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

Finance volume

Contract Research

2020

€2.8 billion

Major infrastructure capital expenditure and defense research

Almost 30% is contributed by the German federal and states Governments

€2.4 billion

More than 70% is derived from contracts with industry and from publicly financed research projects.
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
Wind Energy Technology Today
Europe as a Global Technology Leader

Vestas 236 / 15 MW

Europe ahead of the curve

© Vestas

© 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
Wind Research Scope of Fraunhofer
Supporting the Wind Energy Sector in all Aspects
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

1. Scaling up offshore wind
2. Industrialising floating offshore wind
3. Happy co-existence with the onshore environment and society
4. Repowering onshore wind
5. Wind is going 100% circular

... 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

Full-Load Hours by renewable Source

- Offshore Wind
- Onshore Wind
- Solar PV

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

© 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

Source: 4C Offshore - Planned
Offshore Wind Farm Wakes
Wind Speed Reduction due to Wind Farms
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
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 fatigue cycles representing the service life
Digital Twins for Rotor Blades
Enhancing Physical Tests with Virtual Simulations
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
New offshore transmission technology to decrease the cost of grid connection

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EuroBAR-Conzept: https://www.amprion.net/Netzjournal/Beitr%C3%A4ge-2020/Eurobar-Offshore-Vernetzung-ist-die-Zukunft.html
Simulation of electricity generation and demand by SCOPE

Electricity Generation and Demand in Germany 2050

Source: Fraunhofer IWES (2017): „Analyse eines europäischen -95%-Klimazielszenarios über mehrere Wetterjahre“
Power Flow Analysis
High Load Situation

Generation

Load
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

Efficiency: Reduction of the energy demand from 2012 to 2050

From fossil fuels + electr. to electric vehicles only

- 79%
- 64%
- 72%
- 53%
- 78%
- 11%
- 10%
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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