Turbit

AI Monitoring

Reduce O&M risks at scale


VSB

prokon
Energie. Gemeinsam. Leben.

WIND
PUNX

enercity
erneuerbare

BOREAS
energy unlimited

energiequelle
ENERGIE MIT ZUKUNFT.

Teut
Windprojekte
GmbH

EnergieKontor

wpd
think energy

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WindTeam

ENCAVIS

WOOTIS
TECHNICAL OPERATION & SERVICE

Die Experten für Erneuerbare Energien!
WestfalenWIND
Service

About Turbit

Turbit is an AI Monitoring System for wind turbines. **Detect abnormal behavior early** at a turbine and portfolio level with automated live analytics. Technical operators, directors, and asset managers benefit from Turbit's early and precise analytics.

6+
Years AI Development

12+
API Data Connections

8.000+
Turbine Years of Data

27+
European Customers

2.000+
Turbines

Why Turbit

Wind turbine O&M risks are on the rise:

High workload in operations management due more complex WTG technology and large renewable growth targets.

Inconsistent interpretations and actions arise when individuals read technical wind turbine reports and analytics.

Frequently no detailed history for specific components of the wind turbine, and recurring faults often go unnoticed.

Failing to identify the root causes of underperformance leads to inefficient troubleshooting.

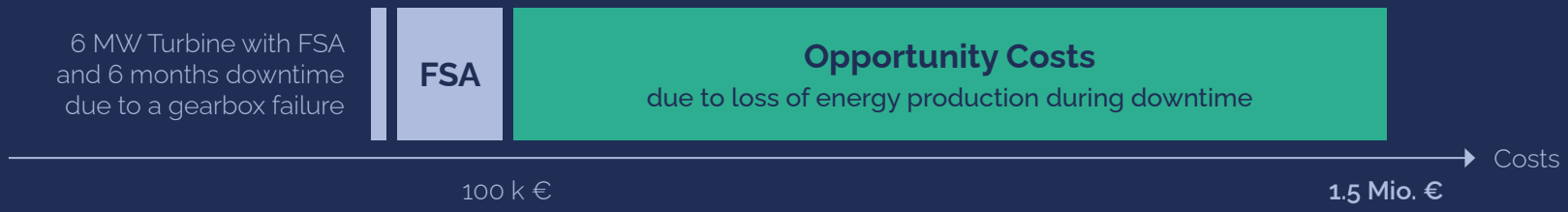
The rising risks lead to:

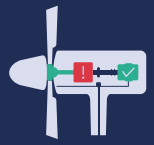
- Underperformance
- Unplanned downtimes
- High spare part costs

These costs scale with fleet size and *jeopardize* financial planning.

Full Service Agreements (FSA) have an uncapped risk

Downtimes are no longer remunerated and availability guarantees decrease, resulting in very high opportunity costs. With higher rated power per WTG and change in FSA contracts operators and owners take more and more risks.





26,000 €
Avg. opportunity costs of unplanned downtime per MW per year

> 10x
Return on invest per year, if you work with Turbit in 2023

Failure Statistics and Downtime Probabilities

Turbit covers gearbox, generator, drivetrain and some power problems.

Turbit's failure database confirms the statistics shown in the meta studies:

https://www.mdpi.com/1996-1073/13/12/3132
https://www.mdpi.com/1996-1073/11/5/1309

Example Calculation Gearbox:

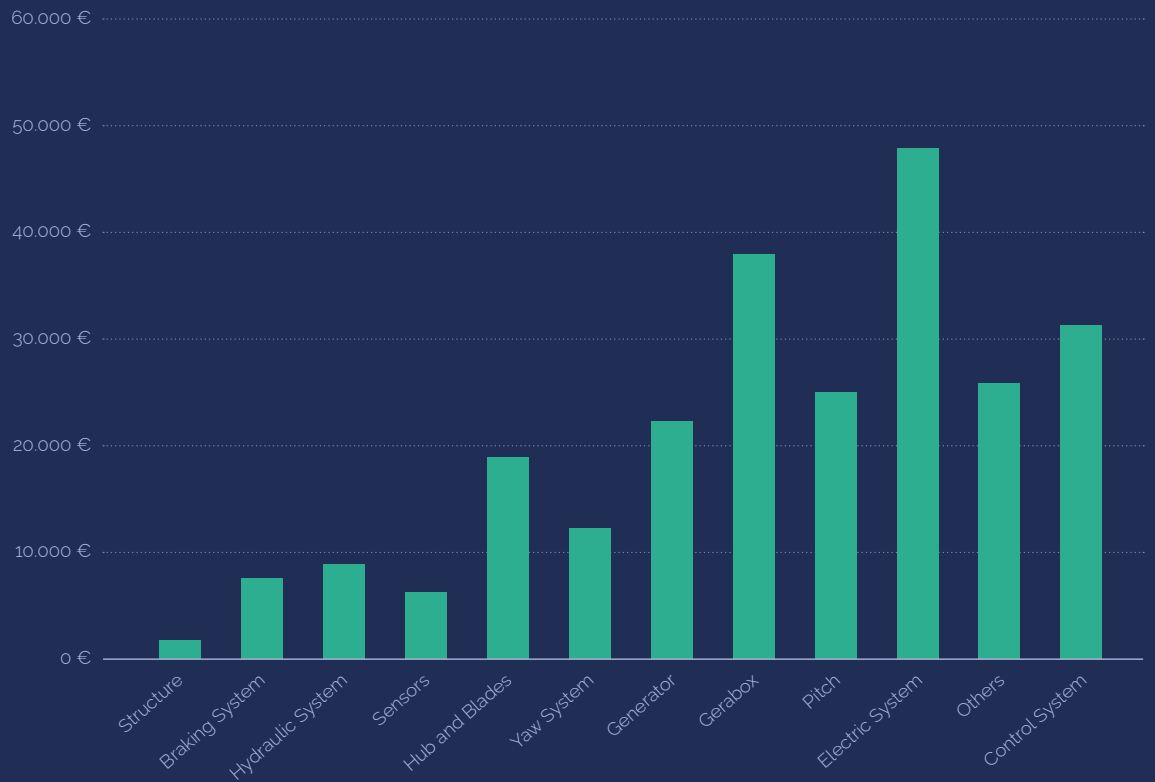
Costs of downtime in 2023 are 500kW * 0,15€ * 1h = 75€/kWh

Costs for gearbox downtime are 17,21%*365*24 *75€ =~ 110.000€

Downtime probability = 8% per year

Expectation costs = 8% * 110.000€ = **8800€**

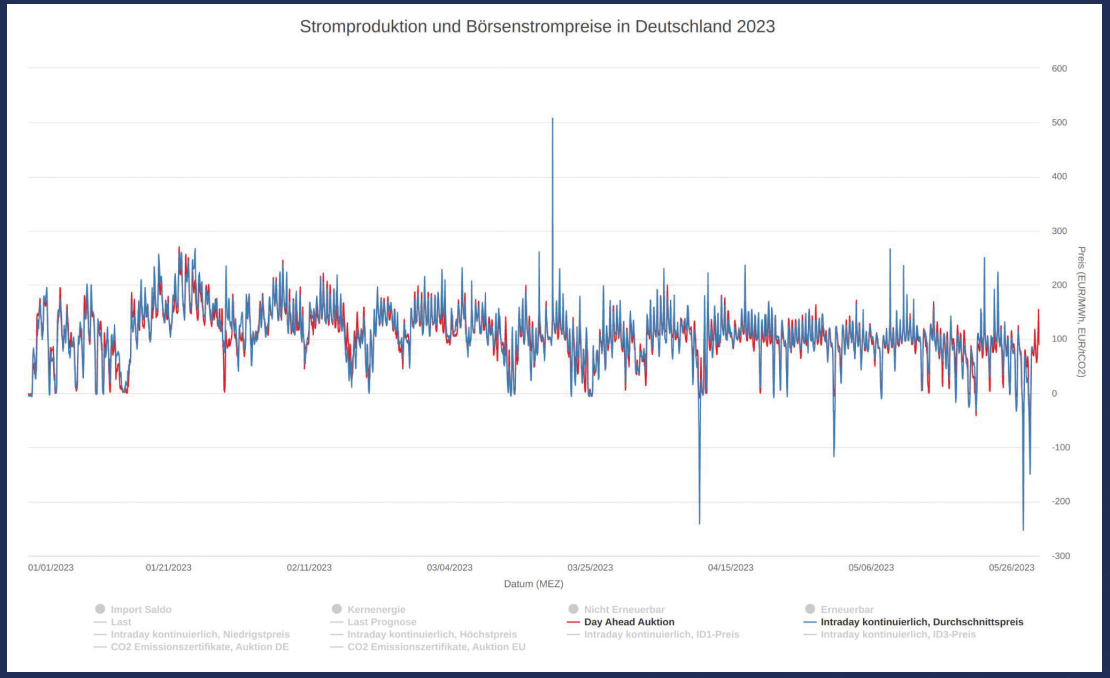
Yield Loss of a 6 MW WTG



Shown are the expected opportunity costs of downtimes calculated with 2023 average stock prices for components of a 6 MW WTG.

Summarizing the components that Turbit monitors in 2023, there are opportunity costs of 10,000€/MW rated power/year, or **60,000€ for a 6 MW** WTG.

Yield Loss Calculation Assumptions



Average electricity stock market prices in Germany for 2022 -2023: 106€/MWh

Formula for calculating the damage expectation values:

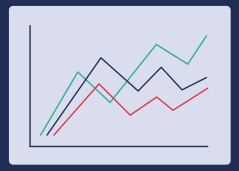
Annual yield:
2000 kW * 0.15€/kWh * 24h * 365 = **2.6 mio €**.

Damage expectation value of the component = Failure rate of the component * Average downtime * Annual yield

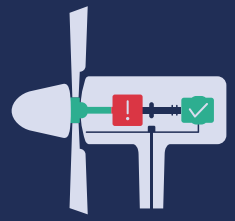
Damage expectation value of all components = Sum of all damage expectation values per component

The Complexity of Wind Turbine Monitoring

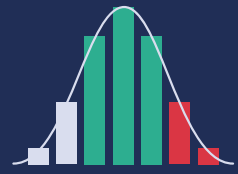
Each turbine behaves differently, even if identical in construction.



Different sites, wakes, turbulences and weather.



Different compositions of components and control software.



Different wear stages of components.

Smart Live Analyses for Every Wind Turbine

Turbit turns complex problems into simple ones:

Analytics

Automated live analytics leverage unnoticed potential and create more time to act.

System Health

Monitoring of health conditions, major components and adjacent subsystems.

Network

mproving anomaly detection with each additional turbine and failure. Smart data development through AI monitoring and fleet learning.

Wildlife Monitoring

Complex wildlife restriction rules made simple.

Turbit AI Infrastructure

The 4 steps of Turbit's fully automated and self improving preventive maintenance infrastructure.

1. Data Engineering

- Raw Data Collection
- Data Lake and Warehouse
- Selection of Training Sets

2. Anomaly Detection

- Classic Deep **NN*** predic normal behaviour
- Outlier Detection
- Transfer Learning

***NN:** Neutral Networks

3. Classification

Anomaly Classification

Failure Mode Prediction

Relevance Prediction

4. Feedback

Customer Feedback Functionalities

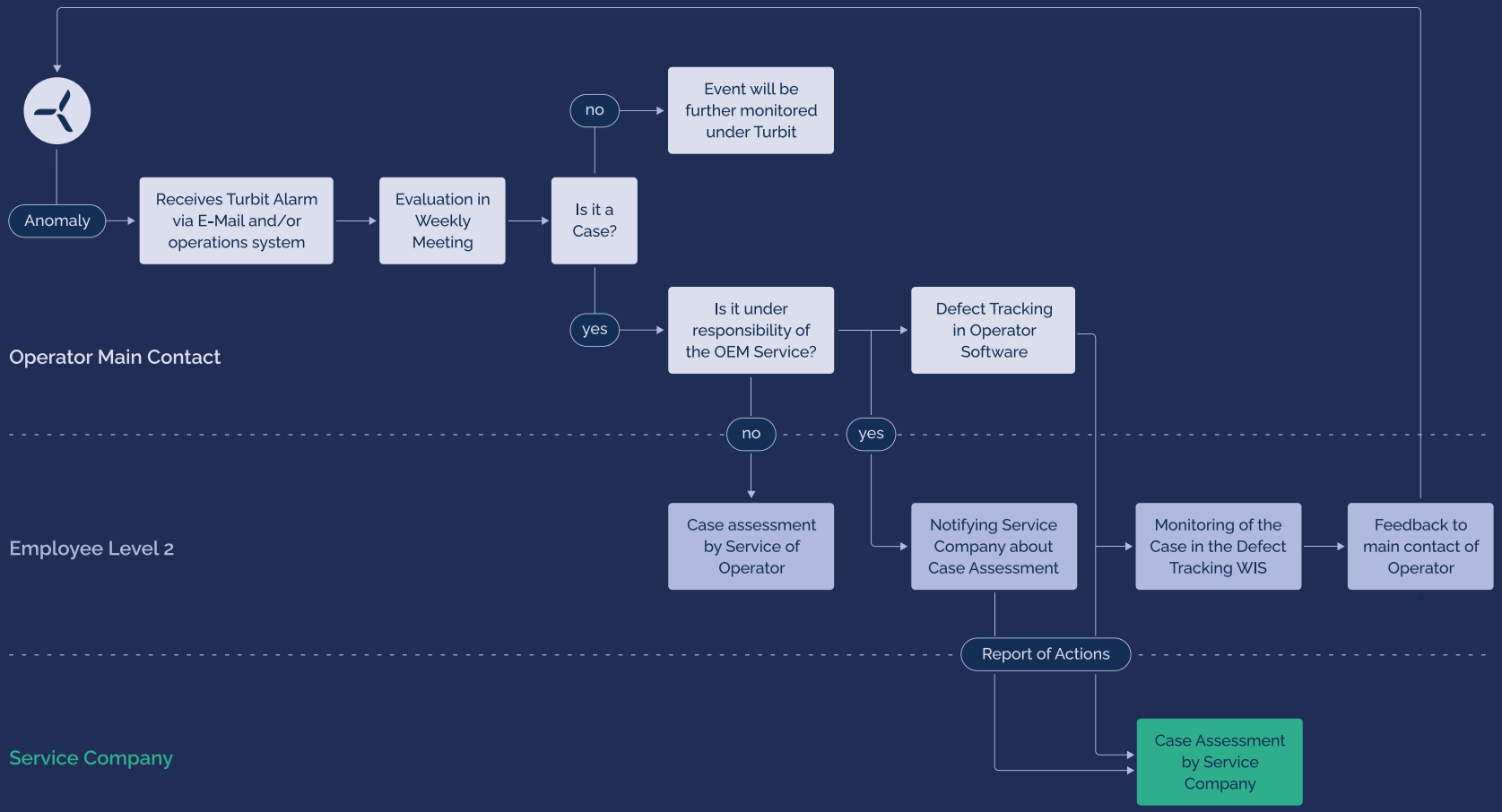
Communication Process with O&M

Reporting & Analytics Tools

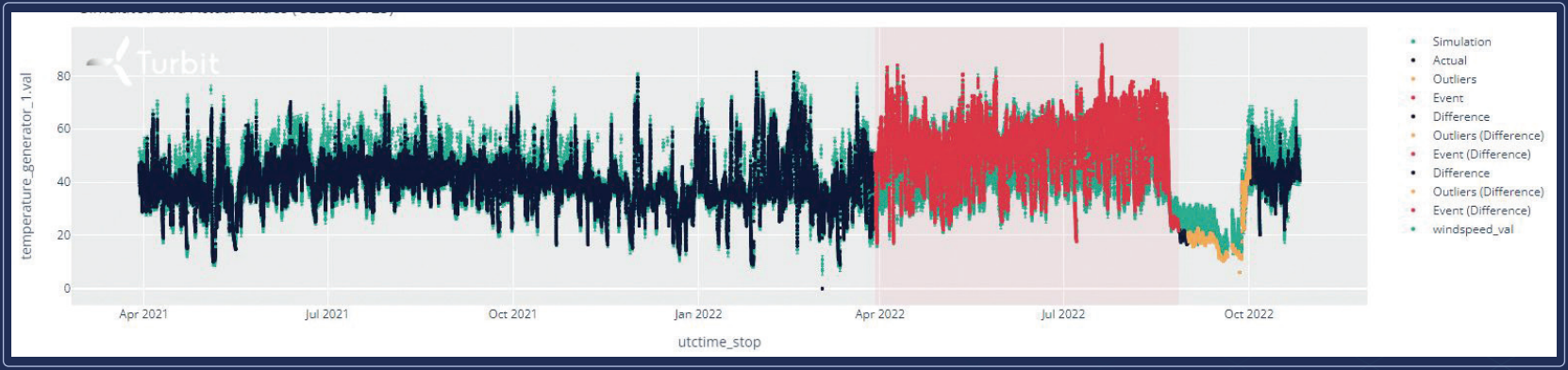
Failure Database

Retraining NN

Workflow of Turbit and Customer



Example of Customer Value:



- Detect failures months ahead
- Plan component replacements months ahead
- Save months in downtime

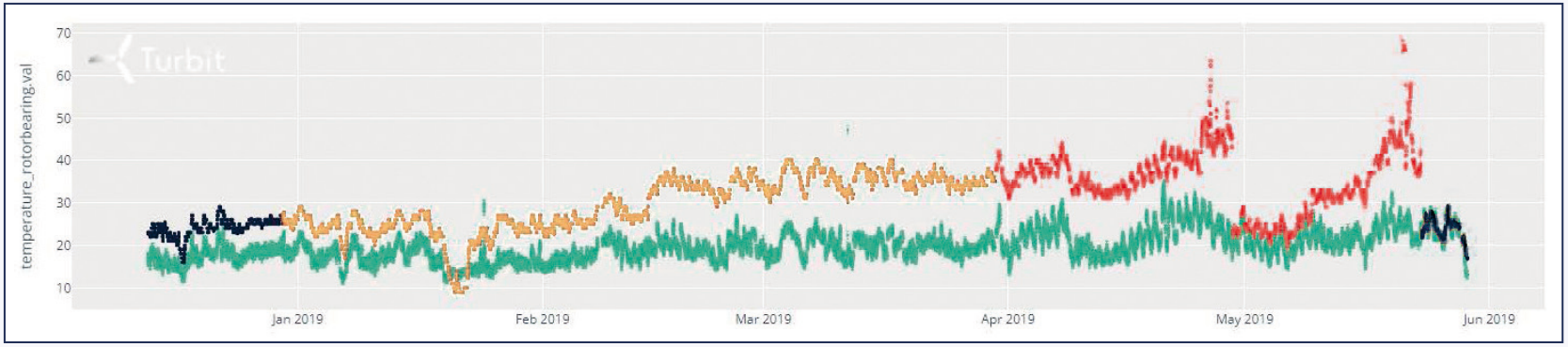
30x
Return on Invest for Turbit Customers in 2023

Show Cases

1. Rotor Bearing - Value 10.000€

Root Cause: Defective greasing mechanism

Precision: ± 0.5°C



1 2 3 4

1 Dezember 2018

Turbit detected an abnormal temperature in the rotor bearing.

2 April 2019

The semi-annual maintenance was performed in April 2019 but the cause of abnormal temperatures couldn't be solved.

3 May 2019

A second service visit was carried out and the defective press connection in the corrugated tube was finally found and replaced.

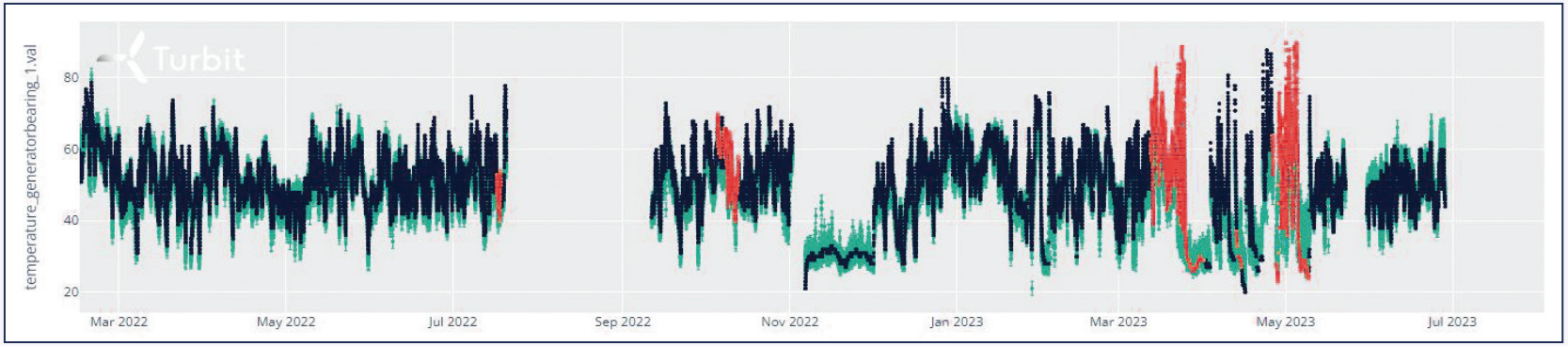
4 End of May 2019

The temperatures of the corrugated bearing then returned to normal behaviour.

Simulation SCADA Outlier Escalated Alarm

2. Generator Bearing- Value 300.000€

Root Cause: Defective generator bearing



1 — 2 - 3 – 4 5 6

1 12.03.2023
Abnormal temperatures detected - no temp. status code.

2 24.04.2023
Communication with service partner.

3 25.04.2023
Renewed alarm.

4 05.05.2023
Service call for inspection.

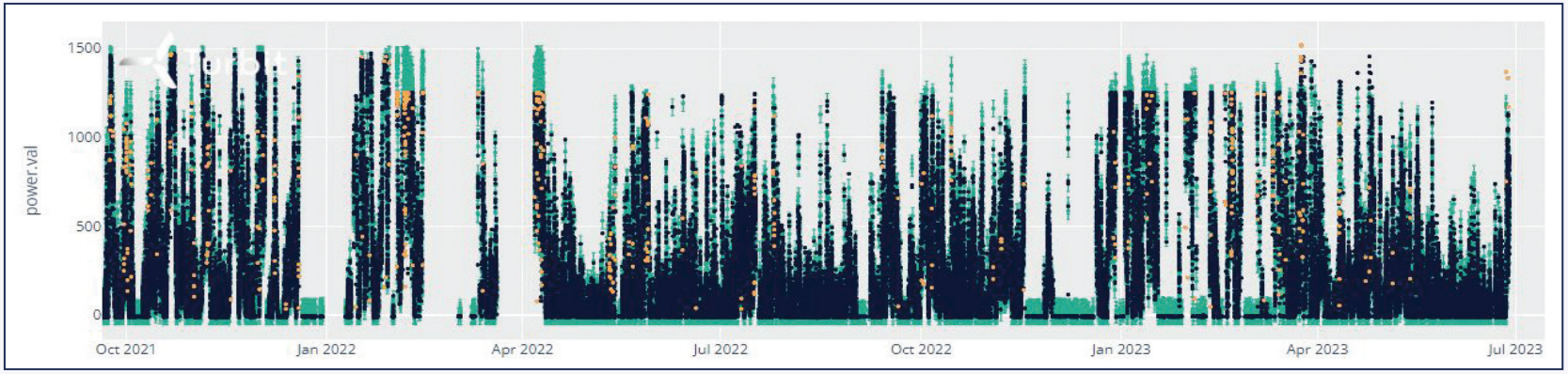
5 09.05.2023
Normal temperatures.

6 10.05.2023
Service call - generator bearing replacement with minimum downtime.

Added Value

3. Underperformance I - Value 60.000€

Root Cause: Defective frequency converter



1 — 2 — 3

1 02.02.2022

Throttling down to 1250kW.

2 18.02.2023

Service call: Converter was repaired.

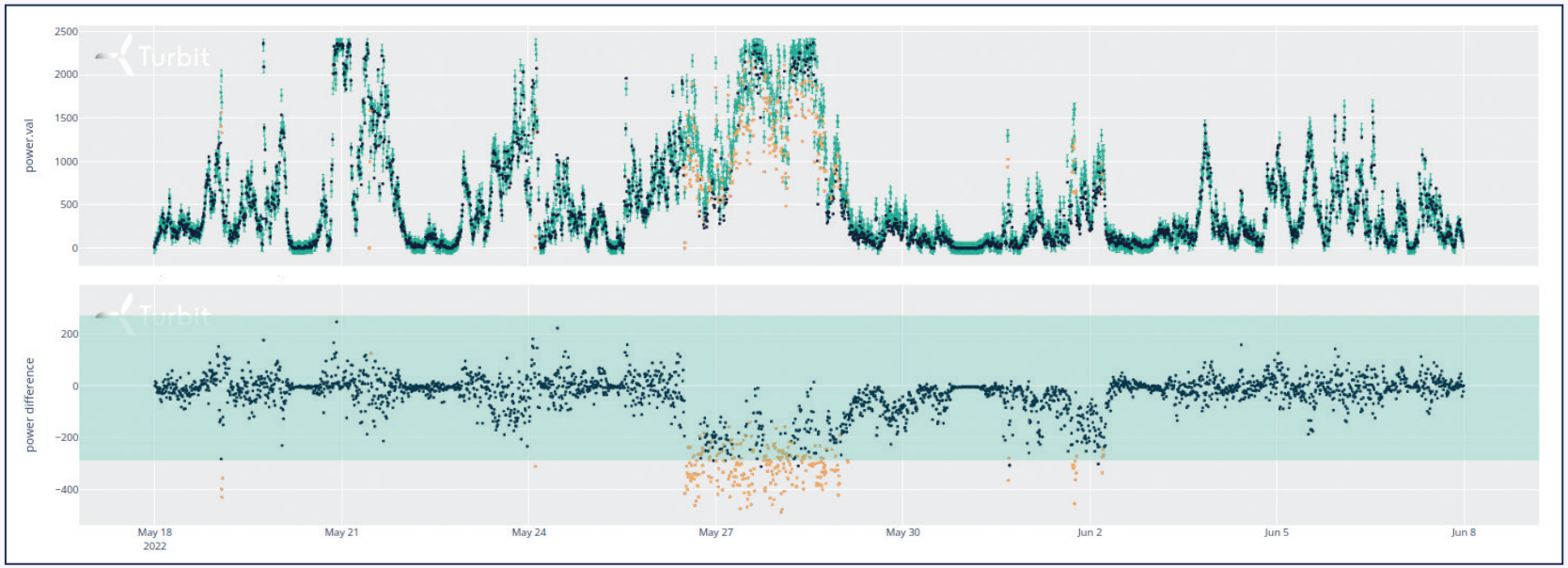
3 01.03.2023

Production again at rated power.

4. Underperformance II - Value 80.000€

Root Cause: Wrong pitch-offset

Precision: ± 30 kW



1 2 3

1 26.05.2022

Turbit detected a loss of power and immediately sent an alarm.

2 28.05.2022

The analysis showed a wrong offset of the pitch, and the operator could send a detailed analysis to the service team.

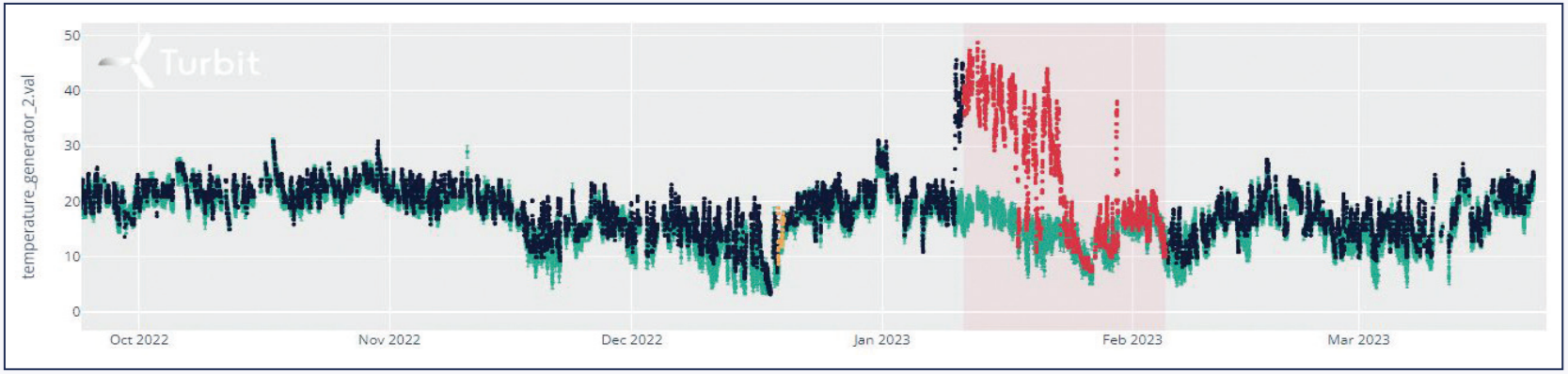
3 02.06.2022

A control software update prevented losses of 1000€ per day, which otherwise would have stayed undetected for months.

Added Value

5. Generator - Value 6.000€

Root Cause: Slip ring fan defect



1 2 3 4 5 6

1 10.01.2023
Abnormal temperatures detected - no temp. status code.

2 17.01.2023
Communication with service partner.

3 19.01.2023
Feedback - fan defect was confirmed.

4 24.01.2023
Normal temperatures.

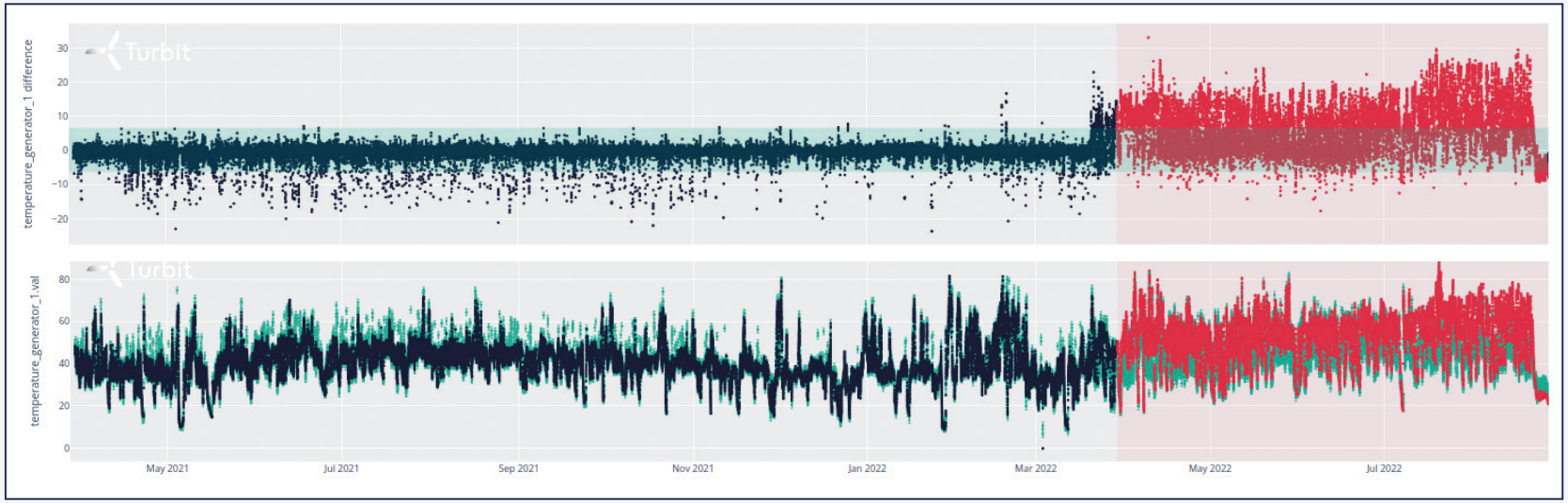
5 24.01.2023
Service - Thermo Relé was exchanged.

6 27.01.2023
Normal temperatures.

6. Generator Bearing - Value 400.000€

Root Cause: Meltdown of generator windings due to increased reactive power

Precision: ± 0.5°C



1 2 3 4

1 March 2022

Turbit first detected an abnormal generator temperature on the 4 WTGs of the park.

2 April 2022

The client informed the maintenance team about those anomalies, but even after a second anomaly report in July, the service replied that they don't see an issue.

3 August 2022

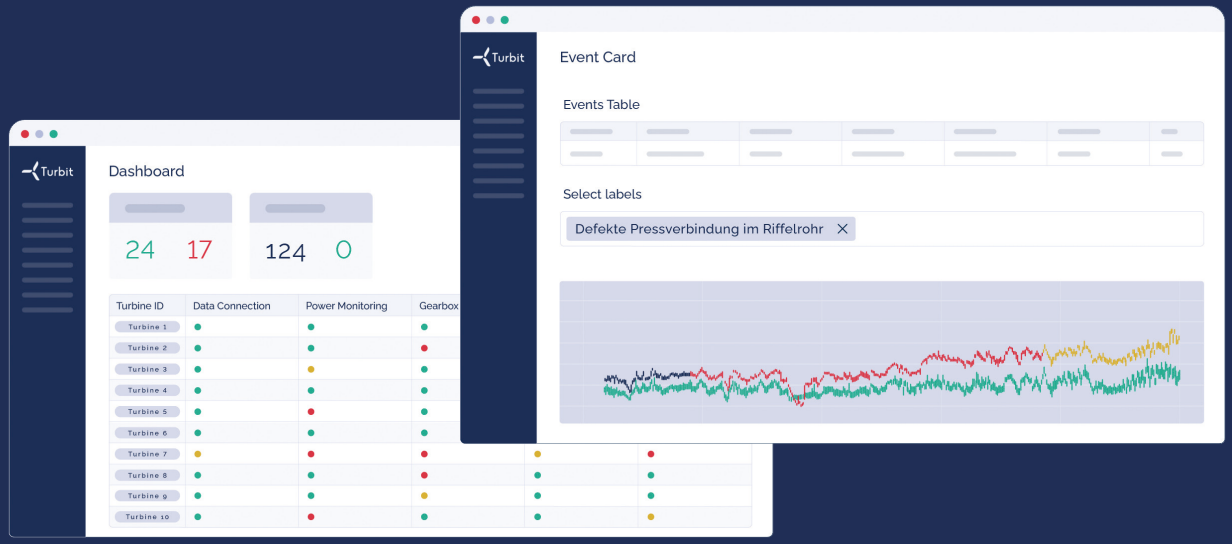
A total generator breakdown occurred.

4 September 2022

The client reported a claim to the service and now saves the 3 other generators and gets a better service quality.

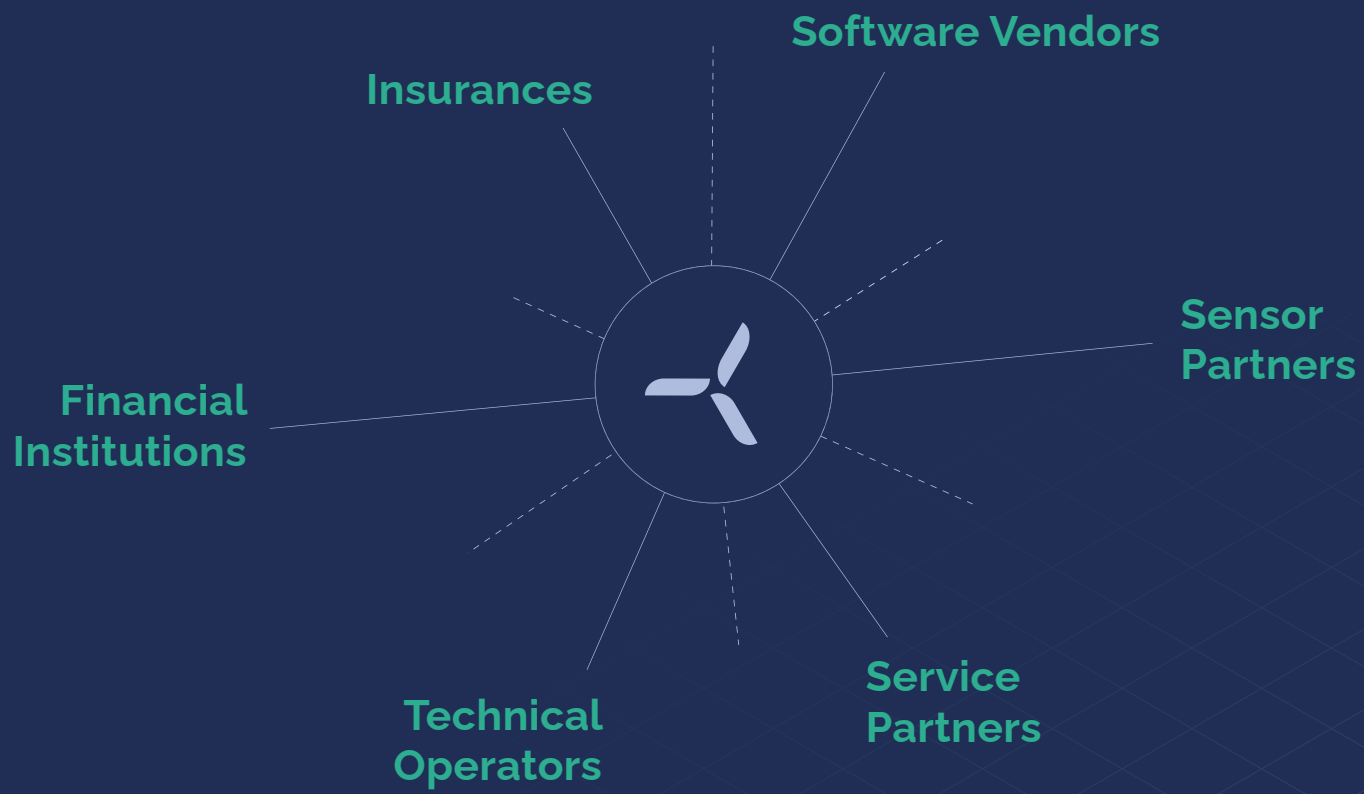
Turbit Product

Turbit offers a scalable AI Infrastructure tailored for the wind industry. Our flagship product, AI Fleet Monitoring, builds on this infrastructure to provide automated failure detection and alert priority assessments, streamlining operations. With Turbit, Fleet ROI improves due to reduced risks.



Turbit's Customer Success team identifies issues and ensures clear communication with Service Partners. Together, Turbit and our customers label Turbit Events continuously enhancing our AI Fleet Monitoring.

Turbit Partner Ecosystem



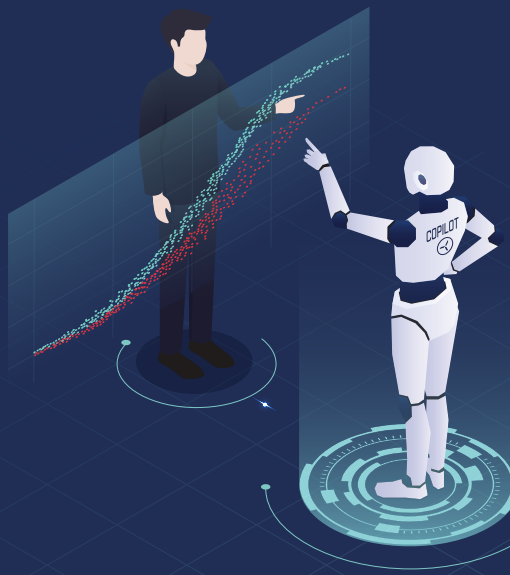
Turbit Copilot

Failure Mode Prediction

- Prediction of the failure modes, root causes and possible solutions with AI
- Individual plots and explanations depending on root causes
- All available data is input data for the Failure Mode Prediction

Relevance Prediction

- Relevance Prediction of each alert
- All Users and Turbit's customer success engineers are labeling the data
- All available data is input data for the Relevance Prediction



Event Similarity

- Displays similar events of the same wind turbine and wind park when Turbit sends a new alert
- The Similar Event Score is built up with raw data and data from Turbit Modules and KPIs in production

PDF AI Reader (Beta Version)

- AI PDF Classification and content extraction
- Monitoring, alerting, and statistics about the completeness of documents and service reports
- Alerts for abnormal oil analysis data or incomplete maintenance protocols

Modules

Power

- Immediate shutdown detection
- Monitor throttling
- Long-term power curve monitoring
- Real-time event reporting via e-mail

Gearbox

- Temperature monitoring of bearings, coolers and oil
- Oil pressures monitoring
- Real-time event reporting via e-mail

Generator

- Temperature monitoring of bearings and coolers
- Real-time event reporting via e-mail

Rotor Bearing

- Temperature monitoring of the rotor bearing
- Real-time event reporting via e-mail

Blades

- Blade CMS Data is used for normal operation monitoring.
- Real-time event reporting via e-mail

Coming soon

More Products

Bat Shutdown

Complex rules with night deciles, wind speed and temperature including hysteresis rules. Immediate alerting if WTG does not run according to rules. Documentation of correct bat shutdown operation.

Sound Reduction

Wind direction based sector sound power curve management. Immediate alerting if WTG does not run according to rules. Documentation of correct sound operation.

Yaw Error

Detection of yaw misalignments with SCADA data in the context of the windpark.

Blade Icing

Detection and automatic loss calculation of blade icing through AI.

Park Efficiency

Analysis and quantification of turbulence effects and wind park efficiencies.

Turbit Systems GmbH
Forster Str. 8
10999 Berlin

info@turbit.de
+49 30 5557 2929 0

↗ turbit.com

Turbit