Winterwind

INTERNATIONAL WIND ENERGY CONFERENCE 2021

WINTERWIND

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Online, April 19-21 2021

Winterwind is an international must-go for everybody that is working with issues related to wind energy in cold climates. Winterwind found early its own niche in wind energy in cold climate and gathers every year the world's wind energy professionals in Sweden to discuss the challenges of generating wind power in cold climates.

WELCOME

to this year's Winterwind conference online!

WE ARE FACING unprecedented crises. In addition to the climate crisis, we have a pandemic that has paralyzed an entire world. At the same time, the energy transition must continue and clean electricity to be developed and produced.

The 13th Winterwind, #Winterwind2021, went from physical conference, to postponed, via hybrid plans to becoming completely digital. It has also been a very tough winter in many places around the world. Many wind energy owners, suppliers, developers and technicians have experienced major problems keeping production going and unfortunately, the winter has also shown that we need to further develop the technology to optimize production in cold climates. There is still a great need for people in the business to interact and Winterwind is the platform!

Sad reasons, but there are advantages to have the conference digitally after all. We have tried to adapt the times so that they also suit Asia and North America. As an attendee you can also get access to most of the content even afterwards.

Keep your eyes open for various competitions and quizzes with great prizes.

Stay safe! Let the show begin!

Jakob Economou
Coordinator, Winterwind 2021

Jeanette Lindeblad
Chairwoman of the Board, Swedish Windpower Association

Swedish Windpower Association

ABOUT
Swedish Windpower Association represents all producers. The association has over 30 years of experience. It started with the visionary entrepreneurs, landowners and others, who invested in one or a few turbines, but today we represent everything from the smaller to the big actors. We are an established referral body and a committed party in energy Sweden who believes in the power of collaborations.

Our main purpose is to promote the development of wind power at reasonable economic and financial conditions. We are involved in wind power related projects and educations, we inform about research results and technological development, often in close collaboration with authorities, organizations and the business community.

MEMBERS BENEFITS
We have contract partners for specially made member benefit offers for example a customized wind power insurance developed by the broker Marsh, specially written to cover a wind turbine and its special activities. Last year we jointly with Marsh launched a new insurance for decommissioning guarantees.

For electricity trading we offer a framework agreement via Bixia. By negotiating an agreement for our members as a group we can offer an agreement that is at the top of the market.

Also, in collaboration with MAQS, we offer our members an hour of free advice in connection with having a case you want to discuss, and a discount on following hours, if needed. MAQS has many years of experience in handling wind power projects that span all phases.

And if you have an interest in the Nordic renewable market, don't miss this opportunity to take part of the most important price effecting news and forecasts. Bodecker Partners electricity certificate report contains the latest updates on politics, growth and price forecasts in Sweden and Norway. This comprehensive report is much appreciated among wind power owners, banks and energy companies. It is available in English and published 5 times per year. As a member you have a discount on the report.

THE MAGAZINE
We publish the magazine: Tidningen Svensk Vindkraft. The magazine aims to work for continued development and dissemination of knowledge-enhancing information on wind power – to nuance the debate, to convey research findings and information on technical development, to monitor and review the wind power industry as well as the work of government and politicians. We also publish an English summary of each magazine.

We are an experienced conference organizer. We annually arrange conferences and informative seminars as:

- **Winterwind International Wind Energy Conference.** Winterwind found early its own niche in wind energy in cold climate and gathers every year the world's wind energy professionals. Organized by Swedish Windpower Association since 2008.
- **RE-Scandinavia.** A conference about energy power purchase agreements, corporate PPAs. Organized by the Swedish Windpower Association in cooperation with the Danish Wind Energy Association who collectively represent more than 5,000 MW of operating wind power capacity. In partnership with Re-Source.

Members of the Swedish Windpower Association receive a discount on standard prices at our events. The association is open to everyone. Among our members are besides producers, both private individuals, suppliers and wind power developers among others.

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

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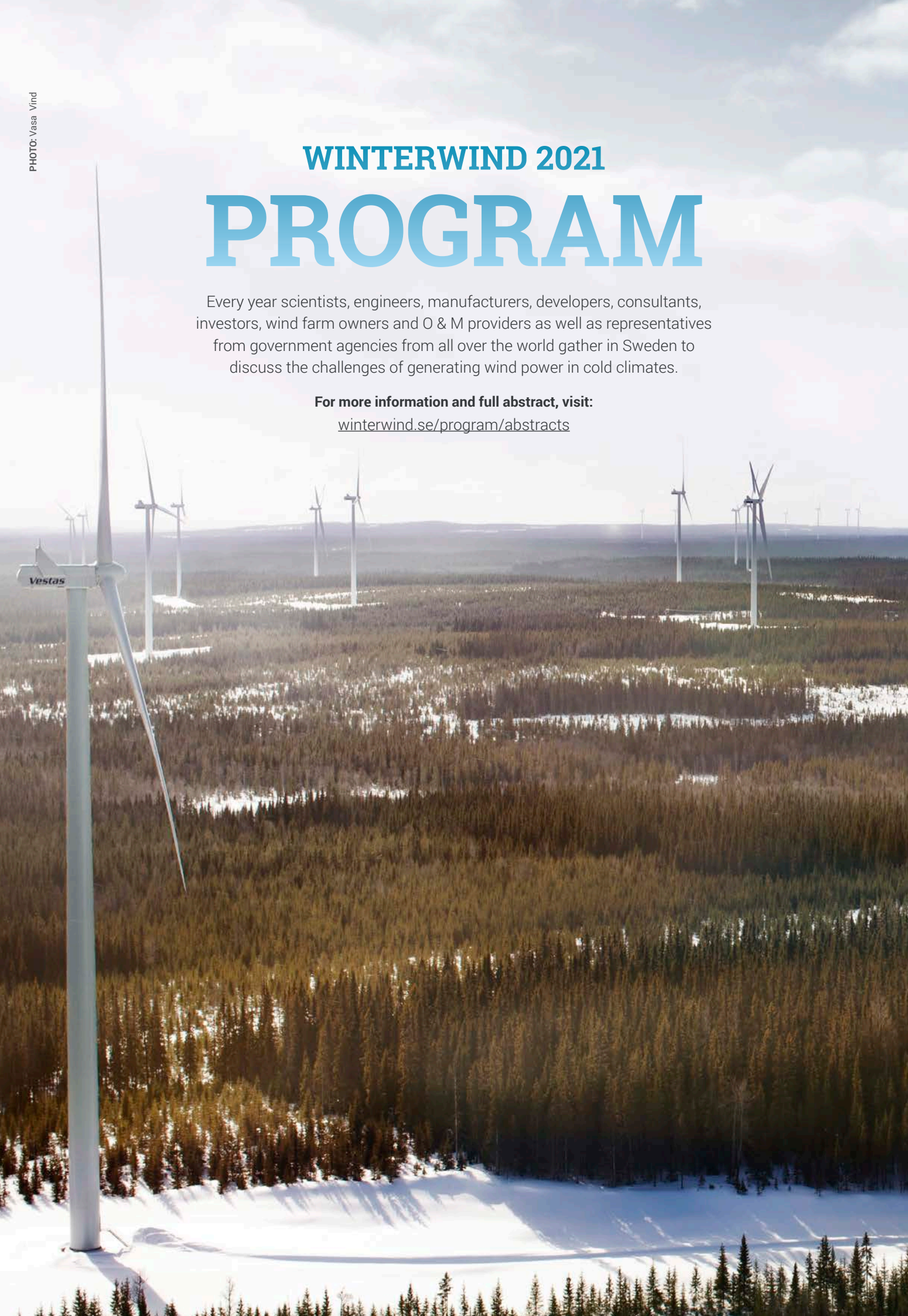

PHOTO: Vasa Vind

WINTERWIND 2021

PROGRAM

Every year scientists, engineers, manufacturers, developers, consultants, investors, wind farm owners and O & M providers as well as representatives from government agencies from all over the world gather in Sweden to discuss the challenges of generating wind power in cold climates.

For more information and full abstract, visit:

winterwind.se/program/abstracts

13:00

OPENING SESSION (1)
Moderators: Jeanette Lindeblad & Stefan Gsänger

13:05 Wind Power Around the World, Stefan Gsänger, World Wind Energy Association WWEA (45)

13:15 Record 2020 masks mounting onshore wind challenges, **Isabelle Edwards**, Bloomberg, GB (12)

13:35 Climate resilience vs. low cost renewables, **Rosemary Barnes**, Pardalote, AU (43)

13:55 Announcements

14:00 **Exhibition break**

14:30

IMPROVEMENTS (2)
Chairs: Tove Hamberg & Stefan Bill

14:35 Wear resistane multi-composite coating for wind power blades, JUN CHEN, Lulea University of Technology, SE (34)

14:50 Yaw optimisation, Thomas van Delft, DNV, UK (17)

15:05 Q&A

14:15 – 15:30 STANDARDS & WARRANTIES (3)
Chairs: Jenny Longworth & Anders Björck

- IEA Wind Task 19: Standardization of pre-construction icing loss assessment in upcoming IEC 61400-15 standard, Ville Lehtomäki, Kjeller Vindteknikk, FI (23)
- Performance warranty guidelines for wind turbines in icing climates, Helena Wickman, Vattenfall, SE (29)

5 minute break

Panel discussion - Standards & warranties
Panel Moderator: Jenny Longworth, KVT AB

Panelists:
Ville Lehtomäki (KVT Oy), Helena Wickman (Vattenfall)
Anders Björck (OX2), Stefan Söderberg (DNV GL)

Conclusions

15:15 **Exhibition break**

15:45

MODELLING ICE (4)
Chairs: Luca Durstewitz & Enrico Sindici

15:50 On-site estimation of effective liquid water content, Patrice Roberge, Université Laval, CA (35)

16:05 Operational icing forecast with a probabilistic approach, Jesper Thiesen, ConWx, DK (20)

16:20 Q&A

ICE PROTECTION SYSTEMS (5)
Chairs: Johanna Bohn & Bastian Ritter

15:50 The evaluation of state-of-the-art anti-icing surface solutions using a large scale icing test set-up, Joey Bosmans, Sirris, BE (24)

16:05 Assessment of ENERCON blade heating performance in various conditions, Gilles Boesch, ENERCON Canada, CA (27)

16:20 Q&A

16:30 **Exhibition break**

17:00

MODELLING ICE ON WT (6)
Chairs: Jennie Molinder & Alexander Stoekl

17:05 Icing impact on trailing edge noise in wind turbines, **Timo Karlsson**, VTT Technical Research Centre of Finland, FI (28)

17:20 A complete model chain for icing of wind turbines, Johan Revstedt, Lunds Universitet, SE (8)

17:35 Q&A

ICING AND ITS CONSEQUENCES (7)
Chairs: Carla Ribeiro & Paul Froidevaux

17:05 Development and calibration of state-of-the-art icing loss estimatesusing a new meteorological dataset, Øyvind Byrkjedal, Kjeller Vindteknikk, Norconsult, NO (33)

17:20 Towards improving wind energy in cold climate: how to quantify the use of alternative operationalstrategies, André Bégin-Drolet, Université Laval, CA (32)

17:35 Q&A

17:45 **Exhibition break/Mingle 45 min**

18:30 **End of day**

TUESDAY APRIL 20

13:00

SESSION (8) - LOAD CONTROL
Chairs: Rosemary Barnes & Richard Sahlberg

13:05 6D inertial sensing on the blade surface - know the moves of your blade's surface, Michael Moser, eologix sensor technology, AT **(10)**

13:15 Improving turbine annual energy production (AEP) and reducing O&M costs with real-time blade airflow quality monitoring and quantification under all environmental conditions and levels of blade contamination, John Maris, Marinvent, CA **(13)**

13:35 Blade intelligence - Combined ice measurement and load monitoring, Nils Lesmann, Pheonix Contact, DE **(2)**

13:55 Q&A

12:15 – 14:15
WORKSHOP: RISK OF ICE FALL (9)
Chairs: Åsa Elmqvist & Michael Durstewitz

- TRiceR, a cloud-based web application for supporting risk-based decisions associated with ice falling from windturbine blades, Xavier Vanwijck/Bossuyt Ottelien, Tractebel, BE **(3)**
- Timeseries-based approach for volume risk assessment, Enrico Sindici, Natural Power, GB **(4)**
- Challenges and opportunities in the communication of risk from Ice Throw, Karl Ove Ingebrigtsen, Norconsult, NO **(15)**

Break, 10 minutes

Workshop

Conclusions

14:00 **Exhibition break**

14:30

DETECTING ICE - SENSORS (10)
Chairs: Marianne Rodgers & André Bégin-Drolet

14:35 From turbines to farms: Using distributed ice detection to increase safety and accessibility, Theresa Loss, eologix sensor technology, AT **(9)**

14:50 Tackling ice throw risks by using sophisticated algorithms of bladebased ice detection, Bastian Ritter, Wölfel Wind Systems, DE **(16)**

15:05 Q&A

REPAIRS (11)
Chairs: Anna Lundsgård and Sven-Erik Thor

14:35 Structural blade repair in artic climate, Resistive Vacuum Infusion, Greger Nilsson, Blade Solutions, SE **(19)**

14:50 Cost effective de-icing blade repairs, Morten Handberg, Wind Power LAB, DK **(25)**

15:05 Q&A

15:15 **Exhibition break**

15:45

MAPPING ICE (12)
Chairs: Eva Sjögren & Nils Lesmann

15:50 Atmospheric icing on offshore wind farms in Northern Europe – a risk map, Carla Ribeiro, Wood Thilsted, UK **(1)**

16:05 Validation of a wind turbine icing model for site assessment, Noemi Tölg, Fraunhofer IEE (Research Institute), DE **(31)**

16:20 Q&A

ICE PROTECTION SYSTEMS (13)
Chairs: Mélissa Hugeux & Charles Godreau

15:50 Linnovation concepts for operation and service in cold climates, Sven-Erik Thor, Lindskog Innovation, SE **(39)**

16:05 IPS retrofit for complex blades, Daniela Roeper, Borealis Wind, CA **(40)**

16:20 Q&A

16:30 **Exhibition break**

17:00

KEYNOTE SESSION (14)
Moderators: Elektra Kleusberg & Stefan Gsänger

17:05 Comparison of four blade-based ice detection systems installed on the same turbine, **Paul Froidevaux**, Meteotest, CH **(18)**

17:20 IEA Wind Task 19: Cold climate wind market study, Timo Karlsson, VTT Technical Research Centre of Finland, FI **(21)**

17:35 Q&A

17:45 **Exhibition break/Mingle 45 min**

18:30 **End of day**

WEDNESDAY APRIL 21

13:00

INTERESTING ODD TOPICS (15)
Chairs: Tanja Tränkle & Michael Moser

13:05 Protection and lifetime improvement for bearings and gears by using silicon-based additive technology, Stefan Bill, Croda, DE **(38)**

13:15 Synergies between icing on wind turbines and UAVs, Richard Hann, Norwegian University of Science and Technology (NTNU), NO **(11)**

13:35 Re-use of wind turbine blade for construction and infrastructure applications, Alann André, RISE Research Institutes of Sweden, SE **(37)**

13:55 Q&A

13:15 – 14:15 THE SOCIAL AND ECOLOGICAL ENVIRONMENT (20)
Chairs: Sigrid Carstairs & Sebastian Meyer

- A road map for the wind energy industry: taking a proactive approach to the biodiversity challenge, Tove Hägglund and Åsa Abel, Ecogain, SE **(41)**
- Digital business and collaboration platform for local anchoring and collaboration, Charlotte Larson and Oskar Ahlman, Vindkraftcentrum and Umeå University, SE **(42)**

12:15 – 14:15 WORKSHOP - HSE (16)
Chairs: Maria Röske & Michael Henriksson

- Safe turbine operation in icy conditions, Eva Sjögren, ENERCON GmbH, SE **(26)**
- Return on experience: Working on a wind farm in icing conditions, Charles Godreau, Nergica, CA **(14)**
- Simple rules-of-thumb for ice fall/throw safety distances, Alexander Stökl, Energiewerkstatt, AT **(5)**

Break. 10 minutes

Workshop

Conclusions

14:00 **Exhibition break**

14:30

ICING LOSSES (17)
Chairs: Theresa Loss & Øyvind Byrkjedal

14:35 Modelled icing losses with WICE: A blind test in France, Stefan Söderberg, DNV, SE **(30)**

14:50 Uncertainties of modelled production losses due to Icing, Marie Pedersen, EMD International, DK **(6)**

15:05 Q&A

EXPERIENCES OF ICING (18)
Chairs: Noemi Tölg & Matthew Wadham-Gagnon

14:35 Lesson in winterisation from the UK, David Armour, Natural Power, GB **(7)**

14:50 Skellefteå Kraft:s experiences of operating wind turbines in cold climate and the need of a physical testing, Krister Efverström, Skellefteå Kraft, SE **(36)**

15:05 Q&A

15:15 **Exhibition break**

15:45

FINAL SESSION (19)
Moderators: Jeanette Lindeblad & Stefan Gsänger

15:50 Combining ensemble icing forecasts with real-time measurements for power line and wind turbine applications, **Bjørn Egil Nygaard**, Kjeller Vindteknikk, part of Norconsult, NO **(22)**

Wind - Breath of life or kiss of death: Analysis of wind energy fatalities, Paul Gipe, Wind-works, US **(44)**

16:20 Q&A

16:30 **Exhibition break**

17:00 **End of conference**

PHOTO: Vasa Vind

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 our sponsors and exhibitors for the 2021 conference. Please visit their websites and social media channels.

MAIN SPONSOR

VASA VIND DEVELOPS, constructs, and operates large scale wind power in Sweden. The portfolio includes 525 MW in operation with an additional 60 MW currently under construction, all in northern Sweden. Furthermore, Vasa Vind has a substantial development pipeline, including one of Sweden's largest development projects. Vasa Vind has a long-term sustainability perspective in all its activities, with particular focus on sustaining local communities and the health and safety of all who work at or visit site. Vasa Vind works closely with suppliers and industry experts to continuously promote further development in these areas.

SPONSORS

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 2021 we present you our "Blade Intelligence". It is a modular rotor blade monitoring system that combines the ice detection, lightning measurement and load monitoring functions in one system.

NORDEX GROUP offers reliable and high efficient multi-megawatt wind turbines for nearly all geographical regions. Also part of the Nordex Group's offer are solution-driven innovations, a dense service network, preventive maintenance, an anti-icing system with warranted performance, and end-to-end modernization. Nordex Group has installed more than 27 GW worldwide and has offices in more than 39 countries around the world. The Swedish subsidiary is located in Uppsala.

AQSYSTEM focuses on the development and commercialization of remote sensing solutions for the wind industry. AQSystem's flagship, the AQ510 is fully IEC classified and measures wind speed, directionand turbulence up to 300m with 5m resolution. The AQ510 is used worldwide and each instrument is calibrated prior delivery against a 100m met mast. Reliable power solution designed for low temperatures is the key to good measurements in cold climates, AQSystem has produced more than 500 standardized power solutions including internet-based communication allowing on-line monitoring and timely alarms.

SPONSORS

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 carboncomponents. This long-standing know-how is used worldwide in over 25 countries for condition monitoring of rotor blades.With our own hard-and software department we offer you individual solutions for all wind turbines from 1MW upwards. With more than 3,500 monitoring systems in use, we can draw on 14,000 machine years of monitoring experience to provide the optimum solution for wind turbines.

VORTEX is an online modeling service that offers wind resource data ready to use for any wind farm development stage and at any coordinate worldwide. As part of Vortex's continuous project development and improvement, we have implemented a fine-tuned high-resolution cold-climate setup of the Weather Research and Forecasting model to track icing event occurrences at wind farm site scale. Vortex started its technology development more than 15 years ago by former wind professionals. We have designed our products after intensive dialogue with the wind industry. Our on-demand approach allows us to offer the latest reanalysis data and atmospheric modeling technology available, being the pioneers of using WRF-LES to generate high-resolution time series with turbulence.

WPD WINDMANAGER As Germany's leading and internationally expanding company in the commercial and technical operations of wind farms and solar projects, wpd windmanager GmbH & Co. KG currently employs 423 people. Worldwide, wpd windmanager manages 528 wind farms with 2,550 wind turbines, 108 solar farms and a total output of 5,631 Megawatt. For over 20 years, funds, national and international investor groups have relied on the company's know-how. In addition to the core market in Germany, wpd windmanager is active in various other European countries, in South America as well as in Asia.

KJELLER VINDTEKNIKK is one of the leading consultancies within meteorological wind and ice modelling in the Nordics. We provide services such as wind measurements, energy yield assessments, icing loss estimations, post production reviews and icing forecasting for all stages of wind farm development. Kjeller has carried out icing loss assessments for over 150 wind farms, been involved in third party performance assessment of de- and anti-icing systems and have supported in warranty discussion connected to anti and de-icing systems.

Kjeller Vindteknikk has more than 20 years of experience, supporting more than 500 clients within wind energy in cold and icing climates.

W3 ENERGY is the independent Asset Manager specialized in cold climate wind farms in the Nordic region. W3 Energy offers proactive coordination and optimisation within four business areas: Technical Management of Windfarms, Financial Management of SPVs, IT Management iand Electrical Management.

Based on the experiences from managing Europe's by far largest wind farm, every part of the process is optimized. This has acknowledged W3 Energy as the reliable game-changer in Active Asset Management, that both technically and financially empowers the green conversion. We are an independent Active Asset Manager with only one loyalty - the customer.

METEODYN Leader in computational fluid dynamics (CFD), Meteodyn is an international wind engineering expert. With our software suite Meteodyn Universe, you may carry out a complete project: Extract and analyze mesoscale climate data (GCS); Analyze and automatically classify wind data into categories, including icing; Perform Measure Correlate Predict method (WDA);

Carry out wind resource assessment, estimating wind farm AEP on all terrain types (WT – the industry's leading CFD software); Optimize your wind farm layout based on production and financial criterion (WFO); Detect and analyze your wind farm performances (WPA); Within our consulting services we may: Provide wind energy production forecasts; Propose mesoscale-microscale coupling for Wind Resource Assessment in cold climates.

ALPIQ is a leading Swiss electricity producer and energy services provider that is active throughout Europe. We offer our customers comprehensive services in the fields of energy generation and marketing as well as energy optimisation. In our daily work for our customers, we develop customised solutions that are reliable and sustainable. We have been generating climate-friendly and sustainable electricity from carbon-free Swiss hydropower for more than a hundred years. Our power plant portfolio also comprises flexible thermal power plants, wind farms and photovoltaic systems in Europe.

As an international energy trader, we are active on all major European markets.

ENERCON products are known for their innovative technology, outstanding reliability and excellent returns on investment, worldwide. With their tried and tested drive system, constant technological sophistication and high quality standards, the company has been setting benchmarks in the wind energy industry for more than 30 years now. Currently, the product catalogue includes turbines ranging from 800 kW to 5.560 kW. ENERCON has already installed more than 30.000 turbines worldwide with a total rated power of 54,5 gigawatts.

EXHIBITORS

ANTEFIL Composite Tech is a young advanced materials start-up based in Zurich, Switzerland. We transform lightweight structures by enabling manufacturers of fibre-reinforced plastics to exploit more cost- and energy-efficient processes through our affordable and sustainable high-quality textiles made from hybrid fibres – even at large scale!

EOLOGIX produces flexible, retrofittable smart sensor solutions for overarching rotor blade monitoring. eologix' key product - installed on more than 400 turbines - is designed for ice detection and temperature measurement on rotor blades, minimizing downtimes caused by ice accretion or de-icing. Further solutions for blade condition monitoring will be introduced into the market this year and thereafter.

SKELLEFTEÅ KRAFT is one of Sweden's largest energy producers, generating wind-power, water-power, heating and bio-energy. Our goal is a Sweden running on 100 % renewable energy. That is why we only sell 100 % renewable energy and put as much as we can into investments and research. It's going to be alright.

VINDKRAFTCENTRUM.SE works to ensure that the large investments made in wind power involve jobs and business in the regions and municipalities where establishments take place. For this, we have a forecasting tool and a digital business platform. We see the electricity system as a whole and work for establishments of electricity-intensive industry. The financier is the Swedish Energy Agency.

BIXIA is one of the leading energy companies in Scandinavia. We are the largest buyer in the Nordic region of locally produced, renewable electricity. Our long experience of conducting successful electricity trading is a security for you as a customer. We act directly on the Nordic electricity exchange market with our own power trading unit. This means that we can offer long-term, sustainable, cost-effective solutions where your wishes and needs are at the core.

WIND SWEDEN Personally engaged and results oriented. Through broad industry knowledge and specialist expertise, Wind Sweden offer market players proactive and strategic advice with qualified services in the development, realization, investment and operation of wind power projects in the Nordic region. The company consists of ten senior consultants. Read more on wind-sweden.com

MEGGER has been a leader in electrical test and measurement globally for 130 years. From power generation to the power outlets in your home, Megger products cover almost every application within the Electrical Supply Industry. Our products are categorised into seven core application segments: cable test and diagnostics, protection relays and systems, circuit breakers, transformer test and diagnostics, low voltage installations, general electrical testing, and motor and generator testing.

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.

CONNECTED WIND SERVICES is an independent, global service partner in the renewable energy market. Our history and heritage go way back 30+ years, our experience has been proven repeatedly over time. Dedicated to advancing the transition to sustainable energy, we challenge the current service solutions and explore new, innovative ways to reduce complexity and optimize the operation of wind turbines by combining our vast knowledge and experience with progressive thinking, this applies in O & M, Up-Tower repair, Refurbishment and partly + full scope service concepts.

WICETEC OY is wind turbine blade heating technology provider. Our technology prevents ice to accumulate on blade surface and therefore enables continuous turbine operation throughout the winter when the winds are high and energy demand and price is peaking. The patented technology is available for new turbines as well as retrofit to existing turbines with field proven lifetime of 20 years. Wicetec staff consists of highly skilled professionals with firm experience of wind power in cold climate environment.

SIRRIS is the collective technology centre for the Belgian technology industry. As a non for profit RTO our goal is to support companies with multi-disciplinary R&D and innovation projects in an industrial context. We innovate together with our customers already since 1949 by executing 41500 projects yearly and having access to high tech infrastructures. Our 160 scientists and engineers work with different technologies and in different markets and applications. Expertise on topics such as material engineering, coatings, advanced manufacturing, mechatronics, data innovation and AI are a few of the technologies we cover.

CRESTO GROUP develops market-leading products and solutions for professional height workers. Our solutions are driven by insight into our customers' needs and challenges, and together we ensure that the work at height, regardless of the environment, takes place safely and efficiently. We also know that knowledge and training are the foundation for performing at heights, and our training program takes an active and driving role in our customers' success.

Challenges in the cold

At the last Winterwind conference, a number of participants took the opportunity to visit the recently commissioned Vasa Vind Åskälen and Munkflohögen wind farms. Here, Vasa Vind explains how they view the challenges of developing and managing wind farms in cold climates.

TEXT: Peter Wiklund **PHOTO:** Vasa Vind

VASA VIND HAS been active on the market since 2008 and is now one of Sweden's largest wind power companies. The business covers the entire chain from development and construction to operations management. Since its inception, the project portfolio has grown and today Vasa Vind has five wind farms in operation in cold climates, with more under development.

«When it comes to projects in cold climates, the entire development process involves a number of challenges,» says Erik Holmgren, Wind Resource and Production Analyst at Vasa Vind. «It starts with design, where it is important to obtain good wind measurements that provide high quality wind data even in cold and icy conditions. It is also important to take into account factors such as the risk of ice throw when choosing the location of wind turbines.»

Erik Holmgren, Wind Resource and Production Analyst

Henrik Svahn, Operations Manager

OF COURSE, ICE is a challenge in other ways for those who work with wind power in cold climates.

«When planning and procuring suitable turbines, it is important to consider whether or not they should be equipped with de-icing systems. The cost, as well as the pros and cons of such a system, must be weighed against the estimated production losses caused by ice. It is challenging to estimate production losses due to icing in advance, but here we have the advantage of managing several operational farms, against which we can validate our prediction models,» he says.

Henrik Svahn, Operations Manager at Vasa Vind, notes that their farms, like others, have been severely affected by ice this winter.

«It has been very noticeable in terms of production. Though we always live with this imminent risk, this year it has been particularly challenging,» says Svahn.

THIS WINTER, VASA Vind has collaborated with Vestas on testing ice protection roofs at the entrance to two of the turbines.

«When it comes to wind power in cold climates, it is important to conduct as much planned maintenance as possible during the summer months, and to do as much as possible remotely,» says Henrik Svahn.

However, as visiting the farms in the winter cannot be avoided entirely it is important to plan for safety. Therefore, this year they are testing out a protective roof over the entrances.

«We are evaluating a few different options, and there are several parameters that play a part. In addition to immediate protection, it is also important that snow removal is possible so as not to restrict access to the turbines,» he says. »

Ice protection roofs are being tested over the year.

Vasa Vind's cold climate wind farms

MANAGEMENT, WIND FARMS INOPERATION

Åskälen
Operational since 2020
Number of wind turbines: 80
Turbine model: Vestas V136 3.6 MW
Installed output: 288 MW
Owner: APG

Munkflohögen
Operational since 2019
Number of wind turbines: 23
Turbine model: Vestas V110 2.05/2.10/2.15 MW
Installed output: 49 MW
Estimated annual output: 180 GWh
Owner: APG

Åmliden
Operational since 2012
Number of wind turbines: 29
Turbine model: Vestas V100 1.8 MW
Installed output: 52.2 MW
Estimated annual output: approx. 150 GWh
Owner: APG

Ytterberg
Operational since 2011
Number of wind turbines: 22
Turbine model: Vestas V90 2.0 MW
Installed output: 44 MW
Estimated annual output: approx. 130 GWh
Owner: APG

Havsnäs
Operational since summer of 2010
Number of wind turbines: 47
Turbine model: Vestas V90 2.0 MW/1.8 MW
Installed output: 93.4 MW
Estimated annual output: 250 GWh
Owner: Swedish Wind 3 S.a.r.l.

UNDER CONSTRUCTION 2020-2021

Raftsjöhöjden
Number of wind turbines: 11
Turbine model: GE 5.5-158 MW
Hub height: 121/141 m
Total height: 200/220 m
Installed output: 60.5 MW
Estimated annual output: approx. 200 GWh
Owner: APG

IN PERMIT PROCESS

Hällberget
Number of turbines according to application: 123
Total height as per application: 200 m
Estimated annual output: approx. 1000-1500 GWh
Location: Överkalix municipality, Norrbotten.

» **SVAHN ALSO MENTIONS** that as managers of the wind farm, it is important to ensure the safety of anyone spending time in them. This includes maintenance personnel, those who conduct business in the area and visitors.

«Through the presence of our local plant managers, we have good knowledge of weather conditions and know what is happening on the farms. This facilitates co-ordination and makes a positive contribution to the challenges facing wind power in winter climates,» he says.

However, he is calling for in-depth knowledge of risk analyses for falling ice and ice throws.

«There are quite a lot of forecasting tools around ice-formation, but as far as I know, no great tools for predicting when ice will fall. Of course, it is extremely important to know when it is suitable to visit a turbine to avoid being exposed to risks.

«We need to continue developing systems and procedures for cold climate operation to minimise the impact of ice and snow. As an industry-wide issue, it is important that we work together.»

HENRIK SVAHN LOOKS forward to further development of de-icing systems and of operating turbines in icy conditions, which he believes could solve many problems.

«Loss of production associated with ice varies greatly from season to season. We work actively with hedging strategies to maximise revenues, but it is a major challenge to have production suddenly hampered by ice build-up at the same time as prices of balancing power increase. It would be highly beneficial to avoid such ‹double losses›.»

WITH THE MAJOR investments being made in northern Sweden, such as in green steel production and battery factories, it is important that wind power continues to be developed and optimised in cold climates, as this is the given local source for meeting increased energy demand.

Henrik Svahn feels that the Winterwind conference has an important task to fulfil here.

«It's fantastic to be able to focus on challenges and solutions that are specific to our conditions. The direction of the conference is also particularly good and rewarding; it is concrete and maintains a high technical level rather than getting stuck in too many political issues.»

ABOUT

Vasa Vind is a wind power company that develops, constructs and manages onshore wind farms in Sweden. The portfolio comprises 525 MW in operation and more than 700 MW under development. Vasa Vind is wholly owned by funds managed by London-based Asper Investment Management.

www.vasavind.se

Continuous growth of the cold climate market

Today, the cold climate market is the largest specialised market in the world. It's now three times larger than the offshore market. Those are some of the preliminary findings from a new study by IEA Wind Task 19. The full extent of the study will be released at Winterwind in April.

Timo Karlsson.

TEXT: Jonas Hållén

IN 2015, THE estimate of installed capacity in cold climate was 130 GW installed effect. Today it's probably around 180 GW and makes up a quarter of the total capacity for wind energy globally.

"Cold climate is no longer a niche market," says Timo Karlsson, author of the report and research scientist at the VTT Technical Research Centre of Finland. "It's a large specialised market that has continued to expand since we started analysing it over the past 10 years."

The market is primarily located in Europe as well as parts of North America, Asia and China.

"The growth is continuing. There are ambitious plans in Sweden and Finland, for instance," says Timo Karlsson.

INITIALLY, AVAILABILITY WAS a big problem in cold climate. The rotor blades often got covered by ice and production had to be stopped.

With the installation of "cold weather packages" which provide heating to turbine components such as the gearbox, yaw and pitch motors and battery, some of today's turbines today can operate at temperatures right down to –30 °C.

Various types of rotor blade de-icing and anti-icing mechanisms, such as heating and water-resistant coatings are currently being employed, as well as operational strategies to limit ice accumulation.

"These systems are being improved, increasing operational availability of the turbines," says Timo Karlsson. "On the other hand the towers are getting higher and the blades bigger, increasing the icing and making de-icing harder."

THE FIRST GLOBAL cold climate market study was published in the BTM World Market Update report in 2012. Then, at the Winterwind conference in 2017, a follow-up was presented. The estimates made in 2012 were found to slightly overestimate the number of sites at severe icing conditions while underestimating the light icing sites.

Overall however, the forecast was pretty accurate.

The horizon of the study done in 2015 ended in 2020. An outlook on the present state of the cold climate market size will be presented at Winterwind 2021, when the accuracy of the previous growth estimates will be evaluated.

A new forecast for a five year horizon based on publicly available climate data, the VTT global icing atlas and databases of wind power sites will also be presented.

THE GROWTH ESTIMATE will be made based on forecasts of the growth of the onshore wind power market globally.

"The approach we use in the study divides the cold climate market into partially overlapping segments: low temperature sites and icing sites," says Timo Karlsson. "Low temperatures create their own set of issues for operations in those areas, but not all low temperature sites are in icing conditions. Similarly, the majority of wind power sites that suffer from icing conditions are not low temperature sites."

Closing in on the icing issue

Production losses due to icing can mean the difference between profit and financial disaster for a wind farm. The industry already uses a number of different methods to estimate icing loss. Now, a new IEC 61400-15 international standard is on its way.

TEXT: Jonas Hållén **PHOTO:** Vestas Vind

Marie Cecilie Pedersen.

Ville Lehtomäki.

> *It's all new information to the wider audience. We haven't published anything before this.*

ESTIMATING ICING LOSSES remains a major challenge in the planning phase of any wind farm in cold climates. In order to compare different sites, a harmonized method for calculating losses and uncertainties is needed.

"For years it was a guessing game and calculations varied greatly between different companies and sites," says Marie Cecilie Pedersen, a wind energy R&D specialist at Danish EMD International A/S.

AN INTERNATIONAL WORKING group is presently preparing an industrial standard on how to assess pre-construction production losses and related uncertainties. In a few years the industry will have a common, official standard.

Ville Lehtomäki, Managing Director of the science-based consultancy company Kjeller Vindteknikk Oy, is part of a working group set up to define the current methods one step further, and devise a new industrial standard. He will present the first draft at the Winterwind wind energy conference.

"It's all new information to the wider audience. We haven't published anything before this," says Lehtomäki.

THE WORK OF creating models to measure and compare icing losses at different wind farms started around 2009-2010, when the first large onshore wind farms in cold climates were built.

Among the pioneers were VTT Technical Research Centre of Finland, the Norwegian Meteorological Institute, Kjeller Vindteknikk and Weather Tech Scandinavia, all expert organizations that have worked with customized wind and weather related reports, icing studies and weather forecast services.

"The issues were first discussed among research institutes and companies at the BOREAS conferences in the 1990s and later at the Winterwind and IWAIS (International Conference on Atmospheric Icing on Structures) conferences in the beginning of the 2010s," says Marie Cecilie Pedersen.

THE FIRST PRACTICAL result of the discussions was the unofficial industry modelling framework on icing and how it affects production in wind farms, which is now widely used. This multi-disciplinary framework was created by meteorologists and engineers and basically consists of a three-step downscaling and modelling chain:

1. modelling atmospheric icing conditions using mesoscale weather data and micro-scale downscaling,
2. modelling ice loads, often using a version of the empirical standard icing cylinder-based model by Makkonen (ISO 12494 standard),
3. translating the modelled ice loads into aggregated wind farm (or turbine-specific) icing losses.

"Acknowledging the uncertainties related to the modelling chain and the variety of interpretation for each step, it still functions as a state-of-the art methodology in the industry today," says Marie Cecilie Pedersen, who will present and discuss the model framework at Winterwind.

THIS STUDY PRESENTS a sensitivity and uncertainty analysis with selected model chain variations: Mesoscale modelling according to different atmospheric boundary conditions – ERA5 and MERRA2. A cylinder-based icing model driven by different boundary conditions and model configurations and finally, transferring the modelled ice loads into an estimated icing loss.

Actual 'ground-truth' icing losses are obtained from SCADA records from wind farms in Scandinavia, typically using the industry standard IEA Wind Task 19 'T19IceLossMethod'.

The next step is to find common ground on icing issues. As Marie Cecilie Pedersen points out, the industry modelling framework on icing losses can be easily adapted for compliance with the proposed IEC 61400-15 standard.

CURRENTLY STILL IN the draft phase, the new international standard will provide guidelines for how to assess the expected energy yield of a wind farm, including how to define the uncertainties of different losses such as wakes, turbine performance and environmental losses like icing.

"Wind energy in cold and icy climates is quickly transforming from a niche, specialist climate industry into a global, mainstream industry. In this transformation, international standards are of paramount importance," says Ville Lehtomäki.

The standardization work is a demand from international investors and an essential part of the global green transition. Investors want to gain a better, and more detailed, understanding of how the energy yield assessment reports have been made, as the assessments typically have a large number of variables and assumptions.

"If you invest in a large wind farm and there's a 4-5 percent difference between expected and real production, that can mean the difference between profit and financial disaster. So standardizing the key elements related to energy yield assessment calculations is essential in order to ensure that they are done in in the same way all around the world."

THE IEA WIND Task 19 international expert group has been working on the development of the new IEC 61400-15 standard regarding icing losses since 2016.

The IEC core working group consists of around 60 globally leading experts in the field of energy yield assessment from all around the world. Ville Lehtomäki has been working with the standardization of icing loss uncertainties since 2016.

The progress has been slower than expected, but this is understandable if you consider the new standard's global importance and the fact that the working group had to start at ground zero, according to Lehtomäki.

"Creating a new industry-wide standard is a time-consuming process. It was already a long slog, and Covid-19 has slowed it down even more," he adds. "The new standard is very different from previous IEC standards, as it does not set out to define how to do things but rather provide minimum requirements and a framework process for quantifying uncertainty drivers for the most important energy yield assessment losses."

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