Winterwind 2018 • Åre • Feb 5-7

INTERNATIONAL WIND ENERGY CONFERENCE
IT ALL STARTED BACK IN 2008 in the small village of Åsele located in southernmost Lapland with approx. 1800 inhabitants. The conference was held in Swedish and was attended by about 150 people. Swedish Windpower Association hosted the first Winterwind conference in Norrköping the same year, then in English. Since 2011, all sessions are held in English for an international audience from around 20 countries.

After 10 years, Winterwind is the most important meeting for wind energy in cold climates and the conference is more up to date than ever before. Wind power in cold climates has become a major growth market, three times the size of offshore wind*. This is a huge opportunity for everybody who’s on the market for wind power in cold climate.

It’s been inspiring to see an increasing number of participants and we’re grateful that many of you are returning year after year.

The conference, has become known for its familiar atmosphere and as a forum for bringing together passionate and creative individuals who are sharing knowledge, ideas, offering varying perspectives, and establishing meaningful connections.

The latest issues and bottlenecks for the continued deployment of wind power in cold climate areas will be discussed during Winterwind along with new findings within science. Just by joining Winterwind you avoid frozen assets due to lack of knowledge.

WELCOME!

Ulla

* Source; IEA Wind TASK 19

Art Direction Winternet Web & Reklambyrå Cover Photo: Adobe Stock Print: Grafika Falkenberg 2018
Nordic renewables and Electricity Certificates
- Report now available in English

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. It also includes interviews with market participants, chronicles and summaries from conferences and other events. This comprehensive report is much appreciated among Swedish windpower owners, banks and energy companies. From January, it is available in English and published 5 times per year.

More info about the report & offers:
In Swedish: www.bodeckerpartners.com/reports/
In English: www.bodeckerpartners.com/en/reports/

Members of Swedish Windpower Association get a 15% discount.

EDUCATION & JOBS
Take the opportunity to present in writing your company and the job opportunities that you offer, during Winterwind! You will reach both senior professionals who are seeking for new challenges and students. The Job Corner is located in connection to Swedish Windpower Association's stand.

NOTE: Job ads must specify were/how to apply or a contact person incl. contact information, as we do not handle any documents at the booth.

About the organizer Swedish Windpower Association

The Swedish Windpower Association represents all producers, ranging from smaller wind power owners to major energy companies. The association has over 30 years of experience. It all started with visionary entrepreneurs, landowners and others who invested in one or a few turbines, but today we represent stakeholders of all sizes, from small operators to big players.

We are an established referral body and an interesting party in energy Sweden. We want to become even bigger, better and stronger. In 2018, we will develop and complement our offering so that we may also serve international investors who want to enter the Swedish market. We will invest resources to meet the needs of our existing members and attract new ones. We will offer new exciting meetings and member benefits, for small and larger producers alike.

www.svensk-vindkraft.org

Kristofer Greczula
Will entertain us at the conference dinner.
Kristofer is an uprising Swedish pop singer, songwriter and musician. Kristofer takes his inspiration artistically and musically from Michael Jackson, Bruce Springsteen, Aerosmith and The Beatles. Among the newer artists Kristofer has great respect for Alicia Keys, Adele, Ryan Adams and Daft Punk to name a few.

We support GIVEWATTS

We do not share any gifts to our presenters. Instead, we donate money to those who need it better. Givewatts is a non-profit organisation bringing clean and safe energy to people in developing nations. They distribute renewable energy solutions to school children and their families that live in areas without access to electricity.

Solar energy lights replaces dirty kerosene and wood, allows children to read their homework and doctors to operate after dark and much more.
**MONDAY**

**FIELD TRIP DAY**

10:00
Bus departs from Hotel Holiday Club, Åre

10:00-15:30
Field trip

15:30
Back in Åre

16:00-20:00
Registration and access to exhibition hall

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**TUESDAY**

**Arenan**

08:30-10:30
Registration and Exhibition

10:30-12:00
OPENING SESSION WINTERWIND 2018

**Solskog (2nd floor)**

12:00-13.00
Lunch

**Snöljus (2nd floor)**

12:30-12:55
Poster presentations

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**WORKSHOP - ICE THROW**

Bengt Göransson and Rolv Bredestad
Risk Area Reduction for Ice Throw,
Bengt Göransson, Pöyry Sweden AB (58)

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**Overview about the icing research at the Institute of Composite Structures and Adaptive Systems (German Aerospace Center) – Transfer to wind energy in cold climate possible?**

Christian Mendig, German Aerospace Center (DLR), GER (37)

**Measurements of cloud droplet size and concentration related to icing**

Mika Komppula, Finnish Meteorological Institute (34)

**Development of a reliable modeling system for the calculation of rime ice loads on overhead transmission lines**

Øyvind Brykiodal, Kjeller Vindteknikk, NO (44)

**SINTEF’s crash test of a potentially dangerous frozen wet-snow cylinder at the Structural Impact Laboratory**

Rolf Erlend Bredesen, Kjeller Vindteknikk (23)
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<td>Pre-construction site assessment, measurements, models and standards</td>
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<td>Chairs: Helena Wickman and Stefan Ivarsson</td>
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<td>From icing loss to production loss – a comprehensive comparison of today’s tools</td>
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<td>Daniel Lindholm, EMD International A/S (25)</td>
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<td>Open Data sets from Cold Climate Wind Farms in Finland</td>
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<td>Simo Rissanen, VTT, FI (13)</td>
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<td>Norwegian guidelines regarding the risk of icethrow for the public</td>
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<td>Rolv Erlend Breidesen, Kjeller Vindteknikk, NO (24)</td>
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<td>Understanding Icing in the Nordics and North America</td>
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<td>Till Beckford, DNV GL (16)</td>
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<td>Modelled vs observed LWC – where do we stand?</td>
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<td>Magnus Balscheffsky, WeatherTech Scandinavia AB (21)</td>
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<td>Health &amp; Safety Best Practices for Wind Farm O&amp;M in Cold Climate</td>
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<td>Charles Godreau, TechnoCentre éolien, Canada (31)</td>
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<td>Numerical simulation of ice-throw from wind turbines in cold climate</td>
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<td>Hamid Sarlak, DTU, DK (25)</td>
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<td>Forecasting and cloud physics</td>
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<td>Making ice fall and throw predictions for wind turbines more reliable</td>
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<td>Sten Barup, ENERCON, SE (7)</td>
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<td>Verification of high-resolution probabilistic forecasts of icing in Germany for the winter 2016/17</td>
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<td>Lukas Strauss, University of Vienna (17)</td>
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<td>Addressing forecast uncertainty of wind turbine icing with deterministic sampling</td>
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<td>Jennie Molinder, Uppsala Universitet, SWE (38)</td>
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<td>Break</td>
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<td>Poster presentations</td>
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<td>Making life easy – over 100 turbines in field under active fos4X rotor ice control</td>
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<td>Bernd Kuhnle, fos4X, Germany (40)</td>
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<td>Acoustic Condition Monitoring of wind turbines</td>
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<td>Timo Mämmelä, APL Systems Oy (47)</td>
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<td>IEA Ice class detection with a mesoscale modeling stream and big data support</td>
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<td>Abel Tortosa, Vortex (33)</td>
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<td>15:30-17:00</td>
<td>Pre-construction site assessment, measurements, models and standards</td>
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<td>Chairs: Jennie Molinder and Matthias Rapp</td>
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<td></td>
<td>Operational experiences incl. performance optimization, big data and production losses</td>
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<td>Chairs: Saskia Burgeois and Sven-Erik Thor</td>
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<td>Site-assessment and icing impact - using ERA5 assimilation data</td>
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<td>Morten Lybech Thøgersen, EMD International A/S (EMD), DK (38)</td>
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<td>Benchmark SCADA analysis of 5 different wind turbine Ice Protection Systems</td>
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<td>Ville Lehtomäki, VTT Technical Research Centre of Finland Ltd (9)</td>
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<td>Sensitivity of icing losses. Terrain versus elevation – a case study</td>
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<td>Rickard Klinkert, Kjeller Vindteknikk, SE (42)</td>
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<td>Retrofittting a de-icing system on turbines affected by extreme icing: Our experience</td>
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<td>Sebastien Trudel, EDF EN Canada (1)</td>
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<td>Forecasting ice accretion on rotor blades: validation against webcam and ice detectors</td>
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<td>Saskia Bourgeois, Meteonest, Switzerland (28)</td>
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<td>Nordex advanced Anti-Icing System for N149/4.0-4.5</td>
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<td>Konrad Sachse, Nordex Energy GmbH, Germany (2)</td>
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<td>Leveraging insight from operational data to optimize performance in cold climate</td>
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<td>Per Egedal, Siemens Gamesa Renewable Energy, SE (10)</td>
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The use of CFD to post-process wind speed data from remote sensing devices in complex terrain
Wulstan Nixon, ZephIR Lidar, UK (46)

Retrofitting anti-icing blade heating on installed wind turbines
Petteri Antikainen, Wicetec, Finland (32)

Vestas Cold Climate Solutions and next steps
Brian Daugbjerg Niesen, Vestas Wind Systems A/S (20)

Development of numerical models for ice accretion predictions
Johan Revstedt, Lunds Universitet, SE (36)

Ice Protection System Performance Assessment Methodology
Matthew Wadham-Gagnon, TechnoCentre éolien (30)

More than 20 years of experience – Retrospect and outlook of ENERCON’s cold climate technologies
Sten Barup, ENERCON, SE (52)

17:00-
Mingle and poster presentations in exhibition hall.
Open innovation awards, based on presentations in Session 1, will be presented at 17:30.

19:30-
Dinner and entertainment

WEDNESDAY

08:30-10:00
Wind turbine manufacturers – cold climate solutions (technical)
Moderators: Jeanette Lindeblad and Christian Kjaer

Task 19 – Ice Protection System Warranty Guidelines
Jenny Longworth, Vattenfall AB, Sweden (48)

Requirements on wind turbines in cold climates
Jonas Sundström, Skellefteå Kraft (50)

Panel discussion with manufacturers: Offering production warranties in cold climates - is it even possible?
Enercon - Claes Jeppsson
Nordex - Nils Lehming
Siemens Gamesa - Per Egedal
Vestas - Brian Daugbjerg Niesen

10.00-10:30
Break, Poster presentations

First 3D accelerometer based measurements at the blade tip: what’s the benefit of the data?
Michael Moser, eologix sensor technology gmbh (43)

Wind Turbine Power Output for Different Cold Climate Conditions
Dimitar Stoyanov, Coventry University, UK (27)

Method for early detection of damage in conductive blade heat systems
Greger Nilsson, Blade Solutions AB (5)

Innovations and developments of ice and damage detection for rotor blades
Timo Klaas, Wölfel Engineering GmbH & Co. KG (41)
MEET OUR SPONSORS AND EXHIBITORS

In the exhibit hall you’ll meet interesting companies and organizations offering services and products specific to your business within renewables.

See below our sponsors and exhibitors for the conference. Please visit their stands, websites and social media channels.

Supportive partner:

The Swedish Energy Agency works for a sustainable energy system, combining ecological sustainability, competitiveness and security of supply. The Agency finances research for new and renewable energy technologies, smart grids, and vehicles and transport fuels of the future. The Agency supports commercialization and growth of energy related cleantech.

Sponsors:

Kjeller Vindteknikk is one of the leading service providers within meteorology on infrastructure in the Nordics. Within wind power, we provide measurements, analysis and modeling for all stages of the wind power project. We have calculated icing and losses due to icing for over a hundred wind farms. In addition, we have been validating the performance of the de-icing systems and anti-icing systems for several of the large manufacturers and also assisted in the development of warranties connected to icing and de-icing systems. This year we celebrate 20 years in the wind power business.

Gill Instruments is a world leader in the design and manufacture of meteorological solutions based on their highly successful ultrasonic anemometer range. Gill has over 25 years’ experience in producing sensors for wind speed and direction using their 2D and 3D platforms, with more complex weather monitoring systems based around the MaxiMet and MetPak platforms. Gill products are renowned for their rugged design and excellent long-term reliability in a wide range of harsh and inhospitable environments where ultrasonic technology is deployed in order to take advantage of enhanced accuracy, reduced maintenance and calibration on the basis of no moving parts.

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 4,200 kW. ENERCON has already installed more than 27,000 turbines worldwide with a total rated power of 46 gigawatts.

ENERGISERVICE takes care of your strategic and operational maintenance so you can concentrate on your core business. We have extensive experience in preventive maintenance and work across the entire process, from optimisation to operational services and emergency preparedness. At new installations and renovations, we can offer project management, design and drawing services. We can also take care of the entire project. With more than one hundred employees we have a broad expertise and our service portfolio includes a number of special services including thermography, vibration analysis, machine analysis, alignment and balancing, industrial climbing and high voltage maintenance. Our clients range from major power utilities to smaller industrial companies.

WICETEC is a company established 2014 to sell the proven Finnish wind turbine blade ice prevention system. Wicetec wraps the technology and Finnish cold climate experience of 25 years to an effective package to deliver “winter ride-through” feature for your wind farm. The turbines will be in operation without icing losses. More than 700MW of wind power is currently operating equipped with the technology.

ILS Nordic AB is Castrol Industrial’s only Ambassador and Representative on the Swedish Industrial Market. This means that we work very close in a strategic cooperation with Castrol, and in addition to our own resources, we also actively cooperate with Castrol’s global research and development center. ILS Nordic markets and sells Castrol’s lubricants for the wind sector in Sweden. Castrol is the leading global supplier of wind lubricants and has several OEM approvals for Siemens Vesta, Nordex, GE and others. With its unique product technology, Castrol is leading the development of gear oils to the wind sector and has gained the position as first fill supplier of gear oils to both Siemens and Vestas.

STV is manufacturing tracked vehicles for heavy transports in remote areas, such as wind turbine parks. Especially wind parks situated on higher altitude, where snow can cause high costs for road maintenance. These types of tracked vehicles are extremely suitable in sensitive environments, and can be used both on bare ground, moors and snow. With the most modern engines installed, we also meet the environmental requirements from the customers. The IceArmorTM has met a great interest and has become State of the Art for protection against ice throw.

DNV GL delivers world-renowned testing and advisory services to the energy value chain including renewables and energy efficiency. Our expertise spans onshore and offshore wind power, solar, conventional generation, transmission and distribution, smart grids, and sustainable energy use, as well as energy markets and regulations. Our expertise supports customers around the globe in delivering a safe, reliable, efficient, and sustainable energy supply. Our testing, certification and advisory services are delivered independent from each other.
Tensar International is a world-leading manufacturer and provider of subgrade stabilization and soil reinforcement solutions to overcome common ground engineering problems in construction and civil engineering. Tensar’s innovative and high-performance geogrid and geotextile products offer alternative approaches to traditional methods and have benefitted thousands of roads, railways and other infrastructure projects around the world.

With an expert technical services team and an international network of distribution partners, Tensar also provides professional support and impartial advice to projects, from product selection and engineering design, to on-site construction guidance.

Exhibitors:

Labkotec

Labkotec ice detectors are designed for the detection of ice on the rotor blades. Labkotec’s LID-3300IP Ice Detector improves turbine production reliability and reduces risks caused by ice formation in icy conditions.

Neas Energy

Neas Energy is an international energy asset management company owned by Centrica plc. Neas Energy provides physical and financial optimization of renewable and conventional energy assets, for independent power producers, on all major energy markets in Europe. The headquarters is located in Aalborg, Denmark and it has offices in London, Hamburg, Düsseldorf and Stockholm.

Uppsala University Campus

Gotland provides capacity building and research communication in the Swedish National Wind Utilization Network, and offer a large selection of multi-disciplinary wind power courses and a Master programme in Wind Power Project Management.

Vindval

Vindval collects and provides scientific knowledge of wind power’s impacts on humans and nature. The program is a cooperation between the Energy Agency and the Swedish EPA.

Vindforsk

Vindforsk is a technical research programme run by the Energy Agency in cooperation with the Swedish industry. The project’s aim is to increase knowledge and strengthen the Swedish wind power industry’s knowledge base.

Deutsche Windtechnik

Deutsche Windtechnik offers a complete maintenance of wind turbines, ranging from basic service agreements to individually tailored full-service agreements. The company operates both onshore and offshore. We have more than 3,000 wind turbines throughout Europe, which have permanent maintenance contracts. We focus on Vestas/NEG Micon, Siemens/AN Bonus, Gamesa, Nordex, Senvion and Fuhrländer turbines.

Bladefence

Bladefence is a specialist for wind turbine blade condition analysis, repairs and maintenance. The company utilises advanced skylift equipment and UV-curing blade repair method in its operations. In combination, these enable operations in harsh weather conditions, cutting-edge efficiency and minimise turbine downtime. The company was certified by Germanischer Lloyd for blade repairs in 2012 as the first company in the Nordic countries.

Blade Solutions

Blade Solutions inspect and repair wind turbine blades. The company uses rope access as primary access method. Specific knowledge of blade heat system repairs and cold climate solutions. Frequently using advanced composite methods such as vacuum infusion and UV-curing systems. The company is based in Piteå, located in northern Sweden.

The Rope Access Group provides contract services in wind power industry with the help of industrial climbing / rope access and offers a wide range of training courses, whether you are a wind technician, subcontractor or rescue personnel. We have offices in Solna (Stockholm), Gothenburg, Helsingborg, Östersund and Piteå.

eologix sensor technology gmbh was founded in 2014 and developed a wireless and easily retrofittable smart sensor system for icing detection and temperature measurement on the surface of wind turbine rotor blades. The measurement data can be used to reduce downtime as well as to control anti- and de-icing equipment. The system configuration ranges from blade based ice detection for a SAFE shutdown (simple ice detection and ice prevention) to a RESTART solution for automated operation – both configurations are DNV-GL certified.

More than 40 systems with over 800 sensors have been installed on turbines all over Europe and also overseas.

WeatherTech

WeatherTech Scandinavia AB offers qualified consultancy services such as customized wind and weather related reports, icing studies and weather forecast services for the power industry and actors on the energy market. We have broad meteorological competence from university and wind industry including many years of experience from modelling atmospheric processes.

In Situ Instrument AB develops and delivers turnkey systems for environmental measurements in soil, water and air.

We provide customized total solutions. Everything from system design and installation to support, service and data collection. In Situ Instrument AB offers its customers maximum accessibility to reliable data!
for all types of industries. Klüber Lubrication offers a comprehensive line of lubricants designed to meet the extreme demands of the wind energy industry. Our product portfolio includes high-performance gear oils and greases for all applications. The solutions we offer for your applications add to your revenue and success. Klüber Lubrication is part of the Freudenberg Group.

**Carbex**

Carbex develops and manufacture carbon brushes for use in extreme environments, for all types of wind turbines and generators on the market. Our brushes are used in cold and dry climate as well as in high humidity offshore installations. Carbex assists in selecting the right grade for your wind farm.

**FUCHS**

FUCHS is a global lubricant provider. Our lubricants business covers everything from research and development to production and sales. We offer a complete range of products and services for all types of industries.

**Connected Wind Services**

Connected Wind Services Welcome to a truly connected world where you get everything you need from one professional, experienced and service-minded Independent Service Provider. Our highly skilled service technicians provide you with unrivalled knowledge and dedication. For more than 25 years, we have focused on getting the best possible yield for the full lifetime of your assets.

As Europe’s first Independent Service Provider, we apply best practices gained from decades of work with operators and owners at a wide array of locations - from the single standing turbine to the largest wind farms.

**Nibe Element Wind Solutions**

Nibe Element Wind Solutions, NEWS, are supplying heating solutions for turbines erected in cold climates. It means, heating of all critical applications in the nacelle to make it possible to start up, after a stand still situation. We make de-icing systems based on hot air as well as heating blankets for curing of blade repair.

**GreenExergy**

GreenExergy specializes in engineering consultancy services within the energy sector. We have technology expertise and possess strong technical competence in CE marking, Safety systems for machinery and Energy storage, making us a reliable partner to your wind power project. We offer: Project management, Energy analysis, Plant and Mechanical design including strength calculations, CE marking, Risk assessment, health and safety analysis.

**TechnoCentre éolien**

TechnoCentre éolien (TCE) is a centre of expertise that supports the development of the wind and solar PV industries through research, technical assistance, technology transfer and technical support for businesses. TCE specializes in developing solutions for renewable energy integration, optimizing wind farm and solar array performance and supporting growing SMEs in the sector.

**Klüber Lubrication**

Klüber As a global leader in speciality lubricants, Klüber Lubrication offers a comprehensive line of lubricants designed to meet the extreme demands of the wind energy industry. Our product portfolio includes high-performance gear oils and greases for all applications. The solutions we offer for your applications add to your revenue and success. Klüber Lubrication is part of the Freudenberg Group.

**PEG LLC**

Polymer Exploration Group LLC (PEG) is a spin-off start-up company from the Virginia Commonwealth University (VCU) to further develop and commercialize an novel Ice Release technology. PEG is the recipient of three SBIR awards including a Phase I and Phase II on ice-release coating from National Science Foundation.

**GreenExergy**

GreenExergy specializes in engineering consultancy services within the energy sector. We have technology expertise and possess strong technical competence in CE marking, Safety systems for machinery and Energy storage, making us a reliable partner to your wind power project. We offer: Project management, Energy analysis, Plant and Mechanical design including strength calculations, CE marking, Risk assessment, health and safety analysis.

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**CUE DEE**

CUE DEE was founded 1978 and since 2001 we have been supplying masts to the wind energy sector. Cue Dee has been a market leader in the Nordic countries for many years and developed a complete range of masts and accessories quality designed to be the best choice for the wind industry.

**Vestas**

Vestas is the energy industry’s global partner on sustainable energy solutions. We design, manufacture, install, and service wind turbines across the globe, and with 87 GW of wind turbines in 76 countries, we have installed more wind power than anyone else. Through our industry-leading smart data capabilities and unparalleled more than 73 GW of wind turbines under service, we use data to interpret, forecast, and exploit wind resources and deliver best-in-class wind power solutions. Together with our customers, Vestas’ more than 22,700 employees are bringing the world sustainable energy solutions to power a bright future.

**fos4X**

fos4X rotor blade sensing. The rules of classical mechanical engineering and turbine construction are well-developed. The next wave of innovation in wind energy is driven by sensors and information. Rotor blade sensing is an enabler for wind power optimization such as active load reduction, blade ice measurement or blade condition monitoring.

**EEM International A/S**

EEM 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.
ENGERCON. Best performance at any site.

For more than 30 years, ENERCON wind energy converters have been the benchmark for innovative technology and best quality products. Thanks to constant further development of all turbine components and the continuous improvement of our core competencies, new turbine generations with top technological features and intelligent grid technology will continue to evolve. In addition, cold climate sites with extreme climatic conditions require WEC technology to be flexible. As an option, all ENERCON wind energy converters can be delivered as cold climate versions, meaning that the power curve at WEC operation is not affected at temperatures above -30°C, and they can be equipped with the well-proven and third party validated ENERCON rotor blade de-icing technology that has been deployed at many sites and offers operators/owners a considerable additional yield.
The market for wind power in cold climates is growing. At present, its annual growth is estimated to be three times higher than that offshore wind power.

What attracts developers and investors to build wind turbines in cold climates when the challenges are that much greater, especially as regards the daily operation and maintenance of turbines?

**Text: Anna Hagnell & Pierre Klasson**
**Photo: A. Vignaroli**

**WHAT CONSTITUTES A COLD CLIMATE?**
In the wind power industry, cold climate sites are defined as sites where the following occurs during significant parts of the year:
- a) icing;
- b) temperatures below the limit that regular wind turbines can withstand; or
- c) both a) and b).

Cold climates affect the choice of turbines, the choice of materials, the layout of the wind farm, operations, repairs and maintenance.

**COLD CLIMATE CHALLENGES**
- Icing on rotor blades, foundations and instruments, which pose particular requirements on the choice of materials;
- Cold makes lubricants viscous, thereby rending them less effective;
- Ice on the blades reduces energy production and may have the long term effect of reducing the mechanical useful life of the turbine;
- Ice on the blades also increases the noise of the turbines and may cause dangerous ice throw – when dislodged from the blades, ice may be hurled a long distance.

**COLD CLIMATE ADVANTAGES**
- Higher wind velocity;
- Higher air density;
- Areas are sparsely populated;
- The land has not been exploited by other industries.

Interest in the market clearly indicates that the advantages of wind power in cold climates are much greater than the challenges. It has therefore become profitable (and necessary) for manufacturers to invest in developing technological solutions that eliminate several of the challenges above, wholly or in part. Currently, ice detection and de-icing is an area in rapid development, and each manufacturer has its own system, such as circulating hot air through channels in the blades or adding electrical wires that work much the same way as those in the rear window of a car. Depending on the solution, de-icing may occur when the turbine is at a standstill or when it is in operation, which affects production output. By connecting the system to various weather databases, the system can be made more or less intelligent, so that it starts to heat up before the ice takes hold.

**IEA’S CLASSIFICATION SYSTEM FOR SITES WITH ICING**

The International Energy Agency (“IEA”) has established a special focus group, the IEA Task 19, with has been tasked with collecting data and coordinating practices for establishing wind power in cold climates. This group of experts has published a checklist aimed at helping developers identify better and safer projects in cold climates. It addresses the awareness of risks, costs, weather conditions and practical approaches.

A milestone for the development of wind power in cold climates was when IEA began to model ice maps instead of focusing on technical measurements. Today, land-based wind energy is divided into three categories: a site not in a icing climate, a low temperature climate site or an icing climate site.

IEA has also created a site classification for meteorological icing (see table).

**GROWTH POTENTIAL IN COLD CLIMATES**
The spread and establishment of wind energy in cold climates is increasing at a rapid pace. Wind power in cold climates is one of the greatest growth sectors, alongside conventional production, particularly because of unutilised capacity. Growth until 2020 is believed to be major. It is estimated that offshore sector will grow by 4 GW annually, while the cold climate sector will triple that and grow by 12 GW. Growth is both taking place in low temperature areas and in icing areas, see graphic.

**CAN YOU...**
...tell the difference between hoar frost and rime? The difference is problematic for the power grid companies and energy producers. The lovely stars of hoar frost are unproblematic when forming on the blades of a wind turbine, but have negative impact when forming on transmission lines; the hoar frost causes a corona effect, which impacts the main line and causes a loss of energy. If you stand next to a transmission line in hoar frost, you can hear how the phenomenon causes the lines to hum. Rime is caused by icing from clouds. When rime forms an ice deposit on the blade of a turbine, it sticks very hard and is difficult to remove. This is the major icing problem in Sweden.

**DID YOU KNOW...**
...that different countries experience different icing problems?
In Sweden, we are mostly affected by icing from clouds, also known as rime. In Japan and on Iceland, the icing of power plants is instead caused by freezing drizzle. In the Great Lakes region of the USA, icing is mainly caused by freezing rain.

This article has been fact checked by Göran Ronsten, researcher and project coordinator of the Winterwind Conference in Åre.
**IEA ICE CLASSIFICATION AND DEFINITIONS**

<table>
<thead>
<tr>
<th>IEA ICE CLASS</th>
<th>METEOROLOGICAL ICING (% OF YEAR)</th>
<th>INSTRUMENTAL ICING (% OF YEAR)</th>
<th>ICING LOSS (% OF GROSS ANNUAL PRODUCTION)</th>
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<td>5</td>
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<td>0.5–3</td>
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<td>0–0.5</td>
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Meteorological icing refers to the period during which the meteorological conditions, such as temperature, wind speed and humidity, allow ice accretion. Instrumental icing refers to the period during which ice is visible on the surface, etc.
When René Cattin summarises the success of wind power in cold climates at Winterwind, he does so as one of the industry’s “grand old men”, at the tender age of 43... while taking the next step in his career.

“TEN YEARS AGO, wind power in cold climates was considered a rather odd and somewhat crazy niche. The developments we have seen since are tremendous. Today, this is a proper industry, with lots going on. It’s impressive,” says Swiss René who until now worked as a geographer, meteorologist and researcher at Meteotest.

He is among the veterans at the Winterwind conference, and this year, he’s giving the honourable concluding speech. With this, he also hands over his research activities to his colleagues, as he will take over as the CEO of Meteotest.

“I though the last conference would be the last one for me. But I felt I had to attend once more, more for emotional friendship reasons than purely scientific...”

René smiles and radiates truly felt commitment. The fact that it was something of an odd industry in the beginning was rather tempting to a man who describes himself as one who prefers "the road less travelled".

“If everyone keeps walking in one direction, I tend to walk the other way. I want to find out what’s there,” says René, whose willfulness (and love of rock ‘n’ roll) is reflected in the characteristic silver rings in his left ear.

“In a way, I’m leaving my passion now that I’m moving away from doing research. But I have noticed the excellent people who are currently working on cold climate issues. There are ideas, and new winds are blowing. I think it’s good that I’m letting go and allowing others to take over, develop matters and make the industry grow.”

He ended up working with wind power in cold climates due to the proverbial banana skin: During his studies, he supported himself by working in a mechanical workshop. At an employment interview, a tool was laying around, and someone asked him if he knew what it was used for.

"Of course I knew that, after my years in the workshop. That clinched the deal. And I’ve always been lucky getting jobs! At Meteotest, I also got the job, even though I was an hour late for the interview," René grins, showing self-distance.
He’s proud of being half Finnish (his mother is from Finland, and René speaks some Finnish), and it was in Finland, at Boreas, that René first came into contact with the area of cold climates.

“I thought it seemed like a lot of fun, and the work was pioneering. Also, the people I met in the industry were so nice. I sort of became a cold climate captive.”

René has worked both locally and internationally. Until a year ago, he was one of the members of IEA’s (the International Energy Agency) working group, Task 19, on wind power in cold climates.

“That group is one of the hardest things to let go of. It’s one of my favourite contexts. New forces must now take the work further, to new heights. We’ve had a lot of fun, while being highly productive. To start with, we had no nomenclature for the work we did, so we had to begin my developing definitions.”

A MEMORABLE MEETING was held in Umeå, headed by Winterwind general Göran Ronsten. The whole Task 19 group were “imprisoned”, complete with black and white striped outfits. In spite of the light-hearted setting, that was when matters such as the difference between icing and low temperatures were defined.

“These are simple definitions, but once they were ready, we could talk to each other using the same assumptions.”

The nomenclature lead to a classification system for cold climate areas. In Switzerland, for example, they only have icing, while Inner Mongolia only has low temperatures.

“But think of the poor Finns! They have both, which is the most difficult of all to handle!” René shows a hint of a smile. He admires the fact that the Nordic countries’ have taken the leadership in wind power in cold climates, and he regrets the fact that Switzerland has installed so little wind energy, in spite of its renowned development work.

“Our home market is very small. In Sweden, conditions are excellent, even if the industry is going through a rough patch due to the low prices. The potential for wind power in cold climates is gigantic!”

It has “always” been known among researchers that wind conditions are particularly beneficial in cold climates, for example due to elevated density, René states. What’s new now is that both technology and industry allow for expansion. “Standards and guidelines are still missing, so we are not there just yet. But after that, the cold climate market will take off. Within two or three years, the industry will have reached its full potential. There is some hard work left. But then…”

RENE LEANS BACK and ponders the fact that he can look back at the development of a whole industry. In the last 10–15 years or so, a lot has happened, he states and mentions a few key moments: In 2007, the industry was in a deadlock after an investigation into ice detectors showed that none of them was up to standard.

“We stood there empty-handed, and could not see a path forward. The big turning point was when we started to focus on weather simulation and ice maps. We began modelling instead of measuring!”

Another important milestone occurred in 2012, when Task 19 carried out a market survey, which was published by BTM’s World Market Update in the following year. “Before that, we had tried to tell people that there were major opportunities to establish wind power. No one believed us. But after the survey, there was a bang, and suddenly there was interest in developing technology and business models.” René states that the pioneers were found to be right, and that developments have occurred step by step: Step one involved meteorologists and other scientists studying icing and developing models. Step two shifted the focus to the art of engineering: solutions for wings, sensors and mathematical calculations.

“I’m so very curious to know what we’ll see next! I imagine that the digital generation will introduce increased digitisation. There will also be more standardisation, and I believe economics will be a more important driver of developments. It’s about to happen!”

Fact box: RENÉ CATTIN

Of current interest because: He will hold the concluding speech at Winterwind.

What he does: He is a researcher with Swiss Meteotest, and in the new year, he will take on the position of CEO. Meteotest works with weather forecasts, climate, solar and wind energy, air quality and measurements.

Education: Master’s degree in geography/meteorology

Age: 43 years

Family: Married with three children

He lives: In Aarberg, 20 km outside Bern

Book on his bedside table: I have several! A book about the marketing of the rock band the “Grateful Dead”, “they also prefer the road less travelled.” Two biographies of the musicians Willie Nelson and Bruce Springsteen. “And when I’m too tired to read the others, I read a Donald Duck pocket book.”
The modern development of wind energy in cold climates was initiated when the Finnish Meteorological Institute (FMI) arranged Boreas I in 1992. Boreas was a series of 7 technical conferences, with 30-70 participants, held in N. Finland that lasted until 2005. The content was purely technical and scientific papers were required to be prepared by all presenters.

VINTERVIND 2008 - In the fall of 2007, two Swedes, Fredrik Sander and Michael Steger, decided that there was a need for a cold climate wind energy conference in Sweden. Luckily, Anders Björck at the Swedish Energy Agency agreed and, after gathering internal support for the idea at the agency, the very first Vintervind conference could be arranged, in Swedish, in Åsele in March 2008 with some 150 participants.

AT THE TIME, offshore was considered to be economically out of reach and with plenty of national cold climate challenges, the Swedish Energy Agency didn’t need lengthy investigations to realize that, provided icing could be mastered, wind energy in cold climates could become a success.

I WAS RECRUITED to the Vintervind 2008 program committee and we quickly decided to skip the requirement for scientific papers and focus on presentations with the latest findings, news and ideas. By the way, proceedings from all previous Winterwind conferences are available on winterwind.se.

WINTERWIND 2008 - A conference in Swedish could hardly replace Boreas. Luckily, Sweden had since 2004 been a member of the EU project COST 727 - Measuring and forecasting atmospheric icing on structures led by FMI. In December 2008, the Swedish Windpower Association could, with a majority of presenters from COST 727, arrange its very first Winterwind conference. The 175 participants were hosted by the Swedish Meteorological and Hydrological Institute (SMHI) in its hometown Norrköping.

THE WIND TURBINE manufacturers were interested in cold climate related challenges only until 2004, which was when their backlogs started to grow out of control. Consequently, standard wind turbines were from 2005 until roughly 2011 sold to be

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installed at ice infested locations. The financial crises in August 2008 was a wakeup call but it wasn’t until the loan crises in 2011, when the backlog dwindled, that the manufacturers started to be truly interested in developing de-/anti-icing systems.

**TODAY, IN 2018**, we’re in the lucky position that it’s once again the buyer’s market, as it ought to be, and the investment costs have come down significantly since 2005 thanks to the benefit of mass production and larger wind turbines.

**WE’VE NOT SOLVED** all cold climate related challenges yet. For example, many of the standards in the IEC 61400 series do not take cold climate issues into sufficient account. When developing standards, it’s important to create a balance of power between buyers and manufacturers. If a country without wind turbine manufacturers plans to build 100 TWh of wind, it seems odd not to participate in the standardization process. Assessing the risk of ice throw, streamlining functional warranties of de-icing systems and many other subjects will be dealt with at future Winterwind conferences.

**I HOPE YOU** will enjoy and benefit from networking at Winterwind 2018. When I started in wind in 1985 and 25 years onward, I thought preparing and presenting my stuff were my most important tasks. Don’t repeat my mistake!

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**Göran Ronsten**
Program coordinator Winterwind 2008-2018
On behalf of the Swedish Windpower Association

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**Summary of Boreas I-VII by Bengt Tammelin at Winterwind 2008:**
winterwind.se/2008/presentationer/P12_Tammelin_Winterwind_2008.pdf

**Link to previous Winterwind conferences and proceedings:**
winterwind.se/about-the-conference/previous-conferences/

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