



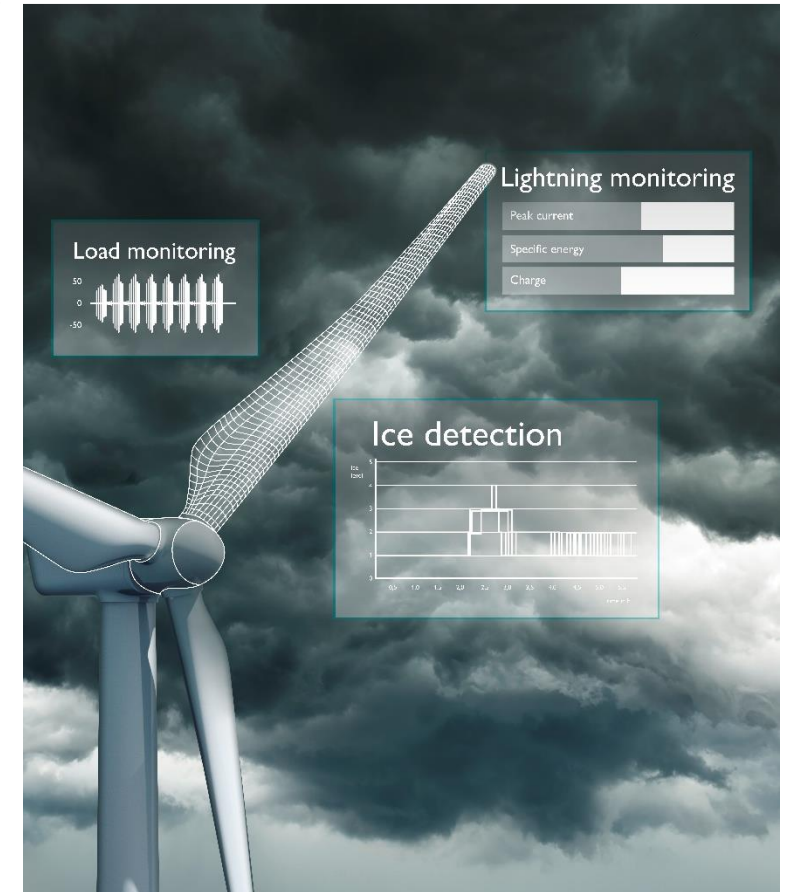
Welcome

Blade intelligence – the modular solution for efficient operation

Rotor blade monitoring with Blade Intelligence

Agenda

- Phoenix Contact about us
 - Blade Intelligence
 - Test Turbine
 - Results
 - Outlook
-



Rotor blade monitoring with Blade Intelligence

Phoenix Contact about us

- **Founding year** 1923 in Essen, North Rhine-Westphalia, Germany
- **Turnover 2020** 2.4 bn. €
- **Number of employees 2020** 17,100 worldwide
- **Production sites** China, USA, Germany, Greece, India, Poland, Russia, Sweden, Switzerland, Taiwan/China, Turkey
- **Products** > 65.000 articles
- **Sales** Represented in more than 55 subsidiaries worldwide

Since Q1/2021 all Phoenix Contact operations in Germany are climate neutral

Phoenix Contact offers you creative solutions in the fields of connection technology, electronics and automation on the journey to a smart world.

A privately held company founded in 1923 that is vertically integrated and independent in its entrepreneurial decision-making freedom.

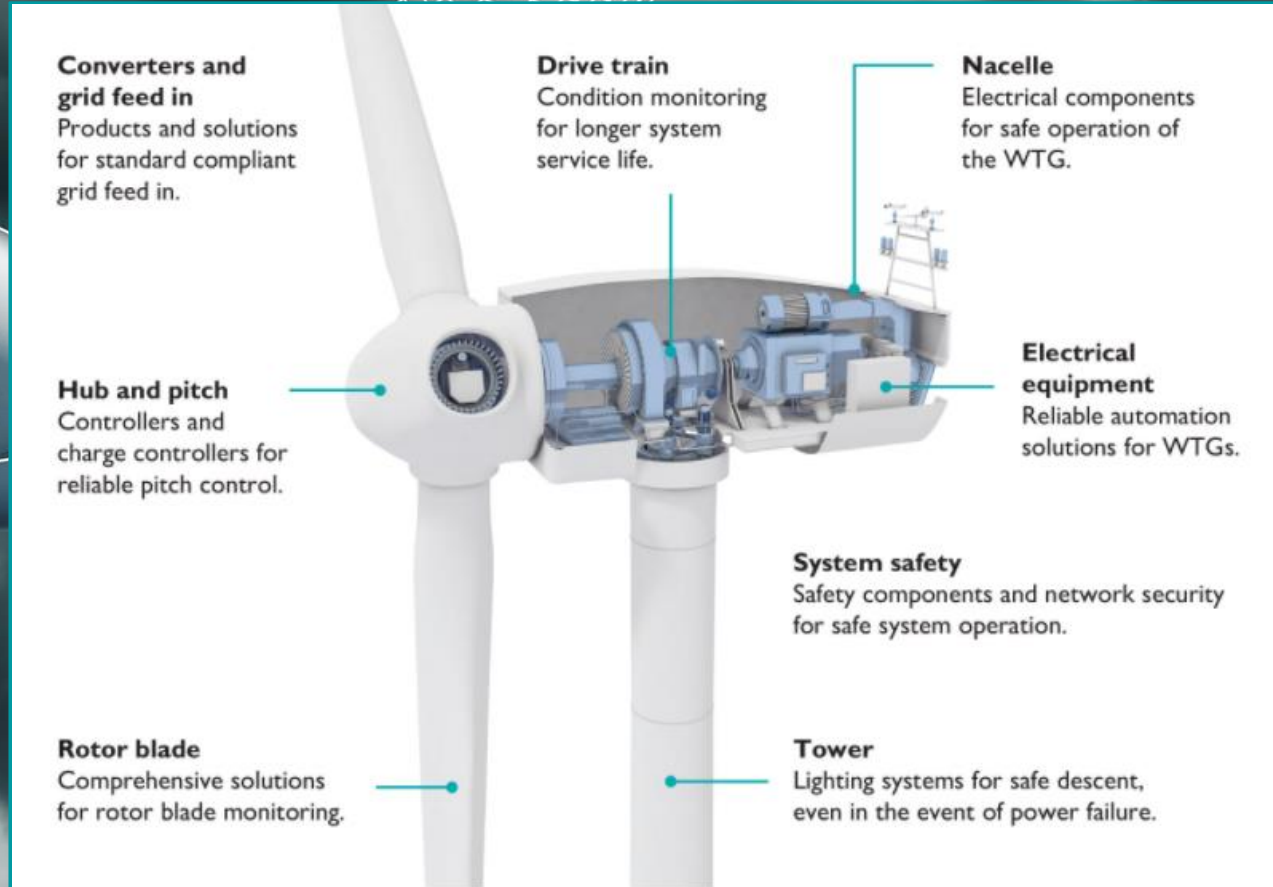
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Phoenix Contact vertical markets

Infrastructure

Process

Factory Automation



Power T&D



Solar Power



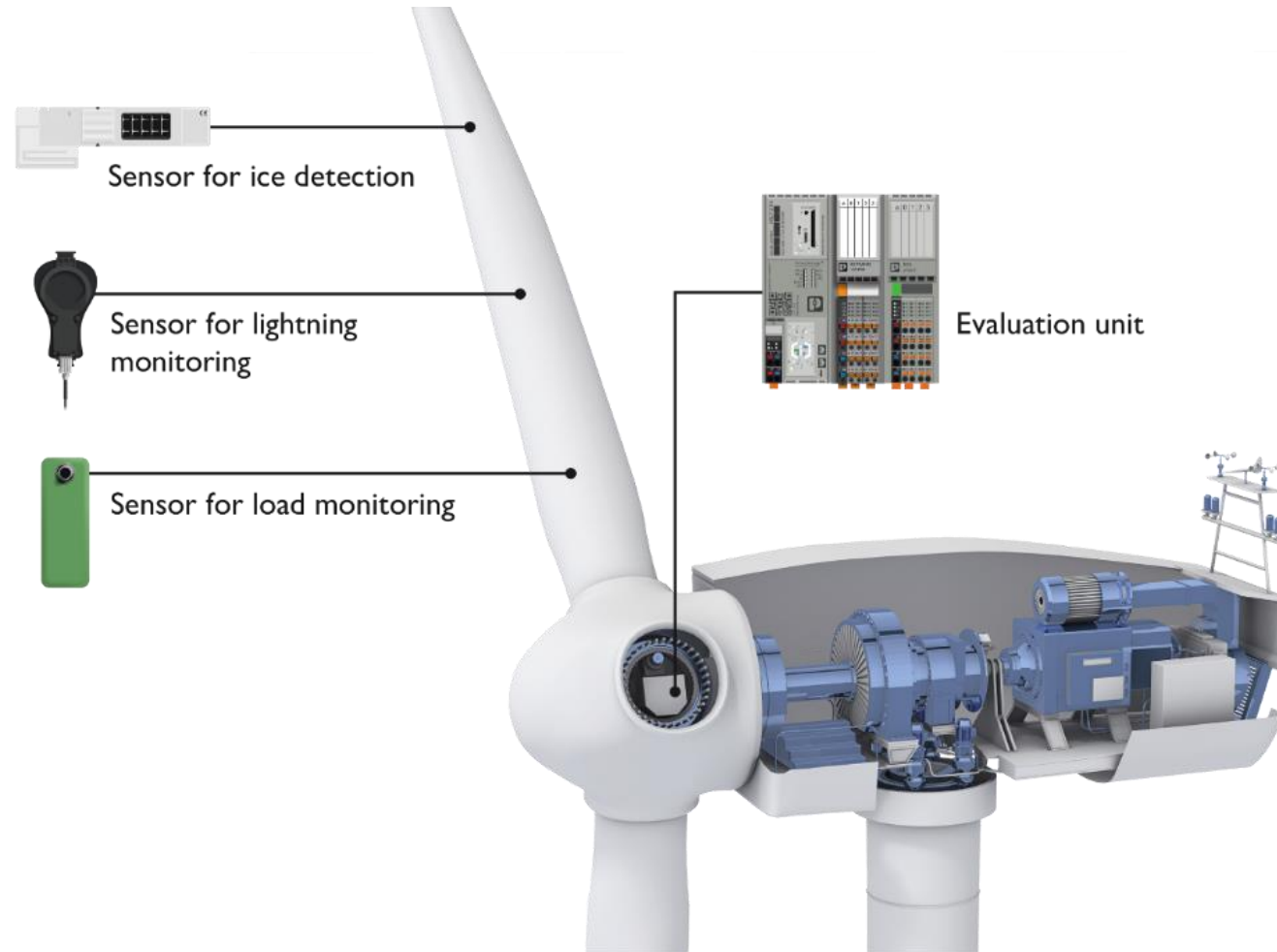
Wind Power



Energy

Rotor blade monitoring with Blade Intelligence

Blade Intelligence



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Track record



Over 2.300 systems world-wide
(onshore and offshore)



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Modular system configuration

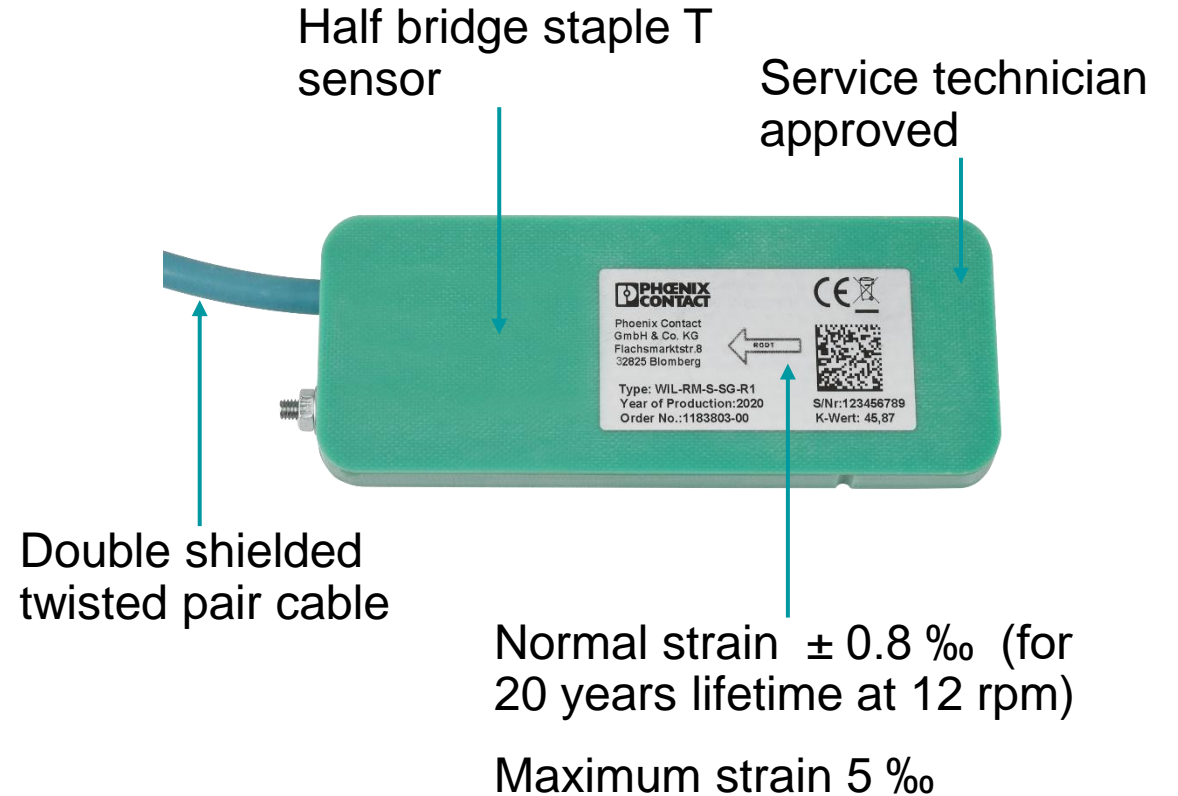
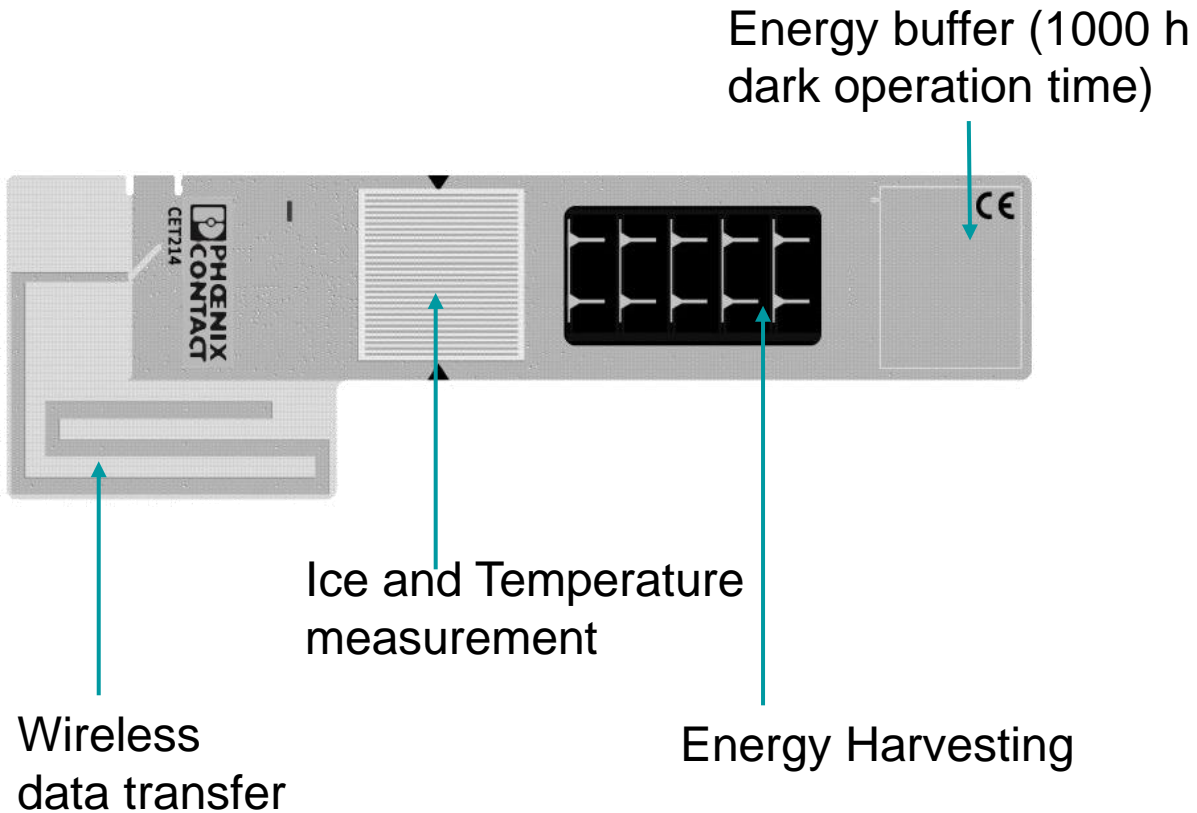
The modular design of this solution allows the individual solutions to be combined as needed depending on the requirements.

Sensors developed specially for installation on the rotor blade provide all the data necessary for processing in a common evaluation unit.



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Sensors Technology

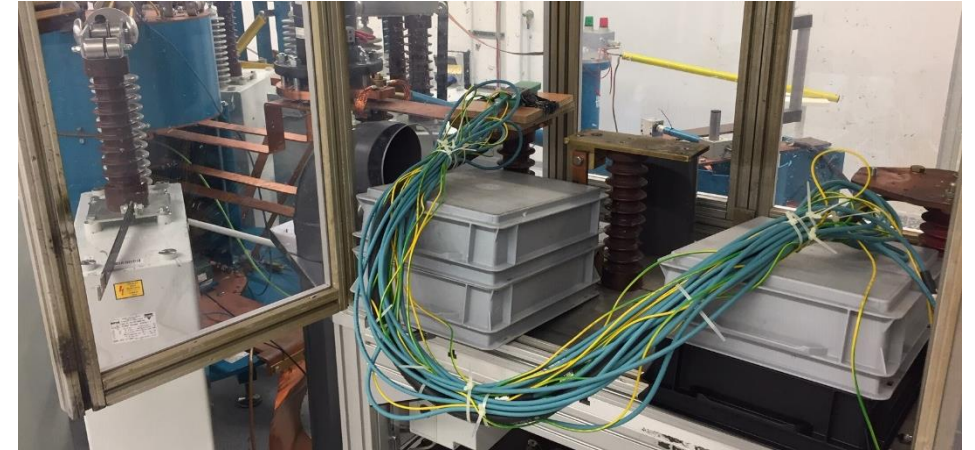


What about Lightning?

Sensors tested up to

- 200 kA 8/20
- 100 kA 10/350

Lightning Impulses



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Nergica Testsite



Location: Gaspé, Quebec, CA (Source: Rotor Mounted Ice Sensor – Performance Assessment by Nergica)

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Icing Event on the 4th of April

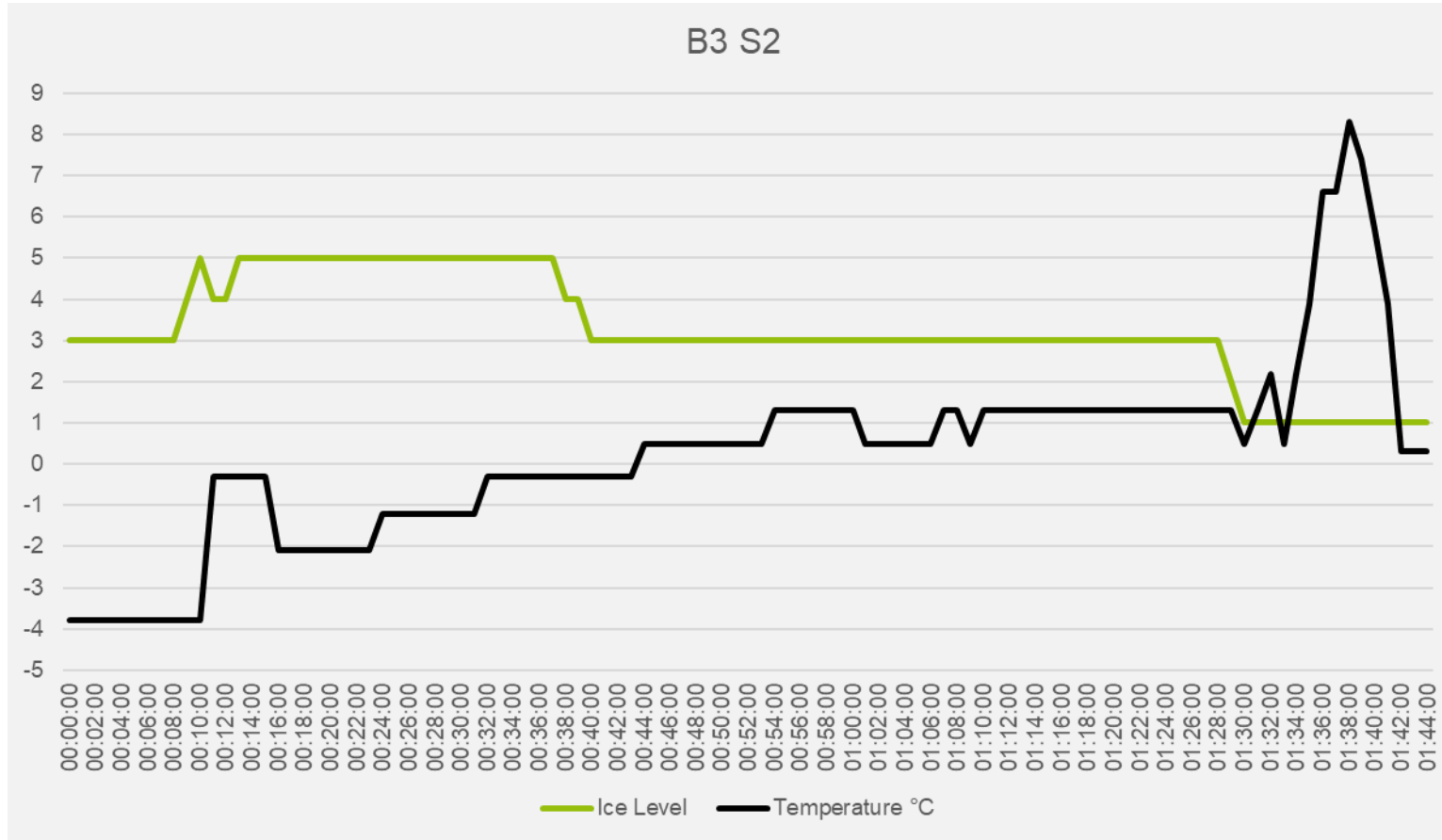
WEC001 / HUBCAM1 / 10.8 degC / Day / 2021-04-04 17:34:59

NERGICA



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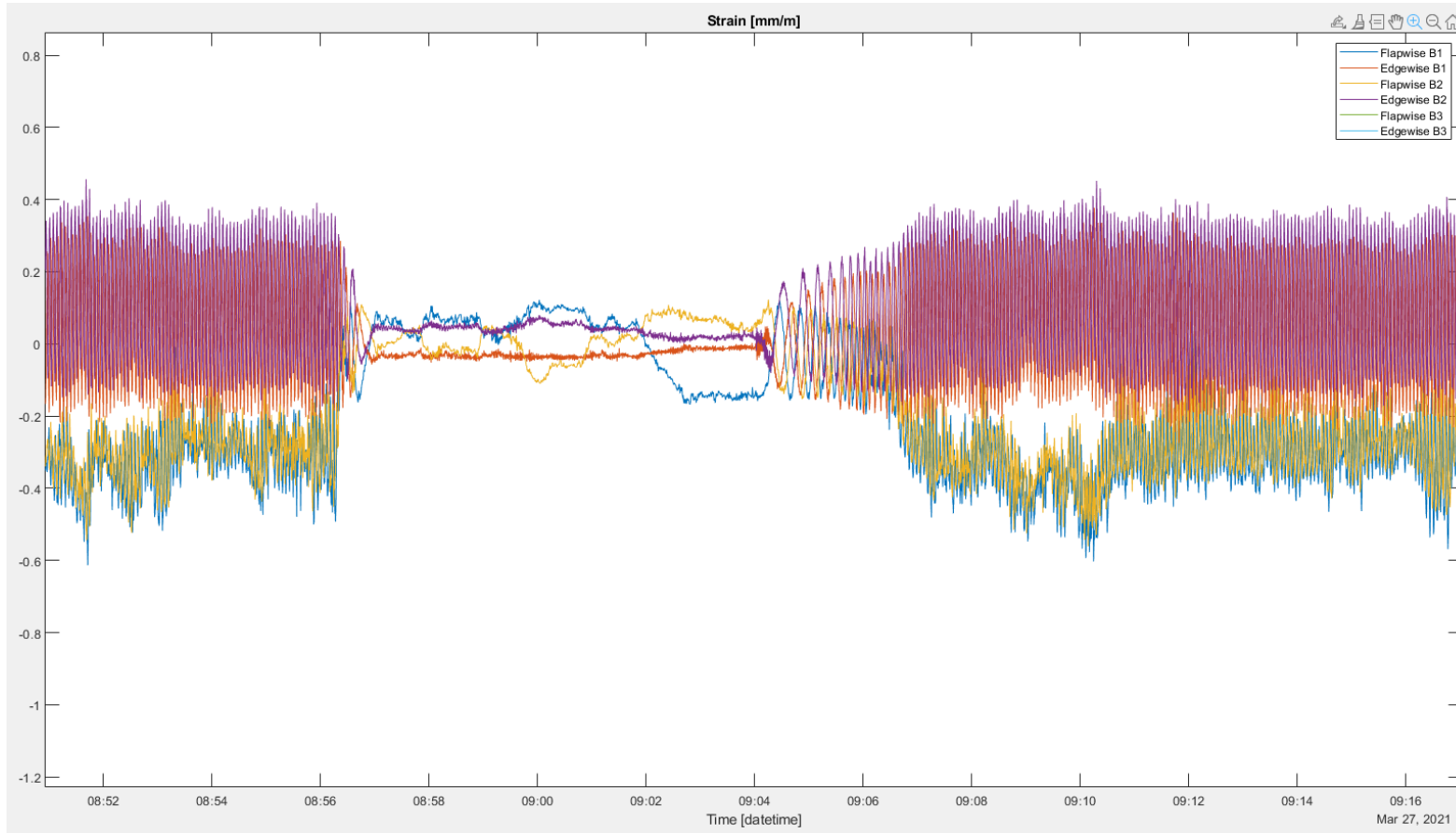
Icing Event



- Ice Level 1: No Ice
- Ice Level 2: < 1 mm
- Ice Level 3: < 10 mm
- Ice Level 4: < 15 mm
- Ice Level 5: > 15 mm

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Load Behavior



- Load Sensor reacting to start and stop of the turbine

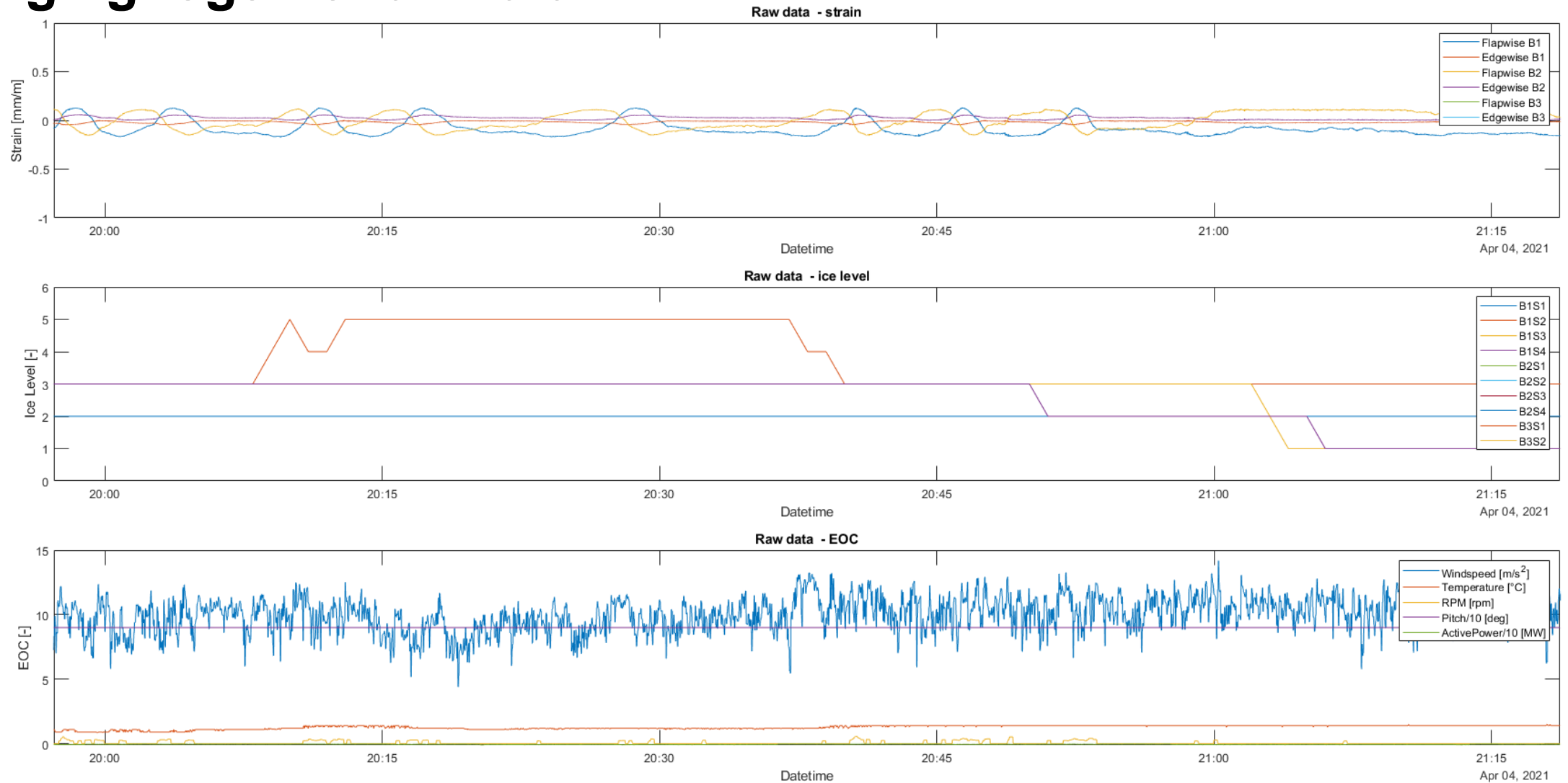
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Bringing together all Data



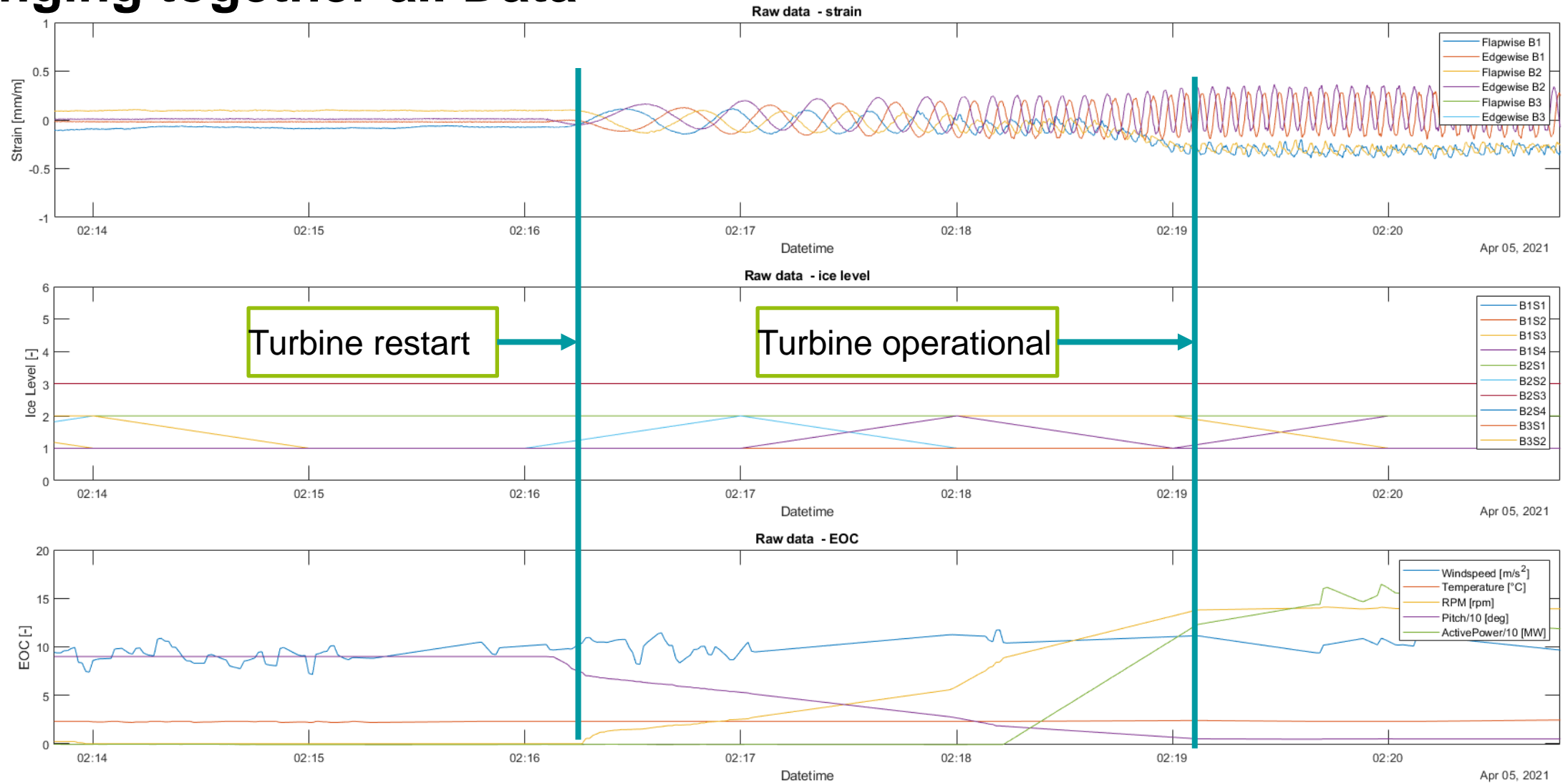
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Bringing together all Data



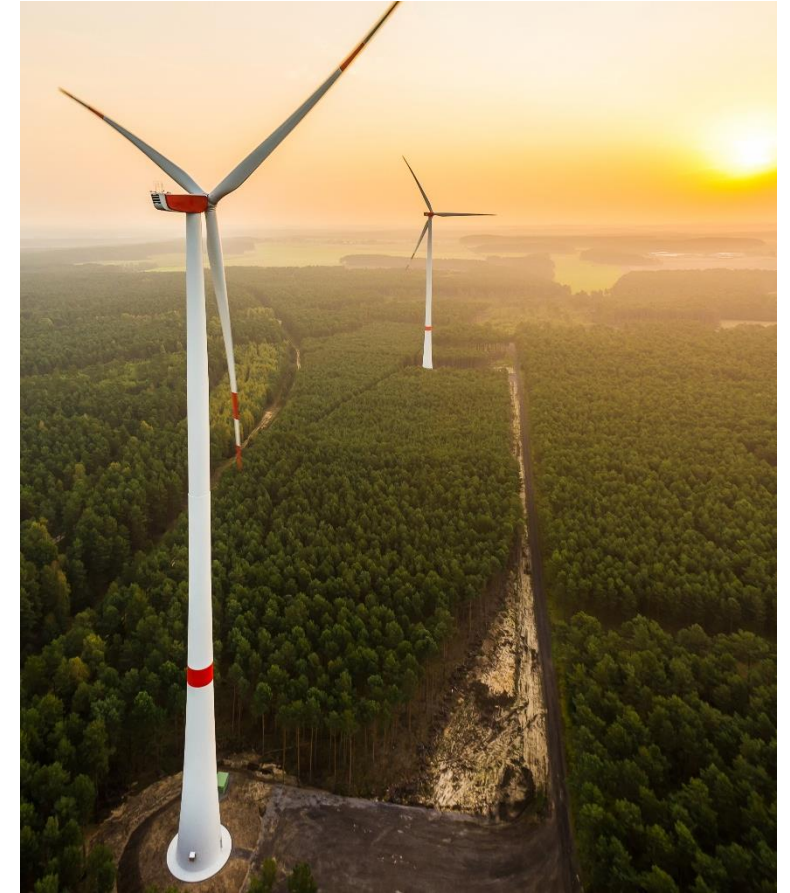
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Bringing together all Data



Conclusion

- Load Monitoring and Ice Detection in the test was hard to overlap
 - Effect of icing is lower than expected
 - Ice Detection stopped turbine before reaching high ice masses
 - Further investigation necessary
- Load Monitoring can be used to obtain Operation with Ice Modes
 - Test Turbine had no mechanical issues according to ice



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Outlook

- Integrating Structural Noise Sensor to Blade Intelligence
 - Availability of Structural Health Monitoring
- Handover of EOC Data to Blade Intelligence System



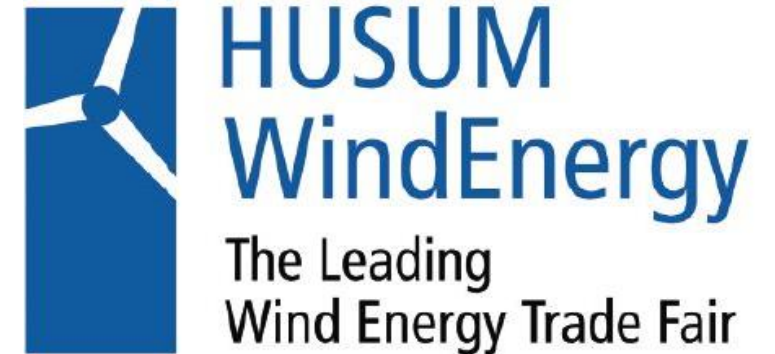
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Because we are not able to meet personally:

Voucher

Get a Tap Beer on Phoenix Contact Booth on Husum Wind September 2021

If fair takes place and the hygiene rules allows this





Contact

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Thank you

more information on our [website](https://www.phoenixcontact.com)