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# WIND SYSTEMS

IN FOCUS

O&M Operations ▾ Turbine Maintenance

## SWARMING: ADDING VALUE TO WIND ASSETS

PROFILE

JLG Industries

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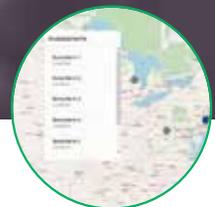
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## IN FOCUS

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*The key to unlocking the potential of wind assets is to connect the dots and ensure turbines are acting on crucial data streams to operate for the entire wind farm.*

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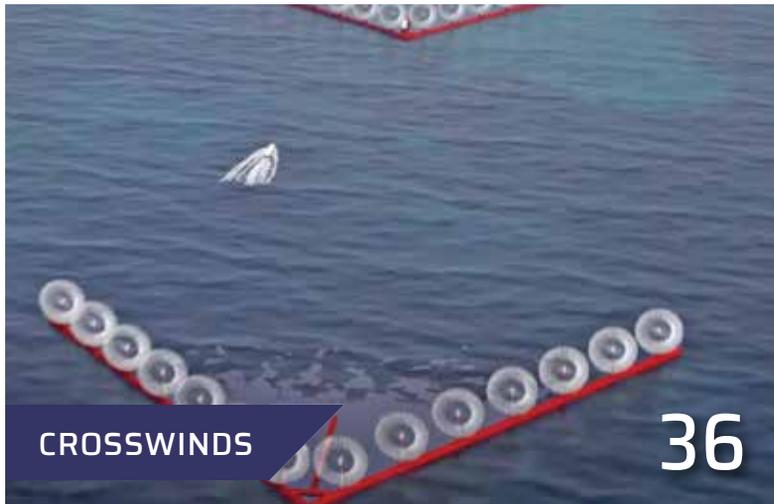
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# FROM THE EDITOR

## Wind Systems — it's easy being green

**B**y the time you read this, we'll be at least six weeks into 2022, and as far as the future of renewable energy is concerned, I feel like it's the beginning of a brighter — and greener — future. And by green, I mean both ecologically and economically.

If you're a recent subscriber to *Wind Systems*, let me explain why this month's issue is only available as a digital copy.

Last year, we took bold steps to decrease our carbon footprint.

Starting last year, *Wind Systems* began publishing six issues in a digital-only platform with the six remaining issues of the year being a print-digital issue combination. To add to our commitment to lower our carbon footprint, the six print issues are published on 10-percent recycled paper.

This, by no means, marked a change in the quality and quantity of the latest and best information about the wind-energy industry we continue to bring to you every month.

Just take a look at what this issue has to offer, and you'll see that our task to bring you interesting and informative wind-industry news has always — and is very much still — our primary mission.

Our cover story is from WindESCo's Ed Wagner. In the article, he discusses the concept of "swarming." This technique allows hardware and software, as part of an integrated system, to help wind-farm owners unlock value by allowing turbines to communicate and learn from each other.

Ronald Kleinjan, director of Mammoet Heavy Duty Pavements, shares his insights on how the maintenance and upgrade of existing wind facilities will play an increasingly important role in renewable energy delivery.

And an article from Firetrace's Angela Krcmar looks at the importance of owner-operators taking fire risk assessments seriously.

In this month's Crosswinds, I had the opportunity to talk with Mark Cann, CEO and co-CTO of CryomatiKs, about his role in using drag-based-designed turbines on floating wind platforms in order to produce green hydrogen, green ammonia, liquid air, and more.

You'll find all that and more in this month's issue. It may be digital, but it's still 100-percent *Wind Systems*.

Stay safe and healthy out there, and, as always, thanks for reading!



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## Mark your calendars for 2022 events

From ACP

Here are highlights for some of ACP's 2022 events. The schedule is ever-evolving, so go to ACP's website for up-to-date information.

### ✔ O&M and Safety Conference

March 8-10 | Coronado, California

The ACP Operations & Maintenance and Safety Conference is where the industry connects to recognize unique challenges and identify solutions in health and safety, operations and maintenance, workforce training and development, and quality assurance.

### ✔ Siting and Environmental Compliance Conference

March 29-30 | Round Rock, Texas

A firm grasp of all the aspects involved with siting and compliance is a critical component for both individual clean-energy projects and having the robust industry we all advocate for so strongly. This event is where industry leaders, experts, and external stakeholders discuss the most challenging issues of the day.

### ✔ CLEANPOWER Conference & Exhibition

May 16-18 | San Antonio, Texas

CLEANPOWER brings together the most knowledgeable minds in the industry and creates a collaborative platform for discussing issues that are important to industry professionals and their companies. Attending helps you get results to grow your business and our industry.

### ✔ Offshore WINDPOWER Conference & Exhibition

October 18-19 | Providence, Rhode Island

Offshore wind is a once-in-a-generation opportunity. This event has cultivated a dedicated and thriving global community of top developers and experts. As more steel goes in the water, this event will only continue to grow in value and scope.



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# DIRECTION

## THE FUTURE OF WIND



A notable shift toward renewable and green energy owing to climate change, rising focus on reducing carbon emissions, and depletion of fossil fuels are major factors driving the market growth. (Courtesy: Shutterstock)

# Report: Offshore wind market to grow by 17.7% annually

Global offshore wind power will grow at a rate of 17.7 percent each year from 2021 to 2027, accumulating \$52.94 billion by the end of 2027, according to Market Study Report.

The report provides a work plan for stakeholders for 2021 to 2027, with predictions for size, shares, and growth patterns.

The document also offers analysis of the sub-markets, including type, application range, and geographical landscape, thus uncovering the major avenues for investment in the coming years.

A notable shift toward renewable and green energy owing to climate change, rising focus on reducing carbon emissions, and depletion of fossil fuels are major factors driving the market growth.

Introduction of advanced technologies and energy-efficient solutions, along with prominent companies undertaking initiatives to reduce their carbon footprint and contribute to a greener planet and sustainability, are adding to the overall market size.

On the downside, high capital costs and various issues related with operations, transportation, maintenance, and logistics are likely to impede the industry progress over the projected timeline.

The report's geographical analysis of the worldwide offshore wind-power industry extends to Asia Pacific, Europe, Middle East and Africa, North America, and Latin America.

The Germany market holds a 57 percent share, while Denmark accounts for a 12 percent market share.

The offshore wind energy market will witness substantial growth over the forecast timeframe owing to the growing demand for clean energy and increasing focus on reducing carbon emissions and promoting environmental conservation.

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

## BOEM, NOAA to collaborate on offshore goals

The Bureau of Ocean Energy Management (BOEM) and the National Oceanic and Atmospheric Administration (NOAA) signed an interagency memorandum in support of the Biden-Harris administration's offshore wind energy goals to advance wind energy responsibly while protecting biodiversity and promoting cooperative ocean use.

The administration set a goal of increasing the nation's offshore wind-energy capacity. This new agreement underscores BOEM's and NOAA's commitment to responsibly deploy 30 GW of wind energy production capacity in federal waters by 2030. The memorandum will help leverage the responsibilities, expertise, and relationships of both BOEM and NOAA in support of the goal by outlining areas of cooperation and creating a framework to develop future, more detailed agreements related to specific program areas.

"We are already seeing the impacts of climate change on communities across the country and the ocean resources that we manage," said BOEM Director Amanda Lefton. "Now is the

time to act. Working together, we will further advance offshore wind, which can play a critical role in meeting our country's energy needs while combating climate change and creating new family-supporting jobs."

"This agreement and the collaboration between BOEM and NOAA show that fighting climate change and responsible resource management go hand-in-hand," Lefton said.

"This agreement is powerful and timely as we face climate change head on," said NOAA administrator Rick Spinrad, Ph.D. "It will help ensure coordination, collaboration, and alignment by NOAA and BOEM at key decision points in support of the Administration's offshore wind energy goal."

"It will also provide specific pathways for NOAA data and services while protecting our ecosystems and marine resources," Spinrad said.

**MORE INFO** [www.boem.gov](http://www.boem.gov)

## NewHydrogen reports progress on reducing green hydrogen cost

NewHydrogen, Inc. a developer of green hydrogen technologies, report-



The new agreement underscores BOEM's and NOAA's commitment to responsibly deploy 30 GW of wind energy production capacity in federal waters by 2030. (Courtesy: BOEM)

ed progress in its technology program and its efforts to reduce the cost of producing green hydrogen.

In 2021, the program developed a non-precious-metal-based catalyst with significant improvement of oxygen evolution reaction (OER) in acidic conditions for proton exchange membrane (PEM) electrolyzers (a device that splits water into hydrogen and oxygen). Researchers then improved the catalyst performance by modifying the structure and optimizing loading conditions. Most recently, application of a unique surface engineering technique further improved the long-term stability of the catalyst. Higher stability implies reduced operating cost of electrolyzers in the longer term.

In a parallel effort, researchers have been developing hydrogen evolution reaction (HER) catalysts for alkaline electrolyzers. Their work is focused on developing platinum-based HER catalysts that use significantly less platinum, as well as a new type of HER catalyst that does not use platinum. To date, progress has been made on both fronts.

“Prior to scaling up the process for studies with a prototype electrolyzer in late 2022, researchers will continue to explore additional improvements to both the OER and the HER catalysts to maximize the overall performance of an actual water electrolysis device,” said Dr. David Lee, CEO of NewHydrogen. Trends in 2022 point to hydrogen produced from renewable sources becoming a key component of a sustainable energy future, NewHydrogen reported.

Despite market uncertainty in many sectors, the global push toward realizing a green-hydrogen economy remains strong entering 2022. In Europe, the green-hydrogen supply chain is growing rapidly, especially in Spain, France, and Germany. As noted at the recent conference of the Green Hydrogen Coalition, the German government is transitioning its energy resources to green hydrogen and away from coal and natural gas, with all dispatchable energy to be hydrogen-sourced.

In the United States, the recently passed federal infrastructure bill included \$8 billion to develop regional clean hydrogen hubs, \$1 billion to decrease the cost of electrolytic hydrogen production, \$500 million for a clean hydrogen manufacturing and recycling program to support domestic supply chain development, and a grant program to support EV and fuel cell EV infrastructure.

The HyDeal LA initiative, close to NewHydrogen’s southern California home, is creating a green-hydrogen hub across the Los Angeles area. The hub is building support for production, transport, and storage of green hydrogen, as well as fueling for energy, transportation, industrial, maritime, and aviation industries. The hub is already creating new jobs supporting families in the LA area and providing a model of opportunities that will be available around the world.

The goal of NewHydrogen’s sponsored research at UCLA is to lower the cost of green hydrogen by eliminating or drastically reducing the use of precious metals in electrolyzers. Electrolyzers rely on rare-earth materials such as iridium and platinum. These materials often account for nearly 50 percent of the cost of electrolyzers.

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

## DNV approved to certify turbines for Korea

DNV, the independent energy expert and assurance provider, has been selected by the Korean Energy Agency (KEA) to deliver Type Certification services for the Korean wind-energy market. This new DNV service for the Korean market will result in a cost-effective process for manufacturers to achieve certification for their wind turbines selected in Korean wind-farm projects. The certification will be granted according to Korean standards and the international certification scheme IEC.

In its latest Energy Transition Outlook Report (ETO), DNV forecasts



DNV forecasts significant scaling of global installed offshore wind capacity from 29 GW in 2019 to 1,748 GW in 2050. (Courtesy: DNV)

significant scaling of global installed offshore wind capacity, from 29 GW in 2019 to 1,748 GW in 2050. In line with this global development, South Korea has plans to increase its wind-energy capacity to realize its commitment to climate neutrality in 2050. According to the Global Wind Energy Council (GWEC), Korea is targeting 9.2 GW of wind power by 2025 and 16 GW by 2030, of which 12 GW will be comprised of offshore wind. To achieve this, the government has announced plans to build an 8.2-GW offshore wind facility, which could become the world’s largest offshore wind power plant.

“Those ambitious targets in an emerging wind-energy market like Korea are creating an increased need for extended risk management via globally recognized certification standards,” said Kim Sandgaard-Mørk, executive vice president for Renewables Certification at DNV. “Together with our local certification team headed by Young Min Paik, Renewable Certification Director Korea, DNV is now enabled to work more closely with KEA and its customers throughout the wind-turbine certification process, creating trust among stakeholders and enabling a safe and reliable growth of wind energy in South Korea.”

“As wind parks will increasingly be erected offshore in greater water depths, harsh climates, and remote locations, we observe that wind-farm developers are also increasingly insisting on certification as a key risk mitigation measure in the technical due diligence process,” said Brice Le Gallo, regional director for Asia Pacific at DNV. ✎

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

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# SWARMING: ADDING VALUE TO WIND ASSETS

In nature, swarming is the collective motion of a large number of insects, birds, fish, or tetrapods (four legged animals). Due to the complexity of these formations and the benefits conferred to the animals, this has been a strong area of research for artificial intelligence. (Courtesy: WindESCo)



*The key to unlocking the potential of existing and new wind assets is to connect the dots and ensure turbines are sharing and acting on crucial data streams to operate for the benefit of the entire wind farm.*

By ED WAGNER

**T**he energy transition from fossil fuels to renewables is fully underway. Concerted action by industry leaders and investors is set to rapidly accelerate renewable energy growth. Although momentum is gaining, new approaches to asset optimization are needed to make best use of the influx of capital into projects.

DNV's "Energy Transition Outlook 2021" forecasts that wind capacity will reach 2 TW by 2029 and 5.9 TW by 2050, contributing to more than 30 percent of the global-energy supply. However, the levelized cost of energy (LCOE) from wind will need to be reduced by more than 40 percent to enable this.

To date, much of the decrease in LCOE for wind farms has been driven by economies of scale in the supply chain and increases in turbine size.

But wind-asset owners and operators looking to boost the productivity of their existing portfolios will need new strategies to ensure they are taking advantage of all available opportunities to improve the financials of their investments.

The latest advances in wind-farm optimization technology make one of the "holy grails" of wind asset management possible — automatically boosting production across an entire site, achieved by focusing on the performance of the entire farm instead of individual turbines.

Made possible by the Industrial Internet of Things (IIOT), this new approach to wind-farm optimization, called swarming, will tackle the root causes of underperformance and unlock billions of dollars in extra revenue for wind investors globally. This article will explain how swarming can provide wind-farm operators with a 3-5 percent improvement in annual energy production.

## THE UNDERPERFORMANCE CHALLENGE

The causes of wind-farm underperformance are complex. Even as power prices trend down in the long-term, reducing profitability, costs have started to increase. Larger rotors unlocking higher capacity factors have helped offset this decline in power prices but have, in turn, increased

repair costs for blades.

The increasing scale of wind turbines has also driven wider manufacturing and maintenance costs up, which has further been exacerbated by supply chain issues, a shortage of skilled labor, and higher commodity prices.

Ironically, despite wind energy playing a key role in moving to a low carbon future, climate change is also affecting the industry. Extreme weather events are on the rise, leading to damaged wind plants and higher insurance costs. Once consistent weather patterns are also becoming harder to predict globally. Ensuring asset reliability in an uncertain world is vital.

The upshot is that widespread underperformance of wind farms, if not tackled swiftly, could leave the wind sector with one arm tied behind its back as it navigates a series of pivotal challenges.

## WAKE EFFECTS

One common cause of energy loss is wind-plant wakes. A myriad of studies show that between 5 and 20 percent of a wind plant's output is lost due to adverse turbine-to-turbine interaction and the wake effect, where upstream turbine operation negatively affects downstream turbine performance — and the collective of the performance of the wind plant as a whole.

Wind-plant size and internal spacing are important factors in determining the extent of wake effects. In general, the larger the wind plant and the more tightly packed turbines are within the plant, the larger the wake losses. Significant wake losses are often experienced by offshore wind farms or within large plants installed in markets with high power prices and limited land availability.

As rotor sizes continue to increase and the optimal on-shore wind sites fill up, newer projects will become more exposed to wake-related performance risks. Feeding off this trend, repowering projects to retrofit larger rotors onto tightly spaced older and smaller turbines also lead to enhanced wake losses.

Ultimately, these factors point to the need to rethink the way wind plants operate. We are living in an increasingly interconnected world. Individuals, businesses, and governments are taking the value of cooperation on board. Driven by and enabling this, new digital technology is being used to interconnect everything from household appliances, to automotives, to healthcare devices.

Despite this, wind turbines continue to operate in isolation. Each wind turbine is treated as a standalone problem to solve.

Whether a wind-farm operator is managing a 10- or 100-turbine wind plant, operators will essentially use the same control strategy that focuses on maximizing the output of each individual turbine, so that each turbine boosts its output based on its own sensors and current inflow conditions.

No information is exchanged between turbines, and the innate interconnectedness of the site is ignored.

## INSPIRED BY NATURE: SWARMING WIND TURBINES

The key to unlocking the potential of existing and new wind assets is to connect the dots and ensure wind turbines are sharing and acting on crucial data streams to operate for the benefit of the entire farm, boosting site-wide production instead of individual units in the farm.

The inspiration for this approach, and the technology which underpins it, comes from nature — more specifically, the concept of a swarm.

## SWARMING IN NATURE

In nature, swarming is the collective motion of a large number of insects, birds, fish, or tetrapods (four legged animals). Due to the complexity of these formations and the benefits conferred to the animals, this has been a strong area of research for artificial intelligence.

Ants, for example, are simple and not particularly effective when acting alone, but as a colony, they perform complex, coordinated activities far beyond the awareness of any individual ant.

Another famous example is starlings, which perform dazzling “murmurations” at specific times, which can involve tens or even hundreds of thousands of birds. They fly in complex formations, without collisions, by communicating with and maintaining an awareness of just a few of their neighbors. In the case of migratory birds flying in a V formation, the cooperation enables the birds to reduce their energy expenditure between 12 to 20 percent while flying long distances.

## SWARMING TECHNOLOGY IN WIND

Swarming combines hardware and software as an integrated system to help owners unlock value by allowing turbines to communicate with and learn from each other.

WindESCo used a multidisciplinary approach to develop the system, combining the fields of turbine loads, controls, meteorology, sensing, and machine learning. The result is a 3 to 5 percent improvement in annual energy production (AEP) by continuously and autonomously optimizing the site as a single system.

The retrofit Swarm application can be divided into four layers:

- Swarm Software/Applications:** The core software layer running on the Swarm Server that communicates with all the Swarm Edge devices and makes real time optimization decisions.

- Swarm Edge:** The IIoT edge device and software connected to the turbine controller gets real time turbine-level data and implements cooperative control.

- Swarm Server:** The wind plant level server within the firewall that communicates with each Swarm Edge and the wind plant SCADA server.

- Swarm Cloud:** The offline data analytics and model optimization layer that provides longer term analytics and

visualization of Swarm effectiveness at a wind plant.

## HOW DOES WINDESCO SWARM WORK?

WindESCO Swarm offers multiple value propositions through separate applications, which together increase AEP between 3 and 5 percent at the wind-plant level. Several of these applications implemented as part of the Swarm system are briefly defined as:

### 1. YAW BY CONSENSUS

When each turbine operates independently, it must rely solely on its sensors to determine the wind direction and appropriately modify its control settings. These sensors are typically mounted on the turbine nacelle and measure the flow direction at a signal point near the center of the rotor, which doesn't adequately characterize the average flow through the wind-turbine rotor sweep

By combining measurements from varying subsets of turbines in the wind plant, the wind-plant complex flow field can be comprehensively characterized, and the yaw positioning of individual turbines can be optimized to ensure maximum energy capture. This sharing of wind knowledge means all turbines can improve their performance.

### 2. WAKE STEERING OF THE SITE

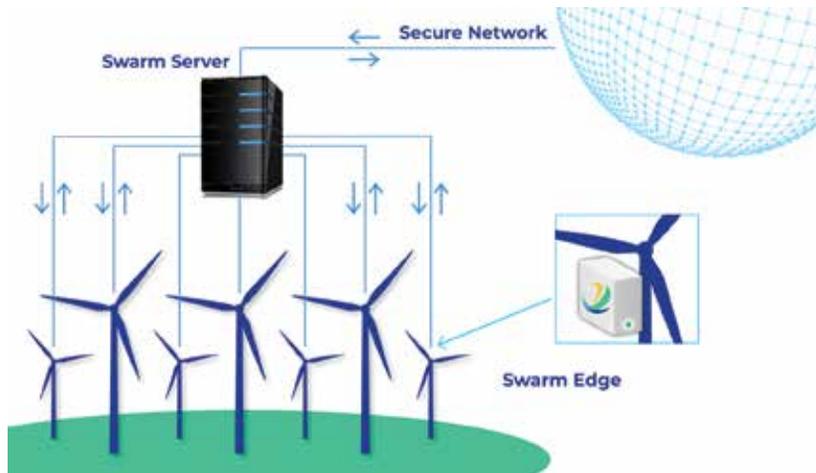
Wind plants lose between 5 and 20 percent of their output to wakes. One of the most effective strategies for mitigating wakes to increase the overall plant production is wake steering. In wake steering, the yaw position of upwind turbines is modified so they no longer face directly into the wind. As a result, the downstream propagation of wind turbine wakes is deflected, or steered, away from the downstream turbines.

The neighboring downstream turbines are then exposed to undisturbed, higher velocity flow and are able to generate more energy. Although the upwind turbines will produce slightly less power than if they were pointing directly into the wind, the wind plant as a whole will generate additional power as a result of the wake losses being mitigated.

### 3. PREDICTIVE YAW

Traditional yaw controllers are slow and rigid, and use wind-direction information at each turbine to make yaw control decisions. Yaw control strategies are defined by the OEM for a specific set of generalized site conditions; however, decisions about when to yaw are often suboptimal due to differences from the modeled site conditions.

Swarm-enabled predictive yaw uses optimal search method techniques combined with machine learning to identify how wind variabilities are propagating through the wind plant and to determine the wind plant global wind



Swarming combines hardware and software as an integrated system to help owners unlock value by allowing turbines to communicate with and learn from each other. (Courtesy: WindESCO)

direction, thereby allowing turbines to make optimized yaw control decisions given the current site conditions. This system enables proactive yaw actions to increase energy capture and preemptive yaw actions to protect turbines from extreme events.

### SWARMING CASE STUDY: LONGROAD ENERGY

Boston-based renewable energy developer, owner and operator Longroad Energy is a long-time customer and partner of WindESCO. The two companies have worked together on wind-asset optimization since 2018.

Longroad is one of the first businesses to optimize AEP across the entire fleet, rather than individual turbines, seizing the opportunity opened up by new AEP optimization technologies. WindESCO Swarm was recently deployed by Longroad Energy to optimize the 306-MW Milford Wind project in Beaver County, Utah, unlocking site-wide AEP gains of 3 to 5 percent for their 165 GE and Clipper turbines.

By adopting a proactive strategy for loss mitigation and revenue growth, Longroad is set to benefit from healthier, more productive assets while seeing a significant return on investment.

### WHAT'S NEXT FOR WIND?

Wind investors and asset managers have a broad suite of tools available to deliver the efficiency gains a smooth energy transition requires.

There are compelling industry-wide reasons for optimizing the global wind fleet. However, the basic choice available to operators is whether they can afford not to take advantage of technology that transforms revenue for far less than traditional repowering strategies. And as ever, the biggest winners will be those which move first. ✌

### ABOUT THE AUTHOR

Ed Wagner is the chief revenue officer for WindESCO.

# INCREASING BEARING CAPACITY AT ONSHORE WIND FARMS

An aerial photograph of a wind turbine under construction in a rural, open field. The turbine's white tower is partially visible, and a large red lattice boom crane is positioned at its base. The crane's boom extends high into the sky, reaching towards the nacelle and the beginning of the blades. The landscape is flat with scattered trees and a clear blue sky with some clouds. In the foreground, there are construction materials, a small white trailer, and a yellow crane. The overall scene depicts a large-scale engineering project in a natural setting.

Using proprietary tools, Mammoet can calculate the pressure exerted at the point the ground will be loaded most heavily — when the crane's boom goes up — and allow for planning based upon the highest level of loading. (Courtesy: Mammoet)

*While new wind-farm construction is vital for the transition to sustainable energy, the maintenance and upgrade of existing facilities will play an increasingly important role in renewable energy delivery.*

By RONALD KLEINJAN

2020 proved to be a pivotal year for the global wind industry, as it recorded its best 12 months with the installation of more than 93 GW of wind power. In Europe specifically, 14.7 GW of new wind capacity was reported; 80 percent of which was installed onshore.

Wind turbines typically require preventative maintenance checks two or three times a year to ensure optimum operational efficiency, performance, and to streamline costs. A good quality, modern turbine that has been routinely maintained has an expected lifecycle of 20 to 25 years.

However, as the turbine ages, maintenance costs increase, and power capacity diminishes, during which time smaller, more effective turbines are introduced into the market, making it necessary for wind-farm owners to upgrade or repower facilities to meet the increasing demand for renewable energy.

Ensuring that the access platforms and cranes used to perform this maintenance work are as stable as possible is vital if they are to be used safely and effectively. So, it is extremely important that ground conditions are accurately assessed, especially given that no two wind-farm sites have the same conditions underfoot.

## A FIRM FOUNDATION

There are many methods available to improve the condition of the ground and increase or maintain its load bearing capacity. However, these methods are subject to deterioration of the ground surface — and what lies underneath can further complicate what is already a complex process to execute a project in a safe, efficient, and cost-effective manner.

Typically, wind farms are installed in remote or isolated environments, along coastal paths, farmland, or on river deltas where the soil is weak and prone to settlement issues, creep, or wash-outs. After initial construction at these sites, the crane pads are removed, but the hardstand frequently remains for the purpose of carrying out maintenance.

However, ground conditions can change over time and are not typically monitored in the same way as other maintenance factors, such as the condition and performance of the turbines. This means the extent of any deterioration is

often unknown, making the specification of maintenance works unclear.

## WHAT LIES BENEATH

Understanding the composition of the subsoil and identifying potential weak spots is vital to ensure the safe and efficient completion of lifting and exchange works. Normally a ground survey is done and a geotechnical report on the wider area is provided.

However, this does not take account of the variances in ground conditions between different parts of a site, and the load bearing capability at specific points — for example where the laydown or storage areas are needed — is often not fully known.

This is where Mammoet's expertise comes into its own,

focusing specifically on the point at which the main crane hardstand, laydown or storage areas will be, as these will be the points that will experience the highest forces. Using proprietary tools, Mammoet can calculate the pressure exerted at the point the ground will be loaded most heavily — when the crane's boom goes up — and allow for planning based upon the highest level of loading.

Typically, plate testing is undertaken to assess the strength of the ground below heavy lifting operations. However, this is often insufficient, as this does not consider the depth of influence that loading has into lower subsoils.

Instead, one or more cone penetration tests (CPTs) can provide clarity

on what the layers beneath the surface consist of. This identifies any risk factors affecting the subsoil and can be further illuminated by 3D simulation of the installation or other load cases to share information on risks with all stakeholders.

## SCARCITY OF AGGREGATES AND SPACE

Aggregate materials are traditionally used to construct the hardstand and to reinforce the quality of the soil. However, we are faced with a global shortage of such materials in the near future. Aside from the obvious impact on the construction sector, the scarcity of granular materials has huge ramifications for onshore wind power.

Lack of storage space around the installation is another

▼ It is a proven solution for improving the condition of hardstands and pads on site at wind farms and allows operators to carry out work much more quickly using locally available cranes. ▼

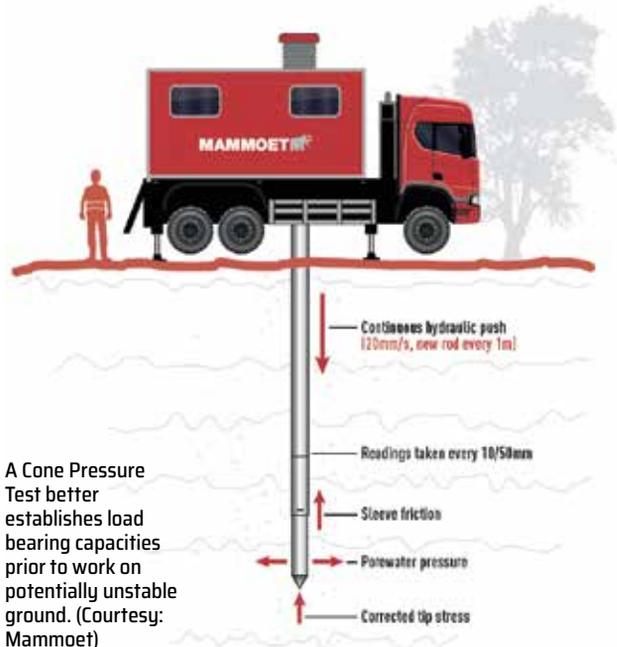


Loads at the surface affect different sub-soils in different ways, across a wider area than the crane's footprint. (Courtesy: Mammoet)

challenge. Because wind farms are typically constructed in remote locations, it isn't possible to permanently store the large and heavy equipment needed for their maintenance. Instead, this machinery must be transported to site, often over multiple surface types. Luckily, solutions exist to quickly bring on-site surfaces up to the high standard required for heavy lifting projects.

Mammoet's Enviro-Mat offers wind-farm operators an efficient, cost-effective, and sustainable solution that increases the ground bearing capacity of a large area within a short timeframe and, therefore, is an ideal solution for the wind sector. Enviro-Mat is a highly developed soil improvement methodology, consisting of a combination of local soil, cement, and additives including all-natural minerals, which increases ground bearing capacity up to customer specifications.

It is a proven solution for improving the condition of hardstands and pads on site at wind farms and allows operators to carry out work much more quickly using locally available cranes. It can also be used to upgrade the bearing capacity of existing roads to withstand heavy transport and for storage of tower sections, nacelles, blades and — in





Civil works at onshore wind farms are undertaken primarily for construction, but are they built to last? (Courtesy: Mammoet)

the offshore wind sector — monopiles and transition pieces.

It uses locally available soil and granular materials and doesn't require additional aggregate or materials to be sourced and transported to site. It is also much faster to install than other ground reinforcement methods and needs less time for preparatory groundworks.

All these factors combined means using Enviro-Mat also reduces the overall carbon footprint of a project. It also allows the site to be given back to nature once work is complete, as it can be crushed back into the soil with no environmental impact.

## STRONGER STILL

More recently Mammoet, together with the Dutch contractor Sterk B.V., has been testing its newest innovation: the Enviro-Wall-Mat combination.

The objective of the Enviro-Wall-Mat combination is to create a solid foundation in ground that has weak subsoil, without the need to pre-load the area beforehand. It works

by creating a trench that is filled with locally sourced soil, cement, and additives to create a pillar-like "wall" under the Enviro-Mat surface, which prevents extreme settlements from occurring.

It almost goes without saying that time saved by not having to pre-load and compact the ground is time that can be spent assembling or maintaining a wind farm to increase its uptime. Working with customers during the feed stage of a project allows us to deliver engineering that adds real value to each project. By mapping material flows, we can deliver load bearing capacity exactly where it is needed, shaving weeks off wind-power projects. ✌

## ABOUT THE AUTHOR

Ronald Kleinjan is director of Mammoet Heavy Duty Pavements, which produces Enviro-Mat; a sustainable solution that improves the bearing capacity of soil for heavy lifting and transport operations. Mammoet helps clients with smarter, safer, and stronger solutions to any heavy lifting or transport challenge.

# AVOIDING CATASTROPHE

Wind farms that have been running for more than five years face significant proneness to fire and accidents caused by fire.  
(Courtesy: Zoltan Tasi)

# *It's important that operator-owners take fire risk assessments seriously in the global wind industry.*

By ANGELA KRCCMAR

**T**he aftermaths of most fires are difficult to contend with. Whether in the home, the workplace, in vehicles, or industrial machinery, when a fire is allowed to take hold, there can be overwhelming financial, legal, and life-threatening implications.

It is no different when a wind turbine catches fire — and the impact is felt on several fronts. Damage to the wind industry's reputation, to the balance sheets of operators, and most importantly, to the safety of those working on wind farms, are all real consequences.

## **FIRE HAZARDS**

There are multiple catalysts for fires occurring in turbines: arcs from faulty generators and electrical components, friction generated from brakes resulting in sparks reaching flammable components, and cables overheating, just to name a few. Estimates place the number of wind turbines catching fire per year between 1 in 2,000 and 1 in 15,000, but the fact that there is no central repository for incidents makes it difficult to know the true number. Disturbingly, 90 percent of the time a blaze in a turbine will lead to its total destruction, leaving an operator with a huge bill, which can be as high as \$9 million, to either replace or repair the equipment. It can also mean 12 to 18 months of lost revenue while the turbine is recommissioned.

Fire safety should therefore be a top priority for all wind-farm operators. The industry's journey toward truly comprehensive protection against fire shouldn't begin at the finish line, letting costly firefighting operations and clean-up processes drain resources, hit P&L sheets, and harm the sector's reputation. The installation of preventative measures such as fire suppression systems, which stop fires before they can spread, are only part of the solution.

It is by evaluating and acting on potential sources of fire risk, with an assessment that is compiled by and shared among stakeholders, that operators can significantly reduce the chances of a fire occurring in the first place — and should one occur, have measures in place to tackle and reduce its effect.

Firetrace's latest report, "How to Evaluate Fire Risk," shows why performing an effective fire-risk assessment (FRA) is a crucial part of wind-farm safety, and how to best execute it.

## **WHAT'S STOPPING THE WIND INDUSTRY?**

It is not entirely surprising that fire-risk assessments are not commonplace in the wind industry. While FRAs have been used (or are legally required) in other industries to identify avenues of fire risk, those in wind face no such legal obligation and continue to operate without proper knowledge or precaution. Combined with the fact that third-party independent service providers do not tend to include FRAs

in their scope of services, this money-saving and potentially life-saving step is woefully neglected.

J.P. Conkwright, assistant professor of fire protection and safety engineering technology at Eastern Kentucky University, says there seems to be little evidence that wind-farm operators are conducting "holistic fire risk assessments following some type of recognized standard." Without the proper legal frameworks in place or enough previous examples to use as best practice, operators may become discouraged with the idea of conducting and trusting an FRA that they themselves don't know for a fact is effective.

The most concerning reason that wind-farm operators do not conduct fire-risk assessments is because they feel having insurance means the assessments are unnecessary, contrary to the National Fire Protection Association (NFPA)'s guidance on recommended practice for fire protection for electric generating plants — NFPA 850 — which encourages the development of a "fire protection design process" and a "fire risk control program" among other measures. Relying on insurance to patch over future damages is both cost-prohibitive and a willful concession to the endangerment of personnel, surrounding communities, and the environment.

## **EFFECTIVE FIRE RISK ASSESSMENTS**

As detailed in the report, a full commitment to FRAs done with proper procedures will benefit a wind farm proportionally to its operational age, helping maintain its longevity. Wind farms that have been running for more than five years face significant proneness to fire and accidents caused by fire, which only worsens and increases with age. In contrast, an effective FRA will:

- ▶ Protect personnel working on site by reducing the probability of fire events occurring.
- ▶ Increase the level of protection for wind-farm assets by reducing the risk of wind turbines being damaged or destroyed by fire.
- ▶ Save on the cost of repairing or replacing a damaged or destroyed turbine.
- ▶ Potentially reduce the amount your business pays for insurance (insurers can potentially adjust rates if wind-farm operators include fire-suppression measures).
- ▶ Reduce the risk of causing wildfires in the surrounding area.
- ▶ Boost the reputation of your company from an operations perspective.
- ▶ Help to bolster the reputation of the wind industry in general.

When the benefits are this great, there is no good reason to avoid the responsibility we have as an industry to make sure turbines are as safe and long-lasting as possible.



Despite the low rate of reported incidence, fires are the second most common catastrophic failure type facing wind turbines according to GCube. (Courtesy: ico\_@stravasnipr)

## CONCLUSION

Despite the low rate of reported incidence, fires are the second most common catastrophic failure type facing wind turbines according to reports over the last decade by GCube, and the costs are inevitably high. There are multiple possible points of origin for turbine fires, each potentially coming from their own location, component, fault, or accident. While most of these fires eventually lead to the turbine's complete destruction, each area of fire risk has a discoverable beginning, and in most cases, a precautionary solution.

Whether hesitancy springs from a lack of trust in the

process, or for fear of wasted time and money, the fact remains that taking a moment to step back and look at how you can make your wind farm safer for your personnel and assets is never a sacrifice; it's an investment, which yields savings above and beyond what your insurance can patch over after the fact.

Let's push the boundaries of energy – not safety. ✨

## ABOUT THE AUTHOR

Angela Krcmar is Global Sales Manager (Wind) for Firetrace. For more information, go to [tinyurl.com/Firetrace-FRA](https://tinyurl.com/Firetrace-FRA)

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# PROFILE

PROFILE: JLG INDUSTRIES

A JLG telescopic handler truck, primarily orange and yellow, is shown from a low angle, carrying a large wooden pallet on its bed. The operator is visible in the cab, wearing a red hard hat and a high-visibility vest. The truck is on a dirt surface, and several wind turbines are visible in the background under a clear blue sky.

# COMMITMENT TO SAFETY AND PRODUCTIVITY

Particularly for the wind industry, JLG offers its high-capacity telescopic handler line, which includes its JLG 1644, 1732, and 2733 models for picking and carrying heavy loads around a work site. (Courtesy: JLG Industries)

*For more than 50 years, JLG Industries has been committed to elevating and advancing the access industry to provide a safer way to work at height.*

By **KENNETH CARTER** ▸ Wind Systems editor

**W**orking at height is part of the job for wind-energy technicians, who spend much of their work day suspended hundreds of feet above the ground; equally important is lifting and placing materials during the construction of those structures.

For decades, JLG Industries has designed and developed equipment dedicated to helping its customers enhance worksite productivity and safety for a variety of industries, including, fairly recently, the wind-energy industry.

The company's lines include mobile elevating work platforms (MEWPs) with articulating and telescoping booms; electric and hydraulic drive scissor lifts; portable personal vertical lifts; low-level access solutions, mobile stock picking lifts, and self-leveling boom lifts; and telehandlers.

Particularly for the wind industry, JLG offers its high-capacity telescopic handler line, which includes its JLG 1644, 1732, and 2733 models for picking and carrying heavy loads around a work site, according to Jennifer Stiansen, director of marketing for JLG Industries.

## TELEHANDLERS

"In general, telehandlers are used for lifting and placing materials," she said. "On a general construction site, the primary spec people are interested in a telehandler's reach so they know how high they can lift and place a load. In the wind sector, height is also important, but capacity is the primary spec as it determines how much a telehandler can pick and carry per load. Our high-capacity telehandler line complements our traditional telehandler line but is used in industries such as wind, where operators frequently move very heavy objects."

"In wind-farm construction, for example, if the operator wants to move one of the blades, or a piece of the tower, that's where a high-capacity telehandler would be used," she said. "It might come on a truck. The telehandler then unloads it before moving it to the area where it's needed."

## MORE THAN WIND

And although the wind industry has a history of its technicians working at height, Stiansen said JLG's focus is not dedicated solely to wind.

"Our innovation strategy applies across a broad number of industries," she said. "Our company was founded in 1969 on the principle of finding a safer way for people to work at height and that drives our thinking still today."

## SAFETY FROM THE BEGINNING

JLG's attitude toward safety goes back to its roots when the company's founder, John L. Grove, witnessed human tragedy during the building of the Hoover Dam and thought, "There has to be a better way." That tragic incident led to many sketches until Grove came up with the boom lift concept,

according to Stiansen.

"Over the years, we expanded the original single model boom lift into a full line of articulating and straight mast booms and added scissor lifts and telehandlers to our product portfolio," she said. "While these are not our only product lines, they are our core product lines."

"The innovative spirit of John L. Grove is alive and strong today across the company," Stiansen said. "We still focus on finding a better way. This focus has three key areas in terms of innovation: We look at safety; we look at productivity, and we look at technology.

Those three things help us continue to elevate the access industry and bring products to market that give customers tangible benefits on the job site. How do we do that? Our engineers visit a lot of job sites, and we do a lot of observation and say, "That looks like it's difficult for that person to do. How could we do that better? How could we integrate something into our product to make that job easier for them?" We call it customer-inspired innovation."

## CUSTOMER-CENTRIC

JLG is able to offer that by its extensive use of customer feedback, according to Stiansen.

"When we're developing a product, we take prototypes out into the field and ask customers for feedback — What do you like about it? What do you not like about it? What would make this have greater value? Is this something that would be of value to your business?" she said. "We take that feedback and then we modify and do rapid prototyping over the course of the product development life cycle."

Even though JLG Industries began focusing on the wind industry in 2017 with the introduction of its high-capacity telehandler line, the company's expertise with other industries laid the groundwork for success.

"Our high-capacity telehandler line was really designed for the wind-energy and related markets, including oil and gas," Stiansen said. "You're going to find our traditional telehandlers on just about every job site where materials are lifted and placed. There was a market in wind for high-capacity telehandlers specifically. Is it our core market? No, it's not. It's really a niche market for us, but you'll find our mobile elevating work platforms in that market as well, doing maintenance on existing structures."

## 50 YEARS AND COUNTING

JLG Industries celebrated its 50th anniversary in January 2019, marking a half-century since Grove spearheaded the access industry with the introduction of the JLG 1 — the world's first boom lift.

"Fifty years is a remarkable milestone for both JLG and the access industry," Stiansen said. "Grove not only started



In wind-farm construction, if the operator wants to move one of the blades, or a piece of the tower, a high-capacity telehandler would be used. (Courtesy: JLG Industries)

a company but an entire industry. This is a key point of differentiation for the JLG brand. We continue to build on this legacy through continuous development of products, services, and technology that advance safety for work at height.”

Since its introduction of the first commercially produced aerial work platform, JLG has claimed many access industry firsts – including oscillating axles for boom and scissor lifts in 1981, the only fuel-cell powered boom lift in 1999, the first environmentally-friendly 60-foot electric boom lift in 2000, and the first straight boom lift to reach 150 feet in 2011, according to Stiansen. The company surpassed its own record in 2014 with the introduction of the 185-foot model 1850SJ, the world’s tallest self-propelled boom lift. In the same year, JLG introduced the first true hybrid diesel/electric boom lift, the H340AJ.

“John L. Grove was a skilled inventor, a savvy businessman, and an extremely hard-working individual who was driven by the pursuit of perfection in the products that bear his initials,” she said. “A former employee once said, ‘You could show John L. Grove anything, even a fountain pen, and he could immediately tell you how to improve it.’”

Grove formed JLG Industries with three investing partners, and in a few short years, the company had developed a product that filled a huge void in the construction industry. Today, JLG is represented across five continents with manufacturing facilities in the United States, France, the U.K., Australia, and China.

## EYES ON THE FUTURE

As the company continues to offer safety equipment for



JLG’s high-capacity telehandler line was designed for the wind-energy and related markets. (Courtesy: JLG Industries)

working at height across the globe, JLG Industries will continue to improve upon its product line in conjunction with the needs of the marketplace, according to Stiansen.

“I think that we will grow with the market by continuing to listen to its needs,” she said.

And as far as the wind industry goes, Stiansen said JLG will keep working closely with that constantly growing market.

“JLG will continue to keep an eye on the wind industry to identify unmet needs, then innovate to evolve its equipment offerings to deliver solutions that meet those needs,” she said. ✨

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



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## Jaymes Sim

General manager ▸ Sales and Marketing | Mooreast Holdings Ltd.

*“Our expertise is in providing mooring solutions to any type of floating structure in the market, and renewables are the natural progression as the market moves away from the oil and gas sector and into sustainable energy.”*

### ▸ What does Mooreast Holdings do?

Mooreast is in the business of providing mooring solutions to the offshore market, traditionally for the oil and gas industry. Mooreast systems are not the ones that are taken by the boats that go from place to place; ours are for permanent offshore infrastructures that need to be moored for 20 years, 25 years, 30 years, because that's the requirement for the design of the float.

It needs to weather the worst-case scenario that happens in that location, since it does not have an engine for escape when bad weather comes in. That's the context of the mooring system that we provide. We are one of three ultra-high holding power anchor designers in the world, and we are the only one in Asia. In house, we do a full suite from design, engineering, fabrication, installation, and we call this package a total mooring solution. We just recently got listed on the Singapore Stock Exchange on November 24 of last year. We are very excited to be in this space now with all the wind opportunities coming up.

So, what do we do? We provide a full suite of total mooring solutions, starting from the design engineering phase. Our core capability is actually in geotechnical and geophysical interpretation. We take the information — the soil, the wind, and the wave — figure out what the numbers are, and then translate it into a load, taking into account other data such as the shape of the float and project requirements to recommend a tailored size and number of anchors.

We do our own fabrication work in Singapore. Of course, in the mooring industry, there are other types of components — such as chains, wires, synthetic rope — and these are done by specialized manufacturers. We work together with them and integrate a full package and solution to the customer. A typical mooring requirement will start from

the customer giving us geotechnical and geophysical information. They will tell us what sort of floater that they are using and ones they're interested in using — What size? What are the dimensions? What's the shape? We run it through our analysis, and then we'll come up with a solution such as how many mooring lines needed and what sort of equipment is available.

From there, we move into the supply phase — procurement as well as fabrication. This timeline typically goes from six months to a year of production, depending on how complicated it is. With the solution comes the installation phase — without a suitable installation vessel, it is actually a waste of money. You spend many days waiting and trying a very bad technique of installation.

However, leveraging our geotechnical interpretation capability — we call it a soft skill — we can design and supply the full suite of mooring subsea foundations best suited for the project, so we ensure we optimize the material costs and hardware requirements for the project, helping our customers to cut the cost in the installation phase.

We've been doing this for 27 years. We started floating wind in 2013, and our first project was the Fukushima Power Project.

### ▸ What made Mooreast decide to explore renewables?

Our expertise is in providing mooring solutions to any type of floating structure in the market. And renewables are the natural progression as the market moves away from the oil and gas sector and into sustainable energy. Here in Southeast Asia, there is a very different market. It doesn't have strong winds like the American, European, and North Asian market. We're also working with solar and tidal energy sources at sea. This is where we also need to make the

project economical so these projects can succeed. If we apply the same offshore standard to wind as the oil and gas industry is taking, these projects will never come to life, and we'll have less customers to service. Our interest is in providing the best fit-for-purpose solution to these customers, whatever the infrastructure that they're working on, and allow them to succeed in the business that they have.

➤ **Is this why you're pursuing the floating offshore turbines because of the nature of the wind where you're at?**

Yes. For example, Japan doesn't have an offshore market, and the reason for that is that they do not have the people and the talents that understand how to handle offshore work. They do not have the engineers that know how to design offshore works. They have civil engineers, and so we come and we support them from an early stage where they are conceptualizing. We may not understand the turbine, but based on the structure that they give us, the center of gravity that they give us, we can help them to design a mooring system that is suitable and within their budget range.

➤ **What high-profile projects have you worked on?**

The Fukushima Power Project was probably the most prominent project that we have serviced. This started when the Fukushima tsunami incident happened, and the nuclear power plant was affected. And because of this incident, the Japanese government wanted to reduce its dependence on nuclear facilities, and offshore wind was the natural first option that they looked into. Japan, because it is facing the Pacific Ocean, the shoreline drops sharply very close to the water, so they do not have a lot of land that is available for fixed foundation wind, and, therefore, they have to explore floating wind.

➤ **How has Mooreast been able to capitalize on experience with other offshore industries to prepare for renewables?**

The oil and gas has been on a downturn for the past eight years; yet, during this time, Mooreast has actually been expanding. We have been increasing our vertical scope of supply. Previously, we were only a product supplier and didn't have a full in-house capability to do design engineering. This was incorporated in 2015, 2016, and then we also increased our capabilities to support installation work. When we are doing design, we have to keep in mind what the installation is going to look like in order to make the project work well. We have been through many cases where the designers do not understand the installation, and as a result, they come up with a specification of products that are not easy to install offshore and which result in a burst of the budget, which is not pleasing to any customer.

Because the opportunity for wind involves multiple turbines in one location, it's different from the oil and gas market where it is one floater for one project, so there needs to be a way to make the project efficient and optimize. This comes down to every single detail such as the sizing of the

anchor. Our anchors are actually designed to hold 80 times their weight, which means to say a 10-ton anchor can hold a maximum of 800 tons of force.

This is where we come into play, especially for offshore wind, because it needs to be optimized, and it can be very easy. You only need a 10-ton anchor while others are supplying a 30-ton anchor. This is a very costly exercise, and it may not be economical for the wind industry.

➤ **What makes Singapore ideal for renewable development?**

The first thing that make Singapore ideal is actually the offshore experience. Singapore has been in the offshore and marine market for many, many years, and because of that, it has the ecosystem and it has the talents to provide this sort of offshore work. Mooring is only one part of the many components required in the offshore supply chain.

➤ **How much of Mooreast's business does it expect to generate from renewables?**

We see an exponential growth, but at an early stage, we are expecting about 50 percent of our revenue to be in renewables in about two years' time. This is conservative in my opinion.

And this is a realistic estimate, but the estimates are driven by the project — how we see the project developing. And of course, at this moment, the market is in the fixed-foundation stage where they do not require floating infrastructure. But we see that already being discussed by many developers across many countries such as Japan, Korea, Taiwan, Scotland, U.K., France, and Denmark. We see all these projects gradually taking shape, and we expect to have a very busy second half of the decade.

➤ **What kind of challenges do you see Mooreast facing in order to grow and evolve with the renewable sectors and how might those challenges be addressed?**

During the downturn in the oil and gas, we see a high attrition of capable people within our market. And this is not only in Singapore; we no longer see younger college students pursuing an interest in the global oil and gas sector. But the fortunate thing is that, throughout the years, Mooreast has been evolving and remains profitable because of our lean size. We have managed to solve this problem internally, but generally as a market, we see that this is an issue.

We hope that with the renewable energy — and a lot of younger people are very into this sustainability trend — we hope that this sustainability trend will continue to attract these younger people and being part of a renewable energy generation is one avenue where they apply themselves. They can actually do something to help to steer the world away from having a heavy carbon footprint with more sustainable energy sources. This is a visible avenue for younger blood to come and join us. ✨

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



Load-out at Kincardine Offshore Wind Farm. (Courtesy Mammoet)

## CONSTRUCTION

### Mammoet completes wind-farm load-out in Spain

Mammoet has completed the load-outs of five floating wind platforms at the Navantia Fene Shipyard in Spain. The platforms will form part of the largest floating offshore wind farm in the world, Kincardine Offshore Wind Farm.

“Having worked at this quay before doing similar complex operations, it was the key factor to deliver the floating wind platforms successfully on time,” said Javier De Pablo Arenzana, Mammoet Spain sales manager. “In

addition to our pool of resources and equipment, this meant we were able to offer our client a high degree of flexibility in terms of the project schedule. We believe these capabilities make us well-suited to supporting the growth of the offshore floating sector.”

Considering platform weights, the surface conditions on the quay were of paramount importance. To minimize operational risk, Mammoet prepared the quay by installing hundreds of steel plates to level the surface in places where it had previously been uneven.

Coordinating with various stakeholder groups flexibly was also required to execute each operation on schedule. This included organizing each operation to meet the appropri-

ate tide levels and weather conditions and marrying these with the availability of the specialist seagoing vessel contractor and Navantia Fene Shipyard.

Once the quay was prepared and the specialist seagoing vessel docked, Mammoet had only a short window in which it could execute each operation. Mobilizing 100 axle lines of SPMTs split between the three columns of the triangular footprint, the floating foundation was loaded onto the three sets of SPMTs, transferred 100 meters across the quay, and transversely loaded onto the vessel using 54 meters of RoRo ramps. Mammoet completed this operation five times over several months.

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

## CONSTRUCTION

# Pattern Energy completes New Mexico energy project

Pattern Energy Group LP has completed construction and begun commercial operation of its suite of Western Spirit Wind power projects, comprised of four wind-power facilities totaling more than 1,050 MW in Guadalupe, Lincoln, and Torrance counties in central New Mexico.

The four wind-power facilities that comprise Western Spirit Wind use a total of 377 GE wind turbines ranging from 2.3 to 2.8 MW in size. The GE turbines use various tower heights to optimize the wind capture at each facility.

“The largest renewable energy project in American history is now up and running — right here in New Mexico,” said New Mexico Sen. Martin Heinrich. “Western Spirit encompasses four new utility-scale wind sites that connect rural communities in central New Mexico to local customers and other major energy markets beyond our state’s borders. This project literally changed the map of our state’s energy landscape, allowing New Mexico to help power our nation with clean electrons.”

“Western Spirit Wind is a groundbreaking megaproject that demonstrates large-scale renewables can be developed and built in the United States,” said Mike Garland, CEO of Pattern Energy. “These projects create significant job opportunities and local economic investments. Western Spirit brought over 1,100 construction jobs to New Mexico, generated local spending, tax revenue, and landowner payments in a remote area of New Mexico, and is now delivering enough renewable energy to meet the electricity needs of more than 900,000 Americans. Pattern Energy has committed to \$6 billion in upcoming wind energy and related infrastructure projects in the state over the next decade. Together, we are building a cleaner and more



The four wind-power facilities that comprise Western Spirit Wind use a total of 377 GE wind turbines ranging from 2.3 to 2.8 MW in size. (Courtesy: Pattern Energy)

sustainable future in New Mexico.”

The wind project and accompanying transmission line involved more than 1,100 workers on-site during the 15-month construction period, including heavy equipment operators, electricians, laborers, and others. More than 50 workers will operate and maintain the Western Spirit Wind facilities in New Mexico.

Western Spirit Wind is projected to provide an estimated \$3 million per year for the three counties and two school districts in the project area.

Western Spirit Wind will provide clean, renewable energy to California and New Mexico through long-term power purchase agreements with the Los Angeles Department of Water and Power, San José Clean Energy, East Bay Community Energy, California Choice Energy Authority and member cities, and international energy company Uniper Global Commodities. Western Spirit Wind will also provide power to New Mexico municipalities, including Los Alamos Department of Public Utilities, through the Uniper Global Commodities power purchase agreement.

The wind power generated by Western Spirit Wind has a complementary generation profile to solar and typically delivers power around the clock. Western Spirit’s wind power will

provide resource diversification to western energy markets to help meet customer demand during the crucial early evening hours when demand is high but otherwise available renewable energy supply is typically low.

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

## CONSTRUCTION

# Mammoet transports offshore wind jackets for assembly

The Mammoet-Giant Taiwan joint venture has supported construction of The Greater Changhua 1 and 2a Offshore Wind Farms by providing a range of engineering and design services, as well as assisting with the transport and integration of the jackets, ready for load-out.

The farms are about 35 to 60 kilometers off the coast of Taiwan’s Changhua County. They are being constructed as part of Taiwan’s transition toward renewable energy use.

Jacket foundations for the Greater Changhua 1 & 2a Offshore Wind Farms are comprised of upper and lower jackets. Mammoet-Giant designed



Upper and lower jackets were sat on top of the custom support saddles that were used on the self-propelled modular transporters to transport both pieces between assembly stations. (Courtesy: Mammoet)

temporary lifting lugs fitted to both the upper and lower jacket sections as they rolled off the production line.

These upper and lower jackets were sat on top of the custom support saddles — also designed by Mammoet-Giant engineers — that were used on the self-propelled modular transporters (SPMTs) to transport both upper and lower pieces between assembly stations. This method ensured a more efficient transportation process compared to other methods by reducing the time needed.

As part of this project, Mammoet's PTC210-DS ring crane was deployed for the first time to Taiwan.

The upper jackets weighed 270 tons and were transported in turn about 100 meters from the storage area to the PTC crane, where they were erected so the transition pieces could be fitted. A 750-ton crawler crane was used for the upending operation.

The lifting capacity of the PTC210-DS ring crane allowed up to four jackets to be assembled at once at the same location, fast tracking the assembly work.

Transports of the jackets were

conducted using the 96 axle-lines of SPMT in two 4-file 24 configuration, with two transport beams. The beams, measuring up to 24 meters in length, were designed to bear the pile stoppers, allowing the transporters to lift the full jackets using the SPMTs' integral hydraulic suspension.

During the fabrication peak time, Mammoet tapped into its global network to make sure lifting equipment was available to meet short-term demands.

The PTC 210-DS ring crane's high lifting capacity, together with the engineering expertise and solutions shown by the Mammoet-Giant team have provided both time and cost efficiency for the operations, according to the Sing Da Marine Structure Corporation.

The Greater Changhua 1 and 2a Offshore Wind Farms will have an installed capacity of 900 MW once completed, enough to provide clean energy to 1 million households in Taiwan. They are also Taiwan's first large-scale far shore wind farms.

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

## INNOVATION

### ONYX Insight to monitor one of first U.K. wind farms

ONYX Insight is partnering with Windcluster, a U.K. wind energy pioneer, to support the life extension of aging assets of one of the U.K.'s oldest wind projects.

ONYX has installed ecoCMS, its condition monitoring system, to monitor the four 850kW V52 wind turbines at Windcluster Haverigg III, at Haverigg airfield in Cumbria.

The system will help to extend the lifetime of the Haverigg III turbines through 2040.

"We chose ONYX Insight because we wanted a credible and innovative partner," said Windcluster founder Colin Palmer. "ONYX has offered a flexible approach to enable us to maximize our investment and has already shown great value. Digitalizing our turbines during this next phase of their operational life is going to be key in ensuring they generate power at full capacity. We will be using the vibration and oil monitoring data analysis and reporting by ONYX to ensure we can extend the life of our assets to 2040. We look forward to ONYX Insight's continued support in this endeavor."

"We are incredibly proud to be working with the team at Windcluster to extend the life of these veteran wind turbines and to keep them producing clean renewable energy for another 19 years," said Keiran Knowles, ONYX Insight's U.K. and Northern Europe business development manager.

Digitalization is set to be key to wind-farm owners and operators seeking to extend the life of aging assets and develop lifetime extension strategies. Understanding a turbine's remaining life, as well as continuously monitoring the condition of turbines in which the lifespan has been extended, so that interventions when faults occur can be made quickly, will be essential in maximizing the return

and effectiveness of the continued operation of aging assets.

By retrofitting both vibration and oil monitoring systems to the wind turbines at Haverigg III, a complete picture of the condition of each wind turbine and its oil health will be provided. The combination of vibration and oil provides better analytics and a more complete condition of the machine health and oil health.

WindEurope estimates that across Europe, more than 34,000 turbines – representing 36 GW of capacity – are now more than 15 years old, with the designed operational lifetime of turbines generally being between 20 and 25 years, at which point repowering, life extension, or decommissioning become the choice of options for owners.

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



Rex Hospital's SCADA system allows it to expand while maintaining reliability, redundancy, and flexibility of its emergency power systems. (Courtesy: Russelectric)

## INNOVATION

### Russelectric offers customized SCADA systems

Russelectric, a manufacturer of power-control systems and automatic transfer switches, recently announced the availability of customized Russelectric supervisory control and data acquisition (SCADA) systems, enabling users to monitor system operation, acknowledge alarms, and review PLC set-points and alarm history.

All screens are custom-designed for each power control system.

The basic SCADA system includes a dynamic one-line display with changing color codes to indicate real-time power switching device status and power source connection to the loads. Event logging, alarm logging, and help screens are also included.

Optional enhancements are available, including graphic displays of the physical arrangement of equipment, control panel close-ups, instrument displays indicating actual values, and the ability to initiate control functions.

Also available is an optional simulation system, based on SCADA system graphics, to enable off-line operator training without affecting operating system parameters.

Founded in 1955, Russelectric maintains manufacturing facilities in Massachusetts and Oklahoma, where it designs and builds automatic transfer switches, switchgear, and controls.

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

## INNOVATION

### DNV provides Hexicon project with first step to certification

Assurance provider DNV has provided Hexicon with a Statement of Feasibility for its TwinWay demonstrator, which will be installed and operated at Metcentre, off the coast of Norway. With achieving this first step in the certification process, DNV considers the TwinWay concept feasible for further development toward a full-scale demonstrator.

The intention of the TwinWay project is to show proof of concept for Hexicon's floating wind foundation TwinWind.

This design allows for the deployment of more turbines per sea area, increasing the energy yield per acreage. Floating wind platforms also enable installation in greater water depth,

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DNV considers the TwinWay concept feasible for further development toward a full-scale demonstrator. (Courtesy: DNV)

allowing higher average wind speed and lower visual impact.

“In DNV’s latest ETO, we forecast Norway’s future installed offshore wind capacity to be 3GW in 2030, 10 G Win 2040, and 14GW in 2050,” said Kim Sandgaard-Mørk, executive vice president for Renewables Certification. “To achieve this growth in a safe, reliable, and sustainable manner, Norwegian wind-energy projects need access to robust and trusted risk management measures such as certification. Mitigating risks via certification is particularly valuable for floating offshore wind projects in securing project finance and demonstrating operational application.”

“The Statement of Feasibility from DNV is a valued milestone in our TwinWay demonstrator project,” said Marcus Thor, chief executive officer of Hexicon.

“After years of development, we are now progressing through the next project phase, aiming to deploy the full-scale version of our patented design for the first time.”

“Certification of innovative projects like TwinWay helps to demonstrate the performance, reliability and commercial viability of technological advances which push the boundaries of current technical and engineering knowledge,” said Sille Grjotheim, director and Norway’s country manager for renewables certification at DNV.

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

## ► MAINTENANCE

### Seocat Weatherly secures Moray wind farm charter

Offshore energy support vessel operator Seocat Services has signed a long-term charter for catamaran Seocat Weatherly to support operations and maintenance activity for the Moray Offshore Windfarm (East) Limited.

The 100-turbine, 950MW capacity wind farm is off the coast of Fraser-

burgh, Scotland.

“The North Sea is a key location for the U.K.’s offshore wind industry; capitalizing on the region’s strong wind speeds is vital as the government pursues its target for all electricity to be green by 2035,” said Mark Drew, Seocat Services managing director.

“At Seocat, we’ve tailored our fleet to support the build out of key offshore wind markets and are proud to be offering our best-in-class support to such important clean energy projects as those in development in Scottish waters.”

“We secured Seocat for this charter due to the reputation of its fleet for safety, reliability, and maneuverability,” said Paul Cavanaugh, Moray Offshore Windfarm (East) Limited asset director. “Seocat’s fleet of Chartwell 24s routinely proves its salt across offshore sites in Scotland and the U.K.; to have a domestic provider with such a track record for delivering high quality performance in the North Sea brings clear advantages to the Moray East project. We look forward to working with them throughout the development and maintenance of the wind farm.”

Building wind farms in deeper waters farther from shore enables operators to harness greater wind speeds with fewer obstructions than on land, but trades its increased power production potential for more complex logistics.

Conducting offshore technicians safely and comfortably to sites such as Moray East is critical for the continuous provision of renewable power to Scotland and the United Kingdom.

Seocat Weatherly accommodates 24 passengers and a total of 11 tons of cargo at a service speed of 26 knots.

Seocat Services operates internationally out of Cowes, U.K., with a fleet of 14 IACS classified multi-purpose offshore energy support vessels.

Each vessel is purpose designed and constructed to conduct safe, fast, comfortable transport and transfer of personnel and equipment in the toughest of marine environments.

**MORE INFO** [www.seocat-services.co.uk](http://www.seocat-services.co.uk)



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The contracts cover the service of 1,963 wind turbines with outputs of between 660 kW and 3.465 MW of unit power. (Courtesy: Siemens Gamesa)

**MAINTENANCE**

## Siemens, Iberdrola partner on Spain, Portugal wind farms

Siemens Gamesa and Iberdrola have signed maintenance contracts totaling 1,928 MW at 69 of the energy group's wind farms in Spain and Portugal for a period of between three and five years.

The contracts cover the service of 1,963 wind turbines with outputs of between 660 kW and 3.465 MW of unit power. With these new contracts, Siemens Gamesa consolidates its position as the main provider of operation and maintenance services for Iberdrola in the region. The agreements include new and renewed contracts.

The contracts account for about 160 employees to maintain the wind farms. Technicians are primarily based in the rural areas where the wind farms are located, so the maintenance activity helps support economic activity and employment there.

The maintenance services for these types of turbines, the oldest in Iberdrola's fleet, are expected to significantly maximize their level of efficiency, as well as extend their useful life in the mid to long term.

"It's a real pleasure to have reached such an important agreement with

Iberdrola, not only because of the size of the deal, but also because it allows us to strengthen our partnership with one of our main customers," said John Paul Larrañeta, CEO of Siemens Gamesa Service for Southern Europe and Africa. "With these agreements, we will go beyond the usual maintenance tasks and offer solutions that the market is increasingly demanding, such as upgrading existing turbines to increase energy production while optimizing the cost of operations and maintenance."

Siemens Gamesa, in addition to offering operation and maintenance services, provides programs to maximize energy production, improve availability and optimize operation and maintenance (O&M) costs over the turbine lifetime.

In this regard, the agreement reached between Siemens Gamesa and Iberdrola also includes design modifications and improvements to the installed fleet during the term of the maintenance contracts, with the aim of modernizing the fleet and safely improving the energy production of the wind turbines.

After this deal, Siemens Gamesa will have 14 GW under maintenance for more than 340 customers in 12 countries in southern Europe and Africa.

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



Gwynt-y-Môr is a 576-MW offshore wind farm off the coast of Wales. (Courtesy: Fisher Renewables)

## MAINTENANCE

### James Fisher announces new contracts

James Fisher Renewables, a technical and operations solutions provider to the offshore renewables industry, has won three new multi-million pound contracts supplying specialist operations and maintenance (O&M) services to support informed decision-making for offshore transmission asset owners at Thanet, Gwynt-y-Môr, and Humber.

The contracts will be performed by JF Renewables' high voltage business EDS HV Group (EDS) for BBEC (Balfour Beatty Equitix Consortium), investors and long-term fund managers of core infrastructure assets.

"The combination of EDS and JF Renewables enables us to offer a much broader suite of services bolstered by our multi-skilled team," said Wayne Mulhall, JF Renewables managing director. "Paired with the introduction of remote technology, such as condition monitoring tools that offset in-person requirements, we can op-

erate leaner without compromising on safety or cost. This win represents the next step in our journey to being a complete end-to-end O&M service provider, and we are excited to be continuing our relationship with Equitix, through this contract with BBEC."

Transmission infrastructure owners can find that unaddressed underlying problems can often result in an unplanned outage that reduces transmission capacity necessitating an emergency response at short notice with commercial consequences. EDS' unique approach allows it to focus the annual operating charge and focus on critical assets that require attention, allowing it to flex in-line with the natural deterioration that occurs in all assets over time.

The agreement will see EDS provide enhanced O&M services for the offshore assets, ensuring safety of the system in-line with HV safety rules and the maintenance of HV transmission assets, alongside the integration of provisions for heating and ventilation systems, fire suppression, lifesaving equipment, and corrosion inspections. Building on its honest, transparent maintenance philosophy, this partnership represents the next

step toward full turnkey O&M solutions, delivered to fortify the safe and sustainable growth of the offshore wind industry.

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

## MANUFACTURING

### Vestas introduces V162-6.8 MW wind turbine

Vestas has introduced the V162-6.8 MW, expanding the EnVentus platform's power output and market applicability.

Renewables are already a critical part in energy systems across the globe with continued scaling and technology development playing a key role in making renewables a dominant energy source.

"We take another step forward with the introduction of the V162-6.8 MW, reaching the next level in applicability and scalability," said Anders Nielsen, Vestas' chief technology officer. "The V162-6.8 MW demonstrates how our modular product development enhances our ability to continuously innovate and lead the industry in developing customizable and sustainable energy solutions that meet our customers' needs. "Today, we are proud to introduce a wind turbine that underlines Vestas' continued leadership within high-quality sustainable energy solutions, optimized for all project-specific conditions."

The V162-6.8 MW is globally applicable and combines an increased power rating and operational flexibility to deliver up to 7 percent annual energy production (AEP) depending on project-specific conditions. The V162-6.8 MW features flexible power ratings of 6.5 MW, 6.8 MW, and 7.2 MW and expanded site applicability through an optional larger CoolerTop. The performance improvements are achieved through enhanced EnVentus powertrain and power conversion systems.

The V162-6.8 MW will benefit from enhanced transportability, as it will be based on Vestas' new modular nacelle concept, where the nacelle structure is divided into the main nacelle house containing the powertrain and the side compartment with the power system including converter and transformer. Both nacelle compartments are dimensionally designed to correspond to general industry logistics standards for road, rail, and ocean transportation with less need for special handling.

The EnVentus platform is the next generation of Vestas technology, building on proven technology from the 2-MW, 4-MW, and 9-MW platforms to meet customization needs more efficiently. Since the launch of the EnVentus platform in 2019, Vestas has secured orders for more than 5 GW across 13 different markets on four continents. ↙

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



The V162-6.8 MW combines an increased power rating and operational flexibility to deliver up to 7 percent annual energy production (AEP) depending on project-specific conditions. (Courtesy: Vestas)

The advertisement features a background image of a wind farm at dusk or dawn, with several wind turbines silhouetted against a dark sky. Overlaid on this image are glowing blue and white lines that form a network, connecting various points across the scene. The text is white and positioned on the right side of the image.

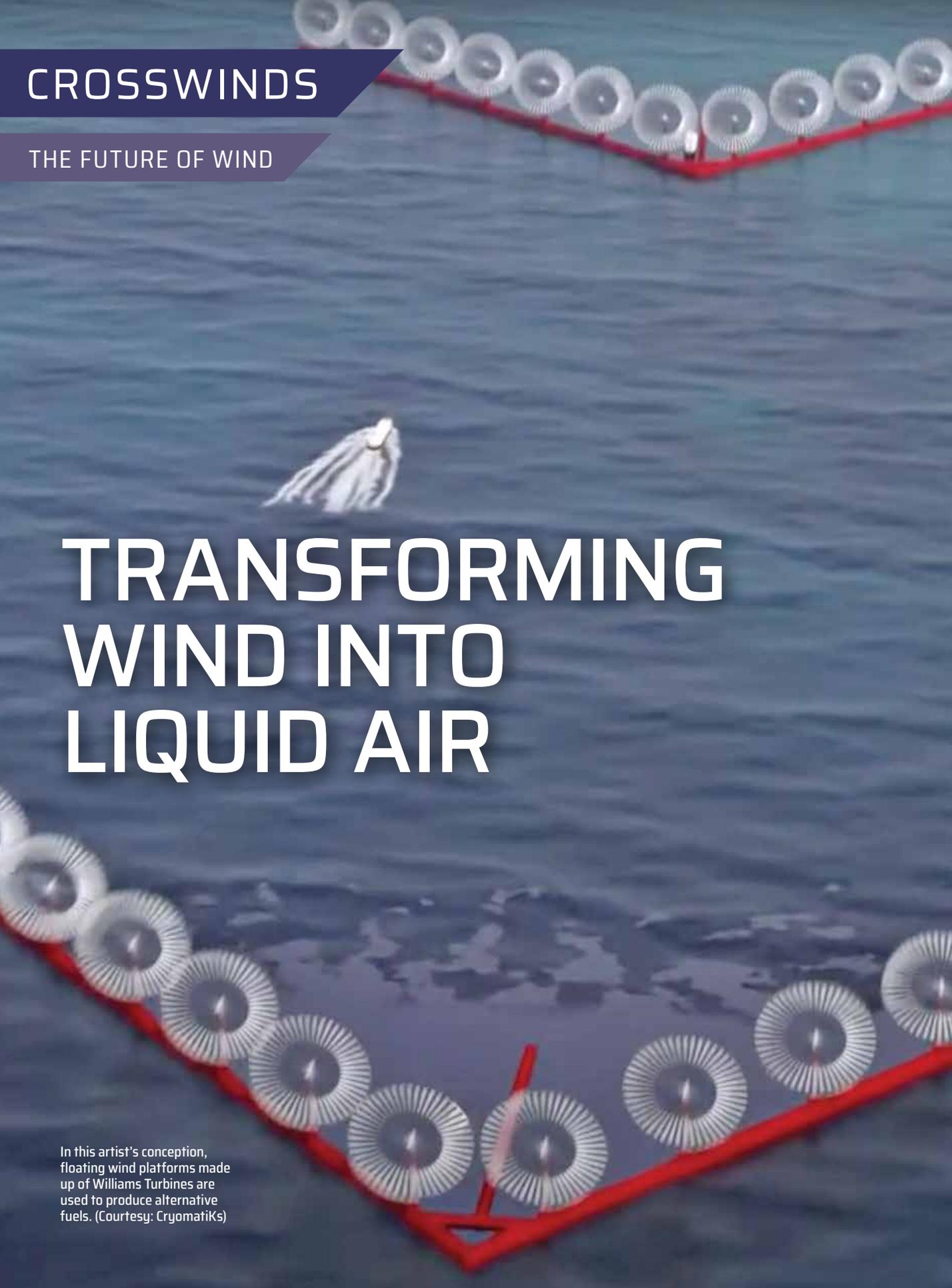
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CROSSWINDS

THE FUTURE OF WIND

# TRANSFORMING WIND INTO LIQUID AIR

In this artist's conception, floating wind platforms made up of Williams Turbines are used to produce alternative fuels. (Courtesy: CryomatIKs)

*The power generated from an innovative turbine design can be used to create green hydrogen, green ammonia, liquid air, and more at a fraction of the cost that it takes to construct a conventional three-bladed turbine.*

By **KENNETH CARTER** ▸ Wind Systems editor

**R**eminiscent of windmills from a bygone era, floating wind platforms using drag-based-design turbines could actually usher in new and exciting ways to harness and take advantage of wind energy.

The advantages of a turbine using drag-based design as opposed to the traditional lift-based design are “night and day,” according to Mark Cann, CEO and co-CTO of CryomatiKs, a product development company that specializes in zero emission technology.

A conventional three-blade wind turbine, which has essentially become the de facto standard today, is constructed with composite-based materials with a large swept area and hub height. So, right away, the cost for a drag-based design turbine, based on a concept developed by Herbert Williams, becomes less of an issue.

“When you’re looking at the upfront material costs, there is a night-and-day difference between material cost,” Cann said. “With the Williams Turbine, it’s literally just steel and aluminum. There is nothing exotic. There are no resins required. There’s no special tooling required. In terms of the manufacturing, you cannot get anything simpler than the physical construction and the layout. That’s really what drives everything. Instead of starting off with something that is very, very expensive, you’re starting off with something that’s very, very low cost. That opens up other things that may not be practical without that low cost.”

With those lower construction costs, gearboxes in the Williams Turbine are mounted in the base, not up in the hub as in traditional turbine designs, according to Cann. This design allows for multiple mounting points at the bottom that splits up the load, and because the drag-based design doesn’t create a massive wake, the turbines can be constructed very close together, making them perfect for offshore floating platforms.

## PROMISING INNOVATION

The offshore platforms using the Williams Turbine have a number of sell points, including an option for a 50-year system lifecycle with routine maintenance performed at sea; a single anchor point instead of multiple anchor points for buoy and tension-based designs; an option for 100-plus MW for a single common platform; multiple gearboxes mounted on the base to help support the mass of the turbine while allowing for the maintenance of liquid air and hydrogen equipment without stopping the turbine; a turbine design that provides a “flywheel” effect so, as the wind varies second by second, the rotation of the turbine itself smooths the output; and the ability to operate at very high winds (20-plus meters a second) without shutting down.

Currently, the Williams Turbine design has been tested with 15- to 25-kW models, with a 1-MW test model being built with a 30-meter diameter, according to Cann. But the tentative goal is to eventually mass produce 70-meter-diameter, 5-MW models.

Cann pointed out that there are a few tradeoffs with the drag-based design when it comes to the power coefficient.

“Your power coefficient’s going to be a little bit lower,” he said. “You’re going to see maybe a 0.3 power coefficient instead of some of the more advanced systems, which are over 0.4. At the same time, you’re also able to operate at a lower wind speed. It’s based on drag of 8 to 10 meters per second, which obviously is that great sweet spot, but you’re still generating output down to say 4 meters per second. Obviously, it’s a lot lower because the wind speed is a cube of your power.”

## PRODUCING GREEN-BASED GASES

More often than not, a turbine’s capacity factor may be much less than that 8-to-10-meters-per-second “sweet spot,” but, even if it’s consistently lower, the turbines are still generating power, which is part of what makes the Williams Turbine design an innovative way to produce byproducts that include green hydrogen, green ammonia, liquid oxygen, and liquid nitrogen — especially when the lower production costs are factored in, according to Cann.

“If you look at a liquefaction facility, especially a large scale one, over the lifetime of that facility, up to 90 percent of their operating costs is electricity,” he said. “It’s not just a large cost; it’s the single largest cost for that entire facility. The rest is really just maintenance and then just your regular payroll and things like that. Electricity is the No. 1 driver. So, at the end of the day, what it costs to liquefy the air is what your power costs. So, going back to the floating wind turbine, when you’re able to tap into these resources that have a high-capacity factor, you get 50- or 60-percent capacity factor and your upfront CapEx is less than a dollar per watt. What that really means is that your cost to produce goes down dramatically, way, way lower than what you could ever get for a grid-based system.”

With a floating platform, a major challenge is always the cost of transporting that power to land, according to Cann. The best wind resources are not close to the shore, so one of the most expensive parts of offshore wind is the undersea cable that connects to the grid. Once connected to the grid, however, surplus power often has nowhere else to go.

## BUILT-IN STORAGE SYSTEM

The floating platform constructed with drag-based turbines



Currently, the Williams Turbine design has been tested with 15- to 25-kW models, with a 1-MW test model being built with a 30-meter diameter. (Courtesy: CryomatiKs)

can become a unique storage system for liquid air and other green-created gases, according to Cann.

“Basically, the platform is a system within a system,” he said. “You have the ‘exterior’ of the platform, and that is your conventional marine setup. That’s designed to survive 40, 50, 60 years out in the open water in the salt. Within that system, we then have storage tanks that are either set up for liquid air or hydrogen or green ammonia. The platform itself ends up being the storage for the output of those systems. Let’s just take liquid air, for example. You have your main platform and then, within that main platform, you can have anywhere from six to 20 individual tanks, and those tanks are going to be storing liquid air. Those are essentially isolated within the main platform. Then, depending on where the system is located, it’s either going to be a barge or something in that neighborhood that’s doing the transport, so your offload is actually built into the platform.”

### SIMPLER CONSTRUCTION

Since the platform is essentially a storage system, it doesn’t require a different build-out for the storage, according to Cann. It’s literally built into the platform from the beginning.

“Everything is designed to be done in dry dock, and then it’s simply towed out,” he said. “Whereas some of these other systems where you have these really specialized, customized crane ships and other things that you have to build, you don’t have any of that. Again, going back to the construction, for the most part, now things are just assembled together and then taken out to sea. Because there are no special tools or anything, you can literally do your assembly

right at the dry dock. For the most part, there’s not very much equipment that’s required. You actually do your assembling right at the dry dock, and it gets towed out. Once it’s actually in its location — I’m going to oversimplify and say a winch system — but essentially once everything is in the right position, then each turbine can then be winched into a standing position.”

And since the construction of these offshore platforms made up of Williams Turbines is so cost effective, it eventually becomes an economically feasible way to create alternative fuels, according to Cann.

“We’re trying to eliminate all the expensive pieces that are normally there,” he said. “You eliminate your expensive materials. You eliminate the specialized equipment. You eliminate the undersea cables, which are a million dollars a kilometer, and you start eliminating all these most expensive things. Again, we definitely have a trade-off of that there are losses involved when you convert into another storage medium. But when you look at it from an economic standpoint, not having these other expenses actually ends up working in your favor.”

### PINPOINTING PREMIUM WIND AREAS

The global map of wind resources boasts locations with 70 percent capacity with mean wind speeds of more than 12 to 13 meters per second, according to Cann.

“It’s just unbelievable resources,” he said. “And those are going to have to be floating wind systems in order to access that. I think there’s a realization that people are saying, ‘Wait a minute, there are these unbelievable resources.’ In order to tap in those resources, you’re going to have to go with floating offshore for wind technology. At the same time, there is huge demand growing for green hydrogen and green ammonia. It’s able to meet these different needs all at the same time.”

Implementation of these floating wind platforms are ideal for areas that don’t have a well-established infrastructure, according to Cann.

“If you were to take the 35 degrees north, 35 degrees south around the globe and make that like a band all the way around, that’s our prime market for liquid-air technology,” he said. “The reason why is because, in those markets, those are all your warmer climates, and we have air conditioning and refrigeration available as a byproduct, and it’s extremely valuable in those climates. Those are the markets we’re going into, and those are also the same markets where they don’t have a lot of existing infrastructure like we do here in the U.S. They don’t have 100 years’ worth of infrastructure. For example, you take a market like Africa, which most people would look at and go, ‘Wait, are you guys crazy?’ But then, if you actually look at it, they have unbelievable wind resources that are available to us. At the same time, they don’t have the grid infrastructure for us to go in and set up a bunch of liquefaction facilities. So, it becomes this natural tie-in where we essentially create our own supply chain as we grow adoption of our EV technology in those markets.”

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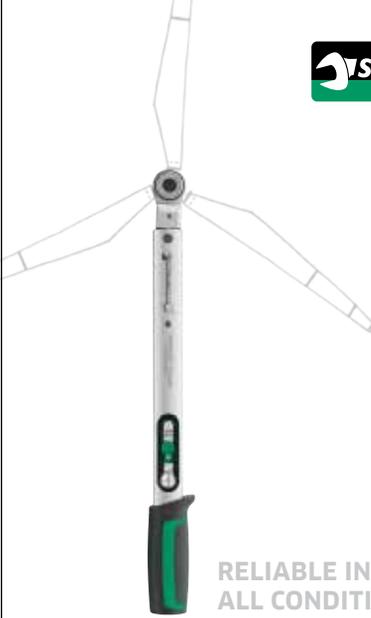
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A Williams Turbine is constructed of steel and aluminum; no exotic materials are needed. (Courtesy: Cryomatiks)

And that means replacing fossil fuels with green-produced gases where fossil fuels are the only method to power generators, according to Cann.

“Any time a market is island-based, they’re going to rely heavily on diesel,” he said. “We’re trying to do everything that we can to displace diesel, so there’s definitely an opportunity in some of those markets to be able to go in there and not only just assist with their electricity, but then get into their transportation with their commercial vehicles and buses.”

### RANGE EXTENDER ORIGINS

The EV technology that Cann referred to began as a range extender for EVs, which is essentially a high-speed expander with a high-speed generator.

“It’s ironic because the high-speed expander is a rotor; it has a five-inch diameter, and it rotates at 40,000 RPMs,” he said. “Now, we’re dealing with something that’s 100 feet in diameter, and it rotates at single digits. But what happened was we were in the process of commercializing the range extenders, and then in a very, very short timeframe, we’re essentially going to be one of the largest consumers of liquid air on the planet. So, we are very aggressive about making sure that we’re going to have a supply chain in place to do that.”

In addition to the need for liquid air, there’s also a need for liquid nitrogen, according to Cann.

“There’s already a global supply chain for liquid nitrogen,” he said. “We’re not starting from scratch. We’re already starting from something that’s there. At the same time, there’s also economic constraints to that, which is that those existing companies have their margins that they’re going to maintain, and so there’s just a limit to what we can do with the existing supply chain.”

### EXPANDING SCOPE

An ironic element of Cryomatiks’ involvement in deploying these floating platform systems is the company originally was just looking to be responsible for the end result, as opposed to the creation and development, according to Cann.

The drag-design turbines developed by Williams and his company, Keuka Energy, were initially seen as a way for Cryomatiks to buy and distribute the liquid air and other products produced, but that goal quickly changed as Cann and his team saw the potential of the floating platforms.

“It just so happens that Mr. Williams is getting ready to start enjoying his retirement,” Cann said. “He’s still involved with the technical side of things, but when it comes to actual deployment, he essentially is turning it over to the next generation, if you will. That opened the door for us to say, ‘You know what? We really want to be able to secure our supply chain.’”

“We’re already, basically, going to be one of the biggest customers of the output of these systems. We are already talking to other companies about doing partnerships so that we can share the output for these systems, so we just ended up taking the very next step and said we’re just going to become a licensee, and we actually are going to help deploy these systems all together. We didn’t start out intending to actually be the ones helping to bring these floating wind platforms to market.

“That was not our goal. But now, we’re saying, ‘Look, whatever the output from the system is, we want to be involved, and we’re definitely willing to have strategic partnerships and do everything we can to accelerate the build-out of these systems because, at the end of the day, it benefits us.’” ✨

**MORE INFO** [cryomatiks.com](https://cryomatiks.com)

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