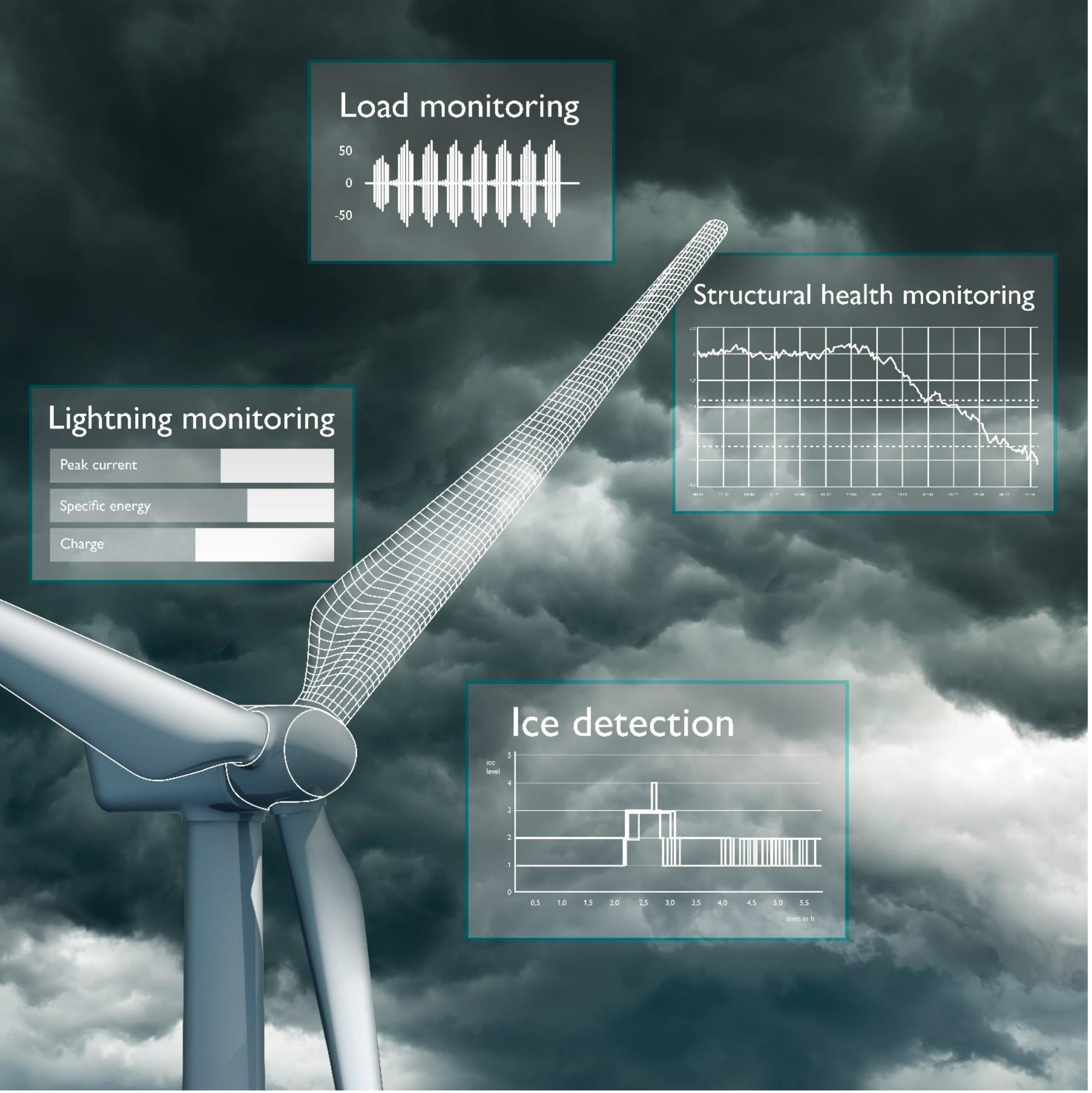
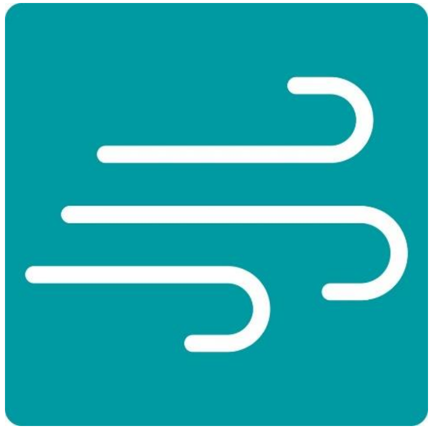


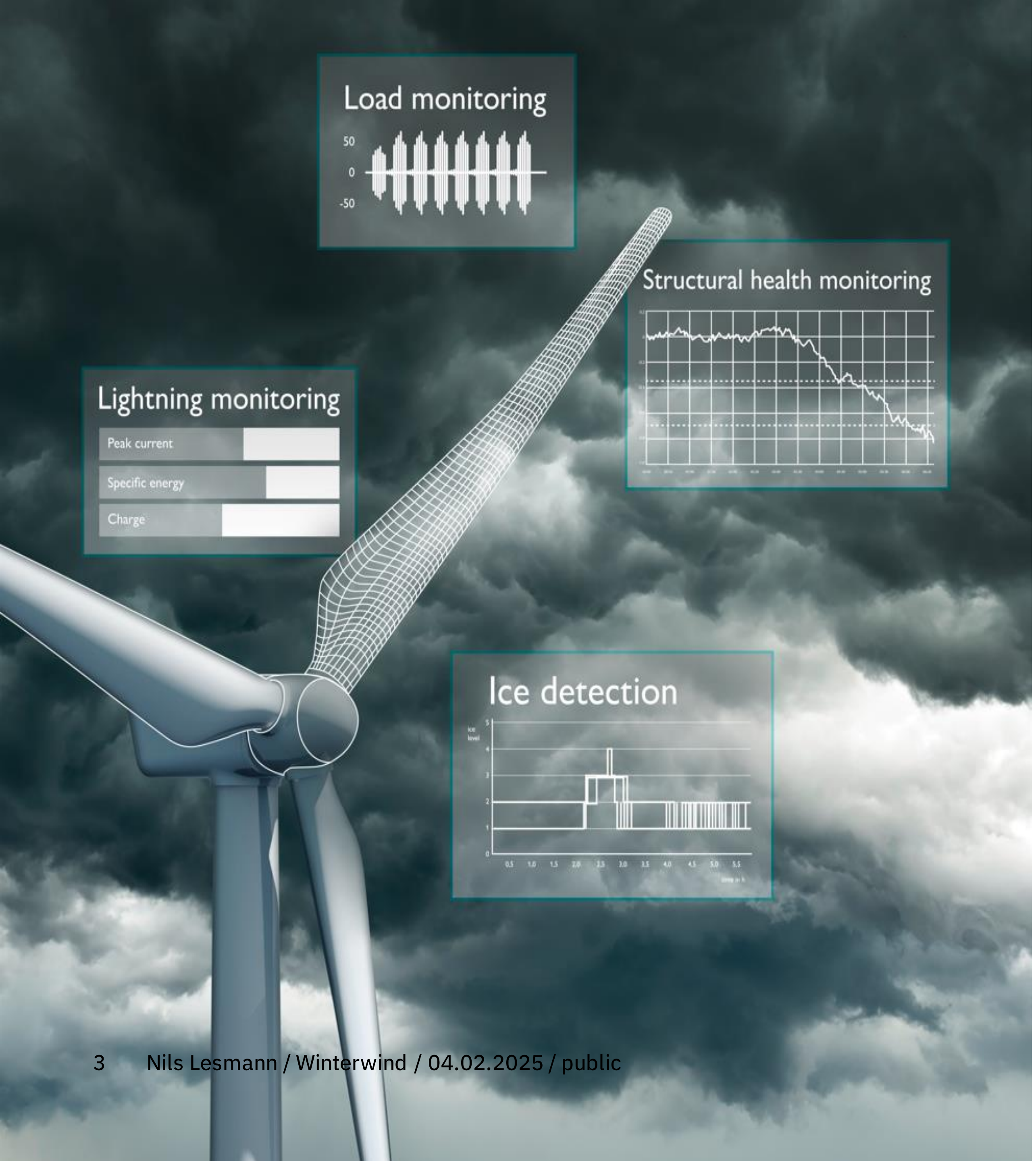
Welcome

One System for all demands in cold climate

PHOENIX CONTACT INSPIRING INNOVATIONS

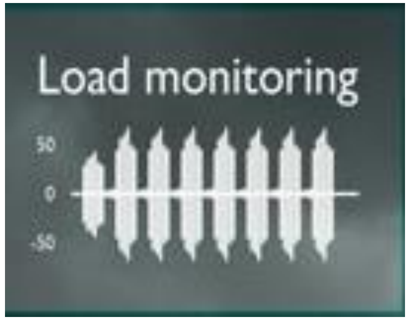
One System for all demands in cold climate





Blade Intelligence

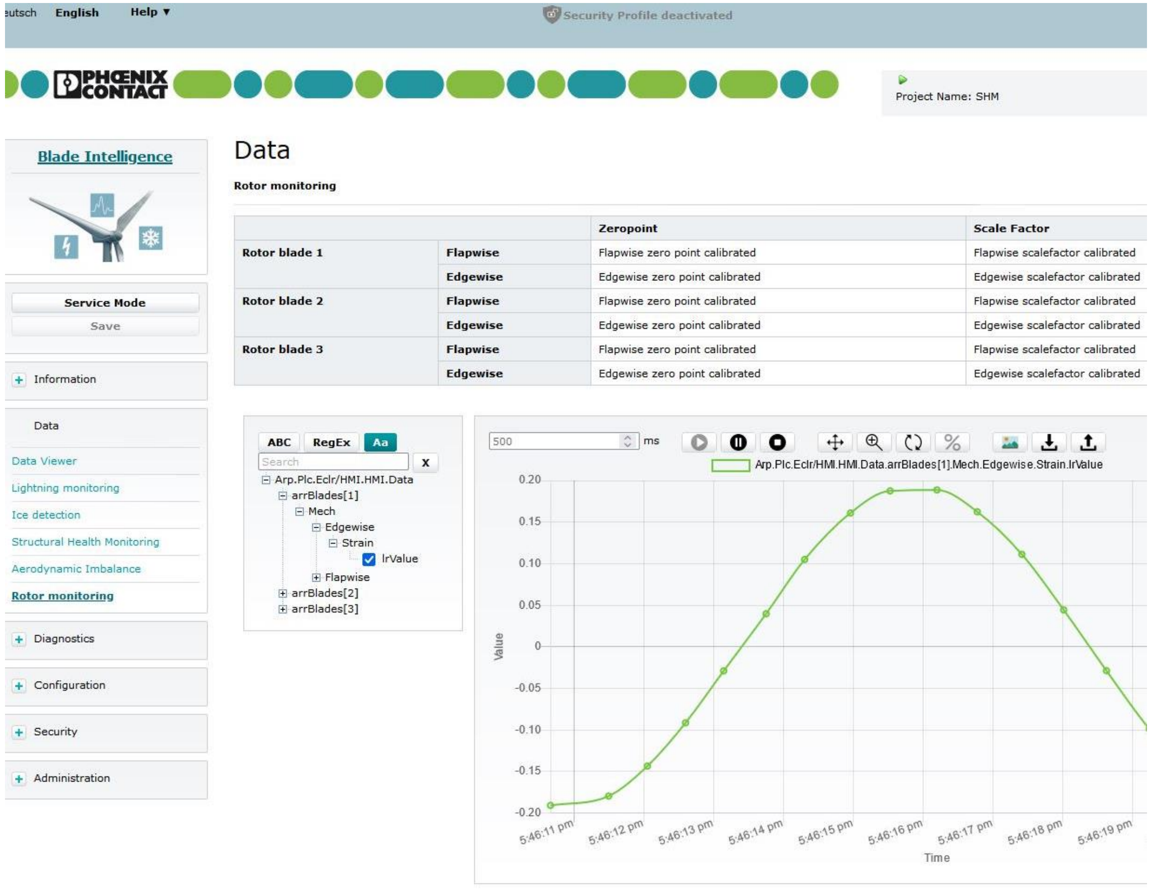
Load Monitoring

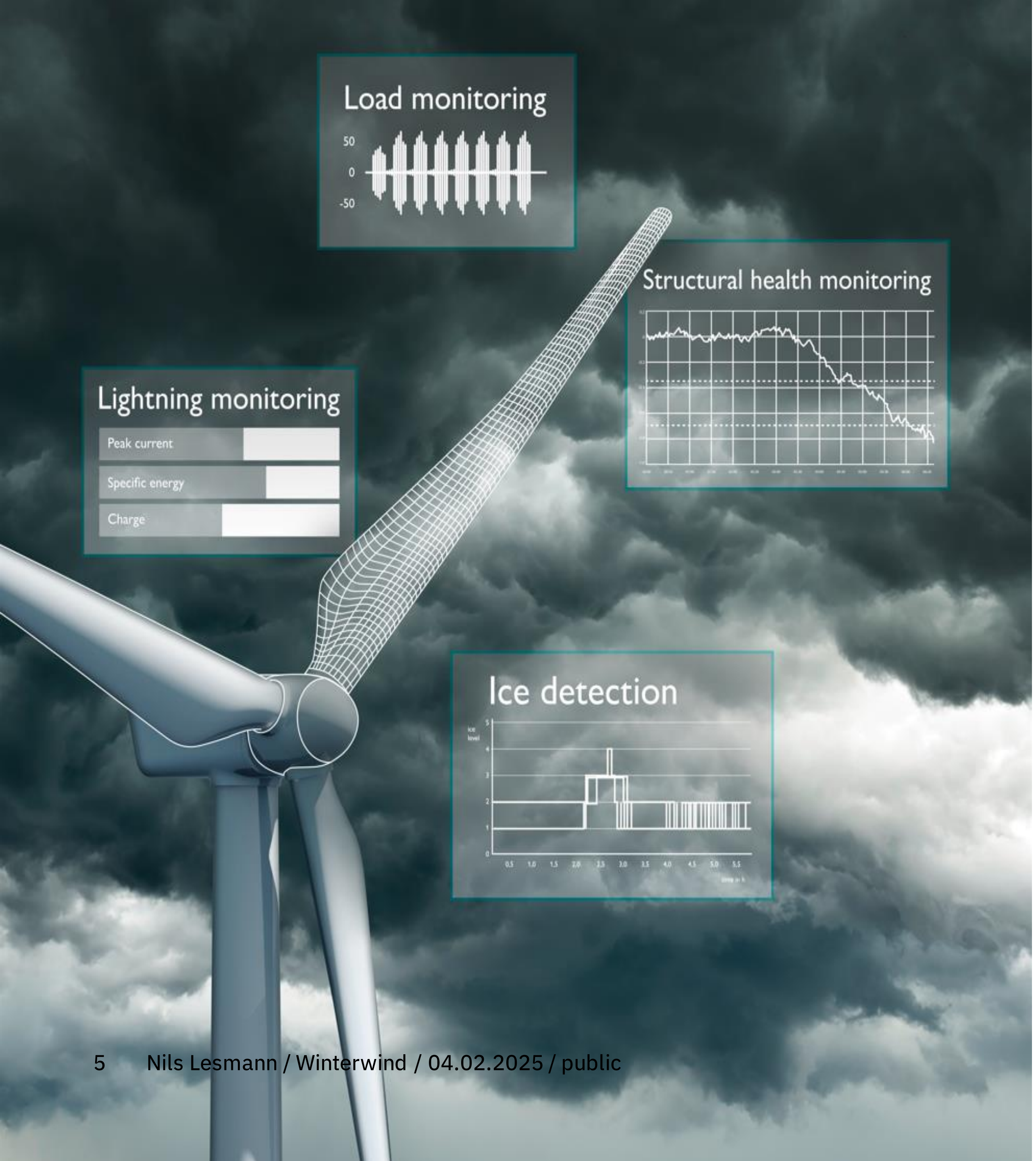


Blade Intelligence – Load Monitoring

Load Monitoring System

- Strain gauge measuring system to detect load on rotor blade
- Optimally pitch control regarding to the load
- Extends the rotor blade life-time
- Increase of efficiency due to adaptation to the wind conditions



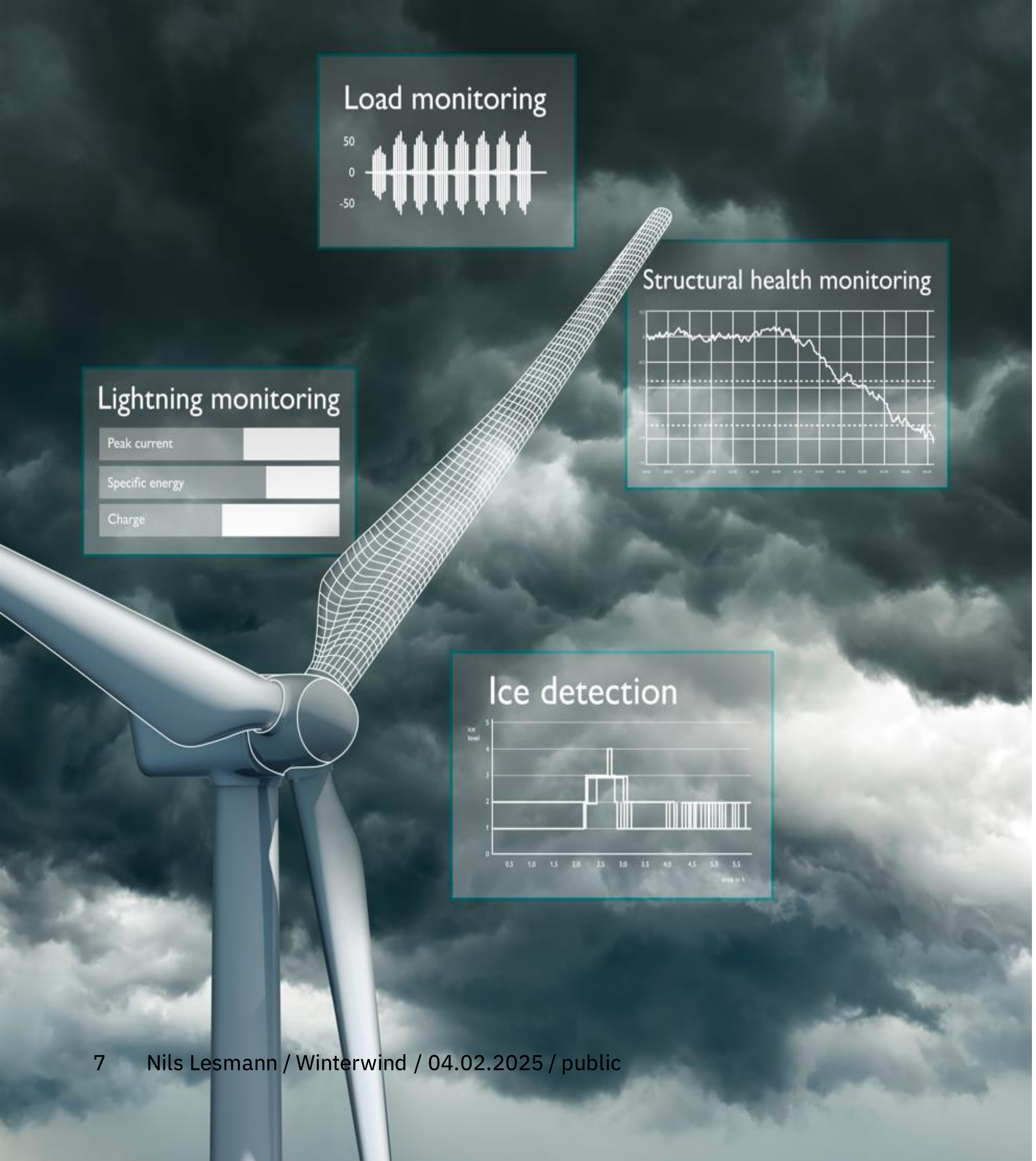


Blade Intelligence

Structural Health Monitoring

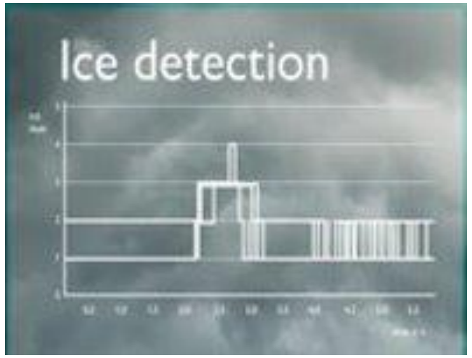
Repairs made plannable

- Highly sensitive monitoring and expert data analysis ensure early detection of structural damage
- Detecting
  - Lost parts → Bolts, Tools
  - Detecting Vibration differences
  - Frequency Anomalies → Damages
  - Aerodynamic imbalances
- significantly lower costs, as service work can be planned.



Blade Intelligence

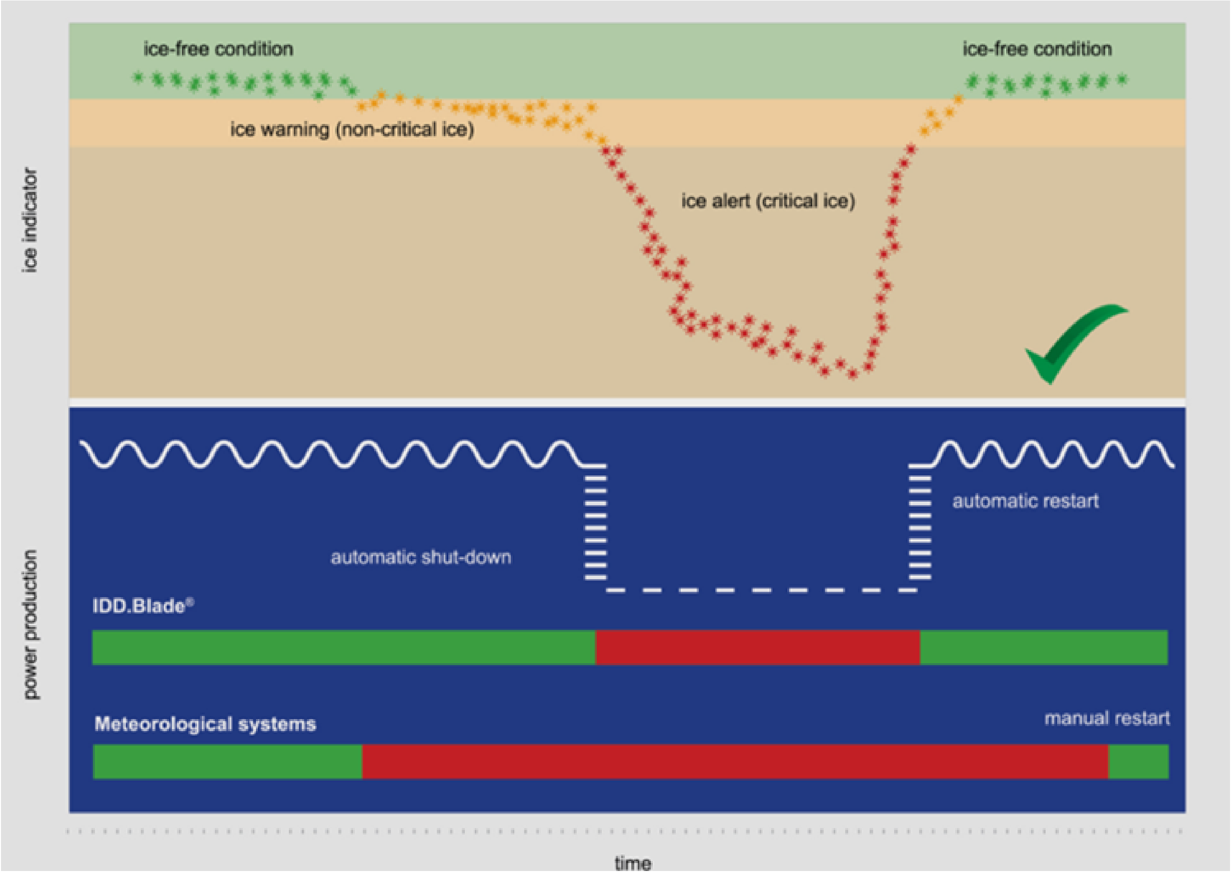
Ice Detection

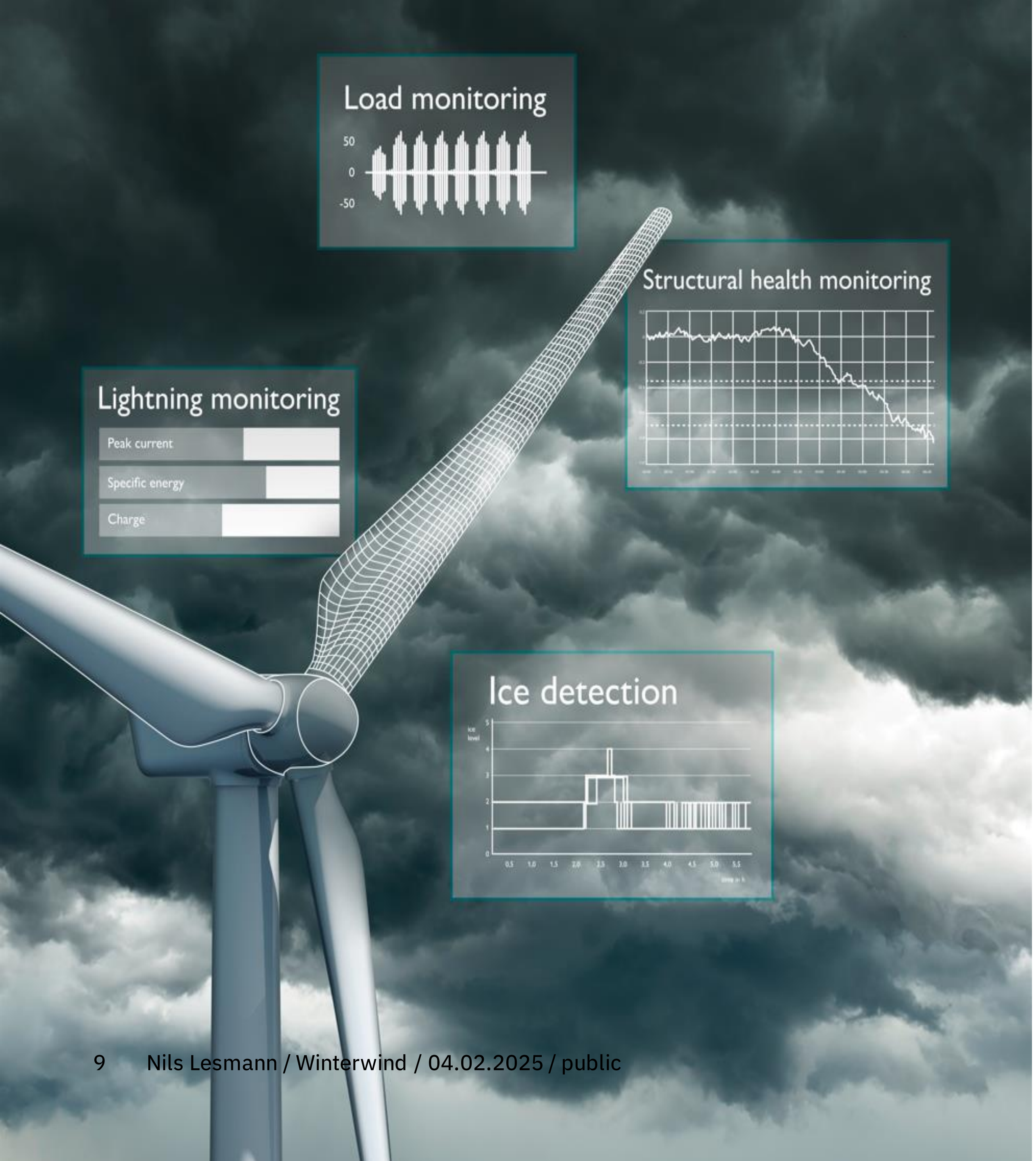


Ice Detection System

Keys to safe and economical ice detection

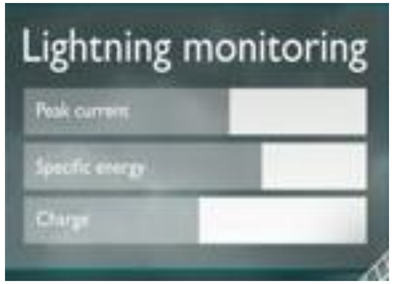
- Early automatic restart even at stillstand (based on DNV-certified methodology)
- Highest accuracy in market benchmark
- Highly integrated PLCnext solution is the most cost effective product in the market
- Minimum ice throw risk and increased energy yield





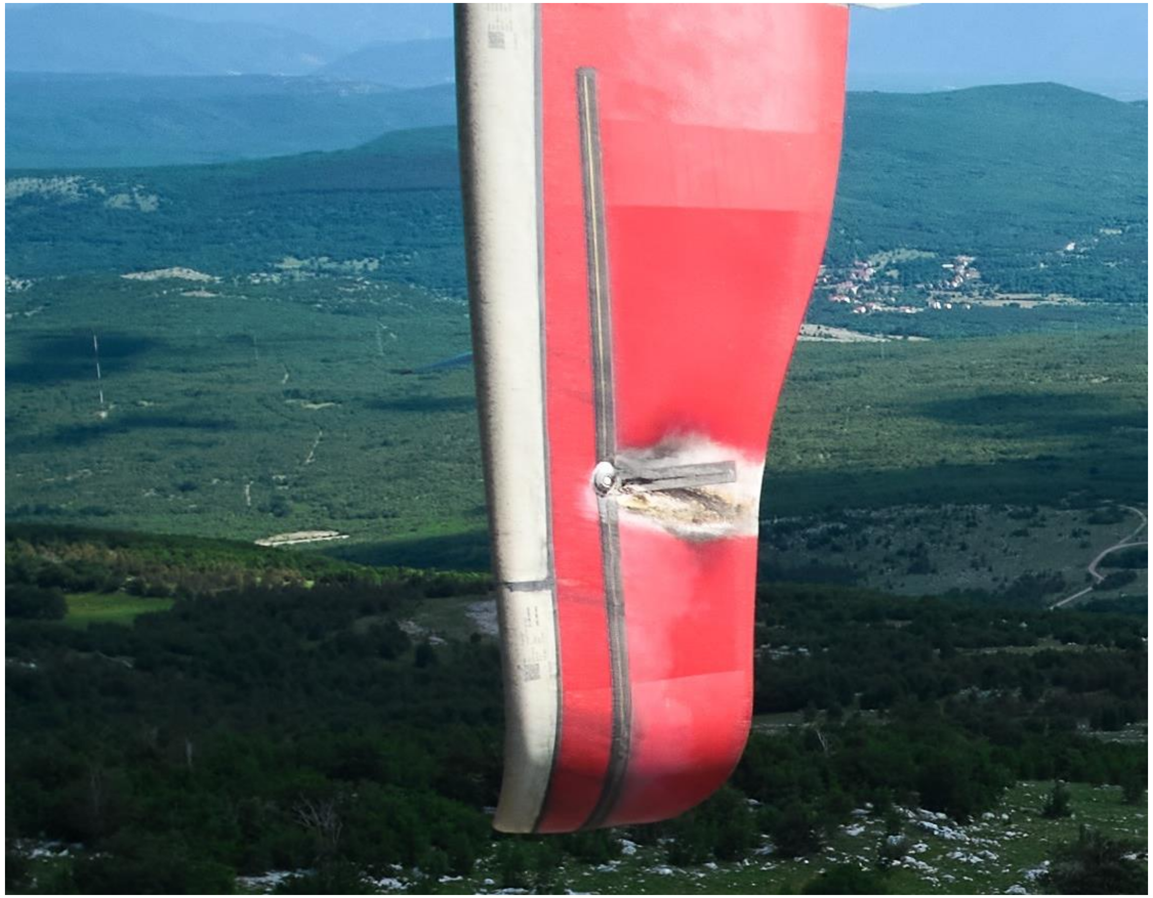
Blade Intelligence

Lightning Monitoring



Rotor blade monitoring with Blade Intelligence

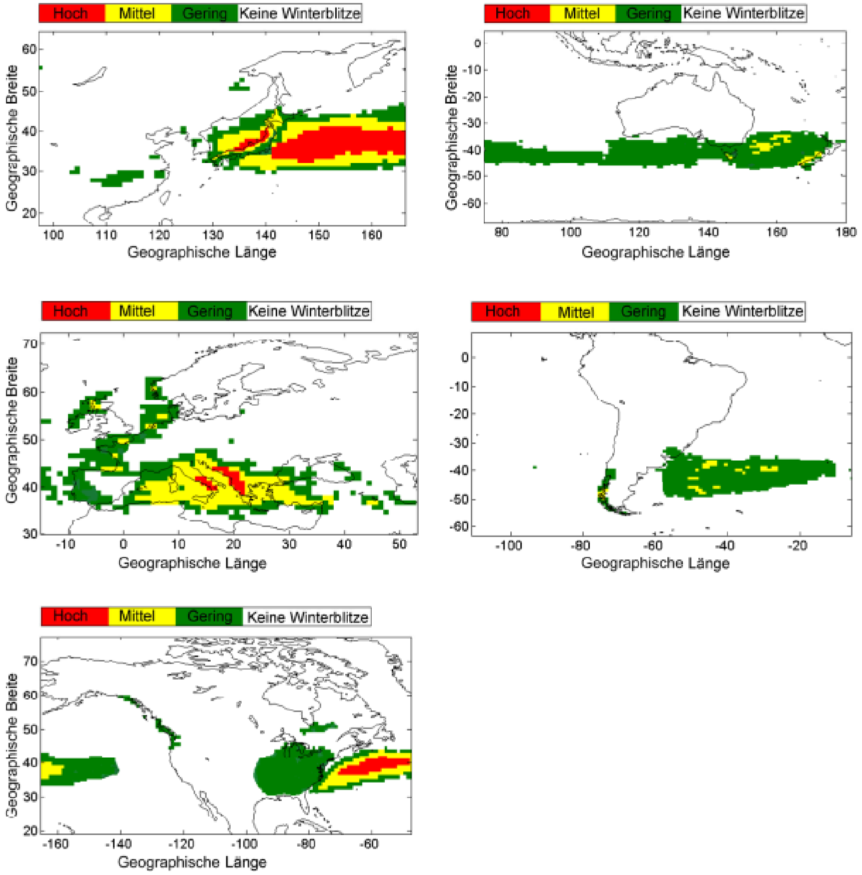
Lightning Monitoring

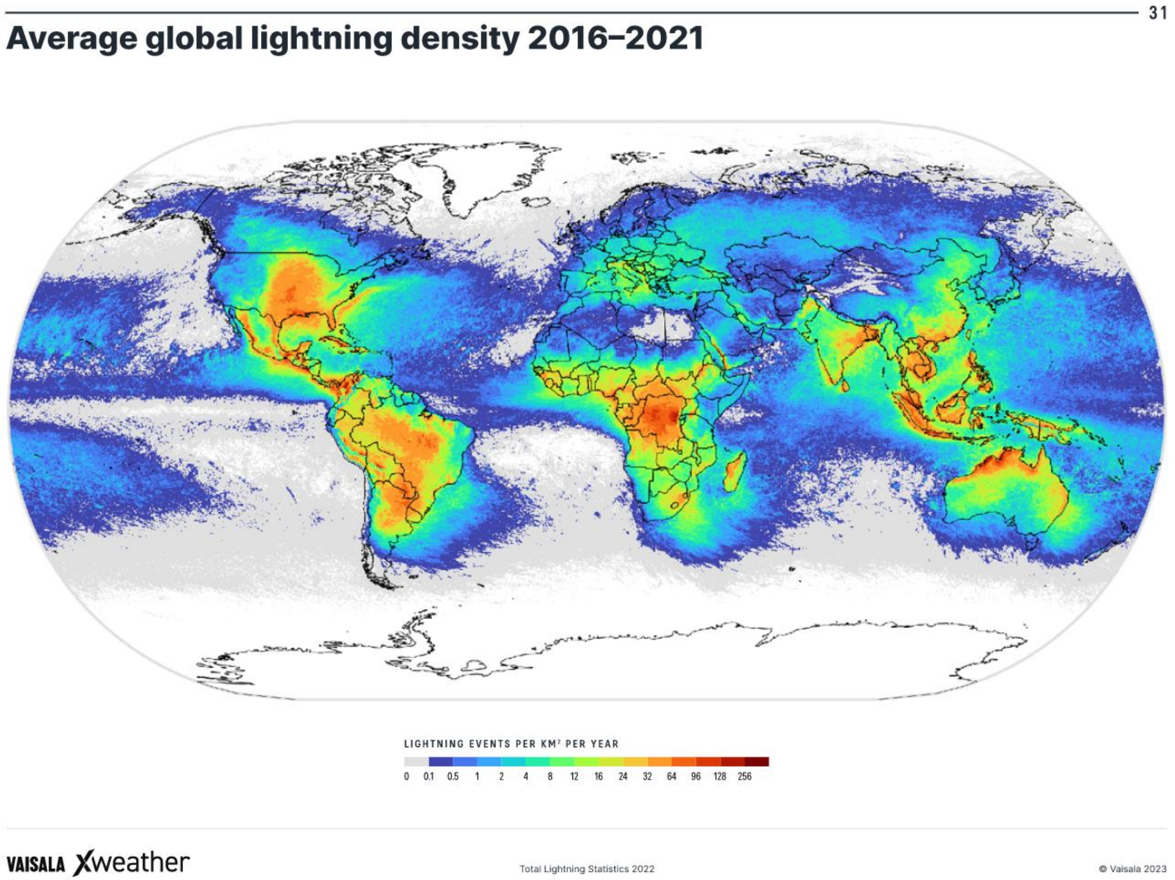


Rotor blade monitoring with Blade Intelligence

Lightning Density

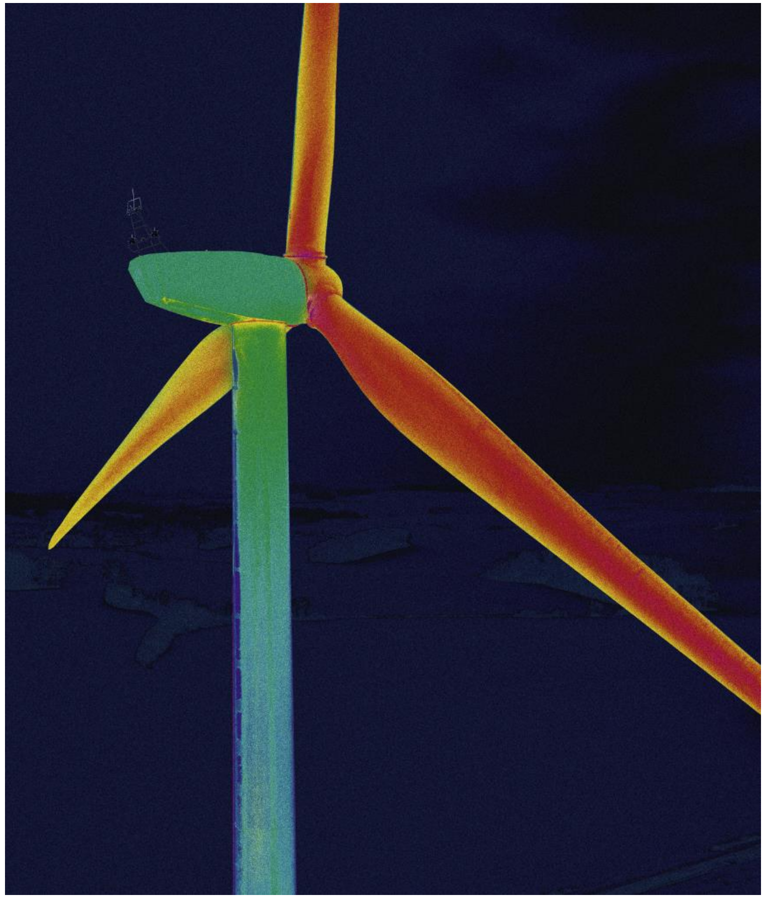
DIN EN IEC 61400-24 (VDE 0127-24):2020-11
EN IEC 61400-24:2019





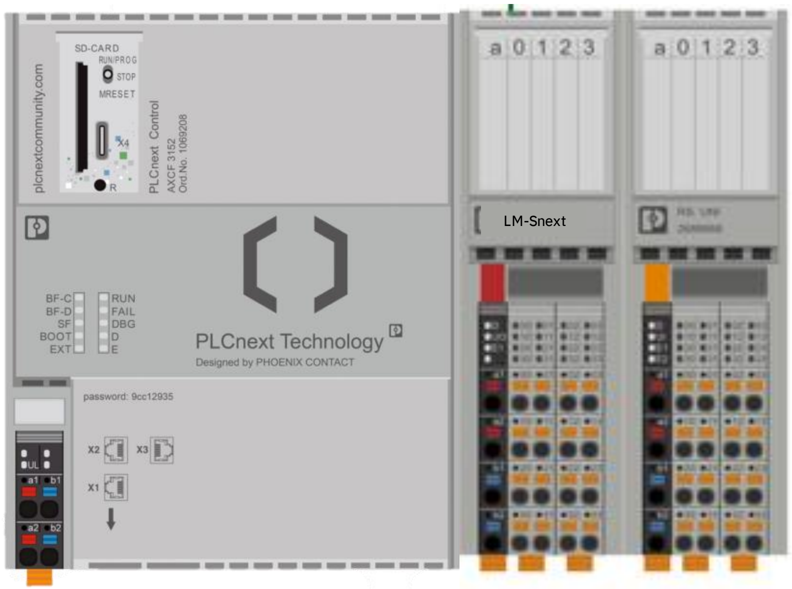
Additional Challenges

- Additional conductive elements in the blade like anti icing systems
- No Lightning assesmant for those windfarms

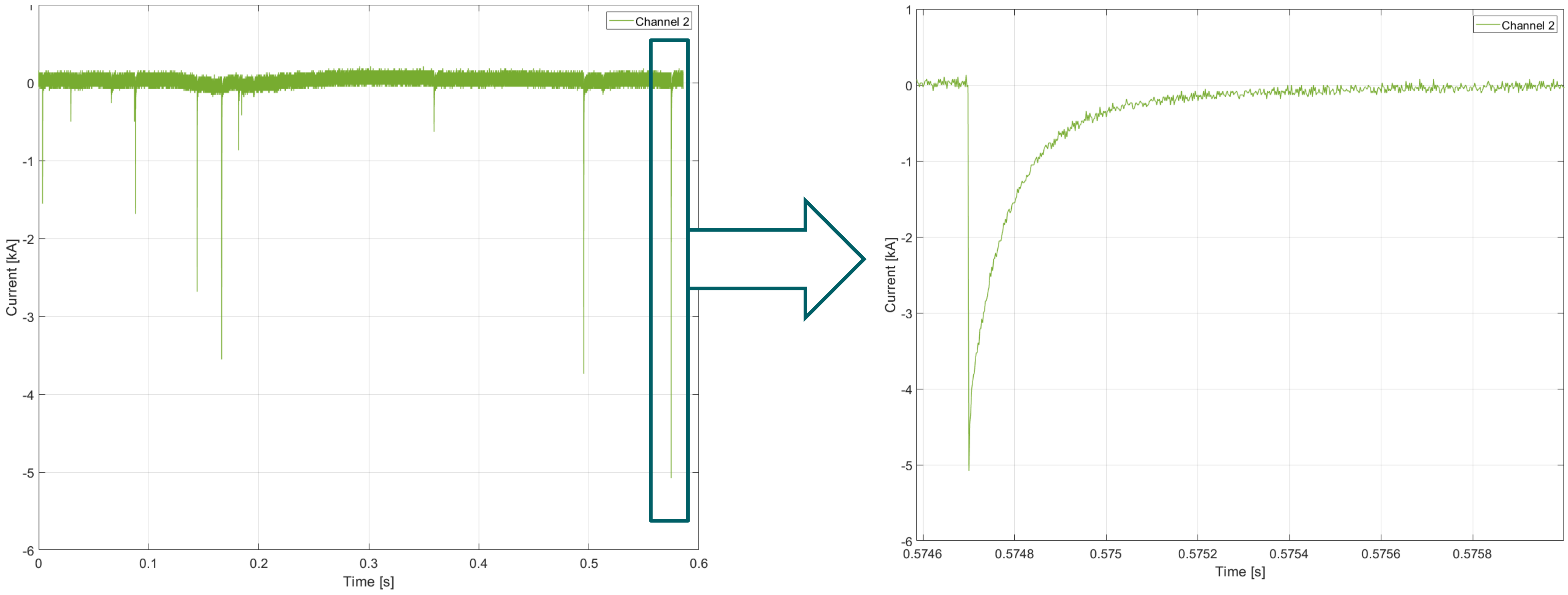


New Generation Lightning Monitoring as IO System

- Live monitoring system for **permanent recording** and analysis of **lightning strikes**
- Detailed **analysis** of
  - lightning currents **Imax**
  - di/dt
  - charge
  - specific energy
- Surge current measuring range: **+/- 1 kA to 250 kA**
- Showing lightning current as Graph
- Seamless integration into Phoenix Contact Automation System

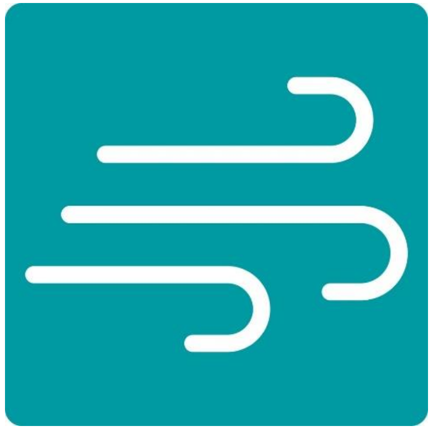


Accurate analysis



Blade Intelligence

One System for all demands in cold climate



Blade Intelligence

What are the benefits of the combined approach

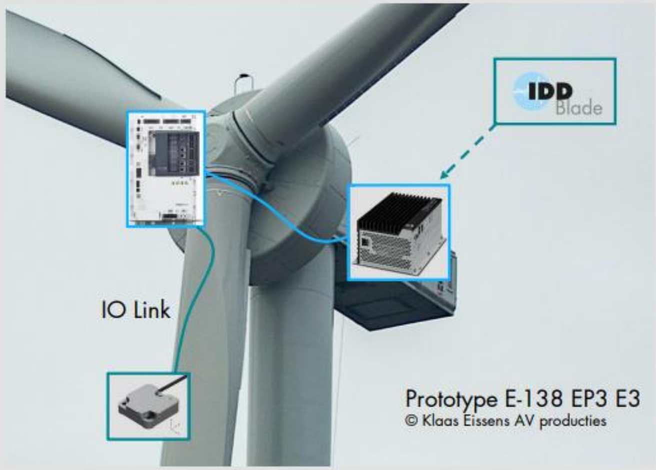
What are the benefits of the combined approach

WÖLFEL APPLICATION IS A MODULE IN THE NEW PLATFORM INTEGRATED CONTROL SYSTEM OF ENERCON

System architecture of the new ice detection device includes

- the standard components
- and additional components for ice detection with IDD.Blade

→ This is the conceptual design to detect reliably ice accretion



COST OPTIMIZATION COMPARED TO TODAY'S ICE DETECTION

- Substantial drop in costs for the ice detection system
- Plus additional savings due to
  - reduced maintenance costs
  - less hardware-related costs
  - reduced costs for device and patch management (software updates)
  - increased revenues "after sales" (simpler retrofit solution)

Classical ice detection system → Next generation ice detection system

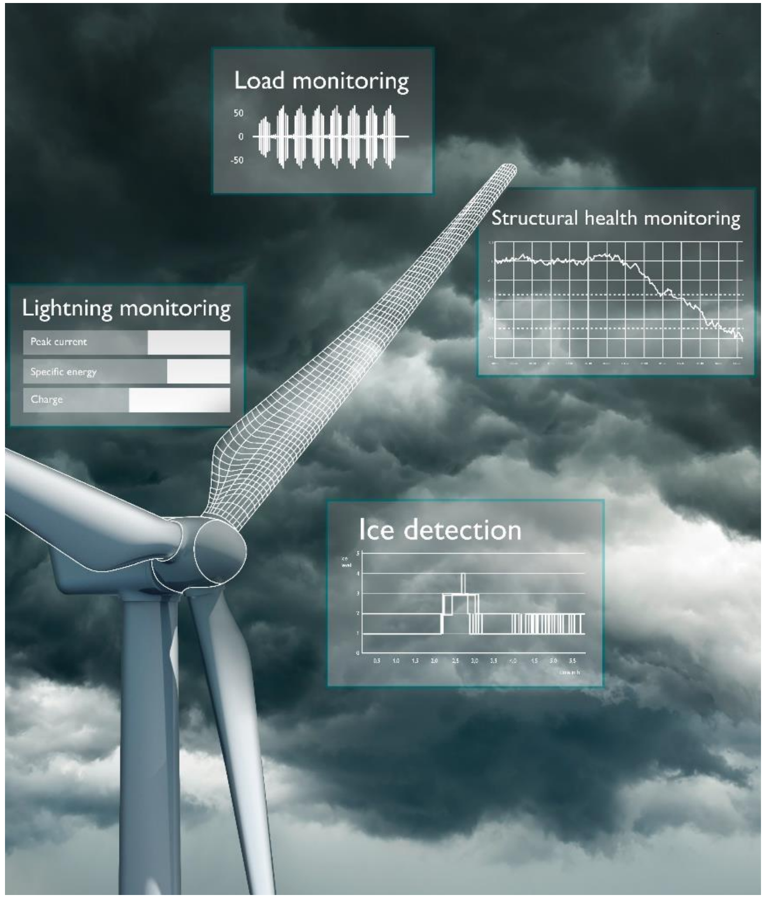
40 – 50 %

Savings 40 – 50 %

Blade Intelligence

What are the benefits of the combined approach

- Ice Detection integration into Main PLC → 50 % Saving
- Combination of Lightning and SHM → 40 % Saving
- Combination of all Systems → 60 % Saving



Contact

Nils Lesmann
PHOENIX CONTACT GmbH & Co. KG
Global Industry Management Wind Power
Nlesmann@phoenixcontact.com
Phone +49 5281 946 - 2237

Thank you

more information on our **website**