30-31 OCTOBER 2018 | SKAGEN BLADE TECHNOLOGY | HEDENSTED, DENMARK

# VIND ENERGY DENMARK

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# Skagen Blade Technology welcomes you to Wind Energy Denmark 2018

### Skagen Blade Technology.....Who?

We are a team of 70+ GWO blade technicians and project managers, who can support you in servicing your blades onshore and offshore.

Our technicians have technical experience from working in blade factories, and are familiar with most aspects of blade repairs, surface treatment, power curve upgrades and leading edge protection.

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## Welcome to WIND ENERGY DENMARK 2018

These years, wind energy is charging new territory and breaking new ground. Innovations and stateof-the-art technology developments have pushed wind energy to new heights and paved the way for a fossil free future that is already within our grasp.

The industry has accomplished a lot so far, but the work is far from done – to stay ahead in the fierce, global competition the industry must have a keen focus on both strengthening the competitiveness of wind energy through a reduction of LCoE and increasing the value of wind through broader utilization of the wind resource in other sectors, developing new storage concepts, and exploring and testing new, innovative Power-to-X concepts.

Being the very cradle of wind energy, Denmark has a long history of breaking new ground and trailblazing new innovations. For the next two days, we are gathered here in the industrial settings of Skagen Blade Technology to take the all-important discussions on where to move the industry next and how to fully harvest the potential of the close collaborations between industry and research world here in Denmark.

Let us make the most of it!



Jan Hylleberg CEO Danish Wind Industry Association



Peter Hjuler Jensen Consortium Manager Danish Research Consortium for Wind Energy

## Join our journey Fossil free living within one generation

VATTENFALL



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## The Conference

WIND ENERGY DENMARK merges technology, research and product development, focusing on the long-term development of wind energy and creating a strong network for the participants.

With more than 100 speakers covering 36 sessions with panel discussions, high-level presentations and workshops, you get new insights and in-depth analysis of the core themes that will shape the future of the wind industry.



High-level sessions



Next generation technologies



Industrialization & standardization



Grid systems, integration & infrastructure



**Operations & maintenance** 

#### **CONFERENCE WEBSITE**



windenergydenmark.dk

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Danish Wind Industry Association



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## Conference program

## TUESDAY 30 OCTOBER 2018

	Skagen Stage	Workshop 1	Workshop 2	Workshop 3	Science Zone			
08.30	Registration   Coffee   Exhibition							
09.30	P. 10 Opening session: How to stay ahead on technology through R&D							
10.15	P. 11 Megavind Annual Agenda	How to utilize How to utilize and industrialize big data	P. 13 Wind meteorology and climate: Are we ready for climate change?	P. 14 Aerodynamics, aeroelastic and hydro dynamics (I)				
11.20	Coffee break   Exhibition							
11.50	P. 15 The global drivers for wind energy	P. 16 The perspec- tives of additive manufacturing – now or never?	P. 17 Towers and founda- tions: Welding and surface treatment optimization	P. 18 Aerodynamics, aeroelastic and hydro dynamics (II)	Wind energy meteorology			
13.00	Lunch							
14.00	<b>P. 20</b> The major breakthrough for standardization is imminent	P. 23 Upcoming EUDP wind projects	P. 24 Wind turbine blade challenges	P. 25 Wind resources: Data and models – insight! (1)	Drones and vibrations			
15.15	Coffee break   Exhibition							
15.45	P. 27 Closing the price and technology gap between now and the zero-subsidy future	P. 28 New standardized test methods for hydraulic pitch cylinders	P. 29 New materials, better performance	P. 31 Wind resources: Data and models – insight! (II)	P. 32 Aerodynamics			
17.00	Drinks   Exhibition							
18.00	Networking dinner							

## Conference program

## WEDNESDAY 31 OCTOBER 2018

	Skagen Stage	Workshop 1	Workshop 2	Workshop 3	Science Zone			
08.30	Registration   Coffee   Exhibition							
09.30	P. 35 Denmark – are we really the global leader in wind energy?							
10.30	Coffee break   Exhibition							
11.00	P. 36 Electrification in a fossil free reality	How to lead your digital transformation	P. 38 Social acceptability and environment (I)	P. 39 Lifetime extension of existing turbines: What do you expect? What is the outcome?	P. 40 Electrical design, grids and control			
12.00	Lunch							
13.00	P. 41 Floating wind power – the winning concept?	<b>P. 42</b> The robots are coming – to help in many processes	P. 43 Social acceptability and environment (II)	P. 44 From 45 to 100 percent wind in the grid	<b>P. 45</b> Driving down cost using blockchain technology			
14.15	Coffee break   Exhibition							
14.45	<b>P. 46</b> Transition or tradition: Global energy trends and supply chain conse- quences	Wind farm layout optimization and control	P. 48 Integrated digital O&M – get inspired to be part of wind digitalization	P. 49 Future grid systems	Offshore wind energy			
16.00	Goodbye – see you again at WIND ENERGY DENMARK 2019 on 1 October!							



## Opening session: How to stay ahead on technology through R&D

#### Date: 30 OCTOBER 2018 Time: 09.30-10.15 Place: Skagen Stage

Wind power is big business for Denmark! The development we have witnessed over the past 30 years in wind energy with respect to scale, innovation, technology development, deployment and cost has been impressive. The speed with which the development is continuing demonstrates that the sector still has a lot of potential for further development.

The opening session gathers representatives from policy, industry and research in a dialogue on how Denmark can stay ahead on technology through R&D. Where can this trinity supplement each other to secure the best possible outcome for Denmark and for Danish industry on research, development, and demonstration of wind energy?

#### Panelists

- Anders Vedel, CTO, Vestas Wind Systems
- Jens Joel, Member of the Danish Parliament and Forum for Energy, Utilities & Climate, The Social Democratic Party
- Peter Hauge Madsen, Head of Department, DTU Wind Energy

#### Moderator

Jan Hylleberg, CEO, Danish Wind Industry Association



### Megavind Annual Agenda



#### Date: 30 OCTOBER 2018 Time: 10.15-11.20 Place: Skagen Stage

Megavind is Denmark's national partnership for wind energy, and acts as catalyst and initiator of a strengthened strategic agenda for research, development, and demonstration of wind energy technology.

One of the aims of the Megavind Annual Research & Innovation Agenda is to strengthen publicprivate cooperation between the state, private enterprises, and knowledge institutions to accelerate innovation processes within several areas of technology.

In order to do so, we need a continuous dialogue on how we together can secure communication, coordination, and collaboration between the public institutions that provide support to RD&D and the companies/knowledge institutions that are interested in developing RD&D projects.

#### Panelists

- Jens Joel, Member of the Danish Parliament and Forum for Energy, Utilities & Climate, The Social Democratic Party
- Niels Langvad, Scientific Officer, Innovation Fund Denmark
- Hanne Thomassen, Programme Manager, EUDP
- Christina Aabo, Director of R&D, Ørsted,
- Peter Hjuler Jensen, Deputy Head, DTU Wind Energy

#### Moderator

Jan Hylleberg, CEO, Danish Wind Industry Association



## How to utilize and industrialize big data

Date: 30 OCTOBER 2018 Time: 10.15-11.20 Place: Workshop 1

This workshop revolves around how to utilize and industrialize big data in the wind industry and looks at what are the barriers and opportunities. It is a workshop where you can share your insights and get inspired by other players in the industry.

"Data is the new raw material" – but should we box it at sell to the highest bidder or share in general? At ARTOGIS A/S they made a change away from the traditional commercial platforms and created a new platform based upon global Open Source technology.

Lars Legaard Christensen from ARTOGIS will provide insight into how the use of a Databackbone and Datarobots can be a cost-effective and easier way to integration, bringing together the right data resources in one Datawarehouse, preparing and enabling the future use of new technologies in BigData, BI, AI, machine learning etc.

Furthermore, we will dive into the opportunities that IoT-devices bring in the capture of data and measurements from remote geographical places and provide concrete examples from other areas of the utilities sector.

Jacob Tornfeldt from DHI will provide application examples of how to bring added value to observational and modelled metocean datasets, to machine learning based forecast models, how to optimize your O&M efficiency, and how to curate BIG data for specific applications.

#### Speakers

- Lars Legaard Christensen, Head of Sales, ARTOGIS
- Jacob Tornfeldt Sørensen, Group Research Board and Sales Manager, DHI

#### Moderator

Peter Aarø Rasmussen, Program Manager, Danish Wind Industry Association

# DANISH WIND

## Wind meteorology and climate: Are we ready for climate change?



Date: 30 OCTOBER 2018 Time: 10.15-11.20 Place: Workshop 2

Highlighting the latest developments in meteorological modelling for the assessment of wind conditions we ask whether we are properly addressing climate change in our approaches, if we are aware of impacts on the wind energy industry, and what we should do about it?

#### Presenters

- Martin Stendel, Climate Scientist, DMI Updated projections for temperature, precipitation and wind in Northern Europe until the end of the 21st century
- Andrea Hahmann, Senior Scientist, DTU Wind Energy
   Super ensembles for wind climate assessment
- Kim Bentzen, Meteorologist, Danish Commodities What is normal in a world of change? – use of the term "meteorological normal" in energy trading

**Moderator** Jake Badger, Head of Section, DTU Wind Energy



## Aerodynamics, aeroelastic and hydro dynamics (I)

#### Date: 30 OCTOBER 2018 Time: 10.15-11.20 Place: Workshop 3

This double-session highlights, both from the perspectives of the industry and the research community, the main achievements within wind turbine performance and response simulations obtained today.

It presents the status and discusses the challenges concerning the prediction on present large flexible turbines, and pinpoints areas where further validation would be beneficial. A further scope is to identify the need for new developments to reduce the risk when designing future large and possibly new concepts.

#### Presenters

- Jens Nørkær Sørensen, Professor, DTU Introductory note: A brief history of "wind turbine" aerodynamics
- Jesper Laursen, SGRE OF TE TD BL, Siemens Gamesa Renewable Energy Industrial perspective on wind turbine aerodynamics
- Niels N. Sørensen, Professor, DTU High performance computing in wind turbine aerodynamics
- Søren Hjort, Director, Volu Ventis Is wake swirl and wake expansion important for rotor design?

#### Moderators

Flemming Rasmussen, Head of Section, DTU Wind Energy Jens Nørkær Sørensen, Professor, DTU Wind Energy



## The global drivers for wind energy



#### Date: 30 OCTOBER 2018 Time: 11.50-13.00 Place: Skagen Stage

The session kicks off with a 15-20 minutes "TEDx" talk by GWEC Senior Policy Advisor, Steve Sawyer, on what he sees as the major global drivers in wind energy, focusing on the global climate change agenda.

Following his talk, we invite three guests to join the discussion and give their view and comments on the developments in the global climate agenda and how they influence the transition towards green energy systems.

#### Panelists

• Steve Sawyer, Senior Policy Advisor, GWEC

Steve Sawyer is working with intergovernmental organizations such as the UNFCCC, IPCC, IRENA, IEA, IFC and ADB to ensure that wind power takes its rightful place in the energy options for the future.

- Jarl Krausing, International Director, CONCITO Representing an independent think tank, Jarl Krausing will contribute with how CONCITO sees the developments in international climate agenda and the opportunities to finance the transformation to a low-carbon society.
- Morten Svendstorp, Senior consultant, Danish Ministry of Energy, Utilities and Climate Morten Svendstorp will contribute with his knowledge about the Danish view on the international climate negotiations, Clean Energy Ministerial etc.

#### Moderator

Jan Hylleberg, CEO, Danish Wind Industry Association



## The perspectives of additive manufacturing – now or never?

#### Date: 30 OCTOBER 2018 Time: 11.50-13.00 Place: Workshop 1

This session offers focus on and discussion around the unique problematics in the wind industry with extreme sizes, forces and weather exposure. You get examples on how AM (Additive Manufacturing) can be beneficial and implemented short term.

The speakers will dive into 3D printing, which is about to transform the very notion of manufacturing in a hugely creative, disruptive way and lead to profound changes in the way many products are designed, developed, produced, delivered, and supported. Are you and your business models ready to embrace it?

Furthermore, we look at the opportunities and challenges from the perspective of innovation and entrepreneurship. How the future lies at the intersect between what we want, what is technically feasible and what is scalable. Technological innovation has frequently been shown to systematically change market structure and value creation. Additive manufacturing is a disruptive technology.

#### Presenters

- Cheng Yang, Associate Professor, AAU, & Henrik G. Larsen, CEO, CFI 3D printing will change your business in the future
- Mads Kjøller Damkjær, CEO, AM-Hub Print the future – how innovation and entrepreneurship create new business opportunities

#### Moderators

Mads Kjøller Damkjær, CEO, AM-Hub Peter Aarø Rasmussen, Program Manager, Danish Wind Industry Association



## Towers and foundations: Welding and surface treatment optimization



Date: 30 OCTOBER 2018 Time: 11.50-13.00 Place: Workshop 2

The area of support structures is a dominant focus in the pursuit of LCoE reductions. It is also an area where the industry can find common ground to optimize processes and challenge existing standards and guidelines.

This session reveals some of the identified potentials and reveals two planned projects involving a broad group of companies.

#### Presenters

- Sune Daaskov Egelund, R&D Engineer, Siemens Gamesa Renewable Energy Industry standard on surface treatment of towers and promising potential in fusion bonded epoxy
- Andreas Lundtang Paulsen, Specialist, Corrosion, Metallurgy and Concrete, FORCE Technology Towers: Testing composition and anti-corrosion properties of protective coating systems
- Christian Højerslev, Head of Department, Siemens Gamesa Renewable Energy
   Offweld project on weld bead removal and steel surface characteristics

#### Moderator

Anja Pedersen, Senior Advisor, Danish Wind Industry Association



## Aerodynamics, aeroelastic and hydro dynamics (II)

Date: 30 OCTOBER 2018 Time: 11.50-13.00 Place: Workshop 3

This double-session highlights, both from the perspectives of the industry and the research community, the main achievements within wind turbine performance and response simulations obtained today.

It presents the status and discusses the challenges concerning the prediction on present large, flexible turbines, and pinpoints areas where further validation would be beneficial. A further scope is to identify the need for new developments to reduce the risk when designing future large and possibly new concepts.

#### Presenters

- Christian Bak, Senior Researcher, DTU Large scale experimental aerodynamics – status and perspectives
- Julio Xavier, Lead Engineer, Control & Operation, Innovation & Concepts, Vestas Wind Systems *Quantifying power gain from multi-rotor aerodynamic interaction*
- Allan Ensig-Karup, Associate Professor, DTU-IMCS Advances and challenges in hydrodynamic simulation methods

#### Moderators

Flemming Rasmussen, Head of Section, DTU Wind Energy Jens Nørkær Sørensen, Professor, DTU Wind Energy



## Wind energy meteorology



Date: 30 OCTOBER 2018 Time: 11.50-13.00 Place: Science Zone

This session presents student projects (MSc and PhD) within wind energy meteorology.

#### Presenters

- Dominique Philipp Held, PhD Student, Windar Photonics / DTU PhD project: Wake detection in the turbine inflow using nacelle lidars
- Erlingur 1. Jóhannsson, MSc Student, DTU MSc project: Quantifying the fidelity of numerically simulated wind resources
- Adit Nand Kishore, MSc Student, DTU Wind Energy
   MSc project: Investigating offshore wind farm wakes through mesoscale modeling
- Erik Haugen, MSc Student, DTU / Delft MSc project: Integrating lidar and LES for wake characterization in complex terrain

#### Moderator

Jacob Berg, Associate Professor, DTU Wind Energy



## The major breakthrough for standardization is imminent

#### Date: 30 OCTOBER 2018 Time: 14.00-15.15 Place: Skagen Stage

The industry needs to find common ground on where the next cost reductions are found and how to get there. Standardization is identified as a key area, but this calls for communication, coordination, and collaboration between all stakeholders in the industry - utilities, OEMs, suppliers, and research institutions. Vestas, Siemens Gamesa and MHI Vestas have agreed to push the industrial standar-dization in the wind industry forward together, selecting technical areas, components or systems and seeking to standardize them together with all parties willing to contribute – suppliers, OEMs, developers, academia, consultants etc. The target is to provide a standardization "hot list" used as a guideline for future RD&D (cost reduction) projects within both onshore and offshore. The cost reduction standardization areas will be presented in the two lists *Wind Turbine Generator List* and *Operation & Maintenance List*.

#### Presenters

- Torben Hvid Larsen, CTO, MHI Vestas Offshore Wind Presentation of the Operation & Maintenance List & Wind Turbine Generator List
- Per Hessellund Lauritsen, Research Manager, Siemens Gamesa Renewable Energy, & Peter Lindholst, Vice President Concept Development, Vestas Wind Systems Presentation of new standardization Co-op between Vestas, Siemens Gamesa & MHI Vestas

**Panelists** – What changes will this bring to the value chain?

- Torben Hvid Larsen, CTO, MHI Vestas Offshore Wind
- Per Hessellund Lauritsen, Research Manager, Siemens Gamesa Renewable Energy
- · Peter Lindholst, Vice President Concept Development, Vestas Wind Systems
- Morten Mørk, CEO, Nordmark
- Per Fenger, CEO, Liftra
- Thorsten Jalk, CEO, Ziton

#### Moderator

Anders Dalegaard, Head of Members & Events, Danish Wind Industry Association



# **Onwards** and upwards

The Vestas 4 MW platform has a powerful legacy. Introduced in 2010 and extended in 2017 with three new turbines variants, it takes onshore wind harvest to the next level. The new variants deliver higher energy output across low, medium, and high wind speeds:

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## **Danish Wind Export Association** ..... 5 fuldtræffere i 2019

Taiwan Offshore – WindEnergy Kaohsiung 2019, Kaohsiung – Taiwan 13.03 – 15.03

WindEurope Wind Summit – Bilbao 2019, Bilbao – Spanien 02.04-04.04

Windpower 2019, Houston Texas – USA 20.05 – 23.05

Husum Wind 2019, Husum – Tyskland 10.09-13.09

Offshore Wind Energy 2019, København – Danmark 26.11 – 28.11

Kontakt os og se alle aktiviteter på www.dwea.dk



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## Upcoming EUDP wind projects



Date: 30 OCTOBER 2018 Time: 14.00-15.15 Place: Workshop 1

In the session, the new EUDP 2018 funded projects are presented:

- Søren A. Nielsen, Technology Director, Universal Foundation Offshore wind suction bucket industrial scale – part 2 test installation (Involved companies: Siemens Gamesa, Universal Foundation, Fred. Olsen Windcarrier, Aalborg University and Offshoreenergy.dk)
- Kim Branner, Senior Scientist, DTU Wind Energy *RELIABLADE – Improved wind turbine blade reliability by using digital twins throughout the lifecycle*  (Involved companies: DTU Wind Energy, Vestas, LM Wind Power, IBM Danmark, FORCE Tech- nology, CEKO Sensors, Dantec Dynamics GmbH, Zebicon, Blade Test Centre, Olsen Wings, DTU Compute and Siemens Industry Software)
- Representative, Vestas Wind Systems or Maersk Supply Service Vertical Installer (Involved companies: Maersk Supply Service, Vestas and MHI Vestas)
- Xiaoli Guo Larsén, Senior Scientist, DTU Wind Energy Global atlas of design parameters (Involved companies: DTU Wind Energy and EMD International)
- Chrisian Bak, Senior Scientist, DTU Wind Energy AeroLoop – accelerated and enhanced quality in aerodynamic and aeroacoustic design loops (Involved companies: DTU Wind Energy, Vestas, Siemens Gamesa, Suzlon and LM Wind Power)

#### Moderator

Peter Hjuler Jensen, Deputy Head, DTU Wind Energy



## Wind turbine blade challenges

Date: 30 OCTOBER 2018 Time: 14.00-15.15 Place: Workshop 2

Wind turbine blades are key components in the continued pursuit of reduction in levelized cost of energy. Rotor diameter continues to increase in size as the wind turbines are developed for larger capacity. Blades for offshore wind turbines are heading towards 100+ meters in length. As the blade length increases, the design, manufacturing, testing, transport and maintenance becomes very challenging.

#### Presenters

- Erik Lund, Professor, Department of Materials and Production, Aalborg University Structural optimization of wind turbine blades
- John Korsgaard, Senior Director, LM Wind Power Challenges in blade manufacturing and testing
- Leo Jensen, Director Chief Specialist, Ørsted Challenges in offshore installation of blades
- **Steffen Laustsen**, Team Lead Blade Materials, Blade Structural Design, Siemens Gamesa Renewable Energy *Challenges in preventing leading edge erosion*

#### Moderator

John Korsgaard, Senior Director, LM Wind Power



## Wind resources: Data and models - insight! (I)



Date: 30 OCTOBER 2018 Time: 14.00-15.15 Place: Workshop 3

In this double-session, leading wind resource experts from the Danish wind industry will share recent insights they have obtained from their deep knowledge of and experience with data and models over many years.

There can be some unusual behavior seen in data, a model that did not behave as expected, a data set that did not confirm current ideas, or some other surprising fact or outcome. These sessions will include onshore and offshore cases, simple and very complex models.

#### Presenters

- Mark Zagar, Senior Specialist, Vestas Wind Systems Simulation and validation of non-standard wind conditions and their impact on turbine performance
- Kurt Hansen, Senior Researcher, DTU Wind Energy Model validation of coastal effects on an offshore wind farm
- Nikolai Gayle Nygaard, Lead Wind Energy Analyst, Ørsted Surprises in energy yield assessment

#### Moderator

Lars Landberg, Director; Group Leader, Renewables; Strategic Research and Innovation, DNV GL



### Drones and vibrations

Date: 30 OCTOBER 2018 Time: 14.00-15.15 Place: Science Zone

PhD and Master students present their exciting work on applications of drones and vibrations for wind turbine production, installation, maintenance, etc.

#### Presenters

- Dylan Cawthorne, PhD Student, SDU Making drones ethical by design
- ASM Shihavuddin, Assistant Professor, DTU Deep learning and advanced augmentation toolbox for wind turbine drone inspection analysis
- Kasper Ringgaard, PhD Student, Aarhus University
   Maximization of machining productivity taking dynamic deflections and stability into account
- Jonas Gad Kjeld, PhD Student, Vattenfall / SDU
   Determination of vibration damping of an offshore wind turbine supporting structure
- Ole Balling, Associate Professor, Aarhus University
   Shallow water damper design using Smoothed Particle Hydrodynamics

#### Moderator

Anders Brandt, Associate Professor, SDU



## Closing the price and technology gap between now and the zero-subsidy future



#### Date: 30 OCTOBER 2018 Time: 15.45-17.00 Place: Skagen Stage

The zero-subsidy future will be upon the industry in a few years, which means that the industry needs to push itself to the next level to maintain the competitiveness of wind power in the future energy system. But where is that next level and which path should the industry choose? For years, the value chain has seen an increased price pressure, and if the road to a subsidy free future doesn't show other paths, many companies will probably be forced to take the next highway exit out of the industry.

The industry has been focusing on LCoE reductions for years and probably will continue to do so, but the next level is also about increasing the value of wind in the energy system, where wind plays a more vital role in the future. The big question for this session is how we create the perfect combination of continued LCoE reductions and increased value of wind through technology and supply chain development, in order to bridge the price and technology gap between now and the zero-subsidy future.

#### Panelists

- Torben Hvid Larsen, CTO, MHI Vestas Offshore Wind
- Mads-Ole Astrupgaard, CEO, Fritz Schur Technical Group
- Sune Strøm, Senior Manager Regulatory Affairs, Ørsted
- Lars Kristensen, Senior Vice President, Bladt Industries
- John Korsgaard, Senior Director, Engineering Excellence, LM Wind Power
- Thomas Poulsen, PhD, Aalborg University

#### Moderator

Jan Hylleberg, CEO, Danish Wind Industry Association



## New standardized test methods for hydraulic pitch cylinders

#### Date: 30 OCTOBER 2018 Time: 15.45-17.00 Place: Workshop 1

Standardization is one of the headline activities in the wind sector at the moment. This session presents commitment beyond what is normally achievable; The hydraulic pitch supply chain has joined forces in a project that aims to:

- · Investigate how various identified root causes affect the wear and lifetime of cylinders
- Develop systematic methods for testing fluid power pitch cylinders based on realistic operating conditions

The project embraces all levels of the supply chain and competing companies on every level. Hear more about project content, ambitions and different company motivations for participating.

#### Presenters

- Henrik Clemmensen Pedersen, Professor, Aalborg University Investigation of lifetime limiting factors for pitch cylinders for wind turbines
- Per Hessellund Lauritsen, Research Manager, Siemens Gamesa Renewable Energy Gains on working with the competition and across the supply chain
- René Vølcker, Technical Manager, Trelleborg Sealing Solutions Supplier benefits also in other sectors

#### Moderator

Anja Pedersen, Senior Advisor, Danish Wind Industry Association



### New materials, better performance



#### Date: 30 OCTOBER 2018 Time: 15.45-17.00 Place: Workshop 2

In the fight for lowering the cost of energy from wind turbines, the dimensions have grown to impressive sizes with rotor blade diameters approaching 220 meters and tower heights of more than 150 meters. Those large dimensions and related large weights have increased the requirements for the mechanical performance of the used materials of composites and metals. Also, a request is coming from the industry on material systems facilitating increased automatization and speed of the production.

#### Presenters

- Ulrik Borg, Project Manager, Fiberline Composites Pultruded composites for wind energy
- Kim H. Klausen, Head of Global Wind Project, Covestro Using polyurethane in turbine blades
- Jakob I. Bech, Senior Development Engineer, DTU Wind Energy Performance of protective materials in leading edge erosion
- Jacob S. Nyvang, Design and Project Manager, Bladt Industries Offshore wind foundation fabrication and optimization

#### Moderators

Lars P. Mikkelsen, Head of Section, Composite Mechanics and Structures, DTU Wind Energy Bo Madsen, Head of Section, COM, DTU Wind Energy

Delivering on the promises of digitalization: Get actionable insights from harnessing the power of big data



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## Wind resources: Data and models - insight! (II)



#### Date: 30 OCTOBER 2018 Time: 15.45-17.00 Place: Workshop 3

In this double-session, leading wind resource experts from the Danish wind industry will share recent insights they have obtained from their deep knowledge of and experience with data and models over many years.

There can be some unusual behavior seen in data, a model that did not behave as expected, a data set that did not confirm current ideas, or some other surprising fact or outcome. These sessions will include onshore and offshore cases, simple and very complex models.

#### Presenters

- Hans E. Jørgensen, Head of Section, DTU Wind Energy 20 years of remote sensing: Lessons learned
- **Cecilie Langhals**, Specialist, COWI Pragmatic approach to overcoming unusual wind phenomena in relation to yield assessment
- Per Nielsen, Manager, EMD International When models need to be twisted
- Jakob Mann, Professor, DTU Wind: Some of the things we learned from Perdigao

#### Moderator

Lars Landberg, Director; Group Leader, Renewables; Strategic Research and Innovation, DNV GL



## Aerodynamics

Date: 30 OCTOBER 201 Time: 15.45-17.00 Place: Science Zone

This session gives state-of-art presentations within recent research topics in aerodynamics. The session covers aspects such as conceptual design and optimization of wind turbine blades, analyses of the influence of leading-edge roughness on laminar/turbulent transition, and investigations on the aerodynamics of wing tips.

#### Presenters

- Henning G. Jensen, Project Director, NerWind Services Identify and fix aerodynamic rotor imbalances
- Mads Aagaaard Madsen, PhD Student, DTU
   Multipoint high-fidelity CFD-based aerodynamic shape optimization of a 10 MW wind turbine
- Özge Sinem Özçakmak, PhD Student, DTU Laminar-turbulent transition prediction on wind turbine blade section by high frequency microphone measurements
- Christian Athit Bak Christensen, Student, DTU Reduction of induced drag on low aspect ratio wing by alteration of wingtips
- Jaime Yikon Liew, Research Assistant, DTU Active tip deflection control for wind turbines

#### Moderator

Jens Nørkær Sørensen, Professor, DTU Wind Energy





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## Denmark – are we really the global leader in wind energy?



#### Date: 31 OCTOBER 2018 Time: 09.30-10.30 Place: Skagen Stage

The session takes a good look in the mirror of the Danish position in the global wind industry. The aim of the session is to discuss the areas in which Denmark is doing well, but especially where the challenges lie, so that we as a global industry and the research community can have a common focus on where we must put in the effort to maintain global leadership in wind.

During the session, we will seek to establish a leadership barometer, which at various measurement points looks at Denmark's position compared to other countries in the world in areas such as research, test & demonstration, integration of wind in the energy system, electrification, market development, access to competencies, policy ambitions etc.

#### Speakers

- Andreas Nauen, CEO Offshore Wind, Siemens Gamesa Renewable Energy
- Masato Yamada, Vice President, CSt.O, MHI Vestas Offshore Wind
- Anders Bjarklev, President, DTU
- Jacob Nørgaard Andersen, Head of Engineering, Offshore Wind, Vattenfall
- Adrian Timbus, Technology & Solutions Manager, Smart Grid and Wind Power, ABB
- Anders Rebsdorf, Director Global Innovation Centre, Envision
- Frank Virenfeldt Nielsen, CEO, JSB

Moderator Jan Hyllberg, CEO, Danish Wind Industry Association



## Electrification in a fossil free reality

Date: 31 OCTOBER 2018 Time: 11.00-12.00 Place: Skagen Stage

This session will address the economic conditions for wind power in an EU and global perspective. The European Trading System (ETS) for  $CO_2$  will be discussed, alongside with new renewable targets and policy measures in the EU. Moreover, business opportunities and related risk will be addressed in a global perspective.

#### Presenters

- Peter Birch Sørensen, Professor, Copenhagen University The European Trading System for CO,
- Adrian Timbus, Technology & Solutions Manager, Smart Grid and Wind Power, ABB Power systems of the future how do we enable them?
- Lena Kitzing, Senior Researcher, DTU Why do we have cross-border auctions for renewable support in Denmark, and what can we expect next from the EU?

#### Moderator

Poul Erik Morthorst, Professor, DTU Management Engineering



## How to lead your digital transformation



#### Date: 31 OCTOBER 2018 Time: 11.00-12.00 Place: Workshop 1

This session evolves around the digital maturity assessment method "AAU 360", developed at Aalborg University as a guide and discussion tool to facilitate a transformation process in Danish companies with focus on digitalization.

Kelvin Koldsø Nygaard, Aalborg University, will introduce the idea of the method, digitalization levels, and some considerations in relation to different learnings from assessment done at both big and small Danish companies.

The presentation will be followed by a discussion on the approach, impact, and context based on the introduction.

#### Presenter

• Kelvin Koldsø Nygaard, Research Assistant, MSc, Aalborg University

#### Moderator

Kelvin Koldsø Nygaard, Research Assistant, MSc, Aalborg University Peter Aarø Rasmussen, Program Manager, Danish Wind Industry Association



## Social acceptability and environment (I)

Date: 31 OCTOBER 2018 Time: 11.00-12.00 Place: Workshop 2

Social acceptability and low environmental impact are key issues for a continued deployment of wind power on land. This session presents you with fresh updates on radar control of obstruction lights – how does it work and what do the neighbours say? In addition, new results from a large study of bird collisions at Østerild will be presented.

The last part of the double session is a participatory workshop that provides you with an insight into the new auction scheme on land in Denmark and discusses possible consequences for land-based wind farms.

#### Presenters

- Lars Nørregaard, Director Defense Solutions, Terma Radar control of obstruction lights. Experiences from Østerild – the technical solution
- Sara Bjørn Aaen, Assistant Professor and PhD, Aalborg University Radar control of obstruction lights. Experiences from Østerild – The neighbors' view
- Ole R. Therkildsen, Senior Advisor, Aarhus University, DCE Danish Centre for Environment and Energy

Investigations of bird collision risk at wind turbine test centre Østerild

#### Moderator

Niels-Erik Clausen, Associate Professor, DTU Wind Energy

# DANISH WIND

## Lifetime extension of existing turbines: What do you expect? What is the outcome?



#### Date: 31 OCTOBER 2018 Time: 11.00-12.00 Place: Workshop 3

A panel of specialists will shortly present experiences with performing LTE load calculations on wind farms, considerations before involving specialists in LTE calculations etc., experiences with LTE on onshore WTGs in Denmark, and status of an EUDP project regarding LTE.

The session will try to answer and comment on the following questions:

- What is the strategy for the wind farm operation in the future?
- Run to failure/Run as long as possible/Sell the park/Repowering?
- Why shall we make LTE calculations and inspections?
- What do we gain from the LTE project? What are the costs?
- Which are the critical components, and can they be repaired?
- Which spare parts should you have in stock? Are any upgrades available? Who is servicing the wind turbines?

The participants in the session can ask questions to the panel and give comments or share experiences on the topic.

#### Panelists

- Jan Behrendt Ibsø, Vice President, Wind Energy and Renewables, COWI
- Anand Natarajan, Senior Research Scientist and Senior Project Manager, DTU Wind Energy
- Michael D. Pedersen, CTO, European Energy
- Benny Thomsen, CEO, Spica Technology

#### Moderator

Strange Skriver, Technical Chief Consultant, Danmarks Vindmølleforening



## Electrical design, grids and control

Date: 31 OCTOBER 2018 Time: 11.00-12.00 Place: Science Zone

Offshore wind farms have additional challenges in the electrical design such as HVDC connections, more stable wakes, and related control issues. Onshore, the trend goes to hybrid systems including solar and storage. This session reports six findings from DTU and AAU MSc and PhD students.

#### Presenters

- Jonas Kazda, PhD Student, DTU Reducing turbine mechanical loads using model-optimized dispatch for power control of waked wind farms
- Daniel Vázquez Pombo, Research Assistant, Aalborg University Coordinated frequency and active power control of hybrid power plants: An approach to fast frequency response
- Monika Sandelic, Research Assistant, Aalborg University Battery system in stationary storage application for a wind dominated power system
- Saeed Sadeghi Lafmejani, PhD Fellow, Aalborg University Flexibility from PEM electrolysers

#### Moderator

Gregor Giebel, Senior Researcher, DTU Wind Energy



## Floating wind power - the winning concept?



Date: 31 OCTOBER 2018 Time: 13.00-14.15 Place: Skagen Stage

This session focuses on creating an overview of the main floating concepts, their maturation and planned way to demonstration and commercialization.

The audience will be involved in assessing the market potential for floating wind power and discussions with the panel about what is important to test and validate before scaling up. If scaling up is possible? Or will we see different solutions per project? Come and join the debate.

#### Speakers

- Henrik Stiesdal, CEO, Stiesdal A/S
- Astrid Skarheim Onsum, VP and Head of Floating Wind, Aker Solutions
- Jesper Møller, Head of Offshore Concepts & Solutions, Siemens Gamesa Renewable Energy
- Vegard Nedrevåg, Principal Engineer Marine Operations Offshore Wind, Equinor

#### Moderator

Christina Aabo, Director R&D Wind Power, Ørsted



## The robots are coming - to help in many processes

#### Date: 31 OCTOBER 2018 Time: 13.00-14.15 Place: Workshop 1

This workshop session offers presentations with robot cases and focus on and discussion around the unique problematics in the wind industry with extreme sizes and complex and heavy handling. You get examples of how robots and automation can be beneficial in new and smart ways and implemented short term.

Through case stories from assembly, quality control (vision, AI), and logistics (driving transport robots as well as drones) we look into the potential and examples from other industries around automation and robot applications, and investigate the opportunities for the wind industry.

We will take this inspiration and bring it into table discussions on questions such as:

- Does the wind industry benefit from and improve competitiveness via automation and robots?
- Can robots help in relation to scarce manpower situation?
- Shall the wind industry go for the low-hanging fruits or be more ambitious to push the development in a more strategic direction?

#### Speaker

• Søren Peter Johansen, Technical Manager, DIRA – Teknologisk Institut

#### Moderators

Søren Peter Johansen, Technical Manager, DIRA – Teknologisk Institut Peter Aarø Rasmussen, Program Manager, Danish Wind Industry Association



## Social acceptability and environment (II)



#### Date: 31 OCTOBER 2018 Time: 13.00-14.15 Place: Workshop 2

Social acceptability and low environmental impact are key issues for a continued deployment of wind power on land. This session presents you with fresh updates on radar control of obstruction lights – how does it work and what do the neighbours say? In addition, new results from a large study of bird collisions at Østerild will be presented.

The last part of the double session is a participatory workshop that provides you with an insight into the new auction scheme on land in Denmark and discusses possible consequences for land-based wind farms under the headline: Removing turbines and competitive bidding: Is onshore wind in Denmark threatened by the Danish Energy Agreement and tendering?

#### Speakers

- Lena Kitzing, Researcher, DTU Management Engineering Wind energy in multi-technology auctions in Denmark: Opportunities and challenges
   David Pudalah Researcher, DTU Wind Energy
- David Rudolph, Researcher, DTU Wind Energy Competitive tendering schemes: Potential implications and open questions

#### Moderator

Laura Tolnov Clausen, Researcher, DTU Wind Energy



## From 45 to 100 percent wind in the grid

Date: 31 OCTOBER 2018 Time: 13.00-14.15 Place: Workshop 3

This session focuses on how we handle 45% wind energy in the grid, and how we take the journey to 100%, looking at learnings for the systems new to wind and learning good aspects from abroad. After an introduction of the topic, two group work sessions assess:

- 1) How we got to 45% wind power penetration so safely?
- 2) How we can get to a fully renewable energy system? Which political or technical measures need to come into play to achieve this? And which learnings can be exported or imported from abroad?

#### Speaker & moderator

• Gregor Giebel, Senior Researcher, DTU Wind Energy Grid Integration, a discussion starter



## Driving down cost using blockchain technology



#### Date: 31 OCTOBER 2018 Time: 13.00-14.15 Place: Science Zone

The wind industry has a shared challenge in driving down cost to compete with other forms of renewable energy. KMD and IBM present their view on how blockchain technology may further simplify processes and drive down cost across the wind industry value chain.

Understand the difference between BITCOIN and BLOCKCHAIN and why blockchain technology is changing business models in many industries like finance, manufacturing, transportation, public etc., all over the world!

Hear how other industries like transportation (Maersk Line) and aviation (Lufthansa) are implementing blockchain technology – and how they benefit from reduced cost and increased digitalization. Have KMD and IBM's view on how blockchain may be used in the wind industry value chain – from R&D, project development, to operation & maintenance of the wind turbines.

#### Speakers

- Sreekanth Vemula, Industry Lead Energy & Utility, KMD
- Claus Krüger, Enterprise Architect and Blockchain Specialist, KMD
- Christian Lassen, Nordic Blockchain Lead, IBM Danmark

#### Moderator Sreekanth Vemula, Industry Lead Energy & Utility, KMD



## Transition or tradition: Global energy trends and supply chain consequences

#### Date: 31 OCTOBER 2018 Time: 14.45-16.00 Place: Skagen Stage

Electrification, decarbonization, and digitalization continues to transform energy industries globally, driving renewables growth at continuously lower cost.

With the proliferation of auctions globally, subsidy ramp-down and increasing merchant exposure, technology convergence, supply chain consolidation in the pursuit of economies of scale, and innovation in technologies as well as business models, the fundamentals for wind and its supply chain is moving from simple to complex, stand-alone to interconnected, and change is accelerating.

#### Panelists

- Jacob Nørgaard Andersen, Head of Engineering, Offshore Wind, Vattenfall
- Dorte Kamper, Vice President, Sales & Marketing, LM Wind Power
- Jan Rietdijk, SVP Global Sourcing, Vestas Wind Systems

Moderator Steen Broust Nielsen, VP, Head of Sales Power & Renewables, Wood Mackenzie



## Wind farm layout optimization and control



#### Date: 31 OCTOBER 2018 Time: 14.45-16.00 Place: Workshop 1

This session presents the newest tools and ideas on how to optimize a wind farm layout, including both loads and the energy production based on LCoE. We present studies of how to operate the wind farm in the optimized ways based on data driven techniques, once the wind farm has been established.

#### Presenters

- Dr. David R. Verelts, Researcher, DTU Wind Energy TOPFARM – A system engineering tool for optimizing the layout of wind farms
- Dr. Pieter Gebraad, Wind Farm Control and Optimization Engineer, Siemens Gamesa Renewable Energy

Control of wind farms

- Dr . Tuhfe Göçmen, Postdoc, DTU Wind Energy Data driven control of wind farms
- Lars Landberg, Director; Group Leader, Renewables; Strategic Research and Innovation, DNV GL Wind farm control

#### Moderator

Hans E. Jørgensen, Head of Section, DTU Wind Energy



## Integrated digital O&M - get inspired to take part in wind digitalization

#### Date: 31 OCTOBER 2018 Time: 14.45-16.00 Place: Workshop 2

As an industry we need to ask our self what are the components of the "digitalization value chain" for O&M in wind, and what are the key challenges and next steps in digitalizing the frontrunning, yet immature, wind industry?

For inspiration we are looking at examples of how the companies KK Wind Solutions and Shoreline are participating in the digitalization value chain.

After the presentations, we dive into a round table discussion revolving around two key questions:

- What is the most important role of your segment in wind digitalization?

- How do you best participate in the digitalization value chain, and what to do differently?

#### Presenters

- · Anders Hvashøj, CEO, ZEVIT
- Mogens Sode Nielsen, Sales Manager, EMEA, Service Sales, Global Service, KK Wind Solutions
- Torben Vendelbo Andresen, Sales Manager, Shoreline

Moderator Anders Hvashøj, CEO, ZEVIT



### Future grid systems



#### Date: 31 OCTOBER 2018 Time: 14.45-16.00 Place: Workshop 3

Wind turbines are constantly facing new demands to their operation – in the past, the most challenging was low voltage ride through operation, but now discussions are going on in terms of emulating inertia, short circuit current capability operating as grid-feeding or grid-forming, as well as the wind farms might see very different grid characteristics (e.g. low short circuit ratio) – and still be able to operate with high performance.

This session will discuss some of those issues and also in the context how more hybrid power plant will enable improved operation to the grid structure.

#### Presenters

- Müfit Altin, Researcher, DTU Wind Energy Estimation of synthetic inertial response from wind turbines and wind power plants
- Rasmus Rode Mosbæk, CEO & Founder, Hybrid Greentech Degradation and performance consideration when integrating energy storage in hybrid power plants
- Mads Blumensaat, Energy Integration Cluster Lead, Vestas Wind Systems Renewable energy hybrid systems: The market and technology rationale
- Ömer Göksu, Researcher, DTU Wind Energy Grid forming offshore wind turbines towards power system black start
- Kenneth Skaug, Senior Engineer Electrical Power System Technology, Vattenfall Grid connection characteristics for Vattenfall Vesterhav projects

#### Moderator

Gregor Giebel, Senior Researcher, DTU Wind Energy



### Offshore wind energy

Date: 31 OCTOBER 2018 Time: 14.45-16.00 Place: Science Zone

In this session, we will get scientific insight into logistics, grid integration and wake modelling and how the latest findings can help to keep reducing LCoE.

Offshore wind is evolving quickly, both in terms of reduced costs and in terms of innovative technology. However, there are still challenges and opportunities in areas like installation, grid integration, O&M, and resources assessment.

Innovative solutions in logistics supported by research can lead to further cost reductions during both installation and operations phases. Another key challenge for offshore wind is the aggregated effects of wakes and the uncertainties in energy production calculations or loads related to very large offshore wind farms and clusters of wind farms. Enhanced grid services and cable optimization can increase the value of offshore wind and reduce costs.

#### Presenters

- Harsha Vemuri, MSc Student, DTU Dynamic Wake Meandering Model (QDWS) for wake accumulation in fast wake models
- Guillermo Esteban, MSc Student, DTU Methodology to benchmark offshore wind farm installation campaigns through logistics modelling
- Thomas Poulsen, PhD, Aalborg University Logistics – cost savings and innovation
- Juan-Andrés Pérez-Rúa, PhD Student, DTU Optimum sizing of offshore wind power plants export cable
- Ali Bidadfar, PhD Student, DTU Frequency support provision from offshore HVDC grids

#### Moderator

Ignacio Marti, Program Manager Offshore Wind, DTU Wind Energy

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- Secure on-time delivery: Our global supply chain ensures economies of scale, and our customers count on our flexible and responsive manufacturing set-up
- Offer fast and reliable onsite assistance: Our network of highly skilled service teams is ready to assist with any technical issue



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