

Åre, March 18th-20th 2024



Winterwind

INTERNATIONAL WIND ENERGY CONFERENCE

Phazebreak:

Pioneering ice mitigation

Frozen turbine blades

mean frozen revenue

Scan the QR code
to watch a video
presentation about
the Swedish Wind-
power Association
on YouTube.



Organizer



Winterwind is an international must-go for everyone working with issues related to wind energy in cold climates. Every year, the world's wind energy professionals meet at Winterwind in Sweden to discuss the challenges and solutions of generating wind power in cold climates.

Welcome to a new year with Swedish Windpower!

2023 was a year in full pace of new renewables construction in the Swedish market. Almost 2 GW were added. Surpassed in the EU by Germany and the Netherlands, and still waiting for final figures from France and the UK, but still a top 5 position.

Approximately 1,2 GW of the wind farms added were located in areas (SE1-SE2) that can be considered "cold climate" locations. The need for research and cold climate operations is greater than ever.

It's with great pleasure that the Swedish Wind Power Association can once again invite you to the best cold climate wind conference – Winterwind 2024.

Personally I'm looking forward to learning from the best experts in the market, the discussions between the sessions are always so interesting!



Per Olofsson
Chairman
Swedish Windpower

The expansion of wind power continues vigorously in Sweden, with a high demand for wind turbines. The industry is looking for cheap and renewable energy that can deliver electricity quickly and support the green transition. However, many are also awaiting political decisions that could accelerate the pace of expansion.

For Swedish Windpower, this means that our focus as an industry association is placed on spreading knowledge. We work to facilitate knowledge about the general benefits of wind energy, both economic and environmental. We also facilitate knowledge about how wind power is a part of the energy mix and what supporting services that are needed in the energy system of the future.

Our work with spreading knowledge, and our membership benefits, are divided into three parts:

1. Unique, innovative, and instructive conferences.

Winterwind, the world's only international conference on wind power in cold climates. This year's theme is "The real cost of ice induced losses and balancing of power".

Operations and Maintenance Days is the only event you need as an owner of wind power to gain knowledge and network with representatives from the wind industry. As a delegate, you should get what you need to fulfil your responsibilities as an owner of a wind power plant and to take advantage of the further opportunities that wind power provides.

2. We publish Sweden's best wind power magazine:



Swedish Windpower. A unique magazine that is published in five Swedish editions annually, with separate English summaries. We talk about the latest developments in the industry and highlight the trends and market conditions that will benefit you as an owner.

3. Membership benefits that make a difference. We have negotiated with and selected the best suppliers in the industry to help you as an owner with a favourable arrangement for your wind power plant. We offer solutions for insurance, energy trading, legal, education and much more.

New membership benefits will be announced in the coming year, so keep up to date by visiting our website and social channels. We believe that all of the above is important, which is why the Swedish Windpower association and the community that the membership provides are so valuable. Together we get the chance to develop our association to continue our role as the natural gathering point for those who work with and for the wind industry.

WELCOME to Winterwind conference 2024

AT A TIME when demand for renewable energy is high, the wind industry is challenged to meet this demand in less than ideal environments.

Winterwind 2024 will assess the challenge of understanding the true cost of icing losses. We also continue to focus on understanding offshore wind in cold climates.

This year we will meet again in Åre, a classic Swedish winter resort. New this year is that we have a moderator for the conference and we will start with an opening ceremony on Monday evening.

We hope you will be able to make new connections, gain new knowledge and together create better business opportunities.

Welcome to Winterwind 2024!



Per Olofsson
Chairman
Swedish Windpower



Mari-Louise Wernersson
Coordinator,
Winterwind 2024

Swedish Windpower Association

Swedish Wind Power was founded in 1986 and is an industry organisation for wind energy producers, with approximately 650 members, ranging from smaller wind power owners to large-scale energy companies. With more than 35 years experience we are an established referral body and stakeholder in the Swedish wind energy sector, working to promote efficient development and economic conditions for wind power in Sweden.

One of the areas that define Swedish Wind Power is the exchange of knowledge, both as a referral body and provider of courses, seminars, and conferences. The seminars and conferences work as meeting points for the wind industry in Sweden. Being a member of Swedish Wind Power has several advantages and we are continuously working to develop new membership benefits to find attractive solutions that provide real and practical value to our members.

Every year Swedish Windpower association arranges international conferences like Winterwind and Operation & Maintenance Days. For our members we offer a wide range of attractive benefits, such as member discounts, inspiring webinars and the magazine "Swedish Windpower".

More about members benefits and the association:
www.svenskvindkraft.com

Membership benefits

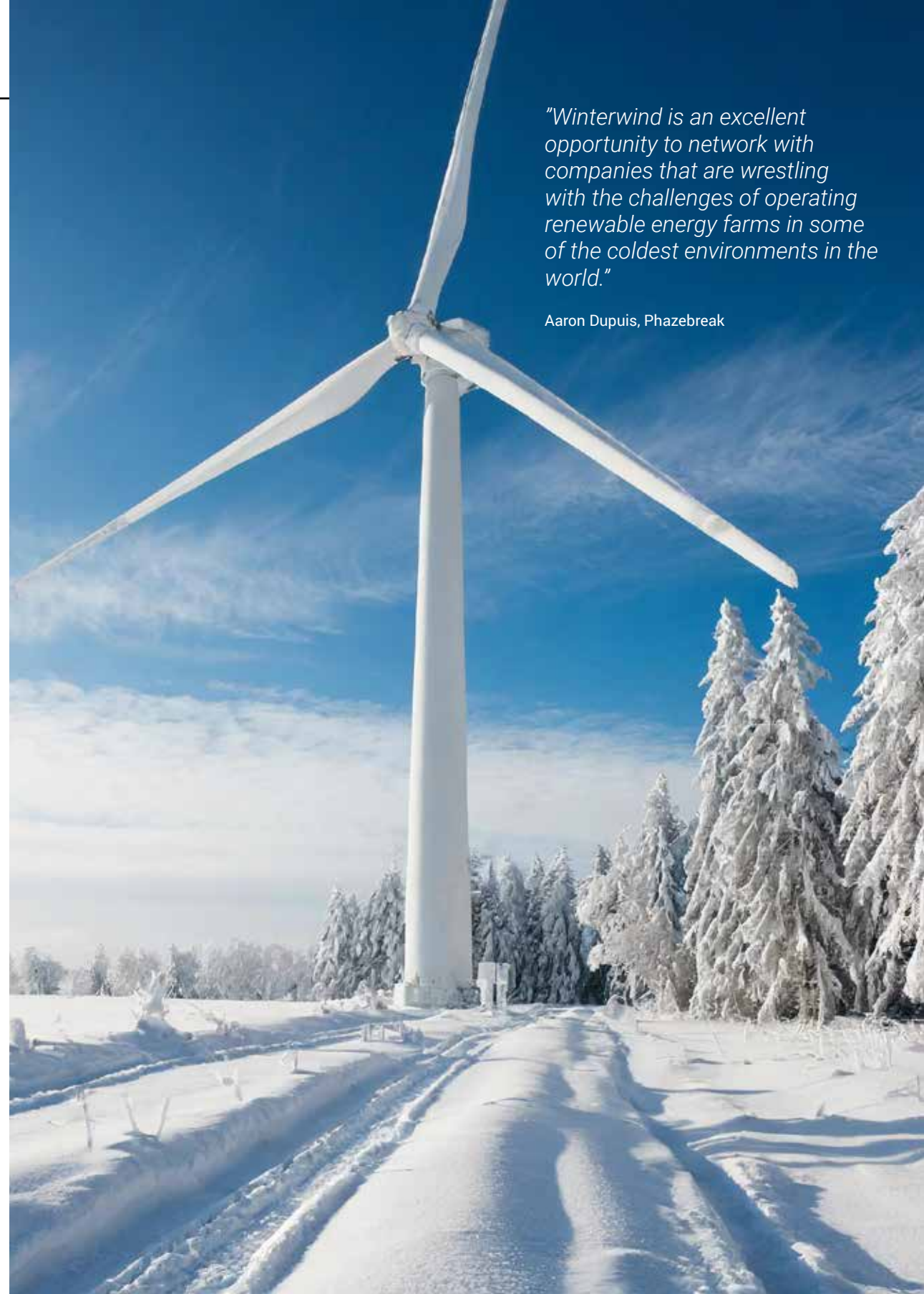
	Private	Company	Company +
Annual subscription to our magazine Swedish Windpower	●	●	●
Discounts on advertisements in the magazine	●	●	●
Discounts on tickets to our conferences and events	●	●	●
Beneficial wind power insurance (MARSH)	●	●	●
Discount on decommissioning insurance (MARSH)	●	●	●
One hour free legal advice (MAQS)	●	●	●
Discount on additional advisory fees (MAQS)	●	●	●
A negotiated framework agreement for electricity, electricity certificates and guarantees of origin as well as advice on binding agreements	●	●	●
Discounts on various market analysis reports	●	●	●
Rebate for ESA Principles education (Rabbalshede)	●	●	●
Rebate for Security Assessment for Windpower (W3 Energy)	●	●	●
Cyberinsurance & advice (MARSH)	●	●	●

* Company without production ** Company with production



Scan the QR code for enlarged version of the membership benefits table shown above.

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"Winterwind is an excellent opportunity to network with companies that are wrestling with the challenges of operating renewable energy farms in some of the coldest environments in the world."

Aaron Dupuis, Phazebreak

HÖGSPÄNNING

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MEET OUR SPONSORS & EXHIBITORS

In the exhibition you'll meet interesting companies and organizations offering services and products specific to your business within renewables. These are the sponsors and exhibitors for the 2024 conference.

Please visit their websites and social media channels.

GigaWatt Sponsors



Phazebreak Coatings has made its name in renewables by encouraging the wind energy sector to reframe the conversation from "ice removal" to "ice prevention." With its patented icephobic coating, NEINICE, Phazebreak has revolutionized how owners and operators respond to the environmental challenges that threaten their turbines (and their bottom line). Phazebreak's cost-effective, safe, and modular installation methods have allowed wind farms to thrive in even the harshest of environments, increasing energy output during storms, decreasing recovery time afterward, and reducing maintenance costs on over 9,000 blades worldwide.

For more information, please visit phazebreak.com.



MegaWatt Sponsors



Kjeller Vindteknikk is the leading consultant within meteorological wind and ice modelling in the Nordics and since 2019 part of Norconsult. We provide services such as wind measurements, energy yield assessments, icing loss estimations, postproduction analysis and icing forecasting for all stages of wind farm development.

Kjeller, with more than 20 years of experience, has supported more than 600 clients within wind energy in cold and icing climates, carried out icing loss assessments for over 170 wind farms, been involved in third party performance assessment of de- and anti-icing systems and have supported in warranty discussion connected to such systems.



As one of the leading companies in the commercial and technical operation of wind farms and solar projects, wpd windmanager manages a total capacity of over 6,000 MW worldwide and currently employs over 500 people. With its offices in Oulu and Piteå, wpd windmanager possesses many years of experience in the Scandinavian market and handles wind farms with a capacity of more than 770 MW for various investors, expanding by adding several new wind farms in 2024. Our staff is highly experienced in managing wind farms in the cold subarctic climate of Scandinavia. Wpd windmanager operates worldwide and has offices across Europe, in South America and in Asia. More information at: www.windmanager.net



As part of the Weidmüller Group, Weidmüller Monitoring Systems GmbH is a powerful partner for wind turbine manufacturers and operators. Since 2004, the Dresden-based company has been using its core competence in the field of multi-dimensional natural oscillation measurement on fiberglass and carbon components. This long-standing know-how is used worldwide in 30 countries for condition monitoring and ice detection of rotor blades on wind turbines. With more than 5,500 monitoring systems in use, we can draw on 20,400 machine years of monitoring experience to provide you with the optimum solution for your turbines.



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KiloWatt Sponsors



As a pioneer of wind energy technology and a partner of the energy transition, ENERCON specialises in the turbine and technology development, production, sales and servicing of onshore wind energy converters. Pursuing its mission of 'Energy for the world', ENERCON has driven sustainable energy generation from onshore wind since 1984. Thanks to its innovative wind energy converter technology, high quality standards and a total installed power of more than 60 GW (32.525 WECs in total), it is one of the world's leading manufacturers. Around 13,000 people work at administrative, sales, production and service locations worldwide for the wind turbine manufacturer with headquarters in Aurich (Germany).



Skellefteå Kraft is a leading operator of wind power in cold climate. We do Technical and Commercial Management, Power Trading, Service and Maintenance in partnerships. We currently own 124 WTGs along with Hydropower, Grids, District Heating and CHP, and more. Sustainability is important for us.



The development, manufacturing, project management and servicing of wind turbines in the onshore segment has been the core competence and passion of the Nordex Group and its more than 9,000 employees worldwide for more than 35 years. As one of the world's largest wind turbine manufacturers, the Nordex Group offers high-yield, cost-efficient wind turbines that enable long-term and economical power generation from wind energy in all geographical and climatic conditions.

Exhibitors



Wölfel Wind Systems is focused on Structural Health Monitoring of the complete wind turbine. We deliver reliable data analysis (Structural Intelligence) for lifetime assessments, increase of energy yield as well as ice and damage detection for rotor blades. Additionally we manufacture systems for reduction of vibrations and structure-borne noise. www.woelfel.de



INKOM together with ORGA NL and FREQCON GmbH deliver climate-safe solutions to the wind power industry with professional knowledge for cold climates, ESS system solutions and obstacle lights according to regional regulations and your unique requirements. Contact us at: www.inkom.se



EMD International A/S is a software and knowledge centre supplying companies and institutions worldwide with software, consultancy services, training and know-how within the fields of project design, planning, documentation and operation of environmentally friendly energy projects.



Deutsche Windtechnik AB, provides complete maintenance, ranging from basic service agreement to individually tailored full-service agreements for wind turbines manufactured by Vestas, Enercon, Siemens, Gamesa, Senvion and Nordex in Sweden. The Deutsche Windtechnik group has around 8000 turbines in total in Europe, USA and Asia. The company operates both onshore and offshore.

Exhibitors



Vaisala provides 360-degree solutions to renewable energy companies around the world: proven and reliable WindCube lidar suite, weather forecasting and historical data, lightning data solutions, and weather sensors and systems. We provide you with the actionable intelligence you need to maximize output, performance, profitability and safety at every project stage.



MERSEN – A Global supplier to the Wind industry. Solutions for wind: Pitch sliprings & retrofits with and without de-icing – Power sliprings – Carbon brushes – brush holders – Grounding systems – Carbon dust extract systems – In situ machining – Fuses – Circuit breaker – Surge protection – With long experience in the wind industry.



A next step in ice prevention systems for wind turbine blades with the patented ADIOS system. ADIOS Technology BV provides ice detection & prevention systems for new and existing wind turbines. ADIOS Technology is a subsidiary of Huikeshoven BV. A Dutch company that develops and supplies heating solutions since 1979.



At eologix-ping, we're dedicated to safeguarding your wind turbines. Our advanced sensor systems are tailored to ensure your wind turbines operate at their best. With our cutting-edge technology, we detect issues like icing, blade damages, lightning strikes and even minor misalignments, providing you with the data you need to make informed decisions.



DNV provides assurance to the entire energy value chain through its advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, the assurance provider helps industries and governments to navigate the transitions in the energy industry. DNV supports customers to transition faster to a deeply decarbonized energy-system.



Phoenix Contact offers you innovative automation and connection technology for the equipment of your wind turbine or wind farm. Many products have been specially developed for the wind industry and impress with their exceptional robustness and clever functions. A user-friendly operation and a seamless interaction are a matter of course. At Winterwind 2024 we present you our "Blade Intelligence". It is a modular rotor blade monitoring system that combines the ice detection, lightning measurement, structural health monitoring and load monitoring functions in one system.



AERONES is the leader in robotic wind turbine inspection and maintenance services. Using a unique patented robotic technology, crucial tasks are performed 3x - 6x faster, with 10x less idle stay days than using conventional methods. Utilizing new technologies is critical to increasing wind energy's efficiency and accessibility as the size and needs of wind assets grow. Aeronex provides inspection cleaning, coating and Leading edge repair services globally.

Exhibitors



Ramboll is a global leader in wind energy with more than 30 years of experience. We leverage our network of more than 700 wind experts to deliver innovative and sustainable solutions that combine global perspective with local expertise. We offer a full range of services, covering the entire project life cycle.



Clobotics Wind Services is the global market leader in onshore and offshore wind turbine blade inspections and maintenance. We deliver a full-scope service offering to operators and manufacturers with our groundbreaking technology. Our technology bundle is developed in-house and includes robotics, autonomous drones, cloud processing, web portals, apps and material technology.



Mast and Tower Construction, is the new distributor of CUE DEE windmasts and accessories. We supply complete measurement masts and also measurement booms, wires, foundations, nuts and bolts. We do mast calculation for customer mast relocations, on site mast inspections, damage assessments and used material inspections.



SKF startade 1907 med en innovation som förändrade världen. Det handlar om att minska friktionen och få saker att rotera effektivare vilket ger våra kunder minskat underhåll på maskiner, förbättrad säkerhet, energibesparing och lägre kostnader. Tillsammans får vi världen att snurra mer effektivt. Vi kallar det ingenjörskonst.



Linnovation is a Swedish technology company specializing in innovation and creative solutions for usage in cold climates. With a focus on research and development, Linnovation works with diverse range of industries and companies, providing innovative heating products and solutions to help companies stay ahead in the ever-evolving market.



Wicetec is the world-leading wind turbine blade heating technology provider. Our solution prevents ice formation on blade surfaces. This enables continuous turbine operation throughout the winter. Our patented technology is available for new turbines and retrofits with field proven lifetime of 25 years. Wicetec staff are highly skilled professionals with firm experience of wind power in cold climate.



Since 1968, HYTORC has been manufacturing torque equipment and has been trusted to deliver innovative technology to the majority of torque tool users worldwide. We stand for quality, safety and with focus on customer satisfaction. We create complete solutions with hydraulic, pneumatic and electric torque tools.



GP JOULE specialises in the technical and commercial management of wind farms and solar assets. Independent expert services are provided in technical operations management, condition monitoring, inspection and engineering to support investors, asset managers and operators in holistic operational life cycle and risk management.

Exhibitors



Icetek presents innovative solutions for optimizing wind energy generation in cold climate. The IC-1 ice conditions monitoring system enables early detection of icing, empowering operators to optimize ice mitigation strategies and reduce loss of production. Icetek offers precise data analysis services to determine the actual payback of implemented strategies. More information at: icetek.ca



Maximise annual energy production and availability through reduced downtime, applying preventive maintenance of turbine blades with automated services. As an independent service provider, Bladecare offers preventive wind turbine blade maintenance services related to cleaning, inspections, and repairs, based on various automated technologies. We enable our customers to maximise annual energy production and availability through reduced downtime. Based close to Stockholm, we cover the Nordic region. More information at: bladecare.se



The BorealisWind Ice Protection System (IPS) is a wind turbine blade heating system developed in Canada in 2016. This proven solution for cold climate wind farms is offered by FabricAir, a Danish HVAC company specializing in fabric ducting with 50 years of innovation in the industry.



We supply our customers with reliable measurement technology products and -solutions for demanding environments. We have developed quality solutions since 1971, and serve customers within the Renewable Energy, Environment, Intelligent Traffic Systems, Offshore and Defence segments.



Mast-och tornunderhåll Sverige AB was established in 1993. We have been building wind measurement masts since 2006. Our ambition is always to solve our clients demands. We have employees and equipment's to make the job done. Not the biggest company but we try to be the best.



Monday March 18th

**08:00 -
15:00** **Field Trip**

**10:00 -
13:00** **Seminar 1**
Ice throw risk mitigation measures

WORKSHOP: How turbine design may reduce ice fall risks for personnel,
John M. Gitmark, Kjeller Vindteknikk/Norconsult, NO (2)

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

**14:00 -
17:00** **Seminar 2**
Performance envelopes of blade heating systems

"Performance envelopes of blade heating systems"
- A subtask of IEA Wind TCP Task 54 "Cold climate wind power",
Claas Rittinghaus, Energiewerkstatt, AT (40)

**18:00 -
19:00** **Opening session**
Performance envelopes of blade heating systems

Navigating icy waters: decoding wind turbine success with the ice index,
Patrice Roberge, Ictec, CA (10)

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

Check the website for the latest updates: www.winterwind.se

Tuesday March 19th

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

09:00 - 10:00 **Forecasting**

*Seminar room: Arenan
Moderator: Lars Thomsson*

Wind power icing loss forecasting and evaluations against T19IceLossMethod, Mihai Chiru, rebase.energy and Modity, SE (34)

Wintersolar: Similarities and differences between developing solar and wind power in cold climates, Sigbjørn Grini, Kjeller Vindteknikk, part of Norconsult, NO (24)

Will we experience less ice induced losses in 2050?, Emilie C. Iversen, Kjeller Vindteknikk, NO (28)

Development

*Seminar room: Solskog
Chair: Sven-Erik Thor, w4e*

Intensity estimate - a step further from on/off to how much?, Tiina Kuula, Labkotec, FI (21)

Data management and real-time algorithm deployment for advancing anti-icing rotor blade heating in wind turbines, Georg Fritze, AIT Austrian Institute of Technology, AT (1)

Determining heating power and control strategy required to optimize ROI if an IPS, Dylan Baxter, BorealisWind, FabricAir, CA (29)

10:00 - 11:00 **Exhibition break**

11:00 - 12:30 **Plenary session - The cost of icing**

Moderator: Lars Thomsson

Navigating uncertainties in the energy market: ice accretion, wind turbines, bidding strategies, and the quest for perfection, André Bégin-Drolet, Université Laval, CA (6)

Strategies and tools for designing and optimizing wind farms for prosperous operation in cold climates, Simon Grenholm, W3 Energy, SE (45)

IEA Wind Task 54: Icing impacts on electricity grids and markets, Timo Karlsson, VTT Technical Research Centre of Finland, FI (17)

12:30 - 13:30 **Lunch**

13:25 - 13:55

Poster session 1 *Chair: Emilie Claussen Iversen, Norconsult*

Development platform for the ice design of offshore wind turbines in the Gulf of Bothnia, Jaakko Heinonen, VTT Technical Research Centre of Finland, FI (4)

CLIMB - A new standard for valuing biodiversity, Åsa Abel, Ecogain AB, SE (19)

14:00 - 15:00

Operation with ice protection systems

*Seminar room: Arenan
Moderator: Lars Thomsson*

On the importance of control for the performance of ice protection systems and wind turbines, Tomas Wallenius, Wicetec, FI (18)

Performance of ice protection systems, Ines Runge, Nordex Energy SE Co. KG, DE (12)

The Costs and Benefits of Blade Heating, Validated with Field Data, Daniela Roeper, BorealisWind, Division of FabricAir, DK (11)

Safety

*Seminar room: Solskog
Chair: Franziska Gerber, Meteotest*

Low temperature autonomous calibration of blade-based ice detection systems, Daniel Brenner, Weidmüller Monitoring Systems, DE (5)

IceRisk tool for Safe Operation of Wind Power in Winter Climate, Rolv Erlend Bredesen, Kjeller Vindteknikk - part of Norconsult, NO (37)

Safety aspects and risks of preventive heating during production, Doris Schadler, eologix-Ping, AT (42)

15:00 - 15:45

Exhibition break & Poster session 2 (15:10-15:40)

Chair: Patrice Roberge, Ictek

Strides in ice mitigation: How NEINICE icephobic coating is evolving, Aaron Dupuis, Phazebreak Coatings, US (26)

Mesoscale-to-microscale flow modelling in cold climate (WRF-to-CFD), Narges Tabatabaei, DNV Sweden, SE (32)

Maximizing wind energy output: The importance of ice-phobic coatings, Kaspars Litavnieks, Aeronas, LV (15)

15:45 - 17:00

Operation *Moderator: Lars Thomsson*

Improving bearing life in harsh environment, Peter Schmidt, SKF (46)

How does cold climate impact WTG performance aside from icing?, Ben Buxton, K2 Management, SE (27)

Smart control for blade heating systems - physics or machine learning?, Franziska Gerber, Meteotest, CH (8)

17:00 - 18:00

Exhibition break

19:00-

Dinner

Wednesday March 20th

08:30 - 09:30 **Prediction of icing** *Moderator: Lars Thomsson*

Modelling icing losses in complex terrain – uncertainties and solutions, Marie Cecilie Pedersen, EMD International, DK (23)

Advanced Predictive Analysis of Icing Events and Power Loss for Wind Parks, Li Bai, ConWX, DK (25)

Snow and ice forecast based on machine learning, Johan Casselgren, Luleå Technical University, SE (39)

09:30 - 10:15 **Exhibition break**

10:15 - 11:15 **Environment**

*Seminar room: Arenan
Moderator: Lars Thomsson*

Co-existence of wind farms and winter navigation – Maritime perspectives on offshore wind energy, (TBC) Emelie Persson Tingström, Swedish Maritime Administration, SE (22)

Early assessment on wind power projects and reindeer husbandry, Åsa Abel, Ecogain, SE (20)

The challenge of detecting the liquid water content with ceilometer and Wind LiDAR, Sara Koller, Meteotest, CH (13)

Planning and operation

*Seminar room: Solskog
Chair: Daniela Roeper, FabricAir*

Exploring cold-climate wind-energy modelling and ice-mapping with the new Copernicus European Regional Analysis (CERRA) dataset, Morten Lybech Thøgersen, EMD International, DK (38)

Developments in Standardization: Test Methods for Anti-Icing Properties of Rotor Blade Coatings, Ute Dr. Bergmann, TU Dresden, DE (30)

Icing loss estimation : practical insights for accuracy, Olivier Fortin-Moreau, Ictetek, CA (36)

11:15 - 12:00 **Lunch**

12:00 - 12:25 **Poster session 3** *Chair: Marie Cecilie Pedersen, EMD*

Simplify operation in cold climate, Nils Lesmann, Phoenix Contact, DE (16)

A field study on acoustic ice detection on wind turbine towers, Eike Lueken, eologix-Ping, AT (41)

12:30 - 14:00 **Closing session - The real cost of icing**

Moderator: Lars Thomsson

The economic costs of icing and the potential of icing forecasts, Mona Kurppa, Kjeller Vindteknikk, FI (3)

The cost of icing in different electricity markets, Petteri Antikainen, Wicetec, FI (31)

Economical effects of icing - a case studie, Sten Lillienau, Centrica Energy, SE (35)

Summary of Winterwind 2024: Jennifer Pettersson, Vattenfall



Frozen turbine blades mean frozen revenue

This year's Winterwind conference will focus on the real costs of icing and what can be done to prevent it. Experts from different countries argue, among other things, that several cost items need to be analysed and better weather and price data need to be produced.

TEXT: Joakim Rådström

THIS YEAR'S WINTERWIND CONFERENCE is attracting participants from around the world. Canada is represented by among others André Bégin-Drolet, Professor of Mechanical Engineering at Université Laval in Quebec province. He points out how a lot of attention has now been given to the effects of icing on the supply side, not just the demand side.

"If you think you'll be able to supply a certain number of MWh tomorrow, but icing occurs and you can't fulfil your commitments to the energy pool, then it creates imbalances", he explains.

Conversely, knowledge of expected icing may allow a wind producer to take this into account in its bid strategies. If you know that other producers are unable to fulfil their commitments, it will lead to a higher electricity price.

"The demand is there, but not the supply. If you have any production left over, you can outsource it at higher prices", continues Bégin-Drolet, who is also the founder and CEO of the company Ictek, which provides ice detection hardware for wind turbines.

HOWEVER, if you don't have a de-icing system in place, you can still go far just by having knowledge of future icing, as this will help you decide not to place any bids. Of course, the system operator also needs to be able to predict the losses on the supply side in order to get more electricity from other sources.

Today, successfully predicting icing is very much about analysing the drop in energy production from a

wind turbine. When this occurs, it is often caused by icing.

"But ice must be formed on the turbine blades in order for electricity production to drop, and in our experience, there's often a delay of between three and six hours from the start of icing to electricity production starting to drop", says André Bégin-Drolet.

The Canadian researchers have therefore started installing equipment on test turbines to try to predict earlier when the de-icing systems need to be switched on. This information will then also be used by the producer to determine whether and when to bid.

HOWEVER, FORECASTS of expected icing on turbine blades, and associated predictions of electricity prices, are particularly complicated to produce. There is definitely room for improvement.

"The last two to three years have seen strong fluctuations with both unusually low and unusually high prices. It's therefore difficult to form an idea of the future based on history", says Sten Lillienau, Senior Originator at the electricity trading company Centrica Energy.



André Bégin-Drolet and Sten Lillienau.



Mona Kurppa

The corona pandemic initially resulted in low electricity prices, then Russia's war of aggression against Ukraine had the opposite effect on prices. Since the effect of a possible icing event is affected by the market situation, the effect

becomes even greater when prices are more volatile," Sten Lillienau argues.

CENTRICA ENERGY is the balance manager, and bids on the market in the morning for the next day based on what connected wind turbines are expected to produce. The bids are placed for the entire 24 hours of the next day.

"Today it's hour by hour, but soon it's going to be every quarter of an hour. If we can't predict a possible icing event and thus get an error in our forecast production, it will be an unbalanced cost", says Sten Lillienau.

At the same time, Lillienau believes it's a myth that wind power doesn't deliver at its best when it's most needed. It's been very windy during January and February this year, and this has pushed down electricity prices in the middle of winter. It's generally windier in winter, and besides, cold air actually supplies more power than hot air at the same wind speed.

"This is because cold air is denser than hot air, which gives better efficiency", he explains.

In addition, icing occurs mainly at temperatures around zero degrees and higher humidity, not in more prolonged periods of stable, cold weather.

Instead, the challenges around wind power production in winter are largely about optimising production and producing forecasts that are as accurate as possible. The more measuring points and the better the cooperation and information exchange with producers, the more accurate the results.

IN ADDITION TO physical supplies, financial contracts are also affected by parameters such as icing. When the effect of the financial contract has to be offset, it is set against the spot revenue, i.e. the variable, physical supply. This means comparing the agreed price for a fixed volume to the average price for that month. However, the wind power producer receives the wind-weighted price and thus bears a wind profile risk.

"This is a problem for those who have signed

large baseload contracts, that is, they have committed to supplying the same amount of electricity all the time. But it's not just icing that causes it", says Sten Lillienau.

The risk is also greatly affected by prices falling when there's a lot of wind production combined with low demand. The same applies in the other direction – with low wind production when there's high demand.

SO WHAT'S THE BEST way for producers to obtain accurate forecasts of icing and market prices? The Nordic wind analysis company Kjeller Vindteknikk has developed a unique model for predicting production losses due to icing.

Mona Kurppa, meteorologist and senior advisor at Kjeller Vindteknikk in Finland, tells us more:

"We performed an economic analysis for a case study for a site in Finland, so we have six years of SCADA data on turbine production. We analysed both the economic impact of icing, and the benefits of using our ice forecasts."

However, like André Bégin-Drolet and his team in Quebec, Kjeller Vindteknikk has noticed that de-icing systems on wind turbines often don't provide enough help, at least not at the start of the icing event.

"After a few hours, the de-icing systems start to help, but since we live in the Nordic region where conditions are icy, there are probably no methods to completely avoid icing", says Mona Kurppa.

It's particularly interesting that the energy market sometimes behaves differently from what you have expected, or that there are clear price peaks.

"For a producer who can't produce as much as they had promised and has no other production method, such as hydro power, they need to buy the missing production on the market", concludes Mona Kurppa.



Managing the risk of ice throw

Two new solutions are under development to address the challenge of ice and snow throw from wind turbines.

TEXT: Jonas Hällén

IN COLD CLIMATE wind farms, for example, you may face the risk of ice being thrown from an operating turbine, ice falling from the blade of an idling or stopped turbine, wet snow falling from the tower, or ice blocks and icicles falling from the nacelle.

In order to prevent these ice incidents from becoming serious accidents that injure personnel, it's important to try to predict when and where the ice fall will occur.

Until now, this has been done mainly by the service technicians themselves, based on their experience and knowledge of the wind farm.

Now, the Norwegian project

“Safe Operation of Wind Power in Winter Climate” - led by Kjeller Vindteknikk - has developed an early version of a planning tool for design of the wind farm layout with respect to risks, as well as an advanced forecasting system for



Rolv Erlend Bredeesen

the service personnel (based on the IceRisk-Forecast).

“Basically, what we're aiming to do is combine the knowledge of

the wind farm's technicians with risk assessment studies of the farm and other tools such as cameras that look for ice on towers, blades and turbines,” says Rolv Erlend Bredeesen, Discipline/Icing Specialist at Kjeller Vindteknikk and Norwegian representative in the IEA Wind Expert Group on Wind Energy in Cold Climates (Task 19/54).

The Norwegian system

is typically used together with time series of meteorologically modeled parameters. It can be used in the planning phase of wind farm development as well as during operation, when it can help personnel assess whether to allow access to a turbine today, assess which turbines are available for service/visit, and determine the risk associated with evacuating or rescuing a turbine (or area) if an accident occurs, among other things.

“Making the right decisions about the possibility of ice throw greatly reduces the risk to technicians and other wind farm personnel, but it also reduces the amount of time turbines are out of service due to uncertain or overly conservative risk assessment,” says



Doris Schadler

Rolv Erlend Bredeesen.

To further

REDUCE the risk of unexpected ice throw in wind farms, the Austrian

blade monitoring company eologix-Ping has developed a control logic in combination with its sensor system. The unique properties of the on-blade sensor allow a finer differentiation of icing and enable preventive heating of the blades during production.

“The control logic uses the same sensors that detect ice and gives a signal to stop the turbine when there is a critical build-up of ice on the blades. These sensors can also tell when the turbine is free of ice and safe to restart,” says Doris Schadler, data analyst and algorithm designer at eologix-Ping.

Eologix-Ping's system ensures that blade heating doesn't start when there is light ice build-up, but only when there is potential ice build-up. Without increasing the risk of ice throw, the turbine can produce energy while preventing further ice formation by heating the blades.

6-7 May 2024 at Marstrands Havshotell.

Operation & Maintenance Days 2024

The Operation & Maintenance Days are aimed at industry players with a focus on the operational phase of wind power, covering issues of importance to owners, producers and partners.

Please note - the conference is held in Swedish.

The programme can be found at



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TOUGHBOOK

Phazebreak: Pioneering ice mitigation

How do you keep ice off wind turbines? This is a question on the minds of everyone who owns wind farms in cold climates. One solution could be an icephobic coating.

TEXT: Peter Wiklund PHOTO: Phazebreak

WHEN U.S.-BASED PHAZEBREAK entered the renewable energy market six years ago, it was because it saw a pain point that operators were dealing with: ice was cutting into their power production and revenue. Their solution: NEINICE, an icephobic coating technology designed to help operators in colder climates keep their blades spinning and avoid costly downtime and ice removal.

“At the time, the NEINICE formula was already developed and we were still looking for the right industry to use it. We saw how expensive and inconvenient ice removal methods were and felt that introducing a cost-effective ice mitigation solution could make a huge difference for owners and operators,” says Aaron Dupuis, Director of Marketing at Phazebreak.

NEINICE is designed to reduce ice build-up on wind turbine blades by creating an icephobic surface that significantly reduces ice adhesion.

Aaron Dupuis points to a case study from a wind farm in Minnesota where one of their customers conducted a field study. The data set collected was a comparison of the performance of coated and uncoated wind turbines during a six-day icing event from December 27 to January 1 a few years ago.

During this event, the coated turbines were able to keep spinning with only brief shutdowns, producing energy throughout the ice event, while the uncoated turbines were at near-zero power levels for the first four days. When the event ended on December 31, the coated turbines were the first to return to optimal

performance levels, while the uncoated turbines took until January 3 to recover from the icing event.

“MORE RECENTLY, a customer shared with us a dataset demonstrating the year-over-year performance of NEINICE at two different wind farms that were coated in 2019. The goal of this study was to determine the life cycle of the coating and establish a reapplication schedule,” says Aaron Dupuis.



These images were taken of the same turbine on the same day. The nacelle surfaces were not coated with NEINICE and had heavy ice buildup. The blade was coated with NEINICE and remained largely free of ice.



Aaron Dupuis

In this case, the data set showed the percentage increase in power output of the coated turbines compared to uncoated turbines in icy weather from winter 2019 to winter 2023.

At wind farm #1, they saw a 25 percent increase in the first year, a 15 percent increase in the second year, and a 10 percent increase in the third year. At wind farm #2, they saw a 40 percent increase in the first year, a 29 percent increase in the second year, and a 12 percent increase in the third year.

“In both cases we determined, along with our customer, that the increase would be at or near 0 percent by the fourth year. Based on this data, our customer determined that they would begin a four-year recoating program as the increase in revenue from these power production improvements would pay for itself.

The same study found a 5-8 percent increase over uncoated turbines during warm months, due to NEINICE’s self cleaning properties.

“If a wind farm is subject to multiple severe ice events per year, it is reasonable to assume that it could recoup its investment within a single calendar year,” concludes Dupuis.

“NEINICE can keep turbines spinning four hours at the beginning of an ice event and recover four hours faster at the end, so the coating makes significant progress in protecting power generation and the operator’s bottom line.”

AARON DUPUIS says Phazebreak is always looking to evolve its formulations.

Recently, they have developed a new coating, Surface Slip, that builds on the backbone of NEINICE. Surface Slip is a water-based formula with all the impact-resistant and self-cleaning properties of NEINICE, without the icephobic properties.

“This means our product can be used in warmer climates and reduce the drag caused by dirt, grime and debris,” says Aaron Dupuis.

PHAZEBREAK, based in Kansas, USA, is a regular attendee at the Winterwind conference.

“Winterwind is an excellent opportunity to network with companies that are wrestling with the challenges of operating renewable energy farms in some of the coldest environments in the world. With their insight and expertise, our company can continue to improve our coatings for even the worst winter storms.”

Each year that Phazebreak attends Winterwind, they also make new connections, notes Dupuis.

“For these reasons, we will attend Winterwind whenever we can. It is an invaluable event for connecting with collaborators and customers alike. Without the insights and connections that Winterwind conferences have granted Phazebreak, our company would not be where it is today.”



NEINICE can be applied in several ways, including by ground crew or using robotics.

Icing often caused by low wind speed

New studies by the company W3 Energy show a clear link between lower wind speeds and greater ice formation. Wind power producers should analyse production under different conditions and consider whether they should optimise their production at higher or lower wind speeds.

TEXT: Joakim Rådström



Simon Grenholm

ACCURATELY MEASURING ice losses and deciding when to switch on de-icing systems can be crucial for the profitability of wind farms in areas exposed to ice. However, the problem with generalising about past weather and prices is that it makes it difficult to assess future icing levels on a wind farm. This is especially difficult in periods of low wind speeds.

“Maybe you can manage the icing well in medium wind speeds. Then the wind speed drops to zero, and when it starts to blow again, the turbine blades are frozen to varying degrees”, says Simon Grenholm, Business Intelligence Analyst at W3 Energy.

This is because it's difficult to measure icing in low wind speeds. Normally, icing is detected when the wind turbine produces less energy than it would have done at a given wind speed. Without wind, there is no information about whether ice has formed.

“Conversely, at high wind speeds we're helped by vibrations and shaking, which can help to crack and shake off ice from the turbine blades”, continues Grenholm, whose main focus is on de-icing

systems, software development and data analysis.

TOGETHER WITH colleagues at W3 Energy, he is working on various solutions to help customers optimise their de-icing strategies, production and profitability. “Ice losses can be big in kilowatt hours, but calculated in kronor, it can become even more critical”, he continues.

Now that wind power has begun to contribute significantly to the national electricity supply, energy prices in the spot market have begun to correlate more and more clearly with wind speed and ice conditions. The link is particularly clear in periods of low wind speeds, where turbines tend to lose production capacity while spot prices rise sharply.

W3 Energy therefore recommends wind power producers to install robust and well-dimensioned ice management systems as an insurance against excessive production losses in winter.

IN ADDITION TO technical installations, the company recommends that the producer reviews the energy production of a wind farm in the longer term. One solution may be to analyse the expected annual revenue at an early stage rather than the expected annual

production, in order to minimise losses during times when icing is a problem.

“You can carry out an assessment where you examine how much the wind farm might produce. There, to a greater extent, you can take into account the times when energy is produced to match with spot prices”, says Simon Grenholm.

Production can then be adjusted based on these prices. For example, you can choose to design for a high energy yield at high wind speeds, or start producing even at low wind speeds – and then accept that you'll lose a little at higher wind speeds.

W3 HAS DEVELOPED unique tools for larger wind farms that will make it possible to detect links and act a bit differently than if you only have one turbine. For example, you can visualise through different view layers, calculate energy losses and revenue losses in time series and in wind speed charts and investigate different scenarios with or without ice protection systems.

“Then you can see, for example, that shortly after a given event something else starts to happen with the turbines. At first glance, it may not seem to be due to ice, but it turns out to be caused by ice anyway”, Simon Grenholm explains.

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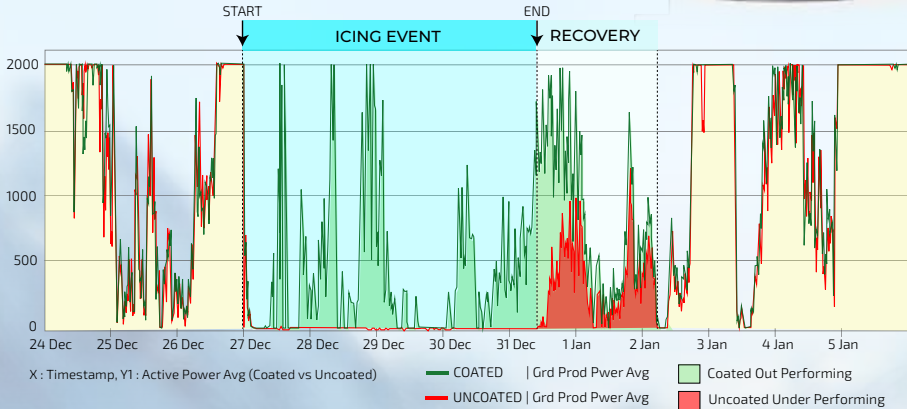
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A patented icephobic coating for wind turbines that effectively promotes ice shedding, mitigates ice accumulation, and provides protection from a broad range of detrimental conditions.



1 DATA | COATED TURBINE COMPARISON



2 RESULTS | COST SAVINGS CALCULATOR

5 TOTAL TURBINES
144 DURATION OF EVENT (HOURS)
\$199 ESTIMATED \$mW/h
0.109 AVERAGE mW/h INCREASE
15.696 TOTAL mW/h INCREASE

EVENT REVENUE INCREASE
PER TURBINE **\$3,123.50**

EVENT REVENUE INCREASE
ALL TURBINES **\$15,617.52**



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