DTU Wind Energy in profile

2018

Technical University of Denmark

DTU

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DTU

Today, it is possible to test seven wind turbines in Østerild.

Wind Energy for the World

Since the foundation of DTU Wind Energy in 2012, our key focus has been to develop wind energy for the world. By developing wind energy for the world we mean the development of:

- the scientific and engineering foundation through research,
- bright young staff for the sector through our master, PhD and continued education programs,
- new technology and innovation and their validation and testing in close cooperation with the industry, and
- decision support to authorities, organisations and companies through consultancy and scientific advice.

The climate challenge is global, the transition towards sustainable energy is global, and the wind industry, including the one in Denmark, is global. Hence, a global outlook and international cooperation is not only necessary but deeply ingrained in our daily life as a mission-driven department. This is supported by international elements of our research, our international partners and clients, our students, our staff and of our research-based software, testing and consultancy services.

We strongly believe that wind energy is part of the global sustainable energy system of tomorrow. Simply, we need to make sustainable energy even more attractive and affordable. We also believe that the development and deployment of wind energy can contribute significantly to several of the UN's Sustainable Development Goals. The way to do so is by creating international partnerships.

At DTU Wind Energy, we are proud of our international activities and of being able to attract scientists, engineers and students and collaboration across the globe, and that we for many are the preferred university partner in wind energy.

We hope that you will see this publication as an invitation to collaborate on the development of wind energy in order to create a better and more sustainable world.

"Since the foundation of DTU Wind Energy in 2012, our key focus has been to develop wind energy for the world."

Peter Hauge Madsen
Head of Department

Research

DTU Wind Energy has a globally, unique position in wind energy research and collaborates with leading research institutions, universities, industry and governments from all over the world, providing added value to the industry and society. The research is organized in three strategic programmes to ensure effective planning, coordination and implementation of the research and innovation efforts.

Wind Turbine Technology

The focus is on how to further develop and mature the wind turbine technology by providing methods, models and tools to extent the rotor design complex, and cover new concepts, components and their design fundamentals, as well as materials and processing.

We develop High Fidelity turbine models to improve design validation and risk assessment of existing and new turbine concepts.

By tailoring the development of new rotors to the site specific conditions like turbulence and wind speeds we aim to increase the capacity factor.

We investigate how the integration of rotor design, control, support structures, drive train models and electrical system can enable the optimization of Wind turbine design.

Offshore Wind Energy

The aim is to maximize the value of offshore wind energy by developing research-based solutions to the challenges specific to the off shore sector. This includes reducing risk in the design and installation phases, optimizing O&M and

New Research Grants from EUDP and Innovation Fund Denmark

IFD
- DeCoWind - Development of low-noise and cost-effective wind farm control technology
- FloatSTEP
- DURALEDGE - Durable leading edges for high tip speed wind turbine blades

EUDP
- AeroLoop - Accelerate and increase quality in aerodynamic and aeroacoustic design loops
- RELIABLADE - Improving Blade Reliability through Application of Digital Twins over Entire Life Cycle
- GASP - Global Atlas for Siting Parameters

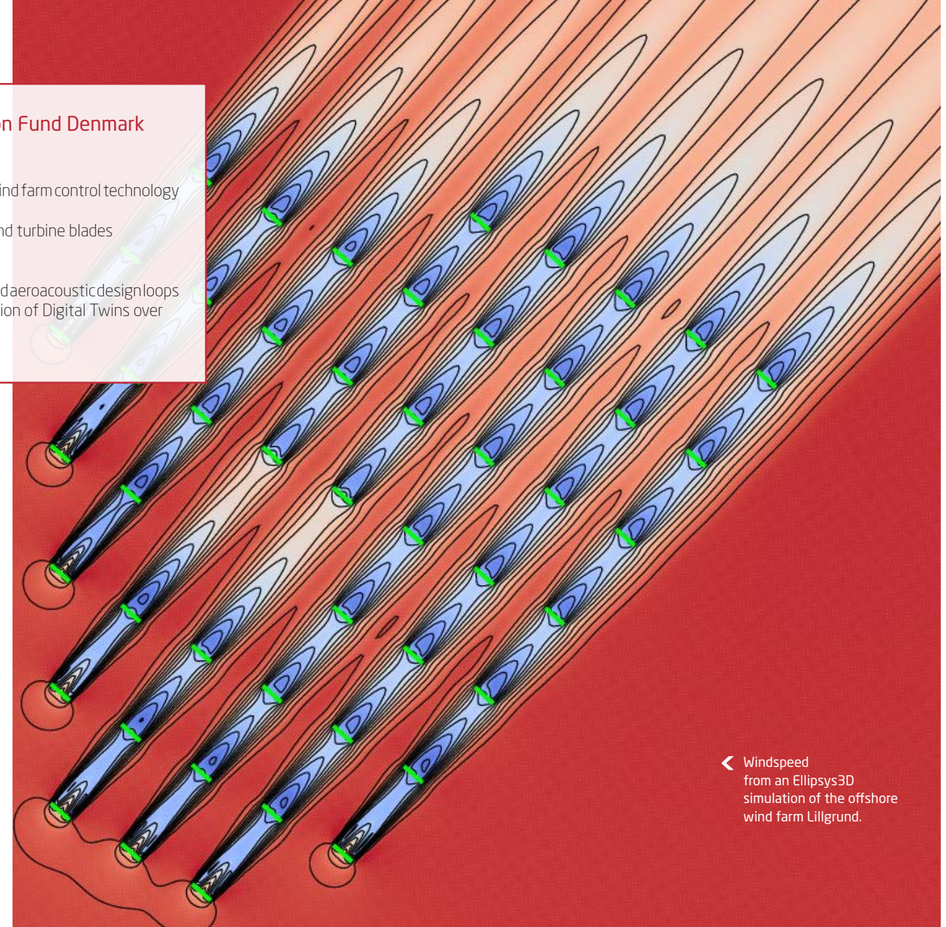
Wind farm layout as well as developing new offshore grids, transmission and distribution concepts.

With advanced metocean measurements and models that account for wind, waves, currents, loads and environmental exposure, we aim to optimize wind farm layout including electrical infrastructure.

We aim to maximize the value of offshore wind energy by developing advanced controllers for wind farms and offshore grids, as well as new offshore transmission and distribution concepts.

We develop life assessment tools able to estimate remaining life and to optimize O&M, based on statistical and damage detection/propagation methods.

The aim is to develop advanced design tools based on integration of the wind turbine and floating foundation.



Windspeed from an Ellipsys3D simulation of the offshore wind farm Lillgrund.

Siting and Integration

This aim is to develop knowledge and tools for a more cost effective siting and integration of single wind turbines and wind farms, including the electrical design and control aspects of wind turbine technology as well as planning and public perception.
With a better understanding of the atmosphere through the study of meteorology and turbulence we enable new planning tools and new design basis for wind turbines/farms.

The goal is to establish a validated system engineering framework for an optimal design and siting of wind farms, including turbine characteristics, control, load reduction and power assessment.

We are investigating how new sensoring techniques, real time data analysis and machine learning can help optimize performance of windfarms.

By developing instruments and new sensoring techniques, we aim to reduce the cost of Siting and Integration of Wind energy.

Duraledge

Duraledge is a new project funded by Innovation Fund Denmark. The aim is to extend the lifespan of wind turbine blades by the use of new coating systems.

Education

www.vindenergi.dtu.dk/english/education

DTU Wind Energy provides education and training in most critical wind energy disciplines such as, aerodynamics, atmospheric physics and materials, grid integration and offshore wind energy. The department offers courses in various wind energy related topics and hosts two master programs in wind energy.

Graduate degrees (MSc)

DTU is the only university in the world to offer a full two-year graduate programme in wind energy. The students acquire a thorough knowledge of technologies related to wind power production that qualifies them to analyse, design, develop and operate future wind energy systems.

PhD

An important part of DTU Wind Energy is our PhD programme. PhD students carry out an important part of the department's research. We also have industrial PhDs, which means that they are partly funded by companies and spend part of their time there.

As of September 1st 2018, there are 39 PhD Students enrolled at DTU Wind Energy. Twelve of them are expected to finish their PhD in 2018

Advisory Board

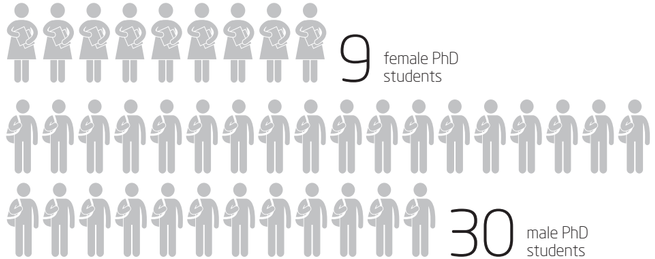
An advisory board for education has been established with participants from the industry and former students, creating a forum for discussion and initiatives with the purpose of ensuring the readiness of the students for the labour market. In general, the students are encouraged to do their MSc project in collaboration with an industrial partner.

Wind Energy Master

In 2017, DTU Wind Energy launched a new Online Master, that covers all essential aspects of wind energy engineering based on the research activities taking place at DTU Wind Energy. The Wind Energy Master programme is a web-based education with a broad academic profile. The programme covers all essential aspects of wind energy engineering based on the research activities taking place at DTU Wind Energy. (http://www.wem.dtu.dk/)

MOOC

MOOC is a Massive Open Online Course about wind energy is available at no cost through Coursera.org. Through online video lectures and calculation exercises, participants can learn the basics of wind energy engineering and consider a future career in this field. Since the beginning in February 2016, almost 37.000 people have participated in the course



European Wind Energy Education

The Erasmus Mundus European Wind Energy Master (EWEM) is a two year programme where the students can specialise in the following tracks: Wind Physics, Rotor Design, Electric Power Systems, and Offshore Engineering. The programme involves four universities: Delft University of Technology, Technical University of Denmark, Norwegian University of Science and Technology and Carl von Ossietzky Universität Oldenburg.

"My experience of doing a PhD at DTU Wind Energy is that you get a lot flexibility and freedom for your work. Even though my PhD project have some very specific objectives, the steps to attain those objectives are not specified. It's quite flexible and I can choose how I want to proceed and what I want to do."

PhD Moumita Sarkar

"Coming to DTU Wind Energy you're close to the industry. You know that if you produce something valuable to the industry, it will be put to the test right away and be used. I think that is really motivating."

PhD Mads Holst Aagaard Madsen

Innovation at DTU Wind Energy

DTU Wind Energy ensures that the knowledge resulting from its research is applied in the real world to create jobs, growth and support the development wind energy for the world.

Industry standard software

DTU Wind Energy has developed several software tools that have become industry standard software within the areas of wind energy resource assessment, wind power integration, wind farm layout, turbine design and advanced models for wind flow in terrain as well as around the turbine blades.

Innovative solutions for mega turbines

DTU Wind Energy has developed a number of innovations that have changed the possibilities for wind energy technology. Together with Danish Company, LM Wind Power, DTU Wind Energy developed a hybrid composite material that enable LM Wind Power to construct the world's longest wind turbine blade. At 88,6 meter, each blade is longer than the wingspan of a Boing 747.

Projects (public and commercial)

From the design of new wind turbine blades to the optimization of towers and substructures or the layout of wind farms, DTU is working with industry to make wind power cheaper and more reliable.

DTU Wind Energy has performed advanced modelling on the majority of floating wind turbine concepts developed over the last 10 years, including the current Equinor Hywind project in Scotland which deploys 5 Siemens-Gamesa Turbines on floating foundations.

DTU has developed the advanced software that allow the use of 3 laser scanners to make 3D images of wind fields behind wind turbines at up to 6 kilometers distance and systems that can be used in wind tunnels for precise wind measurements.

DTU Wind Energy currently supports the testing of the unique multirotor concept wind turbine. The Vestas multirotor is located at the DTU Risø Campus where it has undergone rigorous testing by DTU and Vestas.

Scientific advice at DTU Wind Energy

DTU Wind Energy provides research-based fact-finding, consultancy and advisory services to Danish and international authorities on technical requirements and strategies for planning in the wind energy sector. Through our activities around the world, DTU Wind Energy is supporting the promotion of wind power and building long lasting institutional partnerships.

International scientific advice

DTU Wind Energy has a long history of supporting the development of wind energy globally. Since the early 1980's the wind energy department located at DTU Risø Campus has helped setup wind energy test stations, performed wind resource assessments that has led to national promotion of wind power as in countries such as South Africa and Mexico. Today, part of these activities are done through the DTU Renewable Energy Service initiative that supports the international efforts in establishing integrated energy systems and the utilization of variable renewable energy sources. (www.repli.dtu.dk)

DTU Wind Energy actively supports the UN Sustainable Development Goals on affordable and clean energy.

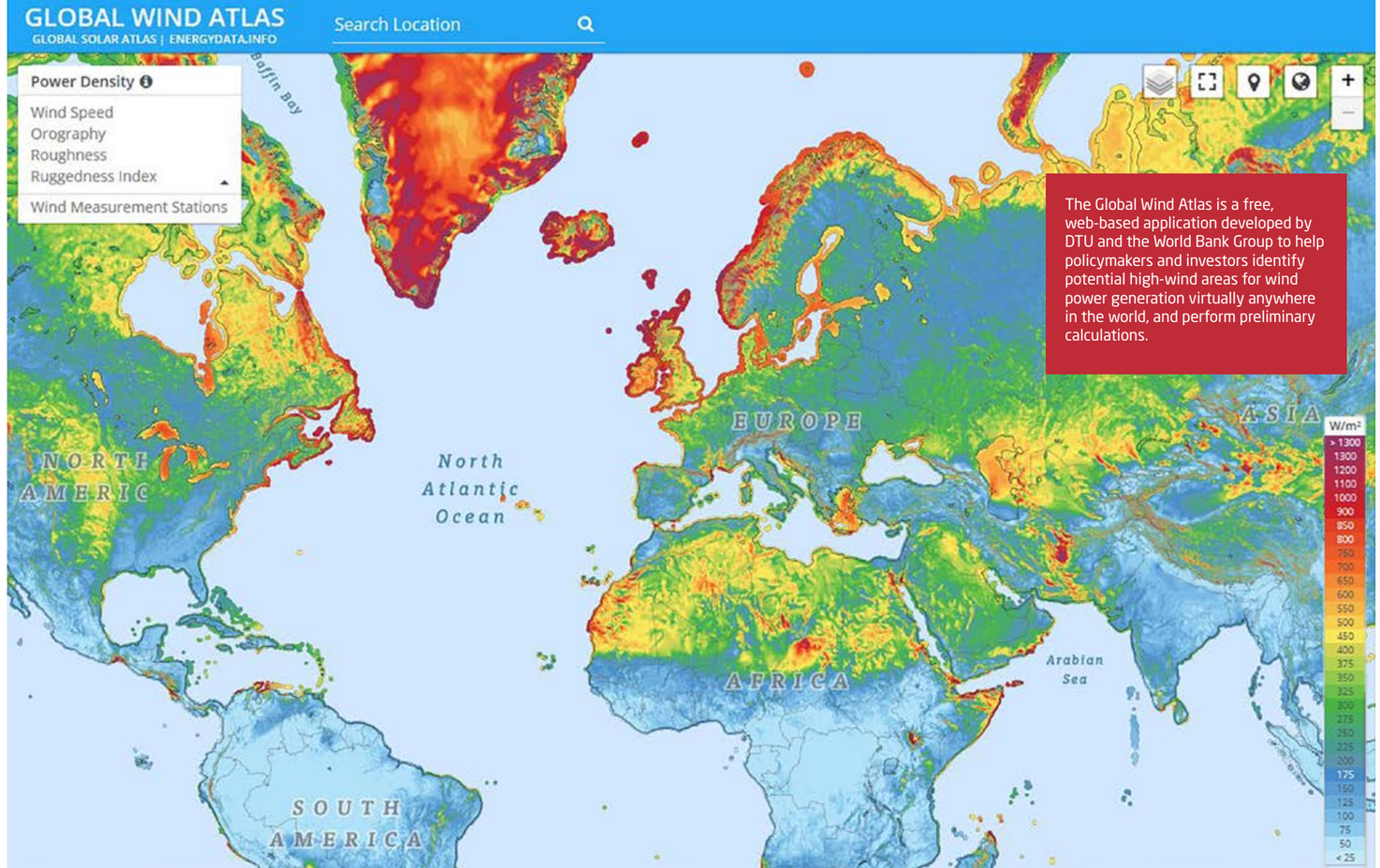
Capacity building - education

As an international front runner in wind energy research and education, DTU Wind Energy is continuously offering courses and workshops around the world to support capacity building as new countries enters into wind energy development at national scale. Courses combine background courses in the use of software such as WAsP and tailored courses addressing country specific needs.

Partnerships

A particular focus for DTU Wind Energy's international scientific advice is the collaboration with international organisations such as the World Bank. DTU Wind Energy has developed the Global Wind Atlas, subsequent projects with the World Bank and international partners have supported further advancements.

The Kenya MiniWind project investigates the potential for integrating small wind turbines in solar powered minigrids in Kenya. Together with the NGO Vedvarende Energi, Vestas and local partner Kenya Climate and Innovation Centre, the project is looking at regulatory, social and technical issues that shape the market for wind in hybrid mini-grid systems. The project is funded by Danida Market Development Partnerships programme.



The Global Wind Atlas is a free, web-based application developed by DTU and the World Bank Group to help policymakers and investors identify potential high-wind areas for wind power generation virtually anywhere in the world, and perform preliminary calculations.

Test Stations and Research Facilities

DTU Wind Energy is responsible for the operation of two of the best test sites for very large turbines and home to a range of state-of-the art test facilities for commercial validation and research development

Material Testing

At DTU Wind Energy, we work within all fields of wind energy. For instance, we have well-equipped laboratories for manufacturing as well as accredited equipment for mechanical testing of composite materials for wind turbine blades. Our work is focused on control and monitoring of the vacuum infusion process and development of methods for static and fatigue testing, together with damage detection.

Large Scale Facility

Large Scale Facility provide research projects and companies with possibilities to perform tests at very large scale. In addition to the testing facilities, DTU Wind Energy offer cooperation with a dedicated team of leading scientists and techniques that can deliver state of the art analysis.

The facility consists of a 1560 square metre test hall with three test stands capable of testing 45 m, 25 m and 15 m blades or other slender structures.

Large Scale Facility at DTU Risø Campus was inaugurated November 2017

WATCH VIDEOS

- Østerild test centre **dtu.dk/profile4**
- Poul la Cour Wind Tunnel **dtu.dk/profile5**

Poul La Cour Wind Tunnel

The wind tunnel is among the biggest university owned tunnels in the world, and the combination of test possibilities makes the wind tunnel one of a kind, not just nationally but globally. This is due to the size of the wind tunnel and high flow speed as well as the possibility to combine measurements of aerodynamics and noise.

Høvsøre

Today, five wind turbines are being tested at Høvsøre. The wind conditions at Høvsøre allow an almost uninterrupted wind speed coming from the North Sea and it reaches the wind turbines at a very high speed corresponding to the turbines erected offshore.

Østerild

There are seven test sites and the tallest turbine reaches a height of 222 metres above ground level. In 2017, The Danish government decided to expand the test centre to nine test stands and allow for the erection of test turbines of up to 333 metres. At the visitor centre in Østerild, guests can learn more about wind energy and the wind turbines at the National Test Centre for Large Wind Turbines.

The research wind turbine V52

The wind turbine is used for the researchers' experiments at DTU. Especially for tests of meteorological equipment, structural and electric measurements and verifications of models of calculations. The 850 kW wind turbine arrived at DTU Risø Campus in 2015.

Strategic Partnerships

Networks and alliances

International alliances and strategic partnerships are essential to excel in research, education, scientific advice, and innovation; promoting quality, impact and synergy.

The department coordinates the European Energy Research Alliance Joint Programme on Wind Energy (EERA JP Wind). The alliance is a recognised key stakeholder in implementing strategic, public research in the framework of the EU Strategic Energy Technology Plan (SET-Plan).

DTU Wind Energy sits on the steering committee of the European Technology and Innovation Platform for Wind Energy (ETIPWIND), the European Academy for Wind Energy (EAWE) and WindEurope and currently chairs the IEA Technology Collaboration Programme for Wind Energy (IEA TCP Wind).

DTU Wind Energy benchmarks itself globally

The department is active in a variety of international projects, alliances, standardization committees and policy initiatives; especially at European level, where the department plays a proactive role towards academic, industrial and policy stakeholders.

European Collaboration

DTU Wind Energy is a key contributor to the European Research Area in the field of wind energy. The department strives to develop strategies and common positions with its European partners to the European Commission to help define European research priorities.

The department has traditionally coordinated some of the biggest EU projects in wind energy. That includes projects such as the INNWIND project, the New European Wind Atlas (NEWA) and The Integrated Research Programme for Wind Energy (IRPWIND). These projects has provided a significant contribution to the overall alignment and coordination of wind energy research in Europe.

International Energy Agency

ETIP Wind
EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON WIND ENERGY

DANISH WIND INDUSTRY ASSOCIATION

DFFV

EERA
European Energy Research Alliance
JP WIND

Wind EUROPE

eawe
european academy of wind energy

Highlights

Master student wins the DANSIS Graduate Award

On October 4, 2017, Marcin Piotr Serdeczny, former Master student at DTU Wind Energy, received the DANSIS Graduate Award.

His thesis was compared to four other strong nominated projects within the field of applied industrial fluid dynamics. The project, suggested by Allan Gersborg from LM Wind Power, included experimental investigation of the distributed pressure development in a composite stack during a vacuum infusion process.

Furthermore, the experiment was modelled numerically including the non-linear evolution of the process, although characterized as a laminar low Reynolds number type of flow.

Since his Master defense, Marcin Serdeczny has started his PhD study involving thermofluid mechanics of 3D printing processes at DTU Mechanical Engineering.

PhD at DTU Wind Energy wins prestigious award

Jayachandra (JC) Sakamuri, former PhD student at DTU Wind Energy won the prestigious EAWE Excellent Young Wind Doctor Award 2017 for his PhD thesis on 'Coordinated Control of Wind Power Plants in Offshore HVDC Grids'.

JC himself was proud of the award. In an e-mail sent to his supervisors Nicolaos Cutululis, Poul Ejnar Sørensen and Anca Hansen he writes:

"Thanks a lot for your support. Special thanks to Nikos for believing in me and nominating me for this award. I am happy that EAWE and Professor Gerard have also acknowledged the contribution for Guidance for Graduates".

JC is not the first PhD at DTU Wind Energy to receive the award. In 2015, Emmanuel Simon Pierre Branlard received the award and two years before, in 2013, Leonardo Bergami received the award as well.

Cable-stayed tower: DTU Wind Energy is testing Vestas' new technology concept for cable-stayed towers at Østerild Test Centre

In regions with low wind, increasing the hub heights of wind turbines can be beneficial. For tubular steel towers this may also increase the amount of steel used for production as well as the cost of transportation due to the large diameters of the bottom tower sections exceeding the diameters allowed on the road.

Consequently, Vestas is testing slim towers using three cable stays for reinforcement at Østerild Test Centre. Here, DTU Wind Energy is carrying out measurements of e.g. loads and vibrations for Vestas. The hub height is 137.5 meters, and the rotor diameter is 126 meters. The three cables are made of fibers of high-tension steel and are attached halfway up the tower.

DTU Wind Energy provides consultancy services for wind measurements for new bridges in Norway

Large new bridges across the fjords are on their way in Norway. Before building the bridges, it is important to know the strength and the structure of the wind where the bridges are to be situated. DTU Wind Energy is a consultant on the wind measurements at the large constructions and the Norwegians have bought the software "DTU Long Range Wind Scanner" from DTU Wind Energy for the measurements.

Inauguration of Large Scale Facility

On September 7, 2017, the new Large Scale Facility at DTU Risø Campus was inaugurated.

The DTU Large Scale Facility provides completely new opportunities for research projects and companies to carry out tests on a very large scale. New advanced testing methods will be developed and the research will help gaining a better understanding of failure in large structures.

The National Wind Tunnel inaugurated

In April 2018, the new National Wind Tunnel at DTU Risø Campus was inaugurated.

The National Wind Tunnel at DTU Risø Campus will be one of a kind. The possibility to combine measurements of large scale aerodynamics and noise makes the tunnel unique. Thus, it was a big day – not only for DTU Wind Energy but for Denmark, when His Royal Highness Prince Joachim of Denmark cut the ribbon and officially inaugurated the wind tunnel.

Organization

DTU Wind Energy consists of ten sections

The management of the department includes the Head of Department, Peter Hauge Madsen, and the Deputy Head of Department, Peter Hjuler Jensen. The management structure of the department is organized with a single management team with the Head of Department as chairman and the Deputy Head of Department and the ten head of sections as members.

Vision

DTU Wind Energy is a globally leading department for wind energy with scientific and engineering competences in the international front and with a unique integration of research, education, innovation and public/private sector consulting.

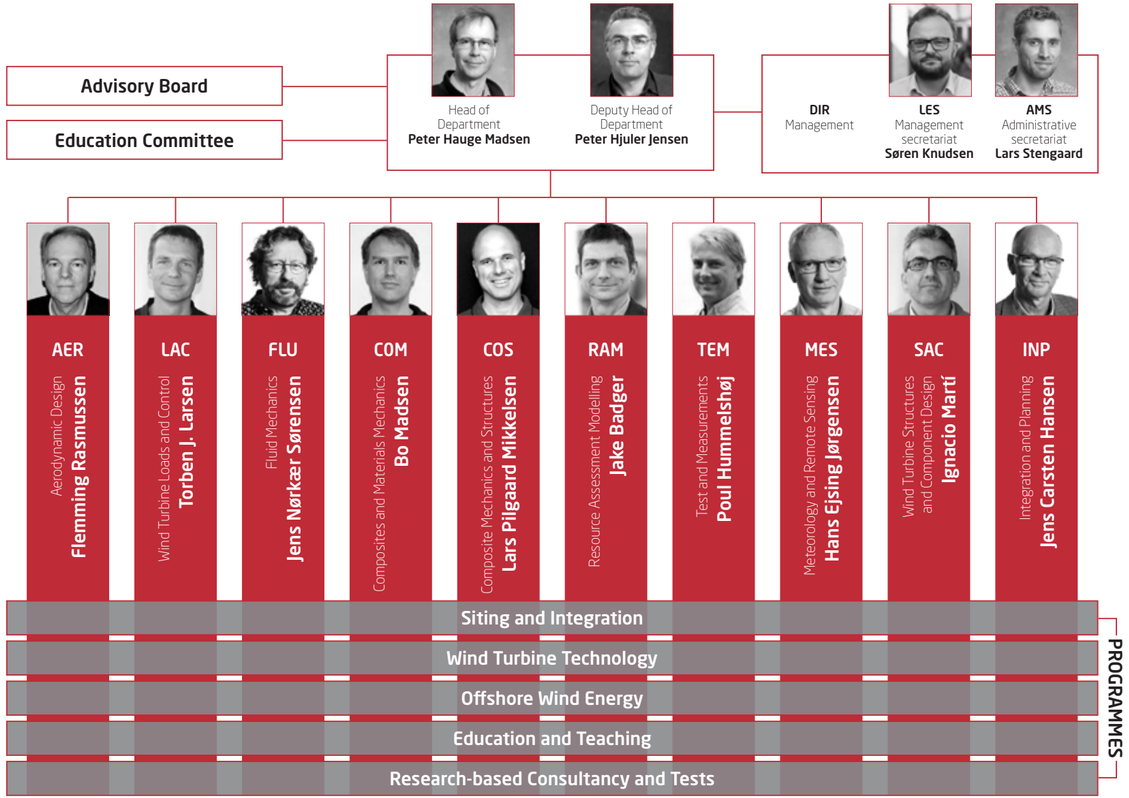
DTU Wind Energy is a key contributor to the realization of the vision of Denmark as a world leading wind power development centre and the activities support and develop the global wind energy sector with a special effort on national industrial development and innovation.

Mission

To develop new opportunities and technology for global and Danish exploitation of wind energy and improve the competitiveness compared to other energy sources

To develop scientific and engineering knowledge and competencies in key fields, which are central for the development and use of wind energy and provide the basis for advanced education at DTU in national and international co-operation.

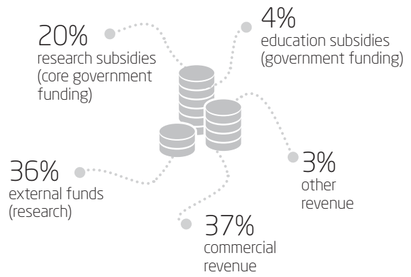
To facilitate the implementation and exploitation of research and development through research-based consultancy and services to industry and the public sector, innovation and education comprising training courses at DTU.



Finances

Income

€30 million



Ordinary operating costs

€26 million

Publications

Contributions to book and reports	17
Monographs	2
Scientific articles in WoS indexed journals	131
Scientific contributions to conferences	108
Contributions indicated as popular	2
Patents	2
Scientific articles in other journals	15
Ph.D. thesis	11
Scientific publications, articles and contributions without peer-review	73
Master thesis	60

Human resources in 2017

252 total staff

- 21 % are women
- 48 % have an international background
- 38 different nationalities
- 49 is the average age of people employed at DTU Wind Energy

116 researchers and educators

- 60 % have an international background

39 PhD fellows employed at DTU

- 84 % have an international back ground
- 23 % are women

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www.vindenergi.dtu.dk/english

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