



EUROPEAN ACADEMY
OF WIND ENERGY

Wind Energy R&D

Centre for
Renewable
Energy

SINTEF
IFE
NTNU

Wind Energy R&D: Centre for Renewable Energy (SFFE) - SINTEF, IFE and NTNU

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The SINTEF Group, IFE (Institute for Energy Technology) and NTNU (Norwegian University of Science and Technology) cooperate on wind energy R&D through Centre for Renewable Energy (SFFE). The Centre is virtual and has a coordinative and consultative function for the education and research groups within renewable energy, including small scale hydropower, wind, solar, wave, and bio-energy as well as the social dimensions of energy use.

Wind energy is a major area of the SFFE-network at NTNU, SINTEF and IFE involving some +30 scientific staff including about 10 professors and 10 PhD students. The activities are multi-disciplinary involving highly qualified scientific staff from various specialist research groups within the network. These research groups are not only working with wind energy, but are specialized on a specific scientific subject, e.g. materials or electrical engineering. All aspects of wind energy are covered, though main focus and strength areas are on grid integration and offshore technology.

Laboratory facilities include a test station for wind turbines, a wind power electro-technical lab with generators, power electronics and loads, a wind tunnel (11x3x2 m) and an ocean basin lab (80x50x10 m). In total NTNU, SINTEF and IFE operates well over 100 laboratories within a large range of fields, e.g. testing and characterizing of materials, corrosion etc.

Research groups involved

The wind activity at NTNU, SINTEF and IFE involves some +30 scientific staff including about 10 professors and 10 PhD students. All aspects of wind energy are covered, though main focus and strength areas are on grid integration and offshore technology. The research units being involved in wind energy are listed below.

Research unit	Activities within wind energy (examples)
SINTEF Energy Research	<ul style="list-style-type: none"> - Coordinator of wind activity within SFFE - Grid integration and market operation - Power quality measurements - Asset management / O&M strategies - Electric components incl. sub-sea - Assessment and design of control systems
MARINTEK	<ul style="list-style-type: none"> - Offshore hydrodynamics - Offshore structures - Marine operations (installation / access) - Logistics and O&M strategies
SINTEF Materials and Chemistry	<ul style="list-style-type: none"> - Materials technology - Corrosion and corrosion protection - Coating selection and maintenance - New materials - Metallurgy / Castings
SINTEF Information and Communication Technology (ICT)	<ul style="list-style-type: none"> - Modelling and simulation of ice and wind conditions over complex terrain and offshore
IFE	<ul style="list-style-type: none"> - Rotor aerodynamics - Aero-elastics (Onshore & Offshore turbines) - Wind turbine optimization - Simulation of wind in complex terrain / offshore
NTNU	<ul style="list-style-type: none"> - Cover all aspects of wind energy - Responsible for MSc and PhD students - Focus on grid integration and offshore - PhD students works include generator technology, power electronics, control systems, offshore structures, materials, hydro and aëro-dynamics, wind assessment and social science

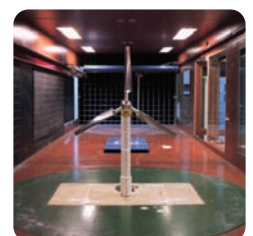
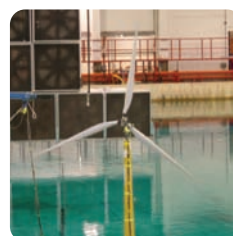
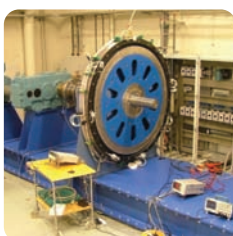
The main activity of the institutes within the SINTEF Group and IFE is contract research, whereas the main activity of NTNU is education of MSc and PhD students.

Facilities & Advanced Research Tools

Test station for wind turbines	Test station at Valsneset at the west-coast some 2 hours drive from Trondheim with good wind exposure (annual average 8.4 m/s at 50 m agl). Installations include met mast and measurement equipment, a service house, one 225 kW wind turbine (currently rebuild for testing a novel hydraulic drive-train), one 900 kW wind turbine (to be installed) and one 2.3 MW wind turbine. New sites / offshore are currently being investigated.
Wind power electro-technical lab	Lab for testing, research, development and demonstration of novel generators, power electronics and control solutions. Strong, weak or isolated grid operation is facilitated with equipment (generators etc) up to 50 kW.
Wind tunnel	Wind speed up to 30 m/s. Test section: 11 x 3 x 2 meters (L/W/H). 6-component balance for measurements of the 3 forces and 3 moments. Equipment for measuring Temperature, Pressure and Velocity.
Ocean basin lab	A total environmental simulation including wind, waves and current offers unique testing conditions for models of all types of fixed and floating structures. A water depth of 10 metres offers excellent testing possibilities for deep water structures intended for the offshore industry in future. Length: 80 m - Width: 50 m - Depth: 0-10 m
Laboratories (general)	In total NTNU, SINTEF and IFE operates over 100 laboratories within a range of fields, e.g. testing and characterizing of materials, corrosion etc.
Measurement equipment	A broad range of advanced measurement equipment, both in labs and portable for use in the field.
Software	A broad range of advanced software tools including both in-house and commercial packages.

R&D Strategy

	short	medium	long
Progress of design tools (analytics, numerical methods and experiments) for the (structural, control, concurrent engineering) design of (deep-sea) offshore wind energy concepts	⊙	⊙	⊙
Assessment, test and development of wind turbine design solutions adapted for offshore / deep-sea conditions, e.g. mono-pile, jackets, floaters, up-wind/down-wind, 2 or 3 blades etc.		⊙	⊙
Test and development of new materials and coatings for offshore wind turbines (e.g. lightweight hub, corrosion protection, etc)	⊙		⊙
Test and development of new robust and light-weight wind turbine drive-train solutions (PM generators, power electronics, hydraulics)		⊙	⊙
Development of solutions for cost effective grid connection of large wind farms, incl. deep-sea novel concepts and components (sub-sea connectors, dynamic cable, etc.)		⊙	⊙
Assessment of an offshore "super-grid" structure, including development of a methodology for optimizing such a grid	⊙		⊙
Facilitate efficient power system operation with large amounts of wind energy (meeting the challenges of EU2020 and beyond), including understanding wind variations and methods to balance these (wind farm control, aggregation, storage, market, DSM, etc)		⊙	⊙
Development of offshore logistics and access technology		⊙	
Development of procedures and techniques for efficient asset management, operation and maintenance	⊙	⊙	
Contributing know-how to wind turbine standardization works	⊙		
Measurement and modelling of power quality characteristics of wind turbines, including fault-ride through capabilities	⊙		
Development of methods (numerical/measurements) for cost effective assessment and on-line prediction of wind conditions and icing over complex terrain and for offshore also waves	⊙	⊙	
Assessment of (offshore) wind impact on society, environment, policy and industry value creation	⊙	⊙	



Education and training activities

Education and training activities constitute a significant part of the wind energy activity within the SFFE-network of NTNU, SINTEF and IFE. NTNU has the main responsibility for the educational activities, graduating MSc and PhD students. The MSc students are graduated within the classical fields of science and technology, whereas PhD students may specialize within specific fields of wind energy. The cooperation between NTNU, SINTEF and IFE largely enhances the quality of both education and research.

General info on SINTEF, NTNU and IFE including contact details on wind energy

The SINTEF Group is the largest independent research organization in Scandinavia with some 1900 employees in nine research institutes carrying out contract research in a broad range of fields. SINTEF's goal is to contribute to wealth creation and to the sound, sustainable development of society. SINTEF generates new knowledge and solutions for its clients, based on research and development in technology, medicine, the natural sciences and the social sciences. www.sintef.no

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Institute for Energy Technology (IFE) is an international research institute for energy and nuclear technology with about 550 employees in five sectors. IFE's mandate is to undertake research and development, on an ideal basis and for the benefit of society, within the Energy and Petroleum sector and to carry out assignments in the field of nuclear technology. www.ife.no

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NTNU, the Norwegian University of Science and Technology in Trondheim represents academic eminence in technology and natural sciences as well as in other academic disciplines. Its academic scope includes technology, the natural sciences, the social sciences, the humanities, medicine, architecture and fine arts. In total some 3000 students graduate from NTNU every year. Cross-disciplinary cooperation at NTNU results in innovative and creative solutions that change our daily lives. www.ntnu.no

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The Centre for Renewable Energy (SFFE) combines and coordinates the competence at NTNU, SINTEF and IFE within renewable energy. The Centre is virtual and has a coordinative and consultative function for the education and research groups within renewable energy. www.sffe.no

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The European Academy of Wind Energy (EAWE) has been initiated by the leading European research institutes and universities in the field of Wind energy. The aim of this initiative is to arrive at a critical mass in an internationally oriented and globalized world and to form a unique European Network of Excellence. www.eawe.eu



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