

WELCOME TO THE 4TH FRAUNHOFER GREEN DEAL WEBINAR

12 October 2021 | 12:00 – 01:00 p.m.

Fraunhofer Green Deal Series



**“Offshore Wind as a cornerstone of the European
Green Deal –
The potential in upscaling production and utilization”**

AGENDA

11:55 a.m. Moderation by Verena Fennemann

Head of Fraunhofer EU-Office Brussels

Welcome and introduction by Prof. Andreas Reuter

Managing Director Fraunhofer Institute for Wind Energy Systems IWES

12:10 p.m. Expert presentation I “Upscaling Offshore Wind to 300 GW” by Nora Denecke

Head of Department Field Tests, Fraunhofer Institute for Wind Energy Systems IWES

12:20 p.m. Expert presentation II “Grid- and system-side challenges in integrating large amounts of offshore wind energy” by Prof. Kurt Rohrig

Executive Director Fraunhofer Institute for Energy Economics and Energy System Technology IEE

12:35 p.m. Setting the scene by Pernille Weiss

Patron of the webinar; Member of the European Parliament

12:45 p.m. Discussion

01:00 p.m. End of the event

Welcome and introduction

by Prof. Dr. Andreas Reuter

Managing Director Fraunhofer Institute for Wind Energy
Systems IWES



The Fraunhofer-Gesellschaft at a Glance

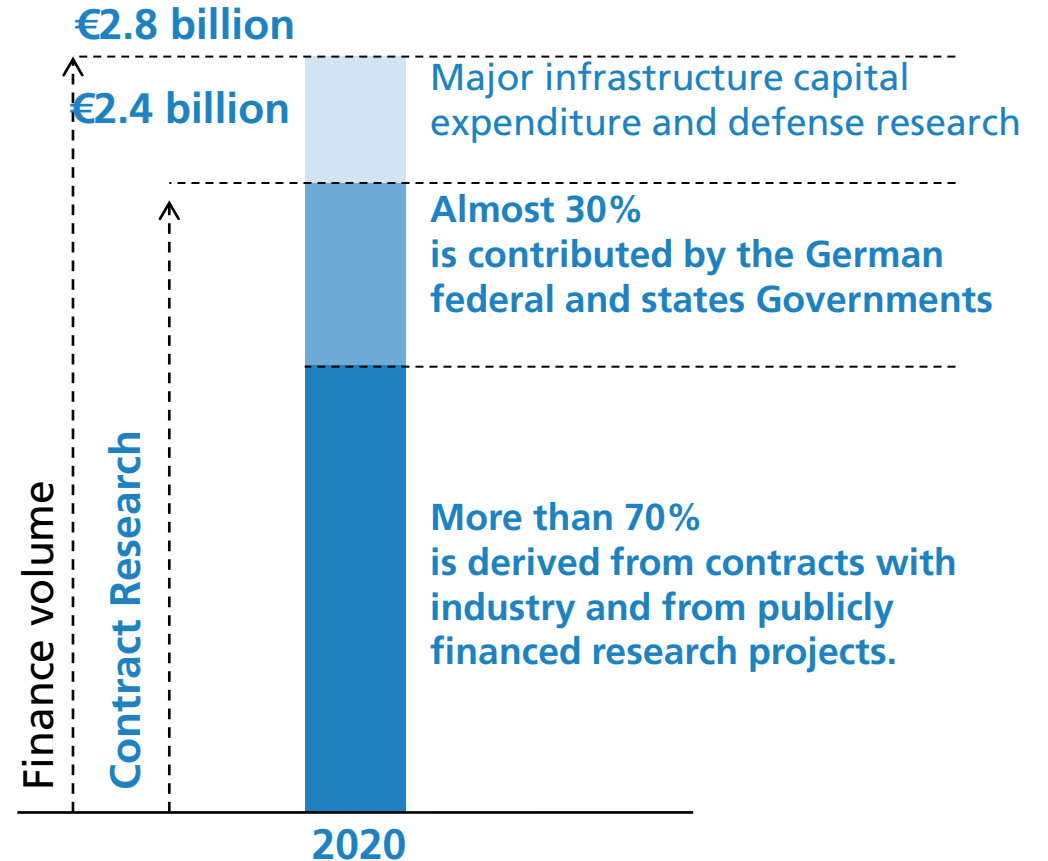
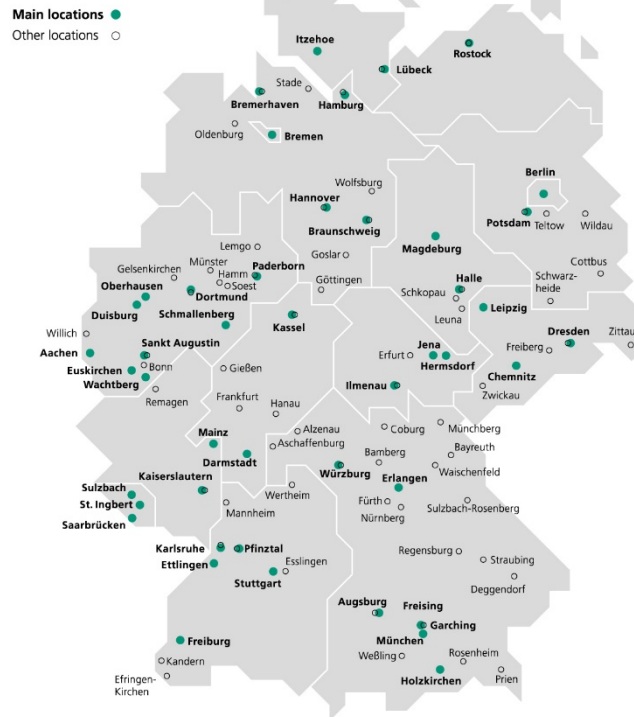
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.



29,000 staff



75 institutes and research units



WIND ENERGY RESEARCH AT FRAUNHOFER

Presenters:



Prof. Andreas Reuter
Fraunhofer Institute for Wind Energy Systems IWES
Introduction



Nora Denecke
Fraunhofer Institute for Wind Energy Systems IWES
Offshore Research Challenges



Prof. Kurt Rohrig
Fraunhofer Institute for Energy Economics and Energy System Technology IEE
Wind Energy Grid Integration

Foto 1 und 2: © Martina Buchholz, Foto 3: © Beushausen

Wind Energy Technology Today

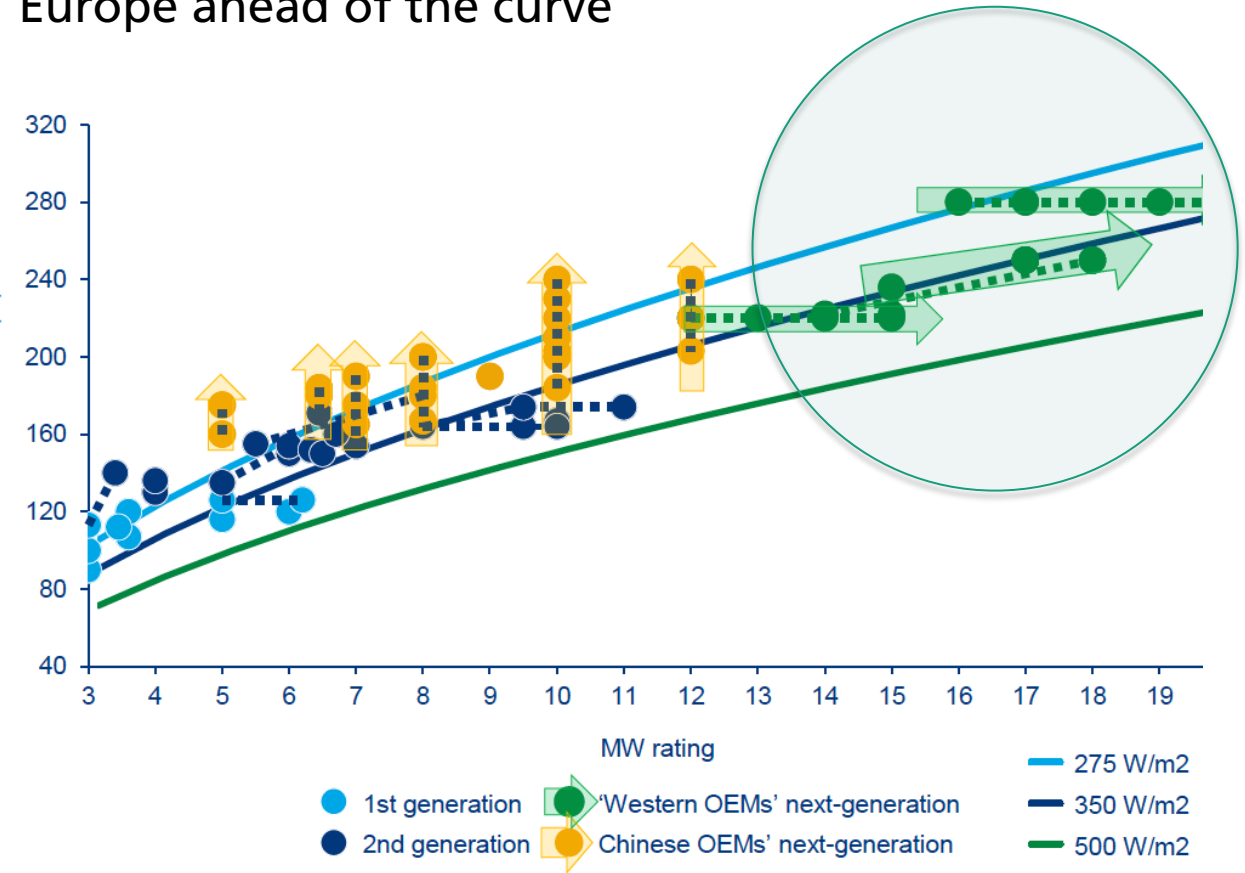
Europe as a Global Technology Leader

Vestas 236 / 15 MW



© Vestas

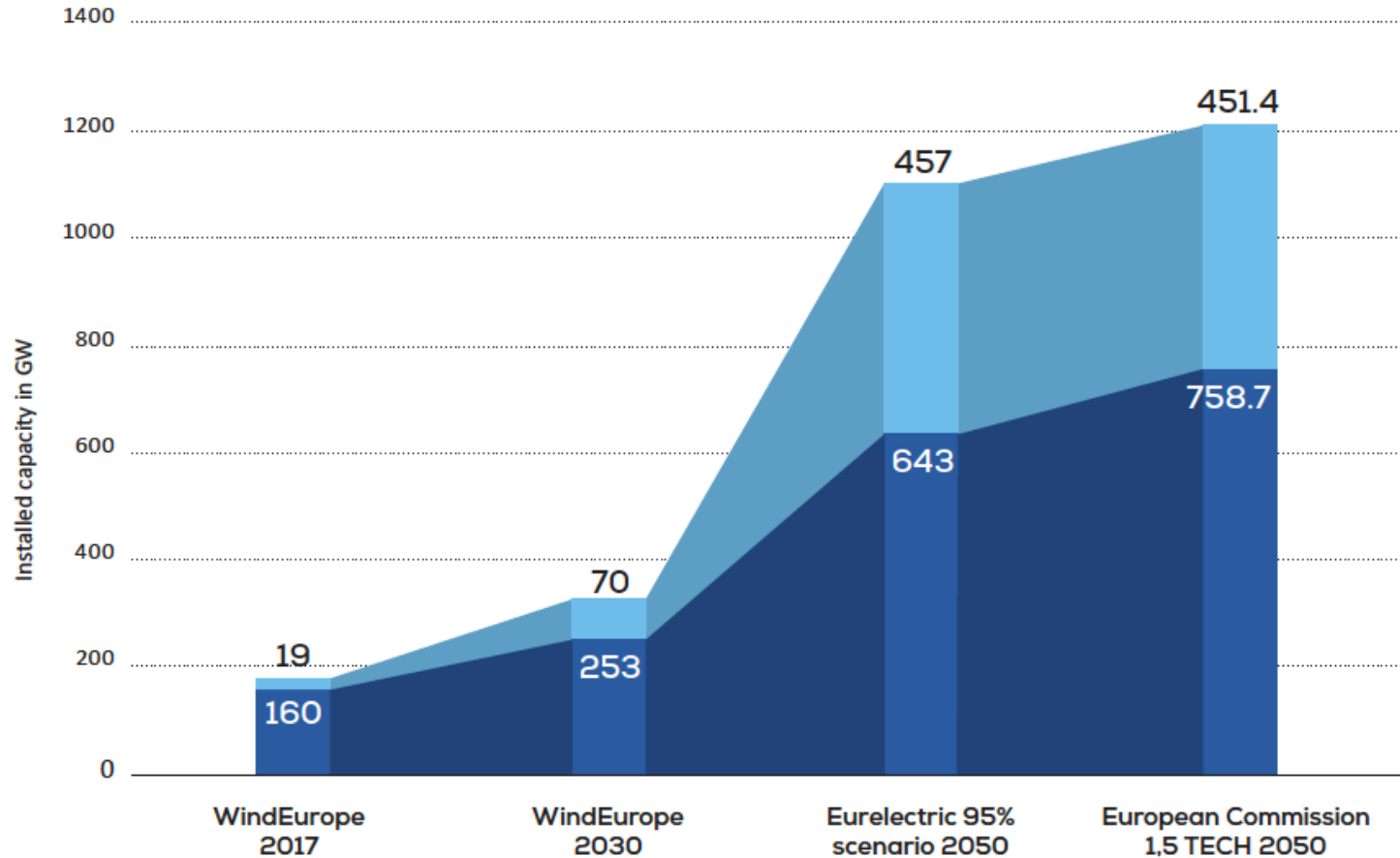
Europe ahead of the curve



© Wood Mackenzie

The Role of Wind in Europe until 2050

Huge Ramp-Up needed to reach Climate Goals



Ambitious plans for wind energy growth in Europe will multiply turbine demand

- Offshore wind
- Onshore wind

© WindEurope

Wind Research Scope of Fraunhofer

Supporting the Wind Energy Sector in all Aspects



© Caspar Sessler

Wind Forecast, Site Assessment and CFD



© Jan Meier

Nacelle Testing and System Reliability



© Jan Meier

Field Tests



© Paul Langrock

Qualification of Composite Materials and Parts



© Marcus Heine

Testing of Drive Components and Large Bearings



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Grid Infrastructure and Connection, Certification of El. Characteristics



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Hydrogen System Performance and Reliability

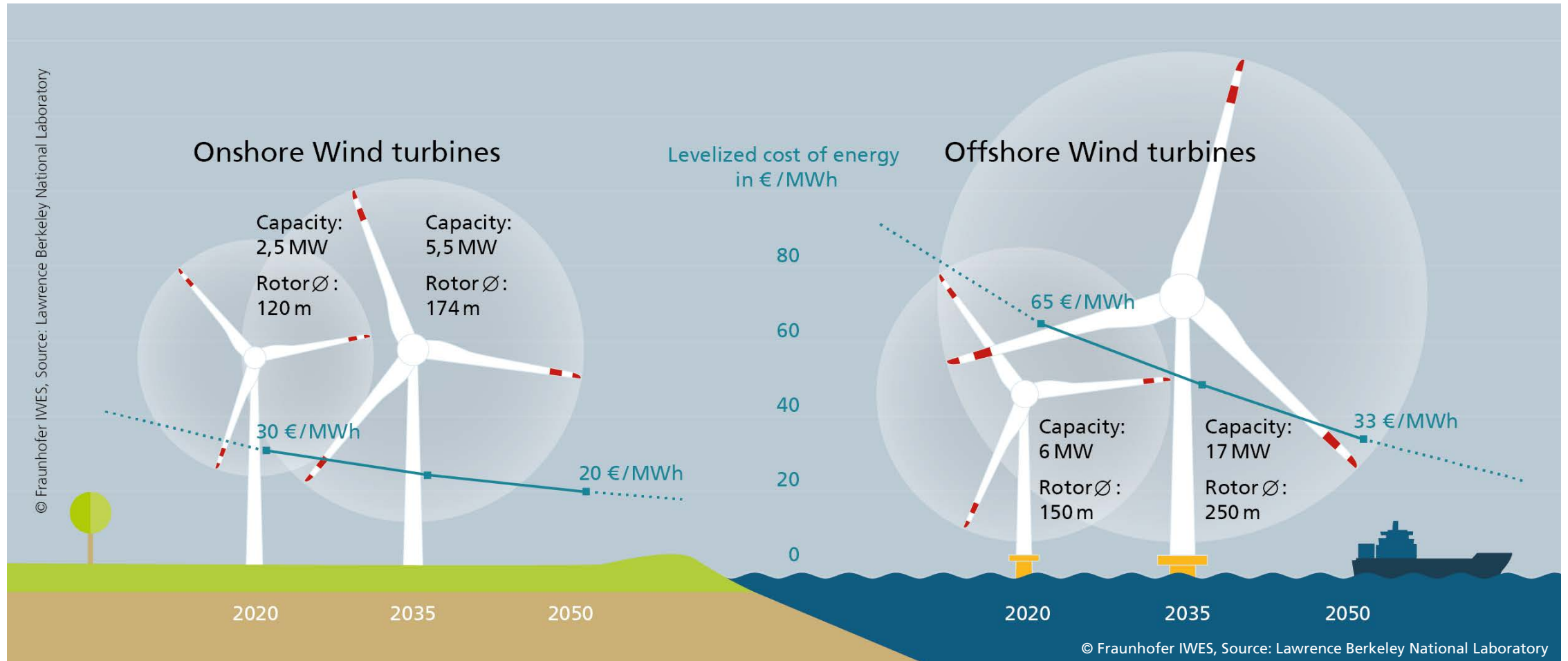


© Jan Meier

Validation of Support Structures

Research Outlook for the Current Decade

Research to Support Up-Scaling of Volumes and Reduce LCOE



Research Outlook for the Current Decade

Research to Support Up-Scaling of Volumes and Reduce LCOE



... but research topics do not focus on costs alone!

Expert presentation I

“Upscaling Offshore Wind to 300 GW”

By Nora Denecke

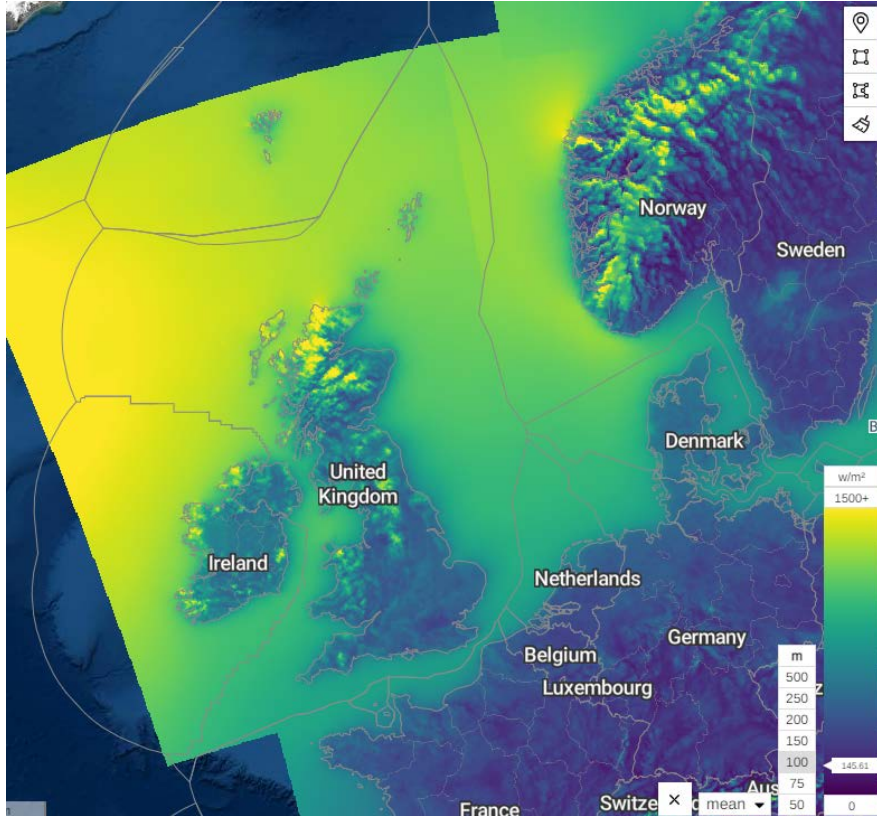
Head of Department Field Tests, Fraunhofer Institute for Wind Energy Systems IWES



Offshore Wind Potential

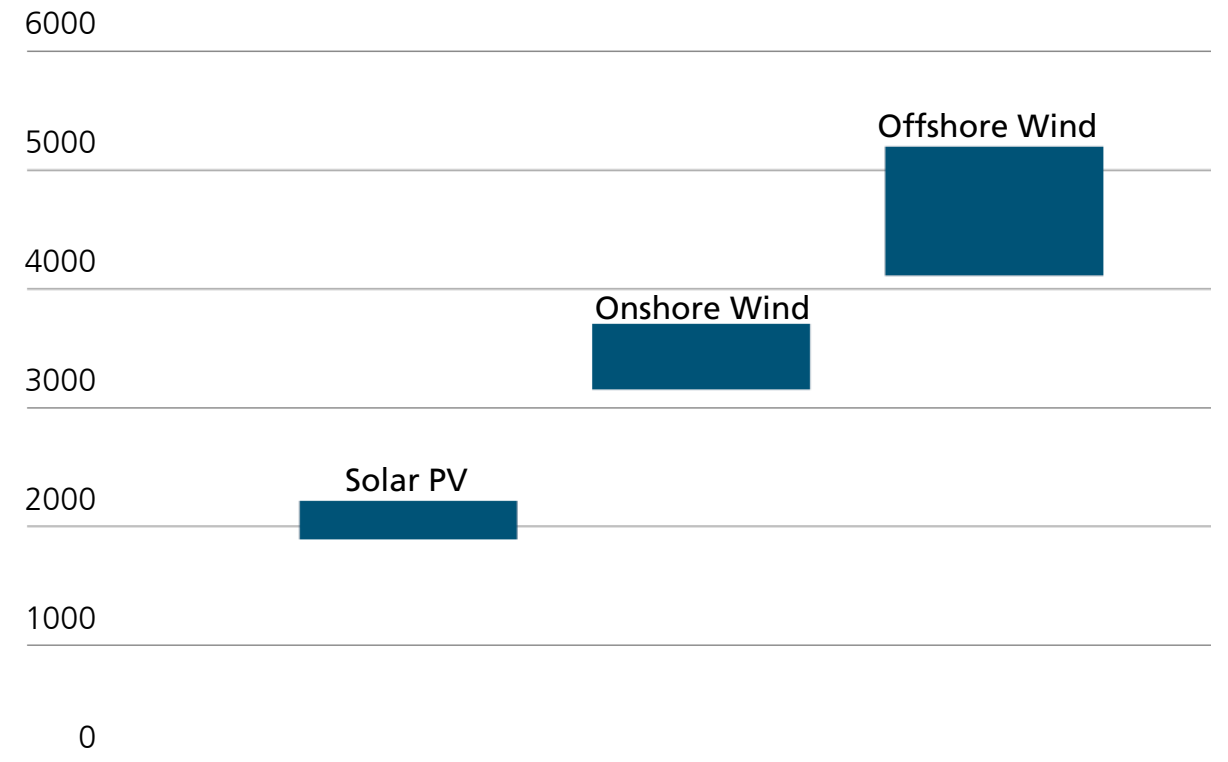
Offshore Wind Offers the most Full-Load Hours and a reliable Forecast

Wind Potential Map



Source: ERANET+project NEWA, New European Wind Atlas, co-funded by the European Commission

Full-Load Hours by renewable Source

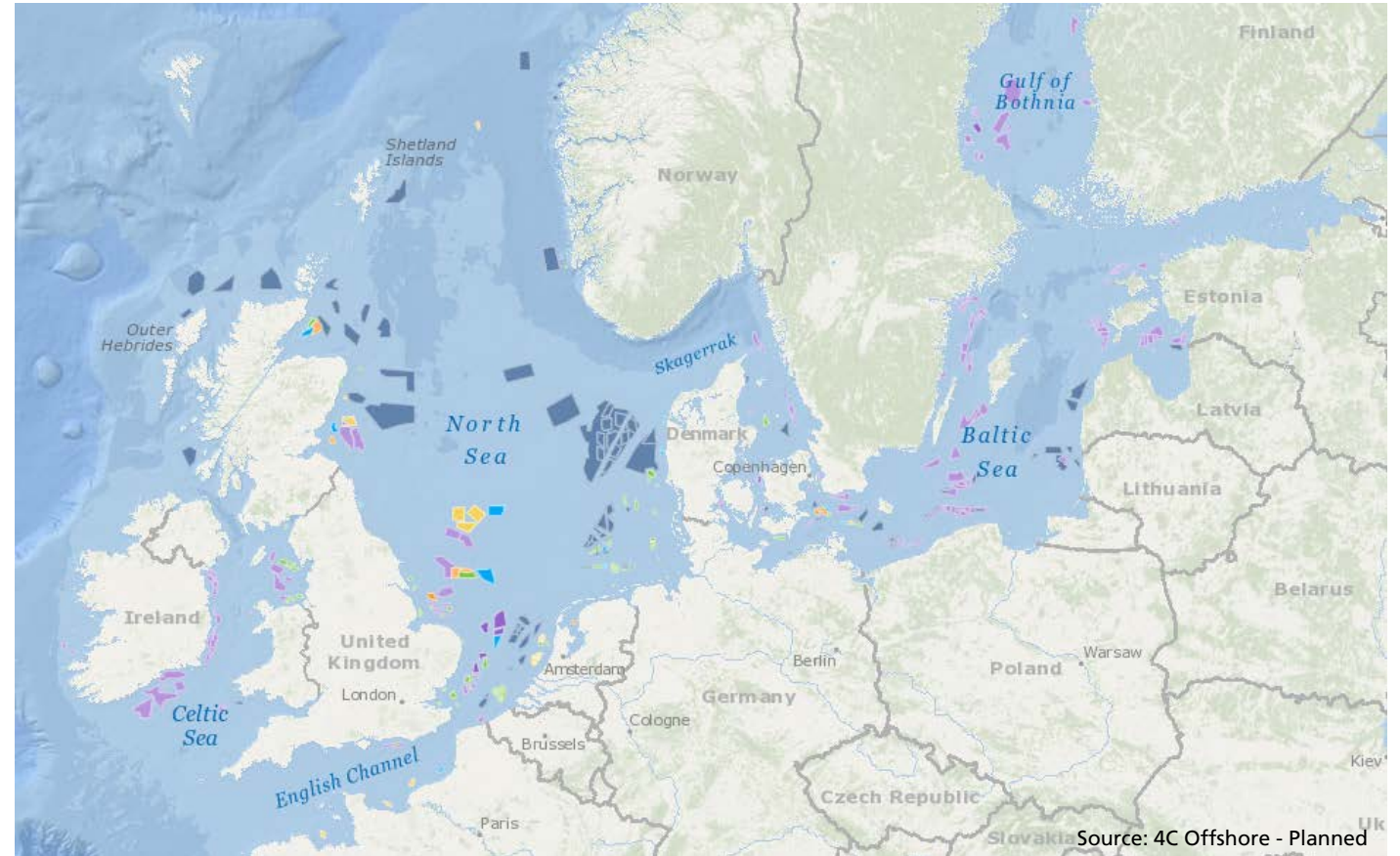


© Fraunhofer IWES, Source: Agora Energiewende, Making the Most of Offshore Wind, March 2020

Planned Offshore Installations

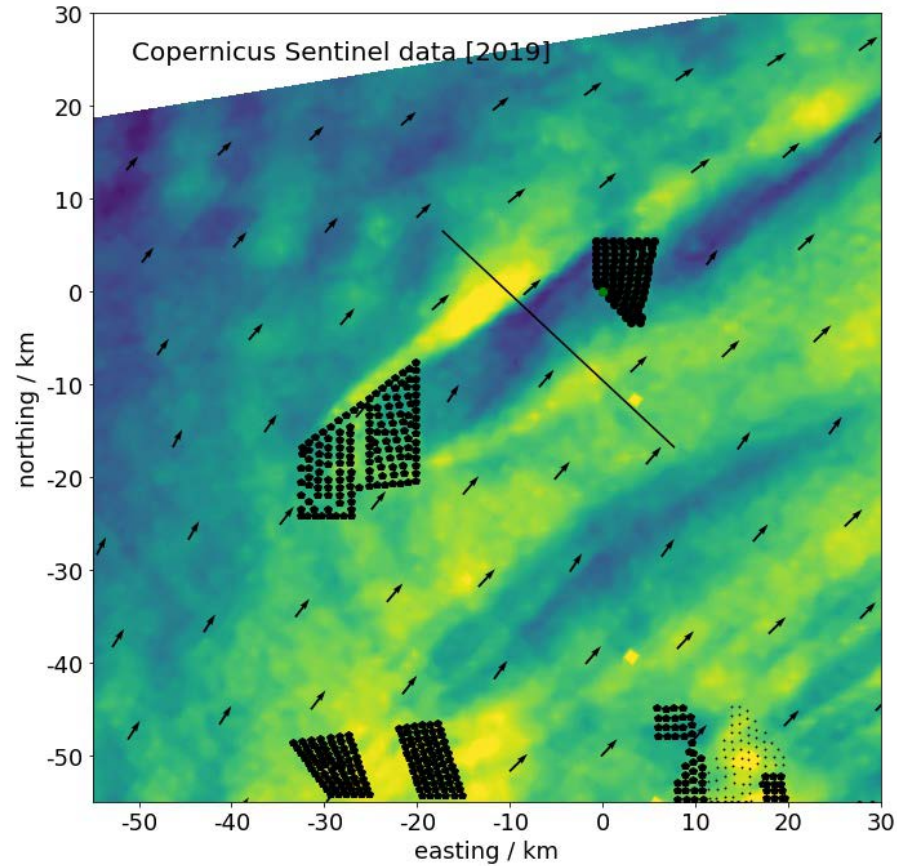
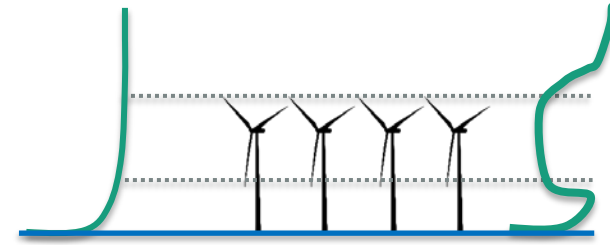
Despite large potential areas are limited due to

- Water depth
- Coastal distance
- Environmental regulations and other use

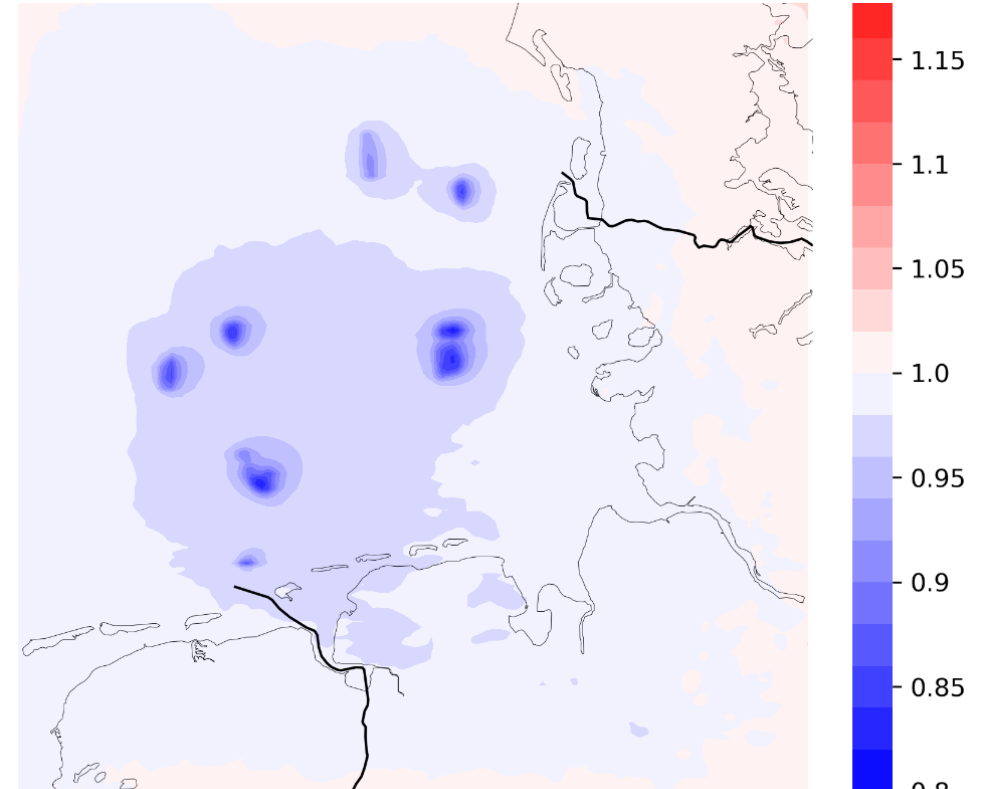


Offshore Wind Farm Wakes

Wind Speed Reduction due to Wind Farms



© Schneemann et al., 2020



© Fraunhofer IWES, 2020

Wind LiDAR Buoy for Offshore Wind Measurements

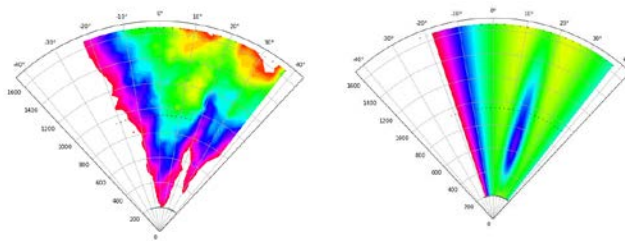


Advanced Wind Field Characterization

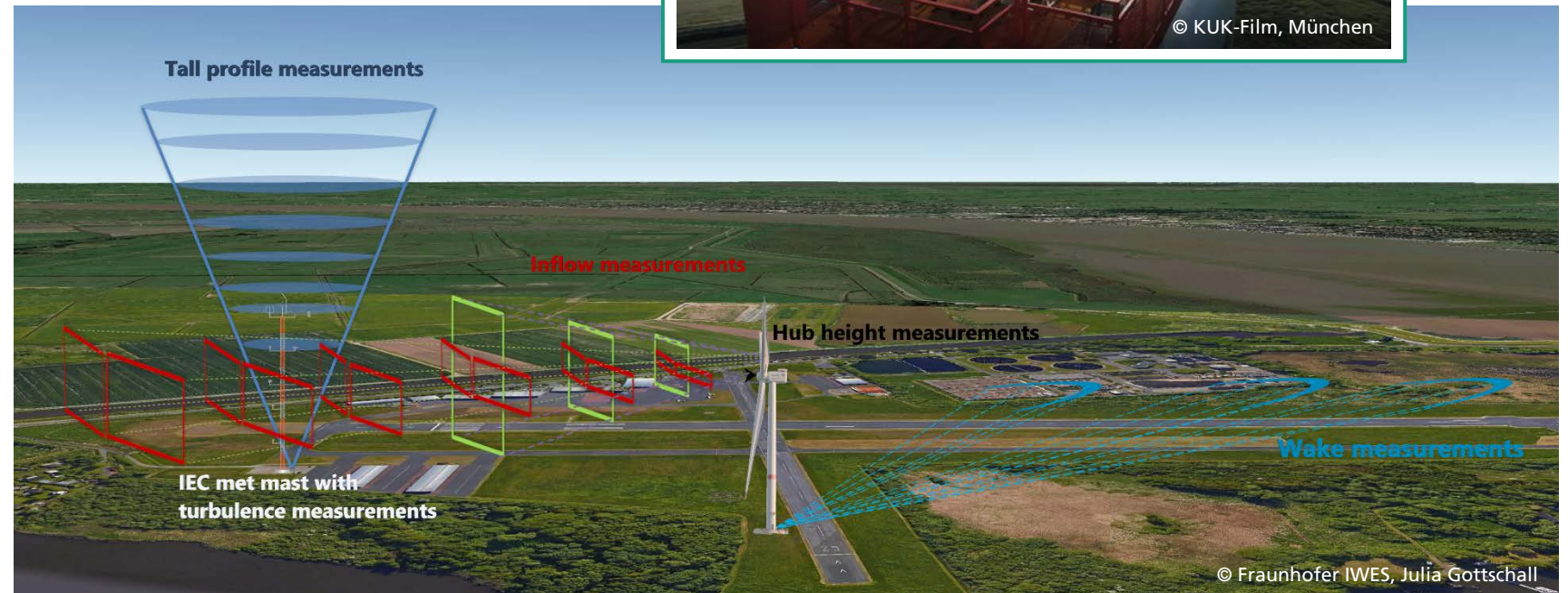
Laser remote sensing helps to visualize, assess and forecast the wind flow around large wind turbines

... for optimizing

- turbine model validation
- yield prediction and
- performance control



© KUK-Film, München



© Fraunhofer IWES, Julia Gottschall

Full Scale Testing of Wind Turbine Blades

- Emulation of 20-25 years of service in a couple of months
- Performance of a set of static tests, representing extreme loads
- Performance of several million fatigues cycles representing the service life



Digital Twins for Rotor Blades

Enhancing Physical Tests with Virtual Simulations

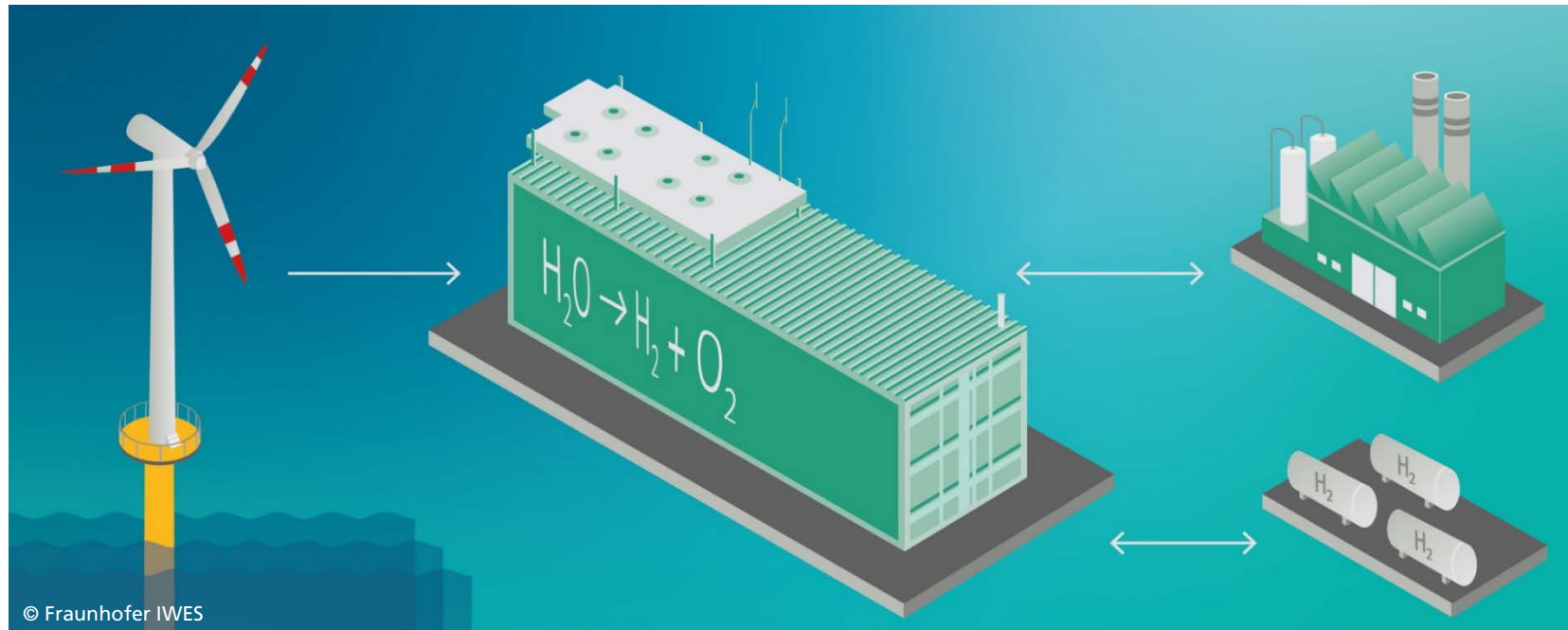


© Fraunhofer IWES, David Melcher

Fraunhofer Hydrogen Labs

Validation of Hydrogen Systems on Field Test Level

The goal: Accelerating implementation



**Hydrogen Lab
Bremerhaven**
System Integration,
Wind and Hydrogen



**Hydrogen Lab
Leuna**
Materials, Microstructure,
Power-to-X



**Hydrogen Lab
Görlitz**
Production Technology,
Power-to-X-to-Power

The Vision:

Floating WTs and perspective Energy Islands

Production of H₂ and derivatives in oceanic strong wind areas

- (Semi)-autonomous operation
- Low environmental impact and NIMBY-effect
- Heavy duty wind turbine generators
- Direct conversion to PtX (seawater electrolyzer)
- Autonomous operation
- Modular manufacturing



Expert presentation II

“Grid- and system-side challenges in integrating large amounts of offshore wind energy”

By Dr. Prof. Dr.-Ing. Kurt Rohrig

Executive Director Fraunhofer Institute for Energy Economics and Energy System Technology IEE



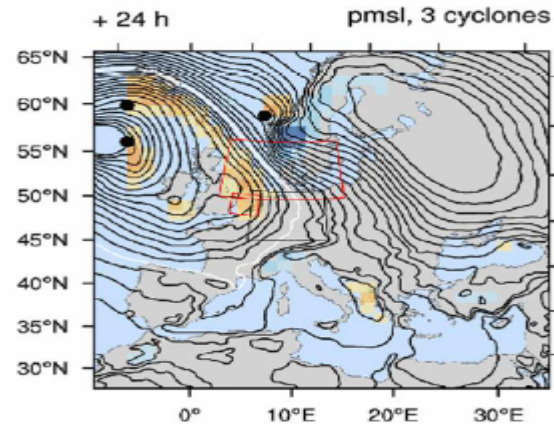
AGENDA

- Introduction - **Key elements of energy transition**
- **New offshore transmission technology**
- Onshore grid-side challenges and solutions
- System challenges and solutions

Key Elements of Energy Transition Process



Grid Planning and Operation



Power Forecasts



System Services



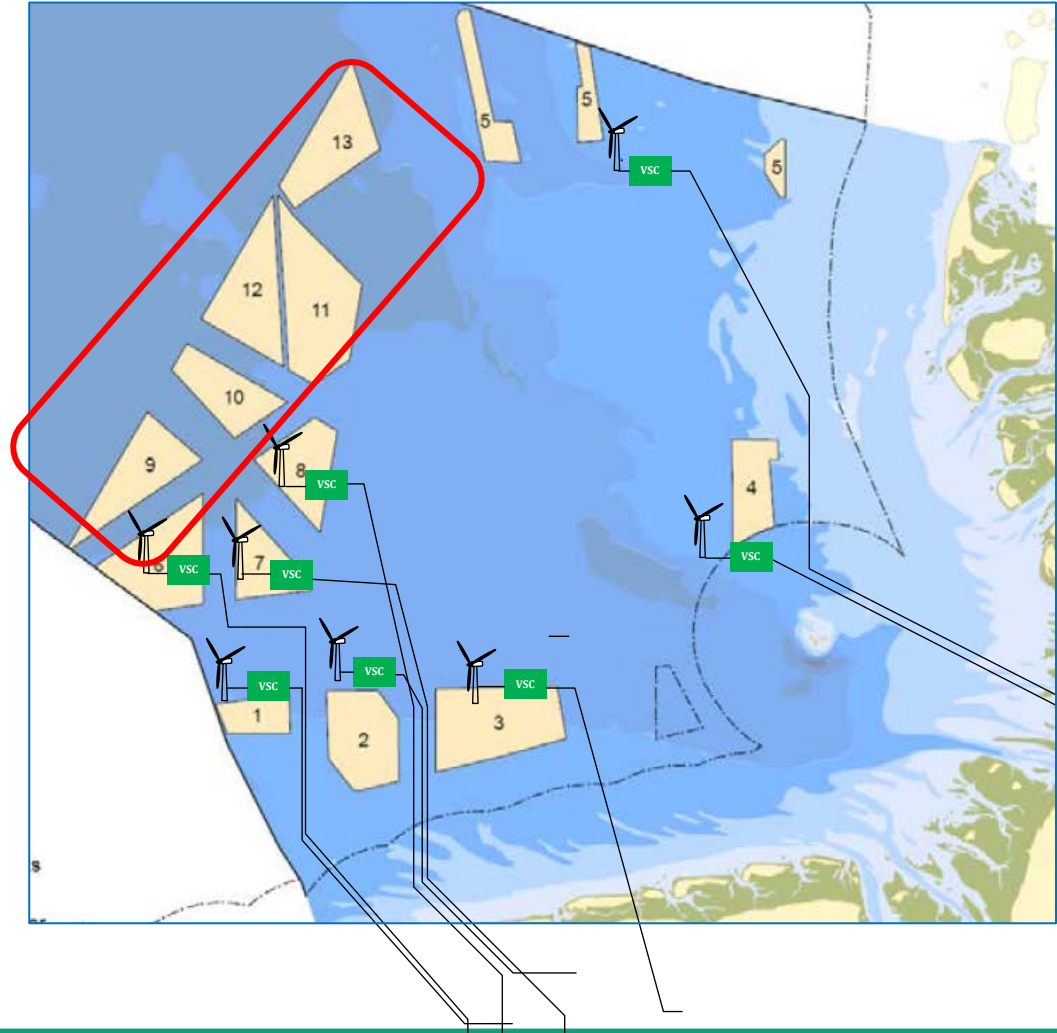
Virtual Power Plants



Smart Demand, Smart Home, Smart Cities

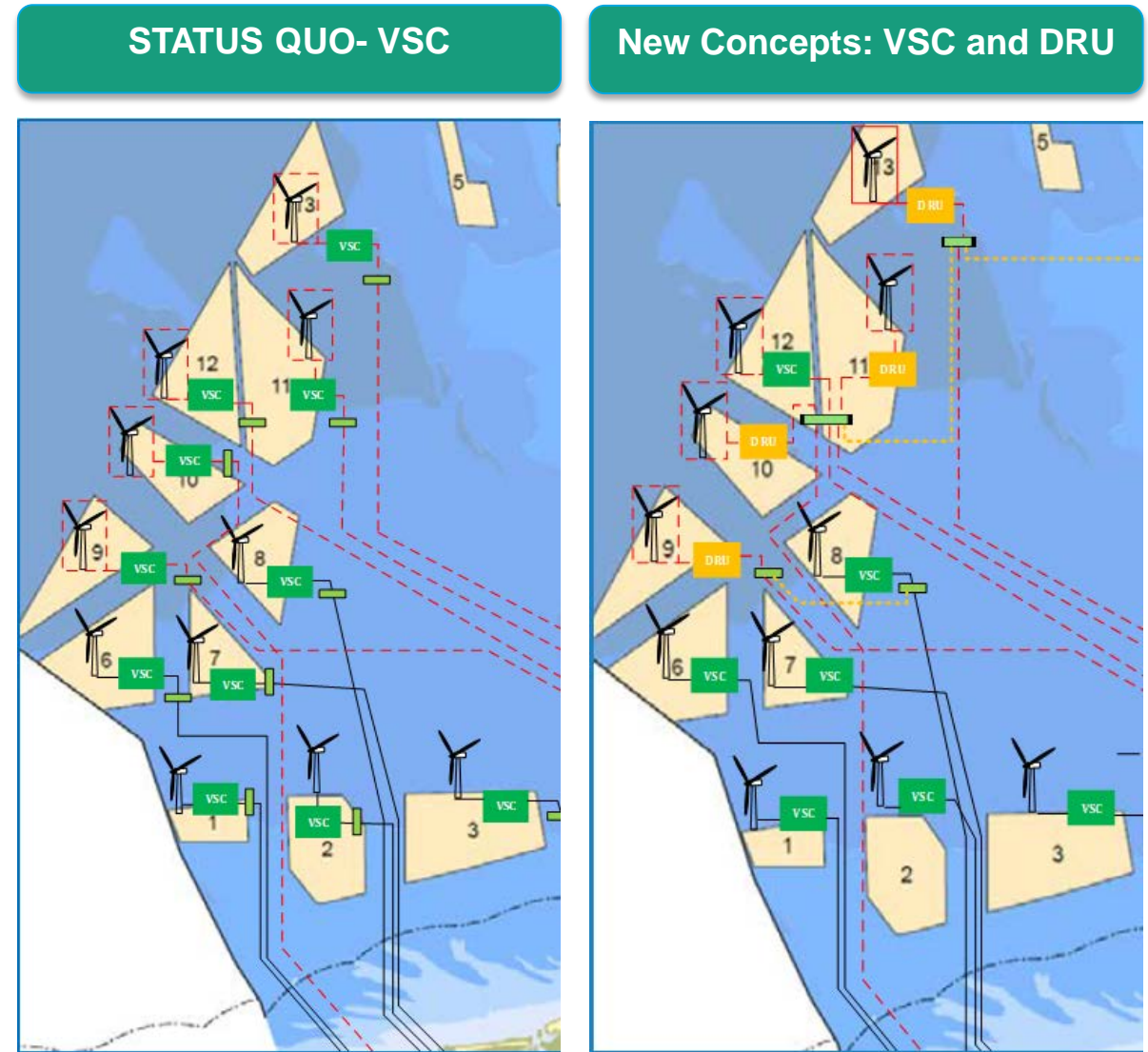
New offshore transmission technology to decrease the cost of grid connection

- Technology options
 - Diode-Rectifier Unit (DRU) vs. Voltage-Sourced Converter (VSC)
 - Peer to peer vs. meshed structures
 - Hub vs. EuroBAR-concept
 - ...
- Further R&D demand required:
 - Used Technology
 - Used Topology
 - New Concepts
 - Operational Aspects
 - Impact on Grid Planning



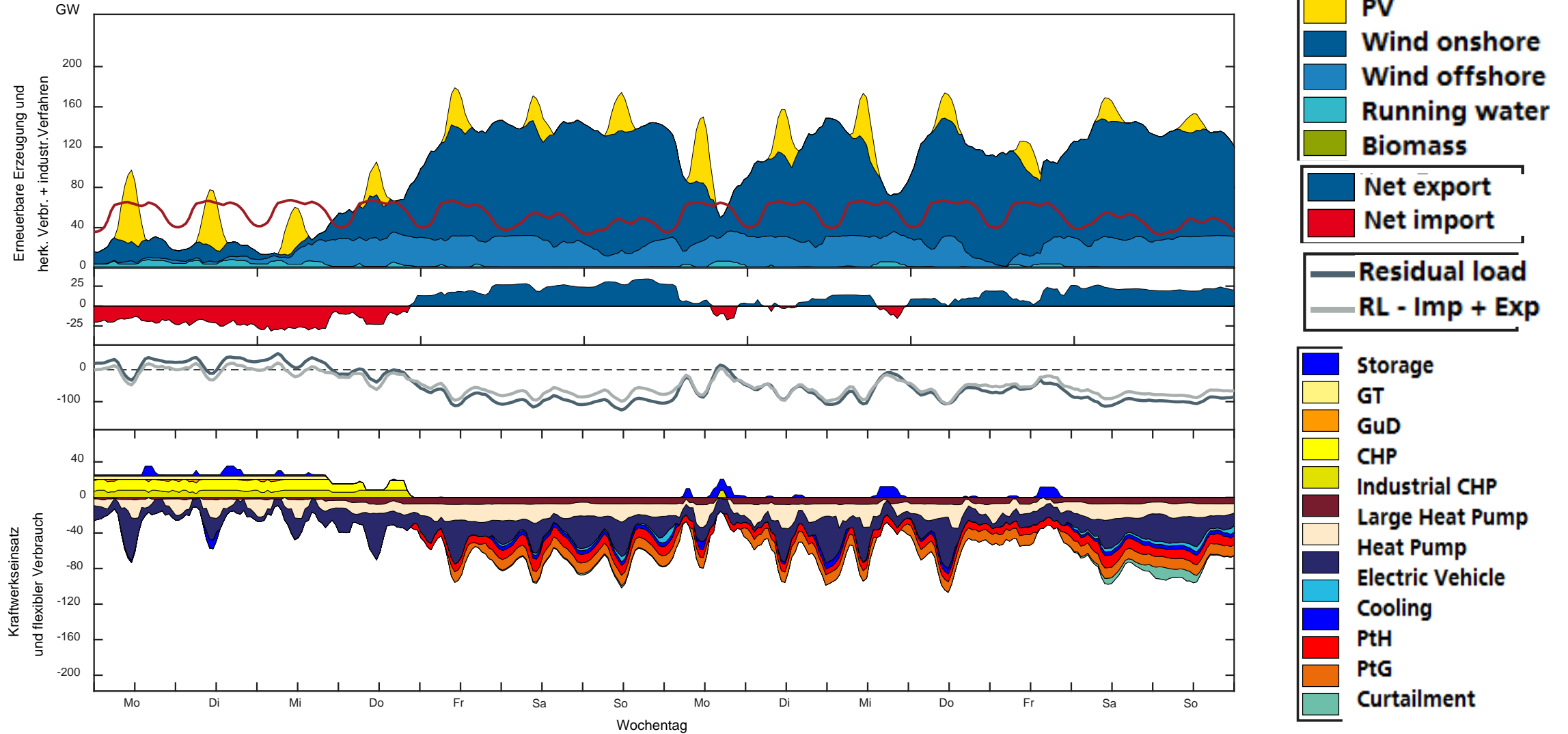
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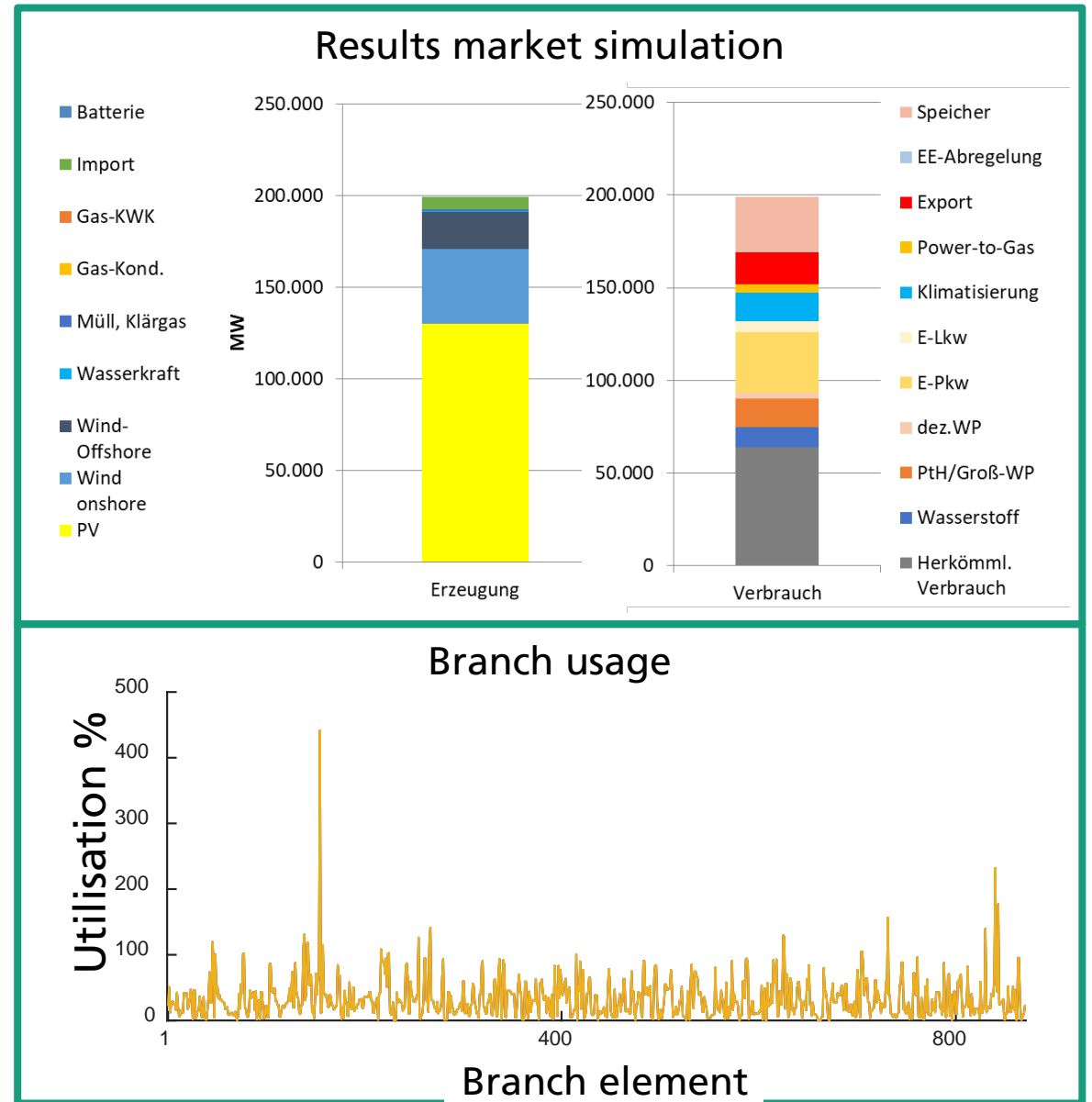
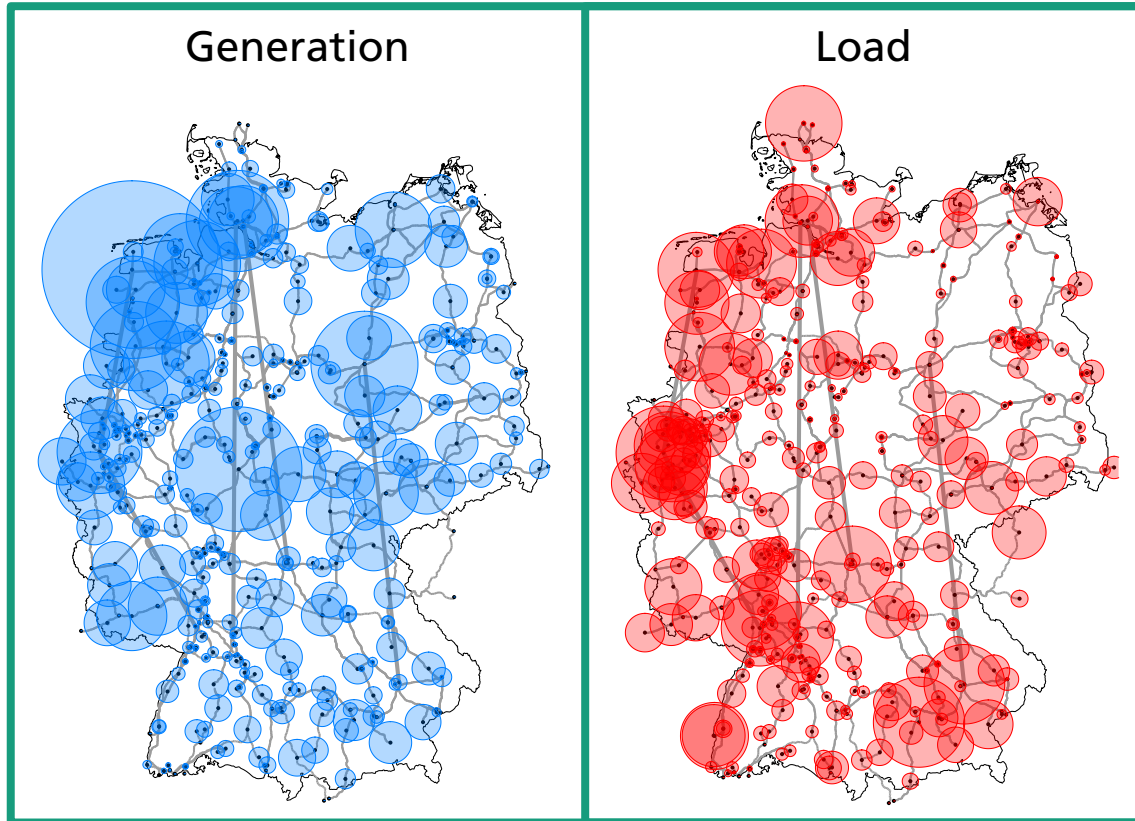
Simulation of electricity generation and demand by SCOPE

Electricity Generation and Demand in Germany 2050



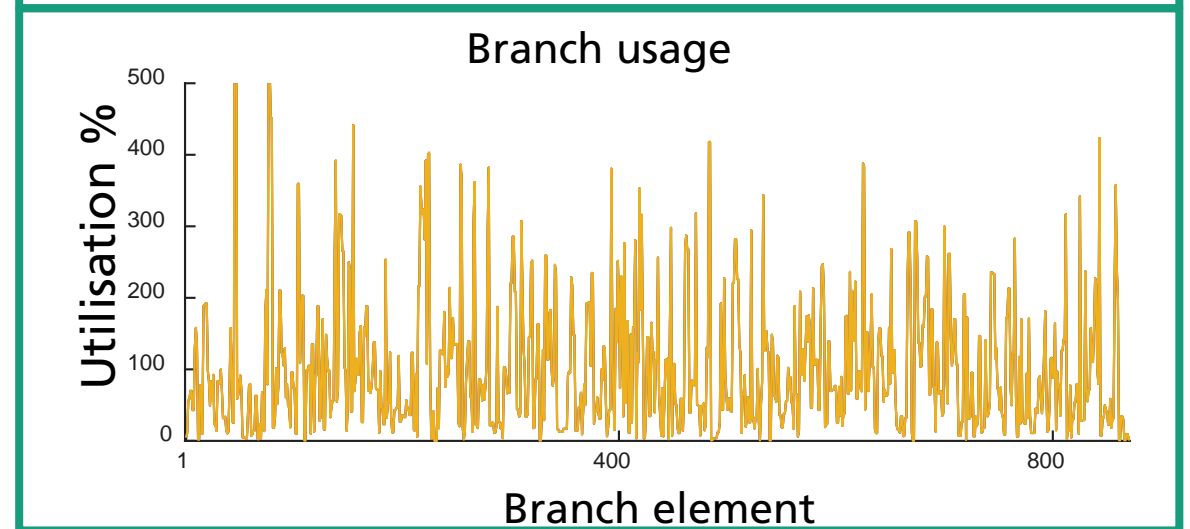
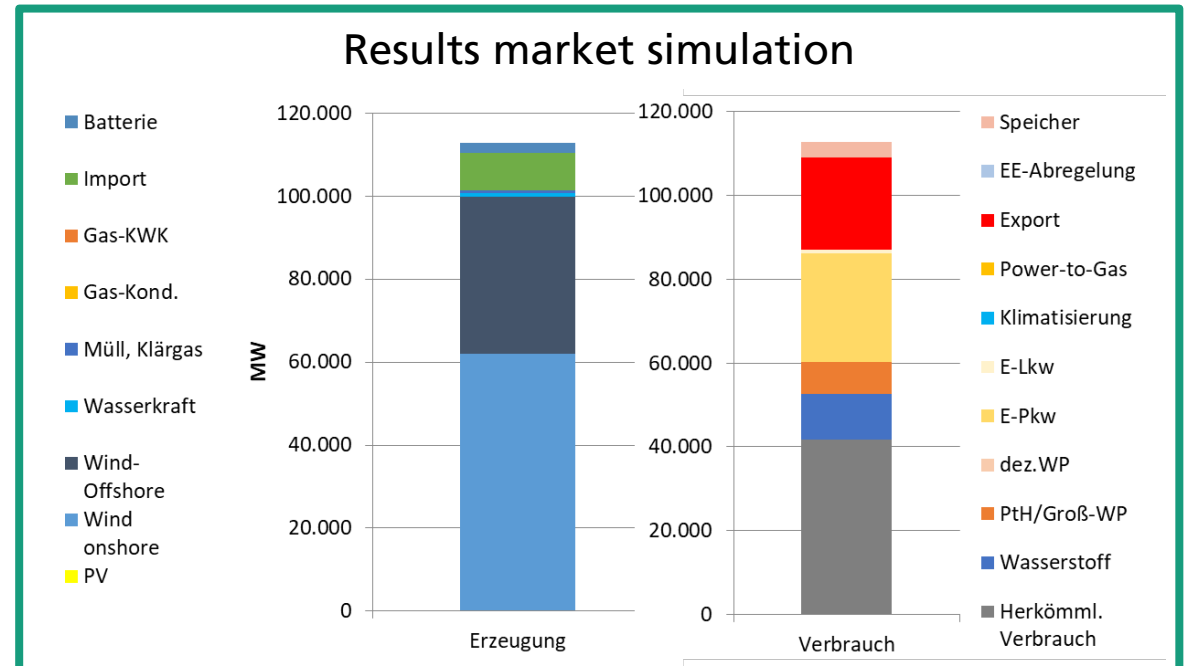
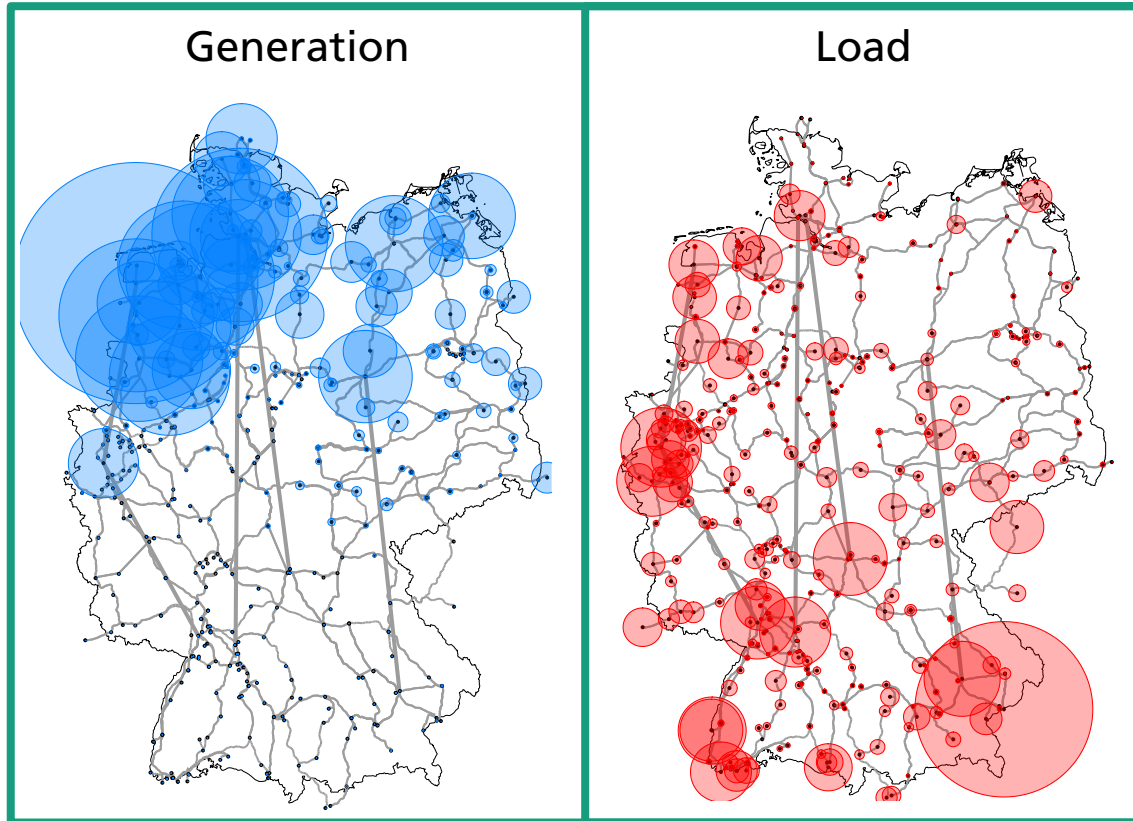
Power Flow Analysis

High Load Situation

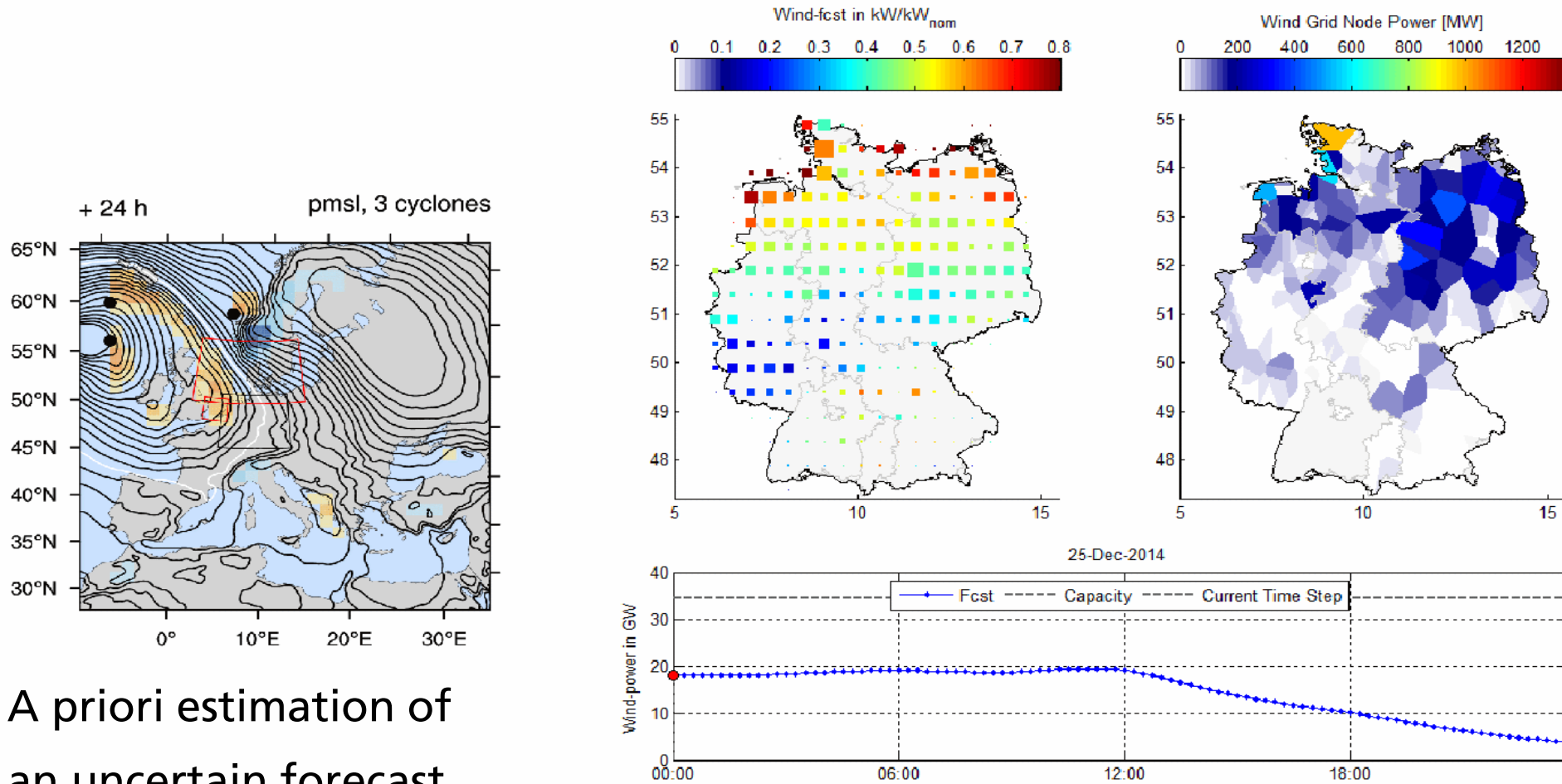


Power Flow Analysis

High Wind Situation

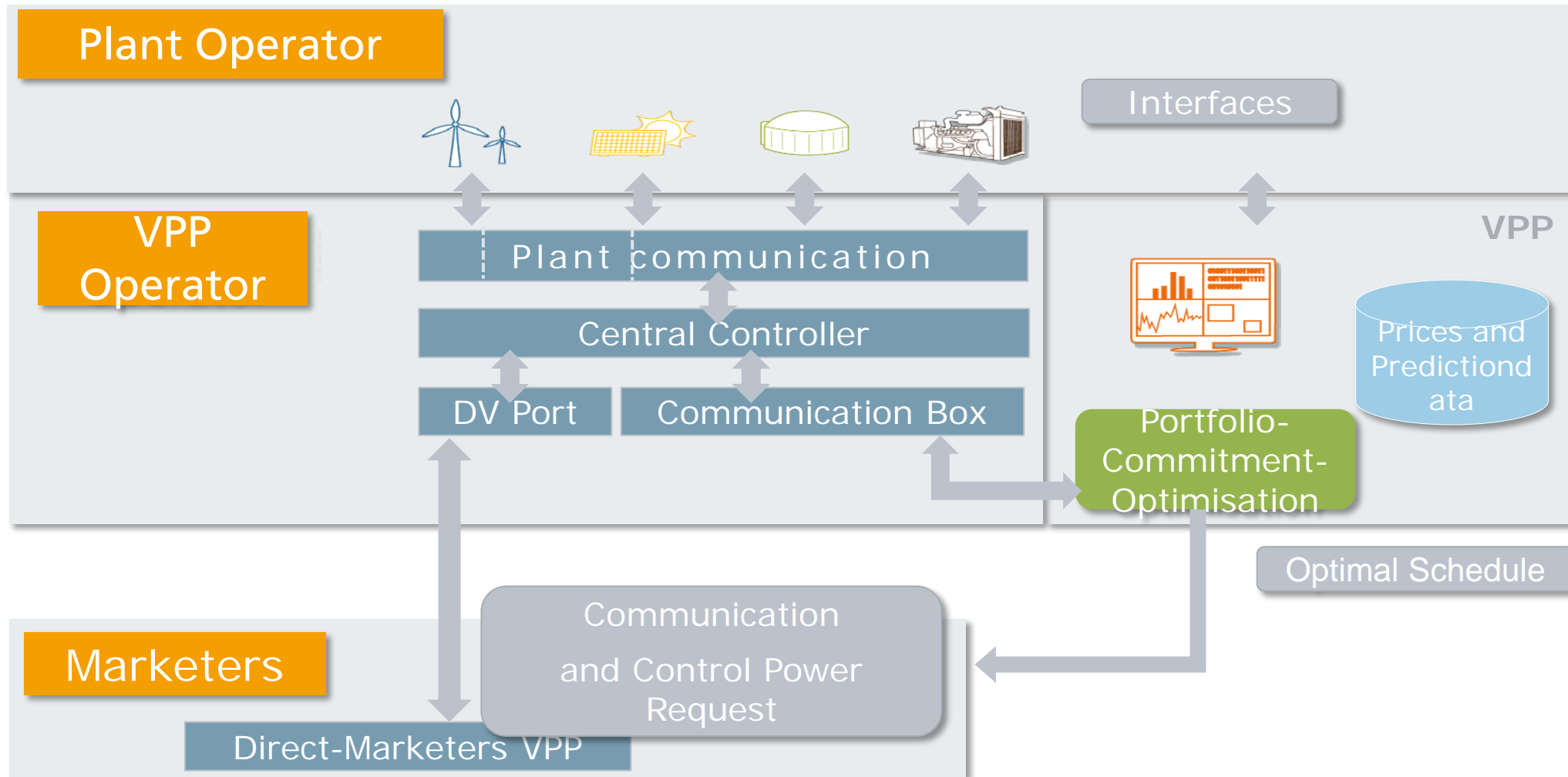


Forecast-Tools: Cyclone Tracking & Grid Node Wind Power Forecast

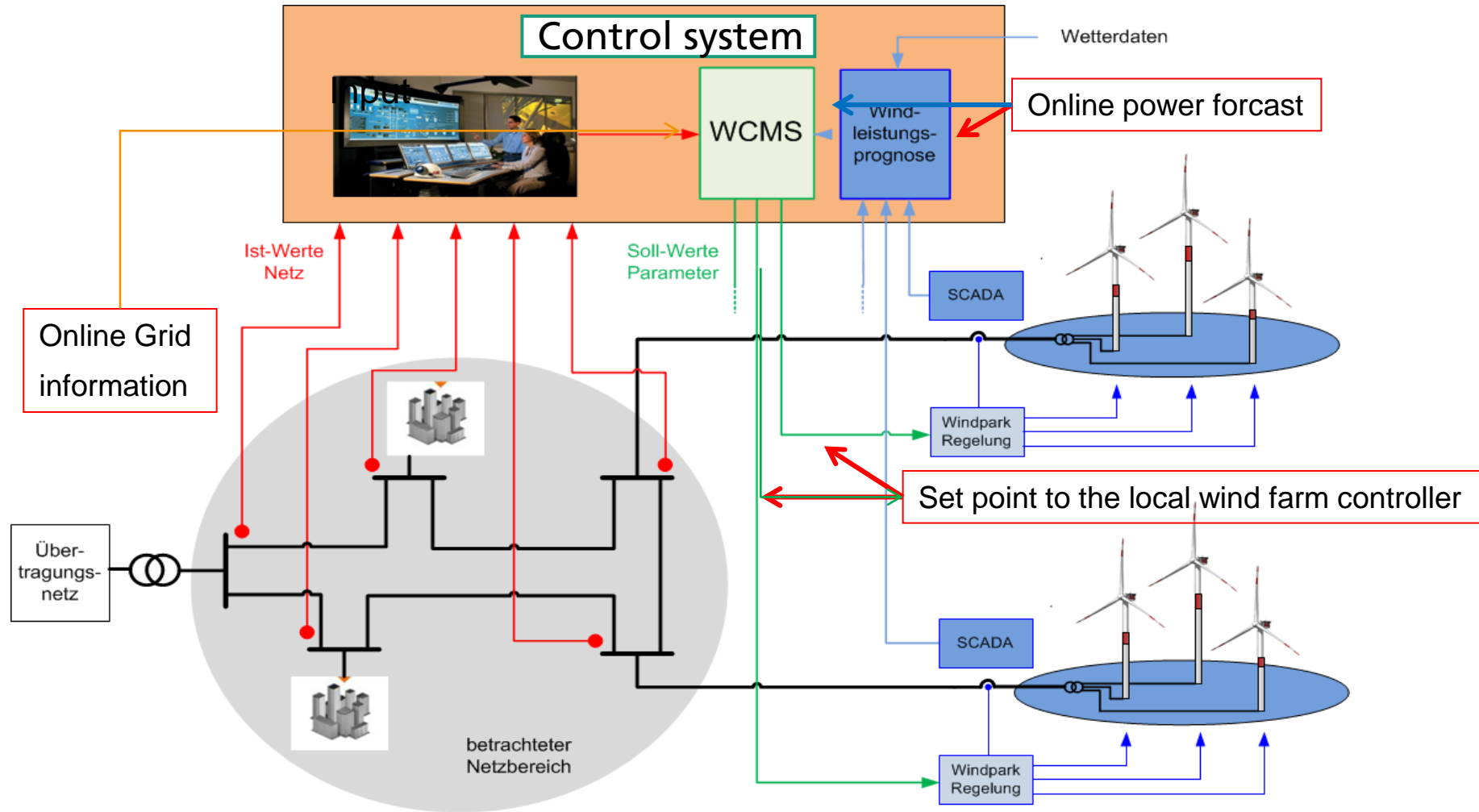


A priori estimation of an uncertain forecast

Virtual Power Plants: Manage renewable energy and power

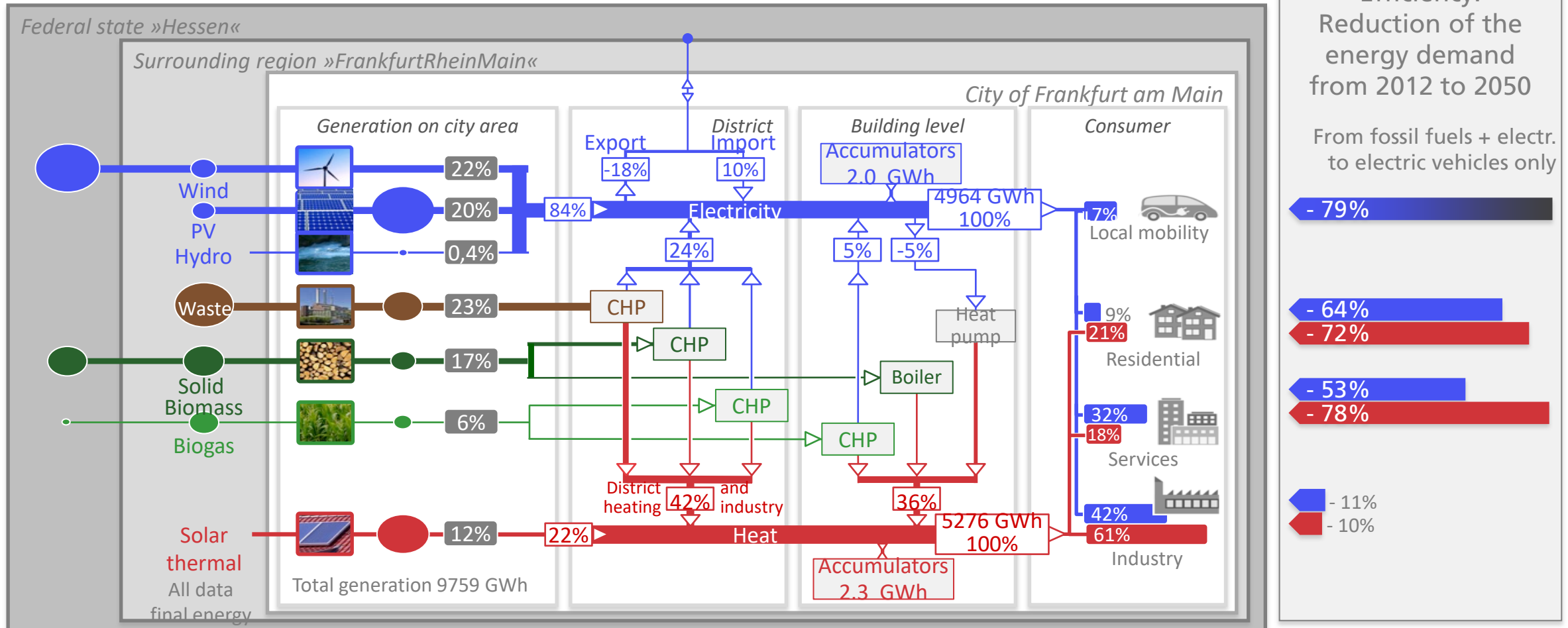


Virtual Power Plants: Voltage support by wind farms

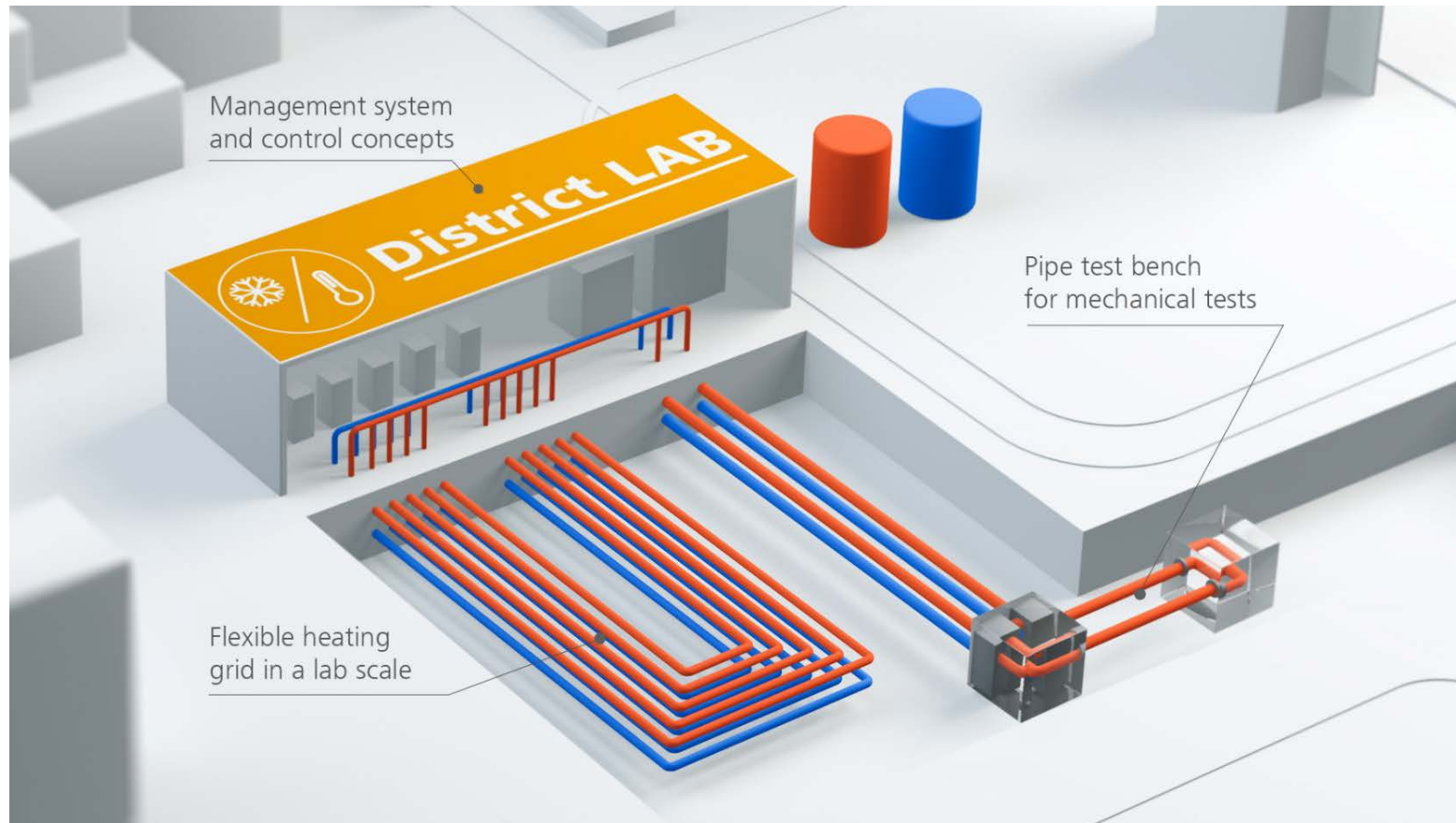


Flexibility/Smart Cities: sustainable urban energy concepts with RES

Structure of the Energy System Frankfurt/M 2050 - based on 95% renewable energy sources – generated regionally



Flexibility/Sector Coupling: approach on city quarter level



The transformation of the energy supply system requires coordinated interaction between the electricity, heating and transport sectors

The sector coupling increases the flexibility of the system and reduces the costs for fossil primary energy carriers

The coupling of electricity and heat requires the massive introduction of heat pumps

Local heating concepts and district solutions for the heat supply are required

Summary

- The climate protection goals require a comprehensive expansion of renewable energy up to 400 GW and more
- A reduction of greenhouse gas emissions by 95% to 100% is not possible without the extensive use of offshore wind
- Grid connection of offshore wind requires new and reliable transmission technologies
- Integration of offshore wind is also a challenge for onshore grids
- Smart demand, smart cities and sector coupling are key elements for system integration
- Fraunhofer develops tools and mechanisms and concepts to manage large amounts of on- and offshore wind



Thank you for your attention

Setting the scene

by Pernille Weiss

Patron of the webinar

Member of the European Parliament

Discussion

Moderated by Verena Fennemann

Head of Fraunhofer EU-Office Brussels



Pose your questions either directly to the speakers or write them in the chat – we will then ask the question for you!

THANK YOU FOR ATTENDING THIS FRAUNHOFER GREEN DEAL WEBINAR

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Fraunhofer Green Deal Series



**“Offshore Wind as a cornerstone of the European Green Deal –
The potential in upscaling production and utilization”**