

The Top-level Research Initiative - A major Nordic venture for climate, energy and the environment

The Top-level Research Initiative (TRI) is a joint effort on the part of the Nordic countries to find solutions to global climate challenges - the largest-ever Nordic venture of its kind.

The Nordic countries have created a platform for cooperation with central players from research, innovation, business and industry.

The TRI is one of the Globalisation initiatives declared by the Nordic Prime Ministers in 2008, intended to increase competitiveness and promote the Nordic region as a pioneer in tackling globalisation. With a programme budget of 53 million Euro, the initiative currently funds 31 Nordic projects amounting to a collective value of some 94 million Euro.

Joint governance across sectors

Three Nordic institutions - NordForsk, Nordic Innovation and Nordic Energy Research - act as secretariat for the initiative, contributing with their combined competencies in the fields of research, innovation and technology. The three organisations are all under the auspices of the Nordic Council of Ministers.

TRI is governed by a Management Board consisting of 15 members representing public financing bodies for research and innovation, as well as the private sector.

The various funded activities involve participants from the whole Nordic region and a range of sectors. Expertise within research, education and innovation is brought together and coordinated in collaboration projects with hundreds of participants from all the Nordic and Arctic countries.

The Top-level Research Initiative addresses six primary thematic areas:

- **Climate (ADAPT)** = Effect Studies and Adaptation to Climate Change
- **Cryo** = Interaction between Climate Change and the Cryosphere
- **Nano** = Energy Efficiency with Nanotechnology
- **Wind** = Integration of Large-scale Wind Power
- **Bio** = Sustainable Bio-fuels
- **CCS** = CO₂ Capture and Storage

Within the framework of these areas, the initiative also includes:

- Advanced climate modelling
- Social sciences and humanities
- Focus on the Arctic

Overall objectives

- To promote the Nordic region as a pioneer within climate, energy and the environment
- To ensure research and innovation of excellent quality by joining the strongest Nordic environments
- To promote Nordic business
- To promote professional environments across sectors and enhance mobility of competence
- To create platforms for international cooperation and to strengthen the Nordic region within EU programmes

Content and results

The TRI has established six Nordic Centres of Excellence (NCoE), one Nordic competence centre, 11 integrated research and innovation projects and 13 thematic networks within climate and energy issues. The projects contribute to enhancing society's knowledge about climate change and to better prepare us for them, such as through technology development and sustainable energy solutions.

Participation from industry

One-third of all the TRI projects have active business participation. This participation gives an opportunity to realise long-term investments and to build strategic networks.

International perspectives and dialogue with the EU

Through various projects and networks, the TRI links research, innovation and industry together, by acting as a platform for further international collaboration. Examples of such collaboration are a project dealing with the continuation of the International Polar Year (IPY) and Arctic issues and involvement in the Joint Programming Initiative (JPI Climate) Connecting Climate Knowledge for Europe.

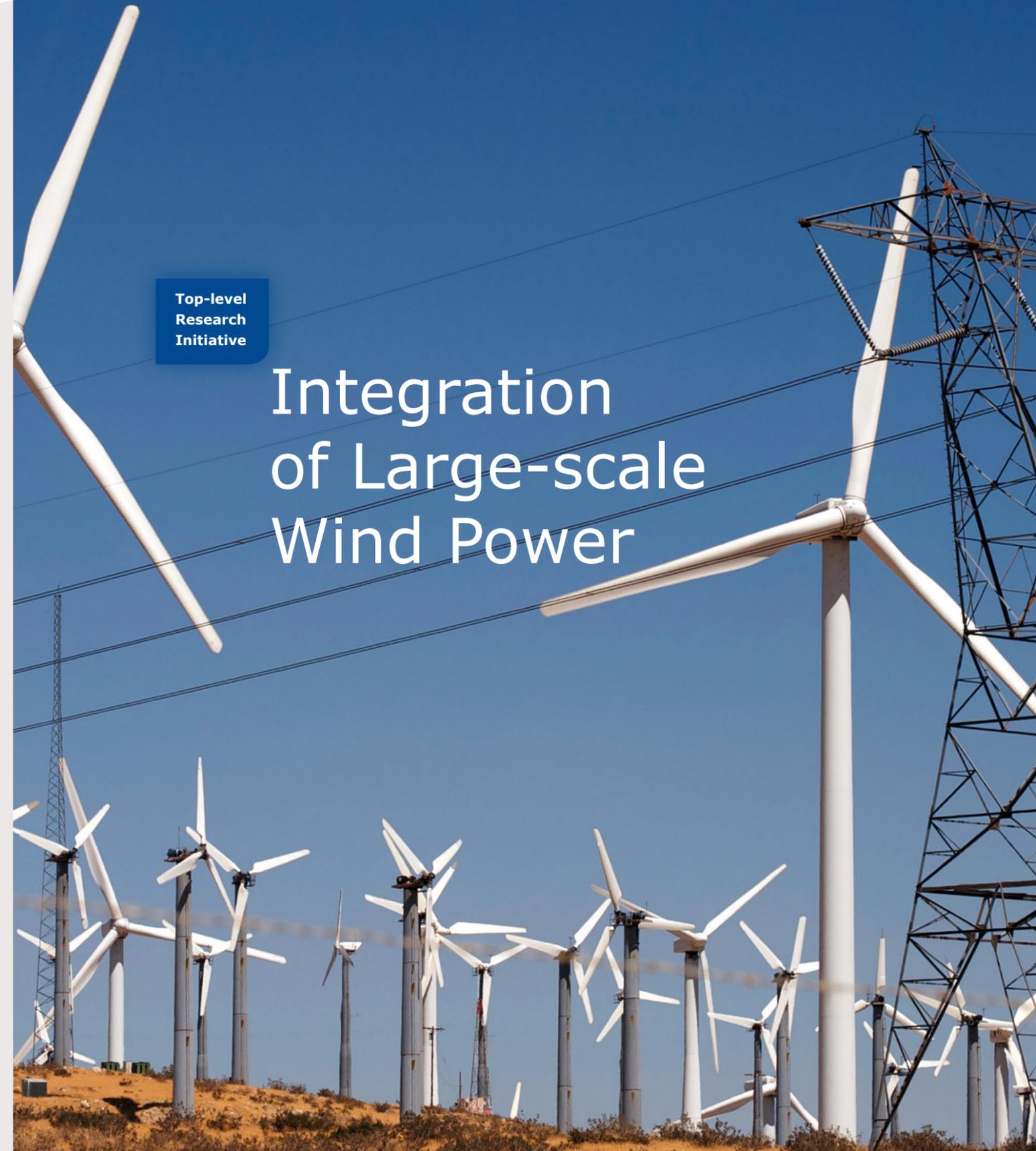
Result-oriented

The Top-level Research Initiative aims to obtain results through effective plans, organisation and processes, and evaluations are carried out in order to document its results.

Outreach and communication

Communication and dissemination of results through various channels is a priority. The initiative participates on various arenas in Europe, and organises a large annual conference gathering many categories of professionals and receiving international attention.

See www.toplevelresearch.org for more information about the initiative.



Top-level
Research
Initiative

Integration of Large-scale Wind Power

Integration of Large-scale Wind Power

With 30 million NOK in financing over five years, the Integration of Large-Scale Wind Power sub-programme supports the development of innovative and sustainable forms of wind energy and its better integration with energy systems. The sub-programme has funded three R&D projects and three networks.

The objectives of the sub-programme are to:

- Promote the development of new, innovative and sustainable forms of wind energy and grid integration aspects
- Create new constellations and co-operation platforms enhancing information exchange and transfer of knowledge between different stakeholders, such as researchers, business and policy makers
- Optimise joint Nordic use of research and innovation infrastructure
- Facilitate implementation of existing knowhow in society

The Nordic countries and the EU have set ambitious goals for the further development of wind energy. The technology is expected to contribute significantly to power production in the next decades, especially with the development of offshore wind. The North Sea, for example, is targeted for its potential to supply Europe with significant power generation from offshore wind farms.

However, a critical issue with all wind power is that the wind is not constant, so power production fluctuates. This causes problems when feed into an electricity grid, making integration issues of critical importance with larger shares of wind power.

This sub-programme focuses on the following areas:

- Grid aspects
- Power and energy aspects
- Energy market aspects
- Operation and maintenance
- Arctic and offshore wind energy

Research projects:



ICEWIND

- Improved forecast of wind, waves and icing

Aim: This research project seeks to address some of the barriers to large-scale integration of wind energy in the Nordic countries. Through improved forecasts and acquiring an overview of icing conditions, wind farms will have a better chance at contributing to a higher share of renewable energy in the Nordic countries.

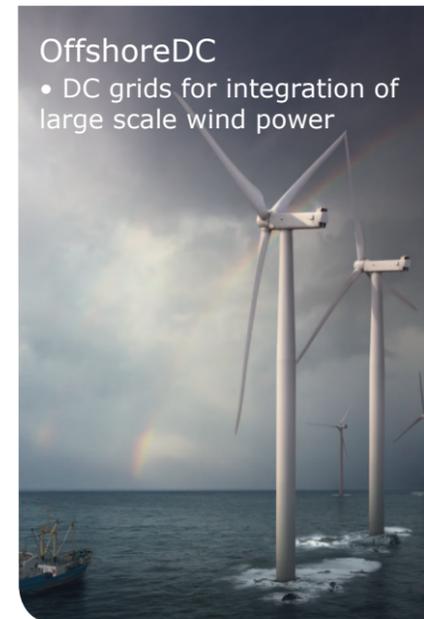
The project objectives are:

- Address cold climate aspects of wind power
- Produce an icing atlas for Sweden and Finland based on long-term meteorological statistics
- Develop and validate short-term forecast of icing
- Develop engineering tool for calculation of production loss in large wind turbine installations in Northern latitudes
- Map offshore wind resources near Iceland
- Improve land-wind resource mapping in order to study the integration of hydro and wind power in Iceland

Participating institutions:

- Risø National Laboratory for Sustainable Energy
- Vestas Wind System
- The Icelandic Meteorological Office
- University of Iceland
- Landsvirkjun
- Landsvirkjun Power
- Kjeller Vindteknikk
- The Norwegian Meteorological Office
- AGR Field Operations
- Gotland University
- VTT
- Statoil
- Offshore Windservice Aps

Project leader: Niels-Erik Clausen, Risø DTU, Technical University of Denmark, Denmark



OffshoreDC

- DC grids for integration of large scale wind power

Aim: To make the use of wind power in the Nordic countries more flexible grids must to a higher extent be interconnected. This research project seeks to study the most promising technical solutions in this area for future large-scale offshore grids.

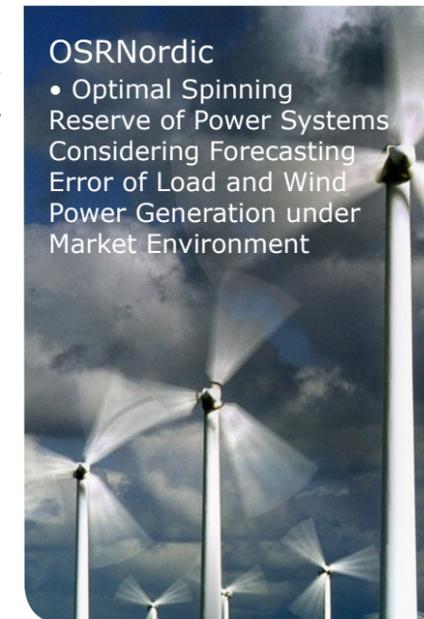
The project objectives are:

- Drive the development of Voltage Source Converter (VSC) based High Voltage Direct Current (HVDC) grid technologies future large scale offshore grid
- Support a standardised and commercial development of the technology
- Improve the opportunities for the technology to support power system integration of large scale offshore wind power
- Help the Nordic stakeholders to benefit from the uniquely ambitious plans for offshore wind power development in the area

Participating institutions:

- Vestas A/S
- ABB
- DONG Energy
- Energinet.dk
- Chalmers University of Technology
- SINTEF Energy Research
- Statnett
- VTT
- Aalborg University

Project leader: Nicolaos A. Cutululis, Technical University of Denmark, Denmark



OSRNordic

- Optimal Spinning Reserve of Power Systems Considering Forecasting Error of Load and Wind Power Generation under Market Environment

Aim: In order to improve the integration of wind farms into modern power systems, a certain amount of reserve production capacity is required. This research project seeks to determine the optimal amount of extra capacity in the wind power system while taking into account system imbalances and forecasting errors.

The project objectives are:

- Investigate and determine optimal spinning reserve requirements for modern power systems integrated with large-scale wind farms
- Consider the forecasting error of load and wind power generation as well as the forecasts of market prices and system imbalances
- Study the effect of using energy storages on the determination of system spinning reserve within the framework of unit commitment optimization issues
- Investigate a combined operation of wind farm and energy storage system and their capability to provide spinning reserve

Participating institutions:

- Technical University of Denmark
- Lund University of technology
- Chalmers University of Technology
- University of Iceland
- ENFOR A/S
- Energinet.dk
- DONG Energy

Project leader: Birgitte Bak-Jensen, Aalborg University, Denmark

Networks:

■ Nordic Wind Integration Research Network (NWIN)

Project objectives:

- Increase the collaboration between different research groups in Northern Europe
- Disseminate research results to researchers and commercial players in a structured way
- Initiate activities with the aim of establishing permanent forms of cooperation that will continue beyond the grant period

Participating institutions:

- Elforsk AB • The Department of Electric Power Engineering at the Norwegian University of Science and Technology (NTNU) • The Department of Electrical Engineering at the Lappeenranta University of Technology
- Project leader:** Stefan Montin, Elforsk AB, Sweden

■ Windpower Operation and Maintenance Network (NWOMN 1)

Project objectives:

- Facilitate cooperation and transfer of experience, knowledge and research tasks and results between the participants in the Nordic countries
- Collaboratively develop a design for a formal Nordic network for operation and maintenance issues regarding wind power plants, and subsequently invite other active actors in the industry

Participating institutions:

- Energi Norge • SINTEF Energy Research • Elforsk • Chalmers • VTT

Project leader: Solgun Furnes, Energi Norge, Norge

■ Integration of wind energy into off and onshore grids (WindGrid)

Project objectives:

- Address key enablers and key risk elements for the grid investments that will be required to integrate large amounts of wind energy in general and offshore wind energy in particular
- Run a series of workshops where academia and business can discuss challenges related to offshore and onshore grids

Participating institutions:

- DNV Research and Innovation • Royal Institute of Technology (KTH) • Swedish Transmission Research Institute (STRI) • Risø DTU • Statnett • NTNU

Project leader: Kjell Eriksson, DNV Research and Innovation, Norway