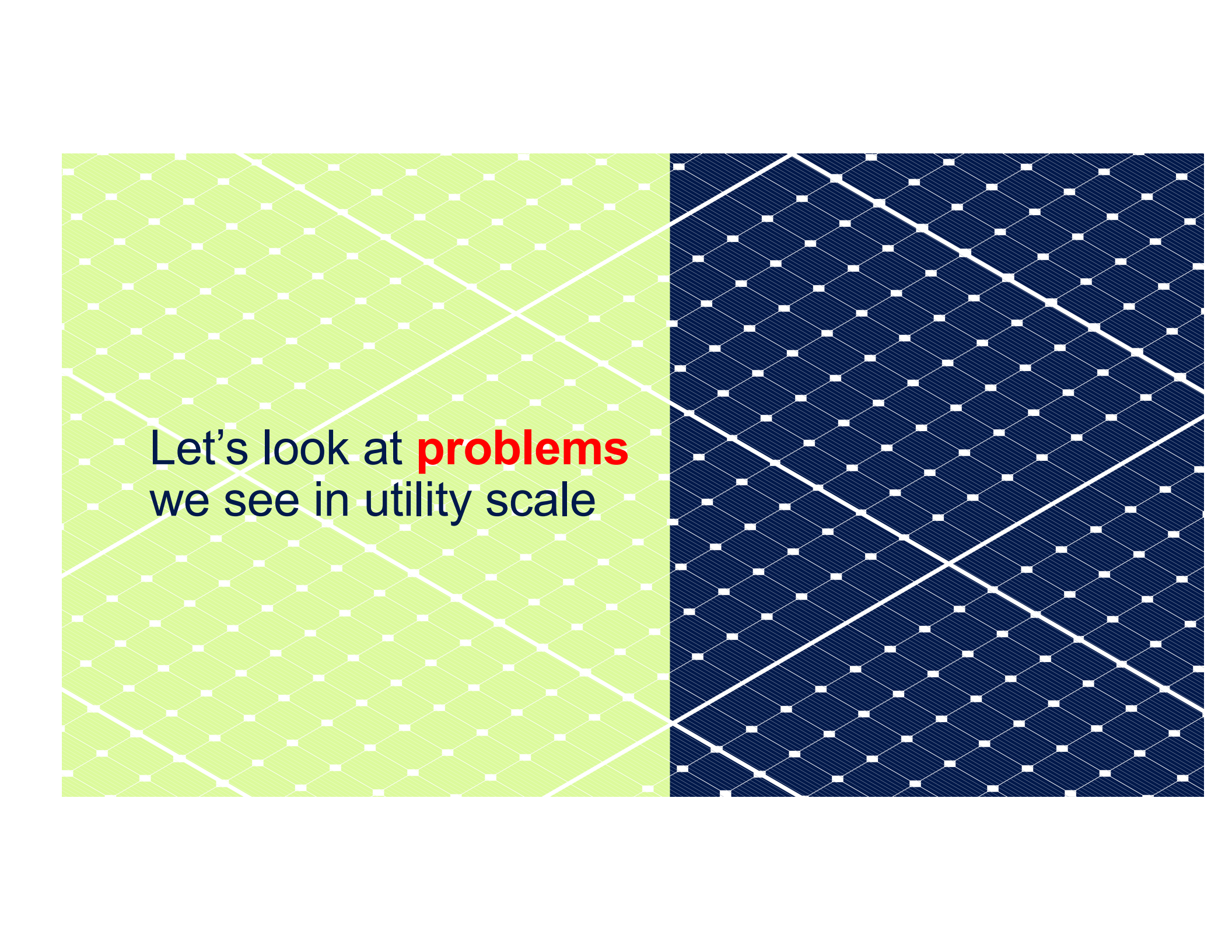
- ALL Trk period – Missing data
 - Average: 20%
 - Median: 13%
- Data missing for short or long time periods
 - NaNs & Stalled data



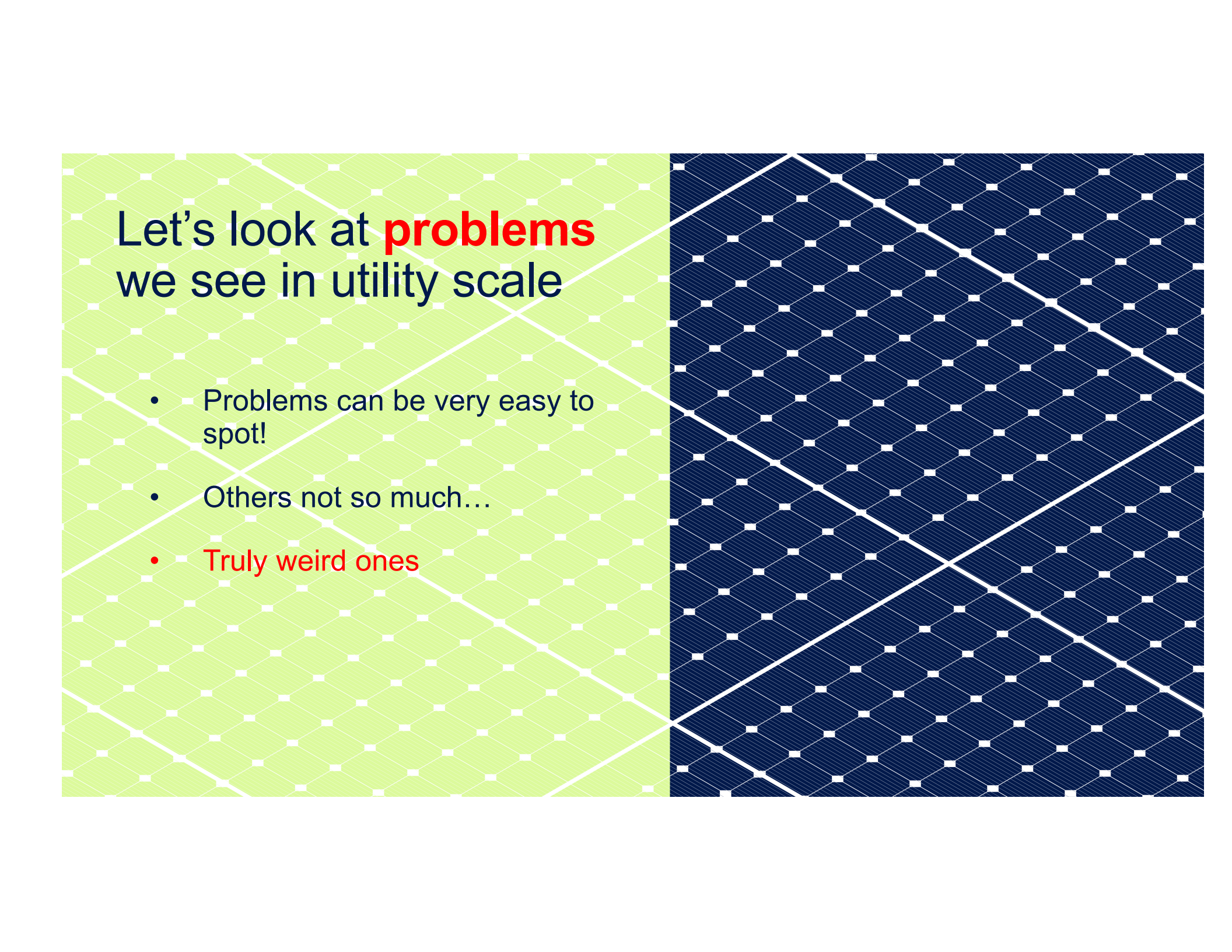
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Let's look at **problems**
we see in utility scale



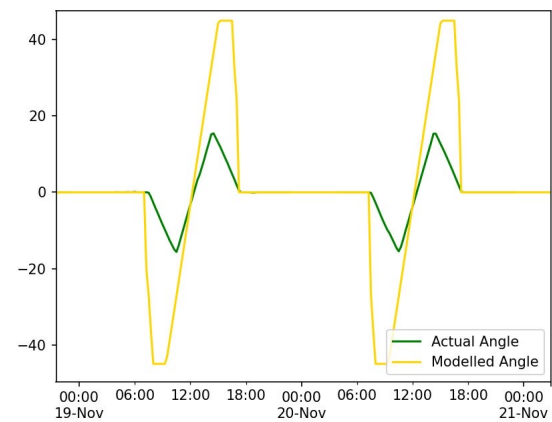
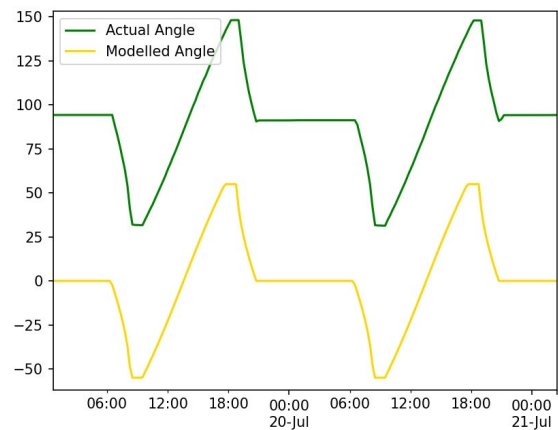
Let's look at **problems** we see in utility scale

- Problems can be very easy to spot!
- Others not so much...
- **Truly weird ones**

Modelling Challenges

Problems can be very easy to spot!

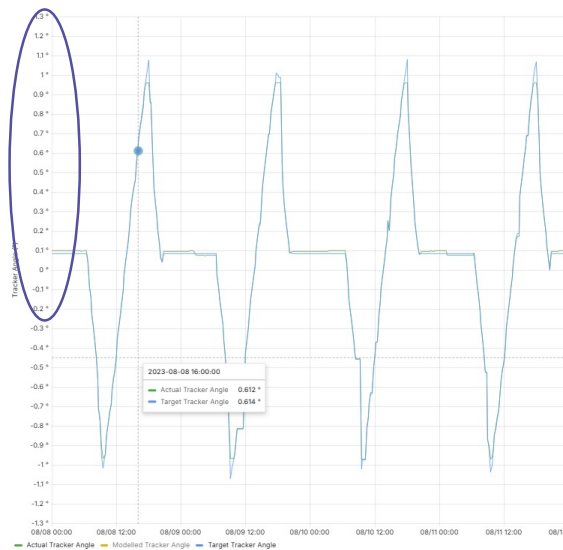
Angle offset



Modelling Challenges

Problems can be very easy to spot!

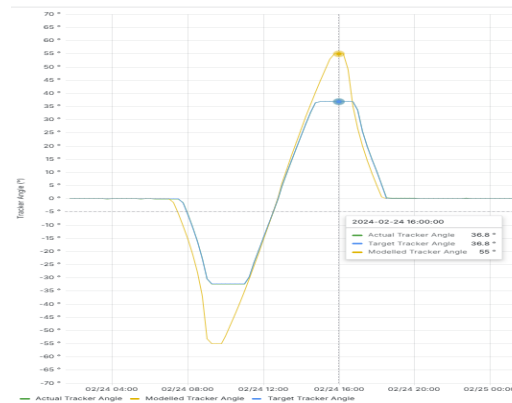
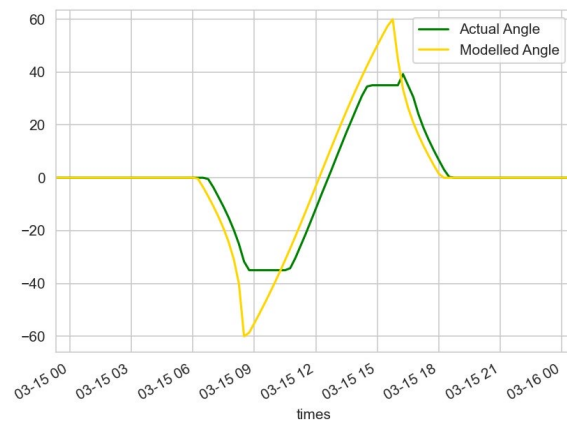
Wrong scaling



Modelling Challenges

Others not so much...

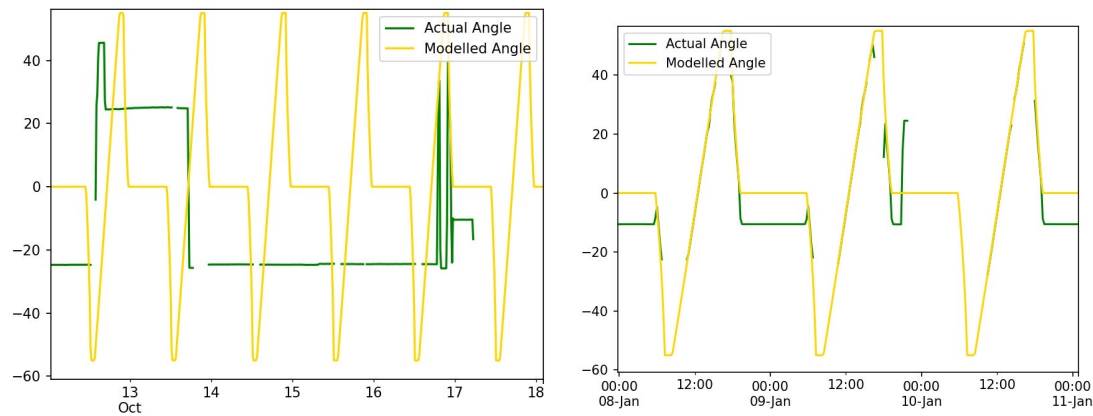
Tracker inconsistent max. angle



Modelling Challenges

Others not so much...

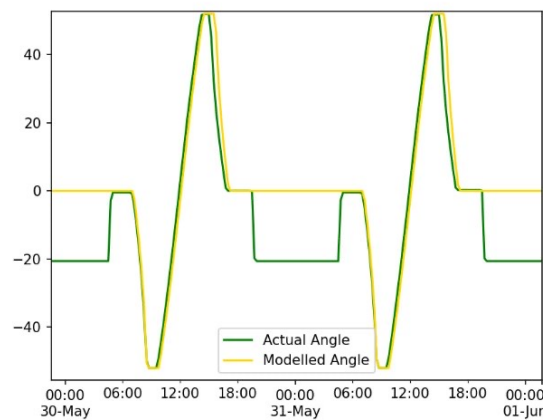
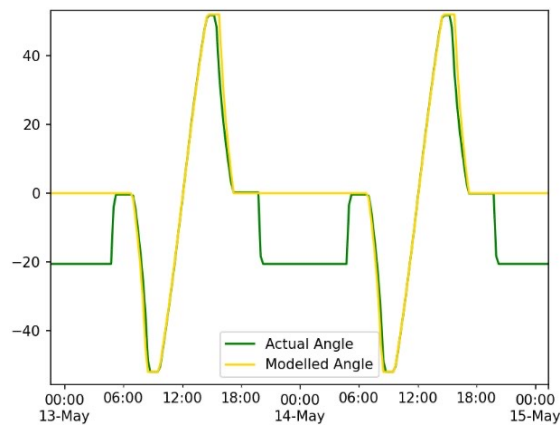
Inconsistent data



Modelling Challenges

Others not so much...

Minor time-shifts over the years



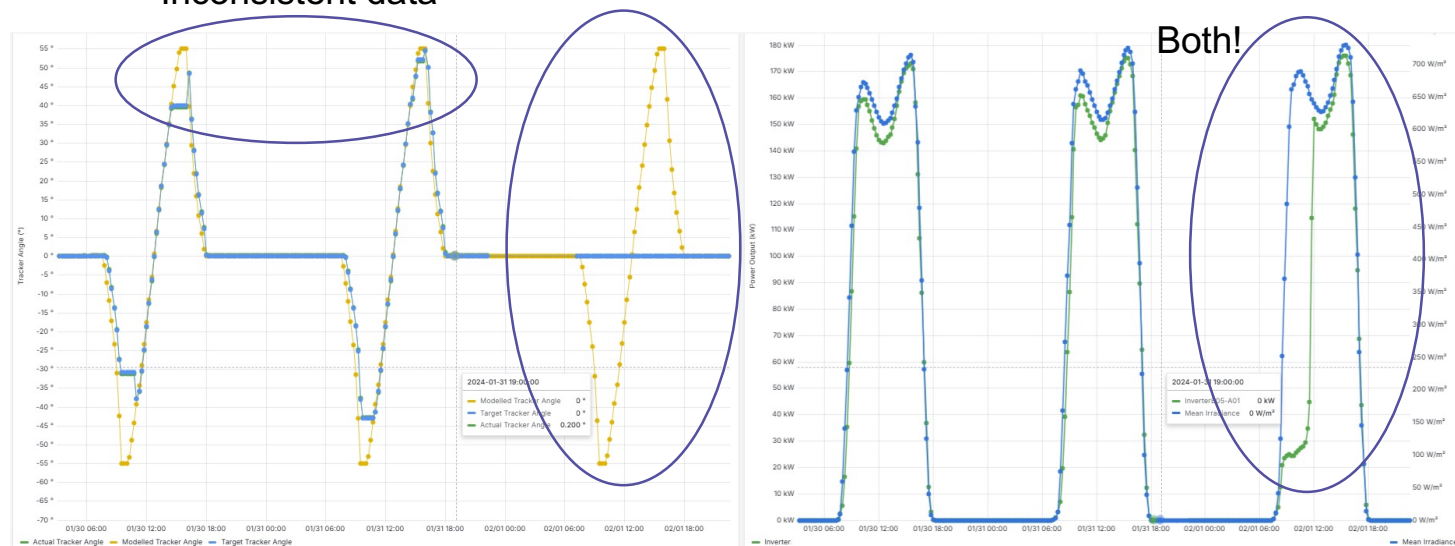
Modelling Challenges

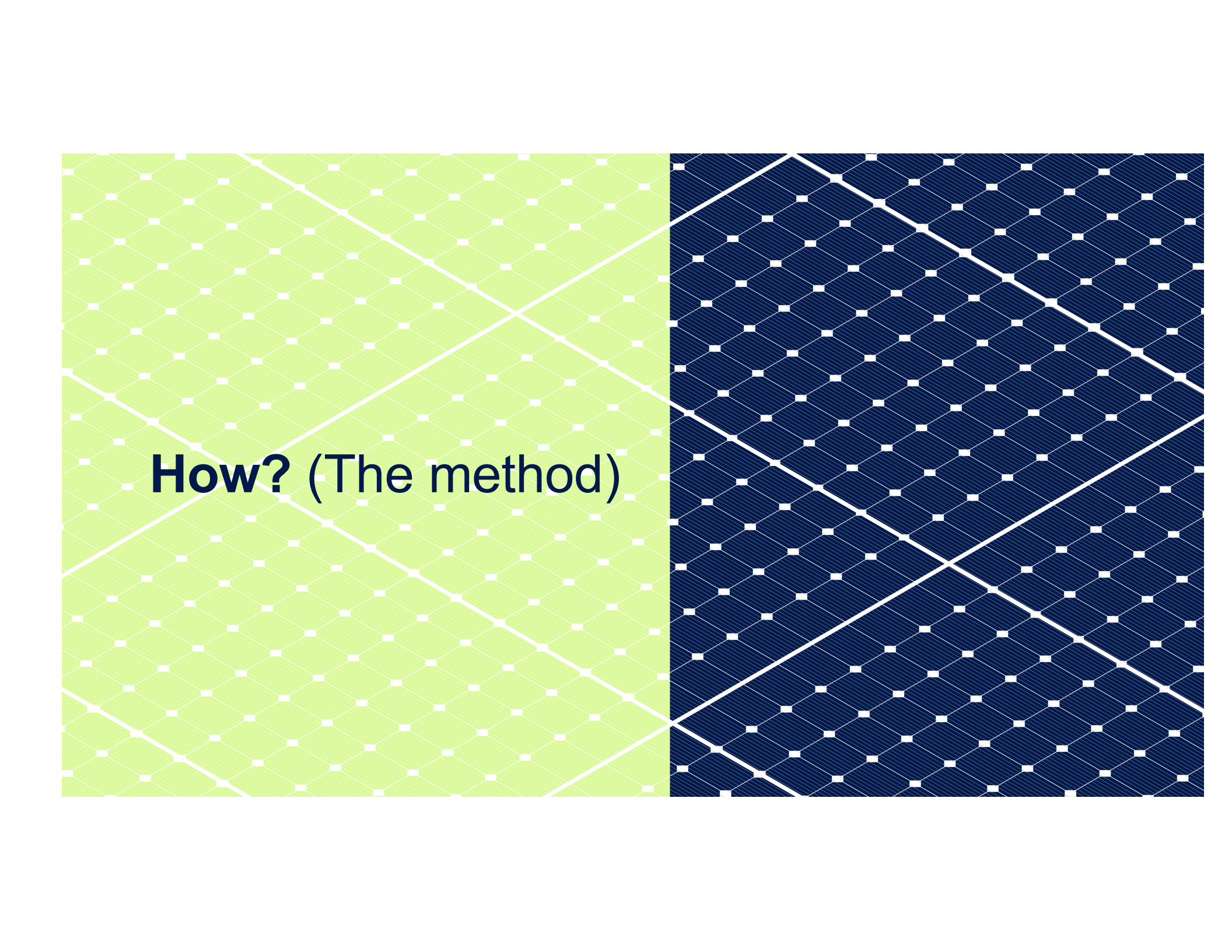
Others not so much...

In 3 consecutive days...

Inconsistent data

Not tracking or
comms gaps?





How? (The method)

If Trackers are that important... Why aren't people looking at Tracker KPIs?!

Tracker algorithms work interconnectedly

- Small scale are not very representative

Utility-scale PV Plants

- Volume of data
 - Monitoring and Q&A challenges
 - KPI implementation challenge
- Smaller energy yield impact than inverters/strings/cables
 - O&M focus is on their contractual guarantee (e.g. inverters)

Propose a simple Tracker KPIs
Discuss challenges in implementation
Overview of SK & 3E Portfolio preliminary
results

Why aren't Tracker manufacturers historically in contractual guarantees?

- Trackers are an optimisation component, not part of generation system
- Tracker manufacturers generally have no control of EPC process

Why is this changing?

- Profit margins are narrower & Guaranteed KPIs have lower safety margin
 - Equipment failure has higher impact on bonus/liabilities
- Tracker systems are becoming more complex
- Manufacturers operate and maintain trackers
 - O&M cannot simply debug an algorithm or fully replace a tracker system



Objectives & Methodology

- Tracker Availability KPI

$$Trk. Av._k = \frac{T_{useful} - T_{down}}{T_{useful}}$$

Where:

T_{useful} – Sum of total datapoints within the evaluated period

T_{down} – Sum of datapoints deemed unavailable within the evaluated period

- Plane-of-Array Irradiance > 0 W/m²
- Wind stows are considered available
- Communication loss is considered unavailable
- Threshold Angle = 5°

- Formula must be effective & simple
 - Use in contracts!

For a datapoint to be deemed unavailable

$$|\theta_{Trk} - \theta_R| > \theta_{Thr}$$

θ_{Trk} : Tracker Angle

θ_R : Reference Angle

θ_{Thr} : Threshold Angle

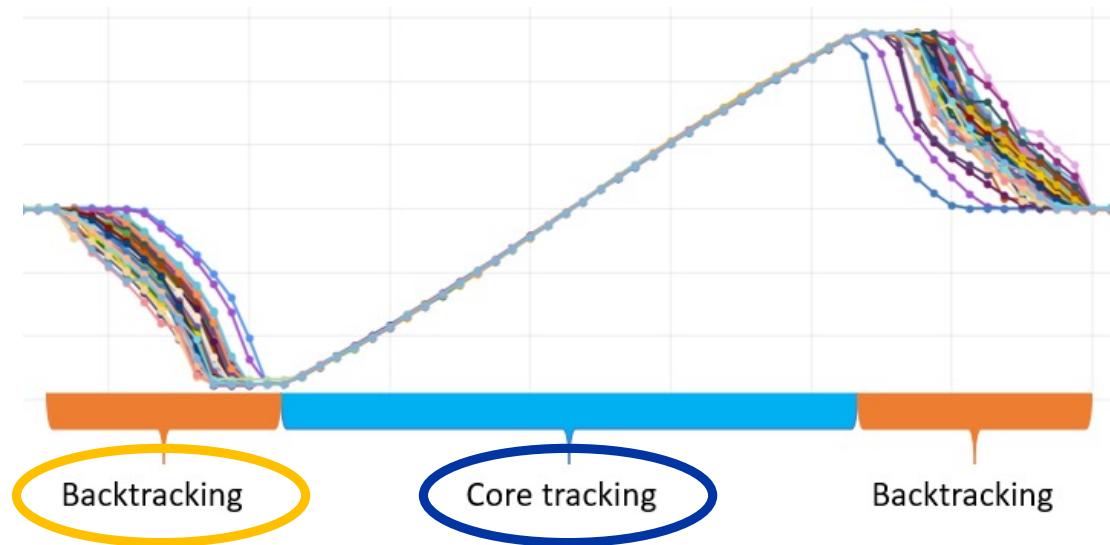


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Methodology



Complex to model

Impacted by topography conditions
Depends on manufacturer algorithm
ML algorithms can learn pattern

Simple to model

Basic algorithms perform well
Basic design inputs are enough



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Methodology

- Actual & Target Tracker angle is provided collected from equipment
 - Target angle is not always available
- Modelled Tracker angle is based on physical model (available pvlb)



Evaluated two methods

Method	Backtracking	Core Tracking
<i>ALL Trk</i>	<i>SK</i> : Compare Actual and Target angle provided by the manufacturer <i>3E</i> : Compare Actual angle provided by manufacturer vs Modelled angle	Compare Actual angle provided by manufacturer vs Modelled angle
<i>Core Trk</i>	Disregarded	



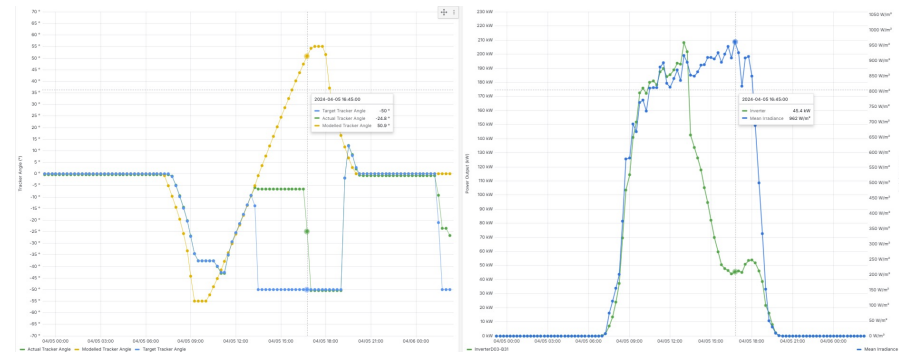
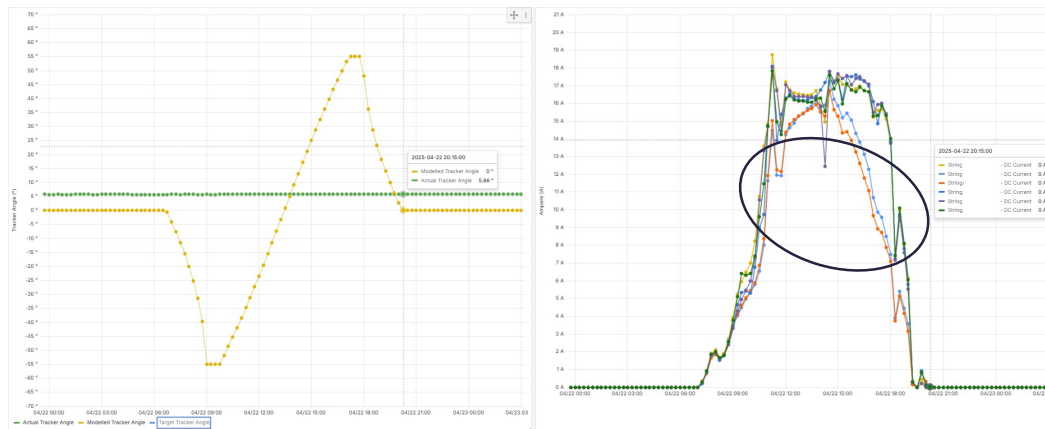
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How can we identify & treat it?

- Tickets from O&M (50MWp ~1500 trackers per plant)
 - ~200 Inverters!
- Power profile generation
 - Hard to detect in cloudy and overcast days
- String intercomparison

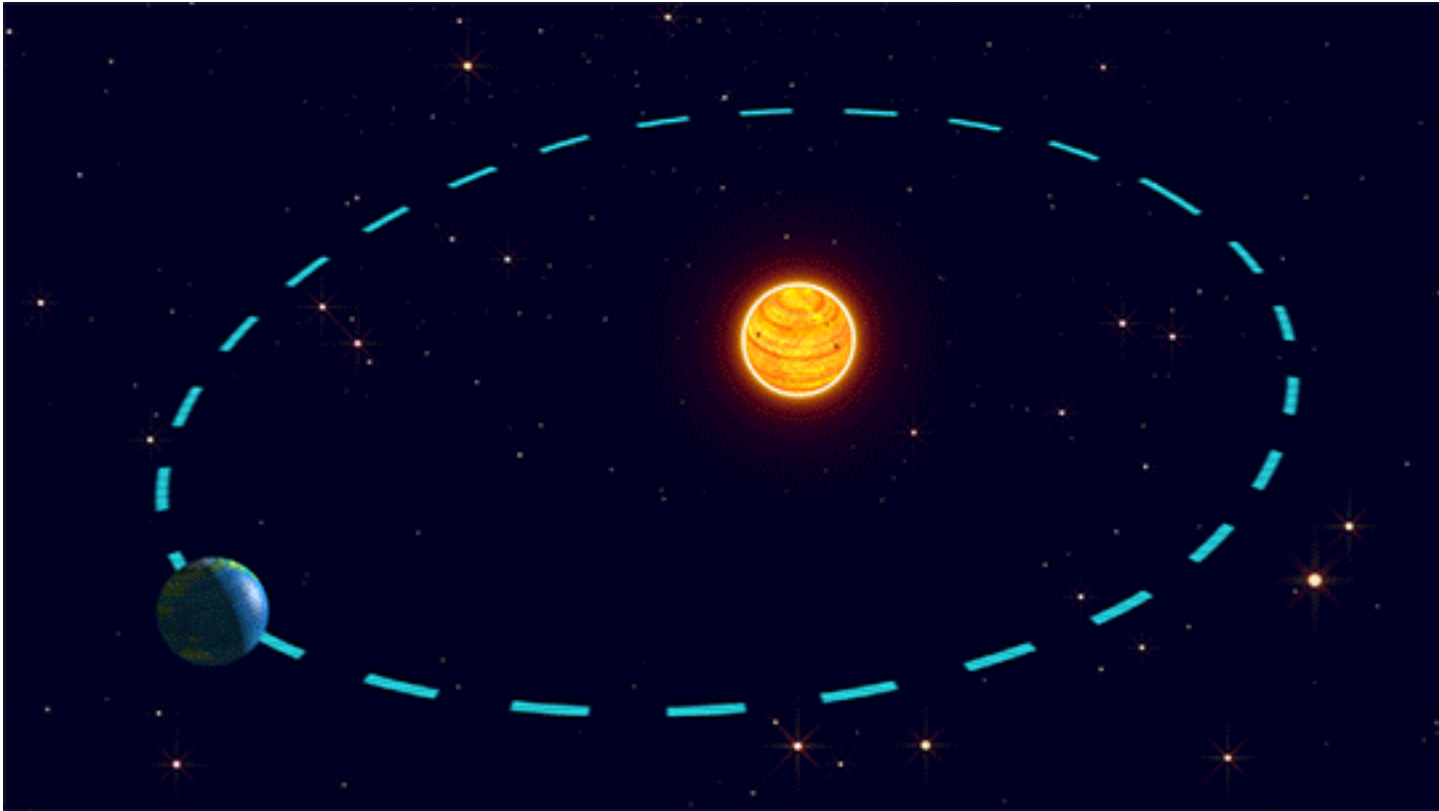


Going forwards...

- Single-axis tracker are key for optimal PV generation
- ~2GWp of tracker data analysed
 - Median of 85% Tracker availability within portfolio
 - On Average 20% of data is lost due to comms issues
 - Tracker availability appears to be far below good operation conditions
- Tracker data can be inconsistent
 - High volume and difficult to Q&A
- WIP & Future work
 - Discussing with manufacturers potential improvements
 - Development of Q&A and gap filling techniques for Tracker angles
 - Improvement of backtracking modelling
 - Sensitivity analysis on Tracker Av. Threshold angle



Pale blue dot....





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Thank you

www.supernova-pv.eu



Co-funded by the European Union under Horizon Europe Agreement No 101146883. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

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