JOHN OLAV GIÆVER TANDE

Winds of change

Senior Scientist with SINTEF Energy Research **John Olav Giæver Tande** is Director of the ambitious project NOWITECH. Here, he describes the groundbreaking progress in the field of wind energy research, grid integration and offshore technology that he oversees at the independent R&D organisation

Could you begin by outlining the purpose of the Norwegian Research Centre for Offshore Wind Technology (NOWITECH)?

NOWITECH's vision is to contribute to the large-scale deployment of deep sea offshore wind turbines, and to be an internationally leading research community on offshore wind technology, enabling industry partners to be at the forefront of innovation.

As Director, what does your role entail?

I work closely with the management team of NOWITECH in setting the scientific direction of our research, pushing for progress and excellence. A significant part of my time is dedicated to presenting NOWITECH and interacting with research partners and industry. This includes developing spinoff projects and innovations from NOWITECH, all with the joint aim of reducing the cost of energy from offshore wind farms. International cooperation is also high on the agenda. We are open to new industry partners joining NOWITECH, and I try to develop such opportunities.

Further to this, is collaboration essential to the development of NOWITECH?

We really treasure the cooperation with industry. Not only does their active involvement ensure relevance, but they are also paramount in bringing the research into application. I very much like seeing the results of our R&D being applied and find it hugely inspiring, as do all of the research partners in NOWITECH. I believe bringing researchers together from various fields to solve a joint task is a good way to stimulate innovation.

Do you have some examples of ways in which these partnerships have positively impacted upon your research endeavours?

The cooperation between research partners is set up so that each research group can focus upon their specialist theme, and then collaborate on any multidisciplinary challenges. One example of this is the 10 MW NOWITECH reference turbine that we are currently developing. In this, our research groups are jointly preparing detailed design specifications. The idea is not to build the turbine, but that the detailed design specification of the turbine can be applied as a common platform in specialist studies to develop better technical solutions.

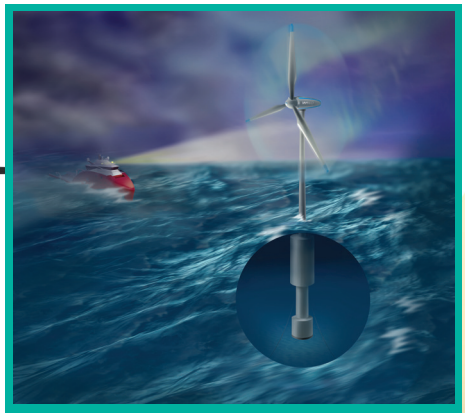
How do you balance the need to disseminate findings with industry's need to maintain the edge over competitors?

In NOWITECH all results are shared between partners, each of whom has equal and free rights to utilise them. We publish findings that we believe are relevant and important for the offshore wind sector, but we do not necessarily publish everything and every detail.

There are clear benefits of being a NOWITECH partner; I think important benefits for industry partners are the potential to influence the direction of research, interact directly with researchers and having first access to detailed results.

Can you elucidate the project's progress thus far?

I think we are doing quite well. Our educational programme and scientific work are progressing according to plan, and we



FLOATING WIND TURBINES SHOW GREAT POTENTIAL IN DEEP WATER

Offshore **wind technology**

At the forefront of research into offshore wind technology, **NOWITECH**'s work simultaneously promotes the development of innovations, while continually striving to reduce the cost of wind power

FOR SEVERAL YEARS, renewable energy resources have not only been a hot topic of R&D, but a growing necessity. The promotion and use of sustainable energy has become increasingly important against the backdrop of global warming. In the context of the European energy targets for 2020, also known as 20-20-20, the development of new and the expansion of already existing renewable energy sources has never been more crucial.

One area of rapid and exciting development has been offshore wind technology, which shows enormous potential in deeper water. Building on experience from their offshore oil and gas exploration, Norway took an early lead in this by installing the first full-scale floating wind turbine in 2009, and the same year also established the Norwegian Research Centre for Offshore Wind Technology (NOWITECH) – a project with the ambition of establishing itself as an international leader in offshore wind technology.

WHAT IS NOWITECH?

SINTEF is the largest independent research organisation in Scandinavia and it is from here, in the Energy Research institute, that Senior Research Scientist John Olav Giæver Tande coordinates the NOWITECH programme. Working closely with industry partners, the focus is on deep sea offshore wind turbines. The overarching objective is to provide pre-competitive research; contributing to industrial value creation and cost-effective offshore wind farms.

Key issues in NOWITECH are education, knowledge building and innovations for reducing the cost of energy for offshore wind. Research within the project encompasses integrated numerical design tools; energy conversion systems (blades and generators); novel substructures; grid connection and system integration; operation and maintenance; and assessment of novel concepts. Particular emphasis is placed on deep-sea (over 30 m) technology, including bottom-fixed and floating wind turbines.

RESEARCH AND DEVELOPMENT

One of the main challenges NOWITECH faces is to make offshore wind power cost-competitive. Whilst the effective technology and knowledge is invariably of an impressive standard, the challenge remains to develop quality innovations while reducing the cost of the energy produced. Ultimately, cost reductions are hugely influential to market development and, as a consequence, improved processes for manufacturing and R&D are vital. It is in this direction that NOWITCH is developing better models and new knowledge which, in turn, reduces uncertainties and costs in the design and planning stages. Such investigations contribute to innovations that can increase the competitiveness of offshore wind.

PARTNERS AND PROJECTS

NOWITECH has a strategy to increase its R&D activity through collaborating with more industry partners, increasing funding and establishing new projects. Any new funding will be used for R&D in agreement with its industry and research partners. Detailed research plans are made every year for approval by NOWITECH's board, which comprises eight mentors from industry and three from academia.

New projects may be direct spinoffs from NOWITECH, with a number of partners – typically driven by an industry partner – joining up to take a certain idea or innovation one step further beyond the pre-competitive phase, or they may expand on critical research areas, typically with funding from the Research Council of Norway or EU Seventh Framework Programme (FP7). New projects have separate contracts external to NOWITECH, but carried out in alignment with the programme. Since NOWITECH began, more than 30 new projects have achieved strong and relevant R&D results. For example, advanced methods and models have been implemented in state-of-the-art integrated numerical design tools for offshore wind turbines; and numerical simulation models, concepts and laboratory installations for grid connection and system integration of offshore wind farms have been developed. Furthermore, the first design of the NOWITECH 10 MW reference turbine has been completed and applied as a basis for testing innovative concepts – such as an adaptive blade technology with improved weight/strength ratio, a full-height lattice tower and a new ironless direct-drive generator with high voltage, direct current (HVDC) output. We have identified an optimised spar design that reduces costs of materials by approximately 30 per cent, and developed a patented control scheme for minimising the motion of floating wind turbines.

Two inventions from NOWITECH – remote presence and SiC coating – are already moving into business developments. Remote presence involves the design and construction of a low cost robot with a camera, microphone and other sensors that can move inside the nacelle and monitor the wind turbine condition remotely from on-shore. This reduces the need for manned service visits. SiC coating is a new patented wear resistant layer that can increase the lifetime of bearings and gears.

NOWITECH – NORWEGIAN RESEARCH CENTRE FOR OFFSHORE WIND TECHNOLOGY

OBJECTIVES

To provide pre-competitive research laying a foundation for industrial value creation and cost-effective offshore wind farms. Emphasis is on deep-sea (+30 m) solutions, including bottom-fixed and floating wind turbines.

KEY PARTNERS

Industry: **DNV**; **DONG**; **EDF**; **Fedem Technology**; **Kongsberg Maritime**; **NTE**; **SmartMotor**; **Statkraft**; **Statnett**; **Statoil**

Research: **SINTEF Energy Research** (host); **Institute for Energy Technology** (IFE); **Norwegian University of Science and Technology** (NTNU); **MARINTEK**; **SINTEF MC**; **SINTEF ICT**

Associated industry: **Access Mid-Norway**; **Devold AMT**; **Enova**; **Energy Norway**; **Innovation Norway**; **NORWEA**; **NCEI**; **NVE**; **WindCluster Mid-Norway**

Associated research: **Fraunhofer IWES**; **Massachusetts Institute of Technology** (MIT); **National Renewable Energy Laboratory** (NREL); **Nanyang Technological University** (NTU); **University of Strathclyde**; **Technical University of Denmark** (DTU Wind Energy); **TU Delft**

FUNDING

NOK 320 million (2009-17)

Research Council of Norway (50 per cent)

Industry partners (25 per cent)

Research partners (25 per cent)

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JOHN OLAV GIÆVER TANDE is Senior Research Scientist with SINTEF Energy Research and Director of NOWITECH. He has more than 20 year experience within the field of wind energy research with a focus on grid integration and offshore technology. Tande has been with SINTEF Energy Research since 1997.

NOWITECH
Norwegian Research Centre for Offshore Wind Technology

with a gross budget exceeding NOK 950 million have been generated involving one or more research partners.

AN OPTIMISED GRID

One example of NOWITECH's impressive work on the facilitation of efficient integration is its development of an optimised grid. The group has developed a model to identify an optimal grid topology for connecting offshore wind farms. Such an ability is vitally important; for example, in the North Sea an offshore grid would connect offshore wind farms themselves, while also having connections to Europe and Norwegian hydropower. These connections assist in balancing variations in demand and generation.

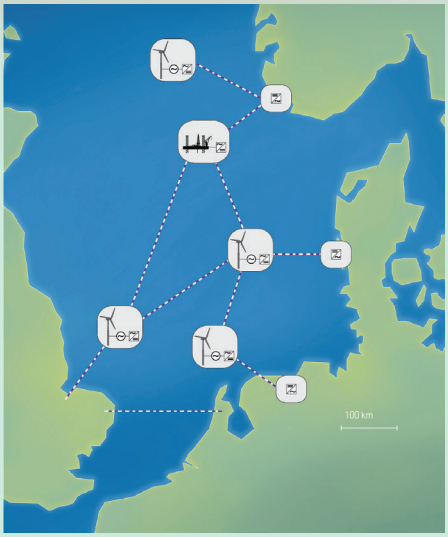
Optimisation involves finding the best lines to build from one location to another, and determining the sufficient capacity of these lines. Ultimately, an optimised grid offers the topology that provides the least overall system costs. The model that NOWITECH has developed can do exactly this, but can also be applied from other perspectives, eg. that of a wind farm developer, and applied to optimise the connection of a wind farm cluster. The number of possible configurations increases dramatically with the number of connection points; with as few as 25 connection points, the number of cable configurations approaches the number of elementary particles in the Universe. With this in mind, it becomes clear what a nebulous task NOWITECH has taken on.

THE IMPORTANCE OF EDUCATION

Education and recruitment are key aspects of NOWITECH. Due to the research-intensive development of offshore wind farms, it is obvious that many new hands and heads are needed to maintain the quality and frequency of innovation. Ensuring that there are enough highly qualified staff in the industry is hugely important for the continued development of offshore wind energy.

It is primarily through educating PhD and postdoctoral candidates that NOWITECH contributes to this; 25 PhD and postdoctoral students are already receiving personal funding

HUGE SAVINGS CAN BE ACHIEVED BY SELECTING THE BEST OFFSHORE GRID CONFIGURATIONS



from the project. However, NOWITECH has also been fundamental to the promotion of offshore wind as an area of specialisation for Master's students; over 100 MSc students at the Norwegian University of Science and Technology (NTNU) have taken up Wind Energy as a subject so far. The new Erasmus Mundus European Wind Energy Master (EWEM) programme at NTNU gives further weight to the educational aspect of NOWITECH's work, and the impressive student programme is set to continue to grow even more in the future.

A SECOND WIND

Funding for NOWITECH is presently set to end in 2017, but the expectation is that the project shall continue beyond this. An appealing option is to align development with the European Energy Research Alliance (EERA) to form a large European research centre on offshore wind energy. In the meantime, it is unsurprising that the researchers want to continue to provide excellent results in all aspects of their work – education, knowledge building and innovations for reducing the cost of energy from offshore wind. Results to date have been outstanding, and are set to continue to improve the viability of offshore wind energy.