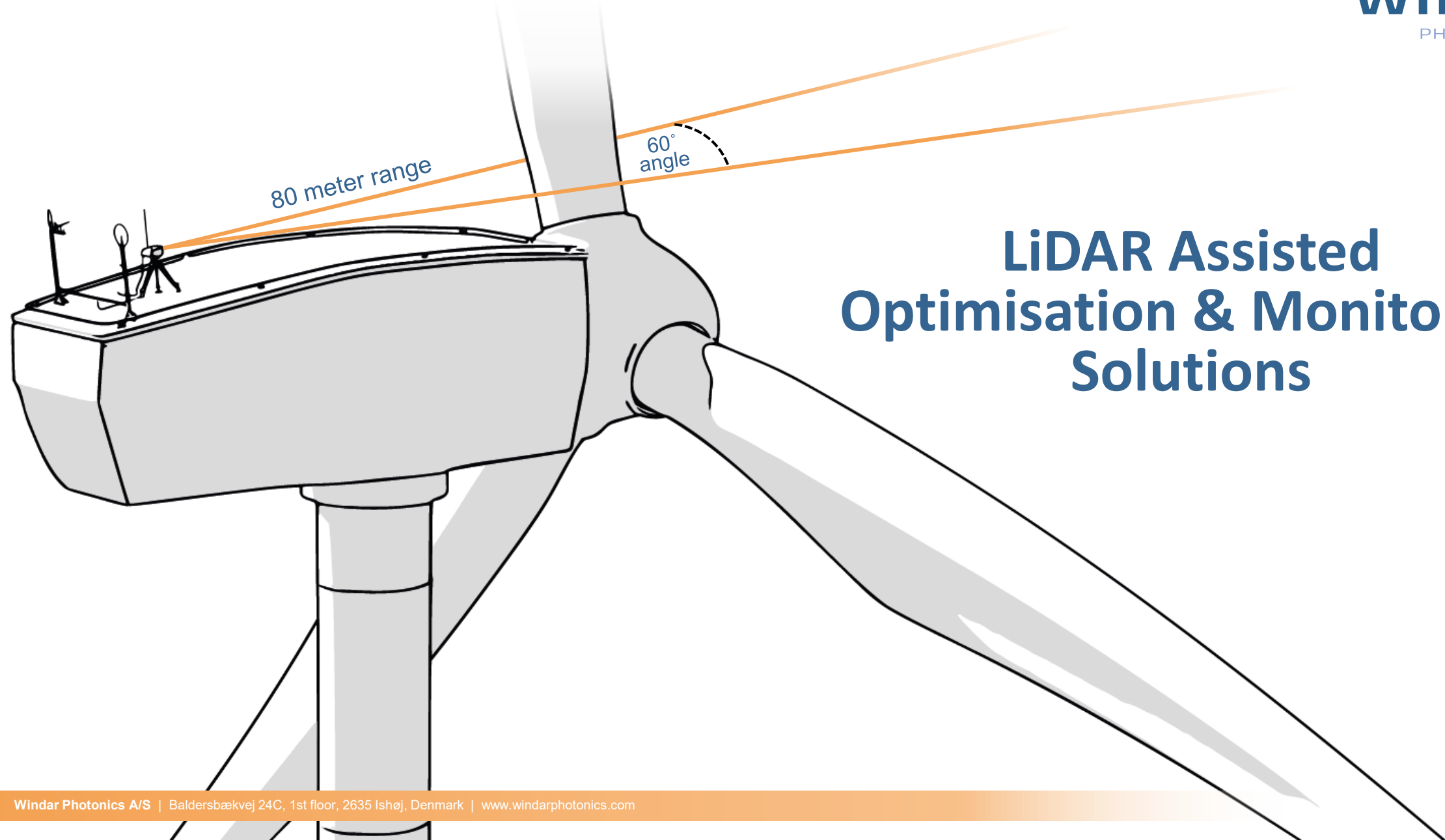




LiDAR Assisted Optimisation & Monitoring Solutions

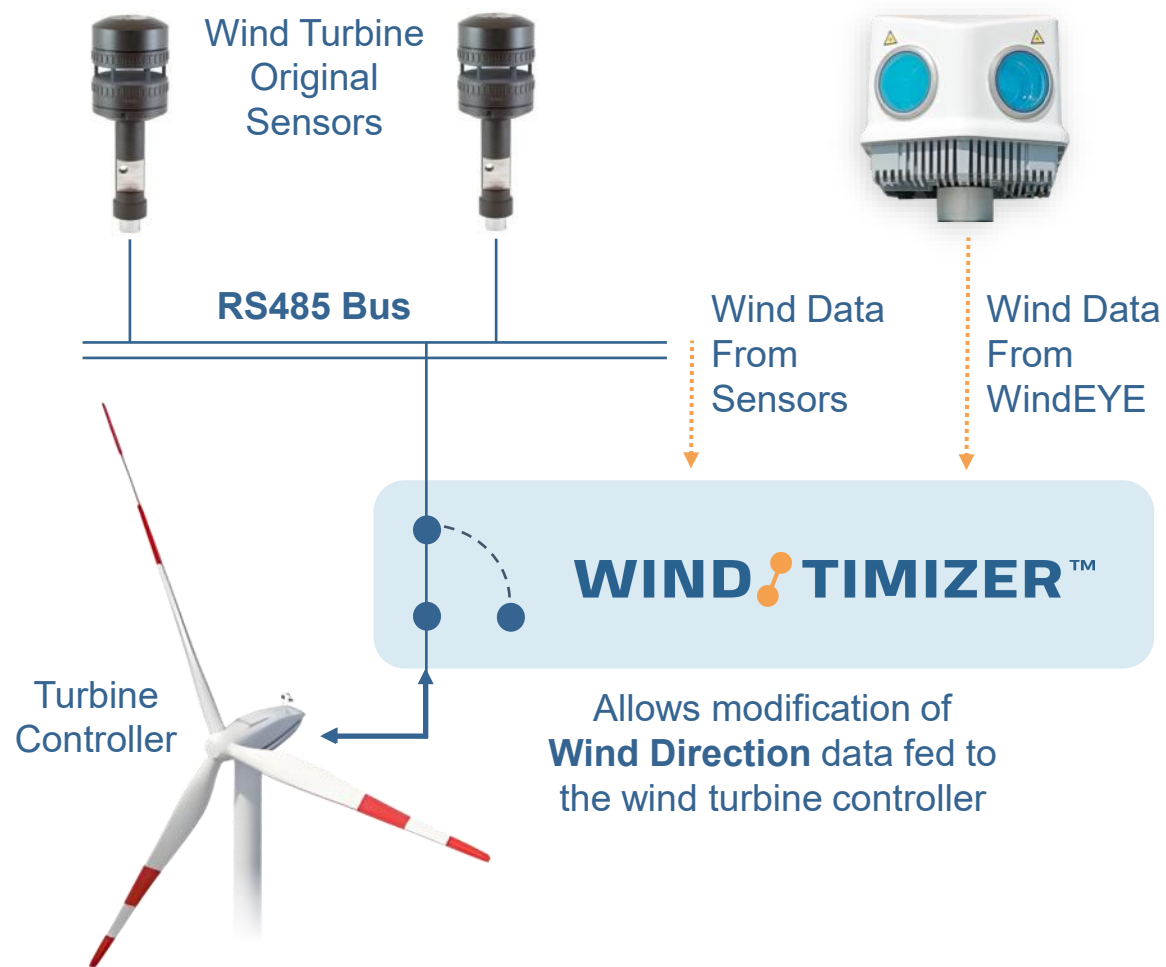
WindEYE Optimisation Solution



WIND●●EYE™

- Remote wind sensing 70 meters ahead of wind turbines in free air flow
- No need for turbine control modifications due to the Plug'n'Play WindTimizer integration technology
- Typical AEP increase of 2-4%
- More than 1,600 wind turbines installed with the WindEYE Optimisation Solution

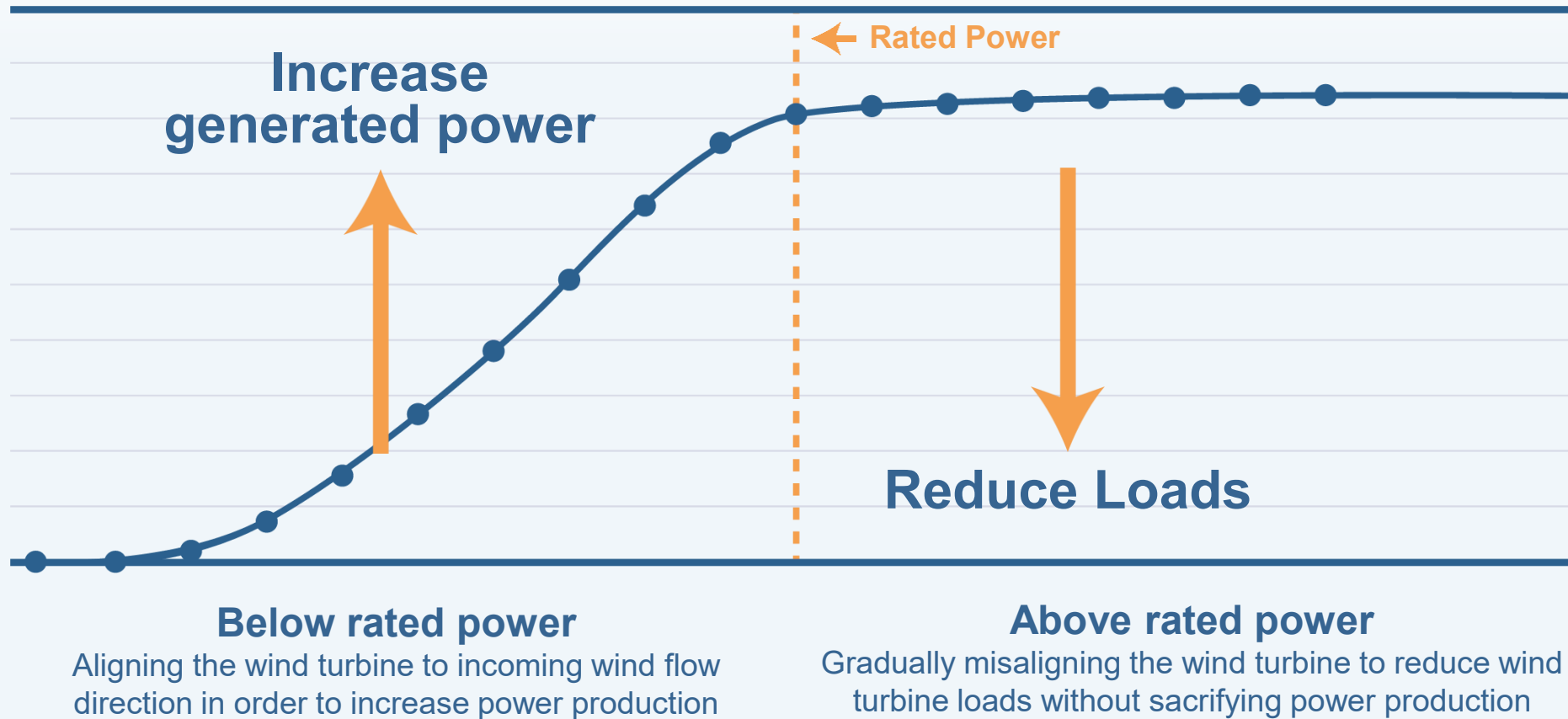
A unique solution to optimise power generation and turbine operation



Enabling unique wind turbine optimization

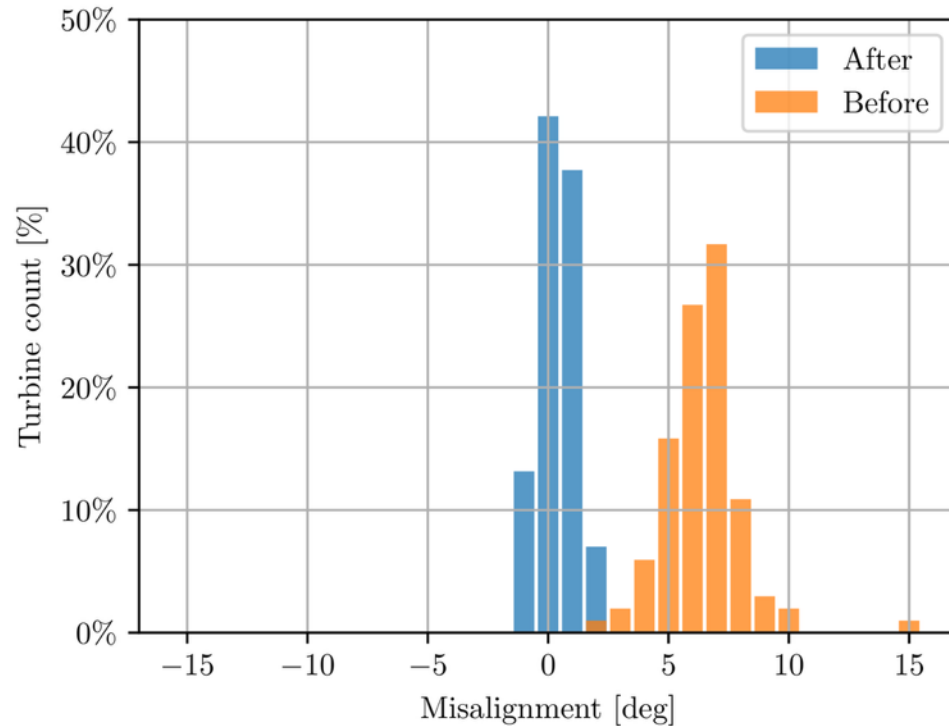
- Enables to realign any given wind turbine to the incoming wind direction below rated wind speed and increase power production
- Misalign wind turbines above rated wind speed to alleviate critical loads
- Does not require modification of the turbine controller
- Supports and automatically identifies majority of turbine sensors on the market

WindEYE Optimisation Solution

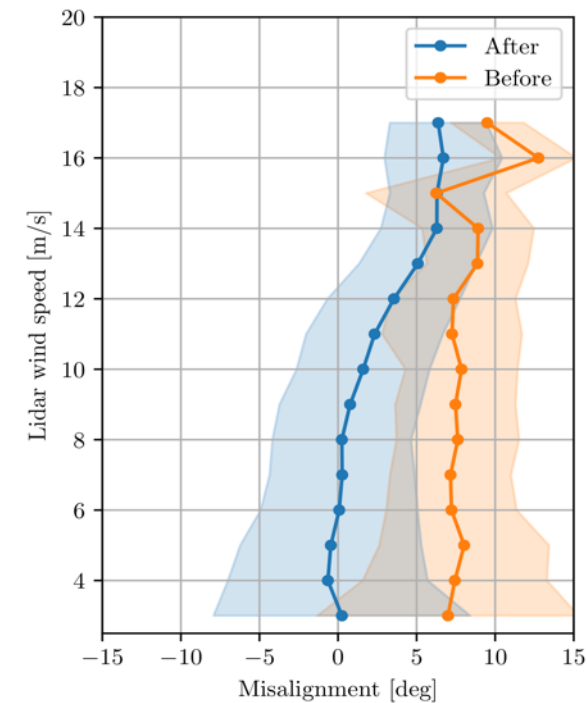


WindEYE Optimisation Solution

Misalignment measurements
from a typical wind farm (Vestas V82)



Example from a realignment strategy
(Vestas V82)



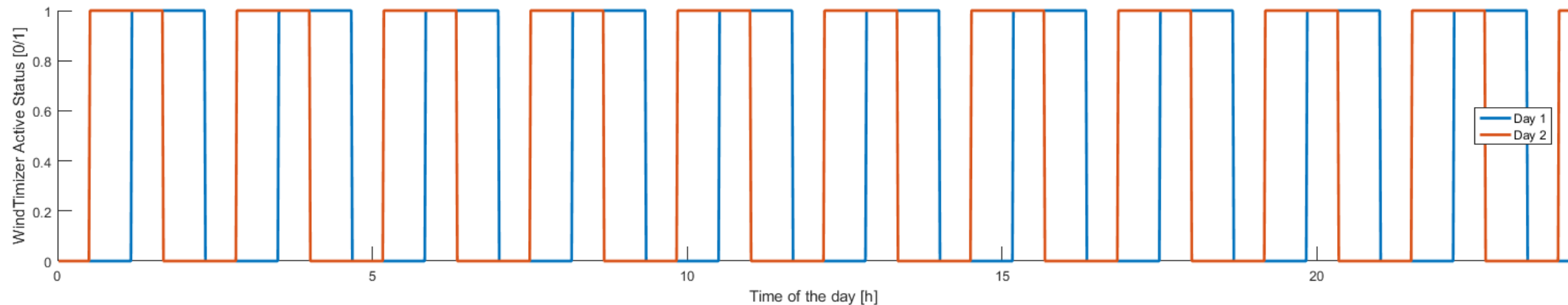
= >2.5% increase to AEP!

Power Gain Verification

Toggling campaign enables tracking of power gain from WindTimizer activation

Automatically toggles WindTimizer from ON to OFF every 70 minutes to mitigate:

- Influence of atmospheric conditions (change in air density)
- Influence of recurrent phenomena (e.g: diurnal atmospheric stability)



Then power productions of Turbine Control periods vs. WindTimizer control periods are compared to derive power gains during the 3 months long campaign.

Retrofit optimisation for any model of wind turbine



VESTAS V82



VESTAS V82



SENVION MM82/MM92



GE 1.5/1.6/2.X/3.X



SENVION MM82/MM92



GE 1.5/1.6/2.X/3.X



GE 1.5/1.6/2.X/3.X



SENVION MM82/MM92



VESTAS V82



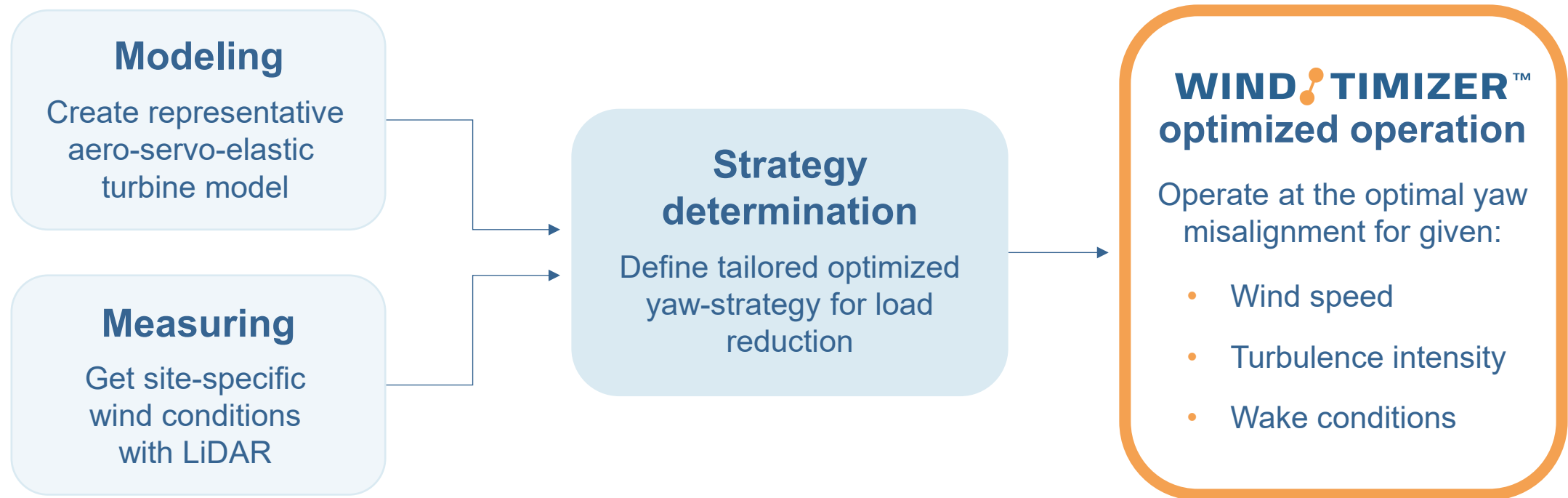
WINDAR

PHOTONICS

Load alleviation by misalignment

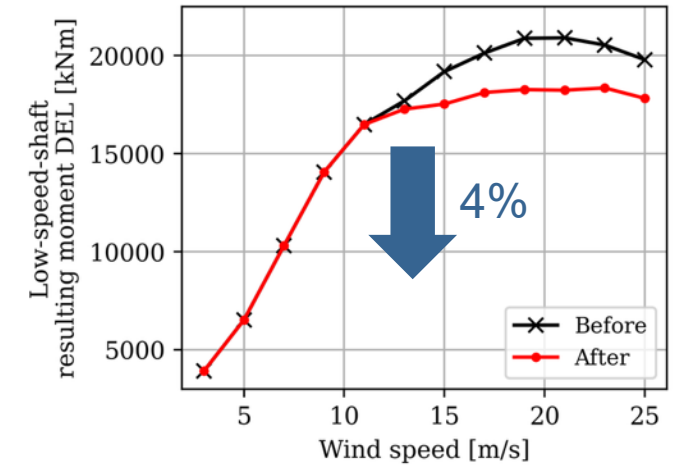
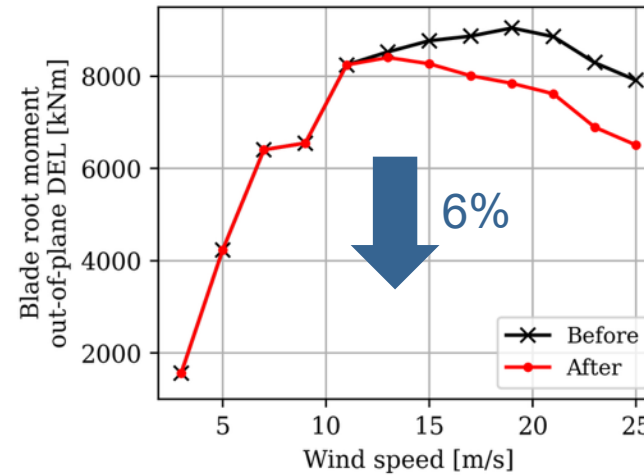
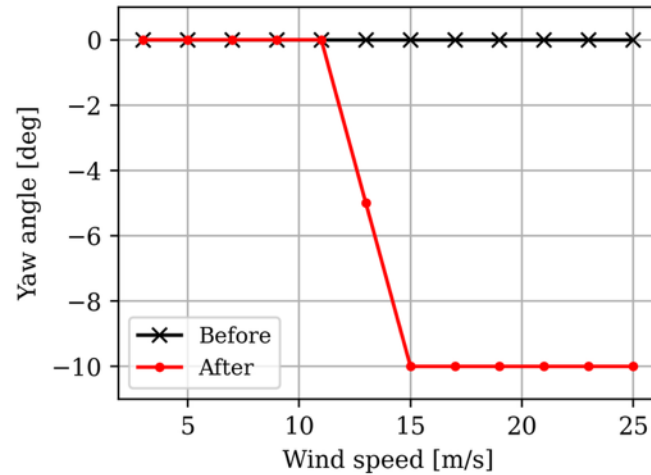
Our approach to specific turbine model strategies

Tailored load reduction strategy



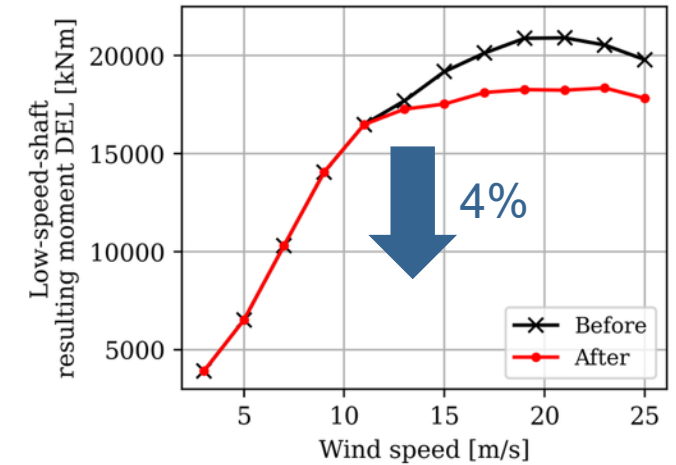
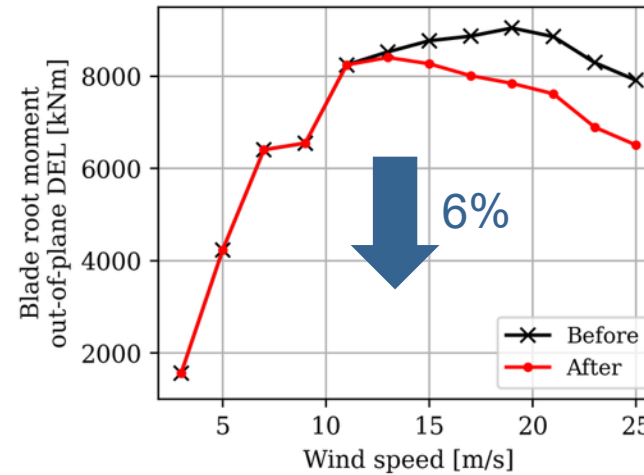
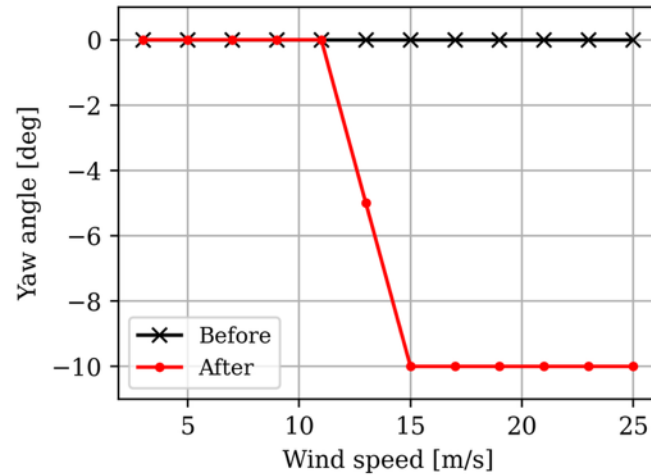
...without any controller change!

Simple strategy example



- No power production loss
- Fatigue reduction at high wind speeds on Blade and Low-Speed Shaft

Simple strategy example

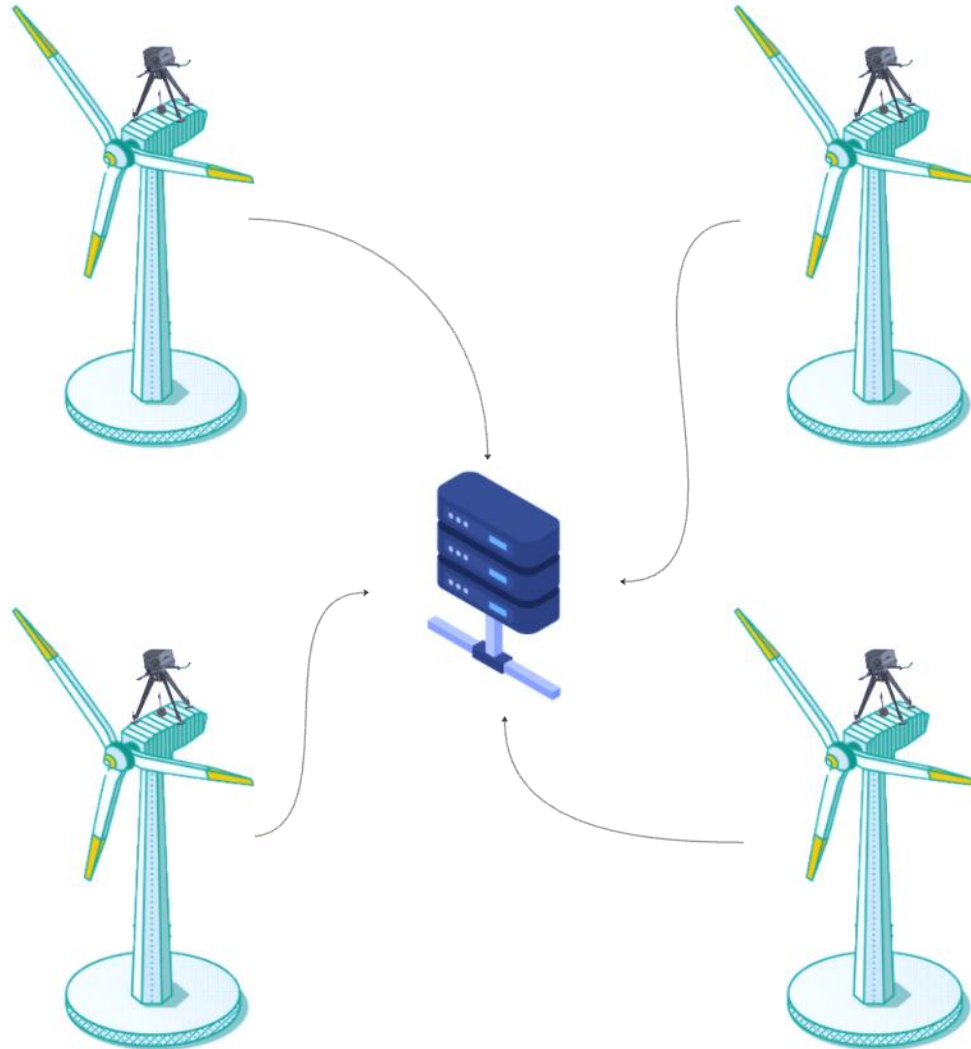


- No power production loss
- Fatigue reduction at high wind speeds on Blade and Low-Speed Shaft

NEXUS OS

A decade of LiDAR and Wind Turbine knowhow
distilled into one Operating System

Nexus OS – On-premises Solution



Nexus OS is an on-premises LiDAR Fleet Management System and is:

- **CyberSafe**
Nexus OS is fully deployable and operates offline thus fulfilling customer's Cyber-security policies without compromising on the benefits of the LiDARs.

Browser-based interfaces avoids any local installations on operators' devices.

- **Autonomous**
Operates with minimal manual intervention to continuously monitor and optimise the performance of the LiDARs.

Nexus OS – What does it do?

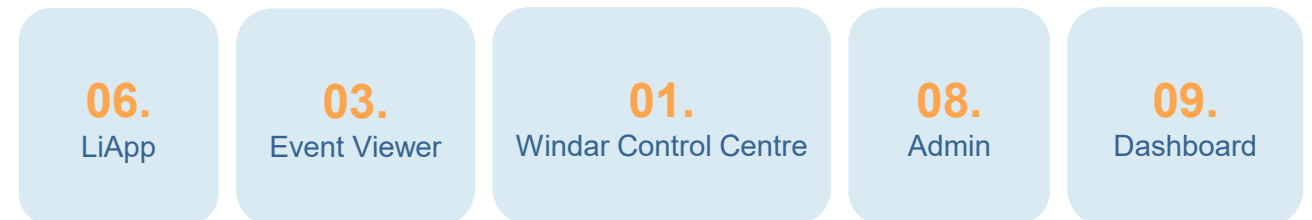
Nexus OS incorporates a Suite of tools which includes:

1. Centralised platform linking all the LiDARs (Windar Control Centre)
2. Automatic data collection and processing
3. Continuous optimization of LiDARs
4. Processed and unprocessed data storage
5. Automatic monitoring and reporting of live and historical events
6. User interfaces through web apps to server and LiDARs
7. Performance and Debug report creation
8. Administrative actions
9. Advanced logging and visualization mechanism
10. Facilitates plug-in modules for new features and upgrades

BACKEND



FRONTEND



Interfaces – Windar Control Centre (WCC)



The default landing page of Nexus OS is the Windar Control Centre

The WCC offers:

- 1. An overview of LiDAR fleet status (Online/Offline/Events)
- 2. Customisable columns depending on information of interest
- 3. Links to LiDAR and Administrator interfaces
- 4. Links to Add-on modules

The screenshot shows the Windar Nexus WCC interface. At the top, there's a header with the Windar Nexus logo, a user guide link, and a welcome message for 'Nexus Admin'. Below the header, there's a table with columns: ID, Serial Number, MAC, Last Seen, IP Address, Turbine ID, HW Revision, SW Ver, Features Enabled, and Product. The table contains 20 rows of data, each representing a LiDAR unit. The units are color-coded: green for 'Online', orange for 'Offline', and red for 'Events'. The table is filtered by 'Last week' and 'Clear' buttons are available for each column. The interface also includes a sidebar with navigation links like 'OTA', 'SSH', 'UI', 'REP', 'US', and 'KAY'.

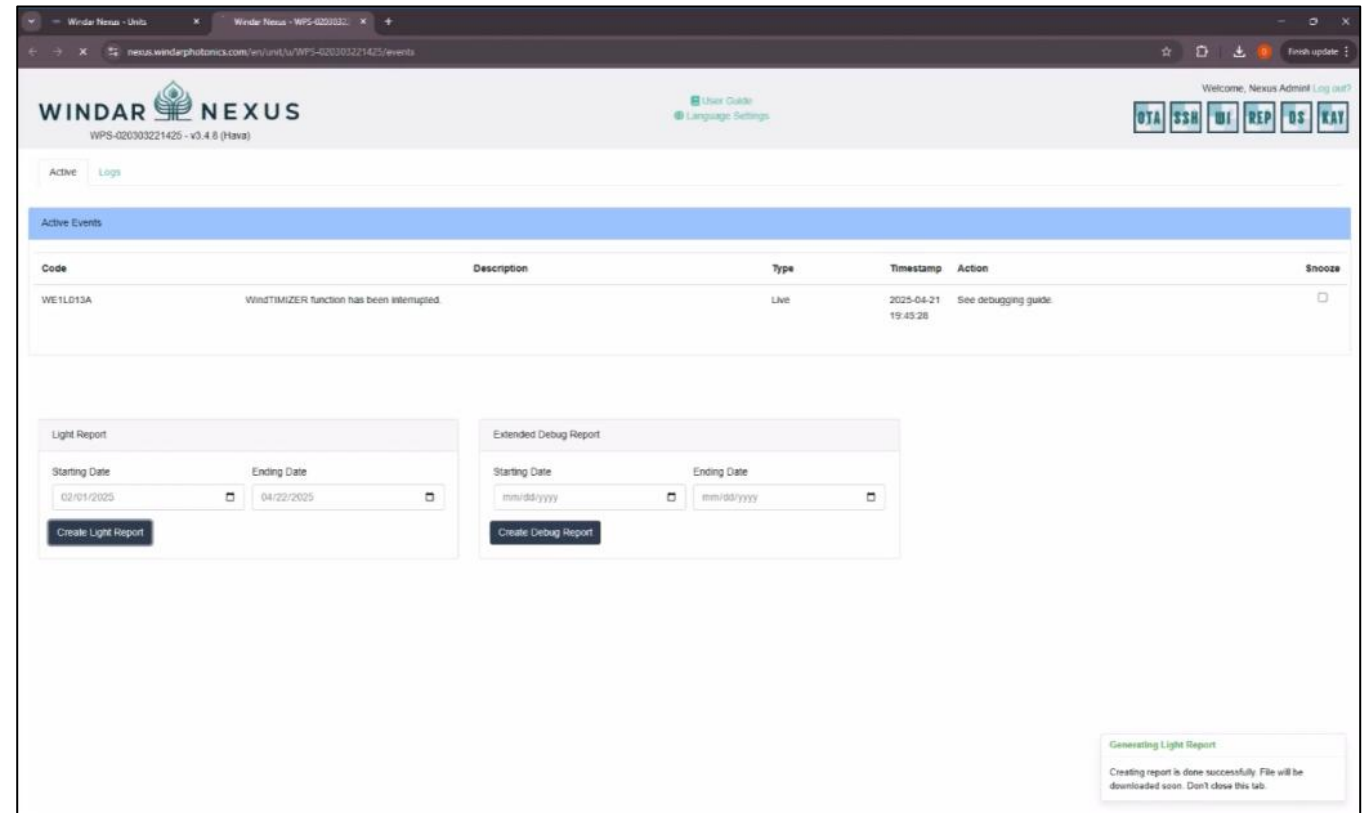
ID	Serial Number	MAC	Last Seen	IP Address	Turbine ID	HW Revision	SW Ver	Features Enabled	Product
1406	WPS-020303221406	70:83:05:5F:D2:06	2025-04-22 10:45:34	10.2.1.30	04X01	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1407	WPS-020303221407	70:83:05:5F:D2:07	2025-04-22 10:45:34	10.2.1.31	04X02	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1413	WPS-020303221413	70:83:05:5F:D2:0D	2025-04-22 10:45:34	10.2.1.26	04X12	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1415	WPS-020303221415	70:83:05:5F:D2:0F	2025-04-22 10:45:34	10.2.1.30	04X07	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1416	WPS-020303221416	70:83:05:5F:D2:10	2025-04-22 10:45:34	10.2.1.29	04X04	C2	D2.5	Wake, Wind speed, WindTRACER	WindEYE Gen3
1422	WPS-020303221422	70:83:05:5F:D2:14	2025-04-22 10:45:34	10.2.1.37	04X05	C2	E1.0	WindTRACER, Wake, Wind speed	WindEYE Gen3
1418	WPS-020303221418	70:83:05:5F:D2:12	2025-04-22 10:45:37	10.2.1.38	04X10	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1419	WPS-020303221419	70:83:05:5F:D2:13	2025-04-22 10:45:43	10.2.1.39	05X07	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1423	WPS-020303221423	70:83:05:5F:D2:17	2025-04-05 16:10:41	10.2.1.71	05	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1424	WPS-020303221424	70:83:05:5F:D2:18	2025-04-22 10:45:50	10.2.1.46	05X08	C2	D2.5	Wake, Wind speed, WindTRACER	WindEYE Gen3
1425	WPS-020303221425	70:83:05:5F:D2:19	2025-04-22 10:45:51	10.2.1.45	05X04	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1436	WPS-020303221436	70:83:05:5F:D2:1A	2025-04-22 10:45:43	10.2.1.47	05X05	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1427	WPS-020303221427	70:83:05:5F:D2:1B	2025-04-22 10:45:50	10.2.1.49	04X14	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1428	WPS-020303221428	70:83:05:5F:D2:1C	2025-04-22 10:45:59	10.2.1.48	04X08	C2	D2.5	Wake, Wind speed, WindTRACER	WindEYE Gen3
1429	WPS-020303221429	70:83:05:5F:D2:1D	2025-04-22 10:30:49	10.2.1.57	4X13	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1430	WPS-020303221430	70:83:05:5F:D2:1E	2025-04-22 10:45:51	10.2.1.58	04X05	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1431	WPS-020303221431	70:83:05:5F:D2:1F	2025-04-22 10:45:45	10.2.1.59	05X17	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1439	WPS-020303221439	70:83:05:5F:D2:25	2025-04-08 13:52:39	10.2.1.60	C4	C2	D2.4	WindTRACER, Wake, Wind speed	WindEYE Gen3
1433	WPS-020303221433	70:83:05:5F:D2:21	2025-04-22 10:45:51	10.2.1.51	05X10	C2	D2.5	Wake, Wind speed, WindTRACER	WindEYE Gen3
1434	WPS-020303221434	70:83:05:5F:D2:22	2025-03-27 14:15:31	10.2.1.62	D0	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1436	WPS-020303221436	70:83:05:5F:D2:24	2025-04-08 14:15:51	10.2.1.65	C3	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1439	WPS-020303221439	70:83:05:5F:D2:27	2025-04-11 16:01:35	10.2.1.52	10X11	C2	E4.0	WindTRACER, Wake, Wind speed	WindEYE Gen3
1440	WPS-020303221440	70:83:05:5F:D2:28	2025-04-11 17:46:26	10.2.1.53	V7	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1441	WPS-020303221441	70:83:05:5F:D2:29	2025-05-28 07:31:54	10.2.1.50	8X10	C2	E4.0	WindTRACER, Wake, Wind speed	WindEYE Gen3
1442	WPS-020303221442	70:83:05:5F:D2:2A	2025-04-10 16:17:36	10.2.1.76	114	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3
1443	WPS-020303221443	70:83:05:5F:D2:2B	2025-05-27 14:24:55	10.2.1.67	11418	C2	D2.5	WindTRACER, Wake, Wind speed	WindEYE Gen3

Interfaces – Event Viewer

The Event Viewer allows the operator to investigate live or historical events that are signaled by the blue cell on the WCC

The Event Viewer offers:

1. A description of the event, type and addressable actions
2. Option to snooze event
3. Option to generate a single PDF report or a complete debug package with system logs for further investigation

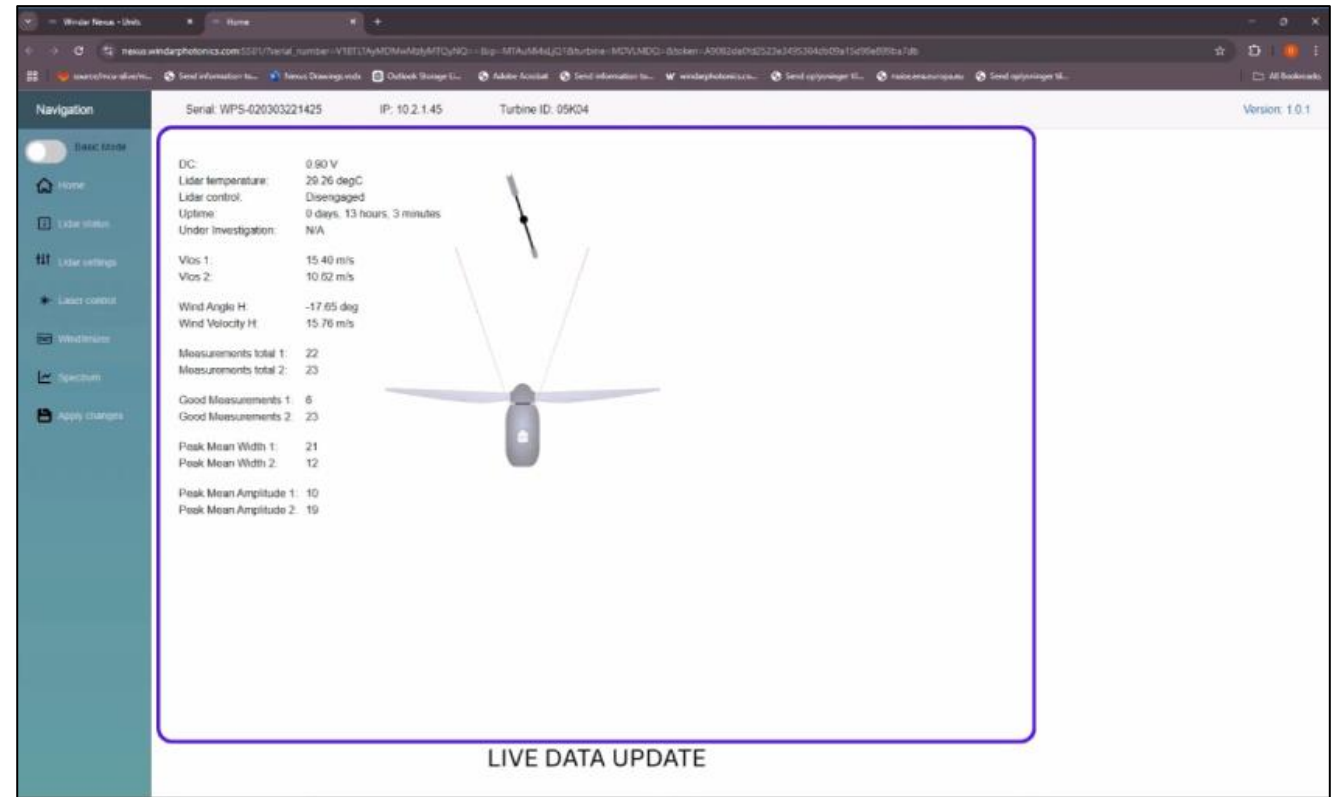


Interfaces – LiApp

The LiApp enables live interactions with a LiDAR

With the LiApp, the operator can:

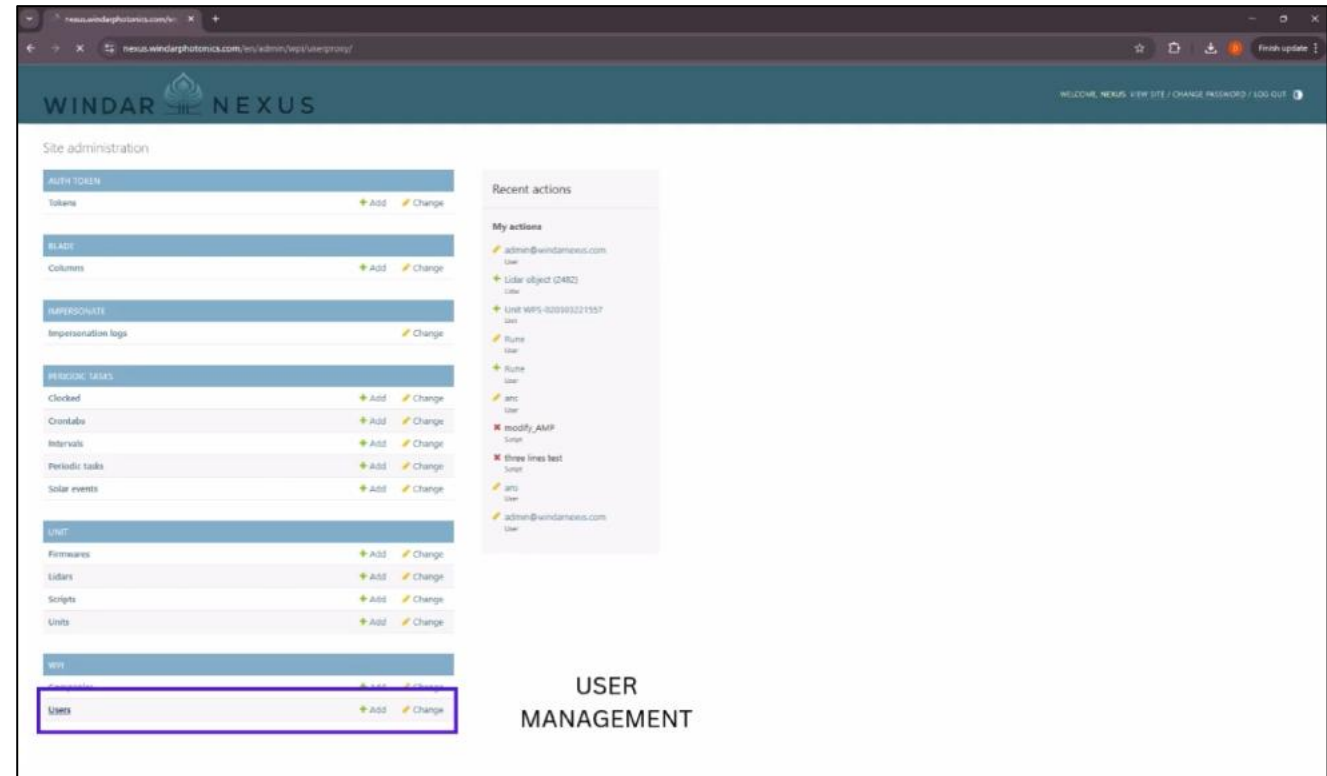
1. Receive live data about various parameters such as Wind speed, Wind Direction, voltage levels, laser power, temperature, humidity, etc.
2. Enter debug mode to change various parameters such as network settings, WindTimizer engagement, etc.
3. View live spectra data
4. Synchronise all changes to both the LiDAR and the database on Nexus server for tracking purposes



Interfaces – Administrator

The Administrator view allows the moderator to:

1. Add or delete users
2. Add, remove or modify user permissions
3. Add, remove or modify LiDAR tracking data



Interfaces – Dashboard

Nexus OS also offers a fully customizable dashboard interface on all available Metrics, Data and logs



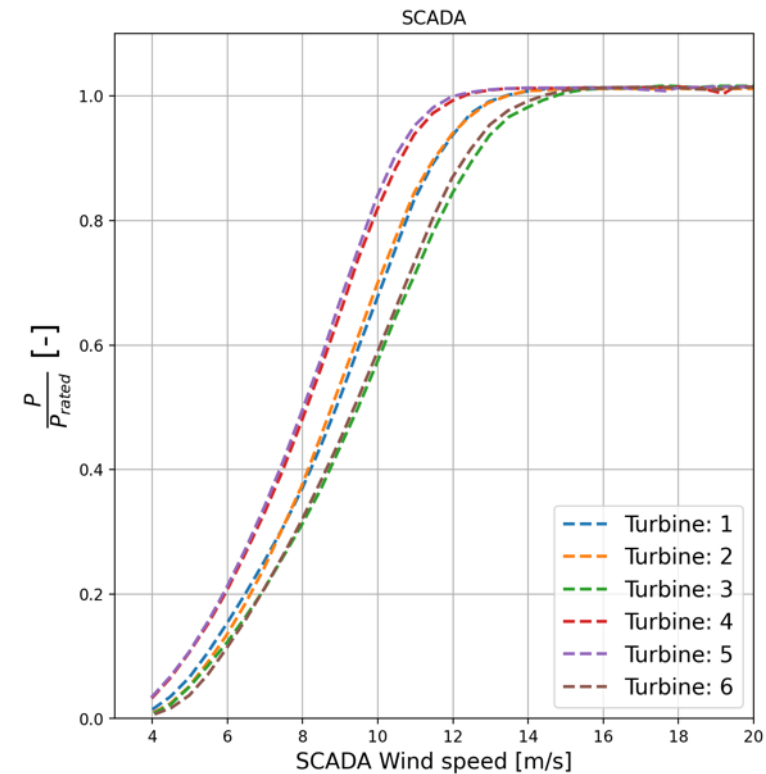
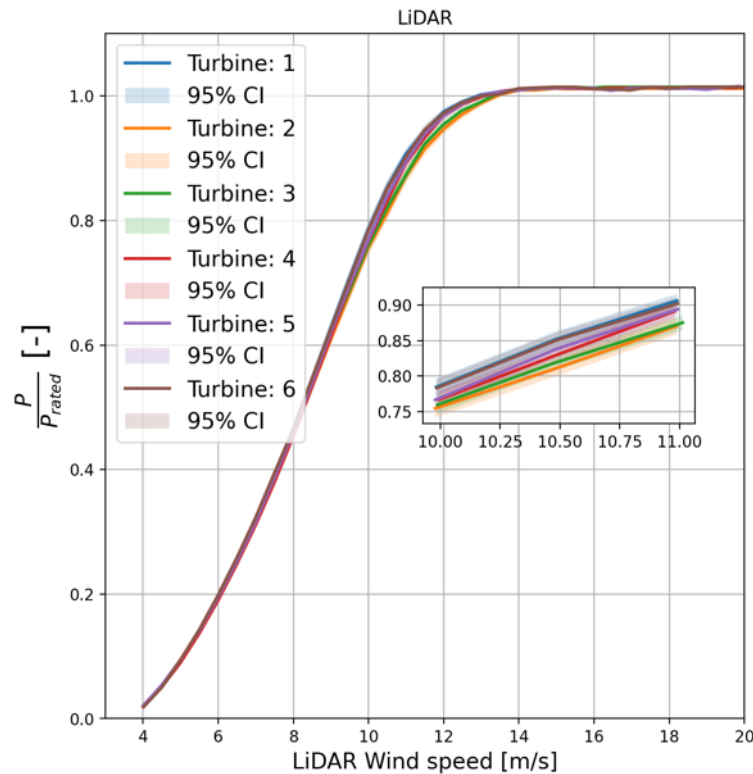
NEXUS TPM

Turbine Performance Monitoring Module
for the NEXUS OS

Analysing performance is key

...but we cannot rely on SCADA wind speed!

Example from a North-American wind farm:



NEXUS TPM

NEXUS TPM traces performance automatically and
independently from SCADA and OEM data

WIND●●EYE™ provides reliable data



80 meter range

60°
angle

Unbiased Wind Field Data:

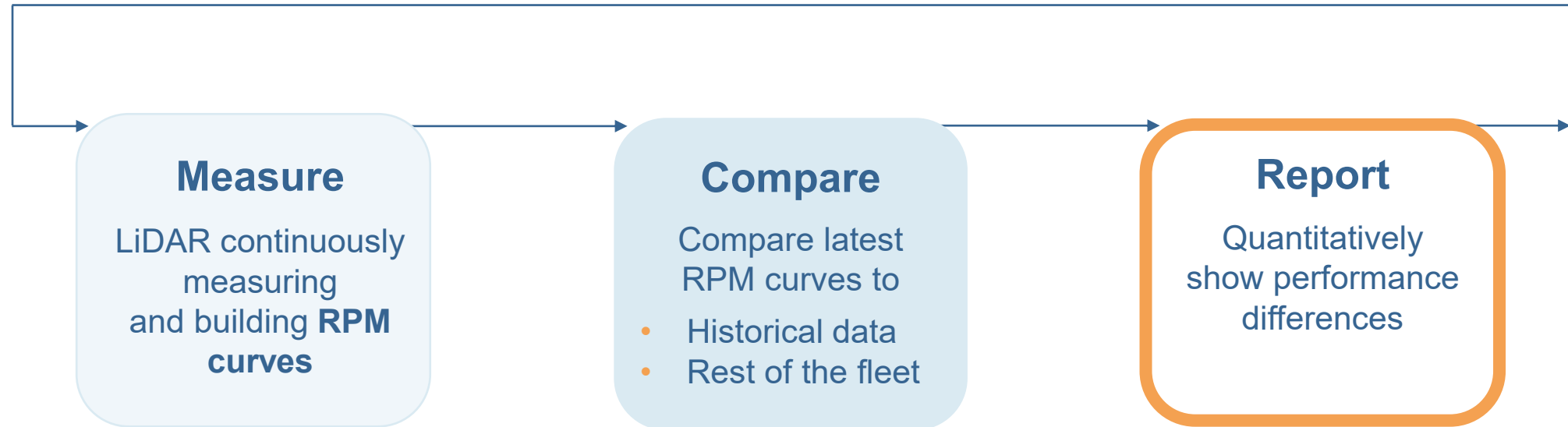
- Wind speed
- Wind direction
- Wake effect intensity
- General turbulence intensity
- Rotational speed
- Air density

Purpose:

Tracking **PRECISE** turbine performance

Tracking performance with LiDAR

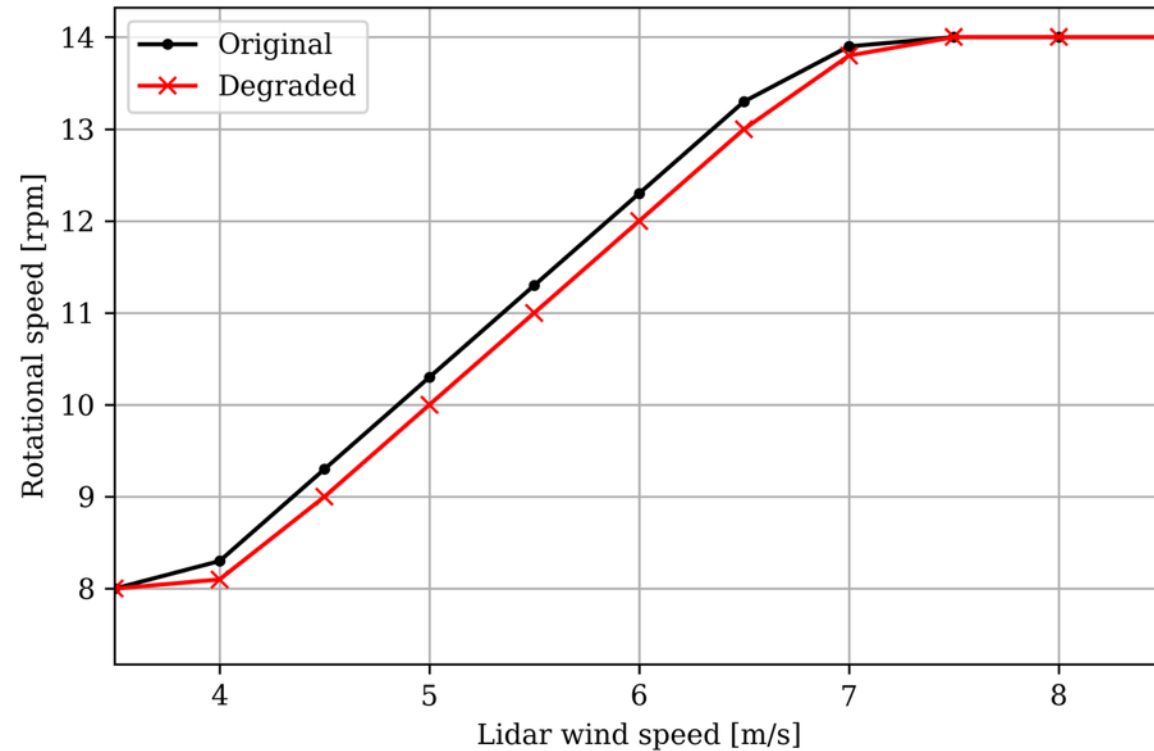
Key idea: power differences are related to RPM differences



RPM-Wind Speed curve: example

The rotational speed related to power production

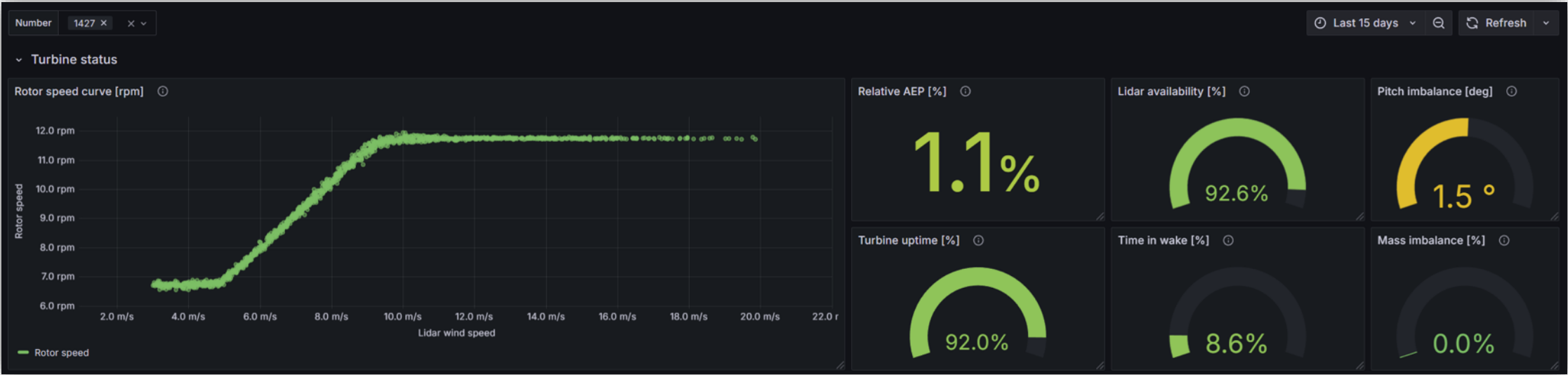
The turbine performance is derived from the rotational curve



NEXUS TPM Fleet Dashboard – Overview



NEXUS TPM Unit Dashboard – Overview



Retrofit optimisation for any model of wind turbine



VESTAS V82



VESTAS V82



SENVION MM82/MM92



GE 1.5/1.6/2.X/3.X



SENVION MM82/MM92



GE 1.5/1.6/2.X/3.X



GE 1.5/1.6/2.X/3.X



SENVION MM82/MM92



VESTAS V82