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# MEETING THE CHALLENGES OF BOLTS AND TORQUE

*Bolt installation in wind turbines can range from the simple to the complex, so it's important to know the pros and cons of all methods used.*

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## Keep an eye on U.S. offshore wind

**W**ith the start of 2019, it's interesting to look at all the wind projects that are in the works, both here in the U.S., as well as internationally. One of the most promising developments is the continued interest in U.S. offshore wind. It looks like it won't be too much longer before Rhode Island's Block Island Wind Farm is joined by other offshore projects. It's just a matter of time before we finally see more "steel in the water."

A recent record-smashing auction for leases off the coast of Massachusetts is proof of it, bringing in \$405 million.

Block Island helped transform U.S. offshore wind into a viable industry when the project came online in 2016. The U.S. Department of the Interior's strong support, paired with ambitious state policies like those in Massachusetts, definitely sends a message to investors and offshore energy developers that the U.S. offshore wind sector is ready for more.

Harnessing offshore wind will result in major new investments in U.S. infrastructure, including port facilities and supply chain factories. Already, Massachusetts is making improvements to the New Bedford Marine Commerce Terminal and MHI Vestas is investing \$35 million in an offshore wind turbine gearbox testing facility at Clemson University in South Carolina, according to AWEA.

Turning those future projects into reality is going to take a lot of hard work and innovation. A lot of that type of work is reflected in this month's issue.

Making those turbines stand tall are simple bolts and the torqueing that keeps them in place. In this issue, experts from AIMCO and HTL Group share their expertise in how to perform this non-glamorous, but essential, part of a turbine's overall makeup.

Wind measurement is also extremely important when it comes to making sure a turbine is performing optimally.

Alan Mortimer, director of Innovation at Wood, discusses an innovative use of Lidar that can extend the life of a wind farm. And in our Conversation feature, an expert from Campbell Scientific chats with us further about the importance of wind measurement.

So join us in the new year as we continue to share the good news and fascinating stories of the wind industry. The good news just keeps getting better for this renewable energy source.

Happy New Year, and, as always, thanks for reading!



**Kenneth Carter, editor**

Wind Systems magazine  
editor@windssystemsmag.com  
(800) 366-2185, ext. 204

**David C. Cooper**  
Publisher

**Chad Morrison**  
Associate Publisher

### EDITORIAL

**Kenneth Carter**  
Editor

**Jennifer Jacobson**  
Associate Editor

### SALES

**David Gomez**  
National Sales Manager

**Tom McNulty**  
Regional Sales Manager

**Jim Faulkner**  
Regional Sales Manager

### CIRCULATION

**Teresa Cooper**  
Manager

**Jamie Willett**  
Assistant

### DESIGN

**Rick Frennea**  
Creative Director

**Michele Hall**  
Graphic Designer

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P.O. Box 1987 • Pelham, AL 35124  
(800) 366-2185 • (205) 380-1580 fax  
info@msimktg.com

**David C. Cooper**  
President

**Chad Morrison**  
Vice President

**Teresa Cooper**  
Operations Director

## Auction expands Massachusetts' offshore wind potential

From AWEA

A highly-competitive auction for three offshore wind lease areas off the coast of Massachusetts concluded with winning bids totaling a record-breaking \$405 million from Equinor; Mayflower Wind Energy, a Royal Dutch Shell and EDP Renewables joint venture; and Vineyard Wind. The completion of this auction kicks off a period of planning for each of these winning companies, including multiple opportunities for feedback from the public and interested parties, before the construction of wind farms can begin.

Eleven companies participated in the auction, including global leaders in offshore energy development and land-based wind developers, reflecting surging interest in America's emerging offshore wind market. Winning bids for all three of the Massachusetts lease areas far exceeded the previous record bid for a single lease area, set by a \$42.5 million bid from Equinor (then Statoil) in a 2016 New York lease auction. Because these leases are in federal waters, winning bids and subsequent lease payments will provide a significant boost to federal revenue.

"The intense competition we've seen in this offshore wind lease auction is completely unprecedented," said Nancy Sopko, director, Offshore Wind, for the American Wind Energy Association. "With strong support from (the Department of the Interior), Massachusetts, and other states, global businesses now recognize the potential of America's world-class offshore wind resources. Today's biggest winners are the American workers who will help build and operate these wind farms and the consumers who will soon have access to a new large-scale source of clean, reliable electricity."

Earlier this year, Massachusetts doubled its offshore wind goal to 3.2 GW by 2035 — one of the most ambitious offshore wind policies in the nation.



The American Wind Energy Association (AWEA) is the premier national trade association that represents the interests of America's wind energy industry. For more information, go to [www.awea.org](http://www.awea.org)

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# DIRECTION

## THE FUTURE OF WIND



Policy commitments in California and industry confidence in exploiting lower value levels of the production tax credit justify a modest upgrade in the U.S. onshore sector. (Courtesy: AWEA)

# More than 680 GW of new wind power planned over next decade

More than 680 GW of new wind-power capacity will come online globally over the 10-year outlook, according to new research by Wood Mackenzie Power & Renewables.

Wood Mackenzie recently upgraded its Global Wind Power Market Outlook Update: Q4 2018 by 2 percent compared to the outlook published in the third quarter. Most upgrades occur in the medium-term, boosting annual capacity additions from 2020 to 2023 by an average of 2.7GW.

## EUROPEAN OFFSHORE MATURES

The maturation of the European offshore sector continues to be a strong driver of wind in the region.

“With 16 GW of offshore wind power capacity installed in Europe by the end of 2018 and more than 47 GW expected to come online in the region from 2018 to 2027, the European offshore sector continues to be a focal point of growth for the wind power industry,” said lead author Luke Lewandowski, director of Americas power & renewables research.

Several of the key upgrades analyzed in the fourth quarter outlook update highlight an indirect consequence of the European offshore experience: announced and expected offshore commitments from emerging offshore wind power markets.

“The European offshore wind power experience has encouraged governments in other regions to support offshore wind to comply with carbon reduction strategies and renewable energy targets as well as more firmly secure domestic power supply,” Lewandowski said.

Favorable announcements from the governments of Japan and South Korea resulted in a more than 1.5 GW upgrade quarter-on-quarter (QoQ). By the end of the 10-year outlook, this support will yield an installed offshore base of more than 2 GW in each country. A significant rate of growth, considering that neither country has

more than 100 MW of offshore wind power capacity installed today.

## ELECTIONS A MIXED BAG FOR AMERICA'S WIND MARKETS

The fledgling U.S. offshore market also received an upgraded QoQ.

“Attractive price signals are expected to motivate an increase in state-level procurement activity from both pioneering states, such as Massachusetts and New York, as well as new entrants over the long-term, such as California and Delaware,” Lewandowski said.

The upgrade will increase installed offshore capacity in the U.S. to approximately 10 GW by the end of 2027, representing 15 percent of all new capacity over the 10-year outlook.

Policy commitments in California and industry confidence in exploiting lower value levels of the production tax credit justify a modest upgrade in the U.S. onshore sector. Cost-out gains and higher production expectations from new turbine technology boost prospects for workable project economics under the phased down incentive.

In the Americas, election results in Brazil, Mexico, and Quebec, Canada, have affected or may affect the wind power outlook in these markets. Conservative wins in Brazil and Canada threaten the prospects for wind-power development in the long-term. The impact of a more liberal administration in Mexico is unclear, but the new government will need to address a balance between development and indigenous interests for the outlook to be fulfilled.

Demand in Australia's onshore sector headlines adjustments in Asia Pacific, as auction awards and financing commitments have flourished ahead of the market's renewable energy target deadline. Recent announcements result in a nearly 2GW upgrade to the outlook QoQ and increase project capacity under construction to 5GW.

## SCANDINAVIAN COUNTRIES CAUSE SIGNIFICANT CHANGES

Countries in Scandinavia, namely

Sweden, Norway, and Finland, represent the most significant changes to Wood Mackenzie's onshore wind power outlook this quarter. Increasingly competitive cost levels and an expectation for higher power prices across Europe have triggered a flurry of project investment announcements and power offtake commitments in the sub-region, specifically from the increasingly important corporate and industrial sector. With a more than 5-GW upgrade QoQ, these three countries will account for 15 percent of new onshore capacity installed in Europe over the next 10 years.

The Polish government awakened its recently dormant onshore market with the award of about 1 GW of capacity and the expectation of additional auction rounds. Downgrades in Ukraine and Russia QoQ, however, dampen the boost from Eastern Europe's largest wind-power market.

## GLOBAL WIND-TURBINE ORDER INTAKE ON THE RISE

Firm offshore turbine order intake in China through three quarters comprised about 25 percent of order intake in the market, indicating the increasing importance of the offshore sector to the local industry. Although the 10-year outlook for China's offshore sector remains unchanged QoQ, the strong turbine order activity in 2018 confirms China's rising position as the leading global market in the offshore sector, as it will account for nearly a third of new offshore capacity added globally from 2018 to 2027.

Global order intake capacity increased 28 percent YoY in Q3/2018 and is up nearly 40 percent through the first three quarters of the year. Although the China market continues to drive firm turbine order volume, there are plenty of encouraging signs from other regions, particularly in Africa. The share of order intake capacity from the offshore sector grows as demand proliferates globally. Although not all order announcements include



In recent years, new products were released at an accelerated pace, with OEMs embracing an evolutionary strategy that led to the new breed of 4.X MW turbine platforms, which left a series of 3.X turbines in their wake. (Courtesy: Vestas)

a specific project location, the assumption is that a large share of this segment is destined to fulfil safe harbor orders in the U.S. market ahead of incentive expiration.

**MORE INFO** [www.woodmac.com](http://www.woodmac.com)

## ArcVera Renewables hires industry expert Gordon Randall

ArcVera Renewables (ArcVera), an international consulting and technical services company specializing in wind and solar energy, recently announced the appointment of Gordon Randall as director of Project Analysis.

At ArcVera Renewables, Randall provides senior level oversight on client deliverables, with emphasis on developing and reviewing analysis methods, and participates in due diligence, energy assessment, and engineering reviews.

During his career in wind energy, which began in 2000, Randall has acquired vast expertise and experience working in multiple sectors, including finance, government, development, and manufacturing. Previously, Randall managed the wind-resource assessment team at Enel Green Power

N.A., conducting analysis on internal projects as input to the firm's investment decisions as well as due diligence and verification of third-party wind resources and energy assessments for potential M&A. At Enel, he also worked extensively with turbine technologies, spanning layout optimization, suitability analysis, and production performance improvement, in addition to assessment of repowering aging wind farms. From 2000 to 2013, Randall worked at Det Norske Veritas, performing energy assessments, technical due diligence, research, and con-



Gordon Randall will be director of Project Analysis at ArcVera Renewables. (Courtesy: ArcVera)

sulting services.

"Gordon has a rare combination of skills that every company in the space wants to have on the inside," said John Bosche, president and principal engineer at ArcVera Renewables. "He has inherent aptitudes for detecting problems, deriving insights, and seeing the bigger picture, plus the know-how to share that vision effectively; we're excited to welcome him."

"Gordon also carries the gravitas of a recognized industry leader who is frequently featured as a speaker and moderator at wind industry conferences and events," he said.

"Much of the renewable energy industry is slow-moving and bureaucratic, but ArcVera Renewables is an adaptable, forward-thinking organization," Randall said. "One of the main draws for me is ArcVera's ability to deliver results with speed, flexibility, and efficiency."

**MORE INFO** [www.arcvera.com](http://www.arcvera.com)

## New tech investments to boost growing global market

Wind turbines are set to become even bigger and better in an effort to main-

tain consistent downward trends of Levelized Cost of Electricity (LCOE), according to new research by Wood Mackenzie Power & Renewables.

“Rapid technology developments have been a large driver of elevating wind to a competitive source of power generation globally,” said lead author and senior analyst Shashi Barla.

The latest edition of the Global Wind Turbine Technology Trends report forecasts rapid innovations up until 2027. These innovations are reducing LCOE on the latest turbines, while at the same time improving performance and reliability.

“Now that auction systems are driving down power prices worldwide, product and service evolution is paramount,” Barla said. “While the shift away from generous incentive mechanisms leads to a short-term market dip, the forecasted growth over the next decade makes the market ripe for innovation.”

To withstand the increasing price pressure associated with a stream of headlines heralding plummeting power-price bids, turbine OEMs are being forced to make large investments in technology. Companies with global operations, strong financial capabilities, and relationships with leading asset owners will harness these commercial advantages to cement their leadership in critical wind markets.

“We expect the global market share of the top five turbine OEMs to rise to more than 73 percent come 2027, compared to just 54 percent in 2016,” Barla said. “Fierce competition is also leading to shorter product lifecycles, as turbine OEMs introduce new product platforms to increase efficiency and performance. Our research predicts the newest platforms will have fewer product variants delivering the same demand volume, reinforcing the evolutionary product strategy approach many turbine OEMs are pursuing.”

“The rapid pace of new product introductions will only begin to slow down post-2020,” he said. “In recent years, new products were released at an accelerated pace, with OEMs em-



Mitja Schulz (left) succeeds Jan Willem Ruinemans (right) as head of the ZF Wind Power Technology Business Unit.

bracing an evolutionary strategy that led to the new breed of 4.X MW turbine platforms. This left a series of 3.X turbines in their wake with barely a chance to recoup their tooling costs.”

According to the research, the U.S., Latin America, and eventually smaller emerging wind markets will transition to 4.X turbines, which were previously expected to be limited to the European market, in the next two years.

The turbine ASP (Average Selling Price) per megawatt has declined by 28 percent since 2010; however, the AEP (Annual Energy production) per megawatt has increased in excess of 50 percent during the same period. As developers are showing proclivity toward merchant PPAs (Power Purchasing Agreements), turbine OEMs are working toward sub 30 euros/MWhr LCOE turbines to address this demand.

**MORE INFO** [www.woodmac.com](http://www.woodmac.com)

## ZF Wind Power Technology CEO steps down

After more than eight years, Jan Willem Ruinemans is leaving ZF in March 2019. Ruinemans leaves the company at his own request in mutual agreement and wishes to seek new challenges outside the company.

Ruinemans joined the company in 2010 and became CEO of ZF Wind Pow-

er Technology in January 2013. During this time, he led the acquisition and integration of Hansen Transmissions and Bosch Wind Gearboxes into ZF Wind Power Technology, one of the global leaders in gearbox solutions for the wind-energy industry.

“Jan Willem Ruinemans was instrumental in growing successfully ZF’s wind gearbox business,” said a ZF board member. “Under his leadership, the company has built a solid position worldwide, with a strong customer base and a unique product portfolio. The ZF Board would like to thank Jan Willem for his vision and efforts during his time at ZF and we wish him all the best in his future challenges.”

Mitja Schulz was nominated as new head at ZF Wind Power Technology. He will assume his new position March 1, 2019, allowing a smooth transition together Ruinemans.

Schulz joined ZF in 2009. During his years at ZF, he has taken up roles in continuously increasing responsibility in Purchasing and Supplier Management and is currently head of Business Unit Commercial Vehicle Steering Systems in Lafayette, Indiana. In this function, he successfully managed the integration of the former TRW business into the ZF group. Prior to joining ZF, Schulz worked in multiple roles at Robert Bosch GmbH in Stuttgart and Porsche AG in their R&D center in Weissach, Germany. ↘

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BOLTING & TORQUE ▸ WIND MEASUREMENT

# MEETING THE CHALLENGES OF BOLTS AND TORQUE





A transducerized torque control system, such as AcraDyne's HT Nutrunner/Gen IV controller system, provides consistent, reliable torque values. This data can be viewed in real time, collected, reported, stored, and analyzed in order to meet productivity, ergonomic/safety, reliability, and quality requirements. (Courtesy: AIMCO)

*Bolt installation in wind turbines can range from the simple to the complex, so it's important to know the pros and cons of all methods used.*

By KEN MAIO

**D**epending on the maker, a wind-turbine installation can include 25,000 bolts or more. These bolts follow different journeys to their final destination where correct installation is critical in order to keep these massive structures safely functional in high-load situations.

Whether the bolts are parts of an assembly put together in the factory, installed by technicians erecting the tower, or monitored for maintenance, they all have a common purpose. The bolted joint must create and maintain the tower designer's intended clamping force (known as clamp load) to keep the components together. These bolts also have a service purpose in mind — they are removable components necessary for serviceability of the tower over its lifespan.

Bolt installation in a wind-turbine joint can be done using several different methods. These methods range from the simple (hand wrench/hand install) to the sophisticated (controlled tooling with data-reporting capabilities).

For many years, installation technicians used a variety of hand wrenches, manual torque multipliers, impact wrenches, and hydraulic power tools to accomplish these tasks. Each of these technologies had its place and still does.

## INSTALLATION CHALLENGES

Bolt installation has several challenges. Wind turbines are growing in size and output. Where a 1.5-MW tower was common and, in its day, considered large, current tower designs have outputs of 12 MW with larger designs still on the drawing board at most of the major makers. Larger output leads to significantly larger tower structures that require higher torque for assembly. Installations must meet the ever-growing requirement that all tasks are done 100 percent correctly without human error.

Technicians are in relatively short supply, and experienced ones are in great demand. Each of these people must have proficiency in a multitude of skill areas to work on turbines. A short list of what these people are tasked with include climbing, safety protocols, working with and around high-voltage equipment, rigging, and torque — all in harsh environments.

Torque values for the fasteners, which once were 1,000 NM to 5,000 NM in range, have increased significantly. What used to be the highest requirement for a tightening solution — 5,000 NM — has now been eclipsed with torque targets of

12,000 NM on many of the offshore installations. Makers are reporting that future torque targets will be 15,000 NM and beyond.

As a result of these challenges, traditional methods that depend on the human element need to change. Tower manufacturers and the farm operators tasked with running them are realizing that monitoring the assemblies within the turbine is the only way to maintain confidence in their integrity.

Speed of work also is an important factor. Farms are being deployed in environments (offshore for one) where running costs of crews are significantly higher, and delays drastically affect the installation.

So, manufacturers and farm operators do have some common objectives that the current tooling market is responding to: productivity, ergonomics/safety, tool reliability, and quality of the assembly.

## NEW SOLUTIONS

New solutions have moved the industry toward achieving these objectives. High-speed (relative to existing solutions) controlled tools can be configured with presets that assist a technician in running a specific job. These presets can be configured by torque-knowledgeable personnel prior to tower work so that the technician up in the tower can simply apply the tool to the bolt and complete the tightening. Preset bolt-counting sequences can further assist the technician in completing all bolts required and identifying situations where one or more may have been missed.

Much of the innovative work in bolt-tightening tooling is about management of the process and recording data from the job. As in aerospace and even vehicle manufacturing, bolts within the turbine are critical to its safe and successful operation. For years, a major gap in the assembly and maintenance procedures for these assets has been a lack of hard data from the handling of the tightening task. Was a bolt tightened properly? Were all of the bolts tightened correctly? Were the bolts the correct quality from the supplier? How can this information be obtained, confirmed, and documented over the lifespan of the tower? Tools that have the ability to control the tightening, collect data, and report it to a database are becoming vitally important.

## IMPACT WRENCHES

Impact wrenches are operator dependent and record no results. Manual procedures with torque multipliers can present data results, but are also operator dependent for constancy. Hydraulic wrenches with their power units produce some data but rely on a pressure gauge and consistent ambient conditions for consistent output.

Many of these techniques rely on an operator component to record the work. Paper and pen records and transportation of these papers back to the office introduce the human element into the equation. These issues, coupled with the technology capabilities of today, beg for systems that are highly accurate in recording data and that provide automated means of keeping records. Systems that are now in



AcraDyne's IEC4W Field Controller/HT Nutrunner system is one example of a high-tech solution that ensures process repeatability and traceability in critical bolting. The tool's built-in transducer coupled with the powerful controller enables comprehensive tool programming and diagnostics, as well as real-time data analysis and troubleshooting. (Courtesy: AIMCO)

demand have repeatably accurate sensors, drive the process, and store the data.

Configuring a torque-driving tool to sense-applied torque is possible via various means. Many systems employ electrical current or hydraulic pressure-sensing gauges that measure the energy used (electrical current or fluid pressure) while driving the bolt. These systems are capable of generating results data but are not repeatable over time due to variations in electrical motor demands, fluid pressure changes from leaks, or ambient temperature changes. To remain credible, these systems require extremely frequent calibrations so that the results are truly what their gauges indicate.

Industry leading systems use a sensor located as close to the bolt being driven as is practically feasible. In tool design, this means placing the sensor at the location of the socket that turns the bolt. By using a sensor that is independent of the energy source used to deliver the torque, these results are repeatable and hold a calibration for as long as one year from verification. These types of sensors, known as strain gauges, have been widely used in assembly applications for years. In laymen's terms, they measure the strain experienced at the material they are bonded to and, through a processor in the control unit, report a repeatable torque value.

## MEASURING ANGLE OF ROTATION

An added benefit of systems of this type is the ability to also measure the fastener's angle of rotation. Systems can be configured to sense initial torque at a point in the process where the materials are all in contact and tightening is beginning. From that "snug" point, the system observes, reports, and can even control the amount of bolt rotation until complete. This capability aids in the detection of cross-threading and any anomalies in the tightening, giving a qualified "good/no good" judgment to the operator and noting it in the data. Sophisticated graphical imagery

can also be plotted from each moment of the tightening process. This “curve” can be used to compare results from known good tightening events to current events, highlighting minute changes in materials, bolts, or operator technique. The benefits of this analytical information are widespread, particularly when reviewing problems or historical trends within specific joints on a tower or series of towers. Common goals are repeatable quality, traceability, and eliminating as many human-element mistakes as possible within a process.

Future trends will revolve around collection of this increasingly available data, management of the data, and real-time observation of what is happening within the turbine from global locales. Offshore wind turbines are a huge growth area where farm deployment and management can be logistically difficult. Tower designs are now being outfitted with network communications for turbine operation, and these connections can and will be used to work with tightening tools as well.

### REAL-TIME DATA

Farm installation and service managers desire an ability to “see” what the tightening tools are doing in real time from outside the tower. Today’s tightening systems can provide that visibility. A bolt-tightening system can be configured to transmit the results data in real time over networks back

to a central data repository and to the manager’s location. This information can then be filed in real time to a Quality Management System (QMS) database. These databases are repositories for all of the data associated with a specific joint on a specific tower, on a specific date, at a specific time, even with a specific operator if so desired.

Another benefit is the ability to program the tightening system from remote locations. This is beneficial when main farm management desires to upload a tightening strategy to a tightening system. This can be integral in systems where the central office controls process revision. It eliminates the need to track down and change every control unit in use. The controlling unit is connected to the network prior to use, and only then would the specific process be uploaded, ensuring that the latest revisions are current in the tightening system’s programming.

Today, farm installers, operators, and maintenance personnel have the power to perform bolting at a highly technical level. No longer is it necessary or required to manually tighten bolts in faraway places. Turbines becoming more massive and prevalent, and the increasing importance of the energy they produce means that keeping them operating in a safe and reliable manner is critical. ✎

### ABOUT THE AUTHOR

Ken Maio is AIMCO’s business development manager.




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# WHERE BOLTING MEETS SAFETY

Hands Free Bolting Back-Up Nut in operation. (Courtesy: HTL Group)

*The correct tools in a wind technician's arsenal can greatly enhance a safe work environment while maintaining joint integrity.*

By FAYE MANN

**W**ith operator safety at the forefront of all industrial operations across the globe, tooling manufacturers are presented with the opportunity to create equipment with unique, innovative safety features to service the demanding safety-conscious needs of the market.

U.K.-headquartered OEM, HTL Group, is a long-serving innovator to the controlled bolting sector with its constant evolutions of Bolt Torque and Tension Equipment to overcome these daily challenges.

Dedicated Square Drive Torque Wrenches are an ideal solution for any torque applications within renewables, presenting a low-weight, yet high-strength, tool to get the job done while maintaining critical joint integrity, putting operator well-being foremost.

## SAFETY FEATURES

The latest DSX Square Drive Torque Wrench range from HTL represents industry-first patented safety features, including an easy-to-use, quick release, retained reaction arm and reversible square drive, which remain connected to the tool while it is adjusted, as well as a working-at-height connection point.

Designed with both operator and job site safety at the forefront, the DSX can be a major contribution to preventing and reducing the number of dropped object incidents avoiding unnecessary costs and unscheduled downtime.

Another key consideration to develop safe bolting practices throughout the industry is the prevention of pinch point, crush, and other hand-related injuries. To combat this, hands-free bolting operations can be implemented with the use of the hands-free bolting range of safety accessories available from HTL.

Simple, yet innovative safety accessories used alongside hydraulic torque wrenches can help eliminate risk and potential hazardous situations when quickly and easily fitted to torque wrenches, providing a safe working environment and reducing injury-related absences, which come at an unbudgeted cost to businesses.

## SPEEDING UP THE PROCESS

Included in the Hands-Free Bolting safety accessory range is the No-Flog® 2, which instantly improves operator safety by completely eliminating the requirement to use a flogging spanner as a backing tool. Quickly and easily removed, this accessory can save time and money by speeding up the bolting process with a non-sparking method.

Also part of the accessory range, the Back-Up Nut allows the operator to remove their hands from the danger zone by holding the tool remotely in place and preventing it from working loose during operation, totally eliminating the need to hold the tool when active.



HTL DSX Dedicated Square Drive Torque Wrench. (Courtesy: HTL Group)



The HTL DSX Dedicated Square Drive Torque Wrench can be a major contribution to preventing and reducing the number of dropped object incidents. (Courtesy: HTL Group)

To compensate for the misalignment of bolt holes in the wind sector, the Flange Alignment Pin can quickly and safely align flanges in place without the requirement for a hammer. The tapered end allows fast operation with only a 180-degree turn required to lock flanges, speeding up operations and preventing dropped objects with an in-built safety tether.

HTL Group's culture is one of driving innovation to meet the highest quality and performance standards, understanding and endeavoring to continually bring safe solutions to market and improve safety standards within the industry. ↴

## ABOUT THE AUTHOR

Faye Mann is the marketing lead at HTL Group Ltd. HTL Group is a network of extremely dynamic, innovative and flexible business teams involved in the sale, hire, and training of Controlled Bolting Solutions for all industry sectors. For more information, go to [htlgroup.com](http://htlgroup.com)

IN FOCUS

WIND MEASUREMENT

# GIVING CLEAN ENERGY A SECOND WIND

Galion 





A Gallion Lidar device sits next to an onshore wind turbine (Courtesy: Wood)

*With the innovative use of Lidar, it's possible to extend a wind farm's life.*

By ALAN MORTIMER

In a highly forested area of Sweden, the landscape is studied by wind turbines whose stately blades are slowly turning under the watchful eye of what appears to be an electronic sheep.

This is the light detecting and ranging (Lidar) device from Wood. It is helping the owners of this particular wind farm to better understand the performance of both individual turbines and the overall estate. And it is making it possible to increase energy yield, improve ROI, and deliver more clean energy for distribution throughout the country.

### WHEN REALITY MEETS DESIGN

Wind turbines are now a familiar site throughout much of Europe and North America. But many are not performing at the level predicted or delivering the output required. At the wind farm in Sweden, turbines capable of delivering 3.45 MW were curtailed to 3.3 MW: a number that looks small on paper, but has a major cumulative effect.

This is not an isolated case. Over many years of analyzing wind-farm performance, it is clear that designers, operators, land-owners, investors, and insurers have a number of competing incentives — and these result in necessary trade-offs and compromises. It is an endemic issue. And it means that wind-farm performance is rarely what was initially predicted.

Naturally, this is a significant challenge. Around the world, the production of wind energy, currently one of the most commercially viable alternatives to fossil fuels, is not yet reaching its potential.

### RETHINKING THE STATUS QUO

Traditional methods for assessing and analyzing wind behavior prior to installing turbines have been based on point measurements. Monitors attached to individual masts gather highly localized data, which is then modeled to give an estimate on what is happening in a wider wind-farm area. Developers and operators use this extrapolated information as the basis of wind-farm development.

The Optimizer service from Wood can change that. The electronic sheep is in fact a host for advanced Lidar technology. It is placed at an optimal location and left for three- to six-month periods to capture wind behavior across a spectrum of conditions. The use of lasers to measure airflow enables it to evaluate a much greater volume of wind flow across a much larger area — up to a radius of four kilometers. That information can then be correlated with actual wind-farm performance.

As a result, when Wood's experts perform their robust analysis and assessment of wind performance for a customer, they are using a much more detailed and accurate data



A Lidar device from Wood is helping a Swedish wind farm better understand the performance of both individual turbines and the overall estate. (Courtesy: Wood)

set. Combined with data from turbines and subjected to standard modeling such as computational flow dynamics as well as Wood's proprietary advanced analytical models, it delivers the insight necessary to extract greater performance from wind-farm assets.

Initially deployed to help predict performance, Optimizer is now widely used to identify and validate production improvements as well.

The Optimizer service looks at the facility in its entirety, and allows Wood to factor in adjustments to individual turbines, the relationships between them, and the effect of the surrounding landscape. For example, forestry has a significant impact on wind flow even above the tops of trees or when it is several kilometers away.

When the Lidar data is combined with long-term SCADA data on turbine output, direction, and rotational speed, what is going on can be properly understood and the best

opportunities for improvement can be quickly targeted. Adding remedial solutions to predictive capabilities was therefore a logical step.

### DELIVERING IMPROVEMENTS

Back in Sweden, the Optimizer technology has already delivered improvements worth approximately \$25 million. It showed that the forests were disrupting airflow, as expected. But it also showed how best to reduce turbulence intensity, and how to maximize energy output while remaining commercially and environmentally acceptable to the landowners.

Instead of chopping down trees unnecessarily, Wood's specialists were able to suggest smarter, more targeted felling plans.

Wood worked with the local authorities and targeted only the tallest trees, most of which were just 10 to 15 years

away from planned felling anyway. The company then replanted to modern forestry and environmental standards, which helps maintain biodiversity and allowed landowners to keep up their crop extraction rate – all while optimizing wind-flow for the turbines.

Wood is now managing the forestry restructuring activity on behalf of the operators.

But this is not the only source of the savings that have been delivered. The analytical work that Wood carries out also enables the operator to extend the life of its existing turbines. With so many turbines around the world getting close to the halfway point of their predicted lifespan, this is a pressing concern for many operators.

In many cases, turbines can be extended beyond their planned lifetime, but it requires detailed engineering and analysis. Component wear rates are affected by wind characteristics, so it's important to establish appropriate monitoring and inspection regimes, along with replacing and refurbishing life-limited components in a practical manner. It needs really accurate information to get that balance right.

Fortunately, Wood's wind team is able to draw on the experience of colleagues in the oil and gas industry, who have been addressing similar problems for the past decade. Those colleagues are also working with Wood's wind specialists to share information on fatigue behaviors, such as

how cracks form and propagate in metal structures, and the best processes to use when monitoring assets as they age.

The point is that even small gains can have a major impact over the life of a wind farm. Wood has optimized the production of more than 50 wind farms around the world, while in some cases also extending their operating life. Measures that deliver typical enhancements of between 5 and 12 percent really make a difference.

Optimizing is not just about immediate performance gains. A wind farm is a long-term investment. Making incremental changes and small adjustments can reduce the load on each turbine, increase lifespan and reduce operational costs. A more efficient wind industry is possible. ✎

#### ABOUT THE AUTHOR

Alan Mortimer is director of Innovation at Wood, where he is responsible for identifying new opportunities in renewables including advanced technologies and analytical approaches. His role covers wind-farm optimization, renewable heat and energy storage, and clean hydrogen. Prior to his role at Wood, Mortimer worked for Scottish Power in renewables development. His roles included Head of Wind Development where he developed the strategy for, and then delivered a wind portfolio including Whitelee Windfarm – which at 539 MW is Europe's largest onshore windfarm.



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# PROFILE

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Insulated tools. (Photos courtesy: Stahlwille)

# With its German roots going back more than a century, Stahlwille offers precise tooling products for the wind industry and more.

By KENNETH CARTER ▸ Wind Systems editor

When it comes to quality tools, the proof can be found in Stahlwille's name.

Almost all of Stahlwille's tools are made in Germany, and those German-made tools have been serving many industries, including wind, for decades.

"We have been really active in the wind business already since the mid '80s in Denmark," said Frank Hansen, managing director at Stahlwille Tools LLC. "Stahlwille is used widely in almost all OEMs, and it's also because of the unique technology of our torque wrenches. Nobody else makes them like we do. That's why we have been very successful, especially in the wind industry and the energy business with our torque products. We do sell everything else as well; it's just the torque products that usually get our foot in the door with new customers."

And that tool selection comes in a variety of products, including torque wrenches, torque testers, calibration equipment, socket sets, spanners, screwdrivers, high-voltage tools, and more, according to Hansen.

"It's pretty well whatever they need in hand tools," he said. "Pretty much the whole pallet of hand tools."

## MADE IN GERMANY

And those tools are the best quality at competitive prices, according to Hansen.

"We do make almost everything in Germany, so we cannot sell cheap," he said. "It's just impossible due to the cost of production in Germany. But we are in complete control of our production process. We start with our own foundry all the way to finishing the product. Hardly anything is outsourced."

Stahlwille sets itself apart by simply offering good service, according to Hansen.

"A lot of our customers complain about some of the bigger competitors that there's no service after they sell something,"

he said. "We usually try to listen to the customers and also come up with custom solutions when it comes to tool kits or tool packaging. I've been personally working in the wind industry for 16 years for Vestas, so I have a decent background in knowing what's needed out there. I've been a technician, myself, and in the last four years with Vestas I've been tool manager in China buying a lot of tools. And we try to use that to make customers' lives a little bit easier. If he has a problem that needs to be solved with a certain kind of tool, then we try to give him a solution. And even if it's not Stahlwille, if we don't have it, we still try to help."

Another aspect of Stahlwille's tools that are unique is their weight — or lack of it, according to Hansen.

"Our products are usually lighter than anybody else's due to thinner walls and different designs, even with the same or higher load limits," he said. "We use different materials, and our production process is more complicated than most of our competitors. It takes much longer for us to make a tool. Especially for wind, that's important. If you have a large wrench, like a two-inch or above, we're talking about a pound less. And that makes a difference if you have to drag it up tower. And I've had to do it many times myself when I was a technician with Vestas."

## INDUSTRY 4.0

End users are often praising Stahlwille's tools, and Hansen said customers should only see more advantages from the company's tools with Industry 4.0.

"With Industry 4.0, we're just starting to promote that in the U.S.," he said. "And we have tremendous feedback on that. We already have demand that I won't be able to even fulfill immediately. I was totally surprised by that."

That demand comes from Stahlwille's wireless torque wrenches.



714 digital torque wrench.



730-5 mechanical torque wrench.

“We now have wireless torque wrenches with open protocol that can talk to almost any software that they use in the factories already,” Hansen said. “And a unique thing that we have that nobody else can offer is an electronic torque wrench range, which still offers you a mechanical ‘click.’ It looks and acts like a mechanical torque wrench, but it’s actually electronic with an electronic display. So now users that are using mechanical torque wrenches want to switch to an electronic torque wrench. With other companies, those wrenches don’t offer a mechanical feel. They don’t click, and they also don’t vibrate or beep.”

Hansen added, because of that, some users have a difficult time getting used to the electronic wrenches.

“A lot of times when users use those electronic torque wrenches, they over torque,” he said. “Because they’re always pulling and waiting for the click. It’s hard for a lot of people to adjust to it, especially if you have a noisy production environment. So, when it comes to the wireless version, we really have a high demand for a product that’s not officially released yet. We’re making it, but it’s challenging for us to make it in the numbers that people are asking for.”

The new wireless electronic torque wrench is based on a model that Stahlwille already has been making for five years, but it’s adding the wireless feature and the open protocol.

Hansen sees the wireless torque wrench being used mainly in production.

“I know in production we have been selling the regular version, which has to be hooked up to download the data,” he said. “But I see them as customers for the wireless version because they also want immediate feedback when they do things, and they can check on the work.”

## OFFSHORE CHALLENGES

As the offshore wind industry moves forward, Hansen said he expects it to bring on its own set of challenges, particularly when it comes to the environments the turbines must inhabit.

“I’ve been actually dealing with one customer in Germany who is doing offshore with our tools,” he said. “That’s pretty challenging for any tool. With the salt water, a tool won’t last as long offshore as they will onshore. Onshore, sometimes they drop them or they get run over with a truck, which is not good for the torque wrench, either. But basically, with offshore it doesn’t matter if it hits the water or not; it’s still going to rust.”

Even though no tool can withstand the harsh salt air associated with offshore turbines, Hansen said he has a U.S. customer who switched to Stahlwille tools because of their comparative longevity. Stahlwille’s tools last more



Combination wrench in TCS.

than twice as long.

“He used to throw away his torque wrenches about every eight weeks because they worked in a very bad environment with high moisture,” he said. “And I just got the wrench back – the one from us – and it looks rusty, but it’s still working. So, it’s going to be cheaper to buy ours and have them working for four or five months than to have to throw theirs away every two months.”

## STAHL IS FOR STEEL

Ever since Eduard Wille started Stahlwille in 1862, steel has been the name of the game. It’s even in the company name. “Stahl” is German for steel. That’s where its quality products originate.

And as it’s grown, the company has opened subsidiaries all over Europe, in China and, most recently, in the U.S.

“As of 2015, we established a subsidiary here in the U.S. in Wisconsin,” Hansen said. “The main reason for establishing a subsidiary that far away out of Europe is basically the products get more and more technical. So, you need the support on the continent at least. You can’t expect the customers to deal with Germany all the time, or deal with a six- or nine-hour time difference to have to call somebody in Germany.”

And as Stahlwille enters the future, Hansen said he sees the tool business to continue to be a challenge, but he ultimately thinks Stahlwille will prevail with its quality products. ↘



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## Roger Smith

Market Sales Engineer ▸ Campbell Scientific

*“We are committed to satisfying the measurement instrumentation needs of our customers.”*

### ▸ What’s a typical day like for you at Campbell Scientific?

A typical day for Campbell Scientific is best described as “constant motion.” We have offices all over the globe. We have teammates working at any given time in Australia, Brazil, Canada, China, France, Germany, South Africa, the U.K. and, of course, headquartered here in Logan, Utah.

Campbell Scientific is committed to satisfying the measurement instrumentation needs of our customers, especially those who are working to advance science and technology for the benefit of humankind. Our products and services help fulfill this mission statement in a number of ways: From freezing road conditions in South Korea to forest carbon sequestration in Canada, we design, manufacture, and sell rugged dataloggers, data-acquisition systems, and telemetry products used worldwide in environmental, research, and renewable energy markets.

So, the typical day is one where we are assisting our customers with the project development and with current operational instrumentation and data collection requests for weather, infrastructure, water quality, solar, and the wind-energy market.

### ▸ Why is wind measurement important for a successful wind farm?

Wind is your input that drives your economic output. So, understanding your resource can help you maximize your investment and create efficiencies that make renewable energy such an important sector in our energy production. Over the years, science has enabled us to be able to track, monitor, and predict where the strongest and most available wind is located.

More reliable data sets provide a stronger certainty or projection of the power available. Wind resource maps and modeling can provide a good starting point, but in order to get the best financing possible, you will need to remove uncertainties in your wind resource.

Data can be directly related to dollars in the U.S. wind industry, so the stronger and more robust data set, using the appropriate sensors, can often times get a wind site the additional “points” needed for successful and profitable operation.

### ▸ Where do you see the wind industry in the next 10–20 years and your place in it?

In just a few years, we have witnessed U.S. onshore turbines increase capacity. This means that turbines can now be profitable in lower wind speed regimes. This added capacity has also led to a greater need for efficiency. The price of power (per MW) has dropped to its current price, so we see a greater need to accurately capture wind-resource data. This data not only needs to be very reliable, but it also requires ready access for the decision makers in our field. As financial margins get tighter, we believe the industry will seek flexibility in gathering data in wind. In my opinion, this is where remote sensing devices will come to the forefront for wind resource assessment and operational needs of a wind farm.

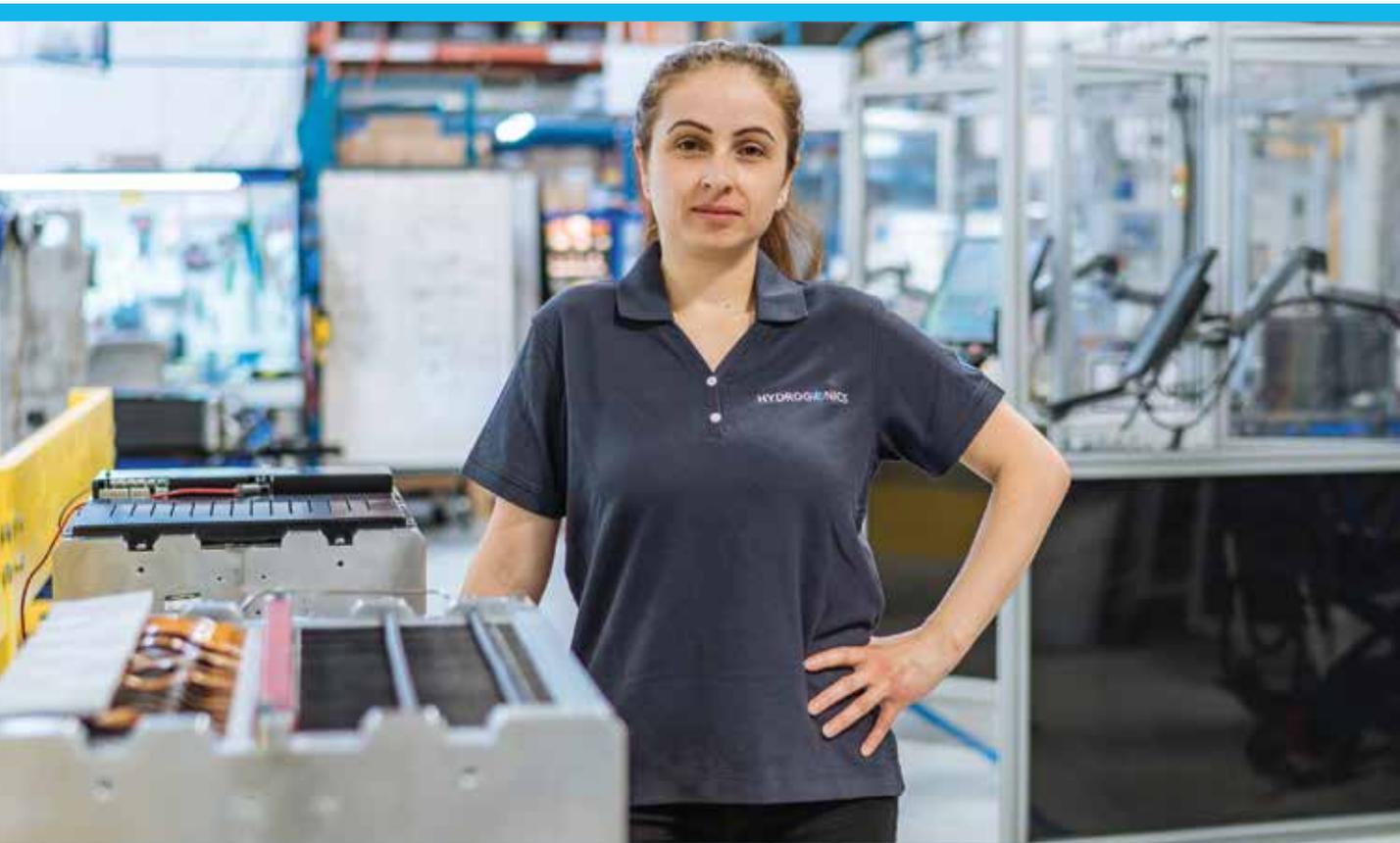
For example, let’s say that your typical wind farm has paid for itself well within the life expectancy of the site and your company wishes to leverage the performance of this site to build another site. Typically, you would have two, perhaps three, met towers across a wind farm. If you could place a remote sensing device (ZX Lidar unit or something similar) at selected locations across that park, you may be able to get a better data set that could remove uncertainties for the financiers. The cost associated with a temporary remote sensing campaign could give your company a better resource assessment and reduce the uncertainties.

In addition, the wind industry will see more requests from the off taker for grid parity and reliability. Campbell is actively developing new products and methods to ensure the reliability and compliance needs of the renewable energy sector. We will see more compliance needs and a stronger request for data certainty in the future.

Where do I see our place in the wind industry in the next 10-20 years? I believe we are going to continue to see advancements in data acquisition and as a result, we will see even greater efficiencies in turbine and grid performance. We are already witnessing immediate access to critical data that increases safety and performance in the field. I see Campbell Scientific as a key component in the sector, an important sector. ↙

**MORE INFO** ▸ [www.campbellsci.com/energy](http://www.campbellsci.com/energy)

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The project will demonstrate and test new offshore wind power technologies. (Courtesy: Siemens Gamesa)

## INNOVATION

### Siemens Gamesa, Aalborg University to lead R&D project

Siemens Gamesa Renewable Energy (SGRE) and Aalborg University (AAU) in Denmark will lead the new i4Offshore research and development project focused on significantly reducing the cost of offshore wind power. Officially entitled “Integrated Implementation of Industrial Innovations for Offshore Wind Cost Reduction,” the project is supported by a European Union (EU) grant of nearly 20 million euros. The project will demonstrate and test new offshore wind power technologies, leading to solutions that will make consumers’ electricity bills both lower and more environmentally-friendly compared to fossil fuel sources such

as oil or coal or other renewable energy sources such as solar or hydropower.

A total of 15 project partner companies are involved in the project in addition to SGRE and AAU. They are all experts within the offshore wind industry, and include Universal Foundation A/S, Bladt Industries A/S, Per Aarsleff A/S, Salzgitter AG, Windar Renovables, Dr. Techn. Olav Olsen AS, NKT Cables GmbH & Co KG, SINTEF Ocean, Bureau Veritas Marine & Offshore SA, Maersk Broker K/S, Deugro Danmark A/S, Fred Olsen Windcarrier, Technical University of Denmark (DTU).

“Siemens Gamesa is committed to reducing the cost of offshore wind energy, and greatly welcomes this grant,” said Jesper Moeller, project lead and senior specialist in Offshore Technologies at SGRE’s Offshore Business Unit. “Our constant focus on innovation — along with strong partners, customers, and support such as from the EU — enables

us to push the industry forward, delivering a lower Levelized Cost of Energy (LCOE) and higher annual energy production. The R&D work we’ll do during this project has clear goals of benefiting our customers, ratepayers, and society-at-large.”

### AN ENORMOUS ENGINEERING PUZZLE

The i4Offshore project, which is based on classical engineering disciplines such as structural analysis, geotechnical engineering, production, and risk analysis, will test a complete installation of a future version of a full-scale Siemens Gamesa offshore turbine. A new 1,000-ton bucket foundation, a steel jacket, a concrete transition piece, and a new cable connection is intended to prove the technology is reliable, and that production, transport, and installation can be done more cost effectively than today.

“One of the challenges of offshore wind energy is that the high cost of building offshore wind turbines has necessitated various governmental subsidies to improve the business case,” said Lars Bo Ibsen, professor at Aalborg University. “While all forms of industrial power generation receive governmental support, whether from renewable, fossil, or other sources, our project aims at making offshore wind energy even more cost-effective without external financial support.”

The project aims to apply the advanced technologies to reduce the Levelized Cost of Energy (LCOE) from offshore wind. The LCOE calculations show the total cost of electricity from a particular energy technology when all costs are included. But before the project reaches that goal, the various elements must prove they can be integrated into an overall solution.

“We already have a lot of pieces that we know work separately,” Ibsen said. “Now we are in the process of assembling them into a large puzzle, and testing that they work together. As this is proven, we look to demonstrate to customers, banks, and investors that offshore wind makes even more financial and environmental sense for the future.”

### MORE THAN 15 YEARS OF R&D

This project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No. 818153. With this funding, the partners aim to bring the technology a step further and provide an even more solid foundation for the creation of future offshore wind power plants around the world. The i4Offshore builds on a wide range of projects implemented with the support of both the EU and a number of Danish funding sources over the past 15 years.

Furthermore, the project will test installation solutions with a minimal environmental footprint. The bucket foundation can be installed virtually noise-free as installation takes place via suctioning into the seabed instead

of being hammered down from above.

“Using a suction-bucket foundation benefits whales and other undersea life by eliminating the soundwaves which hammering causes,” Moeller said. “Also, once the wind turbine has exhausted its many years of operational life, the suction buckets, jacket foundation, and transition piece can be decommissioned and removed relatively easily. The materials, including steel, concrete, and cables, can be re-used in a highly resource-efficient manner.”

**MORE INFO** [www.siemensgamesa.com](http://www.siemensgamesa.com)



Vaisala’s suite of premier lightning detection technologies detect both cloud and cloud-to-ground lightning. (Courtesy Vaisala)

### INNOVATION

## Vaisala launches ability to identify lightning

Vaisala, the global leader in environmental and industrial measurement, including comprehensive lightning data, has developed the capability to distinguish cloud-to-ground lightning strokes that contain continuing

current, the most damaging of lightning strokes. This first-of-its-kind technology offers precision in identifying these strokes, which can last up to 1,000 times as long as a typical lightning stroke and may be more likely to cause fire or other extreme heat-related damage.

“Our patent-pending technique is a game-changer in lightning detection,” said Brooke Pearson, Vaisala’s global solutions manager for lightning. “For the first time, industries where charge transfer from lightning is a threat, including electric utilities, oil and gas, wind farms, and land management organizations, can identify and target the small percentage of lightning strokes most likely to cause asset damage or start fires.”

Vaisala’s suite of premier lightning detection technologies detect both cloud and cloud-to-ground lightning. They include the National Lightning Detection Network (NLDN) in the U.S., which detects cloud-to-ground lightning strokes with a location accuracy of fewer than 150 meters, and the GLD360 global lightning network, which has the ability to detect lightning anywhere in the world.

By leveraging the new data now available from NOAA’s Geostationary Lightning Mapper, Vaisala is able to transform existing NLDN and GLD360 data to provide unprecedented insight to create this innovative capability.

While continuing current strokes account for just less than 10 percent of cloud-to-ground lightning strokes, the sheer number of storms with lightning makes even this small percentage significant. While thunderstorms vary widely in size and intensity, NOAA reports there are roughly 100,000 thunderstorms in the U.S. alone each year, and the NLDN records about 70 million cloud-to-ground lightning strokes in the U.S. annually. That averages approximately 50 continuing current strokes per storm and as many as 7 million per year.

“Whether it’s one, 50, or 100 con-

tinuing current strokes, managing the damage costs time, money, and resources to fix,” said Casey McCullar, head of Lightning Solutions Business for Vaisala. “Knowing precise location information for the most damaging strokes will allow investigation and repair personnel to focus on the areas with the highest likelihood of damage first, making the process much more efficient.”

“This innovation in lightning detection and reporting by Vaisala will enable electric utilities to know not only where lightning has occurred but also where damage to power systems has likely resulted,” said Theo Laughner, president of PowerGrid-RX Inc, an electric utilities consultancy. “This allows utilities to know if repairs are likely necessary before dispatching personnel, thereby reducing outage durations.”

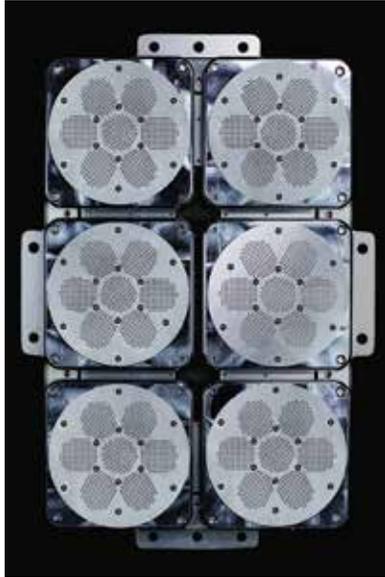
**MORE INFO** [www.vaisala.com](http://www.vaisala.com)

## INNOVATION

### Bat Deterrent System reduces fatalities by 54% at Texas facility

NRG Systems, Inc., a designer and manufacturer of smart technologies for a range of wind, solar, and meteorological applications, has announced that a trial of its ultrasonic acoustic Bat Deterrent System reduced overall bat fatalities at the Los Vientos Wind Energy Facility in Starr County, Texas, by 54 percent. The results of the test prove that NRG Systems’ technology is an effective tool for reducing mortality of certain species of bats caused by wind turbines. The Bat Deterrent System is based on “jamming” the echolocation capabilities of bats, which they rely on for orienting, foraging, and communication, while causing no harm to wildlife that encounter the treated airspace.

The test was led by researchers from Texas State University in partnership with Bat Conservation International (BCI), and involved installing NRG’s



The Bat Deterrent System from NRG Systems. (Courtesy: NRG Systems)

Bat Deterrent Systems on 16 of the facility’s 255 turbines.

“It is no secret that wind turbines cause mortality to bats,” said Brogan Morton, senior product manager at NRG Systems. “This has become an increasingly critical issue as bat populations across North America continue to decline. NRG set out to develop a technology that would allow wind developers and operators to protect bats while creating more energy more of the time. We are incredibly pleased to say that we are well on our way to making this a reality.”

“Our results from a robust, two-year study at an operational wind-energy facility in Texas indicate NRG’s acoustic deterrents significantly reduce Brazilian free-tailed bat and hoary bat fatalities,” said Sara Weaver, doctoral candidate at Texas State University, and biology lecturer at A&M, San Antonio, who led the Los Vientos study. “Based on these results, the technology is a promising tool for reducing bat fatalities at wind turbines.”

While 2018 marks three years of testing for NRG’s Bat Deterrent System, research around using ultrasonic acoustic deterrents to reduce bat fatalities at wind turbines has been underway for more than a decade. This

was led by The Bats and Wind Energy Cooperative (BWEC), an organization that BCI helped launch and continues to coordinate.

“BCI is proud to partner with companies like NRG Systems — entrepreneurs looking to reduce bat fatalities at wind turbine sites,” said Mylea Bayless, senior director of Network & Partnerships at BCI. “We hope that future testing shows continued mortality reduction in additional species and that NRG’s Bat Deterrent System will serve as a highly effective tool for wind developers and operators looking to minimize their impact on bat populations.”

**MORE INFO** [nrgsystems.com](http://nrgsystems.com)

## CONSTRUCTION

### Boskalis wins contract for Ostwind 2 grid connections

Royal Boskalis Westminster N.V. (Boskalis) has been awarded a sizable export cable installation contract for the Ostwind 2 offshore grid connection.

The contract was awarded by 50Hertz and carries a value for Boskalis in excess of 250 million euros, making this the largest cable installation contract acquired by Boskalis ever.

The contract scope comprises design and installation of approximately 270 kilometers of export cable that will connect the planned Arcadis Ost 1 and Baltic Eagle offshore wind farms to the onshore substation in Lubmin, Germany. The project is expected to begin in 2019 with a planned completion late 2022.

Boskalis will execute this contract in consortium with its partner NKT that will supply the high-voltage cable system. For this project, Boskalis will deliver an integrated solution of in-house services including supporting UXO survey, geotechnical, and geophysical surveys (through Boskalis subsidiary Gardline), seabed preparation works, pre-lay run, transport, and installation of the 220kV export cables



The contract scope comprises design and installation of approximately 270 kilometers of export cable that will connect the planned Arcadis Ost 1 and Baltic Eagle offshore wind farms to the onshore substation in Lubmin, Germany. (Courtesy: Royal Boskalis Westminster N.V.)

and seabed reinstatement.

Boskalis will deploy a wide variety of its in-house assets including trailing suction hopper and backhoe dredgers, geophysical and geotechnical survey vessels, cable-laying vessels, and a wide range of trenching tools.

“We are very proud to have been selected for this contract, the largest cable installation contract ever for Boskalis,” said Peter Berdowski, CEO of Boskalis. “The fact that we are able to combine our dredging services, recently acquired survey capabilities together with our cable installation competencies demonstrates Boskalis’ ability to offer a unique breadth of services. We look forward to further expanding this position for our clients as the leading subsea cable installation contractor.”

Boskalis’ strategy is aimed at benefiting from key macro-economic factors that drive worldwide demand in our markets: expansion of the global economy, increase in energy consumption, global population growth, and the challenges that go hand-in-hand with climate change. This project is

related to the development of generating renewable energy due to climate change and increasing energy consumption.

**MORE INFO** [boskalis.com](http://boskalis.com)

## CONSTRUCTION

### Fengate, Longroad Energy Partners to build Maine project

Fengate Asset Management (“Fengate”) and Longroad Energy Partners, LLC (“LEP”) recently announced a co-development and financing partnership to develop and construct the 72.6 MW Weaver wind project in Hancock County, Maine.

“Fengate is very pleased to partner with LEP to further expand our renewable energy investments in the United

States,” said Greg Calhoun, Director, Infrastructure U.S., Fengate. “This investment will build and provide a new source of clean, reliable energy for Maine in partnership with the most experienced and accomplished wind-energy developer in the state.”

“We are very happy to be working together with Fengate on this important project,” said Charles Spiliotis of Longroad Energy Partners. “As we looked to the market for financing partners, their experience and team were impressive and ready to take on all the challenges that developing wind in Maine can bring.”

Fengate is a leading investment firm with a growing presence in Houston, with the two most recent hires joining from ENGIE and NRG. The Houston team specializes in energy infrastructure investing, and Fengate is expanding its renewable energy portfolio comprising wind, solar, hydro, and biomass projects across North

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America. This transaction represents Fengate's fourth clean energy co-development partnership investment in North America — the third in 2018 and the second in the US.

"Houston is a perfect location to build Fengate's U.S. energy infrastructure investment platform," said Andrew Cogan, managing director, Infrastructure Investments, Fengate. "We are committed to continue growing the Houston office due to the investment opportunities in Texas, abundance of energy infrastructure professionals, and central geographic location."

Under the terms of the agreement, Fengate and LEP will co-fund the development and construction of Weaver. The project is in late-stage development and is expected to achieve notice to proceed in mid-2019 with a commercial operations date in late 2020 and will be a new and significant source of renewable energy in Maine.

**MORE INFO** [www.fengate.com](http://www.fengate.com).

## MAINTENANCE

# Seacat takes lead in offshore wind vessel monitoring

Offshore energy support vessel (OESV) operator, Seacat Services, has installed an advanced remote monitoring system across its fleet of 14 class-certified catamarans. The BareFLEET system, developed by Reygar, will give Seacat Services an unprecedented level of insight into the operational performance of its vessels, enabling progressive safety and technical availability gains that benefit crews, clients, and the wider industry.

"Digitalization" of operational practices, coupling remote data collection with advanced monitoring, is gaining pace as offshore wind firms throughout the supply chain aim to keep tabs on the performance of project critical infrastructure, optimize O&M and construction procedures, extend asset lifetimes, and bring down the levelized cost of energy (LCOE).



All 14 vessels in the Seacat Services fleet have been fitted with an "always-on" data connection. (Courtesy: Seacat Services)

To date, much of this investment in digital technologies has been focused on turbines and transmission, but there is now an emphasis on leading OESV operators to match this level of sophistication with more advanced vessel monitoring approaches that enhance the value of the vital service they deliver. While monitoring of key variables such as vessel motion, vibration, navigation, and engine performance is common practice, increasing the efficiency of reporting, and pulling this performance data into one place, is essential to inform more effective fleet-wide decision making.

Seacat Services' rollout of the BareFLEET system is part of the firm's ongoing investment in the quality of the service it provides to offshore wind developers, operators, and contractors, supporting a longstanding commitment to the highest standards of safety and technical availability.

All 14 vessels in the Seacat Services fleet have been fitted with an "always-on" data connection. The BareFLEET system has now been integrated with existing sensors and equipment and will be used to monitor key variables, including navigation data, vessel motion, and the performance of engines and other critical machinery.

Seacat Services will be able to view a live feed of this data from its Fleet Operations Center in Cowes, allowing

the business to keep tabs at all times on the performance of its vessels in the field. Critical alerts — such as an engine alarm — will be flagged instantly to shore-based personnel, leading to immediate action.

As the volume of data collected by the system increases, Seacat Services will conduct trend analysis, condition monitoring, and preventative maintenance, enabling the operations team to detect and address developing faults in critical components before they result in failure or unscheduled vessel downtime.

The system will also improve the capacity of Seacat Services for efficient, regular reporting from the field. By making use of Reygar's Digital Daily Progress Report (DDPR) mechanism, Masters and crews will be able to quickly log completion of key safety procedures such as drills and toolbox talks. BareFLEET is now integrated with CrewSmart — the cloud-based crew and fleet management software Seacat Services is using — bringing all of the data required for safe, effective crew management into one place.

"We've seen the wide-ranging benefits that digitalization of operations has had for turbine owners and operators — and it's time for the vessel market to follow suit by showing a commitment to matching these higher operational standards," said Ian Baylis, managing

director of Seacat Services. “Our investment in BareFLEET will not only enable us to protect our most important assets — our masters, crews, and the vessels they operate — but also ensure that our customers get maximum value from the boats they have under charter. As these digital systems become increasingly integrated, there is huge potential for cross-collaboration throughout the supply chain that ultimately helps us to change the way offshore wind farms are developed, built, and serviced.”

**MORE INFO** [www.seacatservices.co.uk](http://www.seacatservices.co.uk)

## MANUFACTURING

### Cherbourg blade factory reaches 2018 hiring target

Cherbourg blade factory recently completed its 2018 recruitment plan at its offshore wind turbine blade manufacturing site in Cherbourg, France.

The site counts more than 100 employees, 34 percent of whom are women.

The first group of 30 newly hired employees, from all functions, participated in the launch of the factory’s Cen-

ter of Excellence training center September 30. These new employees joined a one-week theoretical class, followed by a week of practicing on an actual piece of a wind turbine blade mold.

After completing the Center of Excellence course, each trainee left Cherbourg to spend a month abroad at other LM Wind Power sites — from Spain, to Denmark, Poland, and even Canada depending on the job scope. Employees from sites around the globe will also travel to Cherbourg to support the ramp-up of the factory. The second group started their training program on October 22.

“The Cherbourg site is a great location to support the development of the offshore wind industry in Europe and beyond, with a positive impact on the jobs and the ecosystem in the surrounding region,” said Alexis Crama, LM Wind Power Offshore Wind vice president. “We are investing in building a strong and sustainable value chain and are happy to welcome the first hundred recruits.”

The construction of the factory is on track to start the prototyping phase in January 2019. The first blade produced will be shipped to ORE Catalyst Research & Development Center in Blyth, U.K., for indoor testing. The next three blades produced will be installed

on GE’s Haliade-X 12-MW prototype at the end of the second quarter of 2019 at a yet to-be-determined site.

“This project entails new challenges and creates enthusiasm as we are starting up a new factory, installing new equipment inside, and welcoming new people with diverse backgrounds,” said Lukasz Cejrowski, LM 107.0 P project director. “At the same time, we are developing a new product: a new blade of a size we have never achieved before. We can witness a significant combination of efforts as we use the expertise from our facilities worldwide to train the people in Cherbourg. This enthusiasm from all our teams will bring us to the successful ramp-up of the factory.”

In parallel to the development of the LM 107.0 P blades in Cherbourg, GE’s Offshore Wind teams is focused on the assembly of the first two Haliade-X nacelles at the Saint-Nazaire manufacturing site in France.

**MORE INFO** [www.lmwindpower.com](http://www.lmwindpower.com)

## MANUFACTURING

### Vestas receives largest order to date in India

Leveraging Vestas’ experience from more than 4 GW of turnkey projects across the globe, Vestas has received an order for a 252-MW Engineering, Procurement and Construction (EPC) project in India. The order is Vestas’ largest order to date in India and placed by Vivid Solaire Energy Pvt. Ltd., a subsidiary of Engie, and was awarded as part of the national level wind auctions organized by SECI.

The project will be in Thattaparai in the Tuticorin district in the Tamil Nadu state and includes delivery, installation, and commissioning of 126 V120-2.0 MW turbines, as well as the project’s civil and electrical work. The turbines will be serviced by Vestas under a 10-year full scope Active Output Management 5000 (AOM 5000) service agreement as well as a Vestas Online®



The first group of 30 newly hired employees, from all functions, participated in the launch of the factory’s Center of Excellence training center September 30. (Courtesy: LM Windpower)

Business SCADA solution.

“This project is particularly significant for us because it brings Engie’s renewable energy generation capacities in India to 1 GW, a major milestone that proves our commitment, both to India and to the development of low-carbon energy sources,” said Malcolm Wrigley, country manager of Engie India. “We have a long history of working with Vestas in multiple geographies and remain confident that Vestas will be a strong, reliable, and value-additive partner in our journey toward achieving our renewables ambitions in India.”

“With this EPC project in India, we underline the broad range of capabilities Vestas can offer to our customers in the Indian market,” said Clive Turton, president of Vestas Asia Pacific. “Our extensive EPC project management experience and ability to develop site-specific solutions to compete in auctions have been key factors in securing this order.”

Turbine delivery is expected to commence in the second quarter of 2019, while commissioning is expected in the third and fourth quarter of 2019.

The production from the wind park will offset around 724,000 tons of CO<sub>2</sub> per year, corresponding to the average residential electricity consumption of 5.88 million urban electricity consumers in India.

**MORE INFO** [www.vestas.com](http://www.vestas.com)

## MANUFACTURING

### Siemens Gamesa to supply its new wind turbine in Mexico

Siemens Gamesa Renewable Energy made a big step forward in strengthening its product portfolio by signing the first contract featuring SG 4.5-145 wind turbines with Enel Green Power, the global renewable energy business line of Enel Group.

The scope of the contract includes the supply of 24 units of the new SG 4.5-145 wind turbines with a flexible



The SG 4.5-145 offers a flexible power rating from 4.2 MW to 4.8 MW depending on site conditions and has a rotor diameter of 145 meters. (Courtesy: Siemens Gamesa)

power rating of 4.2 MW for Parque Amistad III and 36 units for Parque Amistad IV, located in Acuña City, in Coahuila, Mexico, for a combined total capacity of about 249 MW.

These projects represent the first order worldwide for the new generation of onshore wind turbines greater than 4 MW with best-in-class LCOE, and a tower height of 107.5 meters. The SG 4.5-145 offers a flexible power rating from 4.2 MW to 4.8 MW depending on site conditions and has a rotor diameter of 145 meters. It is optimized for medium wind onshore locations to maximize energy production with low noise emission levels.

Both Parque Amistad III (100 MW) and Parque Amistad IV (149 MW) were awarded to Enel Green Power during the Mexican Auction in 2017.

The scope for both projects includes a five-year service and maintenance contract after commissioning of the turbines, which will be manufactured in Spain and China (nacelles) and Mexico (blades and towers).

Across Mexico, Siemens Gamesa has provided more than 2.3 GW of output capacity for more than 25 project sites.

The company has a strong footprint in Mexico consisting of third-party manufacturing, service and offices.

**MORE INFO** [www.siemensgamesa.com](http://www.siemensgamesa.com)

## MANUFACTURING

### Siemens Gamesa signs second order for 201 MW in Russia

Siemens Gamesa Renewable Energy (SGRE) has secured a second order in Russia from Enel Russia, one of the country’s independent power producers (IPP), for the supply of 201 MW of wind turbines. The scope of the agreement includes supply, installation, and commissioning of 57 Siemens Gamesa 3.X platform turbines at the Kola wind farm, in the Murmansk region, Russia. The Kola wind farm is due to be commissioned in 2021. The contract includes full scope O&M (operation & maintenance) services during the first two years with an option to extend.

This order is part of the preliminary agreement signed with Enel in 2017 for the supply of 291 MW to two wind farms in Russia. The first order, the Azovskaya project with 90 MW capacity, was announced by Siemens Gamesa in early October 2018.

With the delivery of its proven wind turbines, Siemens Gamesa will contribute to Russia’s targets to develop local renewable energy resources reaching 3.3 GW of wind installed capacity by 2024 and to ramp up a local wind energy industry.

“We are proud to announce this second big contract in Russia and to continue the successful cooperation with Enel,” said Steven Pryor, CEO Onshore North Europe & Middle East region at Siemens Gamesa Renewable Energy. “Siemens Gamesa is well under way to establishing a strong position in the growing Russian renewables market. We have introduced modern technology and we have taken important steps to ensure local content requirements.”

**MORE INFO** [www.siemensgamesa.com](http://www.siemensgamesa.com)

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# CROSSWINDS

THE FUTURE OF WIND

# NEW TECH GROWS FROM TINY SEED

The PowerCone, which resembles a miniaturized three-bladed turbine, is designed as an enhancement device that can be fitted to 98 percent of all installed turbines around the world. (Courtesy: Biome Renewables)

*With a helping hand from the natural world, a novel device from a renewable energy startup could increase the annual energy production of a wind turbine by more than 10 percent.*

By **KENNETH CARTER** ▸ Wind Systems editor

**W**ind can't be made, but what if there was a way to take better advantage of the wind that's available?

The experts from Biome Renewables say they have discovered a way to do just that with a technology they call the PowerCone™.

A phenomenon called Rotor-Root-Leakage (RRL) at the center of the turbine represents the largest area of aerodynamic loss, according to Ryan Church, founder, CEO, and CTO of Biome Renewables.

"It's a big problem in wind," he said. "What's going on is that you've got an area of low pressure, which develops around the hub, because the blade goes from being an airfoil section into this circular root geometry. So, when the turbine is operating, there's no power being produced there."

In effect, a low-pressure area is contrasting with the high-pressure region around the outer part of the rotor, causing a pressure differential, according to Church. And that pressure differential causes a suction effect upwind of the rotor.

"The wind is actually diving into this central area," he said. "Not only is it not doing its job, not only is it not producing power, but it's actually robbing blades of power that it could be generating."

## FINDING INSPIRATION

For his creation, Church, who is a biomimetic designer, found inspiration in an unlikely place: a tiny maple seed.

"I look at the natural world for inspiration, and I derive technology and solutions from that," he said. "The maple seed is a very efficient structure aerodynamically. What makes it efficient is something called the coning angle, which is the angle the maple seed falls at. And that's based on a phenomenon we've coined Time Dependent Energy Transfer."

Time Dependent Energy Transfer is basically a principle where the seed takes more time to slow down the wind, thus increasing efficiency while limiting turbulence formation.

"The maple seed employs Time Dependent Energy Transfer," Church said. "It's a phenomenon seen quite widely in the natural world in how nature deals with turbulence. I then harnessed this phenomenon into a geometry, which is the PowerCone. The coning angle of the PowerCone — the way that it swoops backwards — is roughly the same coning angle as a falling maple seed, although it's slightly different due to scale and flow speed. The point being, once I saw the maple seed, it sort of triggered an ah-ha moment for me in that you could have a three-winged maple seed of sorts and basically fill in the central area of loss in a wind turbine."

## FITS ALMOST ALL TURBINES

The PowerCone, which resembles a miniaturized three-bladed turbine, is designed as an enhancement device that can be fitted to 98 percent of all installed turbines around the world. It can be installed on the turbine's hub in about a day. The result is an increase of AEP by 10 to 13 percent, according to Church, because the PowerCone shifts the entire power curve to the left, meaning an increase in start-up speed.

The simple and elegant technology also equalizes the pressure distribution across the entire rotor disk and reduces the negative impact of wind gusts over time, essentially boosting performance for the entire turbine while reducing loads — something nearly unheard of in the wind industry, according to Church.

"There are a few aerodynamic mechanisms going on," he said. "It uses something we call a twin-hybrid aerodynamic approach. It smooths out the pressure distribution across the rotor disc. Before, you had an area of low pressure around the hub. When you have the PowerCone on there, now you have an area of high pressure in that region. You smooth out the pressure differential between the outer part of the blade and the center of the turbine. When you do that, you actually even out the velocity differential and decrease the loads on the rotor. So, this is happening at the macroscopic level, in an area far away from the actual device. As the wind is coming into the face of the rotor, it's no longer diving in toward the middle. Actually, the opposite is happening. It's getting pushed out a little bit. We actually impact positively the aerodynamics of the entire rotor, not just the central area where it is located, which is one of the keys to understanding the AEP gains that we get."

In addition to that, the PowerCone also has an effect on the wind that's directly hitting it, according to Church.

"Where the PowerCone is actually located, the wind is coming along, and it's hitting our structure, and it's rubbing along our blades," he said. "That flow gets directed and concentrated onto the section side of the blade. In doing that, you are eliminating flow separation off the blade by increasing the local boundary layer flow velocity, which leads to a reduction in turbulence and associated vibration. All that vibration would normally be going into the drive train, and now it's not."

## PILOT TEST ON THE HORIZON

A full-scale pilot test on an operating wind farm of the PowerCone is planned for the first quarter of 2019, which has Biome Renewables working with Arista, Capstone, DNV-GL, and Vestas, according to Church. Two Vestas V-100 turbines will run side by side. One will be used as a baseline, while the other turbine will be fitted with the PowerCone.

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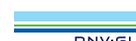


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A ground-based Lidar will be used for atmospheric wind measurements.

“With our tests, what we’re going to be looking at is full turbine loads and impacts on the drive train, including how much vibration we might be reducing,” he said. “We will also be looking at power production and details like nacelle anemometer impact. The PowerCone helps the blade do a better job to produce more lift. The PowerCone itself is providing torque to the system, and it is also channeling that flow onto the blade and allowing the blade to provide more torque.”

That concept is called a twin foil slot technique and is seen in other industries such as sailing, with a main sail and jib, and Formula One.

“In Formula One, in the front of the car, you’ll see these fins channeling the flow around the front part of the tire,” Church said. “That is an aerodynamic technique that is well known. We are doing that on a large scale. The technology is believed to work perfectly well with competitors, too, and may even improve vortex generators and other add-ons that a customer may already have on their turbine, because the PowerCone is simply shunting more air over the VG and enabling it to better do its job.”

## REPOWERING TURBINES

As turbine repowering becomes an option with aging turbines, Church said the PowerCone is an ideal way to approach increasing an asset’s output.

“This will be a huge boon for the repowering market,” he said. “You can repower a turbine with the PowerCone and have the payback stretched out over a number of years. Obviously, if you have a turbine that’s 15 years old and you’re trying to get the last five years out of it, the economics still work, but it’s not as good as if you have 15 to 20 years to do the same thing. This is a question of being the right technology at the right time. There’s a surge occurring in the market, and we’re fortunate to be in the right place at the right time.”

## PERFECT FOR LOW WIND

Another benefit of the PowerCone is its ability to be implemented in areas where wind power wasn’t feasible before, according to Church.

“You can now install wind turbines in areas where you couldn’t before, and the technology has more of an impact in lower average wind speeds,” he said. “Class 3 is low, and that’s 7 1/2 meters per second average. They have a new class called ultra low, which is 6 meters per second average. And soon I’m sure they may have a fifth class, which is

ultra-ultra low, which could be 5 meters per second average. With the PowerCone technology, it works in all wind classes, but it works better in low wind because more of the wind bins are stacking up in the ramp-up portion of the power curve.”

More than 50,000 person-hours over the past few years have gone into the development of the PowerCone, and that hard work is already paying off, according to Church.

“It is selling itself,” he said. “What we know about the technology is that it decreases the cut-in speed of the turbine. And you also hit rated power earlier. So, you shift the whole power curve over to the left, and you get huge gains in AEP because most of the wind distribution is happening



A PowerCone blade during fabrication. (Courtesy: Biome Renewables)

in the low wind bins. When you do that, you really unlock the full potential of wind power. You unlock new markets for wind power. You enable bids for new wind power to be cheaper than they ever were before when you bid in a PowerCone into a project. There are a lot of different business models and plans we’re going after. The O&M market is a huge market for us.”

Along with using the PowerCone for wind, Church said Biome Renewables is also involved in renewable energy as a whole, including adapting the PowerCone technology for tidal energy.

The PowerCone has come a long way since Church built a wind tunnel in his living room to test his theory born from a falling maple seed.

“The PowerCone is the fundamental flagship technology that we’re coming to market with,” he said. “But there’s also quite a few technologies that we’re working on that will complement the PowerCone.”

**MORE INFO:** [biome-renewables.com](http://biome-renewables.com)



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