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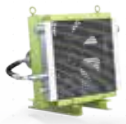

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THE BUSINESS OF WIND

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Momentum continues for U.S. clean-energy manufacturing industry

Hard to believe that 2026 is half over. It seems like I was just ringing in the new year yesterday. And by "ringing in the new year," I mean sitting on my couch watching the countdown.

The year has seen a lot of ups and downs for renewables, but, with ACP's recent release of its second annual "State of Clean Energy Manufacturing" report, there's reason to expect good news ahead.

According to the report:

- U.S. clean energy manufacturing is ramping up, bringing the benefits of new energy projects while boosting industry and strengthening national security.
- Clean-power manufacturing contributes $31 billion to the U.S. GDP annually and supports 216,000 American jobs.
- Clean energy factory workers earn 35 percent more than the average American worker.
- 70 new clean-energy manufacturing facilities came online in 2025, bringing the total to more than 825 facilities across 50 states with large clusters in Texas, Tennessee, Georgia, Ohio, and North Carolina.
- By 2030, more than 950 clean-energy manufacturing facilities are expected to support 374,000 jobs nationwide.
- Every clean-energy manufacturing job supports an additional four jobs across the broader U.S. economy — one additional job from upstream activities, and three additional jobs from household spending.
- More than 235 new clean energy manufacturing facilities have opened in the U.S. in the last five years.
- More than 300 U.S. factories are producing the core components of clean-energy projects, including wind blades, towers, nacelles, solar modules, and batteries.
- Domestic manufacturing capacity is now sufficient to fully satisfy U.S. demand for solar modules, battery modules, wind towers, and wind nacelles.

Good news and something to consider as we all continue to push the momentum of renewables across the U.S., despite considerable head winds from the current administration.

It's an important reason for us all to stay vigilant in cheering for the obvious benefits that clean, renewable energy can offer not just the U.S., but the world.

Enjoy this issue of *Wind Systems*, and, as always, thanks for reading!

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Teresa Cooper
President

Clean energy act can continue in Michigan

From American Clean Power

The Michigan Court of Appeals recently ruled in support of key parts of the state's implementation of the Clean Energy and Jobs Act. The decision follows April 15 oral arguments in which the Michigan Public Service Commission (MPSC) defended its ability to implement the siting and permitting provisions of Public Act 233 (PA 233) and pointed to the clear intent of the legislature and the governor in passing and signing the measure.

As intervening parties in the case, the Michigan Energy Innovation Business Council (Michigan EIBC), Institute for Energy Innovation, Clean Grid Alliance, and Advanced Energy United also participated in oral arguments, pointing specifically to the importance of PA 233 in providing legal certainty and stability for developers, investors, and communities by having a path to obtaining a permit.

In addition to materials submitted by the trade organizations, a broad set of business groups, renewable energy advocates, labor organizations, legislators, and local landowners filed amicus curiae brief petitions in support of the Commission's actions to fully implement the permitting process established under PA 233. This law plays a crucial role in advancing Michigan's clean energy future, ability to meet accelerating energy demand, and economic growth.

PA 233 strikes a careful balance between landowner rights and thorough project review. It ensures farmers can use their own land for wind and solar generation and energy storage, helping support their families, while requiring these projects to be carefully examined before permission is granted. The law was designed to create a statewide, fair siting, and permitting process for renewable energy projects, creating a clear, predictable framework that ensures policies are consistent across the state, with the goal of attracting significant business investment, creating jobs, and positioning Michigan as a national leader in the clean energy sector.

The court upheld the MPSC's authority to implement PA 233 and the MPSC's definition of a "Compatible Renewable Energy Ordinance," providing clarity to landowners, local governments, and developers.

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American Clean Power is the voice of companies from across the clean-power sector that are powering America's future. For more information, go to www.cleanpower.org

DIRECTION

THE FUTURE OF WIND

The Fraunhofer IWES Stage 3+ Wind Lidar Buoy on site in Liivi Bay. (Courtesy: Fraunhofer IWES/ Loïs Legendre)

Fraunhofer IWES completes survey in Estonia commissioned by Enefit

As part of the development of the Estonian Liivi offshore wind farm project, the Fraunhofer Institute for Wind Energy Systems IWES has conducted a site condition monitoring campaign in Liivi Bay, commissioned by Enefit.

The Fraunhofer IWES Stage 3+ wind Lidar buoy, a floating Lidar system, was installed together with co-deployed oceanographic sensors to collect a year of measurements, e.g., wind profiles, turbulence intensity (TI), wave, and current parameters. It was the first commercial campaign to obtain advanced TI measurements from Fraunhofer IWES's high-frequency deterministic motion compensation method. The campaign also involved a land-based Lidar measurement and wind modelling.

A site condition monitoring campaign is essential before building a wind farm, providing the site specific resource and environmental data needed to design the project safely, efficiently, and with best bankability. The campaign in Liivi Bay was conducted from October 2024 to December 2025. Floating Lidar systems like the Fraunhofer IWES wind Lidar buoy have been widely adopted by the wind industry as an efficient survey tool. They allow accurate resource measurements at sea, with traceable and minimized measurement uncertainty, to provide optimum energy yield assessment.

During the sea ice season, the Fraunhofer IWES wind Lidar buoy was temporarily removed from site. This was planned to prevent sea ice damage. The parallel onshore Lidar campaign deployed on Kihnu Island provided a precise wind measurement reference for that period. A horizontal transfer modeling using an offshore-calibrated atmospheric flow model addressed the data gap caused by the buoy's absence and completed the datasets.

"Liivi Bay represents a strategically important location for the development of offshore in the Baltic region," said Johann-Gustav Lend, Baltics Business Development Manager at Enefit. "The insights gained from this measurement campaign will support Enefit in advancing offshore wind capacity that enhances regional energy security and accelerates the transition to a cleaner, more efficient energy system."

In parallel with its recent scientific advancements and publications, Fraunhofer IWES has delivered turbulence intensity (TI) measurements based on its high-frequency deterministic motion compensation method. Enefit and the Liivi Project are the first commercial partners to benefit from this cutting-edge methodology for floating Lidar systems.

"The Fraunhofer IWES project team was delighted to deliver the technically important turbulence intensity measurements based on our own step-up into high-frequency line-of-sight motion compensation, bringing the benefit of applied research to the industry as per Fraunhofer's mission," said Loïs Legendre, Project Manager Wind Measurement at Fraunhofer IWES.

Also involved in the project were the Riigilaevastik (Estonian State Fleet) and their vessel crews providing effective operational support throughout the campaign, as well as Luode Consulting who conducted the oceanographic measurements.

"For the Estonian State Fleet, active participation in scientific research and monitoring activities in national waters highly important, including making state fleet resources available to support such work," said Andres Laasma, Director General of the Estonian State Fleet.

MORE INFO www.iwes.fraunhofer.de/en

KK Group acquires shore power leader PowerCon A/S

KK Group recently announced the acquisition of PowerCon A/S, a Danish engineering and manufacturing company with strong maritime roots that specializes in power conversion technology for the maritime, wind, and battery energy storage industries. The acquisition will create growth opportunities for KK Group by unlocking new markets and strengthening its capabilities in modularized, high-power converters and testing solutions.

PowerCon's shore power technology allows ships to plug into electrical grids and turn off diesel engines while at berth in harbors. Replacing highly polluting marine fuel with shore power from renewables can support the necessary decarbonization of the global maritime industry through electrification.

"PowerCon's unique shore power technology coupled with its clear mission and skilled team is perfectly aligned with KK Group's purpose, Powering Change toward a more sustainable tomorrow," said Mauricio Quintana, CEO of KK Group. "PowerCon has over many years proven to be a highly successful and value-driven partner and through this acquisition, we will leverage PowerCon's skills and technologies to unlock new growth opportunities and support the electrification of the global maritime industry for the benefit of customers, society, and the environment."

PowerCon has its roots in the wind industry, where it developed fully modularized converter solutions and unique testing capabilities. KK Group and PowerCon have an aligned strategic vision based on a relationship built on more than 15 years of collaboration in wind.

"Joining KK Group is a natural next step for PowerCon," said Kim Brøndum Larsen, CEO and co-founder of PowerCon A/S. "We share the same roots in wind and the same belief in what power conversion technology can do for the energy transition. With KK Group's scale and resources behind us, we can bring our shore power solutions

PowerCon's shore power technology allows ships to plug into electrical grids and turn off diesel engines while at berth in harbors. (Courtesy: KK Group)

to more ports and customers, supported by a stable ownership platform that supports continued development, technological advancement, and growth."

PowerCon will become part of KK Group but operate as a separate entity while the two companies explore options for further collaboration.

The former owners and leadership team of PowerCon will keep a minority share of 30 percent in PowerCon as well as play a key role within the organization, ensuring continuity, long-term commitment, local anchoring for customers, suppliers, and employees.

Following the acquisition, more than 200 new colleagues will join KK Group, bringing the total number of colleagues to about 4,000.

The acquisition is expected to close during Q2 2026, following approval from regulatory authorities.

MORE INFO www.kkgroup.com

Thistle Wind Partners submits offshore plans for Bowdun farm

Thistle Wind Partners (TWP) has taken the next step in the development of its Bowdun Offshore Wind Farm project with the submission of its offshore consent application to the Scottish Government's Marine Directorate - Licensing and Operation Team.

This key project milestone takes TWP one step closer to realizing its ambitions for this significant fixed-bottom offshore wind project, which, once operational, will contribute 1 GW of renewable energy to the national grid, enough to power the equivalent of more than 1.2 million households.

Bowdun is expected to support more than 700 jobs in Scotland during its five-year construction phase, alongside about 60 long-term roles through its future operations and maintenance base.

The submission of the offshore consent application means the full project is now in determination with both onshore and offshore elements under consideration. The onshore application was lodged with Aberdeenshire Council in November 2025, and together these represent a major step towards realizing the project.

"Submitting our offshore consent application marks a major step forward for the Bowdun Offshore Wind Farm and reflects the significant progress made by the team to date," said Ian Taylor, Bowdun project director. "Bowdun has been designed not only to deliver up to 1 GW of clean, reliable power, but to maximize economic value for Scotland -- supporting a strong domestic supply chain and creating high-quality jobs across development, construction, and long-term operations."

"We are committed to working closely with local communities, suppliers and stakeholders as the project progresses, and we see real opportunity for the north-east of Scotland to play a significant role, particularly through our planned operations and maintenance base," he said. "With the right frameworks in place, projects like Bowdun can help secure a lasting legacy for the region, accelerating the energy transition while driving investment and skills development."

Since its establishment in 2022, TWP has successfully prepared and submitted four major consent applications across its ScotWind projects, covering both onshore and offshore elements for Bowdun and also the Ayre Offshore Wind Farm project. This achievement highlights the team's ability to progress complex, nationally significant offshore wind developments at pace.

MORE INFO thistlewindpartners.scot

The Monza is an LR2 tanker fitted with two 37.5m WindWings. (Courtesy: Windwings)

WindWings tanker delivered to Union Maritime

The LR2 tanker Monza, fitted with two 37.5-meter WindWings® developed by BAR Technologies, has been delivered to Union Maritime, marking the third vessel in the company's newbuild series to adopt wind-assisted propulsion. Together, the vessels form the world's first dual-fuel LR2 tanker series combining LNG propulsion with WindWings sail technology.

Built by Jiangsu Province, Yangzijiang Shipbuilding, and equipped with WindWings manufactured by CMET, the vessel adds to a growing number of large tankers integrating rigid wind propulsion technology.

Its delivery confirms that WindWings installation is moving into repeatable, commercial deployment across a series of vessels.

The milestone comes as debate at the IMO continues over the future of the Net Zero Framework and the role of market-based measures, with competing proposals offering varying levels of ambition and no clear consensus on carbon pricing.

For shipowners, this uncertainty is increasing pressure to adopt solutions that deliver immediate, verifiable emissions reductions without relying on the availability or cost of future fuels.

Wind propulsion is emerging as a critical solution for reducing emissions, offering a proven, fuel-agnostic pathway to meeting FuelEU Maritime and IMO targets now, without reliance on uncertain future fuel supply or infrastructure. By harnessing a free, zero-emission energy source, WindWings deliver measurable efficiency gains, with performance already demonstrated in commercial service on vessels including Pyxis Ocean and Berge Olympus, as well as across Union Maritime's LR2 newbuild series.

Monza is expected to deliver meaningful reductions in fuel consumption and emissions, consistent with results achieved on earlier WindWings-equipped vessels, supporting compliance with global frameworks including FuelEU Maritime and IMO efficiency targets.

This growing program brings together designers, shipbuilders, class and flag, reflecting increasing industry alignment and a broader shift toward the adoption of wind propulsion on large commercial vessels.

"The successful delivery of Monza demonstrates how wind-assisted propulsion can be integrated efficiently across a series of vessels," said Zhou Kewei, Deputy General Manager of Yangzijiang Shipbuilding Group at the naming ceremony. "Through close collaboration with BAR Technologies, we are accelerating the industrialization of low-carbon ship solutions and supporting the industry's transition to more sustainable operations."

"Monza is the third vessel in a series, and that matters," said John Cooper, CEO of Bar Technologies. "It shows wind-assisted propulsion is no longer a concept or a one-off installation; it is being delivered consistently on commercial ships."

MORE INFO www.bartechnologies.uk/commercial-ships/windwings

THE INVISIBLE WORK KEEPING THE ENERGY TRANSITION ALIVE

Behind every effective maintenance strategy is a highly skilled workforce. (Courtesy: FairWind)

Elevating maintenance to a strategic priority will help ensure that rapid growth in the sector translates into sustained, reliable, and economically viable clean energy generation.

By ALEXANDRA HOF

As the wind industry focuses on ever-larger turbines, supply chain pressures, and evolving policy frameworks, the role of maintenance remains one of the most critical yet consistently under-recognized components within the sector. Often operating behind the scenes, maintenance functions receive far less visibility than development and construction, despite being fundamental to long-term success. When wind farms operate seamlessly, they are largely invisible, but when they fail, they threaten grid stability, investor confidence, and decarbonization targets.

Wind power continues to be one of the fastest growing energy sources, with preliminary statistics from the World Wind Energy Association indicating that 169,014 GW of new capacity was added globally last year — a 35 percent increase on 2024. However, while industry attention is fixed on turbine scale, installation targets, and policy ambition, far less focus is given to what happens after commissioning. The operational phase, which can span 20 to 30 years, represents the longest and most value-critical period of any wind asset's lifecycle. To keep these systems operating effectively across its full operating period requires continuous and often highly complex work. This goes well beyond routine servicing, encompassing detailed diagnostics to detect emerging issues, targeted repairs to address wear and failure, and periodic retrofits to integrate new technologies or extend operational life. Alongside these activities, ongoing performance optimization is also essential to ensure turbines run as efficiently as possible under changing conditions. As turbines age, the nature of this work evolves, shifting from preventative maintenance toward more intensive interventions.

At a time when energy resilience, affordability, and decarbonization are under intense scrutiny, maintenance is a critical element of the energy transition. Recognizing and investing in operations and maintenance (O&M) as a strategic priority is essential to ensure turbines don't just get built, but continue to perform over their full lifespan. Despite this, maintenance is still often treated as a secondary consideration, optimized after installation rather than embedded from the outset. This disconnect is increasingly at odds with

At a time when energy resilience, affordability, and decarbonization are under intense scrutiny, maintenance is a critical element of the energy transition. (Courtesy: FairWind)

the realities of a maturing industry, where long-term performance defines success.

As turbines increase in size and projects move further offshore, this complexity only intensifies. Larger components, harsher operating environments, and more challenging access conditions all increase the consequences of failure. Offshore environments in particular, introduce weather constraints, vessel dependencies, and extended response times, making proactive planning even more critical. In this context, maintenance is a vital enabler of performance, safety and economic viability.

THE COST VS. RELIABILITY BALANCING ACT

Today's maintenance landscape is defined by an overarching need to reduce costs while maintaining high levels of reliability. Global competition, supply chain volatility, and tighter margins have placed sustained pressure on both manufacturers and operators to do more with less. At the same time, the cost of failure, financially, operationally, and reputationally, remains high. Unplanned downtime significantly reduces revenue and can also strain contractual obligations and investor confidence. The result is a delicate balance to manage.

Reducing maintenance spending may deliver short-term gains, particularly under immediate budget pressures. However, this approach frequently moves cost rather than eliminates it, with consequences that only become visible over the full lifecycle of an asset. Increased failure rates, secondary component damage, and extended outages can quickly outweigh any initial savings. In complex systems such as wind turbines, where components are highly interdependent and access is often constrained, the true cost of reactive maintenance can escalate rapidly. For example, a minor component failure left unaddressed can cascade into major drivetrain or gearbox damage, significantly increasing repair costs and operational downtime.

Reactive approaches can also introduce additional hidden costs such as logistical inefficiencies, lost production, and increased health and safety risks associated with unplanned interventions.

These factors rarely appear in upfront cost calculations, but materially affect overall asset performance.

LONG-TERM PERFORMANCE

The challenge is not simply to do less, but to do better. This requires a fundamental shift from cost-driven decision making to value-driven maintenance strategies.

Leading operators are moving beyond traditional time-based maintenance models toward more sophisticated approaches that integrate condition monitoring, data analytics, and risk-based prioritization.

These approaches allow operators to intervene only when necessary, reducing unnecessary maintenance while preventing critical failures.

Digitalization is playing a central role in this change, predicting failures modes and optimizing maintenance sched-

As the wind sector continues to scale, the gap between installed capacity and effectively maintained capacity risks becomes a defining challenge. (Courtesy: FairWind)

ules, but technology alone is not a silver bullet. The real value lies in how insights are translated into action. Organizations that successfully integrate data into decision-making processes, aligning engineering, operations, and commercial teams, are those best positioned to realize meaningful gains. However, this requires technological investment and a willingness to adapt legacy processes and mindsets.

Behind every effective maintenance strategy is a highly skilled workforce. Wind-turbine maintenance is increasingly specialized, requiring technicians to operate at height and navigate complex electrical and mechanical systems. As turbines grow in scale and sophistication, so too does the expertise required to maintain them safely and efficiently. However, the availability of skilled technicians has not always kept pace with industry growth, creating a critical dependency that is often overlooked.

By 2030, the sector is expected to support 39,000 jobs in operations and maintenance, 25,000 in installations and foundations, 155,000 in manufacturing, and 69,000 in planning and decommissioning, underlining the scale of the workforce needed across the full asset lifecycle [1].

Investing in training, retention, and workforce development is essential to safeguarding the long-term performance and reliability of wind assets. Apprenticeships, continuous professional development, and dedicated training programs will all play a role in attracting and retaining the talent required to meet this demand.

STRATEGIC INFRASTRUCTURE

To truly address the under-recognition of maintenance, the industry must reframe how it is perceived. Maintenance should not be viewed as a cost center to be minimized, but as strategic infrastructure that underpins the entire value chain of wind energy. Without effective maintenance, capacity additions alone cannot deliver reliable or affordable power. As the wind sector continues to scale, the gap between installed capacity and effectively maintained capacity risks becomes a defining challenge. Bridging this gap will require not only investment, but also a cultural shift in how maintenance is valued across the industry. If the energy transition is to deliver on its promises, the industry must look beyond the visible symbols of progress such as tower height, turbine scale, and installation speed, and recognize the less visible, but equally critical, discipline that keeps those turbines turning day after day. Only by elevating maintenance to a strategic priority can the sector ensure that rapid growth translates into sustained, reliable, and economically viable clean energy generation.

ABOUT THE AUTHOR

Alexandra Hof is the regional head of service for NCE, FairWind.

REFERENCES

[1] WindEurope: https://windeurope.org/careers/?utm_source=copilot.com.

THE ROLE OF ROVS IN OFFSHORE WIND MAINTENANCE

The U.K. maintains a world-leading position in offshore wind development. (Courtesy: Shutterstock)

As offshore wind capacity continues to expand, even greater efficiency and flexibility will be demanded from ROV systems.

By CHRIS BUCKLE

Remotely operated vehicles (ROVs) have long been associated with one industry above any other: oil and gas. This vital equipment was traditionally used to support subsea operations from pre-lay route surveys through to commissioning; however, there is now an ever-growing need for the technology to support the increasing number of offshore wind farms.

The U.K. maintains a world-leading position in offshore wind development, with more than 16 GW of capacity currently installed and a further 96 GW in the pipeline. Given this growth, the importance of ROVs in supporting the industry is only going in one direction, and recent technical innovations ensure operators are well equipped to match this progress.

SUPPORT AT EVERY STAGE

ROVs play a critical role throughout the offshore wind lifecycle. During early-stage surveys, they provide detailed seabed mapping, delivered using multibeam sonar and laser scanning systems, as well as HD cameras. This data paints a clear picture of seabed conditions, helping operators identify potential obstructions while optimizing turbine and cable layouts.

Next comes one of the most intensive phases in offshore wind development: installation. ROVs perform the pre-installation surveys as well as assisting with foundation placement, often working alongside specialist trenching systems to ensure cables are placed accurately and with a sufficient depth for protection. Real-time video and sensor feedback processing provided by software such as Forum Energy Technologies' (FET) VisualSoft, enable installation teams to make informed decisions that ensure safety and provision.

Once turbines are operational, the role of the ROV transitions into inspection, maintenance, and repair (IMR) work scopes. Routine surveys, typically carried out using Inspection class ROVs, monitor the integrity of the turbine infrastructure and cables. These systems can be supported as required by work-class vehicles, such as FET's XLX Evo III, should more power intensive tasks be required.

Systems can also be equipped to carry out heavy intervention work using manipulators, larger tooling skids, and specialist tooling. Potential risks and damage are detected with plenty of warning, so maintenance can be planned proactively and operational uptime is maximized.

Seamless integration between software and hardware ensures that ROV control is as precise as possible. With enhanced thruster systems and advanced navigation modes, work-class ROVs can maintain stability even in strong currents and low-visibility conditions. Features such as mid-water station keeping, auto-heading, and altitude control functions give pilots greater capacity to focus on inspection accuracy rather than maintaining control.

DATA AND INTEGRATION

As the requirements of ROVs evolve to suit sector demands, the reliance on high-quality data has intensified. Modern ROVs act as mobile sensor platforms, collecting data holistically to build accurate digital records of subsea assets.

FET's VisualSoft provides an integrated data capture and management system, ensuring video and sensor feeds are precisely correlated and easily traceable throughout a wind farm's lifecycle. The benefits of reliable data are twofold: Inspection quality is enhanced, and predictive maintenance strategies can be developed to support reliable wind production throughout the asset lifecycle.

As the requirements of ROVs evolve to suit sector demands, the reliance on high-quality data has intensified. (Courtesy: Forum Energy Technologies)

THE NEXT CHAPTER IN OFFSHORE OPERATIONS

As offshore wind capacity continues to expand, even greater efficiency and flexibility will be demanded from ROV systems. Remote piloting and control centers are expected to become more common, enabling ROVs to be operated from onshore facilities or from motherships overseeing multiple wind farms. Advances in autonomy will see hybrid ROV/autonomous underwater vehicle (AUV) systems performing continuous monitoring and rapid-response intervention.

Electrification and modular design will further reduce maintenance demands and improve environmental performance. Resident ROV systems, capable of remaining subsea for extended periods, are already being trialed as part of floating wind developments, providing near-instant access for inspection and intervention tasks.

The offshore wind sector may be in its relative infancy compared to oil and gas, but its ambitions and importance are only growing. ROV technology, supported by the expertise of companies like FET, is central for the U.K. to continue holding its world-leader status in offshore wind.

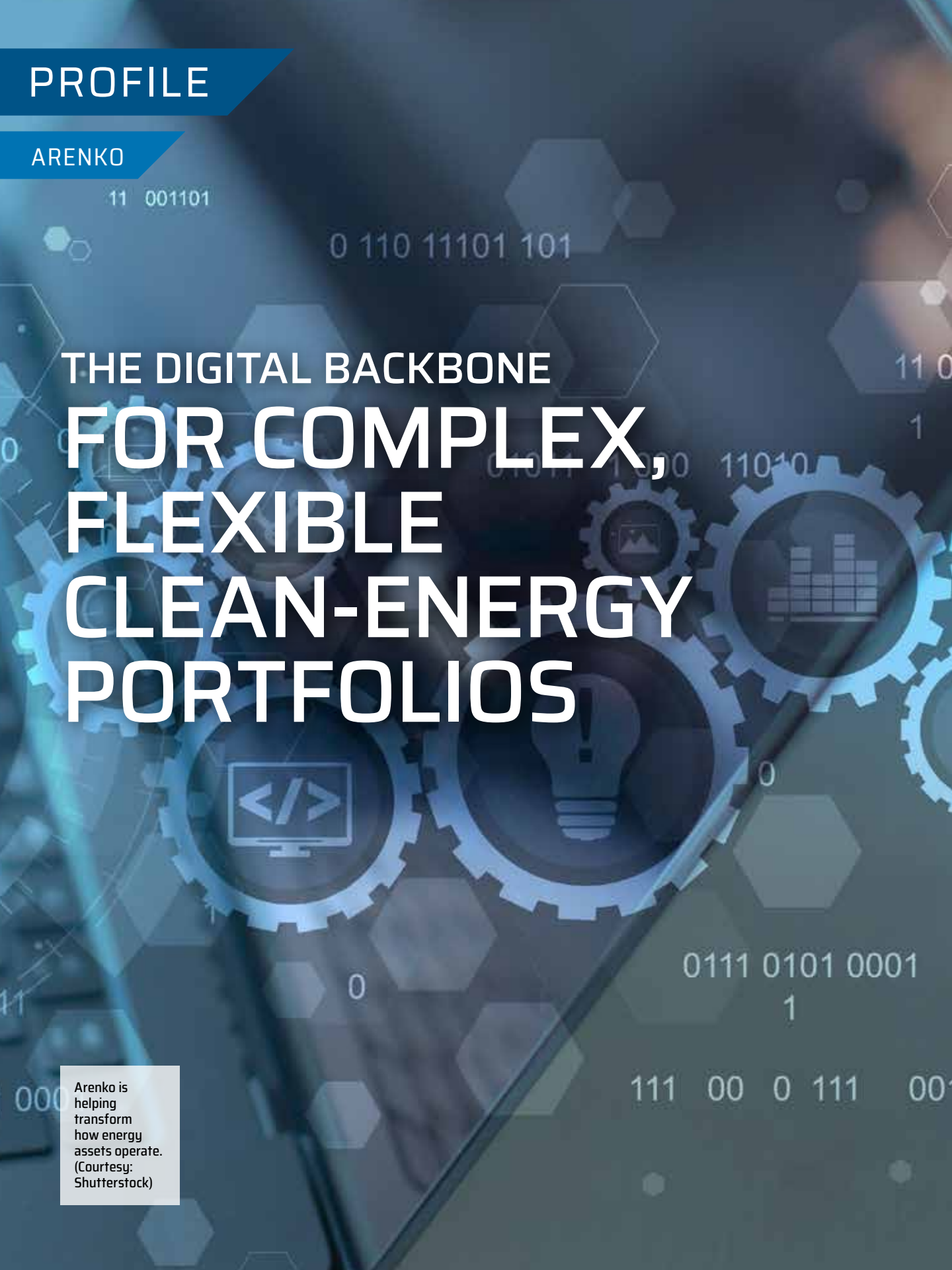
ABOUT THE AUTHOR

Chris Buckle is commercial manager at Forum Energy Technologies.

PROFILE

ARENKO

THE DIGITAL BACKBONE FOR COMPLEX, FLEXIBLE CLEAN-ENERGY PORTFOLIOS



Arenko is helping transform how energy assets operate. (Courtesy: Shutterstock)

Arenko is the software company behind Nimbus, a platform that enables operators of complex, flexible clean-energy portfolios to manage and monetize their assets.

By KENNETH CARTER ◤ Wind Systems editor

When observing a wind farm from a distance, it's very easy to be lulled into the assumption that these gently spinning giants are part of a simple execution: wind to blade to generator to power. However, these massive machines — along with other renewable energy systems — are anything but simple, and it takes innovative algorithms and software to handle the day-to-day complexities.

One company that understands these complexities and is helping operators of flexible clean-energy portfolios to manage and monetize their assets is Arenko.

"There's so much complexity in the energy system in the way that markets have developed, especially as renewables and batteries have come on to market," said Carly Wright, senior business development manager at Arenko. "You're looking at new regulations, new laws, and new market opportunities. It's Arenko's responsibility as a solution provider and a partner to simplify that as much as we can — whether that's with automation or with data insights that point to the real source of truth across a portfolio. That's really where our philosophy is: ensuring that there's resilience in the product that we provide to our customers and that it's scalable across a portfolio."

Along with wind assets, Arenko supports companies managing portfolios of solar and battery storage through its Nimbus software platform. By reducing complexity and delivering significant value from Day 1, Nimbus plays a key role in accelerating growth – whether for a standalone BESS or renewables project, a handful of assets or a multi-gigawatt portfolio. It has three core modules:

- Nimbus Asset simplifies the complexity of site integrations by providing asset control capabilities and delivers high-resolution data.
- Nimbus Trade is a fully automated trading platform that's designed to maximize value.
- Nimbus Performance is an asset-management solution that provides whole site monitoring, making sure its operating and performing effectively and efficiently as well as its longevity.

"We've innovated and changed with the market," Wright said. "Now, as a software and technology provider, we are working over a number of different asset types. We're also expanding outside of our original market — which is the U.K. — and working in places like Germany, Ireland, and the U.S. as well."

CO-LOCATED ASSETS COMPETING WITH STANDALONE

One aspect of the growing world of renewables is the strategy of co-location — combining battery storage with wind or solar. Arenko has seen that by adding co-located BESS to wind and solar assets and using a fully automated trading strategy, these assets can match and, in some cases, even exceed revenue performance levels set by standalone BESS.

Arenko is helping transform how energy assets operate and the Nimbus platform has proved capable of adapting to very different renewable energy generation profiles. This is demonstrated through Arenko's partnership with Vattenfall at the Battery@Ray project, co-located with the Ray Wind Farm in Northumberland. (Figure 1)

"We trade the BESS on site around the wind asset to maximize revenue and value of that asset, through a combination of automated trading algorithms and a flexible constraints engine" Wright said.

"This project highlights the significant value that can be unlocked by combining advanced optimization, machine learning, and real-time market integration, and, as a result, won the hybrid project of the year back in 2024 at the Energy Storage Summit. Having supported this asset for about three years now, what's exciting is the development in the capabilities we've seen around wind and BESS working together really well.

We look at data and forecasts, and we use the core of the product we have, Nimbus, to ensure that any current obligations that the wind farm has — any PNs, etc. — are taken into account. We look at the weather, and we start to commit the BESS into the markets around those constraints."

In essence, Arenko is using as much headroom as it can around the wind farm to create value from the BESS asset, according to Wright.

"There's flexible intraday trading as well," she said. "Every 15 minutes, we're reforecasting the wind and adjusting our trading and what the assets are doing."

In addition to working with the assets, Arenko also has a hand in maximizing grid connections, according to Wright.

"That's something that's really topical for our customers around their co-located projects in renewables is ensuring those very valuable grid connections they have are maximized as much as possible," she said. "A good example of this is at a separate site co-located with solar generation in the U.K. where the grid connection utilization has gone from 8 percent to 29 percent when we're working with them – more than tripling the productive use of the connection and placing the asset among the top 10 percent of U.K. battery projects for annualized revenue performance year-to-date." (Figures 2 and 3)

"We know there's a huge bottleneck around the world with connections to the grid," Wright said. "Utilizing these sites with retrofitting or just building new sites to take advantage of co-locating a battery with a wind or solar site is

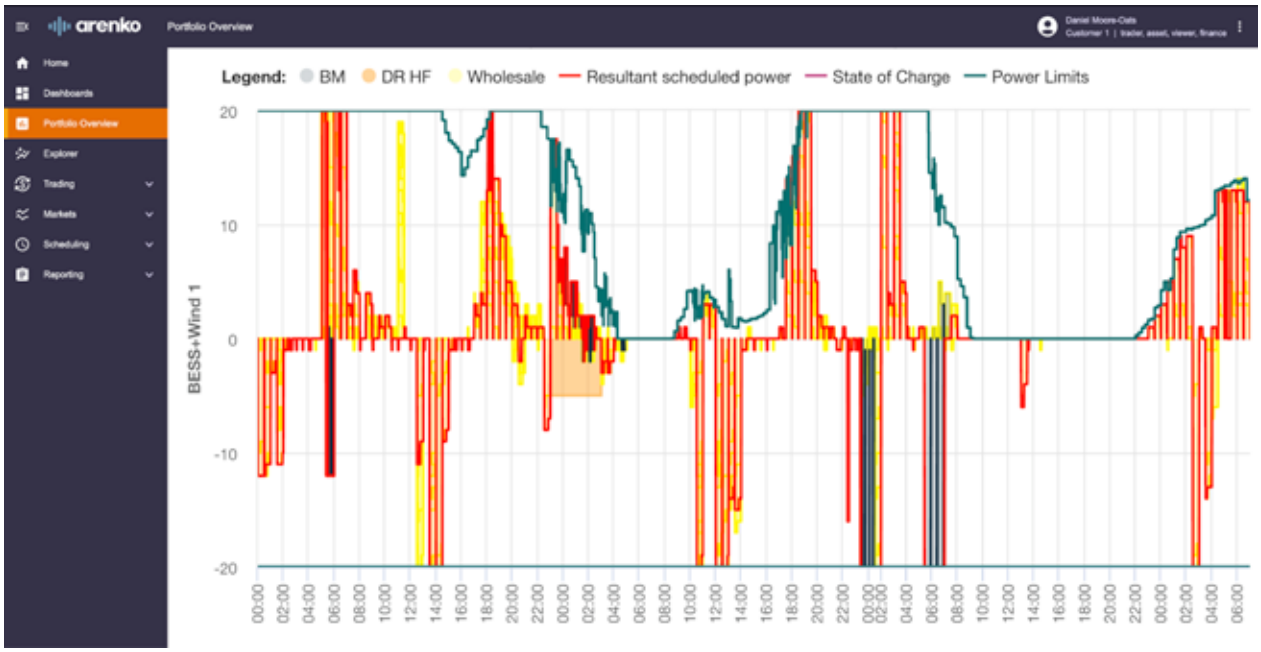


Figure 1: The Nimbus platform tracks real-time power limits, schedules, and state of charge (SoC) for co-located assets like the BESS and wind profiles at the Ray Wind Farm project. (Courtesy: Arenko)

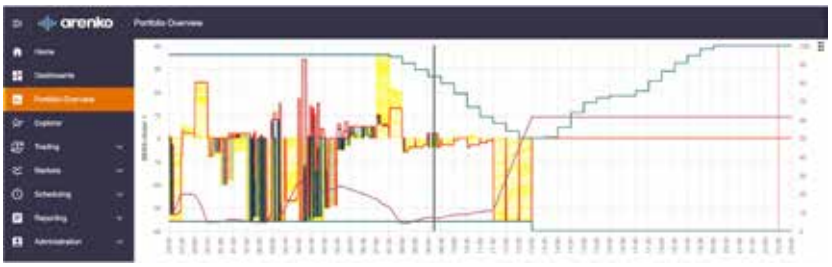


Figure 2: This visualization highlights the ability of Arenko's Nimbus platform to navigate complex site limits. As solar generation rises at 7:30 a.m., the platform dynamically manages BESS export constraints while executing a fully automated strategy, including pre-scheduling charging sessions to ensure readiness for peak evening demand. (Courtesy: Arenko)

really important. That data we're getting from the projects that we're already working on is not just great for our customers and for the ROI for their projects, but also for them getting additional projects green lit. This is starting to bleed out into the rest of the industry as well. Putting these batteries on these sites and building them as part of new sites is real revenue return and a real uplift for companies that we work with."

"That momentum for co-location looks set to be rolled out at pace," she said. "You're seeing countries start to loosen regulations. You're starting to see investment come in where there wasn't any before and that investment case is starting to build."

"You've got sites that will have more revenue opportunities where they're being built together — commercial models that are working across both the battery and the wind or both the battery and the solar," Wright said. "That really will additionally maximize the revenue even more because you've got one strategy across platforms."

WORKING WITH COMPLEX PROJECTS

Co-located renewable and storage projects are operationally complex, and solving those challenges is something that Nimbus excels at, according to Wright. These types of challenges arise when companies have portfolios that consist of new assets, old assets, or acquired assets where a lot of different data and technology types and commercial structures exist.

"That doesn't go away for co-located projects, of course," she said. "But one of the things that we're seeing is if you are looking at a site and they've got different commercial structures on the renewable or maybe it's got a PPA, you're trying to align those incentives and the responsibility across those assets.

Teams are working in partnership because they can see the value of working together. Now, one of those big complexities is starting to fall away, which is great. Technical challenges are always going to be there, but we're a really innovative industry. New technologies are going to continue to develop. We're going to have problems around those supply chains as well for parts, and that's something that people are working around.

They're adept at it. They're building that into their models for these sites and for these projects."

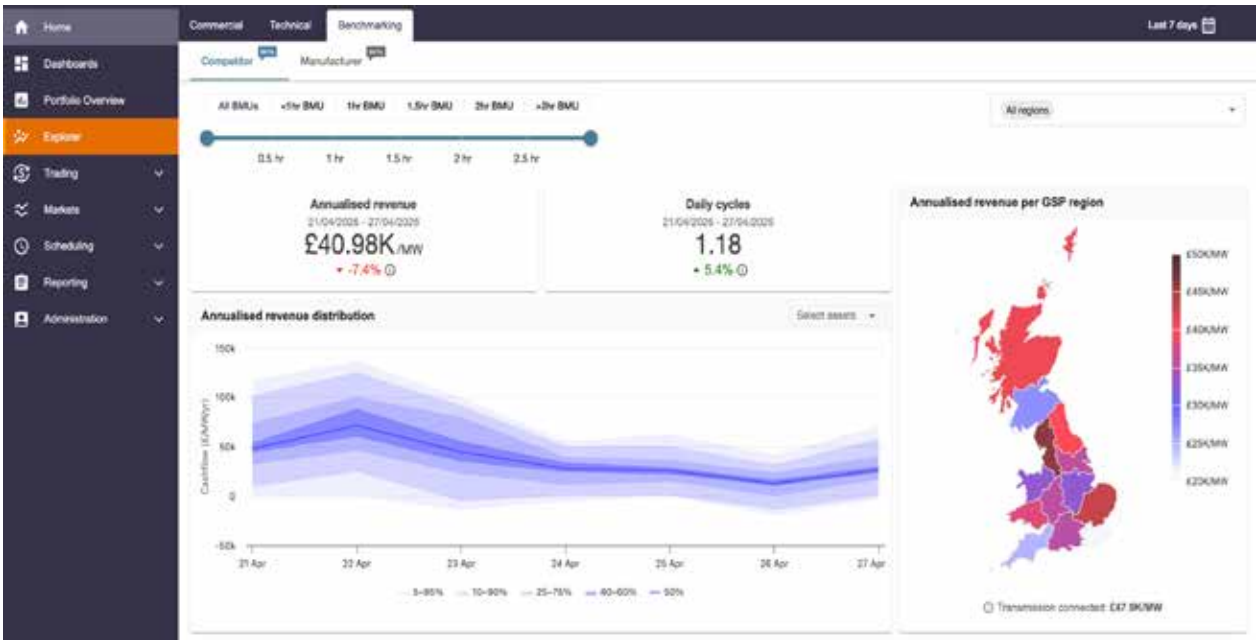


Figure 3: A broad view of the platform's ability to benchmark annualized revenue performance and daily battery cycling data across regional markets. (Courtesy: Arenko)

> The real-time data is really, really important to ensure that we can react quickly and take advantage of any opportunities within a market that we can bid into.

CO-LOCATION SUCCESS DEPENDS ON REAL-TIME DATA

Clean-energy companies are also racing to enhance their in-house capabilities to process huge volumes of technical and commercial data, empower trading teams, and make the transition to real-time, automated operations, according to Wright. Nimbus accelerates and de-risks this journey to flexibility. It offers a secure and versatile digital backbone, designed to extract, standardize and action data from increasingly sophisticated generation and storage assets. What makes this data so unique is that it is gathered in real time, according to Wright.

"We use 20 Hertz data, so it gathers incredibly fast sets of data that we're seeing because batteries need to react sub-second," she said. "The real-time data is really, really important to ensure that we can react quickly and take advantage of any opportunities within a market that we can bid into." In order to do that, Arenko needs to be flexible, according to Wright.

"We're a bit of a Swiss Army knife when it comes to how we work with our customers because we have to be quite modular and flexible," she said. "When you're working with a big utility or a complex organization with lots of subdivisions and competing priorities, they might have a tech stack that we need to insert ourselves into in order to maximize revenue for one of their assets, for example.

We're going to continue to take into account that this is a pretty rapidly evolving industry and innovate with our customers in order to get where we need to be. We've made sure that we're pretty involved in the market — roundtables, consultations, staying inquisitive — and interested in what's coming next."

CONTINUING TO GROW

As innovation continues and co-location opportunities reveal themselves, Wright said that she sees Arenko being at the forefront of that growth.

"We're adapted to it now," she said. "I see us continuing to be part of that — increasing the capabilities that we have in automating new trading markets and decision making that needs to happen around these different asset types and combinations. We'll continue to work on that. The future of the success of renewables and clean power is going to be to manage these complex markets and portfolios at scale. I see us being the digital backbone of enabling this transition with our customers and scaling into additional markets with them, for them, alongside them, and being that global single source of data standardization for them."

MORE INFO: arenko.group

The Nordics are set for a new phase of structural growth in electricity demand. (Courtesy: Shutterstock)

CONSTRUCTION

StormGeo report: Nordics set for growth

The Nordics are set for a new phase of structural growth in electricity demand with expected realization of green steel fabrication projects that can trigger a significant shift in the regional market landscape, according to the latest "Nordic Long-Term Market Outlook – 2050+' from StormGeo.

Expansion of fossil-free steel production using green hydrogen generated by electrolysis has taken a big step forward with developer Stegra recently securing key financing for its proposed 700MW plant in Boden, northern Sweden. "This brings the project a big step closer to maturity and can set the stage for other similar projects being developed," said Sigbjørn Seland, Chief Analyst at StormGeo. "Together with rapid expansion of AI data centers in the region, this can significantly boost local electricity consumption."

Improving wind project economics in the north can reduce the price gap with the southern zone where project development has been hit by permitting issues and local opposition, despite historically stronger market fundamentals and higher prices.

The business case for renewables development in the Nordics has been further strengthened by recent geopolitical instability that has raised fossil fuel supply risk, as well as prices.

Onshore wind is seen as the prime focus for expansion due to its low cost and scalability, while offshore wind needs subsidy support – with Denmark most proactive – and nuclear build-out is mainly seen in Sweden.

"Abundant renewable resources in the Nordics allow low-cost and low-carbon power generation to be secured at the domestic level, increasing regional security of supply," Seland said.

But the report states that capacity expansion hinges on opportunistic investments in a complex and fragmented market landscape, with future investments likely to be dictated by demand location and regional price dynamics. StormGeo analysts also envisage new financing models, such as compensation mechanisms, to facilitate onshore wind development in Norway and Sweden.

Chartwell has seen an increase in orders following AR7 and is expanding partnerships to support fleet transformation and diversification. (Courtesy: Chartwell Marine)

"Resource availability is now not the issue," Seland said. "The key challenge to capture value is to convert this potential into realized capacity in the right locations and at the right price."

MORE INFO www.stormgeo.com

CONSTRUCTION

Chartwell Marine: AR7 project renews confidence in wind

Auction Round 7 (AR7) has provided a welcome boost and renewed confidence for the U.K.'s offshore wind industry following a period of uncertainty. However, it also accelerates a broader trend: Projects are becoming larger, more complex, and are further offshore in deeper waters.

This shift will require a rapid transformation of the offshore wind support fleet to ensure projects are delivered efficiently, on time, and within budget. With AR7 and AR8 projects expected to be staggered, operators must also prepare for periods of fluctuating demand, making fleet versatility an operational and commercial priority, according to Chartwell Marine.

"AR7 is a major step forward for the offshore wind sector, restoring confidence and unlocking a new wave of vessel activity and investment," said Andy Page, managing director of Chartwell Marine. "However, based on past experience, market fluctuations are inevitable. It will therefore be essential for the industry to take a smart, flexible approach and develop fleets capable of supporting a wide range of commercial activities until AR7 and AR8 projects ramp up."

To build more effective, versatile and resilient offshore wind fleets, Chartwell Marine believes the industry must take the following steps:

Adopt next-generation vessel designs: Innovative designs, such as the Chartwell Courageous, Brevity SL & Brevity XL, can improve operational efficiency, flexibility, and safety in deep-water environments. These proven designs can also be built by U.K. shipyards, helping to comply with local content requirements and strengthening regional supply chains.

Invest in supply chains: Expanding shipbuilding capacity, scaling stockbuild programs, forming industry partnerships, and investing in workforce skills will be critical to delivering the next generation of vessels.

Smarter use of existing boats: Ensuring current vessels can be used for multiple roles will help operators manage demand cycles and maintain financial resilience. This may include "re-energizing" existing tonnage through retrofits that enhance sustainability and operational performance.

"Incorporating new vessels is only part of the solution to meeting the challenges facing the offshore wind support fleet," Page said. "The industry also needs to maximize the value of the existing fleet to remain competitive and resilient through future market cycles. At Chartwell, we are committed to delivering proven, next-generation designs and building stronger industry partnerships that

Buena Vista Wind Farm has been refurbished with blade enhancements and modernized control equipment. (Courtesy: DWT)

facilitate the transformation and diversification of the fleet."

MORE INFO www.chartwellmarine.com

CONSTRUCTION

DWT completes Buena Vista Wind Farm refurbishment

DWT has completed a 38-MW refurbishment project at the Buena Vista Wind Farm in California for LRE (Leeward Renewable Energy). The project began in August 2025 and was delivered on schedule in December 2025, reflecting DWT's execution and integrated Engineering, Procurement, and Construction (EPC) capabilities.

This marked DWT's first refurbishment project with LRE and stood as a testament to strong collaboration, seamless coordination, and disciplined execution between both teams. Through teamwork and proactive planning, the companies maintained schedule integrity while navigating demanding site conditions.

The refurbishment project included comprehensive upgrades across all 38 turbines, consisting of blade enhancements and bladework improvements; oil and hydraulic system upgrades, control equipment modernization, and power plant control system enhancements.

"We are proud to have successfully delivered the project on time and on budget," said Melf Lorenzen, CEO of DWT. "This achievement demonstrates the strength of our team and our close collaboration with LRE. By aligning technical expertise with clear communication and joint problem-solving, DWT and LRE ensured smooth implementation across all scopes of work. Even while facing weather interruptions, the teams maintained momentum and achieved completion without schedule delays."

The completion of the refurbishment and the execution of the long-term service agreement underscore DWT's capabilities in turbine refurbishment and overhaul in the U.S. market and its position as a partner for lifecycle wind asset management.

MORE INFO www.dwtglobal.com

INNOVATION

Vaisala launches RM60 precipitation sensor

Vaisala has launched PRECICAP® Radar Precipitation Sensor RM60, the first precipitation sensor built to solve the problems of conventional precipitation gauges at network scale.

Where conventional gauges collect and count rainfall mechanically, RM60 uses patented radar technology to measure each falling raindrop, snowflake, and hailstone individually as it passes through the air. Because RM60 does not rely on catchment, it is not subject to the physical losses that affect conventional gauges. That means more detailed data: not just how much rain fell, but how hard it was raining, what type of precipitation it was, and the size distribution of the drops.

Flood warnings depend on accurate precipitation data; so do reservoir operations, hydrological models, and the climate records used to assess how rainfall patterns are shifting. Getting that data right depends on sensors that work reliably, in the worst conditions, and the most difficult locations, precisely when it matters most.

The data they produce runs consistently low, because the mechanical collection process loses precipitation to wind, evaporation, and freezing. That bias runs through every network and every model built on it. Correction factors help, but they are inconsistent across networks and cannot fully compensate.

In many of the locations most vulnerable to flash floods and debris flows, such as remote mountain slopes and exposed catchments, there are no gauges at all. Conventional gauges require regular on-site maintenance, which makes remote and exposed sites too costly to equip. When intense rainfall hits an unmonitored slope, there is no data to trigger a warning.

"For over a century, precipitation gauges have measured too low," said Anne Jalkala, EVP, Weather, Energy, and Environment at Vaisala. "Not because of how networks were designed or operated, but because of a physical limitation built into the technology itself, one that the entire field had learned to work around. Our engineers

RM60 uses patented radar technology to measure each falling raindrop, snowflake, and hailstone. (Courtesy: Vaisala)

thought differently, and proved it with RM60."

RM60 delivers better ground truth for weather radar networks and richer inputs for forecast models and hydrological simulations. The result is more complete, more trustworthy data for the forecasters, hydrologists, and infrastructure operators who depend on it, and ultimately for the communities whose safety depends on their work.

RM60 has been field-deployed since 2020, with dozens of units operating across a range of climates and environments. More than 700,000 hours of field data cover conditions from subarctic winters to tropical rainfall and high-wind Atlantic conditions.

Over its lifecycle, RM60's cost of ownership is substantially lower than a conventional tipping-bucket station, due to the elimination of maintenance visits, infrastructure requirements, and consumables. A tipping-bucket gauge typically requires at least four maintenance visits per year. RM60 requires none. It can run on a compact solar panel and battery and mounts on a standard mast, making it practical across the full network, including sites that have historically been too costly or difficult to equip. RM60 requires no cleaning, no calibration, and no field visits throughout its service life, and its design eliminates the wind errors that affect conventional gauges without any additional infrastructure.

MORE INFO www.vaisala.com/rm60

INNOVATION

ONYX Insight launches ecoBLADE to cut wind-farm costs

ONYX Insight, a provider of predictive analytics for the global wind industry, recently announced the launch of ecoBLADE, a condition monitoring system providing continuous visibility and analysis of blade behavior and health, unlocking savings for wind farm owners and operators worldwide.

EcoBLADE provides continuous monitoring of health from within an individual blade. With two 3-axis accelerometer sensors per blade, it can detect cracks, structural faults, and other damaging behavior early – even short-lived and high-energy events. This information provides owners and operators with vital and early intelligence to address issues weeks or months before they escalate into something potentially catastrophic.

This early detection provides ecoBLADE users with 10–100x cost savings, potentially higher for offshore turbines, within a short period. Some costs are relatively straightforward to calculate, such as a $300,000 to $500,000 blade replacement, or a complete turbine replacement, which can exceed $5 million. Indirect costs include the impact of business interruption, which can average about $100,000 per day in lost revenue.

"For too long, blade management has been defined by what operators find out too late – damage that's already progressed beyond the point of targeted repair," said Alexis Grenon, CEO of ONYX Insight. "EcoBLADE changes that fundamentally, giving teams continuous intelligence from inside the blade itself so they can act at the point when intervention is still feasible, targeted, and dramatically less costly."

EcoBLADE can detect even minor issues before they are allowed to escalate to potential blade failures, losses, full turbine collapse, or even whole-site shutdowns. By continuously analyzing blade behavior and health, ecoBLADE gives operators the intelligence to run smarter and better-informed operations that prevent damage by providing insights into blade dynamics, fatigue and lifetime extension, and blade-specific conditions causing damage.

EcoBLADE identifies damage at the point when an up-tower repair is still viable, enabling operators to shift from reactive inspections to predictive maintenance powered by real-time alerts. As wind turbines grow larger and blade designs push further against engineering margins, the complexity and cost of blade failures is increasing. In the U.S. alone, blade maintenance exceeded $1 billion in 2025 for the first time, according to Intelstor, and that figure is growing. Blades are composite structures where manufacturing variability, operational age, and environmental conditions all contribute to internal defects that can escalate into structural failures with little external warning.

Blade health monitoring is typically focused on annual drone inspections. While advances in drone technology have made these efficient at identifying slow-developing defects, there are limitations. Drones can only see what's visible externally, and generally only while the turbine is not in operation.

Lengthy intervals between drone inspections mean failures developing over a short period of time frequently go undetected. This means operators miss the opportunity to make low-cost, targeted repairs before they escalate.

Structural degradation deep within the blade, subsurface cracking, and bond-line failures are invisible until they've already become problematic and expensive. Combining drone technology with ecoBLADE provides thorough tracking of both internal and external blade conditions, giving windfarm owners and operators added comfort through a comprehensive view of individual and site-wide blade health.

"Drivetrain condition monitoring has become an industry standard over the last decade, proven to reduce O&M costs and increase turbine availability; blade CMS is now on the same trajectory and the technology is ready," Grenon said. "Every year, tens of thousands of new turbines are being installed around the world, and the sector continues to assert itself as a key source of clean energy. The scale of investment at risk makes intelligent asset protection a commercial necessity for businesses in the wind industry; ecoBLADE was created to do exactly that: maximize the productive life of every blade, on every turbine, across entire fleets."

EcoBLADE is the result of more than a decade of combined OEM-validated R&D, informed by engineering projects, rigorous testing, refinement, and deep technical expertise.

MORE INFO www.onyxinsight.com

Fraunhofer's Floating Lidar System is the first to reach Stage 3+ achievement. (Courtesy: Fraunhofer)

INNOVATION

Fraunhofer Lidar system is first to reach Stage 3+

Following its certification as Stage 3 in 2024, the Floating Lidar System (FLS) developed, manufactured, and operat-

ed by the Fraunhofer Institute for Wind Energy Systems IWES, is the first FLS to achieve Stage 3+ under the third version of the OWA Roadmap (2025). This milestone demonstrates refined accuracy and the capacity to deliver viable Turbulence Intensity (TI) measurements.

By providing validated TI measurements, the Fraunhofer IWES Wind Lidar Buoy reduces uncertainty in offshore wind site assessment and strengthens the basis for site suitability assessments and bankable project decisions. Fraunhofer IWES commissioned Oldbaum Services Ltd. to independently assess an extended body of evidence. Stage 3+ designation is the highest level of commercial acceptance validation under the Carbon Trust OWA Roadmap for floating Lidar technology.

"We are proud to be able to demonstrate to the offshore wind industry that we can reach this latest pre-normative milestone, and that our research efforts translate into further methodological and accuracy advancement to the benefit of our clients." said Loís Legendre, Project Manager Wind Measurement at Fraunhofer IWES.

Maximizing the quality of the field measurements is very important to provide the best possible estimate of the wind conditions and the expected energy yield of a wind farm derived therefrom.

Offshore verification trials prove that the TI measurements of the Fraunhofer IWES buoy fully satisfy all requirements defined in the Carbon Trust Roadmap. This was achieved by Fraunhofer IWES's recent scientific advancements, published in peer-reviewed publications, which allow the derivation of high-accuracy TI data using a high-frequency, deterministic motion compensation method. This advanced approach for Floating Lidar System compensates for motion effects directly at the line-of-sight level by combining high-frequency motion data with time synchronized lidar measurements.

As a purely physics-based approach, the method offers full transparency and traceability, without dependence on black-box models or machine learning. It does not rely on training data and is not site dependent. The algorithm improves the precision and reliability of TI measurements, provides deeper insight into offshore atmospheric turbulence, and builds confidence in the data.

MORE INFO www.fraunhofer.de

MAINTENANCE

AMSOIL announces marketing deal with Repsol

AMSOIL Inc. recently announced a strategic distribution agreement with Repsol Lubricants under which Repsol Lu-

AMSOIL Inc. recently announced a strategic distribution agreement with Repsol Lubricants under which Repsol Lubricants will market and sell AMSOIL Wind products. (Courtesy: AMSOIL)

bricants will market and sell AMSOIL Wind products, including proprietary AMSOIL Synthetic Power Transmission Gear Oil (PTN) products, across Europe and South America. The agreement expands the global availability of AMSOIL Wind products and combines advanced AMSOIL lubricant technology with Repsol's extensive international reach and strong presence in the energy sector.

AMSOIL Wind products are engineered to meet the demanding requirements of wind-turbine applications, helping operators improve equipment reliability, extend component life and reduce maintenance costs. AMSOIL Synthetic Power Transmission Gear Oil (PTN) is at the center of the agreement, a proprietary line of premium synthetic gear oils developed to provide exceptional protection against micropitting, wear, oxidation, and sludge formation in heavily loaded wind turbine gearboxes.

"Partnering with Repsol Lubricants represents an important step in our global growth strategy for the wind-energy market," said AMSOIL General Manager, Global Wind Paul Swenson. "Repsol's presence in key wind energy regions will allow more operators to benefit from the proven performance of AMSOIL Wind products."

Under the agreement, Repsol Lubricants will offer the AMSOIL Wind portfolio to customers to countries across Europe and South America where it maintains a direct sales and service organization. The companies will work together to support wind-farm owners, operators, and maintenance providers with products, technical expertise, and field support.

"By adding AMSOIL Wind products to our portfolio, we are able to offer customers a premium lubricant solution designed specifically for the challenges of modern wind turbines," said Director, Repsol Lubricants Clara Velasco. "The AMSOIL Synthetic Power Transmission Gear Oil (PTN) family delivers outstanding performance and complements our commitment to helping customers improve reliability and lower operating costs."

The AMSOIL Synthetic Power Transmission Gear Oil (PTN) family has a strong record of successful use in wind-turbine gearboxes operating in harsh environments and extreme temperatures and carries approvals from every major gearbox and turbine manufacturer supplying the market today. Its advanced formulation helps maximize oil life, reduce downtime and protect critical gearbox components under the most demanding conditions.

Product availability begins in select Repsol markets during the second quarter of 2026 and expands through the year.

MORE INFO www.amsoil.com

MANUFACTURING

Flender begins Brazil wind-energy operations

Flender has started operating its new location in Brazil, strengthening its presence and service offerings in South America, especially in the wind-energy sector, but also in the broadly diversified industrial business. This move follows the acquisition of the service business for wind turbine and assimilated industrial gear units from Wärtsilä Brasil Ltda., which started as a partnership in 2018 and represents the natural progression of this collaboration.

By taking the strategic decision to assume the business lead and establish a direct presence in Brazil, Flender has sealed its commitment to supporting customers locally. Through the acquisition, the gear unit service business, including its service workshop in Cabo de

Flender has started operating its new location in Brazil and is strengthening its presence and service offerings in South America. (Courtesy: Flender)

Santo Agostinho, 35 kilometers south of Recife, Brazil, has been transferred to Flender.

With the EU-Mercosur trade agreement taking effect on May 1, Flender is strengthening its foothold in one of South America's most dynamic industrial markets at exactly the right moment. Brazil's strong position in renewable energy — from wind to hydropower — creates ideal conditions to deepen customer partnerships and grow the company's local service capabilities.

"The establishment of our own location in Brazil is a logical step in advancing our service business in South America," said Andreas Evertz, CEO of Flender. "It lays the foundation for long-term growth, further investments and even closer collaboration with our customers across the region."

The facility, opened in 2022, spans 5,000 square meters and is equipped with testing capabilities for wind-turbine gear units of current power classes. It is the first facility in Latin America with such capacity and provides a solid foundation for Flender's service activities. The focus is on the installed base of wind turbines in the region, with priority given to continuing to serve local customers with excellence through investments in local spare parts and equipment to boost availability and shorten lead times. Flender is also considering future growth opportunities, such as upgrading test bench and lifting capabilities to service larger and next-generation wind turbines drive trains in South America, which have expanded over the last six years.

With the acquisition, Flender welcomes the Wärtsilä Brazil gears service team, including staff from sales, workshop team, and general management. This integration of qualified specialists will further enhance operational capabilities and outstanding customer service in the region.

The takeover benefits Flender's global service network. Next to the wind business, the new location opens growth opportunities for industrial gear units, industrial customer service, couplings, and generators, further strengthening the company's market presence.

"With the opening of the location in Brazil, we are ready from day one to serve our customers locally," said Antti Turunen, VP Wind Service. "Thanks to the long-standing cooperation with Wärtsilä as a service partner, we already have an established network, local expertise and a deep understanding of the Brazilian market. We are now building on this strong foundation."

The official signing was August 18, 2025. With the final, unconditional approval from the Brazilian competition authority (CADE), the transaction has now been completed.

MORE INFO www.flender.com

MANUFACTURING

Vestas receives 186-MW order from EDF Power Solutions

Vestas has received a 186 MW order from EDF Power Solutions North America to supply 28 EnVentus V162-6.2 MW wind turbines and two EnVentus V162-6.0 MW wind turbines for the Forêt Domaniale wind project in Québec, Canada. The order includes a 10-year Active Output Management (AOM) 5000 service agreement. Once operational, Forêt Domaniale will provide clean and secure energy to tens of thousands of Québec homes while supporting local job creation and industrial development.

The 186-MW Forêt Domaniale order builds on a series of EnVentus projects with EDF in Québec in 2025, including the 275 MW Madawaska project and the 124 MW Haute Chaudière wind project. Together, these projects amount to almost 600 MW of EnVentus orders in the province, underscoring the momentum behind wind development in Québec.

"Forêt Domaniale represents our third project with EDF Power Solutions North America in Québec in just the past year, underscoring the strength of our collaboration and the impact that world class technology paired with

proven supply chain expertise can deliver," said Laura Beane, president, Vestas North America.

"Through continued investment in Québec's energy future, we are helping unlock large scale renewable development across the province. With Hydro Québec targeting 10 GW of wind capacity by 2035, momentum is clearly accelerating, and partnerships like this are essential to turning that ambitious vision into reality."

Delivery of the turbines is expected to begin in the second quarter of 2027, with commissioning scheduled for the fourth quarter of 2027.

"Our collaboration with Vestas continues to be a cornerstone of our success, and Forêt Domaniale Wind — the third project secured through Hydro-Québec's call for tenders — is a strong reflection of that," said Tristan Grimbert, president and CEO of EDF Power Solutions North America. "We are proud of this collaboration and remain deeply committed to playing a meaningful role in shaping Québec's energy future."

Vestas is a leader in Canada's onshore wind market, with an installed base of more than 5 GW across all 10 provinces and a supply chain supported by more than 300 local suppliers. The Forêt Domaniale project builds on a milestone year for Vestas in Québec in 2025, marked by new turbine sales and construction and commissioning milestones that will deliver more than 1 GW of clean energy impact.

"As a technology leader with deep local expertise, we're able to deliver projects that reflect exactly what our customers need; reliable performance, execution excellence, and long term value," said Jeff Fuchs, senior vice president, Onshore Sales, Vestas North America.

"We are committed to supporting our customers and the province with solutions that deliver meaningful, lasting benefits for communities for generations to come."

As part of a shared commitment to strengthen local manufacturing and job creation, EDF and Vestas have partnered with Québec-based Marmen

Vestas has received a 186-MW order from EDF Power Solutions North America to supply turbines in Canada. (Courtesy: Vestas)

as the tower supplier, supporting 150 direct jobs in Matane.

"Forêt Domaniale is a strong example of how sustained collaboration between developers, OEMs and local manufacturers can advance the energy transition while strengthening the regional economy," said Vincent Trudel, President and CEO, Marmen.

MORE INFO www.vestas.com

MANUFACTURING

Leitwind selects Recyclamine epoxy system

Aditya Birla Advanced Materials recently announced that Leitwind, a manufacturer of wind-turbine systems, has selected Recyclamine® recyclable epoxy system for the newest generation of its LS20.X wind-turbine blade. This milestone demonstrates the growing industry confidence in Recyclamine as the benchmark for next generation recyclable composite solutions and reinforces Leitwind's commitment to enabling truly circular solutions for wind energy blades.

By integrating Recyclamine into the resin system as well as the bonding paste, Leitwind is embedding recyclability at the core of its blade manufacturing process.

These two materials are essential structural components of any wind-turbine blade, and incorporating Recyclamine enables true recycling of blades at end of life, addressing one of the most pressing sustainability challenges facing the global composites sector.

The first prototype set of LS20.X_MK2 blades is now under production, designed for installation on Leitwind's proven LTW42 wind-turbine generator. A dedicated test blade will also undergo a validation program later this year, including structural certification under IEC 61400-23 and lightning protection testing under IEC 61400-24.

This initial pilot, comprising four LS20.X_MK2 blades, represents the beginning of a strengthened collaboration between Aditya Birla Advanced Materials and Leitwind.

Following the successful integration of Recyclamine into this blade design, Leitwind is evaluating a phased rollout of the technology across its broader portfolio, including the LS39 and LS44 platforms for the LTW80 and LTW90 turbine generators.

As global demand for sustainable, circular, and regulation compliant composite materials accelerates, the adoption of Recyclamine positions Leitwind at the forefront of environmentally responsible blade manufacturing.

MORE INFO www.leitwind.com

REAL-TIME WAVE MEASUREMENTS: GANGWAY SAFETY'S MISSING LINK

Real-time wave data provide a direct view of conditions at the turbine location. Combined with vessel motion prediction, it allows operators to assess whether gangway transfers can be carried out safely. (Courtesy: Adobe Stock)

Live monitoring of waves supports vessel stability, protects equipment, improves planning, and minimizes downtime across a range of offshore operations.

By LARS IVAR LEIVESTAD

An urgent safety notice issued by the U.K.'s Health and Safety Executive (HSE) served as an important reminder of the need to keep gangway safety high on the energy industry's safety agenda.

The regulator called on oil, gas, and renewable energy operators to review their gangway systems following fresh reports of motion-compensated gangways (MCG) retracting without warning. This latest alert comes just one year after a similar warning, which followed a series of serious injuries offshore.

MCGs are used across the energy industry for transferring personnel and equipment between vessels and offshore assets, such as oil platforms or wind turbines. They are designed to withstand the motion caused by wind and waves, creating a stable platform. However, despite their advanced technology, MCGs have been shown to experience failures in adverse conditions, resulting in auto-retraction.

The notice from the HSE warned that sudden, unannounced retraction can lead to personnel facing hazards, including falling onto the gangway, being struck by moving parts, or falling from height.

FORECASTS HELP PLAN THE OPERATION

While operators are taking action to address the concerns highlighted in the HSE's notice, one proven solution that could have an immediate impact is real-time ocean monitoring. The issue is not only whether a gangway system can react when limits are exceeded, it is whether the crew has a reliable view of the conditions before people are exposed on the gangway.

In gangway operations, risk can increase when the conditions used for planning no longer match the conditions at the vessel. Forecasts are essential, but they are not the same as measured reality. If local wave height, wave period, wave direction, or vessel motion moves toward operational limits, crews need to know before the gangway system is forced to react.

THE TRUTH LAYER BENEATH EVERY OPERATIONAL DECISION

Forecasts play an important role in offshore planning. They help teams prepare, schedule, and assess whether a weather window may be suitable. But during walk-to-work operations, the critical question is not only what was forecast, it is what the sea is doing at the vessel, right now.

That distinction matters.

Gangway transfers happen in a live environment where sea state, wave direction, wave period, and vessel motion can change faster than a forecast can reflect. A forecast may say conditions are within limits, while the actual local sea state tells a different story. The reverse can also be true. Without real-time measurements, operators are left to make critical decisions from estimates, experience, and delayed information.

WHERE REAL MEASUREMENTS BECOME THE TRUTH LAYER

Real-time sea state data give crews and decision-makers a grounded view of the conditions they are actually operating in. It helps verify whether the operational model reflects reality. It gives AI and prediction tools a reliable foundation to work from, rather than forcing them to depend only on assumptions or broad-area forecasts.

That point is important. AI does not remove uncertainty by itself. A model is only as strong as the data it is built on and continuously checked against. In offshore operations, prediction without measurement can become a polished estimate. Prediction grounded in real-time measurement becomes operational intelligence.

For gangway safety, this truth layer can support better decisions before people are exposed. Captains and gangway operators can see whether conditions are moving toward or away from operating limits. Marine coordinators can better judge whether to proceed, pause, or wait. HSE leaders can build stronger assurances around how transfer decisions are made and documented.

The goal is not to replace human judgment. The goal is to give experienced people better evidence in the moments it matters most. When personnel are stepping from a moving vessel onto an offshore asset, assumptions are not enough. Forecasts help plan the operation. Real-time measurements help protect the transfer.

While sudden changes in wave height, period, or direction can create unsafe conditions for MCGs, these are not always visible with enough local detail or timing in a forecast alone. Real-time wave measurement and monitoring give offshore teams continuous visibility of actual sea conditions, offering an additional safety measure that strengthens the forecast-based planning process with measured truth from the operating location. By measuring the local sea state in real-time, operators can make informed decisions about when to safely deploy MCGs and minimize weather-related risks. They can also document that decisions were based on actual conditions, not assumptions alone. That matters for captains, marine coordinators, HSE teams, and everyone stepping onto the gangway.

THE ROLE OF WAVE AND MOTION PREDICTION

This is the role Miros plays, turning the sea state from an assumption into a measured input for operational decisions. Its wave measurement solutions deliver real-time sea state data directly at a vessel's location. Meanwhile, its PredictifAI

Example of a Miros real-time data dashboard showing sea surface conditions. Installed on turbines, substations, or vessels, Miros' wave sensors deliver continuous, location-specific data on wave height, period, and direction, along with derived insights such as wave spectra and vessel response in all weather conditions. (Courtesy: Miros WaveSystem)

Anticipate waves and vessel motion that exceed operating limits ahead of time. Miros' PredictifAI technology automatically adapts to varying sea and weather conditions to continuously provide optimal results. PredictifAI provides deterministic prediction of ocean waves and vessel motion. (Courtesy: Miros PredictifAI)

technology is developed to continuously adapt to changing weather and ocean conditions to provide optimized wave and vessel motion predictions. The value is not prediction for its own sake. The value is prediction grounded in measured reality. That is what gives crews a stronger basis for deciding whether to continue, pause or stand down.

PredictifAI can reliably anticipate and verify incoming waves from as little as one meter in height up to two minutes before they reach the vessel, giving crews critical warning of disruptive motion. In walk-to-work operations, that warning time can be the difference between starting a transfer and waiting for a safer moment. This level of foresight helps operators avoid risky gangway transfers in marginal conditions, dramatically reducing the likelihood of unexpected retractions and incidents.

INDUSTRY-WIDE ADOPTION TO SAFEGUARD GANGWAY SAFETY

While real-time wave measurements, as well as wave and vessel motion prediction technologies, are available today and already used in demanding offshore environments, they have not yet become standard industry practice. Whether due to resistance to change or a lack of regulatory pressure, many operators have yet to adopt real-time wave monitoring as a standard safety measure for gangway operations.

With two safety alerts about MCGs issued in the space of a year, the message from the HSE is clear: The current approach to managing MCGs is not sufficient. The industry should not treat this only as a gangway equipment issue. It is also a decision-quality issue. Do teams have enough measured information before they expose people to the transfer?

Miros' technology directly addresses the risks raised and can support operators to avoid the risk of sudden retractions. The benefits also extend beyond this specific safety challenge. Real-time wave monitoring informs workers of waves and vessel motion that exceed operating limits ahead of time, allowing for better timing of offshore operations such as crane usage and optimizing instrument deployment, for example, ROVs.

Overall, live monitoring of waves supports vessel stability, protects equipment, improves planning, and minimizes downtime across a range of offshore operations. However, the question remains: How long will the industry accept that critical transfer decisions are being made without access to a real-time layer of measured truth directly from the vessel itself?

ABOUT THE AUTHOR

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