Winterwind

INTERNATIONAL WIND ENERGY CONFERENCE

Winterwind 2025

Book of Abstracts

In session order

SWEDISH WINDPOWER ASSOCIATION

Program

Monday February 3

PRE-CONFERENCE (open for everyone)

9:20 -17:00 **Field trip**
To the Önusberget Wind Farm, part of the Markbygden cluster, located 35 km west of Piteå.

10:00-13:00 **Green industries** *Moderator: Lisa Ek – Scene 2*

Nordion - Green hydrogen, *Anders Järvelä, Nordion, SE (38)*
The grid of the future, *Inger Edlund Pedersen, Hitachi Energy, SE (43)*
Regional development towards a net zero world, Ove *Bryggman, Skellefteå kraft, SE (44)*
Canada's green industries, *Charles Godreau, Nergica (CA) (48)*

TBA
Panel discussion
Anja Palm, Business Development Director, Skellefteå municipality

13:00-14:00 **Lunch on your own**

14:00-17:00 **IEA Task 54** – *Scene 2*

Chairs: Jennifer Pettersson and Timo Karlsson
WORKSHOP: IEA Task 54: Methodology to assess production losses due to icing from power curve analysis, *Jennifer Pettersson, Vattenfall, SE (27)*

17:00-18:00 **Break**

18:00-19:00 **Opening session** *Moderators: Lisa Ek and Per Olofsson*
Helene Hellmark Knutsson - *The governor of Västerbotten*
Global insights on wind turbine icing: operational envelopes and ice protection system efficiency across diverse climates, *André Bégin-Drolet, Université Laval, CA (46)*

19:00- **Dinner on your own**

Tuesday February 4

08:00-09:00 **Exhibition and registration**

09:00-10:00 **Hybrid systems** – *Scene 1*

Chairs: Sara Koller and Andreas Wickman

Lessons learned from solar measurements in the Nordics, *Sigbjørn Grini and Ola Kaas Eriksen, Kjeller Vindteknikk, part of Norconsult, SE (21)*

Evaluating curtailment uncertainty in wind and solar hybrid projects, *Henning Straume, DNV, NO (36)*

Hybridization of wind and solar, how to handle icing and curtailment, *Dina Martinsen and Sigbjørn Grini, Kjeller Vindteknikk, part of Norconsult, NO (24)*

09:00-10:00 **Rotor ice detection** – *Scene 2*

Chairs: Erika Dahlin and Charles Godreau

Influence of elevation, rotor diameter and hub height on blade icing duration, *Stefan Reimann, Weidmüller Monitoring Systems GmbH, DE (8)*

"Validation of cantilever sensors for ice detection on rotor blades", *Holger Fritsch, Bachmann Monitoring GmbH, DE (10)*

One system for all demands in cold climates, *Nils Lesmann, Phoenix Contact, DE (34)*

10:00-11:00 **Break**

10:15-10:45 **Poster session**

Chair: Narges Tabatabaei

Optimizing conductive heating for rotor blade anti-icing using wireless blade sensors,
Eike Lueken, eologix-ping, AT (42)

11:00-12:30 **Plenary session - Production and revenue** *Moderator: Lisa Ek – Scene 1*

Operational wind power forecasting at Hydro-Québec in winter conditions,
Eric Desrosiers, Hydro-Québec, CA (30)

The future of the prices and power balance in the power market,
Tor Reier Lilleholt, Volue Insight. NO (3)

What is Hybrid-PPA, and why is they important?,
Jens Nordberg, Varberg Energi, SE (1)

12:30-14:00 **Lunch**

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Tuesday February 4

14:00-15:00 Risk management – *Scene 1*

Chairs: Sigbjørn Grini and Tor Reier Lilleholt

How to Hack Windfarms: Exposing ICS Vulnerabilities Using Shodan, *Sascha Buhle, energy consult, DE (4)*

Improved daily planning for wind farm operators: Developing ice risk forecast based on automatic ice detection from nacelle cameras, *Sigmund Guttu, Kjeller Vindteknikk, part of Norconsult, NO (16)*

Wind Turbine Risk Assessments, *Christoph Schmidt, DNV Energy Systems Germany, DE (35*)

14:00-15:00 Icing events – *Scene 2*

Chairs: Jennie Molinder and Eric Desrosiers

Deep learning models for use in icing event prediction, *Rasmus Dovnborg Frederiksen, Siemens Gamesa / Aalborg University, DK (15)*

Eye-On-Site, Johan Casselgren, Pileus *Scandinavia, SE (28)*

Illustrating icing events complexity using the IEA Task54 public database, J*érôme Kopp, Meteotest AG (5)*

15:00-15:45 Break

15:45-17:00 IPS Manufacturers – *Scene 1*

Chairs: Emilie Iversen and Stefan Skarp

Ice-prevention through coating solutions, *Matiss Sivins, Phazebreak Coatings, US (18)*

Virtual temperature sensor in blade heating system and its validation, *Markus Heinonen, Wicetec, FI (6)*

Triggering ice protection systems with weather forecasts, *Dylan Baxter and Daniela Roeper, FabricAir, CA (32)*

Nordex: 15 Years of AIS Evolution, *Nils Lehming, Nordex SE, DE (12)*

15:45-17:00 Icing losses – *Scene 2*

Chairs: Jennifer Pettersson and Timo Karlsson

Validation of various approaches to forecasting production losses due to icing, *Christoffer Hallgren, Kjeller Vindteknikk, part of Norconsult, SE (23)*

WICE 2.5: Enhanced modelling of icing losses for North American and European regions utilizing mesoscale modelling, operational data and Machine Learning, *Luis Baquero, DNV, DE (37)*

How to adapt standard ice loss assessment models to local conditions?, *Marie Cecilie Pedersen, EMDI nternational, DK (11)*

Accurately quantifying changes in long-term, sitespecific, operational icing losses, *Ben Buxton, K2 Management, SE (2)*

17:00-18:00 Exhibition break

18:00-19:00 Leisure time

19:00-23:59 Networking among the exhibitors
Conference Dinner

Wednesday February 5

08:00-08:30 **Exhibition and registration**

08:30-09:30 **IPS Assessment** *Moderator: Lisa Ek*

Blade heating system performance envelope field validation - practical experiences,
Tomas Wallenius and Daniela Roeper, Wicetec, FI and FabricAir, CA (7)

Availability of Ice Mitigation Systems – A key driver for performance and revenue,
Simon Grenholm, W3 Energy, SE (22)

The missing piece: Solving the puzzle of Ice Protection System performance,
Patrice Roberge, Icetek, CA (14)

09:30-10:15 **Break**

10:15-11:15 **Assessment** – *Scene 1*

Chairs: Marie Cecilie Pedersen and Maria Mächtel

Retrofit of IPS – can we estimate the potential gain based on SCADA and model data?, *Jennie Molinder, Kjeller Vindteknikk, part of Norconsult, SE (20)*

Using icing measurements to investigate potential new areas for wind power in severe icing conditions, *John Magne Gitmark, Kjeller Vindteknikk, part of Norconsult, NO (25)*

Assessing the influence of anti-icing systems (AIS) on energy production – is AIS consumption adequately considered in pre-construction energy yield assessment?, *Sam Williamson, Wood, GB (26)*

10:15-11:15 **A suitable mix** – *Scene 2*

Chairs: Daniela Roeper and Johan Casselgren

IEA Wind Task 54: Ice, noise and impact on acceptance, *Timo Karlsson, VTT, FI (19)*

Wind climate research in Svalbard: the relevance of local processes, *Matthias Henkies, The University Centre in Svalbard, NO (29)*

Simulating ice throw risks in wind and hybrid farms – Monte Carlo simulations, icing modelling, and probability calculations, *Helmi Uusitalo, AFRY Finland, FI (40)*

11:15-12:30 **Lunch**

12:30-14:00 **Closing session - A cross section** – *Scene 1*

Moderators: Lisa Ek, Per Olofsson and Charles Godreau

Climate change and wind energy; how can you estimate future yield?
Emilie Iversen, Kjeller Vindteknikk, part of Norconsult, NO (31)

A sustainable energy transition is integrated and circular,
Gitte Haar, Center for Circular Economy, DK (9)

Summary of seminars: Green industries and IEA Task 54

Summary of Winterwind 2025

R&D areas/s: A) Wind

Global insights on wind turbine icing: operational envelopes and ice protection system efficiency across diverse climates

André Bégin-Drolet, Université Laval, CA

Philippe Guay (Icetek, CA), Patrice Roberge (Icetek, CA)

Icing on wind turbines poses significant challenges to energy production and turbine integrity, particularly in cold climates. This study provides a global perspective on wind turbine icing by utilizing data collected from sensors installed in Canada, the USA, Norway, Sweden, and Switzerland. Through the use of time-lapse imagery, we analyze ice accretion patterns across these regions and identify the meteorological conditions leading to icing events.

To contextualize the findings, we introduce the concept of operational envelopes—defined as the range of conditions (wind speed, air temperature, and liquid water content) within which ice protection systems are effective. Our analysis demonstrates that despite geographic and climatic differences, there are striking similarities in the conditions that lead to ice accretion. These results highlight the potential for universal principles in ice protection system design and operation.

This presentation aims to bridge the gap between regional studies and global strategies for mitigating icing losses in wind energy. By understanding the operational envelopes across diverse climates, we can enhance the efficiency and reliability of wind energy production worldwide.

Web site: www.gmc.ulaval.ca

Short biography: André Bégin-Drolet is a full professor of mechanical engineering at Université Laval in Canada. His research, in the wind energy sector, focuses toward improving wind power production in cold climate where atmospheric icing is prevalent. His research led him to the design of a patented smart sensor, the Meteorological Conditions Monitoring Station (MCMS), adapted to measure meteorological conditions in cold and icy environment. Moreover, he is very interested in developing methods to improve the production of wind energy in icing conditions using this novel instrument. In 2020, he launched the spinoff company Icetek with purpose to help the wind energy in cold climate to improve its performance. Wind is also part of his hobbies as he is an active racing sailor who loves to perform in both inshore and offshore regattas.

R&D areas/s: D) Hydrogen

Swedish hydrogen infrastructure

Anders Järvelä, Nordion Energi H2 AB

Anders Järvelä (SE)

Nordion Energi develops transmission solutions for hydrogen, especially in the northern parts of Sweden. As an example, we are developing the project Nordic Hydrogen Route together with Finnish gas TSO, GasGrid, with the aim of being able to commission a cross-border hydrogen network in the early 2030s. NHR is a prioritized EU project, a project for common interest.

The presentation will tell about how the project has developed so far and what is planned forward

Web site: https://nordionenergi.se/

Short biography: I have 30 years of experience in energy solutions, especially in electric power generation and electricity market. I have worked in large energy companies with the development of wind power in cold climates, among other things.
Working since two year with developing hydrogen infrastructure solutions mainly in Sweden

R&D areas/s: Grid challenges and solutions

The grid of the future

Inger Edlund Pedersen, Hitachi Energy, SE

Hitachi Energy (SE)

An overview of the challenges the grid faces, from weakness, decentralization, lack of stability and resilience in the new energy landscape. Going into the possible solutions to enhance and stablize the grid for the increased demand of electrification.

Web site: www.hitachienergy.com

Short biography: Inger E Pedersen is a key account manager at Hitachi Energy working closely with industry clients to support them with solutions for their energy transition, from energy storage to power quality. With the foothold in Luleå she focuses on the large industrial investments in northern Sweden. In her spare time she likes to work out, spend time in the stable and relax at home with the family.

R&D areas/s: Energy company representative

Regional development towards a net zero world

Ove Bryggman, Skellefteå Kraft, SE

Ove Bryggman (SE)

The global green energy transition is reshaping industries and economies, offering unprecedented opportunities for regions rich in renewable energy resources. We will explore how regions with abundant wind hydro and solar energy resources are uniquely positioned to lead in the development of green technologies and industries. These regions hold a competitive edge in the global race toward sustainability, driven by their ability to generate cost-effective and reliable renewable energy.

Skellefteå Kraft have the ambition to enable the production of sustainable aviation fuel (eSAF) in the region. eSAF is a key innovation in the journey toward decarbonizing the aviation industry and represents a transformative solution for reducing greenhouse gas emissions in one of the most challenging sectors to decarbonize. In our partnership we are at the forefront of establishing an industrial ecosystem for eSAF production, leveraging the region's ample renewable hydro and wind power. This clean energy foundation not only enables the energy-intensive processes required for eSAF production but also positions the region as a leader in the renewable energy economy.

By highlighting the role of renewable energy in enabling high-impact industries such as eSAF production, we aim to underscore the strategic importance of harnessing regional strengths to build a more sustainable future.

Join us as we examine how renewable energy-rich regions are seizing the moment to redefine global industrial competitiveness and lead the way toward a net-zero world.

Web site: 0

Short biography: Ove Bryggman is Head of Strategy and Business Development at Skellefteå Kraft, where he has been working since 2020. He has over 25 years of experience from Swedish industry.

R&D areas/s: A) Wind, B) PV, C) Energy storage, D) Hydrogen, E) Offshore

Renewables, electrification and green hydrogen in Canada

Charles Godreau, Nergica,CA

Charles Godreau, (Nergica, CA)

Canada is a federation of provinces where each province is responsible for the energy sector and associated policies. The federal government also implemented a Clean Electricity Strategy and made significant investments in renewables, electrification and green hydrogen in response to various geopolitical situations.

This presentation will present the electricity generation context in Canada, the adoption of renewable energy across the country, provide recent examples of projects aimed at increasing the share of renewable energy on the grid, electrification and production of green hydrogen.

The presentation will end with a few examples of strategic planification towards a carbo-neutral society with the Quebec Plan for a Green Economy, Hydro-Quebec Action Plan 2035 – Towards a Decarbonized and Prosperous Québec, and the Government of Canada Clean Electricity Strategy.

Web site: https://www.linkedin.com/in/charles-godreau/

Short biography: Charles Godreau specializes in wind turbine performance assessments in cold climates and icing detection/protection systems. He possesses strong skills in data analysis for operational turbines as well as for developing, planning and implementing research projects. He notably represents Canada in the International Energy Agency's Task 54 working group on wind energy in cold climates and is an active member of Winterwind's program committee. In his free time Charles enjoys improv and backcountry skiing.

R&D areas/s: A) Wind

WORKSHOP: IEA Task 54: Methodology to assess production losses due to icing from power curve analysis

Jennifer Pettersson, Vattenfall, SE

Timo Karlsson (VTT, FI), Charles Godreau (Nergica, CA), Claas Rittinghaus (Energiewerkstatt, AT), Hamid Sarlak (DTU, DK)

Production losses is one the biggest challenges for wind power in cold climate and is a topic that is addressed continuously in the wind industry. An accurate assessment of production losses due to icing is important to monitor and especially to keep track of the performance of our wind assets in a more volatile market situation that's been experienced the last years.
More than 5 years ago, IEA Wind TCP Task 19 (now Task 54), an international expert group working with wind power in cold climate, released a publicly available tool to assess historical production losses due to icing. The aim for the release was to make a standardised method available for anyone with access to SCADA data for simplified use for comparison of production losses between different sites, validation of IEA Ice class, evaluation of Ice Protection Systems efficiency.
IceLossMethod is based on analysis of the power curve and deviation from the power curve using SCADA data from individual turbines.
The method is divided into 3 main steps:

- Calculate reference power curve for non-iced data using the binning method.
- Calculate start-stop timestamps for respective ice loss category.
- Calculate production loss for the identified icing events.

There are 3 ice loss categories defined in the IceLossMethod:

- Operational production loss due to icing.
- Standstill production loss due to icing.
- Overproduction, due to iced anemometers.

As of today, the methodology is widely spread internationally, and we've seen presentations, reports, and various adaptations of the method. With years of experience from the method, that also have been used by the industry, IEA Task 54 is planning for an updated version, Ice Loss Method 3.0, in next terms work plan for the extension of the IEA Task work.
IEA Wind Task 54 is therefore inviting users of the method, or participants with experience of assessing production losses, for an open discussion to gather insights and experiences. The discussion is with focus on finding possible improvements, learn from users of possible adaptations, discuss thresholds and much more.

Web site: https://iea-wind.org/task54/

Short biography: The missionof Task 54, Cold Climate Wind Power, is to improve the largescale deployment of cold-climate wind power in a safe and economically feasible manner.

R&D areas/s: B) PV

Lessons learned from solar measurements in the Nordics

Sigbjørn Grini and Ola Kaas Eriksen, Kjeller Vindteknikk, part of Norconsult, SE

Mina Elise Holter (Kjeller Vindteknikk, part of Norconsult, NO)

To obtain an accurate estimate of production and determine investment decisions of a utility-scale solar project, on-site solar irradiation measurements using pyranometers are recommended [1]. At higher latitudes, more snowy and cloudy areas, satellite imagery methods yield higher uncertainty. These uncertainties make having ground measurements even more important compared to conventional sites. As the solar irradiance is generally lower at these sites in terms of irradiance, some of the production can be improved by high bifacial gain and low temperatures.
Unfortunately, these harsh winter conditions also add uncertainty to solar measurements. Snow, dew and frost will cover the sensor and affect the measurement and require regular maintenance. In this work, we will present our experience and lessons learned in this relatively new field in the Nordics. In the research "RFF PV Production in Mountainous Areas" project, we have set up a state-of-the-art solar measurement station in conjunction with PV modules of different orientations at Gålå, located roughly 1000 m.a.s.l. The site offers unique conditions for studying solar measurement setup in harsh conditions. For instance, we have studied the effects of maintenance and auxiliary equipment such as ventilators underneath the pyranometers. This use of ventilators has proven very effective in removing snow and has kept the availability of solar measurements to near 100 %. However, the ventilators require significant amount of power consumption which makes them unusable in the winter period without a grid connection.
The novel solar measurement station provides research into which sensors provide added value for utility-scale solar projects at mountainous and harsh winter climate areas and what measures needs to be taken to ensure high accuracy and low uncertainty. As more solar projects are being developed in such climates the need for reliable data becomes increasingly important.

[1] Sengupta, Manajit, et al. Best practices handbook for the collection and use of solar resource data for solar energy applications. No. NREL/TP-5D00-77635. National Renewable Energy Lab.(NREL), Golden, CO (United States), 2021.

Web site: www.vindteknikk.com

Short biography: • Sigbjørn Grini holds a PhD in Solar Energy and is head of R&D for wind and solar in Norconsult. He has for the past 5+ years been working at Kjeller Vindteknikk focusing on research, especially within icing, operational services and solar energy. In his spare time you will likely find him playing tennis or programming using AI.

• Ola Kaas Eriksen holds a MSc in physics and is field measurement manager in department Kjeller Vindteknikk in Norconsult. He has for the past 7+ years been working with meteorological measurements in the Nordics, especially wind and solar measurements in cold climate. In his time off you will probably find Ola on board his sailboat somewhere along the coast of Norway or Sweden.

R&D areas/s: A) Wind, B) PV

Evaluating curtailment uncertainty in wind and solar hybrid projects

Henning Straume, DNV, NO

Sergio Jiménez (DNV, ES)

Hybrid power plants are gaining popularity as they help optimize the network usage by integrating additional capacity from complementary technologies. These hybrid plants offer benefits such as reduced energy production costs through shared land, infrastructure, O&M expenses, enhanced operational flexibility, and reduced investment uncertainties through better utilization of existing infrastructure. In some regions, favourable regulations further encourage the proliferation of hybrid projects by fostering development and streamlining permitting processes.
Solar and wind hybrid projects typically exceed the authorized grid evacuation capacity. Therefore, in addition to assessing the expected energy production of the solar and wind plants, calculating the expected energy curtailments are essential given the grid export limit. The extent of curtailed energy depends significantly on the specific realization of power time series for both wind and solar technologies over time. Accurate energy production estimations for new hybrid plants require power modelling with high time resolution to ensure that long-term climate variability and wind-solar correlation are well captured.
DNV has evaluated various real-world hybrid projects with differing levels of accuracy for wind energy assessments, including those based on operational data, pre-construction assessments using measurements from meteorological site masts, and pre-construction assessments based on mesoscale data. The objective was to assess and quantify uncertainties in energy curtailment estimations based on the quality of input data and different modelling approaches.
DNV analysed the differences in estimated energy curtailment depending on the accuracy levels (meter data, site mast-based, and mesoscale-based) of the underlying power time series used for the calculations. Additionally, energy curtailment exhibits high temporal variability, influenced by fluctuations in wind and solar energy production and changes in the correlation patterns between the two resources. The study evaluated the differences in energy curtailment assessment based on the duration and representativeness of the period used for power modelling, considering historical data, long-term synthesized data, and typical meteorological years.
Finally, the research investigated the significance of time resolution in time series modelling, analysing the potential underestimation of expected curtailment when using hourly instead of sub-hourly data. This comprehensive analysis provides valuable insights for enhancing the precision and reliability of energy curtailment evaluations in wind and solar hybrid projects.

Web site: www.dnv.com

Short biography: Henning has worked in DNV in Norway since 2023 as a Wind Energy Analyst. Specializing within wind resources and energy yield having performed multiple energy yield assessments offshore and onshore, while also having experience within bid and project manager for wind and hybrid projects. Henning also assisted the Norwegian Water Resource and Energy Directorate in finding 30GW of offshore wind areas while finishing his MSc in Renewable energy from the Norwegian University of Life Sciences. He also holds two BScs in Meteorology & Oceanography and Economics from the University in Bergen.

Henning is vividly interested in football and is head of DNV Norway's football team. He often finds himself watching football tactic videos and following his team Brann around Norway.

R&D areas/s: A) Wind, B) PV

Hybridization of wind and solar, how to handle icing and curtailment

Dina Martinsen and Sigbjørn Grini, Kjeller Vindteknikk, part of Norconsult, NO

Sigbjørn Grini (Kjeller Vindteknikk, part of Norconsult, NO)

Initial studies show that for Nordic weather conditions, curtailment due to wind and solar producing at the same time is relatively small even for similar installed capacity for both (Grini, Winterwind 2024). The interest in hybrid solar and wind projects has increased the past few years, and as more such projects are being developed, handling the challenges related to co-location and simultaneous energy production from the two variable sources has become increasingly important.

For Nordic conditions, in-cloud icing occurs in most wind farms causing production loss, but also ice falling from the structure or being thrown from the turbine blades. Here, risk and economic assessments must be outlined to account for the potential ice falling on the solar panels. Analyzing the tradeoff between increasing probability of strikes per year per square meter and increasing the amount of solar panels installed within striking distance of ice throw and ice fall, has become increasingly important. Up to a certain point, it is economically beneficial to account for some panels needing to be exchanged during the lifetime of the project to achieve a higher installed capacity. We follow an event-based approach, where the number of significant icing events are accounted for in contrast to the conventional strikes per year, since one event can yield several hits, but only causing to repair the site once.

For solar energy, conventional software for energy yield assessments, PVsyst, uses a TMY approach, which allows for a faster simulation and exploration of different plant designs. However, this method does not allow for assessing the curtailment due to grid limitations for a hybrid wind and solar project. For such analysis it is essential to align the solar and wind timeseries into a hybrid typical meteorological year (TMY). To create such a hybrid TMY, monthly values from the wind and solar timeseries are carefully chosen such that each month chosen from the timeseries does not deviate significantly from the long term mean for the month, while at the same time ensuring the total annual r value does not deviate from the long term annual mean. Here, a semi-automatic approach can be used that searches through many possibilities and presents the most suitable TMYs that have the least deviations for both wind and solar. Further, the TMY can be chosen from this list based on which deviations are most acceptable. Using such a TMY, the industry standard TMY approach for EYA can be maintained, while also ensuring a representative curtailment and actual hybrid production estimate can be achieved.

Web site: www.norconsult.com

Short biography: Dina Martinsen holds a master's degree with a major in Energy Technology from NTNU. She is a renewable energy consultant in Norconsult with a special focus on solar PV. Dina is main responsible for the continuous improvement and further development of Norconsult's methodology for Solar EYA. She has a special focus on improving the basis for selecting parameter inputs in the software PVsyst, implementing location-specific parameters such as snow data for adaptation to local conditions, irradiance model accuracy and post-processing of simulation results to imporove accuracy by taking into account loss mechanisms that are not implemented in the software.
When she’s not busy optimizing solar energy systems, Dina transforms into an outdoor enthusiast. She is happiest in the mountains, splitboarding during winter or exploring the trails in the summer.

R&D areas/s: A) Wind

Influence of elevation, rotor diameter and hub height on blade icing duration

Stefan Reimann, Weidmüller Monitoring Systems GmbH, DE

Daniel Brenner (Weidmüller Monitoring Systems, DE)

Often customers ask why some turbines of the same wind park stop earlier than others standing nearby. Another frequent question is why the duration of the downtime differs quite a lot.
With a blade based ice detection system it is possible to measure the ice growth rate of individual turbines.
We have evaluated several ice events regarding information about elevation, rotor diameter and hub height to find out the influence of maximum blade tip height on individual downtimes due to ice accretion. It can be demonstrated what are the main drivers for early icing or long duration.
Additionally the presentation shows the influence of blade heating strategies on the blade icing duration based on data of several winter seasons and different wind farms in central Europe and Scandinavia. It will be shown that with observation of the individual ice mass the heating strategy can be optimized.

Web site: https://www.weidmueller.de/de/loesungen/industrien/windenergie/bladecontrol/index.jsp

Short biography: Stefan Reimann studied electrical engineering at the Dresden University of Technology. During the last 11 years he has been responsible for the development of ice detection methods for wind turbine rotor blades at Weidmüller Monitoring Systems.

R&D areas/s: A) Wind

Validation of cantilever sensors for ice detection on rotor blades

Holger Fritsch, Bachmann Monitoring GmbH, DE

Thomas Iwert (Bachmann Monitoring, DE), Michael Schulz(Bachmann Monitoring, DE)

Cantilever sensors (CLS) are designed for critical applications in wind turbine rotor blades, enabling real-time load measurements to identify critical operational states. Originally, CLS sensors were intended primarily to record load history (e.g., via Rainflow Counting), provide Individual Pitch Control (IPC) input, and conduct deviation analyses between blades to detect blade errors or pitch angle discrepancies. This paper explores an innovative application for CLS: ice detection on rotor blades. The CLS technology enables multifunctional use. In addition to load measurement, the CLS sensor can be applied for structural anomaly detection in rotor blades and ice detection. After a brief introduction to the measurement principle, the focus will be on the implementation of ice detection. First, the validation methodology is explained, which uses comparative camera images as a reference standard despite the inherent limitations of this approach, which will also be discussed. This method still allows for demonstrating the demonstration of the ness of CLS sensors compared to other (anonymized) ice detection systems. Finally, the potential of CLS sensors in the wind energy sector will be briefly discussed, particularly concerning monitoring structures such as hybrid towers, foundations, and rotor blades. The versatile applications of CLS sensors, which allow for consolidating multiple monitoring functions solely through application software within a single measurement system, reveal significant potential for use in the wind industry.

Web site: https://www.bachmann.info/en

Short biography: Holger Fritsch (born 1964) studied Physics at Otto von Guericke University in Magdeburg, specializing in Experimental Physics. From 1993 to 1997, he worked as a research associate at the university's Institute for Process Measurement Technology and Electronics, focusing on projects related to sensor development, particularly micromechanical resonant vibration sensors. After his academic career, Holger joined µ-Sen GmbH, where he took on roles in FEM simulation, sensor design, machine diagnostics, and data analysis. He eventually served as managing director of the company, expanding its focus on advanced sensor ap-plications. Since 2011, Holger has been the managing director of Bachmann Monitoring GmbH, responsi-ble for developing new business models, including innovations in CMS Remote Monitoring. He has coor-dinated pilot projects to monitor both onshore and offshore wind energy assets, positioning Bachmann Monitoring as a leader in wind turbine condition monitoring. Beyond his professional interests, Holger is passionate about philosophy, physics, reading, and sports.

R&D areas/s: A) Wind

One System for all demands in Cold climates

Nils Lesmann, Phoenix Contact, DE

Nils Lesmann (Pheinix Contact, DE)

The Blade Intelligence System by Phoenix Contact is an advanced modular solution designed for the comprehensive monitoring of wind turbine rotor blades. This system integrates various sensors to measure lightning currents, detect ice formation, and monitor structural loads, ensuring optimal performance and longevity of wind turbines, especially in harsh, cold climates.

In cold environments, wind turbines face unique challenges such as ice accumulation on rotor blades, which can significantly impact their efficiency and safety. The Blade Intelligence System addresses these issues through its innovative ice detection capabilities. By continuously monitoring the ice thickness on the blades, the system provides real-time data that allows for timely interventions, preventing potential damage and reducing downtime.

Additionally, the system's lightning current measurement feature is crucial for protecting wind turbines from the frequent lightning strikes that occur in cold regions. This functionality not only safeguards the structural integrity of the blades but also ensures the safety of the entire wind turbine system.

The structural load monitoring aspect of the Blade Intelligence System further enhances its utility in cold climates. By tracking the stress and strain on the rotor blades, the system helps in predicting maintenance needs and optimizing the operational parameters of the wind turbines. This proactive approach to maintenance minimizes unexpected failures and extends the service life of the turbines.

Learning how those system are working together and enabeling you to adapt the systems to your windfarms or windturbines

Web site: https://www.phoenixcontact.com/wind

Short biography: Nils Lesmann has been a dedicated professional in the wind energy sector for over a decade. He began his journey at Phoenix Contact with a bachelor's thesis focused on surge and lightning protection for small wind turbines. After graduating as an application engineer, he took on the role of platform manager for the Blade Intelligence System, a cutting-edge solution for monitoring wind turbine rotor blades.

Throughout his career, Nils has contributed significantly to the development and implementation of advanced technologies aimed at enhancing the efficiency and reliability of wind energy systems. His expertise in lightning protection and structural load monitoring has been instrumental in ensuring the safety and longevity of wind turbines, particularly in challenging environments.

R&D areas/s: A) Wind

Optimizing conductive heating for rotor blade anti-Icing using wireless blade sensors

Eike Lueken, eologix-ping, AT

Eike Lueken (eologix-ping, AT)

Effective ice management on wind turbine blades is critical for ensuring reliable performance and maximizing energy yield in cold climates. This contribution showcases the results of a 2024/2025 field study conducted with three turbines in Jämtland, Sweden. The study focused on optimizing a conductive heating solution integrated with eologix-ping's wireless blade sensors. These sensors provide precise on-blade surface temperature and icing condition data, enabling a highly responsive Anti-Icing mode operation. The performance of this innovative system was compared to a neighboring turbine equipped with a nacelle-based ice detection system. Key metrics, including heating activation efficiency, turbine downtime and energy yield, were analyzed. Special attention was given to minimizing unnecessary heating, particularly during periods of low wind and elevated power purchase prices. This approach not only reduces operational costs but also improves alignment with energy market dynamics. The results demonstrate the advantages of precise, blade-specific data in avoiding wasteful heating cycles while ensuring operational safety and reliability. This novel method enhances turbine performance, optimizes anti-icing operations, and sets new benchmarks for icing management in the wind energy sector. In the full paper, we will present a data set and results over more than two months of winter operation in Sweden.

Web site: www.eologix-ping.com

Short biography: to be supplied

R&D areas/s: A) Wind

Operational wind power forecasting at Hydro-Québec in winter conditions

Eric Desrosiers, Hydro-Québec, CA

Slavica Antic (HQ, CA), Guillem Candille (HQ, CA)

Winter conditions are very challenging in wind power forecasting, especially in northern regions like in Québec, where very low temperatures and icing events have a high impact on the wind farm energy production, and this, during the winter where the high load period is demanding due to electrical heating of the dwelling.
Accurate forecasting of wind generation is crucial for efficient grid management and energy distribution. Québec has a peak in demand during the winter months, making it more important to have accurate wind power production forecasts for winter conditions. Forecasting production losses due to frost, ice or snow accumulation, or cold temperature conditions becomes more important.
At Hydro-Québec (HQ), a wind power forecasting team, which provides the forecasts for the wind farms installed in Québec (nearly about 4 GW), has developed specific production loss models for low temperatures and icing. We use a combination of numerical weather prediction (NWP) models and statistical auto-adaptive algorithms to improve forecast accuracy. Historical data on weather conditions and production losses observed at wind farms in operation are analyzed to calibrate the winter production loss models. The results show a significant improvement in forecast accuracy compared to the methods without losses.
On the one hand, the low temperature model is quite simple and performs well since NWP signal for the event temperature below -30°C is very accurate. The low temperature events, even if they rarely occur, have high impacts on the production but they are quite predictable few days ahead. On the other hand, the icing model is much more complex since there is no clear characterization between the atmospheric icing, which is already very complex to be modelled by NWP, and the production loss. A statistical model only runs when icing underproduction is detected over a wind farm and predicts the temporal evolution of this production loss depending on the NWP variables, such as wind speed, temperature, and humidity. With hourly auto-adaptive update this model significantly reduces the forecast errors due to icing. However, it cannot predict the beginning of icing events, which is our main wind power production forecasting problems in winter.
This Hydro-Québec reality will be presented through few examples of case study showing the impact of winter conditions on the grid management and how the wind power forecasting is important to help in taking decision on day-to-day. The different aspect of the wind power forecasting models will be covered and avenues of improvement currently explored.

Web site: https://www.hydroquebec.com/about/

Short biography: As Energy Supply Advisor, Mr. Desrosiers joint the Wind Forecast Team at Hydro-Québec in 2014. His scientific and technical background allows him to understand the behaviour of the weather systems which influence the wind forecast. Combined with extensive experience in the wind industry, he has a comprehension of the wind resource and the impact on energy production.

Amongst others, Mr. Desrosiers is involved in daily operational forecasting tasks, development of analysis software tools and in studies of the contribution of the wind generation in the Hydro-Québec energetic provision plan. Having been involved in implementing mathematical and numerical models for a number of atmospheric physical phenomena, Mr. Desrosiers has developed a solid experience to perform the interpretation and correlation of simulation results, generated by different atmospherics models, with real-time observations.

R&D areas/s: Power market expectations

The future of the prices and power balance in the power market

Tor Reier Lilleholt, Volue Insight. NO

Tor Reier Lilleholt (Volue Insight, NO)

We in Volue Insight serve the power business with objective power analysis and assumptions to support market participants handling their risk and be able to handle the green transition. In the presentation you will get an European overview of what is going on in the power market with the power balance in the Nordic based on assumption of new renewable investments until 2055. Where are we in the green transition right now. The results of the price simulations for all Nordic and connected Continental areas in the same period will be shown.
We in Volue find it very important that all investments in the future power market should be aware of the potential future price which will be important to balance both consumption, production and climate goals. An overview of the price and power balance development will be important for all kind of equipment in the power market and give insight of the future potential.

Web site: https://volueinsight.com/en/product-descriptions/

Short biography: Tor Reier Lilleholt is the Head of Analysis at Volue Insight. He holds a Master of Science from the Norwegian University of
Technology and Science (NTNU). He joined the analysis section of consultancy Markedskraft in 2001, participating in
building analysis and advisory services for the Nordic electricity market and adjoining markets. He has managed Volue
Insight's Nordic analysis team since 2011 and included the responsibility for the Continental team as well since 2016.

R&D areas/s: A) Wind, B) PV, C) Energy storage, D) Hydrogen, E) Offshore

What is Hybrid-PPA, and why is they important?

Jens Nordberg, Varberg Energi, SE

Jens Nordberg (Varberg Energi, SE)

The future is electric and we need to produce more electricity at low costs to ensure our industrial competitiveness while taking big steps towards a fossil-free society. But what will be required of the energy companies in order for more wind power to be built? At this session, the pioneer and visionary energy company Varberg Energi will tell more about how the product "hybrid-PPA" becomes completely decisive for the larger wind farms in- and offshore must be able to see the daylight of reality. The strength lies in combining wind power, PV, hydrogen, BESS and match the hybrid-PPA with large industrial customers who want to lead development forward with low profile risk.

Web site: https://www.varbergenergi.se

Short biography: Jens Nordberg is one of Sweden's leading energy traders and has worked exclusively with various types of energy trading since electricity was deregulated in Sweden in 1996.

With a background at Statkraft and then moving on via Göteborg Energi, MFT Energy (Denmark) and now working for Varberg Energi since the last 4 years, Jens is always interesting to listen to when it comes to energy trading strategies.

R&D areas/s: A) Wind, B) PV

How to hack windfarms: Exposing ICS vulnerabilities using Shodan

Sascha Buhle, energy consult, DE

Sascha Buhle (energy consult, DE)

This presentation focuses on the growing cybersecurity risks targeting wind farms, specifically through vulnerabilities in Industrial Control Systems (ICS) like SCADA and remote access controls. Using Shodan, a search engine designed for discovering internet-connected devices, we will expose how these critical systems can be identified and potentially exploited by attackers. By analyzing real-world examples of exposed wind farm infrastructure, this talk will offer a detailed look at the vulnerabilities that make these systems susceptible to attacks. This work aims to raise awareness of the importance of securing ICS within renewable energy infrastructures, and the strategies required to do so. Attendees will gain insights into the operational technology landscape, learning how attackers might exploit these systems and the necessary best practices to protect against such threats. The content of this presentation is based on new research and has not been presented at any other conference.

Web site: https://www.energy-consult.net/en/services/cyber-security/

Short biography: Sascha is an OT Security Manager and Information Security Officer at energy consult, specializing in cybersecurity for critical infrastructure, particularly within the wind energy sector. With extensive experience in vulnerability management, risk assessments, and supplier evaluations, he is deeply involved in safeguarding operational technology environments. Sascha provides expert advice on protecting critical infrastructure, ensuring that robust security measures are in place.

R&D areas/s: A) Wind

Improved daily planning for wind farm operators: Developing ice risk forecast based on automatic ice detection from nacelle cameras

Sigmund Guttu, Kjeller Vindteknikk, part of Norconsult, NO

John Magne Gitmark (Kjeller Vindteknikk, part of Norconsult, NO)

In addition to risk of ice throw, snow and ice on the wind turbine nacelle may cause an additional risk. The main focus on risk associated with ice on wind turbines has been on the ice forming on the blade due to in-cloud icing (so called rime icing), and there is a lack of studies on ice on the nacelle roof, as well as icicles forming on the nacelle wall. It is known that the ice on the nacelle causes a risk for operating personnel in Nordic wind farms, especially when entering the turbine.

Previous projects and experience have shown that the state-of-the-art operational ice risk forecast for third persons has a limited relevance for the operating personnel in their daily planning and routines. A more relevant and detailed forecast can help to make more informed and strategic decisions on when to access certain wind turbines and areas of a wind farm. Hence, the forecast may provide a valuable contribution during the daily coordination of the planned operations. Therefore, in an ongoing research project ("Safe Operation of Wind Power in Winter Climate") supported by the Norwegian Research Council and wind farm operators, we attempt to develop a model that represent the snow and ice forming on the nacelle, with the goal of increased prediction accuracy of the risk of falling ice.

The transformation from an initial snow cover into icicles involve complex physical process where both specific weather conditions and turbine specific features are involved. To improve the model skill, we have chosen to install cameras in wind farms in Norway and Sweden. In addition to provide a nowcast for the icing risk, the historical camera images are used to train a machine learning model for ice detection, recognizing ice and snow, hence, detecting changing conditions on the nacelle. The output from this model can then be used to improve our model representing ice on the nacelle, both by improving the representation of the snow to ice processes and corrections in operational forecast mode.

Web site: https://www.vindteknikk.com/services/research/sviv/

Short biography: Sigmund Guttu has a PhD in meteorology and climate sciences from the University of Oslo. He has been working in Norconsult department Kjeller Vindteknikk for four years. His main work fields cover icing and wind related topics, over the last year with a particular focus on operational forecast of icing and participation in the research project "Safe Operation of Wind Power in Winter Climate". In addition to swimming in ice cold water, personal interests include football, bass trombone playing, and cross country skiing.

John Magne Gitmark has a master's degree as mechanical engineer with specialisation within energy-process and fluid flow. He has worked close to 5 years for Kjeller Vindteknikk, with icing as one of the main topics. The focus has especially been towards the risk of ice throw and ice fall, in addition to power loss ice accumulation.
Ice is also included in the personal interests. In addition to making homemade ice cream, few things feel better than dipping your naked toe into a frozen lake...

R&D areas/s: A) Wind

Wind turbine risk assessments

Christoph Schmidt, DNV Energy Systems Germany, DE

Lennart Hawmann (Principal Engineer), Ferhuda Birge (Junior Consultant)

The DNV Wind Turbine Risk Assessment presentation provides an overview of the risks associated with onshore wind turbines, with a particular focus on the German and European market. The presentation covers various risk factors, including ice throw, blade failure, tower collapse, and nacelle breakage. It also discusses the regulatory framework and best practice guidelines for mitigating these risks. Key topics include the safety implications of wind turbines, the methodologies for calculating and assessing risks, and the tools and software developed by DNV to support these assessments. The presentation highlights the importance of accurate risk zoning and the use of advanced technologies based on a risk based approach such as ice detection systems, blade heating and other risk mitigation measures to enhance safety. The session will also feature case studies from recent projects, demonstrating the practical application of DNV's risk assessment services. Attendees will gain insights into the latest developments in wind turbine risk management and the strategies employed to ensure the safe and sustainable operation of wind energy facilities.

Web site: www.dnv.com

Short biography: Christoph Schmidt is Team Leader and Principal Consultant working for DNV Energy Systems in the Risk Management department in Northern Europe. He is responsible for a team of safety & risk consultants in Germany which are serving clients with technical risk assessments.

R&D areas/s: A) Wind

Deep learning models for use in icing event prediction

Rasmus Dovnborg Frederiksen, Siemens Gamesa / Aalborg University, DK

Rasmus Dovnborg Frederiksen (SGRE / AAU, DK)

Combining wind turbine operational data with meteorological data will create the ideal dataset for deep learning prediction models. These data sources are temporal in nature and consists of continual variables which are well suited for recurrent neural networks. In my research I have done exactly this, and these models are the basis of further research into deeper challenges of deploying such models for predictive maintenance. In the development of these models, I have tested several wind turbine downtime events as the response that I am predicting and one of these responses are icing events. At this conference, I would like to present the architecture of these models, explain why they function well, and how they are able to forecast icing events before they happen. Additionally, I will also showcase some of the issue that will appear as we are trying to deploy these models, such as data drift, concept drift, and some of the methods I have researched for the mitigation of such issues.

Web site: https://siemensgamesa.com/

Short biography: I am currently working on an industrial PhD, which has given me the opportunity to combine my background in mathematics, my experience in the wind industry, and my interest in deep learning. I am researching in the field of Operations Research which requires not just that I create the actual deep learning models, but also analyse how to use these effectively. With 7 years of experience with data science in Siemens Gamesa, I have several times supported projects related to the icing topic, which have created a curiosity of the cold climate issues for me. Because of this, icing events have often become the target of some of my prototyping of models and I look forward to attending this conference and learn more on the topic from the real experts.

R&D areas/s: Ice

Eye-On-Site

Johan Casselgren, Pileus Scandinavia, SE

Torbjörn Gustavsson (Pileus Scandinavia, SE), Jens Sperens (Pileus Scandinavia, SE)

The demand for energy is set to increase in the coming years, especially with the ongoing green transition. However, building new energy production facilities is both costly and time-consuming. Last year, Luleå University of Technology and Pileus Scandinavia introduced a new method to detect and forecast ice accumulation on wind turbine blades—a solution that was tested in collaboration with Statkraft and Vattenfall. This innovative method could boost wind power production by up to 10%, without the need for new wind farms.

Not only does this technique improve energy output, but it also enables better planning. By accurately predicting when ice will accumulate, operators can incorporate ice into their production plans rather than seeing it as an unpredictable issue. The precision of this forecasting allows for smarter decisions, making ice a manageable part of the process rather than an obstacle.

At Luleå University of Technology, extensive research has been conducted for several years on snow, ice, and their impact on different structures. One key focus has been developing new techniques to measure and record when and how quickly snow or ice accumulates. This research led to the development of an optical technology specifically designed for monitoring ice growth on wind turbine blades. Pileus Scandinavia has since taken on the task of transforming this research into a commercial product.

During the research phase, the method was tested offline only. Over the past year, Pileus has been working to implement and further develop a tool that helps power companies treat ice not as a problem, but as a component of their everyday operations. This year's presentation will focus on how this system has been adapted for real-world applications and how the information is being effectively delivered to customers.

Web site: https://www.pileusab.com

Short biography: Dr. Johan Casselgren is an Associate Professor in Experimental Mechanics at Luleå University of Technology (LTU), specializing in the study of snow and ice. With over 18 years at LTU, he has developed innovative solutions to challenges posed by cold climates. Notably, he created a system that combines camera technology, artificial intelligence, and weather data to detect and predict ice formation on wind turbine blades, enhancing their efficiency during winter months.

Dr. Casselgren's research extends to various applications, including the development of a portable bevameter for measuring snow properties in the field, aiding in vehicle and tire testing on snow-covered tracks. He also contributed to the discovery of the "snabel snöflingan," a unique snow crystal, using advanced imaging techniques.

In recognition of his contributions, Dr. Casselgren was named Innovator of the Year 2023 at LTU. Beyond his professional endeavors, he is passionate about outdoor activities, particularly skiing, which aligns with his research interests and provides practical insights into the dynamics of snow and ice.

R&D areas/s: A) Wind

Illustrating icing events complexity using the IEA Task54 public database

Jérôme Kopp and Sara Koller, Meteotest, CH

Jérôme Kopp (Meteotest, CH), Paul Froidevaux (Meteotest, CH), Claas Rittinghaus (Energiewerkstatt, AT), Charles Godreau (Nergica, CA), Patrice Roberge (Icetek, CA), André Bégin-Drolet (Université Laval, CA), Jennifer Petterson (Vattenfall, SE), Franziska Gerber (Meteotest, CH)

Atmospheric icing is a natural phenomenon of high complexity. Supercooled liquid water in the form of cloud droplets or rain drops hit a structure and freeze, leading to ice accretion. The rate of ice accretion, as well as the type of ice (from glaze ice to soft rime) and the ice load distribution on the structure is very dependent on the so-called meteorological icing conditions. These icing conditions are strongly variable, leading to a remarkably large variety of icing on structures in terms of ice loads, ice types and spatial distributions. Ice removal is especially complex because of its chaotic nature. In fact, the ice often does not melt on the structure, but instead becomes unstable and eventually falls off. Moreover, some of the icing conditions, namely the droplet size distribution and droplet concentration are particularly difficult to model, predict or measure.
Regarding wind energy, the effect of blade ice on production losses, its dangerousness with regard to ice throw and the possibilities to remove it actively by blade heating are therefore extremely variable:

- between different regions of the world,
- between different icing events at one particular site and even
- during a single icing event.

This complexity and variability are very challenging for diverse applications related to wind energy. The experience of the Task54 in the past years indicates a general lack of awareness and understanding about icing events complexity and variability from many stakeholders (manufacturers, wind park planners, owners and operators). One of the reasons is likely the fact that the very large majority of data collected about icing of turbine blades is kept confidential.
In order to raise general awareness and understanding on this topic, the Task54 collected observational data of real icing events on wind turbines and made it publicly-available. The so-called Task54IcingEventsDB has been initiated: https://transfer.meteotest.ch/s/moPeLp7EzEpscRD
The presentation will illustrate this complexity using real icing events from the public database.

Web site: https://meteotest.ch/

Short biography: After a first career in the banking industry as risk and compliance manager, I decided to change for meteorology and climate sciences. I completed a master degree in climate sciences with a focus on atmospheric sciences in 2020 and a PhD in climate sciences in 2024, both at the University of Bern, Switzerland. My PhD was focused on the analysis and verification of hail observations in Switzerland from different sources: dual polarization weather radars, automatic hail sensors and crowdsourced hail reports from the Swiss meteorological services (MeteoSuisse). After finishing my PhD, I started as a project manager in the Wind and Ice team of Meteotest AG, a Swiss private company providing services in weather, climate, environment and computer science.

R&D areas/s: A) Wind, Coating Technology

Ice-prevention through coating solutions

Matiss Sivins, Phazebreak Coatings, US

Aaron Dupuis (Phazebreak, US)

Every year, icing causes millions in losses for the wind energy industry. As wind turbines grow in size, ice removal becomes more complex and the lost MWh become even more costly. Heated blades can slow the formation of ice, but they require energy to use and have maintenance issues of their own. Perhaps, then, the answer is not ice removal, but ice prevention.

For this reason, Phazebreak has developed NEINICE icephobic coating for use on wind turbine blades as well as common leading edge protection (LEP) systems. Used in the field since 2018, the patented NEINICE formula has been deployed on over 10,000 blades around the world.

NEINICE helps to improve turbine energy output during winter storms and reduces recovery time following such events, while also diminishing the risk of severe ice throw.

Phazebreak has recently reformulated NEINICE, doubling the coating's icephobic capabilities and increasing the activated pot life. In addition, the formula has become more environmentally friendly and compliant to regulatory bodies: a tin catalyst and all PFAs have been removed.

This presentation focuses on successes we've seen in helping owners and operators improve turbine performance: By reducing ice build-up before removal is necessary, NEINICE also helps lower maintenance costs, prevent ice throw, protect blade integrity, promote worker safety, and ensure that profitability remains high for owners and operators.

To this end we will present data on the following:
Turbine output data comparing the performance in MWh of coated vs uncoated turbines.
Robotic application procedures and efficacy
Real-world data on the lifecycle of the coating and best re-application procedures
Materials from ice adhesion tests demonstrating an increase in efficacy
In-field data from over 6000 coated blades over the last 4 years

Web site: www.phazebreak.com

Short biography: Matiss Sivins is the European Sales Director at Phazebreak Coatings, Inc. Before joining the Phazebreak team, Matiss worked as a Business Development Manager at Aerones, working with clients to maintain turbines with Aerones' ground breaking robotic technology. He is a graduate of University of Arkansas - Fort Smith, and is a talented basketball player.

R&D areas/s: A) Wind

Virtual temperature sensor in blade heating system and its validation

Markus Heinonen, Wicetec, FI

Markus Heinonen (Wicetec, FI)

Traditionally, physical temperature sensors have been used as process variables in wind turbine blade heating systems. However, physical sensors are associated with high capital expenditures (CAPEX) and operating expenses (OPEX). An innovative alternative is the implementation of a virtual temperature sensor, utilizing advanced physical thermal model of the blade. This software-based solution offers enhanced reliability, safety, and scalability compared to traditional sensor-based solutions.

The principle behind the virtual temperature sensor involves continuously modeling blade temperature values using standard operational data from the turbine combined with a thermal model of the blade structure and the surrounding airflow. These iteratively calculated temperature estimate values from different parts of the blade can be used to control the heating system.

This presentation will show the results of a rigorous validation process of the virtual temperature sensor, including wind tunnel experiments, blade factory acceptance tests and standstill turbine assessments using drone-mounted thermal camera. Also, the blade heating system performance analysis of several operational turbines with virtual blade temperature sensors will be assessed.

Web site: https://wicetec.com

Short biography: I'm a control engineer at Wicetec with master's degree in electrical engineering. Over the past three years, I developed and validated a Sensorless temperature control system for wind turbine blade heating system. This project provided extensive experience in scientific research, implementation of the research results into control systems, hands on data collection in wind turbines and measurements done with drone. I also gained experience in data analysis of both system and turbine performance. My one personal interest would be long-distance sports.

R&D areas/s: A) Wind

Triggering ice protection systems with weather forecasts

Dylan Baxter and Daniela Roeper, FabricAir, CA

Dylan Baxter (FabricAir, CA)

Ice Protection Systems (IPS) are designed to prevent and remove ice build-up on wind turbine blades, potentially recovering up to 75% of power losses caused by icing. Several key factors influence the effectiveness of an IPS, including power consumption and the extent of heated area coverage. However, the most critical factor is the triggering method.
The primary energy gains from an IPS come from preventing turbine standstill. An effective IPS does everything it can to prevent the turbine from entering reduced-power-curve or yaw-idle modes. An efficient IPS only operates when necessary to minimize energy consumption. Therefore, a high performing IPS operates mostly in anti-icing mode, preventing ice from forming, then occasionally in in de-icing mode, which removes accumulated ice. To achieve this, it is crucial to activate the IPS as early as possible during an icing event but no earlier than necessary.
Previous generations of the Borealis Ice Protection System (BIPS) have utilized various triggering mechanisms, such as turbine operation codes, power curve degradation per IEA Wind TCP Task 19, heated vs. unheated anemometer comparisons, third-party ice detection sensors, and manual activation by customers.
FabricAir has now introduced an optional advanced trigger, leveraging open-source weather forecast data and fuzzy logic to anticipate icing events and schedule expected power consumption. This new control logic will be evaluated against validated ice detection signals at three anonymized sites in North America. An efficacy factor will be established for BIPS units using the forecast-based triggering method exclusively.
Future steps will explore how this forecasting approach can be integrated into the broader performance framework of the BIPS. Additionally, incorporating power price forecasting could refine the fuzzy logic decision-making process, determining whether to activate the BIPS immediately or wait for more favorable forecast and pricing conditions.

Web site: https://www.linkedin.com/in/baxterdylan/

Short biography: Dylan Baxter P.Eng, is the Director of Technology for BorealisWind at FabricAir and a big fan of wind energy and winter sports like ski-touring. With 9 years experience creating heating systems for wind turbines, he has a B.A.Sc. in Mechanical Engineering and conducted graduate level research for multiple universities in Canada and Germany pertaining to thermal, fluid, and mechanical simulations.

R&D areas/s: A) Wind

Nordex: 15 years of AIS evolution

Nils Lehming, Nordex SE, DE

Nils Lehming (Nordex SE, DE)

Nordex has started in the year 2010 to equip turbines with an rotor blade Anti-Icing System. The presentation gives an insight on the lessons learned over the years, how the AIS has been further developed and the latest status of the development.

Web site: https://www.nordex-online.com/en/

Short biography: Nils Lehming is a Senior Product Manager working at Nordex SE headquarter in Hamburg/Germany since 2010. Nils is a Graduate Engineer from the Polytechnic University Lübeck and has been awarded from Milwaukee School of Engineering a Bachelor of Sience degree.
Nils worked from 2010 until 2013 as a Sales Engineer for the Nordic region.
Since 2014 Nils works as a Product Manager and is responsible for the Delta 3.X MW and Delta4000 4.X and 5.X generation wind turbines. One important feature of the Delta4000 platform is the latest generation of the Advanced Anti Icing System (AIS) for rotor blades.
One of Nils personal interests is sailing.

R&D areas/s: A) Wind, Icing loss forecasts

Validation of various approaches to forecasting production losses due to icing

Jennie Molinder and Sigmund Guttu, Kjeller Vindteknikk, part of Norconsult, SE

Christoffer Hallgren (Kjeller Vindteknikk, part of Norconsult, SE), Mona Kurppa (Kjeller Vindteknikk, part of Norconsult, FI), Jonas Mundheim Strand (Kjeller Vindteknikk, part of Norconsult, NO), Jennie Molinder (Kjeller Vindteknikk, part of Norconsult, SE)

Turbine icing is the second largest source of production losses in cold climates. Accurately accounting for icing losses is crucial both during the pre-construction phase of wind farm projects to reduce uncertainty in energy yield assessments and during operation to minimize the economic costs of icing in energy trading. Despite decades of discussion, wind-farm-scale numerical models for production loss due to icing for different turbine types still require further development.
As an alternative or additional enhancement to traditional physical icing models, machine learning (ML) tools and site-specific SCADA tuning have been proposed. At Kjeller Vindteknikk, we have a physical model, IceLoss, to assess long-term average icing losses for wind farms in the pre-construction phase, which has been continuously developed since its release in 2008. Since 2012, we have also introduced a day-ahead icing forecast model, IceLossForecast, for energy trading. To further improve the performance of these physical models and make them more site-specific, we are developing and testing different ML solutions and site-specific SCADA tuning.
In this presentation, we will share our experience of running commercial icing loss forecast services and how ML-based modeling techniques and site-specific SCADA tuning can be implemented into an existing icing production loss modeling chain. Additionally, we will discuss the requirements and challenges associated with using SCADA data as training data.

Web site: https://www.vindteknikk.com/services/wind-energy/forecasting-wind-iceloss-and-icerisk/

Short biography: Christoffer Hallgren is a meteorologist who began his career forecasting icy roads before diving into the wind energy sector. After earning his PhD, focusing on characterizing and forecasting wind conditions over the Baltic Sea, he joined Kjeller Vindteknikk, where he’s now setting up icing forecasts at full speed. When he’s not busy with weather and wind, Christoffer is a fencing coach, a hobby pianist, and loves to hit the trails for some hiking adventures.

R&D areas/s: A) Wind

Evaluating icing losses outside the Nordics with the WICE model

Luis Baquero, DNV, DE

Luis Baquero (DE), Mirko del Hoyo (CA), Daniel Burtch (US), Adnan Shah (US), Wolfgang Winker (DE), Onur Kaprol (US), Elizabeth Traiger (US)

Understanding the impact of icing on energy production is becoming increasingly important in the context of increasing onshore wind capacity worldwide. While cold climate regions like the Nordics have long been a focal point for addressing ice accretion on wind turbines, there is a growing need to extend this understanding to other regions with different climatic conditions outside of the most experienced one, the Nordics.

This presentation will showcase DNV's experience using the WICE model to assess ice-related losses due to ice accretion on wind farms across various regions. Each country has its own unique set of project requirements, operational restrictions, and winter climatic conditions, which can significantly impact wind energy production. The WICE model, which has been applied in several regions, helps quantify these impacts, and valuable experiences have been gained.

We will highlight the differences in the model's application across diverse regions through case studies. This includes a validation case conducted in Spain, where the model adapted to local conditions that deviate from the Nordic context, and a cluster assessment in France, contributing to a better understanding of the icing situation for a small development area. We also explored the current conditions in Germany and its main constraints regarding icing and addressed specific needs in a project located in Canada under a 24x7 energy delivery contract. These experiences have been instrumental in refining the future concept of the WICE model, ensuring that it better accounts for the diverse challenges faced by developers, operators, and manufacturers across these markets.

An ongoing project enhances the WICE model to capture even more specific regional needs, ensuring its continued relevance and accuracy for a global market. This presentation will also touch on the model's future development and how it can further support the wind energy industry in mitigating the impacts of icing on turbine performance and energy production.

Web site: https://www.dnv.com/services/wice-icing-loss-assessment-157379/

Short biography: Luis is a Senior Engineer at DNV in the Northern Europe Project Development and Engineering Team, with 13 years of professional experience in the energy sector. He began his career as an Electrotechnical, Data Analyst Engineer, and project management in the oil and gas industry, earning a master's degree in Oil Industry Management in Chile during this period.

Over the past six years, Luis has focused on the energy transition, leveraging his expertise in data analysis, software development, and project management to support the shift from fossil fuels to renewable energy. In 2020, he completed a Master of Science in Renewable Energies in Germany with a merit thesis about using machine learning for wind speed vertical extrapolation.

Since joining DNV, Luis has specialized in analysing wind farm operational data to assess its performance and forecast energy yields. He leads the Icing Climate Assessments group, developing advanced analytical tools for onshore wind farms in cold climates and supporting turbine and ice protection system manufacturers with validation works.

In addition, Luis is actively involved in innovation projects, driving digitization within his team and developing software for wind farm analysis aligned with German regulatory frameworks. He has also contributed to research groups, specializing in data analysis and machine learning for solar and wind technologies.

Luis enjoys gravel and road cycling and bouldering outside of work and has recently taken up kickboxing. During my stay in Sweden for Winter Wind 2025, I want to have my first experience skiing and hope to make it back home without too many bruises.

R&D areas/s: A) Wind

How to adapt standard ice loss assessment models to local conditions?

Marie Cecilie Pedersen, EMD International, DK

Morten Lybech Thøgersen (EMD International, DK)

Standard models for production loss assessment due to icing can in principle be applied at any locations, as long as the driving hindcast data is available. However, some local conditions might challenge the standardized setup of the modelling methodology, which as a consequence requires additional attention. In this work we present and discuss challenges for the standardized ice loss assessment model, as well as proposed solutions. We use the EMD-WRF On-Demand ICING [1] [2] as the standardized setup and the topics and challenges addressed have been collected by the consultants at EMD or comes from external users.

Typical standardized ice loss assessment models are driven by hindcast atmospheric data from a meteorological model configured for icing conditions. The setup imposes some limitations in complex terrain, due to the relatively smooth terrain of the meteorological model. This can require downscaling to actual terrain, higher resolution modelling (computationally very expensive) or a multi-point approach which allows for more advanced uncertainty studies. Complex local conditions can also challenge modelling of the key weather parameters for ice accretion, such as the cloud liquid water and temperature. The problem can be addressed by long-term correcting the icing variables by combining a low resolution WRF model covering one season with the long higher resolution WRF time series and adding any additional condensates to the cloud liquid water. For light icing climates, the bias of the modelled temperature can have a big impact on the modelled icing and thereby impact on the production loss assessment. A temperature bias correction can be done if local measurements are available, otherwise temperature sensitivity analysis on the modelled temperature is a good option. From local met mast measurements instrumental icing can also be identified [1] and correction by an icing index derived from the modelled timeseries of icing to incorporate the year-to-year variation. If local or nearby production data are available, they can be used to validate/support the production loss assessment by extracting the turbine specific losses using the T19 IceLossMethod [3]. A final scenario encountered is "out of bounds modelling" for extreme offshore and extreme north, where it has been found beneficial to combine more and different datasets (and masts if available) in the assessment.

In the presentation we address selected topics from the review above with the perspective of acknowledging and limiting the uncertainties of using standard models for production loss assessment due to icing.

References

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Web site: https://emd.dk/

Short biography: Marie Cecilie Pedersen is a wind energy R&D specialist at EMD International A/S located in Aalborg, Denmark. She started working with wind power in cold climates in 2014 during her Industrial PhD. studies. Her competences stretch from micro-scale modelling of icing accretion on structures using Computational Fluid Dynamics (CFD) to preconstruction production loss assessment and

R&D areas/s: A) Wind

uncertainty studies for wind power in cold climates and ice throw modelling. The topic of icing is also part of Maries hobbies as she loves all kinds of skiing with her family (downhill, telemark and cross country), when weather allows in Denmark or in the Norwegian mountains.
Marie holds a PhD. (2018) and a M.Sc. in Energy Technology from Aalborg University, Denmark.

R&D areas/s: A) Wind

Accurately quantifying changes in long-term, site-specific, operational icing losses

Ben Buxton, K2 Management, SE

Will Jowitt (K2 Management, GB)

Recognising the critical need for more reliable and accurate long-term icing loss predictions, K2 Management has developed a novel site-specific and machine learning-based approach to calculating long-term icing losses at operational wind farms for periods where direct observational data is lacking.

Wind farm energy yield losses due to icing are highly variable and can fluctuate significantly from year to year. This variability presents a substantial challenge when it comes to predicting the future performance of operational wind farms. The challenge primarily arises from the complex variability and interdependence of the numerous variables that influence icing-related losses, including wind resource, climatic conditions, turbine operation, and site topography, amongst others. Consequently, even when accurate icing loss data from operational wind farms is available for a relatively long period of a few years, putting this into a long-term context corresponding to the planned future operational period is inherently uncertain. Often the loss prediction can introduce significant upward or downward bias in the predicted wind farm net energy yield.

In regions where icing significantly impacts energy yields, this lack of accuracy, if left uncorrected, leads to considerable uncertainty when estimating future wind farm energy yields. This can have profound implications when evaluating the long-term financial performance of wind assets.

Additionally, it is difficult to quantify the effect of Ice Protection Systems. Without reliable predictions, it becomes nearly impossible to determine the true benefit of such technologies, whether in terms of improved efficiency and energy yield, or extended operational life. As a result, asset valuation and the clarity of investment decision-making are undermined.

The innovative icing prediction method presented here leverages advanced machine learning algorithms combined with site-specific SCADA data and long-term, open-source reference data from reanalysis. By integrating these various datasets, K2M's method enhances the accuracy of icing loss predictions for the wind farm lifetime, well beyond the observed period.

The benefits of this approach are manifold:

- More accurate long-term prediction of icing losses, leading to reduced uncertainty in future energy yield predictions for operational wind farms.
- Wind farm operators and investors can confidently assess the performance of installed Ice Protection Systems, supporting better informed decisions about further technology deployment.
- The likelihood of abnormally high icing losses reoccurring is known. This is crucial for risk management and financial forecasting in wind energy projects.

By addressing the inherent uncertainties in icing loss predictions over the project's lifetime, K2 Management's newly developed method offers a powerful tool for improving the realistic valuation and performance assessment of operational wind energy assets in regions prone to icing events.

Web site: https://www.k2management.com/

Short biography: Ben Buxton has worked in the wind industry since 2010 and holds a master's degree in Engineering. He has worked across diverse markets around the globe in both consulting and project developer roles with over 10 years of cold-climate focus. At K2 Management, Ben is a Principal Specialist within Analysis Services, providing support to the wind farm analysis team and in due diligence. He is moreover responsible for coordinating training across the global analysis team. Driven by an interest in both the details of the data and the big picture of the project, he enjoys using his experience in the technical attention required in wind farm development from analysis to design to contractual matters.

R&D areas/s: A) Wind

Ben counts good food (cooking and consuming) as one of his passions and enjoys foraging for ingredients.

R&D areas/s: A) Wind

Blade heating system performance envelope field validation - practical experiences

Tomas Wallenius and Daniela Roeper, Wicetec, FI and FabricAir, CA

Daniela Roeper (BorealisWind/Fabric Air, CA), Markus Heinonen (Wicetec, FI), Juho Siivola (Wicetec, FI)

[this is a joint presentation together with Daniela Roeper (BorealisWind/Fabric Air)]

The cold climate wind industry has been struggling to define how blade heating systems perform in different weather conditions, namely ambient temperature, wind speed and icing conditions. To tackle this IEA Wind Task 54 Sub Task is developing a method how to define performance envelope of blade heating systems. Basically, performance envelope of a blade heating system describes the weather conditions where the particular blade heating system is able to either keep the blade ice free or remove the ice, depending on the operational principle of the system. The method includes both field measurements and modelling to complement the field measurements.

In this presentation the authors are going to show practical experiences of the field measurements of blade surface temperatures using infrared (IR) cameras from ground and with drone. Measurements and field validation are done for two different blade heating systems installed on two different wind turbines, one is a retrofit system, and the other factory installed. Results and lessons learned from the IR measurements will be shared with the audience.

Web site: https://wicetec.com

Short biography: Tomas Wallenius is a co-founder and chief technology officer of Wicetec Oy, a company developing wind turbine blade heating system technology founded 10 years a go, as a spin-off from VTT Technical Research Centre of Finland. Tomas has worked in wind industry more than 15 years, always engaged in wind energy in winter conditions. Prior moving to industry side, he was a senior scientist at VTT and took care of Operating Agent duties of IEA Wind Task 19 - Wind Energy in Cold Climates working group and was a wind turbine power performance analyst as a part of accredited testing laboratory team. Tomas holds a Master's degree in mechanical engineering (major subject applied thermodynamics) from Technical University of Helsinki. Outside work life, and besides family life, he still restores his beloved tiny little night fire red classic Mini car.

R&D areas/s: A) Wind

Availability of ice mitigation systems – A key driver for performance and revenue

Simon Grenholm, W3 Energy, SE

Simon Grenholm (W3 Energy, SE)

Great effort goes into designing and fine-tuning the technical functionality of new Ice Mitigation Systems (IMS). Once installed and tuned, additional efforts are put into measuring operation and performance. But even the most powerful, state of the art technology for mitigating ice, is of no use if it is faulted. In a tough real-life environment, minor or mayor issues may case an IMS to fail. Blown fuses, loose cables, communication issues or incorrect meter readings may all require actions, repair work, spare parts or new software logics to get the system up and running again.

Turbines with faulted IMS cause increased ice losses and lost revenue. Therefore, monitoring turbines with faulted or functional IMS – aggregated as IMS availability – can give key information for economic decisions, as appropriate levels of repair teams and min/max levels of spare parts stock holding.

Even if the IMS availability is crucial for performance and revenue, the wind turbine supply and service contracts are often vague on the matter. There is also a lack of an industry standard for calculating IMS availability. Further, the turbines´ own information regarding IMS state are sometimes not reliable when the IMS is faulted, as the state logics may be part of the fault.

This presentation will show the main outlines of a calculation method developed and used by W3 Energy to estimate IMS availability and transform the results to business decisions.

The IMS availability calculation method takes ground from Task 19 methodology. It makes use of basic data signals and messages available on most wind turbine models. Each turbine is evaluated against its actions when it is tested by tougher icing events. Does the turbine then respond adequately by running blade heating? Such key events, when a blade heating response should be expected, are used to flag IMS as functional or faulted, and the state is extended until next time the turbine is tested.

IMS availability – together with Task 19 ice losses and hourly spot prices – is combined to show the value of fully functional IMS.

Web site: https://www.w3e.se/

Short biography: Simon Grenholm works as a Business Intelligence and Performance Analyst at W3 Energy, with a specialization in ice mitigation systems, software development and data analyses. He has graduated from Luleå University of Technology with a Master of Science in Environmental Engineering, with a focus on renewable energy sources. He also has a long-time experience as a software developer for the construction industry. Simon is passionate for a living planet and a sustainable development.

R&D areas/s: A) Wind

The Missing piece: Solving the puzzle of Ice Protection System performance

Patrice Roberge, Icetek, CA

Patrice Roberge (Icetek, CA)

Ice protection systems (IPS) for wind turbines have come a long way since their early versions. Today, most major turbine manufacturers and third-party providers offer solutions to mitigate the impact of icing on wind energy production. However, many wind farm owners find that these systems often fall short of expectations. To determine whether these expectations are too high or if the technology is underperforming, it's essential to understand the various factors that can influence IPS performance.

- IPS Availability is Critical: Surprisingly, the average availability of ice protection systems is quite low. Malfunctions are often detected late, leading to prolonged periods of reduced performance.
- Heating Trigger Strategy Shouldn't Be Overlooked: Sometimes the heating system is available but doesn't activate when needed, resulting in significant losses. This is especially problematic when the window for effective heating is small. Ideally, the system should trigger based on actual icing conditions.
- Turbine Control Strategy Matters: Even under the same conditions, the sensitivity of a turbine's icing stoppage can double the losses. Turbines with sensitive stoppage settings need highly effective IPS, as even small ice formations on the blades can reduce performance enough to trigger a stoppage.
- Mother Nature Always Wins: Factors like ambient temperature, wind speed, and liquid water content (LWC) determine the blade surface temperatures that the heating systems can achieve. Performance can be estimated using the IPS performance envelope.
- Heating Power Isn't Always the Limiting Factor: In some cases, it's the blade properties that limit temperature. This is particularly true for de-icing, where reduced convective heat transfer forces heating systems to cycle rapidly.
- Centrifugal Forces Helps Ice to Shed: Operating in anti-icing mode provides a significant advantage, as centrifugal forces reduce the amount of ice that needs to melt for shedding. Pairing blade coatings with IPS can also have a similar effect.
- The Heated Area Matters: The effectiveness of IPS can vary with the turbine's operating mode. When idling, the blade's angle of attack shifts, causing ice to accumulate beyond the leading edge. Blade add-ons can also gather ice, affecting overall turbine performance.

Web site: www.icetek.ca

Short biography: Patrice completed his Ph.D. in mechanical engineering at Université Laval under the direction of André Bégin-Drolet. He has been working on the operation of wind turbines in cold climates for nearly 9 years where he had the chance to contribute to the development of an ice detection device. He has authored and co-authored over 15 scientific publications. He is a very inquisitive person that loves to learn and understand the why and the how of the everyday phenomena. He is passionate about football, skiing, snowshoeing and trekking.

R&D areas/s: A) Wind

Retrofit of IPS – can we estimate the potential gain based on SCADA and model data?

Jennie Molinder, Kjeller Vindteknikk, part of Norconsult, SE

Jennie Molinder (Kjeller Vindteknikk, part of Norconsult, SE)

The last two winters have had many icing events causing wind farms in the Nordics to suffer from high icing-related production losses. For sites without any ice protection system (IPS) the question arises if it could be cost efficient to retrofit a de-icing and/or anti-icing system. For these sites, the historical icing loss can be estimated with SCADA and the Task19 method. The question arises: Based on this, is it possible to estimate the potential gain of installing an IPS?

Kjeller Vindteknikk utilizes observed icing production loss time-series from SCADA together with potential production and an in-house icing model (IceLoss) to estimate the potential benefit of IPS for each icing event. Ice build-up periods, for turbines both with and without IPS, are difficult to estimate solely from the SCADA using the Task19 method, especially when the turbine is completely stopped due to several days of icing. Therefore, the icing model is required in order to predict whether ice is expected to accumulate during the de- or anti-icing cycle or later during the icing event. Ice build-up during icing events would result in a less efficient IPS cycle and possible require a restart of the IPS.

By using the IceLoss model, SCADA and our experience of icing on wind farms both with and without IPS, we can estimate how the production loss could decrease during icing events if the turbines would have been equipped with IPS. As a final step, the estimated short-term production loss calculated both with and without IPS is long-term corrected by using a 20-year time-series of modelled icing losses. By comparing these time-series, we can estimate the potential production gain of installing an IPS system.

Web site: www.vindteknikk.com

Short biography: Jennie Molinder is a meteorologist who has done a PhD focusing on modelling of icing related production losses. She has been working at Kjeller Vindteknikk for the past 4 years, mainly focusing on icing related projects and pre- and post-construction analyses. In her spare time, Jennie likes to travel, build a lot of lego and do crocheting.

R&D areas/s: A) Wind

Using icing measurements to investigate potential new areas for wind power in severe icing conditions

John Magne Gitmark, Kjeller Vindteknikk, part of Norconsult, NO

John Magne Gitmark (Kjeller Vindteknikk, part of Norconsult, NO)

In an energy transition period from fossil fuel to renewable energy, possible new locations for wind power are valuable. Despite the need of electric energy, new projects occasionally face significant challenges, such as vulnerable local environments, lack of wind resources, local resistance and political disagreements.

In general, higher mountains in rural Nordic regions usually have great wind resources, limited environmental value, and lower negative impact among locals. However, such areas also often come with severe or extreme icing conditions, which in some cases can be a dealbreaker for a possible development project. In areas with such severe and extreme icing conditions, it is therefore important to obtain an accurate and detailed understanding of the actual conditions that are to be expected.

By using weather model data (such as WRF), icing on structure may be modelled [1, 2]. The models are often quite precise for typical wind farm areas. However, at some mountainous locations with complex terrain and extreme icing conditions, local effects often cause large uncertainty in the model simulations with a substantial influence on the results. In addition, the conditions may be outside the range of the icing model, especially when the accumulated ice load is modelled. Ice shedding also needs to be validated properly in such conditions.

As an attempt to investigate if wind power can be enabled at a location with severe icing conditions, Kjeller Vindteknikk (Norconsult), together with our collaborators (Troms Kraft Vind and Ymber), are currently performing icing measurements in high terrain in the polar region. The measurements are performed by using own developed icing sensor (IceTroll), which measures the ice build-up over time on a standard cylinder (ISO 12494).

The ongoing measurements will be used to validate both the weather model and the icing model, as well as tuning the icing model in the higher range of icing intensities and ice loads. An improved icing model can be used as important input when dimensioning met masts for wind measurements, and to provide useful statistics to estimate production losses.

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Web site: https://www.vindteknikk.com/

Short biography: John Magne Gitmark holds a master's degree in mechanical engineering with a specialization in energy- process and fluid flow. He has worked for nearly 5 years at Kjeller Vindteknikk, with icing as one of the main topics. The focus has especially been towards the risk of ice throw and ice fall, in addition to power loss and ice accumulation.

Ice is also included in the personal interests. In addition to making homemade ice cream, few things feel better than dipping your naked toe into a frozen lake...

R&D areas/s: A) Wind

Assessing the influence of anti-icing systems (AIS) on energy production – is AIS consumption adequately considered in pre-construction energy yield assessment?

Sam Williamson, Wood, GB

Iain Nisbet (Wood, GB)

Anti-icing systems (AIS) are commonly installed on wind turbines to mitigate the influence of icing events on energy production. AIS allow turbines to produce energy with no, or reduced, levels of performance degradation due to ice accretion on the blades and can prevent turbines from standstill during more severe icing events.

AIS may be considered beneficial at wind farms where icing is prevalent, although cost considerations are relevant to establish if investment in AIS is economically viable. To evaluate the viability of AIS installation, the influence of icing loss on production is appraised. This may comprise:

- Site-specific modelling (typically using ice model based on mesoscale data and ice accretion model).
- Estimation of icing losses based on instrumental icing observed onsite (pre-construction meteorological mast) and consideration of regional icing conditions.
- Consideration of icing losses at operational wind farms deemed representative of icing conditions expected at the development under consideration (i.e., regional validation).

However, while in operation, AIS consume power at individual turbine locations while the AIS is active. This power consumption occurs 'behind the meter', that is, the power produced by the wind farm is used to power the AIS, assuming the wind farm is not in standstill. Based on experience, consumption at wind farms 'behind the meter' is typically considered as an operational cost relevant only during periods of standstill: therefore, the power consumption of AIS during operation, which influences energy production at the revenue metering point, may remain unconsidered.

At an operational wind farm, the potential influence of AIS consumption on energy production can be assessed through interrogation of 10-minute SCADA power data at individual turbine locations and comparison with power metered at the revenue meter. In conditions where icing is not present, the difference in energy production between the turbine and revenue metering points may be attributed solely to the electrical transmission efficiency (dependent on the electrical design specific to the wind farm). Where icing conditions are relevant and installed AIS is active, the difference in energy production between the turbine and revenue metering points may be expected to relatively increase, representative of both electrical transmission efficiency and AIS power consumption.

Based on an anonymised Nordic wind farm operational dataset (where AIS installed), an investigation of power consumption by AIS is conducted. The analysis investigates seasonal (monthly) distribution in electrical transmission efficiency and AIS power consumption, with summer (non-icing affected months) being representative of electrical transmission efficiency losses in isolation and winter (icing affected months) being representative of both electrical transmission efficiency and AIS power consumption during periods where AIS is active.

Following comprehensive data analysis, icing losses are derived from SCADA data according to the IEA Task 19 methodology. SCADA signals are used to identify periods where AIS is active. Concurrent, to the operational period considered, modelled mesoscale data are investigated to provide commentary on the potential levels of icing on a monthly basis and in the context of long-term icing expectations. Seasonal (monthly) distribution of electrical transmission efficiency and AIS power consumption are presented on a per wind farm basis, as well as on an aggregated basis considering the entire operational dataset. The influence of AIS power consumption in isolation is inferred based on the seasonal profile and considering periods where AIS is active according to SCADA signals.

The findings of the analysis are used to opine on the potential implications of not considering AIS power consumption in the context of pre-construction energy yield assessment at wind farms in cold climates where AIS is relevant.

Web site: https://www.woodplc.com/solutions/key-markets/energy/renewables#wind

Short biography: Dr. Sam Williamson is a senior renewable energy consultant within the analysis team at Wood with extensive experience in both pre-construction and operational energy yield assessments. Since joining Wood, Sam has been responsible for delivery and project management of a number of wind farm

R&D areas/s: A) Wind

analysis projects across Europe, the Americas, the Middle East and Asia. The wind range of project locations has resulted in a wealth of experience in a range of climatic and project-specific conditions. This includes both onshore and offshore analysis across a wide range of environments.

Sam has extensive experience on conducting wind resource and pre-construction energy yield assessments including analysis of onsite measured datasets (including meteorological masts and remote sensing devices), long term correction through measure-correlate-predict procedures, horizontal wind flow extrapolation, utilising both linear wind flow and computational fluid dynamic models, energy yield assessment and uncertainty analysis.

Sam has also conducted a number of operational energy yield analyses, utilising both SCADA and monthly datasets. These projects have involved the analysis of the raw 10-minute wind turbine generator production, wind speed and direction time series, definition of loss events within the SCADA data using system alarms and events data, normalisation of the available data to correct for data coverage losses and operational energy yield calculation based on the correlation of this corrected data with suitable reference sources.

Sam has gained experience using a number of software packages, including WAsP and Meteodyn WT wind flow modelling software, Windfarmer, Windpro, Python for various analysis procedures and SQL.

Outside of work Sam enjoys cycling and pub quizzes (both taking part and compiling/hosting).

R&D areas/s: A) Wind

IEA Wind Task 54: Ice, noise and impact on acceptance

Timo Karlsson, VTT, FI

Timo Karlsson (VTT, FI)

In cold climate wind power sites ice can collect on wind turbine blades. Primary drivers for icing are in-cloud icing, where the turbine blades collide with super cooled cloud droplets or freezing rain. In both cases ice accretion will

Icing degrades the performance of a wind turbine because the ice accretion on the blades changes the shape and surface properties of the airfoil. The same process will also have an
impact on the sound produced by the wind turbine blades. Changes in the noise properties have also been used for ice detection. Ice impact on noise related experiments have been done in acoustic wind tunnels and in field in additions to modeling studies.

Icing on turbine blades can increase noise emission levels from the turbine. The increased noise emission levels can lead to issues with public acceptance of wind turbine projects and can lead to longer zoning distances required for wind power installations. Dramatic changes to audible distances can have an impact on the project public perception and acceptance.

Understanding the changes in the noise propagation can help in project planning and siting considerations in cold climate environments. Some guidelines could be made based on state-of-the-art of research on these topics.

Task 54 has collected a review of the research being done on impacts of ice on noise and would present review on the current state of the art of the research into both noise creation related to icing but also noise propagation in cold and snowy environments.

Web site: https://iea-wind.org/task54/

Short biography: Timo received his M.Sc. degree form Aalto University in 2012, from the School of electrical engineering, with speciality in automation and control engineering. He has been employed at VTT since 2011 working as a research scientist in VTT Wind power technologies group. He has been the Operating Agent of the IEA Wind research task on cold climate wind since 2017. During his time at VTT Timo has been working on numerous R&D projects related especially to wind power technology development. These projects have covered developing signal processing tools for wind turbine performance assessment and automatic ice detection, control system design for blade heating system, embedded system development, and development of GIS tools for icing risk assessment for wind power applications.

R&D areas/s: A) Wind

Wind climate research in Svalbard: the relevance of local processes

Matthias Henkies, The University Centre in Svalbard, NO

Matthias Henkies (UNIS/NTNU, NO), Knut V. Høyland (NTNU/UNIS, NO), Aleksey Shestov (UNIS, NO), Anna Sjöblom (UNIS, NO)

The Norwegian High-Arctic archipelago Svalbard is in the phase of transitioning to renewable energy supply. Therefore, the development of wind power is considered. Because it is a unique place in a harsh climate and complex terrain, local knowledge of the wind climate is needed to facilitate the transition. Concentrating on a large valley in Svalbard, wind characteristics with high relevance for wind power are explored, such as the wind profile and low-level jets.
The results show that the average wind profile is not strictly increasing with height due to thermally-driven circulations and possibly other effects of the topography, which is not well represented in regional analyses.
The results are in general in accordance with valley wind literature. However, they differ from other tall wind profiles taken in flat terrain.
The special wind characteristics should be considered for the placement of potential wind turbines in the Arctic.

Web site: https://www.unis.no/research/arctic-technology-research/

Short biography: Matthias Henkies is a PhD candidate at The University Centre in Svalbard (UNIS) and Norwegian University of Science and Technology (NTNU) in Norway.
He works on understanding the Arctic wind climate and its relevance for renewable energy. This includes meteorological processes, especially in the complex terrain of Svalbard, and wind resources, but also how solar panels can be affected by the wind, e.g., through snowdrift.
He concentrates on the analysis of observational data and has many years of experience in Arctic fieldwork.
Before his PhD he studied at TU Munich, NTNU, UNIS and LMU Munich with a B.Sc. Physics and M.Sc. Meteorology.
His personal interests include all kinds of mountain sports, especially hiking and backcountry skiing, as well as singing and going everywhere by bike, sometimes even to the airport.

R&D areas/s: A) Wind, B) PV

Simulating ice throw risks in wind and hybrid farms – Monte Carlo simulations, icing modelling, and probability calculations

Helmi Uusitalo, AFRY Finland, FI

Helmi Uusitalo (AFRY, Finland), Mika Laitinen (AFRY, Finland), Bengt Göransson (AFRY, Sweden), Riku Suutari (AFRY, Finland)

Simulating ice throw risks in wind and hybrid farms – Monte Carlo simulations, icing modelling, and probability calculations

Icing can cause large production losses as well as significant safety risks for persons and equipment present in the vicinity of wind turbines during ice throw events. The major problems associated with ice accumulation on wind turbines are production loss, ice drops and throws, increased maintenance cost and reduced technical life of the turbines. Even small size ice lumps thrown from the turbines can be fatal when hitting a person, which makes the estimation of ice throw important during the development of a wind farm, to keep the risk probabilities on an acceptable level [1].

According to AFRY's development, ice throw risks can be determined by modelling the icing frequency in a certain area and simulating the ice throws from the wind turbines, using the information of the ice lump mass distributions, wind turbine specifications, wind profile in the area, ground heights and terrain information. Simulation method is based on the initial information stated above, the equation of motion, and Monte Carlo simulation, to define a distribution diagram and a probability map of ice throw probabilities.

AFRY's development of wind farm icing modelling [2] and applying ice accretion physics [3] make it possible to estimate the assumed number of icing events during a season for a specific wind farm location. Alternatively, for operating wind farms, icing frequency can be calculated directly using measured data from wind turbines [4]. Using the calculated ice throw probability distribution in a wind farm area and the assumptions of ice throw frequencies, the ice throw risks for different cases can be calculated. The risks can be determined for example to humans walking in the area, cars driving in nearby roads, railways, permanent structures, or to solar panels in hybrid farms. Damage risks for solar panels can be calculated by integrating over the projected solar panel areas, duration of the icing season, and the calculated probability distribution, taking the direction of an ice hit and solar panel tilt angles into consideration. With these methods and assumptions, the possible damage and risks caused by wind farm ice throw can be reliably determined and minimized.

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3. ISO 12494. (n.d.). Atmospheric Icing of structures, International Standard, ISO/TC98/SC3/WG6.

4. IEA Wind Task 19: Task 19 Ice Loss, IEA Wind, 2019.

Web site: afry.com

Short biography: Helmi Uusitalo (M.Sc.) from AFRY's Wind and Solar Finland unit has a background in Engineering Physics (Advanced Energy Technologies) from Aalto University. She has developed wind farm icing modelling in her Master's Thesis (Analysis and Modeling for Predicting Icing Losses in Finnish Wind Power Production, Aalto University, 2022) and continued the icing modelling development in AFRY after completing her studies. Prior to AFRY, Helmi has worked in University of Helsinki in Institute for atmospheric and Earth system research studying new particle and droplet formation in atmosphere. Helmi has experience of many years from wind power analyses, measurements and modelling, as well as

R&D areas/s: A) Wind, B) PV

development related to icing and turbine operational data. Helmi has long been very interested in wind power icing being one of the most complicated phenomenon in wind power production, that is difficult to predict. The challenge has led her to a development journey to better simulate, understand, and predict the effects caused by ice accretion and breakage from the wind turbines.

R&D areas/s: A) Wind

Climate change and wind energy; how can you estimate future yield?

Emilie Iversen, Kjeller Vindteknikk, part of Norconsult, NO

Jennie Molinder (Kjeller Vindteknikk, part of Norconsult, SE), Pyry Pentikäinen (Kjeller Vindteknikk, part of Norconsult, FI)

For purposes such as feasibility studies or investment decisions in wind farm projects, it is important to estimate as accurately as possible the future energy yield of the project. With a changing climate, important factors controlling the energy production will change, and so are crucial to consider.

For example, as the globe is warming, the air is becoming less dense, something that negatively affects the wind energy production. Simultaneously, warming implies less atmospheric icing on the wind turbines in the winter months, which in case positively affect production. The wind resource itself may also change. Climate projections for mean wind speeds are relatively weak and uncertain. However, if the different seasons are isolated, a stronger signal immerges, with tendencies of decreasing wind speeds in the summer and increasing in the winter. Winter is usually the season with the highest electricity prices, and therefore this could potentially have a positive impact on the income from produced energy.

All of these climate change effect on energy yield are possible to take into account, by applying data from climate models, downscaled to an appropriate resolution for wind farm specific analysis. It is important to note that such an analysis will not provide an accurate estimate of the future energy yield, but will give an estimated trend and associated uncertainties. Although there are large uncertainties involved in climate projections, this is a better approach than not considering the future climate at all. If climate change is not considered, the uncertainties will be unknown. With the approach presented here, the uncertainties will be fully explored and thereby constrained, which serves as a better foundation and a larges security for investment decisions.

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Short biography: Emilie has worked on the topic of atmospheric icing and meteorological modelling for almost 10 years, through consultancy work at Kjeller Vindteknikk and several large research projects. She completed her Doctoral degree in this field in 2022, which also contained research on climate change impacts on icing. The complex topic of climate change is of specific interest to her, and particularly how it will affect our winter climate in the years to come. This is also of high relevance for her spare time passions, snowboarding and split boarding.

R&D areas/s: overall making RE sustainable

A sustainable energy transition is integrated and circular

Gitte Haar, Center for Circular Economy, DK

Gitte Haar (Center for Circular Economy, DK)

Renewable energy technologies offer clean and renewable energy sources, but these installations are not inherently sustainable. We are now in the Anthropocene Age, where human activity dominates the planet, posing existential threats through climate change, the depletion of wild habitats and biodiversity, and the scarcity of raw materials. This keynote introduces the Climate Nexus, an integrated approach that emphasizes Circular Economy and Biodiversity as central elements for achieving a sustainable energy transition.

Circular Economy
The shift toward a clean, circular economy is a new business imperative essential for the new market conditions and legislation in many regions, such as the EU Green Deal and the Circular Economy Action Plan (CEAP). New EU Ecodesign criteria (under the European Sustainable Product Regulation) focus on extending product lifespans, minimizing waste, and enforcing Extended Producer Responsibility (EPR). The Circular Economy is increasingly vital due to the geopolitical landscape and the growing dependency on raw materials, particularly critical raw materials. Integrating circular practices into the energy transition will enable efficient resource management by prioritizing reuse and recycling, reducing reliance on continuous raw material extraction, and ending the linear production of waste.
The vast amounts of waste generated—particularly in industrialized nations—must be curtailed, redirecting available resources into local circular economies. Reuse and recycling are crucial to establishing a fair, sustainable planet, essential for a comprehensive green transition. Extracting resources from existing materials is now more cost-effective than maintaining traditional linear supply chains. By adopting a holistic approach to energy transition and rethinking long, opaque, and unstable raw material value chains, we unlock substantial business and environmental potential, with significant energy savings achieved through recycling for a more efficient transition.

Biodiversity and wildlife
Human activity, including renewable energy installations, also threatens biodiversity and wildlife. Most countries struggle to meet UN biodiversity targets of maintaining 10% wild, unspoiled land and protecting 30% of nature, facing rapid biodiversity loss essential to human food production and climate resilience. Placing renewable energy installations in natural areas disrupts wildlife and ecosystems, and installations located near cities or villages may impact human well-being and face resistance from local communities. This restricts options for an intelligent energy transition.
A prime example is the widespread development of large PV solar parks. We need agricultural land for food production and open land for wildlife habitats. Solar panels should be integrated into existing infrastructure—such as buildings, parking lots, roads, railways, and protective barriers. This approach could enhance the architectural quality of our cities while preserving land for wildlife regeneration, provided we embrace innovation and implement effective regulations.

The keynote includes a case of a circular business model in the wind turbine industry: FabricAir – BorealisWind.

This keynote built on the books:
-The Great Transition to a Green and Circular Economy. Climate Nexus and Sustainability. Gitte Haar. 2024. https://bit.ly/3ScvOmq
-Rethink Economics and Business Models for Sustainability. Sustainable Leadership based on the Nordic Model. Gitte Haar. 2024. https://bit.lyt/3LrL8HI
-Nordic Case Collection on Sustainability and Transition to a Circular Economy. Gitte Haar. 2025. https://link.springer.com/book/9783031786372

Web site: www.c-c-e.dk

R&D areas/s: overall making RE sustainable

Short biography: Gitte Haar is based in Copenhagen (Denmark) and has for the past 15 years advised corporations on transforming their business opportunities into a new green economy and a circular economy and preparing for the new market conditions that ESG brings. Thereby developing methods and processes for companies and their green transition. Gitte Haar is also a non-executive board member of companies that work actively with the green transition and circular economy. Gitte combines natural science with business development and financials to create a strategic focus on corporate transformation and the importance of sustainable leadership. Gitte Haar holds an MBA from Copenhagen Business School, and a Master of Science from Copenhagen University. Gitte Haar is also an experienced management consultant with prior experience from Arthur Andersen and Deloitte. Gitte Haar is the author of several textbooks on sustainability, climate nexus, circular economy, sustainable leadership and rethinking of economics and business models.
Gitte Haar is the owner of the consulting company: Center for Circular Economy assisting private and public companies.

My personal interests are exploring the world and taking lots of pictures while doing so.