New and Ongoing Wind Power Research

in Sweden 2017

A compilation of Swedish research programs and new scientific publications on wind energy

UPPSALA UNIVERSITET

The National Network for Wind Utilization

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Liselotte Aldén, liselotte.alden@geo.uu.se
Marita Engberg Ekman, marita.ekman@geo.uu.se
Josefin Mardi, josefin.mardi@geo.uu.se
Annie Nyström, annie.nystrom@geo.uu.se
José Pedro da Silva Soares, jose.soares@geo.uu.se

Wind Energy Campus Gotland
Department of Earth Sciences
Uppsala University
www.geo.uu.se

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Photographer: Maria Klemm

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www.natverketforvindbruk.se

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Contents

1. Introduction

Uppsala University Campus Gotland annually publishes a summary of *New and Ongiong Wind Power Research* in Sweden. The summary is published on the website of the National association for Wind Utilization, where both the English and Swedish versions are available at Nätverket för vindbruk.

The aim of this summary is to provide an easily accessible overview of what is happening annually in wind power research for interested parties. This report is the sixth edition of the series.

This compilation is divided into two sections. The first is a presentation of the research centers and research programs active in wind power research in Sweden. Then a topic-based list of the wind power research published in 2017 follows where at least one of the authors is active in a Swedish university. Here one also can find doctoral and licentiate theses as well as theses at bachelor and master levels that have been published during the year. All have direct online links to the publications. This report also includes tables which compile the new publications.

The data for this report is taken from various databases and websites, and also from direct contact with universities, researchers and representatives of the various programs. We would like to take this opportunity to thank everyone for your contributions and help. To complete this report for the coming year, we will gladly accept more information!

Uppsala University Campus Gotland is the node with responsibility for education and competence development within the National Association for Wind Utilization which is financed by the Swedish Energy Agency. The 2017 summary of current wind power research is a part of this task.

All editions of *New and Ongoing Wind Power Research* are published on the website of the Association for Wind Utilization.

2. Research programs and research centers

In Sweden, there are several universities and colleges that conduct research in a number of areas linked to wind power both on land and offshore. The research is extensive and includes technical development, operational solutions, environmental impact, acceptance and other issues. This summary describes activities during 2017 at research centers and programs that grant funding for research into wind power.

2.1. Vindval

Vindval is a knowledge program with research on the impact of wind power on humans, nature and the environment. The program is collaboration between the Swedish Energy Agency and the Swedish Environmental Protection Agency and is chaired by a steering committee with representatives from these authorities. The program includes a reference group of experts in the focus areas covered by the program.

The program started in 2005 and is now in its third stage that continues with knowledge building, as well as following up and communicating experiences from wind parks that are in operation. Vindval will also increase contact with other countries in order to achieve a more effective knowledge transfer. This stage will end in June 2018.

In February 2018, the Energy Agency decided to renew the program for a fourth stage which will continue until 2020. Following political commitments of a 100 percent renewable electricity system, where the Energy Agency estimates that the large-scale expansion of wind power will continue, it is important that the conversion process attempt minimize its negative impact on human, animals and nature. This fourth stage will focus on planning around the conversion.

More knowledge is needed about the impacts of wind power on a larger scale. Balancing different interests as well as increasing the level of knowledge about wind power's impact on population levels and its cumulative effects are also relevant.

The objective for the program is that its results will help contribute to the sustainable development of wind power nationally and that the environmental effects of wind power will be placed in relation to the impact from other actors.

In the new research announcement, project proposals are welcomed in the field of wind power's impact on the reindeer, with particular focus on the impact in winter operations during the operational phase of the wind turbines. In 2018 there will also be an announcement for projects that deal with large-scale planning of wind projects.

In previous stages, Vindval has included 30 research projects, four synthesis projects and sixteen films. Projects within the program have mainly conducted in four areas: human interests, birds and bats, marine life and mammals on land. The results of this research can be used as a basis for environmental impact assessments, in planning and approval processes for wind power. Booklets and short informative films that are developed refer to a broad audience and can be used, for example, in consultation.

Vindval publishes a newsletter six times a year, which can be subscribed to and also found at their website.

In 2017, Vindval published five reports as well as a translation into English of the updated synthesis report on birds and bats.

The effects of wind power on birds and bats
The report contains national and international research published 2011-2015, as well as a compilation and analysis of information in the completed Swedish control programs concerning the effects of wind power on birds and bats. Report number: 6740 (sv) (2017), 6791 (eng) (2017). Research report. Authors: Jens Rydell, Richard Ottvall, Stefan Pettersson, Martin Green. Project Manager: Jan Olof Helldin, Calluna.

Samhällsnyttans betydelse vid tillståndsprövningen av vindkraft
The report analyzes how the concept of community benefit is handled in the permit examination of wind power. There is clearer scope in the legislation to take into account the negative effects of wind power than to take into account the positive effects. The authors propose a change of rules so that the environmental benefits of wind power, and other similar activities, must be done in the examination of permits.

Author: Kristina Ek, Associate Professor in Economics, Lars Bäckström Ph D and scientist in jurisprudence and Maria Pettersson, professor in jurisprudence. The authors are active at Luleå technical university. Report number 6738 (2017).

Betydelsen av kungsörnars hemområden, biotopval och rörelser för vindkraftsetablering. Del 2
The report describes biotope selection, flight altitude and movement patterns studied during 2011-2015 for eagles marked with GPS transmitters in northern Sweden (report 6589, 2013). Detailed studies showed that the eagles flew higher near wind turbines than outside the park, but they seem to continue to use the area after the establishment of wind power. Report Number 6734 (2017).

Studie av kontrollprogram av buller vid vindkraftsverk
The project has investigated and categorized control programs and reports relating to energy and emission measurements of wind power. The report also includes checklists for what should be included in the control program for noise. Author: Karl Bolin, KTH, Martin Almgren, Almgren Akustikkonsult AB. Report No. 6739 (2017). Research report.

Kontrollprogram för vindkraft i vatten - sammanställning och granskning, samt förslag till rekommendationer för utformning av kontrollprogram
The report contributes new information on the environmental effects of wind power offshore, as well as highlighting the challenges associated with monitoring the effects of wind power on aquatic life. The authors' suggestions for recommendations aim at facilitating the application of supervision and control programs and provide a basis for well-balanced and transparent decisions on the establishment of wind power offshore. Author: Carolina Enhus, Hanna Bergström, Roger Müller, Martin Ogonowski , Martin Isæus. All authors worked at the Aquabiota Water Research report. Report Number: 6741 (2017). Research report.

Multikriteriemodeller vid lokalisering av vindkraft
The report's primary finding is that the establishment and licensing of wind power projects creates complex decision issues. The purpose of the report is to initiate an investigation to determine to what extent multi-dimensional decision theory (multi-criteria decision analysis) can be used to design practically useful decision support models. The report provides a new perspective on how to rationalize and handle the challenges that are relevant to the location planning of wind power. Project leader: Stig Blomskog, Gävle University.

During 2017 the following projects were ongoing in the Vindval research program:

The impact of wind power on human interests

People's experiences of noise from wind power in hilly terrain related to sound measurement. Project Manager: Anna Rutgersson, Uppsala University. Project reporting: March 31, 2018

Explanatory models for wind turbine
The purpose of the project is to investigate dominant factors for perceived noise disturbance. Project leader: Dag Glebe, RISE (Swedish Research Institute, former SP). Project reporting: March 31, 2018. The projects are collaborating.

The impact of wind power on birds and bats

How the capercailzies behavior is affected from wind turbine parks – an international comparison
The project will collaborate with a five-year research program in Germany and Austria. The goal is to evaluate the risks in Western Europe on the threatened capercailzie that are linked to wind power. The Swedish project will tag and inventory capercailzie in areas in Sweden where wind power activity is occuring as well as from forest landscape where the capercailzie is not threatened. Project leader: Henrik Andrén, Swedish University of Agricultural Sciences, Uppsala. Project reporting: 21December 2017. Project review will take place in spring 2018.

Insects' concentration around wind turbines and its impact on insect eating bats and birds
The project studies whether insect concentrations and incidents associated with wind turbines can attract insect eating bats and birds, such as nightjars and swallows. Insects are detected using laser-based remote sensing technology, the movements of common swifts are monitored using GPS logging technology, and movements of insect eating birds are studied using a vertical radar. The aim is to document how the insects accumulate and vary in different weather conditions, and if their occurrences attract bats and birds to the vicinity of the wind turbines. Project leader: Susanne Åkesson, Biological Department, Lund University. Project reporting: December 31, 2019

Bats, particularly the Barbastelle and Northern Bat, and wind turbines – collection of a better knowledge base and the development of new guidelines
The project will study how Barbastelle is influenced by wind power and present scientifically substantiated guidelines for how the occurrence of the species should be

managed. In addition, the project will study how consideration should be given to Northern bat as wind power development continues in the north of Sweden. In depth analyses of data from control programs around bats and wind power from southern Sweden are also included in the project. Project leader: Martin Green, Biological Department, Lund University. Project reporting: 1 December 2017. Project review in progress (March 2018)

Factors with impact on the occurrence of insects and bats at high altitude
The study demonstrates the presence of bat and insects at the ground as well as at peak height at wind turbines, with high precision and a number of environmental factors are mapped. Insect attraction are measured using experiments with varying light intensity and color to investigate which factors contribute to high incidence of insects and bat. If these factors become better known, and if the insect attraction can be reduced at the wind turbines, controlled stops can be restricted and bat collisions can be avoided.
Project leader: Johnny de Jong, Center for Biological Diversity, Swedish University of Agricultural Sciences. Project reporting: March 5, 2018.

Reduced bats mortality with new colors
The project will investigate whether painting wind turbines a different color and using different obstacle lighting can reduce insect occurrence and , as a result, reduce bat mortality around wind turbines. Project leader: Jonas Victorsson, Department of Ecology, Swedish University of Agricultural Sciences. Project reporting: June 2018. Project review in progress (March 2018).

Population modeling for eagles: relative importance of mortality factors and possibility of compensatory measures
The study makes an effort to understand the impact that wind power development can be expected to have on Sweden's eagle populations and how this impact can be compensated for. Available compilations regarding eagles indicate that wind power accounts for less than 2 percent of total mortality while impacts with trains (37 percent), fires (26 percent) and natural causes (15.6 percent) account for far more deaths. The study points to a potential to compensate for a possible increase in wind power related eagle mortality by reducing other risks to which the eagles are exposed. The study was limited in scaleand was completed in February 2018.

The influence of wind power on mammals

Vindkraft og reinsdyr – en kunnskapssyntese (Vindkraft och renar – en kunskapssammanställning)
In the project, Swedish and Norwegian researchers formulate a common knowledge base on the effects of wind power on reindeer and reindeer husbandry. In Sweden and Norway, several studies have been conducted on wind power, reindeer and reindeer husbandry in the last decade. The results of the studies differ in part, which creates uncertainty about how the results should be interpreted and applied. The report summarizes eleven different studies that have studied the effects of wind power and power lines on reindeer. The project team includes Anna Skarin and Per Sandström at SLU, Jonathan Colman and

Sindre Eftestøl, Oslo University. The work is led by Olav Strand at NINA (Norwegian Institute for Nature Research).

Projektansvarig: Anna Skarin, SLU.

The report Vindkraft og reinsdyr – en kunnskapssyntese has been scientifically reviewed by NINA (Norwegian Institute for Nature Research) and published in the NINA report series (2017). The report is translated into Swedish and is published as Vindval's reportnumber 6799 in the spring of 2018.

Vindval website

Register to Vindvals newsletter

Ongoing research reports 2018 (pdf)

The announcement for finance applications about the impact from wind power on reindeers

Planning Vindvals fourth stage

2.2. Vindforsk IV

Vindforsk IV is a program running between 2013 and 2018. It has been implemented in the cooperation between the Swedish Energy Agency and wind power companies through Elforsk and has been funded 50 percent by the industry and 50 percent by the Swedish Energy Agency. Beginning in 2017 new projects are applied for and funded by the Sweden Energy Agency's new research program, VindEL. Read more about VindEL in chapter 2.4

Planning is currently under way for continued collaboration and finance between industry and wind power research. The structure around it will hopefully be set and take shape in the spring of 2018. Furthermore, work is being done to develop priorities for the future.

Vindforsk IV has been structured into three business areas: Wind resources, design and establishment, operation and maintenance, as well as wind power in the electrical system. At present research projects are being carried out in areas that include wind turbine de-icing, gearbox maintenance, frequency regulation and synthetic inertia.

Ongoing projects within Vindforsk:

- Bayesianska methods for maintenance
- Dynamic rating
- Impact in I 36 kV-nätet
- LoadMonitor
- Forestwind

Research Projects during 2017:

- Wind Turbine Performance Decline
- Harmonics and windpower
- Inertial support from Variable Speed
- De-icing systems for wind turbines

Reports from the wind research projects are available on the website, where you can also sign up for their newsletter.

Vindforsk via Energiforsk

2.3. Wind Power in cold climate

The cold climate wind turbine research and development program started in 2013 and continued until 2016. From 2017, it is possible to apply for funding for cold climate research projects through VindEL, which is the Swedish Energy Agency's new program for wind power research projects, read more in chapter 2.4.

In the program, the Energy Agency allocated funds for research related to method development to predict ice formation on wind turbines, the impact of ice formation on electricity generation and technological development to counteract ice formation. The program has also included environmental and safety issues linked to wind power in cold climate.

The long-term mission of the program has been to encourage and simplify a conversion of the Swedish energy system, and that Swedish research will take a leading position and develop special knowledge in wind power in cold climate. This project, in the long run, aims to facilitate the establishment of larger wind parks in northern Sweden in the next decade that able to handle the challenges of wind power in colder areas.

The program has also aimed to promote the building of appropriate academic skills that will contribute to a necessary knowledge base for continued progress, primarily in research and development, in collaboration between academia and industry. The aim has also been to promote the development of technical solutions that correspond to the areas of need that impede and delay the establishment of wind power in cold climate.

Ongoing projects during 2017 in the research program Wind Power in cold climate:

Wind-turbines in cold climate: Flow dynamics, ice accretion and terrain effects
Project Time 2013-09-01--2018-06-30. The project aims to increase knowledge about how icing affects noise from wind turbines, as well as how noise diffusion is affected by snow or ice formation on the ground, as well as the impacts of of terrain and temperature variations. The project will also investigate whether acoustic measurements can be used to detect the degree of icing. The results of this research will be used to develop freely available open source simulation tools and models.

Vibrations and load on windpower units subjected to ice
Project Time 2013-09-01--2017-10-31. The project concerns research in ice formation, flow mechanics, structural dynamics and load monitoring to contribute to the development of technical solutions for cost-effective construction, operation and maintenance of wind power in cold climates. Through national and international collaboration, the research team will develop methods for the simulation of ice growth, flow of ice-rudder blades, linear and nonlinear dynamics as well as load monitoring.

Wind power in cold climate - modelling of icing and production losses
Project Time 2013-09-01--2018-02-28. Weather models used by Sweden's meteorological and hydrological institutes, WeatherTech Scandinavian AB and Uppsala University will be refined with focus on parameterization of cloud physics and turbulence. The aim is to optimize the models' ability to calculate depletion and production loss of wind turbines operating under de-icing conditions. The project is expected to contribute to more accurate assessments of ice occurrences and production losses.

Read more about Wind Power in cold climate

2.4. VindEL

VindEL is the Swedish Energy Agency’s new research and innovation program in wind power. The program aims to contribute to the transition to a sustainable and renewable energy system through research and development of technologies, systems, methods and issues related to wind power. Together with the Vindval program, the Energy Agency’s current research efforts in wind power are gathered here.

The main task for the program is to contribute to the wind energy impact targets that the Energy Agency points out in its wind power strategy:

• Wind power is an important part of Swedish electricity supply.

• Wind power contributes to the climate, business development and stability of the electricity system.

• The operation and expansion of wind power takes into account social, ecological and economic sustainability.

As with the Energy Agency's other research and innovation programs, a large part of the program funds are distributed to projects through research calls.

VindEL’s funding comprises SEK 133 million, spread over five years and ending in 2021. The first call for research applications took place in spring 2017 with funding decisions being announced in autumn 2017. There are no completed projects within the program. The research calls are aimed at the areas identified as priority areas of the strategy.

The program now has three overall priority areas of action which are:

1. Wind power in Swedish conditions
2. Long-term durability
3. Integration into the electrical system

During spring 2018 a new research call will be made by VindEL. The previous priorities remain, but during this call the following three categories will be used:

A. Demand-driven research at universities and colleges or institutes

B. Enterprise-driven innovation and development projects

C. Verification projects in relevant test environments

Applications in categories B and C are especially encouraged. In category A, applications are only open for the topics of Swedish conditions and sustainability.

More about VindEL

Current announcement within VindEL, closing May 25th 2018

The first announcement within VindEL

Granted projects within VindEL pdf

Swedish Energy Agency strategy for wind power

Projects accepted within the 2017 VindEL- research call

Effective trade for integration of wind power
The purpose of the project is to develop agent-based models to analyze how trade would work in electricity markets with different market structures. The models will be tested on realistic systems and are expected to be the basis for new simulation tools to analyze the development of the electricity market through continued large-scale expansion of wind power. Royal Institute of Technology, Mikael Amelin.

Impact and short-circuit analysis in wind farms with 36 kV cable network and vacuum switches
This project investigates how high frequency transients in a cable network affect connected components. Both generation and propagation and apparatus protection are studied. In the project, measurements are planned in the StorRotliden wind park where there have been breakdowns of cable termination at transformers. Compared to previous work in this theme the focus is on the design of the soil system, especially its high frequency properties with different soil resistance. Furthermore, it is analyzed how the transients affect connected objects and what protection may be required. Chalmers Technical University AB, Tarik Abdulahovic.

Harmonics and switching transients in wind parks – towards a better understanding of simulations and measurements
This project is aimed at harmonics and switching over-voltages in and near wind farms connected to higher voltage levels. The project is a collaboration between the Electric Power Engineering Group at Luleå University of Technology, Vattenfall R & D, Skellefteå Kraft Production and a number of partners through a reference group. The need for simulations and measurements for the mentioned phenomena is large, but there are a number of challenges in both, which limit the possibilities. The purpose of this project is to go a step further with these challenges and to provide guidance for future research in this

area. The project will consist of three specific parts: development of theoretical basis; application to measurements in a number of existing wind farms; dissemination of results. Luleå tekniska universitet, Mathias Bollen.

Sound optimization of wind parks
Wind turbines create noise and guidelines for such are in Sweden, often the dimensional factor in choosing the type of work, the number of works and its location. The project will investigate whether sound propagation models can be used to optimize the operation and planning of wind power using prevailing meteorology and wind turbine guidelines. The aim is to achieve more effective utilization of existing parks and a more efficient planning of new projects. Royal Institute of Technology, Karl Bolin.

Detecting and eliminating bearing currents for longer lifespan of mainshaft bearings
The primary purpose of the project is to extend the lifespan of wind turbines by detecting and eliminating the impact of bearing currents. The aim of the project is to understand the appearance of bearing currents in wind turbines as well as the approaches to eliminate them. This means that the life span of the bearings, and in many cases also the life of the entire wind power plant, can be extended. The work will be concentrated on the turbine's bearings on the main shaft. The project is carried out in cooperation with 3 wind power owner/operators and 1 bearing manufacturer in Sweden. The project begins with a basic study of how bearing currents can occur and its modeling as well as laboratory tests. In addition, measurements are do on on-site wind turbines with suspected bearing current problems. The impact of dynamic mechanical stress on bearing currents will be investigated. Finally, methods to eliminate the bearing currents will be reported and presented publicly. Chalmers Tekniska Högskola AB, Ola Carlson.

The influence of clearings in forests: CFD simulations and LIDAR measurements
This project will investigate how forest clearings impact the load and energy production of a wind power project. Advanced CFD simulations (CFD=Computational Fluid Dynamics) coupled to load and production simulations will be performed, and the simulations will be validated against LIDAR measurements. The measurement campaigns will be performed before and after tree felling next to a wind power projects (in the predominant wind direction). Simulations will be carried out to provide general recommendations on how and where to clear forest around a wind farm, and how key-hole cuts should be designed to minimize the maintenance costs and fatigue loads on turbines. Chalmers Tekniska Högskola AB, Lars Davidson.

Improved deicing system - Industrial research and experimental development based on previous
The project aims to develop, demonstrate and validate a full-scale prototype of a wind turbine deicing system that can be used in a so-called "retrofit". Lindskog Innovation AB, Sven-Erik Thor.

Voltage dip characteristics for improved fault-ride-through of wind-power installations
This project combines knowledge on power quality (specifically voltage dips) with knowledge of wind turbine fault-ride-through. The project is a collaboration between

Luleå University of Technology (LTU) and Chalmers University of Technology (CTH) with input and receipt of results through an industrial reference group. LTU contributes with models of voltage drops; CTH with models of wind turbines. In the project, the models will be used to get further understanding of the fault-ride-through resistance of wind farms. The project will lead to increased understanding of how different properties of voltage dips affect wind turbines and wind farms. Results from the project will allow various stakeholders to improve fault-ride-through of wind turbines, thus contributing to a more robust power system with large amounts of wind power. The results of the project will be distributed directly to the various stakeholders. Luleå Tekniska Universitet, Mathias Bollen.

Grid-forming wind power plant - A coordinated control of wind power and energy storage system to facilitate large penetration of wind power
The aim of this project is to develop a coordinated control strategy between the wind power plant and the energy storage system in order to provide the wind plant the same grid-forming properties of a conventional synchronous generator. Control strategies for operations under normal as well as fault conditions will be analyzed and implemented. New ancillary services for the power system that can be enabled thanks to the control coordination will be investigated. A feasibility study of the most suitable energy storage media as well as of the needed power electronic interface for the energy storage will be carried out. Proper dimensioning of the energy storage system will be conducted, aiming at reducing the storage requirements as compared with todays solutions. Chalmers Tekniska Högskola AB, Massimo Bongiorno.

Eagle Watch – intelligent technology eliminates collisions between large birds and wind turbines
In recent years, many promising wind power projects denied permits due to risks that eagles would get hit by rotating wind turbine blades. IdentiFlight is a technology based on smart cameras that monitors the airspace within a wind farm and if an eagle comes within distance when the risk of collision is present the actual turbine is shut down temporarily. IdentiFlight In-ternational, Vattenfall Vindkraft and the Wind Power association on Gotland will now test the technique on a windfarm on Gotland, which carries Sweden's most dense population of eagles. The project is linked to the research project "Coexistence wind power and eagles on Gotland" that Uppsala University currently is running. Two stated goal of this project is to develop a technical specification for bird protection system and to analyse the acceptability of bird protec-tion system of key stakeholders. The technology may lead to that several thousand MW of wind that currently cannot be built will be possible to establish. Vindelproducenternas Förening, Andreas Wickman.

Timber meets wind power: Development of weather protection
The project is part of the development of modular wind towers in biobased materials (Gluelam, CLT & LVL) with the aim of reducing costs and CO2 emissions in the production, transport, installation and operation of wind turbine towers. The aim of this specific project is to develop weather protection with functioning condensation management for wooden wind towers. For wooden wind towers to be commercially viable in the market, development in the field of weather protection is required, as weatherability is vital for

the life of the tower structure and functionality and for keeping maintenance costs low. Modvion AB, Otto Lundman.

Design of cost effective DC-based collection-network for inland-sea wind-farm using series high-frequency transformers
In this project, the design of a medium frequency transformer for inland sea is proposed. The design is intended for applications when the series coupling of the output of multiple DC/DC converters on their high voltage side is done to achieve high voltages for collecting energy from wind parks, where today expensive platforms are needed to accommodate the heavy 50 Hz transformers. The focus is on the isolation of medium frequency high voltages which should at the same time be able to dissipate the heat produced from the losses. The work builds on a three years collaboration between RISE and Chalmers around a PhD project and has resulted in one journal article and 2 conference publications so far. The goal is to determine what power density can be achieved at different frequencies and output voltages. The work begins with the determination of the study case and the isolation study, and then the project is finalized with the design and verification of a prototype and LCC calculations. Rise Research Institutes Of Sweden AB, Mohammad Kharezy.

Wear resistant multifunctional coatings for wind turbines in cold climate
Ice formation on wind turbines creates serious problems like a reduction in energy production, increased wear of mechanical components and risks for people and animals close to the wind turbines. This makes the use of wind turbines in cold climates less attractive. The purpose of this project is to develop a new technology for prevention of ice formation and anti-icing when ice formation could not be prevented. The proposed project will develop and evaluate a wear resistant, water repellent and heat generating polymer composite coating. The aim is that the coating should be applied by spraying and therefore significantly reduces the cost for application and repairs compared to competing technical solutions. Furthermore, since the heat is generated where it is needed, in the coating itself, the power consumption can be decreased. A successful project will lead to increased efficiency, economy and increased attractiveness for wind turbines in cold climates. Luleå tekniska universitet, Yijun Shi.

Variation management for efficient integration of high amounts of wind-power
The aim of this project is to determine how variation management strategies (e.g. by means of batteries and hydrogen production) can contribute to grid integration by providing grid stability and frequency control in high wind scenarios in the Swedish electricity system, while at the same time considering import/export between regions. The modeling takes departure in a previously developed electricity system modeling package which will be further developed to take power system engineering aspects into account. Chalmers Tekniska Högskola AB, Filip Johnsson.

Local effects on icing for wind power in cold climate
This project addresses how local surface details affect atmospheric icing on wind turbines. The distribution of land use, the forest characteristics, and its snow cover influences vertical heat, momentum and moisture fluxes, thus affecting the possibility and height distribution of atmospheric icing.

These effects will be studied by developing a state-of-the-art modelling chain of numerical weather prediction, icing and related loss of wind power production and by comparison with local observations of meteorological parameters, icing and production losses. The local effects will then be implemented into a probabilistic forecasting system allowing for the operational assessment of icing risks. The overall goals of the project are a better understanding of these local effects on atmospheric icing, the improvement of the probabilistic prediction system and its increased usage for wind power in cold climate, and the education of a PhD student. SMHI, Heiner Körnich.

IceLoss 2.0 – detailed calculations of ice loads and the associated production losses on wind turbines
Blade icing is a major issue for wind farms in cold climate areas, decreasing energy production (up to 15% and more on an annual basis depending on the site) and potentially reducing wind turbine lifetime by increased vibrations and fatigue loads. The main purpose of the project is to give developers of wind power, investors and banks more accurate estimations of losses due to ice on the turbine blades. The loss related to ice is often, part from internal wake losses within the wind farm, the single largest loss when the long-term production for a wind farm located in a cold climate area is being assessed. Better estimations of icing losses will give possibilities for increased profitability in the projects. Increased profitability can be achieved through better decisions, early in the project, being made with respect to the need of investments in de-icing equipment. A more accurate production estimate will also lead to better economic conditions at banks and other investors. Kjeller Vindteknikk AB, Johannes Lindvall.

Control design methodologies to reduce high-frequency resonance interactions in power-electronic converters to enhance wind power generation
The aim of this project is to investigate the risk for converter control interaction in systems with high penetration of wind power. In particular, the focus of the project is on interactions in the high-frequency range. Key control and system parameters that have a major impact on the system stability will be identified and new control algorithms together with design guidelines and recommendations will be proposed to avoid this kind of instabilities. This will ease the interoperability of multivendor systems, thereby facilitating large penetration of wind power without compromising the system stability. Finally, the proposed solutions will be verified analytically, via simulation and over a small-scale laboratory setup. Chalmers Tekniska Högskola AB, Massimo Bongiorno.

2.5. Research and innovation for the future electricity grid – SamspEL

The Swedish electricity system is facing a period of continuous and major changes, both on the production and user side. In 2016, the Swedish Energy Agency initiated the program SamspEL to support research, development and innovation around the electricity grid and will contribute to the development of a completely renewable electrical system - the sociotechnical system, its actors and rules - and the interplay within the system. The program will contribute to the development of an electrical system that is flexible, resource efficient and robust. Within the program, several projects have been funded that are relevant to wind power.

Examples of ongoing projects related to wind power in the SamspEL program:

Power electronics-based DC transformers for ocean-based DC interfaces	Torbjörn Thiringer	Chalmers
Minimization of loss in large numbers of wind and solar power in power systems	Lennart Söder	KTH
Effective regulation of power balance in electrical systems with a high proportion of renewable production	Magnus Perninge	Linnéuniversity
Compensation for a power system dominated by renewable sources	Urban Lundin	Uppsala University
New forecast support for resource efficient operation of power grids	Niclas Ehn	Expektra

More about the research program SamspEL

2.6. RISE

RISE (Research Institutes of Sweden) is an independent, state research institute with 2,300 employees, of which approximately 700 are PhD researchers. Here, all types of business research projects and innovation processes for technologies, products and services in many areas are run and supported, which wind power is one. RISE collaborates internationally with companies, academia and the public sector to contribute to a competitive business community and a sustainable society.

Research and innovation in the field of wind power has grown at RISE for several years, mainly focusing on testing and certification services. Wind power research has been a topic of focused research for a couple of yearsand will continue and expand in line with the owners' (Swedish state) objective of 100% renewable electricity generation by 2040.

The aim of RISE's commitment to wind power is to conduct, as research institute, applied and business research at relatively high levels, while at the same time collaborating with universities and colleges around research. This is done in accordance with RISE's mission to support companies in their research and innovation work and to promote business development. In 2018 RISE will continue its efforts towards innovation and research in the field of wind power. A part of this effort has been to launch an internal focus area in renewable electricity generation to realize innovative research projects.

Another effort is an internal collaborative initiative to focus different research areas on the needs for successful wind power development within RISE. Both initiatives aim to launch new research projects in collaboration with the wind power industry during the year. Both initiatives aim to launch new research projects in collaboration with the wind power industry during the year. Both of these initiatives have also received internal funding with additional targeted funding from the Ministry of Industry, as they are considered important in the process of achieving the 100% renewable energy target in sustainable manner by 2040.

As part of the strategic work on skills supply and knowledge dissemination, RISE will hire additional researchers and project managers focusing on wind power in the coming year. In 2018, European research cooperation will be expanded through greater involvement in the wind power portion of EERA, the European Energy Research Alliance, and similar research networks in order to strengthen Sweden's role as a knowledge center in wind power.

Selected priority areas for the coming years are:

- Cold climate testing and verification as well as technology and materials for deicing

- Sea-based wind power in Swedish conditions

- Efficient operation and maintenance methods for increased technical life, additional cost reductions and increased durability

- Increased contribution / benefit from wind power for the stability of the electrical system

- Fire and fire protection for wind turbines and electric power equipment

Read more on RISE website

Below are current projects presented in 2017 at RISE with relevance to wind power:

Cold Climate Test
The project aims to establish a full-scale test facility for testing new models of wind turbines in an authentic cold climate environment in cooperation with the energy industry. RISE took over the project from Swerea 2016 and has concluded an appropriate test site for the last year and started the design work to create a test center. There is more

information on the project's website where the application for the project newsletter is also available. Kontaktperson: Stefan Ivarsson.

Test Center Skagerrak
RISE works together with, among other parties, the Lysekils municipality to build a partnership between technology developers, subcontractors, researcher and the public sector with the aim of establishing Test Center Skagerrak as a test and demonstration area for sustainable marine and marine research and innovation. Part of the activity in the project is aimed at the field of offshore wind power. Contact person Kerstin Hindrum.

Design of cost-effective DC-based catchment network for indoor wind power park by series-connected high-frequency transformers
Project 2017-11-01--2020-10-31
In this project, a special wind farm configuration for intermittent transformer indoor environment is to be investigated. The design involves serial coupling the output of several DC / DC converters on their high voltage side to achieve high DC voltages for energy collection in a wind park. Thus expensive platforms carrying the heavy 50 Hz transformers can be avoided. The focus is on high voltage isolation at medium frequency levels. In addition, thermal properties will be investigated to ensure appropriate operating temperature. The work is based on a three-year research collaboration between RISE and Chalmers, which has so far resulted in three publications.

The goal is to determine what power density can be achieved at different frequencies and output voltages. The work begins with typing for theoretical isolation studies, and then the project is completed with design and verification of a prototype and LCC calculations for a planned wind park. Contact person: Mohammad Kharezy.

Offshore West
Within the Offshore West Innovation Network, RISE operates a number of collaborative projects between industry parties. In the field of wind power, a number of preliminary studies have been conducted focusing on the potential of member companies in the field of offshore wind power development in Swedish conditions. Contact person: Tanja Tränkle.

Deicing
RISE has continued its work in the energy area of cold climate around the deicing of various components and has built a new ice-wind tunnel located in a Stockholm lab. The new ice-tunnel tunnel provides the opportunity to create different kinds of atmospheric ice on different materials, as well as to measure the adhesion of ice to these. Here tests and research on ice / frost repellent materials and anti-ice surfaces for various applications is done. Contact person: Kenth Johansson

Operation and maintenance of wind turbines
In the field of operation and maintenance, RISE's assets include, among other things, developing new improved models for VMEA, Variation Mode and Effect Analysis, for better reliability forecasts and service forecasts. Cooperation with SEES, the Swedish Association for Environmental Resilience Technology, has led to a jointly arranged conference focusing on innovations in maintenance technology in the wind power industry. Contact person: Anette Granéli and Stefan Ivarsson.

Explanation models for interference from wind turbines

RISE conducted a mapping of noise levels from wind turbines in the 2-3 MW turbine class in different terrain. An evaluation of the perceived disturbance due to the characteristics and strength of the sound was made in two parts. First, residents of different wind parks responded to a survey, then experiments were conducted with subjects in the sound field simulation laboratory at RISE. The project also evaluates how perceived ownership or local economic gain affects the perceived disturbance. The final report is expected in Q1 2018. Contact person: Dag Glebe

Wind turbines of wood
a) Validation of the wood structure with focus on binding.
RISE assists Modvion in the development of the wood construction and establishes and performs a number of tests to verify structural strength in critical sections.
b) Validation of surface layers for the wood construction
RISE assists Modvion in validating design, implementation and durability of the surface layers of wind turbines made of wood. Certain tests will be carried out in a lab environment to ensure that the solution lives up to the expected life span.

2.7. STandUP for Wind

STandUP for Wind is a research center for the establishment and development of wind energy in Sweden. The center is collaboration between the Royal Institute of Technology KTH, Uppsala University, Luleå Technical University and the Swedish University of Agricultural Sciences within the government's strategic research area.

STandUP for Energy was formed in 2009, following a government decision to allocate funds to universities and colleges for the development of 24 research areas which were considered strategically important. One of these areas was renewable electricity generation on a larger scale and its integration into the power grid. Within this agreement, wind parks were gathered in the research center STandUP for Wind, where the intention is to facilitate the development towards a larger proportion of electricity from wind power in the grid through interdisciplinary working methods.

Researchers from the respective higher education institutions meet regularly and exchange knowledge and experience. Within the association of STandUP for Wind, there is also a knowledge exchange with companies in the wind power industry. The aim is to ensure that research is done on the issues which are most important for industry to solve and that the research results reach relevant recipients.

STandUP for Wind, which aims to facilitate the conversion to renewable energy sources and the development of the needed network conditions, has profiled itself a leader in project development and planning of wind parks in Sweden.

The associations research topics range from how the wind is generated to how electricity is integrated into the Swedish grid.

In an evaluation initiated by the Swedish Energy Agency, STandUP for Wind has been identified as a strong research environment with special strengths within both project development and grid conditions.

Projects are currently underway in the following areas:

- Wind mapping and cold climate
- Current mechanics for wind turbines in parks and forests
- Electrical systems
- Sound
- Vertical wind power systems
- Generators and control systems
- Landscape and participatory planning
- Operation and maintenance

Energy conversion is a priority area where discussions and collaborations are ongoing about future projects and opportunities.

Read more on the website, STandUP for Wind

2.8. Swedish Wind Power Technology Centre

The Swedish Wind Power Technical Center (SWPTC) was established in 2010 with the aim of strengthening Swedens expertise in wind power technology and meeting the needs of the rapidly expanding global wind power industry.

Today, the focus of SWPTCs work is the development of wind turbines, which optimizes the cost of manufacturing and maintenance. The objective of the business is to build up component and system knowledge that enables the development and production of subsystems and complete wind power turbines in Sweden.

SWPTC also assists the wind power industry with knowledge of engineering technology and training of engineers. SWPTC is headed by Chalmers University of Technology and is run in collaboration with Luleå University of Technology and companies in the wind power industry.

The research at SWPTC focuses on major wind parks in forest, mountainous and offshore parks and is conducted in six thematic groups that reflect the design and operation of wind turbines. These are:

- Electricity and control systems
- Turbine and wind load
- Mechanical power transmission and system optimization offshore
- Maintenance and reliability
- Cold climate

At the moment, stage 2 is ongoing, which has funding until September 2018, when the current projects will be completed. Planning is in progress for stage 3 **.**

Projects ongoing during 2017, SWPTC:

TG0-21 Wind turbines with difficult operating conditions

TG1-21 Electromagnetic Transient study of wind farms connected by HVDC

TG2-22 Vindkraft i skog – Wind power in forest - impact of forest clearings

TG3-22 Modeling of driveline dynamics based on data from monitoring systems

TG4-21 ISEAWIND – Innovative design solutions for wind power foundations at sea

TG4-22 Analysis of floating wind farms

TG5-21 Optimal maintenance of wind power turbines

TG6-21 Increased reliability of heating systems on wind turbine blades

Of these, TG1-21 and TG4-22 were completed in 2017. Other projects will continue in 2018. In two of the projects, life-time calculations for components and wind turbines as a whole are included.

Read more about WPTC via Chalmers

2.9. Summary

The various research programs and research centers presented here provide a picture of what is happening in wind power research in Sweden. The Swedish Energy Agency is a main financier for Vindval, Wind power in cold climate, the new VindEL research program and part financier of Vindforsk IV.

Vindval is a collaboration between the Swedish Energy Agency and the Swedish Environmental Protection Agency, focusing on the impact of wind power on human, nature and the environment, with forthcoming announcements about large scale planning and impact on reindeer. Vindforsk IV has a technical focus and is financed by the Energy Agency and the wind power industry through Energiforsk. Cold climate wind power has a clear focus on the challenges facing wind power in colder areas.

During 2017, the Swedish Energy Agency has gathered its support for wind power research within the new program VindEL, Vindval and SamspEL. Here is a comprehensive approach for the continuation of previous Vindfork and Vindkraft programs in cold climate can be seen.

There is also planning for an industrial consortium for cooperation between industry and academia that can take place after completion of Vindforsk IV.

STandUP for Wind is a research center that is collaboration between the Royal Institute of Technology, Uppsala University, Luleå Technical University and the Swedish University of Agricultural Sciences. Research on how the wind is generated and how it integrates into the Swedish electricity system with profiling on the design and planning of wind power is gathered.

The Swedish Wind Power Technical Center (SWPTC) is run by Chalmers in collaboration with Luleå University of Technology. This strengthens the expertise in wind power technology to meet the needs of the rapidly expanding global wind power industry. The focus is on the development of the wind turbine construction that optimizes the cost of manufacturing and maintenance.

As of 2017 the research institute RISE is also included in this compilation. Here, research and innovation in the field of wind power has grown for several years, mainly with a focus on testing and certification services.

In addition to the above research programs and centers, there are also international cooperation projects for wind power. An example is the New European Wind Atlas, which is a European cooperation in wind power research.

3. Published scientific articles and reports

In this listing, scientific articles are listed according to the subject. This includes articles that have been published during or in connection with conferences.

Some of the links below require login in Scope. When you open the link, you are free to open and read the document.

3.1. Financing, electricity market

Characteristics of investors in onshore wind power in Sweden
Darmani, Anna, et al., Environmental Innovation and Societal Transitions, ISSN 2210-4224, E-ISSN 2210-4232, Vol. 24, p. 67-82, 2017

Wind power volatility and its impact on production failures in the Nordic electricity market
Fogelberg, S., Lazarczyk, E., Renewable Energy, Volume 105, May 2017, Pages 96-105

Faster market growth of wind and PV in late adopters due to global experience build-up
Gosens, J., Hedenus, F., Sandén, B., Energy. Vol. 131, p. 267-278, 2017

Invention, innovation and diffusion in the European wind power sector
Grafström, J., Lindman, Å.,Technological Forecasting and Social Change, Volume 114, January 2017, Pages 179-191

Value of wind power – Implications from specific power
Johansson, V., Thorson, L., Goop, J., et al, Energy. Vol. 126, p. 352-36, 2017

Handling financial resource mobilisation in technological innovation systems - The case of chinese wind power
Karltorp, Kerstin, et al., Journal of Cleaner Production, ISSN 0959-6526, E-ISSN 1879-1786, Vol. 142, p. 3872-3882, 2017

Cost Performance and Risk in the Construction of Offshore and Onshore Wind Farms
Sovacool, B., Enevoldsen, P., Koch, C., et al., Wind Energy. Vol. 20 (5), p. 891-908, 2017

An investigation of renewable certificates policy in Swedish electricity industry using an integrated system dynamics model
Tang, Ou, International Journal of Production Economics, ISSN 0925-5273, E-ISSN 1873-7579, Vol. 194, p. 200-213, 2017

Spectral decomposition of regulatory thresholds for climate-driven fluctuations in hydro- and windpower availability
Worman, A.; Bottacin-Busolin, A.; Zmijewski, N.; et al. WATER RESOURCES RESEARCH Volume: 53 Issue: 8 Pages: 7296-7315 Published: AUG 2017

3.1.1. *Conference proceedings*

Proposing an Hourly Dynamic Wind Signal as an Environmental Incentive for Demand Response
Nilsson, Anders, et al., ADVANCES AND NEW TRENDS IN ENVIRONMENTAL INFORMATICS: STABILITY, CONTINUITY, INNOVATION, Springer, 2017, p. 153-164

3.2. Wind resources, energy calculations

Wind farms in complex terrains: an introduction
Alfredsson, Bo, et al., Philosophical Transactions. Series A: Mathematical, physical, and engineering science, ISSN 1364-503X, E-ISSN 1471-2962, Vol. 375, no 2091, 207

Wind-Wave Interaction Effects on a Wind Farm Power Production
Alsam, A., Szasz, R., Revstedt, J. Journal of Energy Resources Technology, Transactions of the ASME Volume 139, Issue 5, 1 September 2017, Article number 051213

Analysis of conditions favourable for small vertical axis wind turbines between building passages in urban areas of Sweden
Awan, Muhammad Rizwan, International Journal of Sustainable Energy, ISSN 1478-6451, E-ISSN 1478-646X, Vol. 36, no 5, p. 450-461, 2017

Towards Improved Understanding of the Applicability of Uncertainty Forecasts in the Electric PowerIndustry
Bessa, Ricardo J.; Mohlen, Corinna; Fundel, Vanessa; et al., ENERGIES Volume: 10 Issue: 9 Article Number: 1402 Published: SEP 2017

A survey of modelling methods for high-fidelity wind farm simulations using large eddy simulation
Breton, S.-P., Sumner, J., Sørensen, J.N., (...), Sarmast, S., Ivanell, S., Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering SciencesVolume 375, Issue 2091, 13 April 2017

Wake losses from averaged and time-resolved power measurements at full scale wind turbines
Castellani, F., et al., Journal of Physics, Conference Series, ISSN 1742-6588, E-ISSN 1742-6596, Vol. 854, no 1, article id, 2017

A linearized numerical model of wind-farm flows
Ebenhoch, Raphael, et al,Wind Energy, ISSN 1095-4244, E-ISSN 1099-1824, Vol. 20, no 5, p. 859-875, 2017

Effects From Complex Terrain on Wind-Turbine Performance
Hyvärinen, Ann, et al., Journal of energy resources technology, ISSN 0195-0738, E-ISSN 1528-8994, Vol. 139, no 5, article id 051205

Qualitative analysis of wind-turbine wakes over hilly terrain
Hyvärinen, Ann, et al., Journal of Physics, Conference Series, ISSN 1742-6588, E-ISSN 1742-6596, Vol. 854, no 1, article id 012023

Using long term synthetic time series to assess the impact of meteorological extreme events on renewable energy systems: a case study of wind and hydro power in Sweden
Höltinger, Stefan, et al., Geophysical Research Abstracts, ISSN 1029-7006, E-ISSN 1607-7962, Vol. 19, article id EGU2017-14131

High-Order Numerical Simulations of Wind Turbine Wakes
Kleusberg, Elektra, et al., Journal of Physics, Conference Series, ISSN 1742-6588, E-ISSN 1742-6596, Vol. 854, no 1, article id 012025, 2017

Parametric study of the actuator line method in high-order codes
Kleusberg, Elektra, et al., Stockholm: KTH Royal Institute of Technology, 2017. , p. 35

Complex terrain experiments in the New European Wind Atlas
Mann, J., et al., Philosophical Transactions. Series A: Mathematical, physical, and engineering science, ISSN 1364-503X, E-ISSN 1471-2962, Vol. 375, no 2091, p. 1-23, article id 20160101, 2017

Estimation of Weibull distribution for wind speeds along ship routes
Mao, W., Rychlik, I., Proceedings of the Institution of Mechanical Engineers Part M: Journal of Engineering for the Maritime Environment. Vol. 231 (2), p. 464-480, 2017

LES and PANS of turbulent flow through a staggered tube bundle
Minelli, G, et al., American Society of Mechanical Engineers, Fluids Engineering Division (Publication) FEDSM Volume 1B-2017, 2017ASME 2017 Fluids Engineering Division Summer Meeting, FEDSM 2017; Waikoloa; United States; 30 July 2017 through 3 August 2017; Code 131290

PANS study of the flow around an oscillating, simplified truck cabin with flow control
Minelli, G, et al., American Society of Mechanical Engineers, Fluids Engineering Division (Publication) FEDSM Volume 1B-2017, 2017ASME 2017 Fluids Engineering Division Summer Meeting, FEDSM 2017; Waikoloa; United States; 30 July 2017 through 3 August 2017; Code 131290

Wind-farm simulation over moderately complex terrain
Segalini, Antonio, et al., Journal of Physics, Conference Series, ISSN 1742-6588, E-ISSN 1742-6596, Vol. 854, no 1, article id 012042

Linearized simulation of flow over wind farms and complex terrains
Segalini, A., Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences Volume 375, Issue 2091, 13 April 2017

Validation of the actuator disc approach using small-scale model wind turbines
Simisiroglou, Nikolaos, Breton, S.-P., Ivanell, S., Wind Energy Science, ISSN 2213-3968, E-ISSN 2366-7443, Vol. 2, p. 587-601, 2017

Modelling spatially and temporally correlated wind speed time series over a large geographical area using VARMA
Yunus, K., Chen, P., Thiringer, T., IET Renewable Power Generation. Vol. 11 (1), p. 132-142, 2017

3.2.1. Conference proceedings

An Investigation of Wind Farm Power Production for Various Atmospheric Boundary Layer Heights
AlSam, A.; Szasz, R.; Revstedt, J. Conference: 2nd International Conference on Next Generation of Wind Energy (ICNGWE) Location: Lund Univ, Lund, SWEDEN Date: AUG 24-26, 2016 JOURNAL OF ENERGY RESOURCES TECHNOLOGY-TRANSACTIONS OF THE ASME Volume: 139 Issue: 5 Article Number: 051216 Published: SEP 2017

The Long distance wake behind Horns Rev i studied using large eddy simulations and a wind turbine parameterization in WRF
Eriksson, O, et al., Journal of Physics: Conference Series Volume 854, Issue 1, 13 June 2017, Article number 012012Wake Conference 2017; Uppsala University's Gotland Campus Visby; Sweden; 30 May 2017 through 1 June 2017; Code 128466

Swedish Wind Power Forecasts: Procedure, Error Distribution and Spacio-Temporal Correlation
Herre, Lars, et al., 6th International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants, Berlin, 2017, article id WIW17-124

Effects From Complex Terrain on Wind-Turbine Performance
Hyvarinen, Ann; Segalini, Antonio. Conference: 2nd International Conference on Next Generation of Wind Energy (ICNGWE) Location: Lund Univ, Lund, SWEDEN Date: AUG 24-26, 2016. JOURNAL OF ENERGY RESOURCES TECHNOLOGY-TRANSACTIONS OF THE ASME Volume: 139 Issue: 5 Article Number: 051205 Published: SEP 2017

Using long term synthetic time series to assess the impact of meteorological extreme events on renewable energy systems: a case study of wind and hydro power in Sweden
Höltinger, Stefan, et al. 2017

Wake Flow Simulation of a Vertical Axis Wind Turbine under the Influence of Wind Shear
Mendoza, V., Goude A., Journal of Physics: Conference Series Volume 854, Issue 1, 13 June 2017, Article number 012031Wake Conference 2017; Uppsala University's Gotland Campus Visby; Sweden; 30 May 2017 through 1 June 2017; Code 128466

Identifying well-behaved turbulent boundary layers
Sanmiguel Villa, C., et al., Progress in Turbulence VII, Springer Science Business Media B.V., 2017, Vol. 196, p. 67-72

Towards canonical adverse-pressure-gradient turbulent boundary layers
Örlü, Ramis, et al., 10th International Symposium on Turbulence and Shear Flow Phenomena, TSFP 2017, International Symposium on Turbulence and Shear Flow Phenomena, TSFP10 , 2017, Vol. 3, 2017

3.3. Design and loading of wind turbines

Enhancement of Free Vortex Filament Method for Aerodynamic Loads on Rotor Blades
Abedi, H., Davidson, L., Voutsinas, S., SWPTC , Journal of Solar Energy Engineering, Transactions of the ASME. Vol. 139 (3), p. Article number 031007-, 2017

Influence of execution tolerances for friction connections in circular and polygonal towers for wind converters
Heistermann, Christine, Advanced steel construction, ISSN 1816-112X, Vol. 13, no 4, p. 343-360, 2017

Induction in Optimal Control of Multiple-Kite Airborne Wind Energy Systems
Leuthold, R., Gros S., Diehl, M., IFAC-PapersOnLine. Vol. 50 (1), p. 153-158, 2017

Prediction of wind-turbine fatigue loads in forest regions based on turbulent LES inflow fields
Nebenführ, B., Davidson, L., SWPTC, Wind Energy. Vol. 20 (6), p. 1003-1015, 2017

Critical Speed Control for a Fixed Blade Variable Speed Wind Turbine
Rossander, Morgan, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 11, article id 1699, 2017

Mechanical torque ripple from a passive diode rectifier in a 12 kW vertical axis wind turbine
Rossander, Morgan, IEEE transactions on energy conversion, ISSN 0885-8969, E-ISSN 1558-0059, Vol. 32, no 1, p. 164-171, 2017

Fatigue Crack Detection for Lifetime Extension of Monopile-based Offshore Wind Turbines
Stutzmann, J., Ziegler, L., Muskulus, M., Energy Procedia, Volume 137, October 2017, Pages 143-151

3.3.1. Conference proceedings

On Heat Transfer Issues for Wind Energy Systems

By: Sunden, Bengt; Wu, Zan. Conference: 2nd International Conference on Next Generation of Wind Energy (ICNGWE) Location: Lund Univ, Lund, SWEDEN Date: AUG 24-26, 2016. JOURNAL OF ENERGY RESOURCES TECHNOLOGY-TRANSACTIONS OF THE ASME Volume: 139 Issue: 5 Article Number: 051201 Published: SEP 2017

3.4. Electrical grids, integration into electrical grid, electrical power

A Wavelet-Modified ESPRIT Hybrid Method for Assessment of Spectral Components from 0 to 150 kHz

Alfieri, Luisa, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 1, article id 97, 2017

Multi-objective Design Optimization Using Dual-Level Response Surface Methodology and Booth's Algorithm for Permanent Magnet Synchronous Generators

Asef, P., et al., IEEE Transactions on Energy Conversion 22 November 2017

Interharmonic currents from a Type-IV wind energy conversion system

Bollen, Math, et al., Electric power systems research, ISSN 0378-7796, E-ISSN 1873-2046, Vol. 143, p. 357-364, 2017

Analysis of Energy Curtailment and Capacity Overinstallation to Maximize Wind Turbine Profit Considering Electricity Price-Wind Correlation

Chen, P., Thiringer, T., IEEE Transactions on Sustainable Energy. Vol. 8 (4), p. 1406-1414, 2017

Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar

Clack, Christopher T. M., et al., Proceedings of the National Academy of Sciences of the United States of America, ISSN 0027-8424, E-ISSN 1091-6490, Vol. 114, no 26, p. 6722-6727, 2017

Implicit Integrators for Linear Dynamics Coupled to a Nonlinear Static Feedback and Application to Wind Turbine Control*

Gros, S., Quirynen, R., Schild, A., Diehl, M. IFAC-PapersOnLine, Volume 50, Issue 1, July 2017, Pages 545-551

Real time economic nonlinear model predictive control for wind turbine control

Grod, S., Schild, A. International Journal of Control 90(12), pp. 2799-2812, 2017

Simulating intra-hourly wind power fluctuations on a power system level

Olauson, Jon, et al., Wind Energy, ISSN 1095-4244, E-ISSN 1099-1824, Vol. 20, no 6, p. 973-985, 2017

Wind turbine performance decline in Sweden

Olauson, Jon, et al., Wind Energy, ISSN 1095-4244, E-ISSN 1099-1824, p. 1-5, 2017

Wind Turbine Performance Decline in Sweden

Olauson, Jon & Bergkvist, Mikael, Uppsala University. Per Edström, Sweco. Nils-Erik Carlstedt, Vindstat. Energiforskrapport 2017-436. ISBN 978-91-7673-436-0

Electrical hubs: An effective way to integrate non-dispatchable renewable energy sources with minimum impact to the grid

Perera, A. T. D., Vahid, N., Mauree, D. et al., Applied Energy. Vol. 190, p. 232-248, 2017

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Pereira, H.A., et al., Electric Power Components and SystemsVolume 45, Issue 18, 8 November 2017, Pages 2007-2016

Frequency control by variable speed wind turbines in islanded power systems with various generation mix
Persson M., Chen, P., IET Renewable Power Generation. Vol. 11 (8), p. 1101-1109, 2017

Frequency evaluation of the Nordic power system using PMU measurements
Persson M., Chen, P., IET Generation, Transmission and Distribution. Vol. 11 (11), p. 2879-2887, 2017

Permanent Magnet Working Point Ripple in Synchronous Generators
Sjökvist, Stefan, et al., The Journal of Engineering, ISSN 1872-3284, E-ISSN 2051-3305, p. 1-8, 2017

Generation Adequacy Analysis of Multi-Area Power Systems With a High Share of Wind Power
Tomasson, E., et al., IEEE Transactions on Power Systems2 November 2017

Optimal transmission access for generators in wind-integrated power systems: stochastic and robust programming approaches
Uzuncan, Ezgi, et al., IET Generation, Transmission & Distribution, ISSN 1751-8687, E-ISSN 1751-8695, Vol. 11, no 6, p. 1345-1359, 2017

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Grid Code Testing of Wind Turbine by VSC-based Test Equipment
Carlson, O., Espinoza, N., Wind Energy Science Conference 2017, SWPTC, DTU Lyngby, June 2017

Evaluation of the synthetic inertia control using active damping method
Chamorro, Harold R., et al., 2017 6th International Conference on Clean Electrical Power: Renewable Energy Resources Impact, ICCEP 2017, Institute of Electrical and Electronics Engineers (IEEE), 2017, p. 269-274, article id 8004826, 2017

Mitigation of SSCI in DFIG based wind farms through modification of Rotor-Side Converter Controller
Chernet, S. and Bongiorno, M., 2017 IEEE 3rd International Future Energy Electronics Conference and ECCE Asia, IFEEC - ECCE Asia 201725 July 2017, Article number 7992107, Pages 603-6083rd IEEE International Future Energy Electronics Conference and ECCE Asia, IFEEC - ECCE Asia 2017; Kaohsiung; Taiwan; 3 June 2017 through 7 June 2017; Category numberCFP17IFE-PRT; Code 129571

Inverter Loss Analysis and Comparison for a 5 MW Wind Turbine System
Kitagawa, W., 2017 19th European Conference on Power Electronics and Applications, EPE 2017 ECCE Europe Volume 2017-January, 6 November 201719th European Conference on Power Electronics and Applications, EPE 2017 ECCE Europe; Warsaw; Poland; 11 September 2017 through 14 September 2017; Category numberCFP17850-ART; Code 132330

Efficiency analysis of 5MW wind turbine system in an all-DC wind park
Kitagawa, W., et al., 2017 IEEE 3rd International Future Energy Electronics Conference and ECCE Asia, IFEEC - ECCE Asia 201725 July 2017, Article number 7992275, Pages 1542-15473rd IEEE International Future Energy Electronics Conference and ECCE Asia, IFEEC - ECCE Asia 2017; Kaohsiung; Taiwan; 3 June 2017 through 7 June 2017; Category numberCFP17IFE-PRT; Code 129571

Cable Impact on Integration of Wind and Solar Power
Stankovic, Stefan, et al., 2017

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Stankovic, Stefan, et al., 2017, IEEE Innovative Smart Grid Technologies (ISGT) Europe, 2017

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Wang, L., et al., 8th International Conference on Applied Energy, ICAE 2016; Beijing; China; 8 October 2016 through 11 October 2016;, Elsevier, 2017, Vol. 105, p. 1192-1198

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Xing, H, et al., 19th International Conference on Electrical Machines and Systems, ICEMS 201630 January 2017, Article number 783722319th International Conference on Electrical Machines and Systems, ICEMS 2016; APA Hotel and Resort Tokyo Bay Makuhari Chiba; Japan; 13 November 2016 through 16 November 2016; Category numberCFP16801-USB; Code 126281

A new re-synchronize control strategy for hybrid offshore wind farm auxiliary power supply system
Xing, H, et al., 19th International Conference on Electrical Machines and Systems, ICEMS 201630 January 2017, Article number 783722419th International Conference on Electrical Machines and Systems, ICEMS 2016; APA Hotel and Resort Tokyo Bay Makuhari Chiba; Japan; 13 November 2016 through 16 November 2016; Category numberCFP16801-USB; Code 126281

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An artificial neural network based condition monitoring method for wind turbines, with application to the monitoring of the gearbox
Bangalore, P., Letzgus, S., Karlsson, D., et al., Wind Energy. Vol. 20 (8), p. 1421-1438, 2017

Recommended practices for wind farm data collection and reliability assessment for O&M optimization
Berthold Hahn, et al., Energy Procedia, Volume 137, October 2017, Pages 358-365

Designing for safe operations: promoting a human-centred approach to complex vessel design
de Vries, L, et al., Ships and Offshore Structures Volume 12, Issue 8, 17 November 2017, Pages 1016-1023

A Parameter Selection Method for Wind Turbine Health Management through SCADA Data
Du, Mian, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 2, article id 253, 2017

New method for lubricating wind turbine pitch gears using embedded micro-nozzles
Farré-Lladós, Josep, et al., Journal of Mechanical Science and Technology, ISSN 1738-494X, E-ISSN 1976-3824, Vol. 31, no 2, p. 797-806, 2017

Investigating How an Artificial Neural Network Model Can Be Used to Detect Added Mass on a Non-Rotating Beam Using Its Natural Frequencies: A Possible Application for Wind Turbine Blade Ice Detection
Gantasala, Sudhakar, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 2, article id 184, 2017

Force measurements on a VAWT blade in parked conditions
Goude, Anders, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 12, article id 1954, 2017

On the attachment of dart lightning leaders to wind turbines
Long, Mengni et al., Electric power systems research, ISSN 0378-7796, E-ISSN 1873-2046, Vol. 151, p. 432-439, 2017

Modeling the Attachment of Lightning Dart and Dart-Stepped Leaders to Grounded Objects
Long, Mengni et al., IEEE transactions on electromagnetic compatibility (Print), ISSN 0018-9375, E-ISSN 1558-187X, Vol. 59, no 1, p. 128-136

A health condition model for wind turbine monitoring through neural networks and proportional hazard models
Mazidi, Peyman, et al., Journal of Risk and Reliability, ISSN 1748-006X, E-ISSN 1748-0078, Vol. 231, no 5, p. 481-494, 2017

A dictionary learning approach to monitoring of wind turbine drivetrain bearings
Martin del Campo Barraza, Sergio, et al., Mechanical systems and signal processing, ISSN 0888-3270, E-ISSN 1096-1216, 2017

Strategic Maintenance Scheduling of an Offshore Wind Farm in a Deregulated Power System
Mazidi, Peyman, et al., Energies, ISSN 1996-1073, E-ISSN 1996-1073, Vol. 10, no 3, article id 313, 2017

Hierarchical method for wind turbine prognosis using SCADA data
Chen, Niya; Yu, Rongrong; Chen, Yao; et al. +IET RENEWABLE POWER GENERATION Volume: 11 Issue: 4 Special Issue: SI Pages: 403-410 Published: MAR 15 2017

3.5.1. Conference proceedings

Condition monitoring of wind turbine pitch controller: A maintenance approach
González-González, Asier, et al.,15th IMEKO TC10 Workshop on Technical Diagnostics 2017: "Technical Diagnostics in Cyber-Physical Era", 2017, p. 200-206, 2017

Performance Analysis and Anomaly Detection in Wind Turbines based on Neural Networks and Principal Component Analysis
Mazidi, Peyman, 2017

Bearing faults in the wind turbine drivetrain: Comparative study of monitoring with FFT and the Discrete Wavelet Transform
Strömbergsson, Daniel, et al., 2017

3.6. Resource management of renewable energy sources

Motives to adopt renewable electricity technologies: Evidence from Sweden
Bergek, A., Mignon, I., Energy Policy. Vol. 106, p. 547-559, 2017

District heating system operation in power systems with high share of wind power
Dimoulkas, Ilias, et al., Journal of Modern Power Systems and Clean Energy, ISSN 2196-5625, E-ISSN 2196-5420, Vol. 5, no 6, p. 850-862, 2017

Political Economy of Safe-guarding Security of Supply with High Shares of Renewables: Review of Existing Research and Lessons from Germany
Gawel, Erik, et al., Stockholm: Energiforsk, 2017. p. 81

Natural resource endowment is not a strong driver of wind or PV development
Gosens, J., Renewable Energy. Vol. 113, p. 1007-1018, 2017

Solar Photovoltaic and Wind Energy Providing Water
Jones, Lawrence E.; Olsson, Gustaf, GLOBAL CHALLENGES Volume: 1 Issue: 5 Special Issue: SI Article Number: 1600022 Published: AUG 15 2017

Using resource based slicing to capture the intermittency of variable renewables in energy system models
Lehtveer, M., Mattsson, N., Hedenus, F., Energy Strategy Reviews. Vol. 18, p. 73-84, 2017

3.7. Planning and Policy

Motives to adopt renewable energy technologies: evidence from Sweden
Bergek, Anna, et al., Energy Policy, ISSN 0301-4215, E-ISSN 1873-6777, Vol. 106, p. 547-559, 2017

Toward Technology-Sensitive Catching-Up Policies: Insights from Renewable Energy in China
Binz, C., Gosens, J., Hansen, T., et al, World Development. Vol. 96, p. 418-437, 2017

Comparing electricity transitions: A historical analysis of nuclear, wind and solar power in Germany and Japan
Cherp, A., Vinichenko, V., Jewell, J., Suzuki, M., Antal, M., Energy Policy, Volume 101, February 2017, Pages 612-628

China's next renewable energy revolution: goals and mechanisms in the 13th Five Year Plan for energy
Gosens, J., Kåberger, T., Wang, Y.,, Energy Science and Engineering. Vol. 5 (3), p. 141-155, 2017

Policy-induced expansion of solar and wind power capacity: economic growth and employment in EU countries
Jaraite, Jurate, et al., Energy Journal, ISSN 0195-6574, E-ISSN 1944-9089, Vol. 38, no 5, p. 197-222, 2017

Wind Power Policy Implementation: The Beliefs of Sovereigns, Policy Outputs and Policy Impacts
Newell, David, Environmental Politics, ISSN 0964-4016, E-ISSN 1743-8934, 2017

Values, beliefs and elite decision-making: The case of the Markbygden wind power development
Newell, David, et al., Environmental Policy and Governance, ISSN 1756-932X, E-ISSN 1756-9338, 2017

Om beslutsteoretiska verktyg vid tillståndsprövning av vindkraft
Odelstad, Jan, Gävle: Gävle University Press, 2017, p. 73, RD-report, ISSN 1403-8749 ; 47

3.7.1. Conference proceedings

GIS-based methods for sustainable wind power planning
Byström, Gustaf, et al., 2017

3.8. Regional development and social benefits

Samhällsnyttans betydelse vid tillståndsprövningen av vindkraft
Ek, Kristina, et al., Stockholm, 2017. , p. 61; Rapport / Naturvårdsverket, ISSN 0282-7298 ; 6738

Distributional justice in Swedish wind power development – an odds ratio analysis of windmill localization and local residents' socio-economic characteristics
Liljenfeldt, Johanna, et al., Energy Policy, ISSN 0301-4215, E-ISSN 1873-6777, Vol. 105, p. 648-657, 2017

Estimating the spatially explicit wind generated electricity cost in Africa - A GIS based analysis
Mentis, Dimitris, et al., Energy Strategy Reviews, ISSN 2211-467X, E-ISSN 2211-4688, Vol. 17, p. 45-49

Geographic aggregation of wind power—an optimization methodology for avoiding low outputs
Reichenberg, L., Wojciechowski, A., Hedenus, F., et al., Wind Energy. Vol. 20 (1), p. 19-32, 2017

Reindeer habitat use in relation to two small wind farms, during preconstruction, construction, and operation
Skarin, A., et al., Ecology and Evolution, ISSN 2045-7758, E-ISSN 2045-7758, Vol. 7, no 11, p. 3870-3882, 2017

3.9. Acceptance

3.10. Impact on birds

Samexistens örnar och vindkraft på Gotland
Aldén, Liselotte, et al, Uppsala University, Department of Earth Sciences, 2017, p. 83

Betydelsen av kungsörnars hemområden, biotopval och rörelser för vindkraftsetablering: Del 2
Singh, J. Navinder, et al., Stockholm, 2017. p. 57, Rapport / Naturvårdsverket, ISSN 0282-7298; 6734

3.11. Climate and environmental impact

Kontrollprogram för vindkraft i vatten: Sammanställning och granskning, samt förslag till rekommendationer för utformning av kontrollprogram
Enhus, Carolina, et al., Stockholm, 2017. , p. 109; Rapport / Naturvårdsverket, ISSN 0282-7298 ; 6741

3.12. Noise and vibrations

A Vibration Estimation Method for Wind Turbine Blades
Aihara, Aya, et al., Experimental mechanics, ISSN 0014-4851, E-ISSN 1741-2765, Vol. 57, no 8, p. 1213-1224, 2017

Location of aerodynamic noise sources from a 200 kW vertical-axis wind turbine
Ottermo, Fredric, Journal of Sound and Vibration, ISSN 0022-460X, E-ISSN 1095-8568, Vol. 400, p. 154-166, 2017

3.13. Others

Wind turbine impact on operational weather radar I/Q data: characterisation and filtering (ENV/IMPACT)

Norin, Lars, Atmospheric Measurement Techniques, ISSN 1867-1381, E-ISSN 1867-8548, Vol. 10, no 5, p. 1739-1753, 2017

Benthic and fish aggregation inside an offshore wind farm: Which effects on the trophic web functioning? (ENV. IMPACT)

Raoux, A., et al., Ecological Indicators, Volume 72, January 2017, Pages 33-46

Analyzing a wind turbine system: From simulation to formal verification (SOFTWARE)

Seceleanu, Cristina Cerschi, et al., Science of Computer Programming, ISSN 0167-6423, E-ISSN 1872-7964, Vol. 133, p. 216-242, 2017

Spectral decomposition of regulatory thresholds for climate-driven fluctuations in hydro- and wind power availability (BALANCING)

Wörman, Anders, et al., Water resources research, ISSN 0043-1397, E-ISSN 1944-7973, Vol. 53, no 8, p. 7296-7315, 2017

3.13.1. Conference proceedings

Evaluating coverage effectiveness of multi-camera domes placement for volumetric surveillance

Alqaysi, H., et al., ACM International Conference Proceeding Series Volume Part F132201, 5 September 2017, Pages 49-5411th International Conference on Distributed Smart Cameras, ICDSC 2017; Stanford University Stanford; United States; 5 September 2017 through 7 September 2017; Code 132201

Exploiting opportunities in solar and wind power diffusion: the business models of private intermediaries

Aspeteg, J., Bergek, A.. The 8th International Sustainability Transitions (IST) Conference, 2017

EEM 2017 Forecast Competition: Wind power generation prediction using autoregressive models

Dimoulkas, Ilias, et al., European Energy Market (EEM), 2017 14th International Conference on the, IEEE conference proceedings, 2017

Placement Strategy of Multi-Camera Volumetric Surveillance System for Activities Monitoring

Fedorov, Igor, et al., ICDSC 2017 Proceedings of the 11th International Conference on Distributed Smart Cameras, New York, NY, USA: Association for Computing Machinery (ACM), 2017, Vol. F132201, p. 113-118

3.14. Reviews

Capacity value assessments of wind power

Milligan, M., Wiley Interdisciplinary Reviews: Energy and Environment, Volume 6, Issue 1, 1 January 2017, Article number e226

3.15. Summary of published articles and conference proceedings

The table below summarizes the academic publications from 2017. For this year, conference contributions in the form of papers and articles are not included in the table.

Tabel 1. The number of scientific articles and reports published in 2017, excluding papers and contributions to conferences.

Ämnesområde	2015	2016	2017
Financing, electricity market	5	4	9
Wind resources, energy calculation	5	5	20
Design and loading of wind turbines	4	9	7
Electricity grid, integration into electricity grid, electric power	7	14	17
Operation and maintenance	4	11	13
Resource management of renewable energy sources	2	-	6
Planning and Policy	2	3	8
Regional development, public benefits	5	4	5
Acceptance	1	1	-
Impact on birds	1	-	2
Climate and environmental impact	3	3	1
Sound or noise from wind turbines	1	-	2
Others	-	7	4
Reviews	2	3	1
Total	**42**	**64**	**95**

The summary is based on this report and *New and ongoing wind power research 2015 and 2016.*

According to the compilation in Table 1, the number of publications in wind power research has generally risen sharply in 2017 compared with 2015 and 2016. It is mainly articles in *Wind Resources, Operations and Maintenance* and *Planning* that have increased. There is also an increase in the *Finance* and *Electrical grid* categories. Within these areas there are well established research environments at Swedish universities.

The title of the *Combinations of Wind Power*, *Solar Energy and Hydrogen Production* has been replaced by *Resource Management of Renewable Energy*. The content of the category is the same. There has also been a significant increase in the number of publications in this category.

The category *Climate Impact* was expanded this year to include environmental impact.

4. Academic dissertations and theses

4.1. Doctoral dissertations

Distributed Control of HVDC Transmission Grids
Babazadeh, Davood, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Modelling interactions between distributed energy technologies and the centralised electricity supply system
Goop, Joel, Chalmers Technical University, 2017

Technological Change in the Renewable Energy Sector: *Essays on Knowledge Spillovers and Convergence*
Grafström, Jonas, Luleå University of Technology, Department of Business Administration, Technology and Social Sciences, Social Sciences, 2017

Where the Wind Blows: the socio-political geography of wind power development in Finland, Norway and Sweden
Liljenfeldt, Johanna, Umeå University, Faculty of Social Sciences, Department of Geography and Economic History, Economic and social geography, 2017

Impact of High levels of Wind Penetration on the Exercise of Market Power in the Multi-Area Systems
Moiseeva, Ekaterina, KTH, School of Electrical Engineering (EES), Electric Power Systems, 2017

Noise, eigenfrequencies and turbulence behavior of a 200 kW H-rotor vertical axis wind turbine
Möllerström, Erik, Halmstad University, School of Business, Engineering and Science, The Rydberg Laboratory for Applied Sciences (RLAS). Uppsala University, Uppsala, Sweden, 2017

Control and Planning of Multi-Terminal HVDC Transmission Systems
Nazari, Mohammad, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Locating Wind Power Policy: The Mechanics of Policy Subsystem Interactions
Newell, David, Luleå University of Technology, Department of Business Administration, Technology and Social Sciences, Social Sciences, 2017

Frequency response by wind farms in power systems with high wind power penetration
Persson, Mattias, Chalmers Technical University, 2017

Variability and variation management in a renewable electricity system -large-scale wind- and solar power deployment in Europe
Reichenberg, Lina, Chalmers Technical University, 2017

Electromechanics of Vertical Axis Wind Turbines
Rossander, Morgan, Uppsala University, Disciplinary Domain of Science and Technology, Technology, Department of Engineering Sciences, Electricity, 2017

Steady state analysis of HVDC grid with Wind Power Plants
Yunus, Kalid, Chalmers Technical University, 2017

4.2. Licentiate dissertations

Estimation of electromagnetic material properties with application to high-voltage power cables
Ivanenko, Yevhen, Linnaeus University, Faculty of Technology, Department of Physics and Electrical Engineering, 2017

Wind turbine simulations using spectral elements
Kleusberg, Elektra, KTH, School of Engineering Sciences (SCI), Mechanics, Stability, Transition and Control, 2017

Combined Electrical Power Generation using Solar and Wind
Mathiasson, Ingemar, Chalmers Technical University 2017

4.3. Master theses (two years)

On the impact of wind power on CO2 emissions in a power system
Ahlfors, Charlotta, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Risk Management in Offshore Wind Farm Development
Ahlgren, Erik; Grudic, Edis, Design and construction project management, Chalmers University of Technology, 2017

Assessment and comparative study of design method for onshore wind power plant foundations
Ahlström, Marcus; Holmquist, Carl, Structural Engineering and Building Technology, Chalmers University of Technology, 2017

Grid stability benefits with Seatwirl vs horizontal shaft windpower plant
Akel, Nour, Electric power engineering, Chalmers University of Technology, 2017

A Revised Model to Determine Leasehold Fees for Development of Wind Farms
Bills, Adam, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, 2017

Automatic wind turbine operation analysis through neural networks
Boley, Alexander, KTH, School of Electrical Engineering (EES), 2017

Kalman Filter with Adaptive Noise Models for Statistical Post-Processing of Weather Forecasts
Borau, Noelia, Linköping University, Department of Computer and Information Science, 2017

An Experimental Study of the High-Lift System and Wing-Body Junction Wake Flow Interference of the NASA Common Research Model
Brundin, Desirée, KTH, School of Engineering Sciences (SCI), Mathematics (Dept.), Optimization and Systems Theory, 2017

Implementation and Validation of Algorithm forEstimating the Possible Power of Curtailed Wind Turbines Exposed to WakeEffects
Defour, Loïc, KTH, School of Engineering Sciences (SCI), Mathematics (Dept.), Optimization and Systems Theory, 2017

Benefit and value of Li-Ion batteries in combination with largescale IRES: The case of solar PV in India and wind power in Sweden
Erdozia Perez de Herdeia, Agurtzane et al., KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems., 2017

Gravitationsfundament för vindkraftverk: Fallstudie Lyrestad vindkraftpark
Erikson, David, Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering, Mining and Geotechnical Engineering, 2017

Simulation and Optimization of a Hybrid Renewable Energy System for application on a Cuban farm
Frisk, Malin, Uppsala University, Disciplinary Domain of Science and Technology, Technology, Department of Engineering Sciences, Solid State Physics, 2017

Optimal Placement of FloatingTwo-Turbine Foundations in Offshore Wind Farms
Gelotte, Lovisa et al., KTH, School of Industrial Engineering and Management (ITM), Energy Technology, 2017

Aerodynamic performance of a wind-turbine rotor by means of OpenFOAM
Giannopoulos, Evangelos, KTH, School of Engineering Sciences (SCI), Mechanics, 2017

Online Regime Switching Vector Autoregression Incorporating Spatio-temporal Aspects for Short Term Wind Power Forecasting
Gilleran, Sean, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Strategier vid avveckling av vindkraftverk - en livscykelanalys: Miljöpåverkan för vindkraftverket Lucia af Boholmen från vaggan till graven
Hammar, Mikael, Karlstad University, Faculty of Health, Science and Technology (starting 2013), Department of Engineering and Chemical Sciences, 2017

Economic Modelling of Floating Offshore Wind Power: Calculation of Levelized Cost of Energy
Heidari, Shayan, Mälardalen University, School of Business, Society and Engineering, Industrial Economics and Organisation, 2017

Effektivt utnyttjande av elnät
Hosseini, Arash et al., KTH, School of Chemical Science and Engineering (CHE), 2017

Resistance of Polygonal Cross Sections of Lattice Wind Tower
Jia, Bicen, Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering, 2017

System-Wide Evaluation of Inertia Support Potentials from Wind Farms
Jung, Paul, Chalmers University of Technology, 2017

Power system performance when implementing dynamic rating on a wind farm connected transformer
Karlsson, Rikard, KTH, School of Electrical Engineering (EES), Electromagnetic Engineering, 2017

Windy Business: Exploring a Local Wind Power Project in Germany
Kimm, Dennis, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

The impact of wind power generation on the wholesale electricity price: Evidence from the Swedish electricity market
Li, Xiaoying, Umeå University, Faculty of Social Sciences, Umeå School of Business and Economics (USBE), Economics, 2017

Navier-Stokes modelling of offshore wind turbines using the SPH method
Le Goff, Jean-Marie, KTH, School of Industrial Engineering and Management (ITM), 2017

Retrofitting a Single-family Home with Increased Use of Renewable Energy
Ma, Chenwen, KTH, School of Architecture and the Built Environment (ABE), Civil and Architectural Engineering, Building Service and Energy Systems, 2017

Feasibility Study of Small Hydropower/PV/Wind Hybrid System for Off-Grid Electrification of Liben and MedaWoulabu Villages
Mandefro Bezie, Yalewayker, University of Gävle, Faculty of Engineering and Sustainable Development, Department of Building, Energy and Environmental Engineering, 2017

Localising suitable areas for wind power development in Kiruna Municipality.: A spatial multi-criteria decision analysis.
Marcianò, Pietro, Umeå University, Faculty of Social Sciences, Department of Geography and Economic History, Economic and social geography, 2017

Feasibility Analysis of the Use of Hybrid Solar PV-Wind Power Systems for Grid Integrated Mini-grids in India
Mata Yandiola, Cristina, KTH, School of Industrial Engineering and Management (ITM), Energy Technology, Heat and Power Technology, 2017

Analysis of Swedish Wind Power Forecast Quality over Forecast Horizon and Power System Operation Implications
Matusevicius, Tadas, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Bayesian Neural Networks for Short Term Wind Power Forecasting
Mbuvha, Rendani, KTH, School of Computer Science and Communication (CSC), 2017

On Control and stabilisation of floating wind platforms with the help of CFD analysis and the Magnus effect
Neumüller, Georg, KTH, School of Engineering Sciences (SCI), Mathematics (Dept.), Numerical Analysis, NA., 2017

Systemtjänster från vindkraft – en marknadsstudie.
Reckman, A., Richter, M., KTH, School of Industrial Engineering and Management (ITM), Energy Technology, 2017

Offshore Floating Platforms: Analysis of a solution for motion mitigation
Rodriguez Marijuan, Alberto, KTH, School of Architecture and the Built Environment (ABE), Civil and Architectural Engineering, Structural Engineering and Bridges. Kungliga Tekniska Högskolan, 2017

Finite Element Modelling and Parametric Studies of Semi-Closed Thin-Walled Steel Polygonal Columns - Application on Steel Lattice Towers for Wind Turbines
Ryan, Bona, Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering, 2017

Electricity generation from hybrid PV-wind-bio-mass system for rural application in Brazil
SONG, CONGCONG, KTH, School of Industrial Engineering and Management (ITM), Energy Technology, 2017

Grid connected large-scale energy storage: Literature review regarding present technology and application, with a complementary case study that investigates the profitability of storage within a wind farm
Skoglund, Per, Umeå University, Faculty of Science and Technology, Department of Applied Physics and Electronics, 2017

The relationship between weather forecasts and observations for predicting electricity output from wind turbines
Stamp, Alexander, KTH, School of Computer Science and Communication (CSC), 2017

Structural design of a wooden wind tower structure
Steen, Petra, Applied mechanics, Chalmers University of Technology, 2017

Cathodic Corrosion Protection in the Context of Lifetime Extension of Monopile-based Offshore Wind Turbines
Stutzmann, Jutta, Sustainable Energy Systems, Chalmers University of Technology, 2017

North European Power Systems Reliability
Terrier, Viktor, KTH, School of Electrical Engineering (EES), Electric Power and Energy Systems, 2017

Sustainable Development on Colonised Land: A Critical Discourse Analysis of the Sustainability of Wind-Power
Waara, Oskar, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Additive Manufacturing Applications for Wind Turbines
Wahlström, Niklas, KTH, School of Industrial Engineering and Management (ITM), Machine Design (Dept.), 2017

Sametingsvalet: Väljare, kandidater och exploateringar i Sápmi
Weber, Eric, Stockholm University, Faculty of Humanities, Department of Media Studies, 2017

The Impact of Wind Power Production on Electricity Price Volatility: A Time-Series Analysis
Wirdemo, Alexander, Luleå University of Technology, Department of Business Administration, Technology and Social Sciences, 2017

Analysis of reliability improvements of transformers after application of dynamic rating
Zarei, Tahereh, KTH, School of Electrical Engineering (EES). Kungliga Tekniska Högskola, 2017

Using Unsupervised Machine Learning for Outlier Detection in Data to Improve Wind Power Production Prediction
Åkerberg, Ludvig, KTH, School of Computer Science and Communication (CSC), 2017

4.4. Master theses (one year)

Multi-Criteria Decision Analysis in Wind power Project Development: Case study in Latvia
Antans, Andis, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Energy mapping of public buildings: A study at Älvkarlebyhus
Crowley, Kieran, University of Gävle, Faculty of Engineering and Sustainable Development, Department of Building, Energy and Environmental Engineering, 2017

Improvement of RANS Forest Model via Closure Coefficient Modification
DeSena, Geoffrey, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Computational sound propagation models: An analysis of the models Nord2000, CONCAWE, and ISO 9613-2 for sound propagation from a wind farm
Guimarães da Silva, Jôse Lorena, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Suitability Of The Emd-Conwx Europe Mesoscale Data For Wind Resource Assessments
Haxsen, Sören, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

The Strategic implementation of Urban Wind Turbines within the consumer market: Visualizing the possibilities for Urban Wind Turbines in the Netherlands
Jacobs, Stephan, KTH, School of Industrial Engineering and Management (ITM), Industrial Economics and Management (Dept.), Industrial Marketing and Entrepreneurship, 2017

Utilizing Energy Storage Applied on Floating Wind Turbine Economics Using a Spot-Price Based Algorithm
Johansson, Jim, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Performance Analysis of Operating Wind Farms
Khatab, Abdul Mouez, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Vessel Fleet Optimisation For Offshore Wind Power Maintenance
Liapodimitris, Dimitrios, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Modeling And Control Of Pv/Windmicrogrid
Myla, Bharath Kumar, Halmstad University. Mr. (Renewable Energy Systems), 2017

Aesthetic Impacts Of Wind Farm Obstruction Lighting: A Study About Aviation Safety Protocols, Lighting Technology, And Public Attitudes
Qureshi, Umer, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

An analysis of the discrepancy in availability and production at a wind farm in Sweden
Sadler, Edward, Halmstad University, School of Business, Engineering and Science, 2017

LES Simulation of Hot-wire Anemometers
Süer, Assiye, Luleå University of Technology, Department of Computer Science, Electrical and Space Engineering, 2017

Opportunities and challenges for a floating offshore wind market in California
Vandenbrande, Pieter-Jan, KTH, School of Industrial Engineering and Management (ITM), Industrial Economics and Management (Dept.), Industrial Marketing and Entrepreneurship, 2017

Measurement Driven Fatigue Assessment Of Offshore Wind Turbine Foundations
Wilberts, Frauke, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

A View Into Future Potential Ice Throw Policies And Their Effect On The Yield Of A Virtual Wind Farm
Wild, de, Marc Noël, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

4.5. Bachelor theses

Assessment of the Electricity Generation Mix in Ghana: the Potential of Renewable Energy
Ahmed, Amber, KTH, School of Architecture and the Built Environment (ABE), Sustainable development, Environmental science and Engineering, Industrial Ecology, 2017

Lightning protection for floating windmill
Al-Saidi, Elias; Norman Hult, Tobias, Maskiningenjör, Chalmers University of Technology, 2017

Anslutning av två vindkraftverk till befintligt nät
Arezoomande, Daniel, Högskolan Väst i Trollhättan samt hos Kungälv Energi AB i Kungälv, 2017

Integration of Large Scale Wind Power and the Issue of Flexibility
Claesson, Gabriel, KTH, School of Electrical Engineering (EES), 2017

Simulations of vertical axis wind turbines with PMSG and diode rectification to a mutual DC-bus
Fjellstedt, Christoffer , Uppsala University, Disciplinary Domain of Science and Technology, Technology, Department of Engineering Sciences, 2017

Kartläggning Och Analys Av Metoder För Att Förebygga Och/Eller Avhjälpa Isbildning På Vindkraftverkens Rotorblad
Gillström, Sara, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Public Attitude Towards Wind Power In A Developed And A Developing Wind Market – Case Study Of Spain And Poland
Gulatowski-Henk, Marcin, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Hållbara energilösningar för Ulleråker: En studie om integrering av hållbara energilösningar för värmeenergibehovet av stadsdelens planerade nybyggnation
Hajek, Isabelle, KTH, School of Architecture and the Built Environment (ABE), Sustainable development, Environmental science and Engineering, Industrial Ecology, 2017

Intelligent Wind Turbine Using Fuzzy PID Control
Hedlund, Richard and Timarson, Niklas, KTH, School of Industrial Engineering and Management (ITM), Machine Design (Dept.), Mechatronics, 2017

Detektion av fasta ekon vid vindmätning med SODAR
Holmgren, Viktor, Vikmyr, Karl-Johan Jönköping University, School of Engineering, JTH, Computer Science and Informatics, 2017

Förbrukning av mineraler ur ett livscykelperspektiv vid produktion av vindkraft kopplat till Vattenfalls utbyggnad av förnybar energikapacitet: En studie gjord för och i samarbete med Vattenfall AB
Holmqvist, Fredrik, Linnaeus University, Faculty of Health and Life Sciences, Department of Biology and Environmental Science, 2017

Energilagring i vätgas
Johansson, Marcus, Luleå University of Technology, Department of Engineering Sciences and Mathematics, 2017

Investigation of possibilities to analyze corrosion and discontinuities at early stages in wind turbine foundations
Lund Johansson, Jessica, Uppsala University, Disciplinary Domain of Science and Technology, Earth Sciences, Department of Earth Sciences, 2017

Coordination of Wind Power and Hydro Power
Solhall, Axel, KTH, School of Electrical Engineering (EES), 2017

Nya koncept för huvudskenstråki SVC-anläggningar
Wikström, D., Sundbom, P., Uppsala University, Disciplinary Domain of Science and Technology, Technology, Department of Engineering Sciences, Microsystems Technology, 2017

I sökandet efter nya vindkraftsområden: En studie om vindkraft i Södermanland
Wolk, Lars Teodor, Stockholm University, Faculty of Social Sciences, Department of Human Geography, 2017

Analys av egenfrekvenser och laster för en vertikalaxlad, skruvad Savoniusturbin: slutsatser om möjliga materialval och geometrierför att undvika resonans
Zetterkvist, Victor, Uppsala University, Disciplinary Domain of Science and Technology, Technology, Department of Engineering Sciences, Industrial Engineering & Management, 2017

4.6. Summary of academic dissertations and theses

The table below shows the number of academic dissertations and theses from 2015, 2016 and 2017.

Tabel 2. Number of doctorial, licentiate, master and bachelor theses from 2017.

Nivå	2015	2016	2017
Doctoral theses	11	13	12
Licentiate theses	3	4	3
Master theses (2 years)	17	22	46
Master theses (1 year)	16	11	16
Bachelors theses	10	10	17
Total	**57**	**60**	**94**

The summary is based on this report and *New and ongoing wind power research in Sweden* 2015 and 2016.

Masters (2 years) and Bachelors theses have increased during this period, especially in 2017. The number of doctoral dissertations and licentiate theses has held relatively steady during the same period.