WIVALDI FORSCHUNGSPARK WINDENERGIE

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14.09.2023, Husum

DLR

DLR at a glance

The German Aerospace Center (DLR) is the national aeronautics and space research centre of the Federal Republic of Germany

Locations and employees

- More than 10.000 employees work in 55 institutes and facilities at 30 sites across Germany
- International offices in Brussels, Paris, Tokyo and Washington D.C.

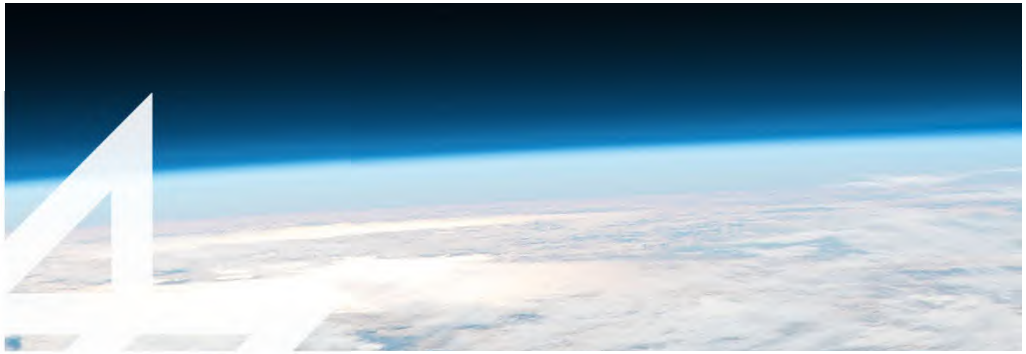
Main features of the overall strategy

- Excellent science
- Industry partner
- Contributions to addressing the challenges facing society

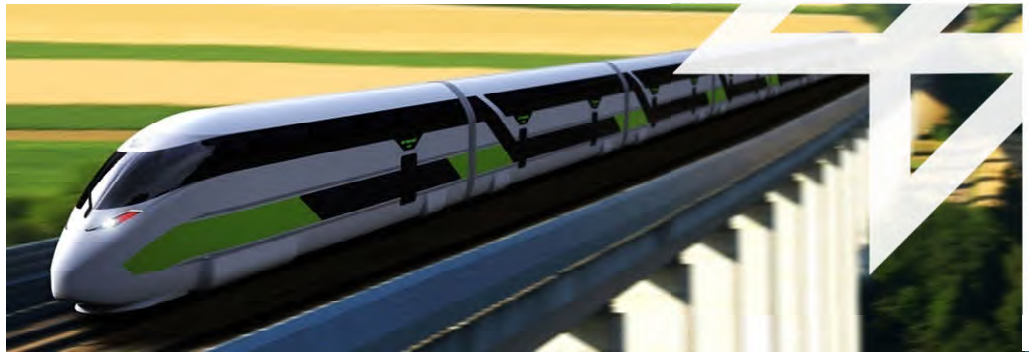
DLR at a glance

Aeronautics

Space research and technology

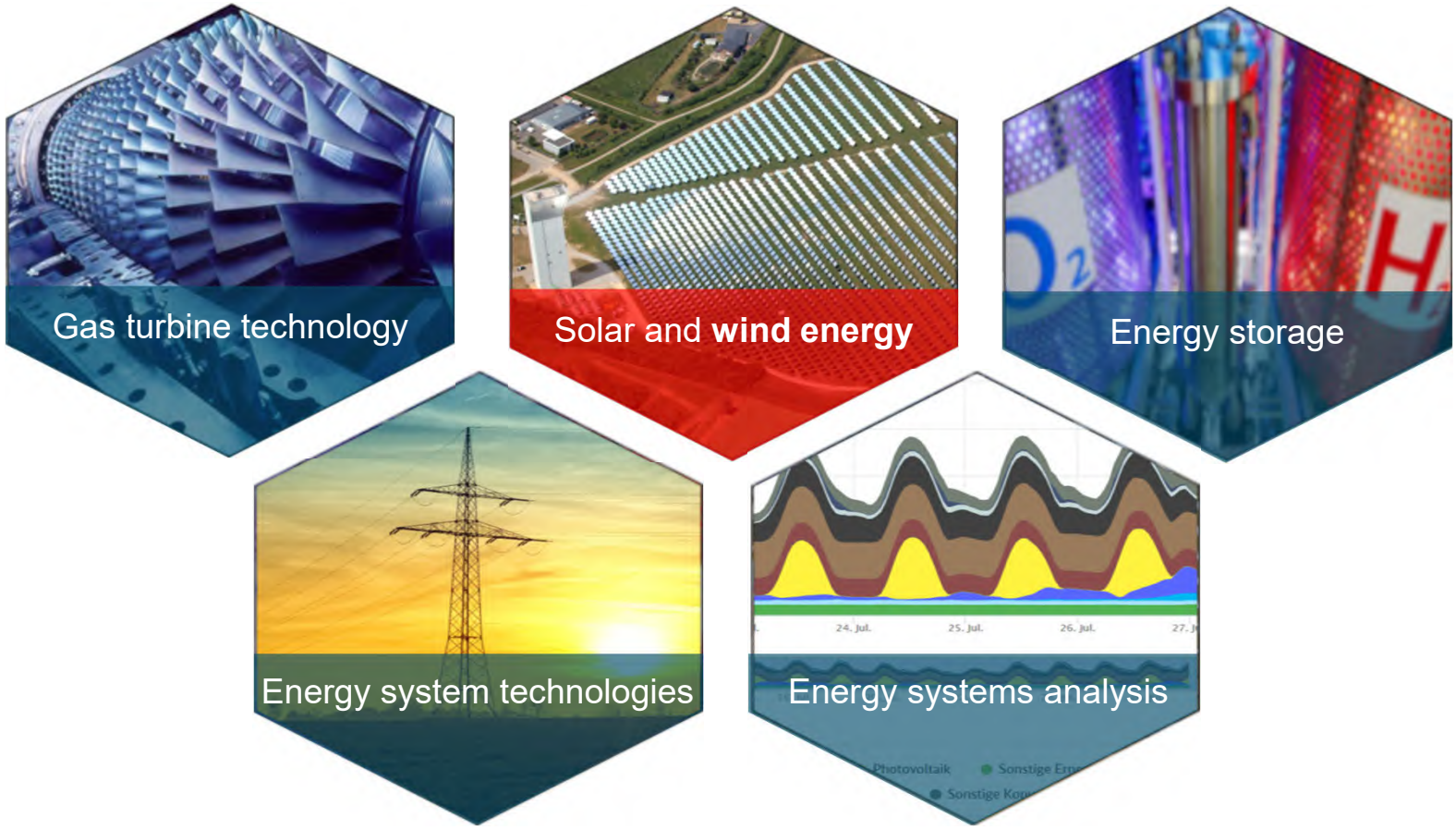


Transport

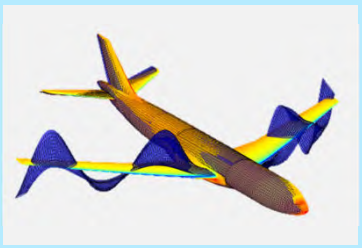
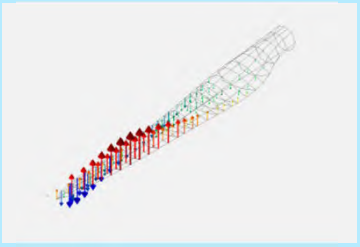


Energy

Energy research @ DLR



Synergies: aerospace and wind energy research @ DLR

	Aeroacoustics	Aerodynamics	Atmospheric Physics	Aeroelasticity	Composite Structures and Adaptive Systems
Aerospace					
Wind Energy					

Large-scale research facilities @ DLR

Test systems and simulators

Solar thermal plant

German Antarctic Receiving Station (O'Higgins)

Research aircarfts

WiValdi – Wind Energy Research Farm

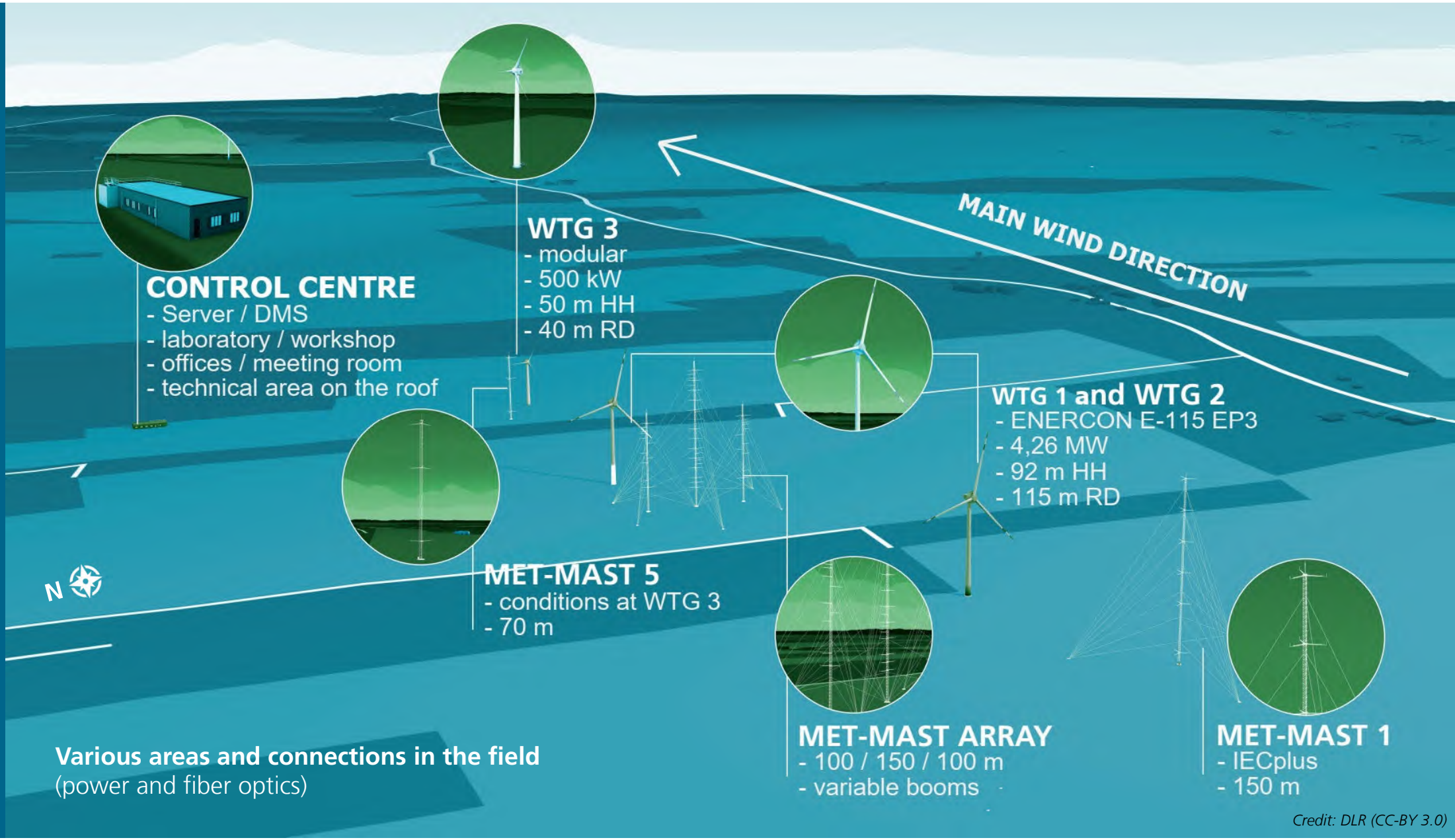
Goal: Covering the entire process chain – *from whole-system turbine planning, innovative rotor concepts, turbine technology and operational management, to their environmental impact and acceptance research, as well as the integration of wind turbines into the power grid.*

WiValdi – Wind Energy Research Farm

WiValdi: What‘s that?

- Key data at a glance

WiValdi – Wind Energy Research Farm



Various areas and connections in the field
(power and fiber optics)

Operator and co-operation partner

Supported by:

Niedersächsisches Ministerium für Wissenschaft und Kultur

Federal Ministry for Economic Affairs and Climate Action

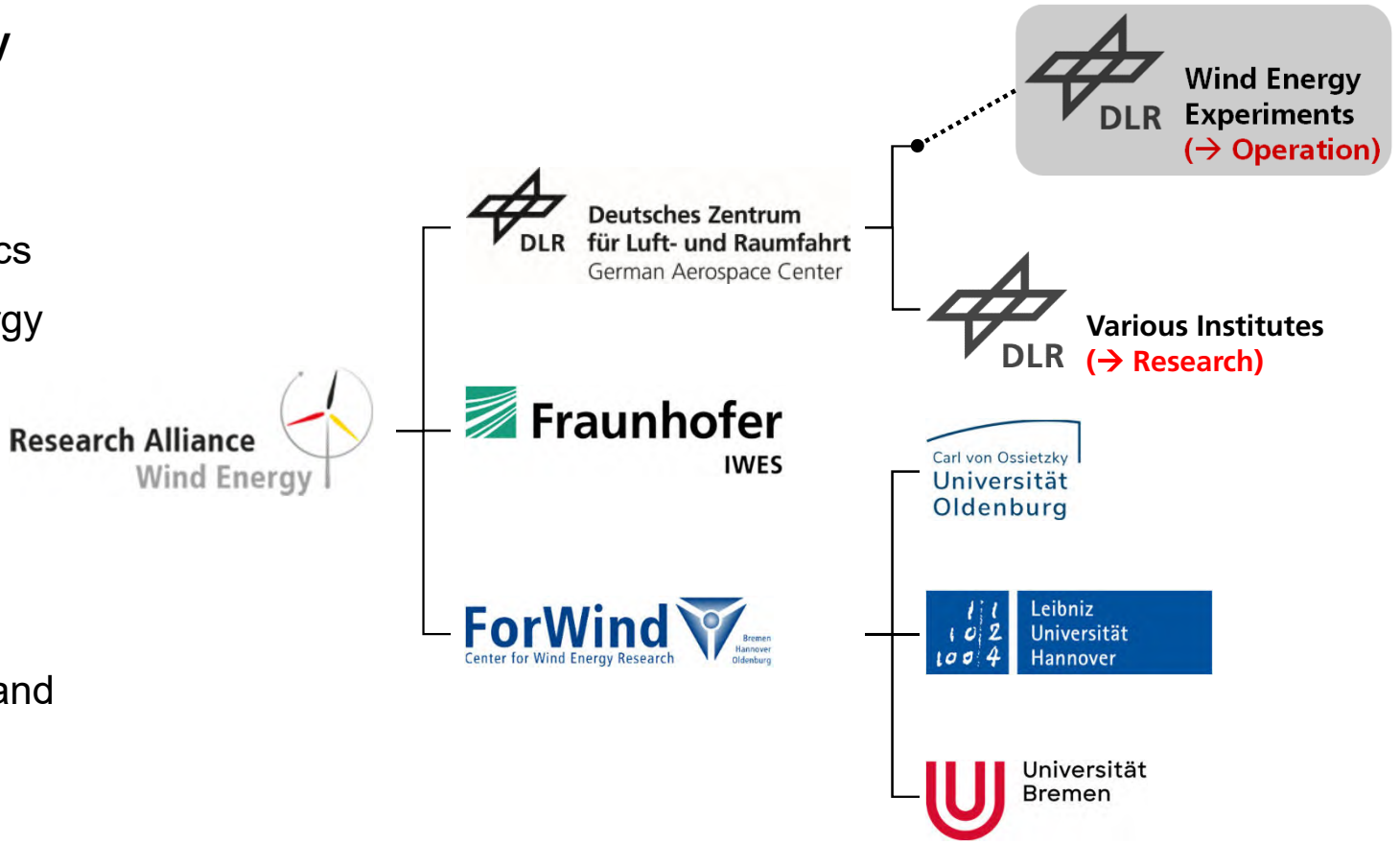
Research Alliance Wind Energy

- > 20 institutes and facilities
- > 600 researchers
- covers the entire range of topics

→ development of the Wind Energy Research Farm

DLR WX
(Wind Energy Experiments)

- operator
- point of contact for academia and industry
- advisory service



WiValdi – Wind Energy Research Farm

WiValdi: Why?

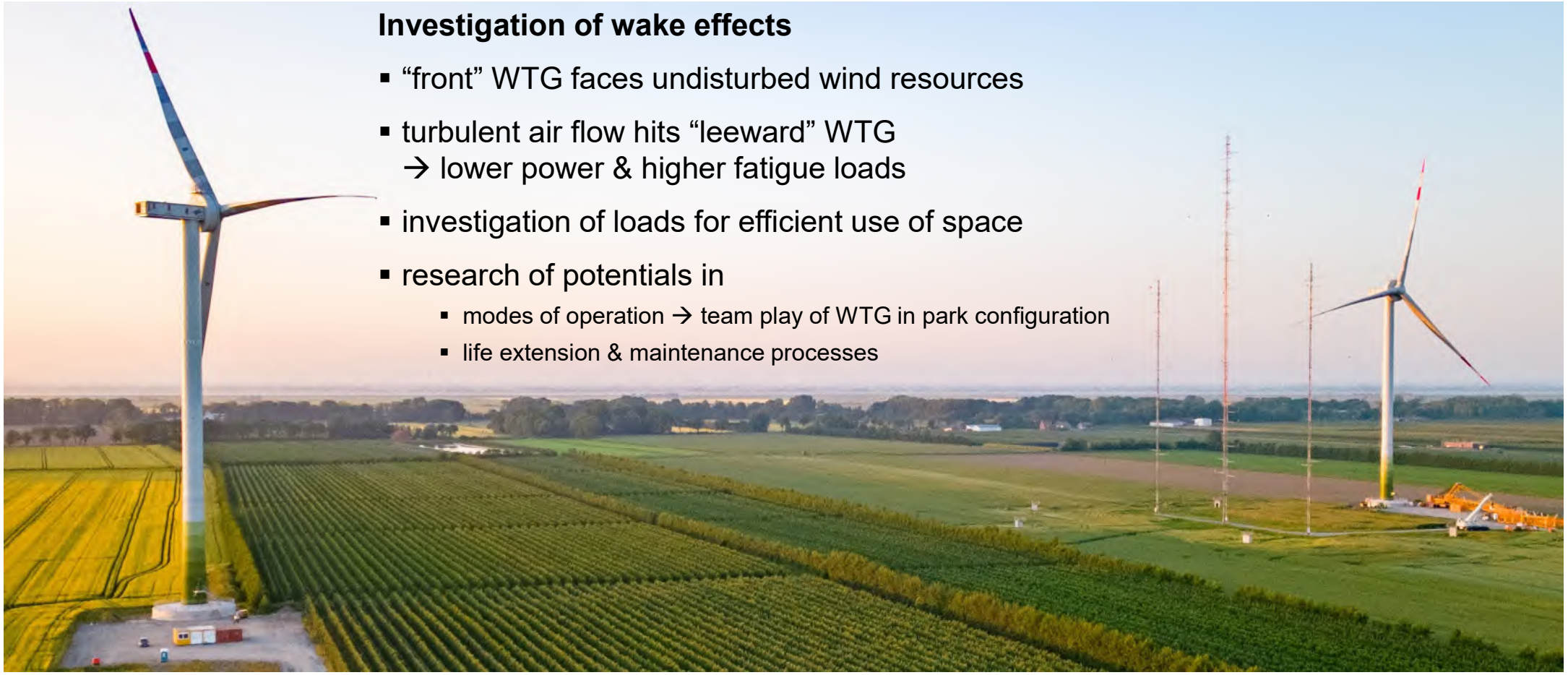
WiValdi – Wind Energy Research Farm

Research for efficient use of limited space

Dr. Jakob Klassen, WiValdi - Wind Energy Research Farm

WiValdi – Wind Energy Research Farm

Research for efficient use of limited space



Investigation of wake effects

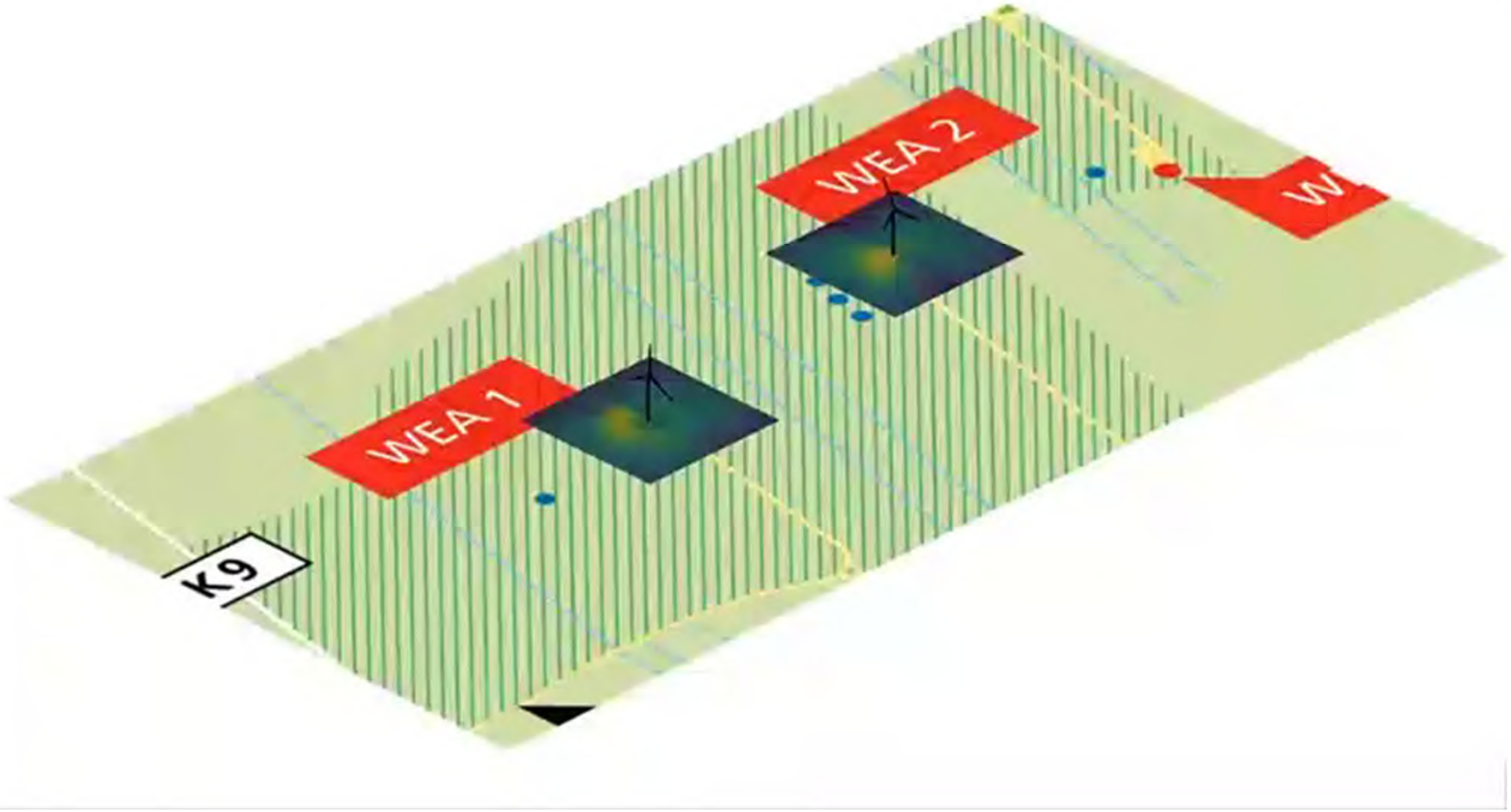
- “front” WTG faces undisturbed wind resources
- turbulent air flow hits “leeward” WTG
  → lower power & higher fatigue loads
- investigation of loads for efficient use of space
- research of potentials in
  - modes of operation → team play of WTG in park configuration
  - life extension & maintenance processes

WiValdi – Wind Energy Research Farm

Research for low noise wind parks

WiValdi – Wind Energy Research Farm

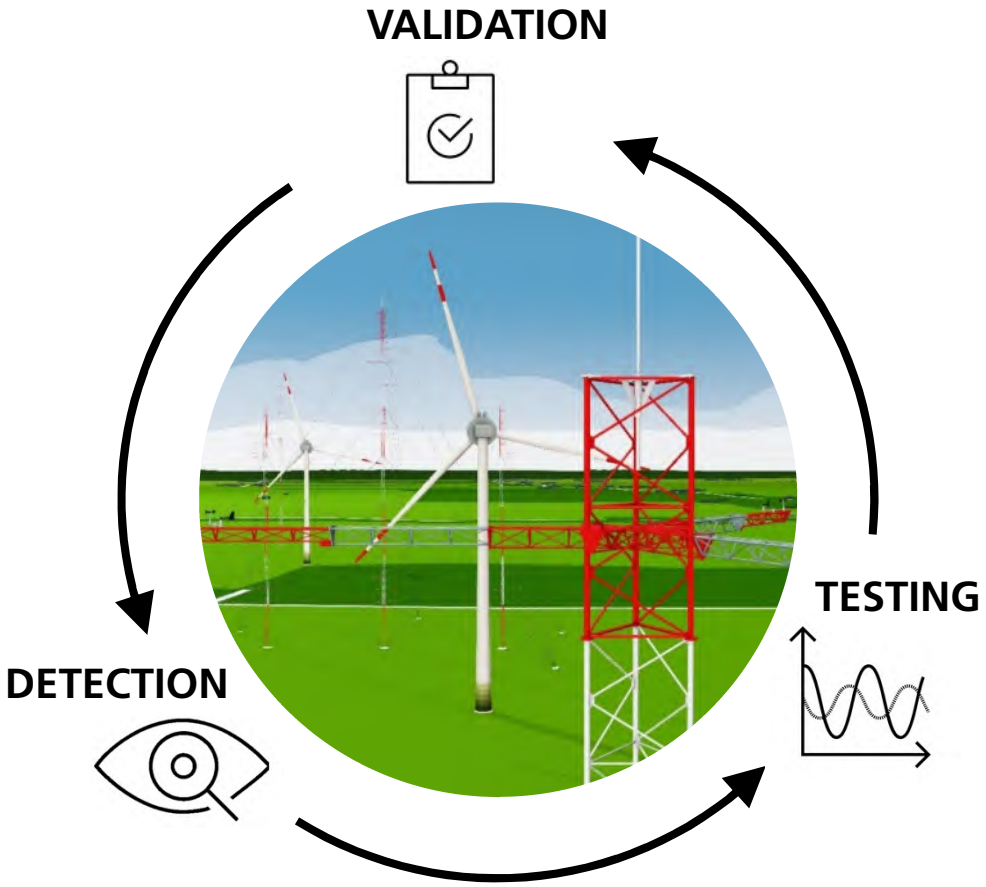
Modelling and measurment of noise emission



M. Herr, DLR-AS

WiValdi – Providing a unique research infrastructure

…"from the air molecule to the electron in the power grid"



- BYO equipment for test and validation
- access sensor data
- access WTG data
- test WTG and system modifications
- not limited to wind energy research
- real digital twin

WiValdi: Detection

- … of physical phenomena
- … with over 2.000 sensors

WTG – E115 EP3 E4 (E-NACELLE)

Bildquelle: Enercon Windblatt 03/2020
https://www.enercon.de/fileadmin/Redakteur/Medien-Portal/windblatt/pdf/201201_Windblatt_03_20_DE.pdf

WiValdi - OPUS 1 & OPUS 2

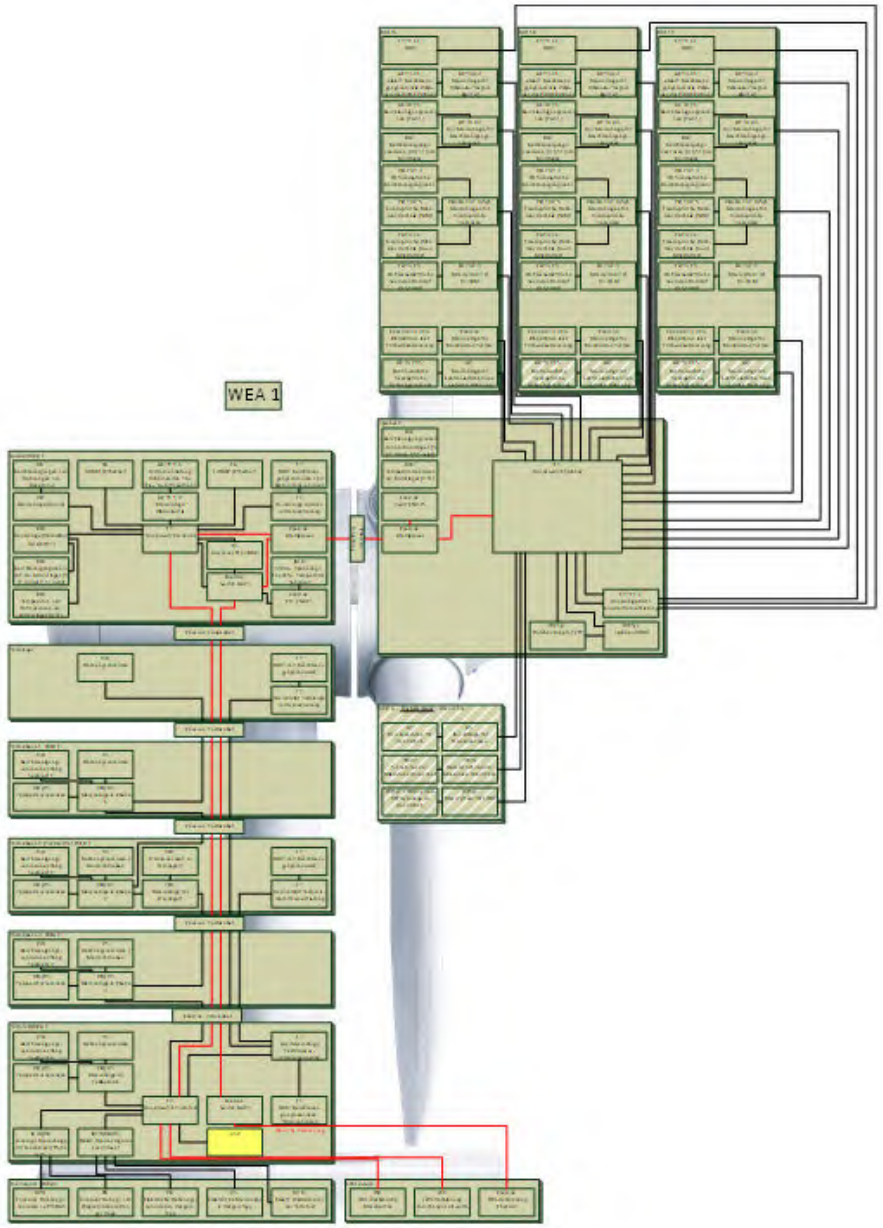
ENERCON E115 EP3

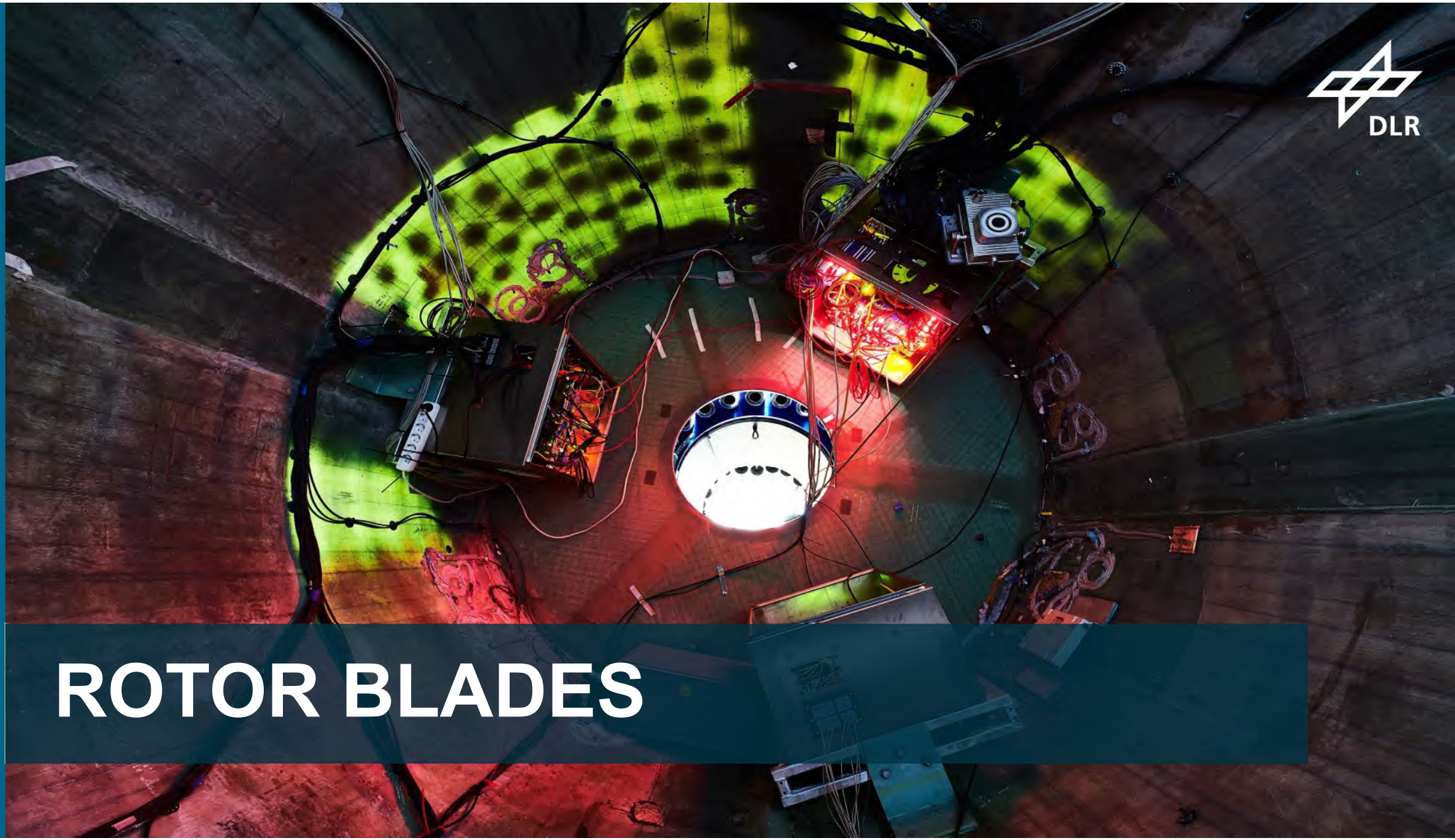
- 4.26 MW
- 92 m HH
- 115,7 m RD

equipped with extensive measurement technology in

- foundation
- tower and nacelle
- electrical components
- bearings
- rotor blades

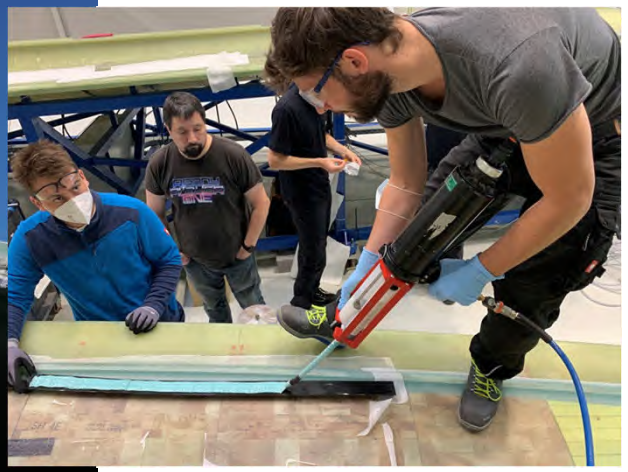
Adapted controller for experimental operations



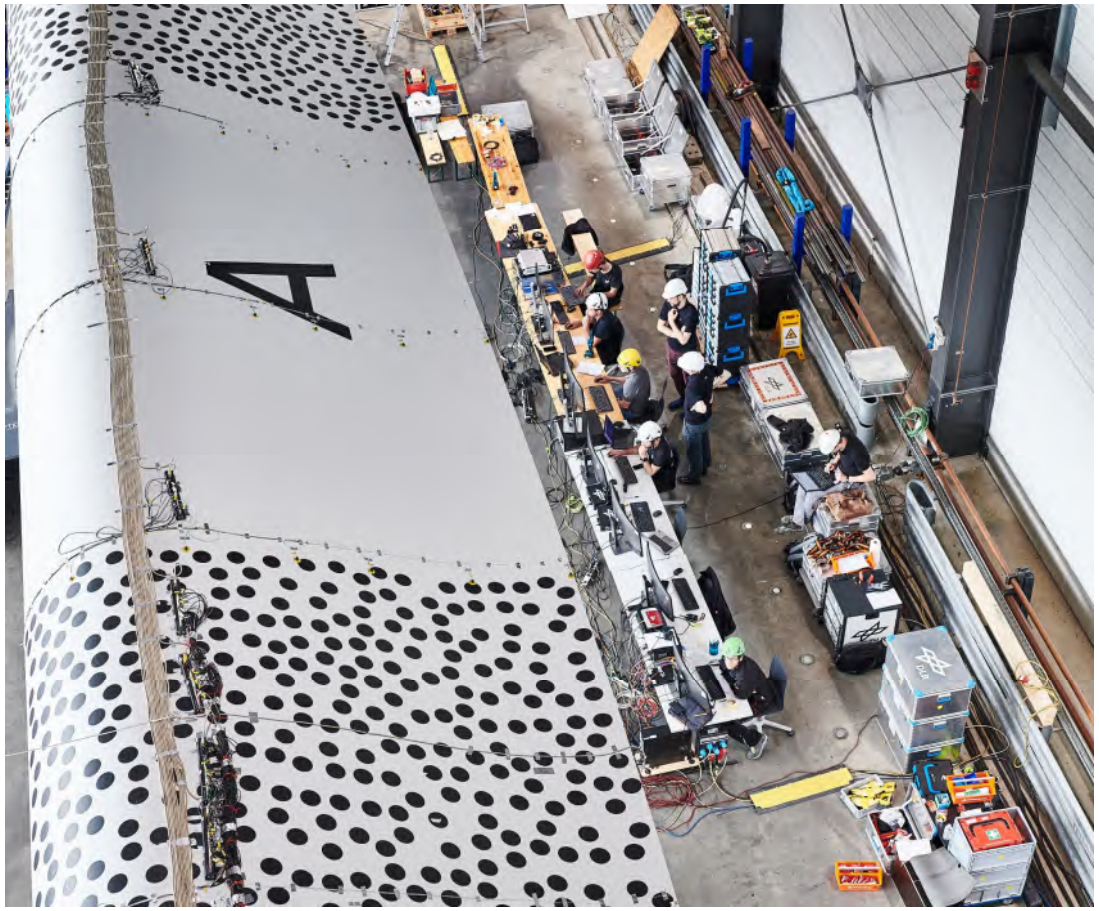


ROTOR BLADES

Rotor blades – highly instrumented during manufacturing



Rotor blades – thorough characterization before installation



Dr. Jakob Klassen, WiValdi - Wind Energy Research Farm

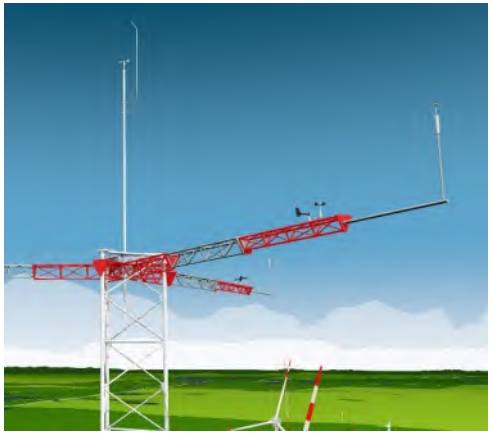
MET-MASTS

Meteorological masts

5 masts provide a comprehensive overview of the prevailing wind field at any time

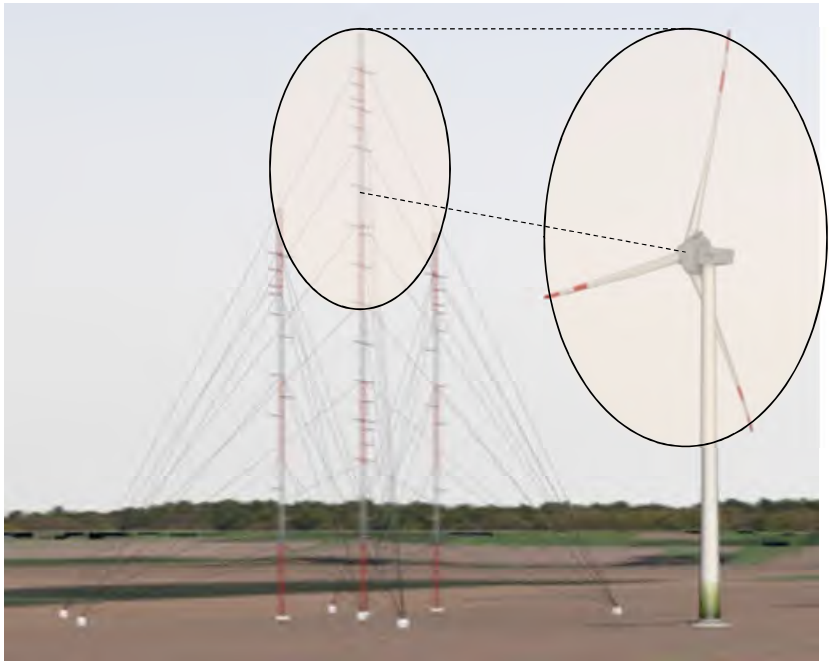
Mast 1 (150 m) & Mast 5 (70 m)

- instrumentation according to IEC standard
- several sensors
- additional platforms variable in heights



Mast Array

Combination of 3 masts to cover the entire swept area of WTG 2



FIELD INSTRUMENTATION

WiValdi: Testing

- Innovative components
- New technologies
- Across sectors

WiValdi - OPUS 3 (modular turbine)

Installation planned for 2024

- Composed from various manufacturers
- developed in-house
- 500 kW; 50 m HH; 40 m RD

modified to serve as a **test rig** with

- exchangeable blade tips (→ economical set-up variation)
- dynamic pitch system (→ control algorithms, IPC)
- slender / elastic rotor blades (→ to meet scale effects)
- extensive SHM systems
- open controller (→ implement controller, add signals)
- semi-integrated drive train (→ tip speed up to 105 m/s)
- stiffened tower

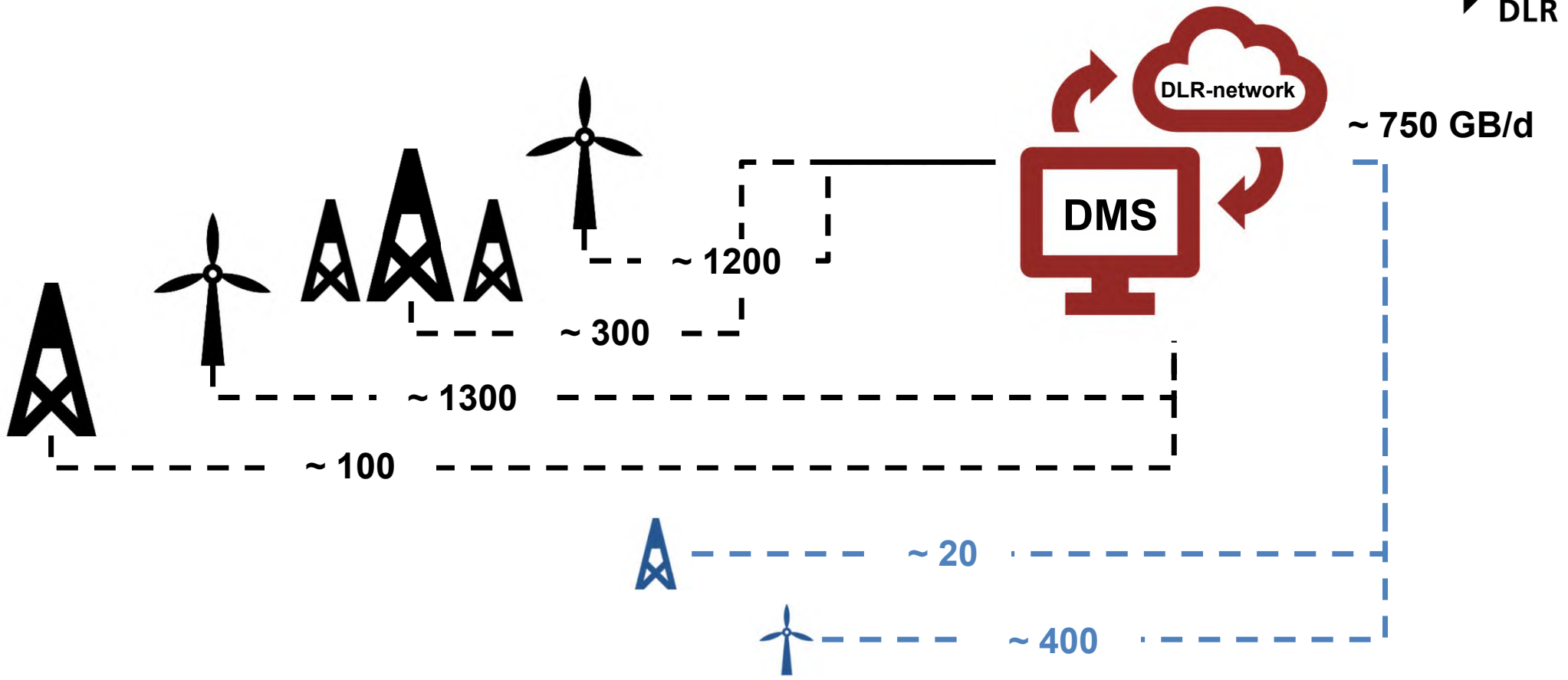
Credit: DLR (CC-BY 3.0)

WiValdi: Validation

Validation of numerical methods with

- … time-stamped and synchronized data
- … sophisticated data acquisition and management

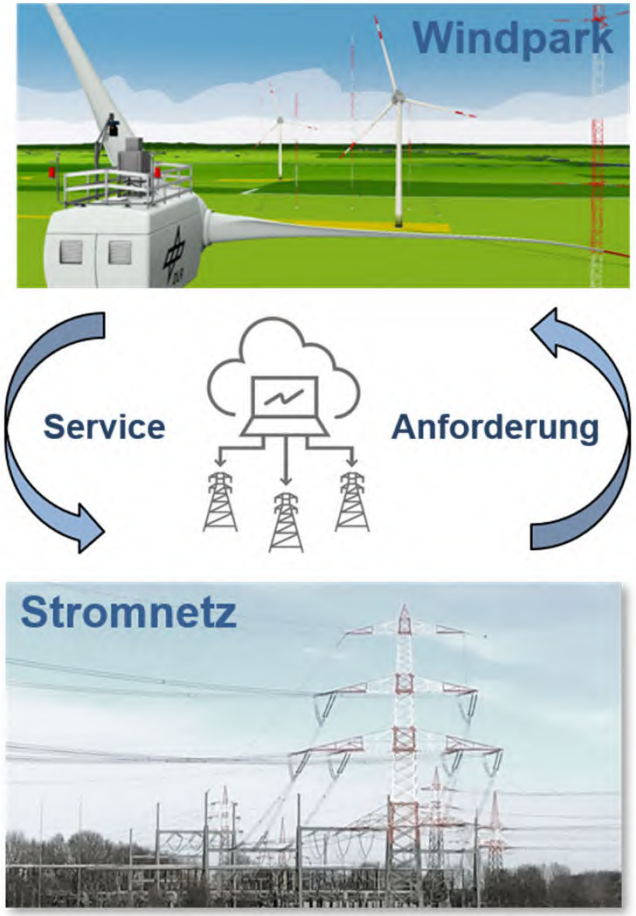
WiValdi – Data management system



WiValdi: meets research needs

for sustainable progress on social challenges

- efficent use of limited space for wind energy
- acceptance issues:
  - modeling and measurment of noise emission, transmission and immission
  - suitable characterization for regulation issues
- coupling of wind energy with storage and grid for delivering energy on system demand



WiValdi is open…

- for collaboration
- for academia and industry partners
- to the field of wind energy research and beyond

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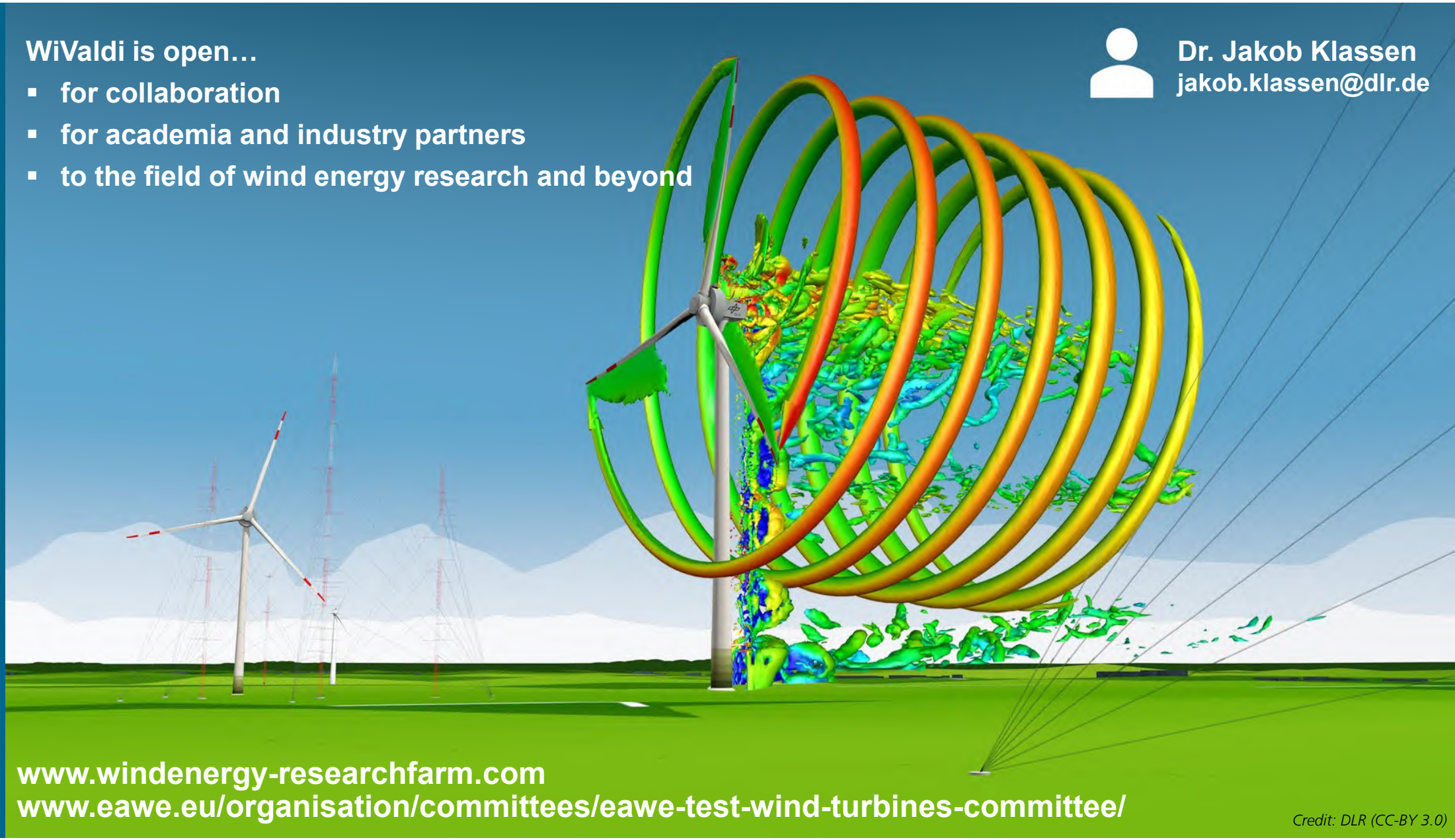

www.windenergy-researchfarm.com
www.eawe.eu/organisation/committees/eawe-test-wind-turbines-committee/

Impressum

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