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CONVERSATION

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CEO and Co-Founder | Youwind Renewables

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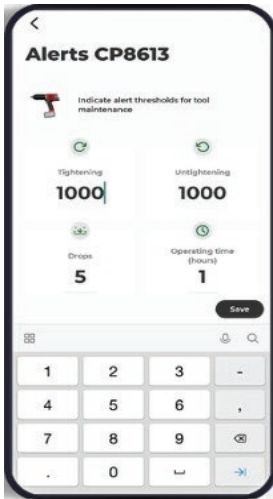
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END-OF-LIFE CONSIDERATION

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Exploring blades, repowering, and more

With an ambitious plan to ensure the U.S. achieves a 100 percent clean-energy economy and reach net-zero emissions by or before 2050, it's important that we all do our part to ensure this becomes a reality sooner rather than later. Not only might the fate of the planet depend on it, but it just makes good business sense.

With that in mind, the October issue of *Wind Systems* tackles some important topics, many of which will be important to help the U.S. reach that goal, not to mention the rest of the world.

This issue focuses on blades and repowering — vital subjects that run the gamut from the micro to the macro.

With turbines growing in size and complexity as technology advances, maintenance becomes more of a challenge, particularly when these turbines reach the end of their life expectancy.

Our cover article from Payton Maddaloni looks at how digital twin technology has the potential to increase the lifespan of floating offshore wind turbines

through re-powering methods.


Blades arguably are subjected to the most wear and tear during their tenure, so it's vital that methods are employed to keep them going as long as possible.

In an article from Belzona's Chloe Hirst, she discusses how the lifespan of turbine blades can be extended more quickly and efficiently with the use of polymeric leading-edge protection.

Eventually, though, blades will need to be retired and replaced, but what happens to these massive objects once that is necessary? In our third inFocus article, Pitbull Shredding Solutions' Cody Earle shares his insights on how the need for effective end-of-life managements solutions — for not just wind turbines, but solar panels and lithium-ion batteries — are becoming increasingly important.

And be sure to check out this month's Conversation feature, where I had the pleasure of talking with Youwind CEO and co-founder Anna Rivera. In the article, she discusses her company's newest software development, Pixel+, and how it can streamline the complicated screening process involved with offshore wind projects.

You'll find all that and much more in our October issue. I hope you enjoy it. As always, thanks for reading!



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Report: Record-breaking 2nd quarter

From American Clean Power

The American Clean Power Association recently released its Clean Power Quarterly Market Report | Q2 2024, showcasing extraordinary growth and milestones across the U.S. clean-power landscape. In a record-breaking second quarter, U.S. developers added 11 GW of new utility-scale clean power capacity, marking a 91 percent increase from Q2 2023.

The strong quarter brought year-to-date installations up to 19 GW, more than double the five-year average for H1 installations. With the second half of the year typically much stronger than the first half for clean power additions, the stage is set for a second consecutive record-breaking year in 2024.

“Clean energy is answering the call to unleash more American energy, with another record quarter of deployment. While all clean-energy technologies are expanding their market share, energy storage is scaling at a stunning speed,” said ACP CEO Jason Grumet.

MAJOR MOMENTS

▸ **Record second quarter:** Developers added more than 11 GW of new utility-scale solar, storage, and wind capacity in the second quarter, 91 percent more than the same period in 2023.

▸ **Robust clean power pipeline:** The annual growth in the clean power pipeline increased by 13 percent from the previous year, with significant expansions expected in offshore wind in the coming months.

▸ **Onshore wind recovery:** At mid-2024, 5.5 GW more onshore wind projects were under construction than at the same point in 2023, bringing the total volume under construction up to more than 14 GW.

▸ **Historic volume of OSW under construction:** Q2 2024 set a record for the most offshore wind capacity under construction with more than 4 GW of capacity.

As the U.S. clean-power sector heads into the second half of 2024, the data indicates potential for another record-setting year. With more than 283 GW of clean power now operational, the industry continues to play a crucial role in modernizing our electricity generation.



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



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DIRECTION

THE FUTURE OF WIND



BOEM finalizes Maine offshore wind environmental assessment review

In support of the Biden-Harris administration's goals for deploying 30 GW of offshore wind energy capacity by 2030 and 15 GW of floating offshore wind energy capacity by 2035, the Bureau of Ocean Energy Management recently announced the availability of its final environmental assessment of the Wind Energy Area in the U.S. Gulf of Maine.

The final EA evaluated the potential issuance of commercial wind-energy leases off the coasts of Maine, New Hampshire, and Massachusetts. It considered the potential environmental impacts associated with activities such as conducting surveys and installing meteorological buoys, but not the installation of offshore turbines, which would be assessed in a separate environmental review if a leaseholder submits a project proposal. BOEM found that leasing and site assessment and characterization activities will not have a significant impact on the environment.

"BOEM is actively assessing proposed offshore wind activities in the Gulf of Maine by collaborating with Tribes, state and federal agencies, ocean users, local communities, and other stakeholders," said BOEM Director Elizabeth Klein. "We are committed to ensuring that future offshore wind development proceeds in a manner that reduces potential impacts on other ocean activities and the surrounding ecosystem."

MORE INFO www.boem.gov/renewable-energy

Pattern Energy names Rhodes as new CFO

Pattern Energy Group LP, a leader in renewable energy and transmission infrastructure, recently appointed Matt Rhodes as Chief Financial Officer, reporting to the CEO, Hunter Armistead.

"We welcome Matt to Pattern's executive leadership team, where he will

play a pivotal role in achieving our financial goals," Armistead said. "Matt will enhance the company's relationships with key financial institutions, and his strong track record of enterprise scaling and financial discipline will be instrumental in realizing Pattern's vision to Power the Future."

"I am excited to join the talented team at Pattern as they transform the energy markets and lead the industry across North America," Rhodes said. "Building on more than 15 years of success, the company is well-positioned to achieve its financial goals, and I look forward to helping achieve its mission to transition the world to renewable energy."



New Pattern Energy CFO Matt Rhodes. (Courtesy: Pattern Energy)

and market-based businesses, most recently as executive vice president, strategy and corporate development at Essential Utilities, Inc.

Previously, Rhodes served as managing director in Goldman Sachs' natural resources investment banking group leading coverage for more than 25 electric and gas utility companies. Rhodes has also held positions with Bank of America and Duke Capital Partners.

Pattern Energy is a privately-owned developer and operator of wind, solar, transmission, and energy-storage projects. Its operational portfolio includes more than 30 renewable energy facilities with an operating capacity of nearly 6,000 MW across North America.

MORE INFO www.patternenergy.com

Bureau Veritas acquires ArcVera Renewables

Bureau Veritas, a leader in testing, inspection, and certification services, recently announced the acquisition of ArcVera Renewables, a provider in finance-grade consulting and technical services for wind, solar, and battery storage projects worldwide. This acquisition is aligned with Bureau Veritas' LEAP | 28 strategy to create a new stronghold in the renewables sector.

Bureau Veritas contributes to the energy transition by providing the power sector customers solutions to meet the challenges of developing and operating renewable assets. This acquisition will expand Bureau Veritas's capabilities, primarily in North America, to support landowners, developers and owners, and investors in delivering their wind and solar farm projects.

ArcVera Renewables provides customers with technical site and resources assessments, and consultancy during the development and operations stages of utility-scale renewables projects. The company's engineers, technical, and subject matter experts support clients with risk reduction and ensure optimal asset performance. Since its inception, ArcVera Renewables has supported 9 GW of solar projects in North and South America and has evaluated projects now representing 93,000 MW of wind capacity in the U.S.

"ArcVera Renewables has built a reputation for excellence in due diligence and operational verification on renewable projects," said Hinda Gharbi, Chief Executive Officer of Bureau Veritas. "Their expertise will be a valuable addition to Bureau Veritas's portfolio of capabilities for the energy transition services. I warmly welcome all new colleagues from ArcVera Renewables to Bureau Veritas."

"We saw how the broad and deep technical prowess of Bureau Veritas



Riad Habib and Mike Davis (SVPs of Bureau Veritas), John Bosche (president, ArcVera Renewables), Greg Poulos (CEO, ArcVera Renewables), Sunil Gotmare (technical center sr. director, Bureau Veritas), Renato Catrib (SVP Growth Strategy & Sales, Bureau Veritas). (Courtesy: Bureau Veritas)

would be a powerful catalyst for ArcVera Renewables,” said Greg Poulos, CEO of ArcVera Renewables. “Since inception, our goal has been to accelerate the clean transformation of the world’s energy sector by delivering trustworthy, valuable, detailed, and independent technical analysis for the success of our clients. Joining Bureau Veritas is a leap forward in achieving this goal and is likewise transformational for the ArcVera team and its growing global renewable energy client-base.”

MORE INFO group.bureauveritas.com

Vaisala acquires Speedwell Climate to address weather risks

Vaisala has acquired Speedwell Climate Ltd, a leader in climate and environmental risk transfer. The acquisition enables Vaisala to enter the insurance segment with tools for organizations to protect themselves from financial losses caused by weather-related uncertainties.

Speedwell Climate provides data and software to structure, price, and settle index-based climate risk trans-



Speedwell Climate provides data and software to structure, price, and settle index-based climate risk transfer contracts. (Courtesy: Speedwell Climate)

fer contracts. The company serves various industries, such as insurance, investment funds, and renewable energy, with leading customers such as the CME Group.

Through climate risk transfer contracts, organizations can move their weather-related risks to a parametric insurance provider. This way, they can receive compensation in case of certain environmental or weather-related triggers, such as storms, floods, or heatwaves. Climate risk transfer is also vital for the energy transition as it protects renewable energy projects from financial risks due to the variable nature of wind and solar.

The acquisition strengthens Vaisala’s position as a leader in measurement instruments and intelligence for climate action. It aligns with the company’s strategy to build recurring revenue in data, creating opportunities to broaden offerings and scale growth within existing and new customer segments.

“The combined skills and dataset of Speedwell Climate and Vaisala Xweather bring new opportunities to help customers mitigate and adapt to climate change,” said Samuli Hänninen, head of Vaisala Xweather. “With weather becoming increasingly unpredictable, organizations need new tools to man-



Jack Van Den Brink, left, and S.C. Roe. (Courtesy: Mammoet)

age their risk position. We are very excited to welcome the skilled Speedwell Climate people to our team — together, we can turn weather anxiety into weather confidence.”

Founded in 1999, Speedwell Climate is headquartered in Harpenden, U.K., with a subsidiary in the U.S.. Following the acquisition, 24 professionals will transfer to Vaisala.

The acquisition of Speedwell Climate Ltd and its group companies is subject to regulatory approval and is expected to be closed in Q4 2024.

MORE INFO www.vaisala.com

Mammoet teams up with South Korea's Samyang Marine

In a move to support South Korea's growing offshore wind industry, Mammoet and Samyang Marine Group recently entered into a partnership.

This collaboration is set to establish Offshore Service Port (OSP) facilities to

serve projects across sectors in South Korea, with a focus on upcoming offshore wind projects. The partnership will integrate full-spectrum terminal management, including handling, staging, marshaling, and stevedoring services, with heavy lifting and installation capabilities.

The OSPs, in the ports of Busan and Masan, will cater to projects in South Korea and the broader Asia-Pacific region.

The partnership responds to the urgent need for an enhanced offshore wind supply chain and services to meet the ambitious targets outlined in South Korea's Renewable Energy 2030 implementation plan, which includes 14.3 GW of offshore wind by 2030. Crucial to achieving this target is the readiness of the supply chain, responsible for delivering the components and services vital for the construction of offshore wind farms.

“South Korea's offshore wind sector holds immense potential, and our partnership with Mammoet brings together local and international expertise to

provide comprehensive solutions for the industry,” said S.C. Roe, Chairman of Samyang Marine Group. “Together, we will deliver world-class services to support the construction and operation of offshore wind farms, driving the sector's growth.”

“We're excited to collaborate with Samyang Marine Group to address the critical challenges in South Korea's offshore wind market,” said Jack van den Brink, Mammoet Projects AMEA managing director. “This partnership is all about leveraging our combined strengths to create value and foster the growth of renewable energy in the region.”

Leveraging Mammoet's expertise in heavy lifting and integrated logistics with Samyang Marine Group's local knowledge and extensive terminal operations capabilities, this partnership represents a step in enhancing South Korea's offshore wind supply chain capabilities, supporting the country's renewable energy objectives. ↘

MORE INFO www.mammoet.com


A high-angle, close-up photograph of a white wind turbine blade extending from the top right towards the center of the frame. The blade is set against a vast, deep blue ocean that stretches to the horizon under a clear sky. In the distance, another smaller wind turbine is visible on the water. The overall scene is bright and clear, emphasizing the scale and isolation of offshore wind energy.

IN FOCUS

RE-POWERING ▸ BLADES & GEARBOXES

END-OF-LIFE CONSIDERATION FOR OFFSHORE TURBINES

As progress is being made for the beginning stages of a life cycle for floating offshore wind turbines, end-of-life has been looked at as a phase for the future. (Courtesy: Shutterstock)



Digital twin technology has the potential to increase the lifespan of floating offshore wind turbines through re-powering methods.

By **PAYTON MADDALONI**

With Mother Nature's clock ticking and as the climate shifts, renewable energy has become a heightened priority. The goal toward sustainable infrastructure is clear, but the road to get there is full of obstacles. Technology, as well as policy, has been developed to guide energy consumers in the right direction. However, the untapped market of the floating offshore wind turbine (FOSWT) has not yet begun on this journey. The primary assessment of the source's life cycle has been heavily discussed in the industry, but the end-of-life phase has been seen as an issue for the future. With tools and policy further discussed, they can be used in combination to not only extend the life of FOSWT farms but help limit the Earth's unnatural progression.

Karen Wilcox from the University of Texas, Austin reported on a technology that has the potential to increase the lifespan of a FOSWT. A digital twin is a personalized dynamic model of a physical system [8]. This can be compared to an Apple Watch for a human [8]. The watch creates personalized models based on the data collected from one's daily activities. These models adapt over the course of someone's life to then be used to form predictions on future behaviors. This technological methodology has been translated over into physical structures in the form of digital twinning. The concept has received backing from software and renewable energy companies including Bentley Systems, Siemens, and Nvidia.

EXPLORING DIGITAL TWIN TECHNOLOGY

Industry has been exploring digital twin technology in the form of sneakers and bridge removal. ASICS is using their digital shoe models and real-life data from feet to bridge the gap for the Perfect Consumer Product [6]. ASICS acknowledges that no two people have identical feet, and the digital twin software allows this mass customization. Each customer can have their shoes tailored not only to their lifestyle but to satisfy what their whole-body needs.

Additionally, the City of Denver used Bentley Systems iTwin IoT Software to monitor bridge vibrations [7]. There were 16 sensors placed, feeding the city a steady stream of data of bridge movement [7] shown in Figure 1.

Rather than rely on yearly inspections, specific movements that exceeded a design threshold would be flagged and brought to immediate attention. This allows the city to keep up with maintenance not based on anticipated routine but daily statistics, limiting the amount of bridge closures due to unforeseen damages. The digital twinning software concept has been brought to life in many forms and making it transferable to floating offshore wind turbine maintenance with the possibility of end-of-life extension.

FLOATING OFFSHORE WIND

The floating offshore wind turbine industry has tremendous opportunity since President Joe Biden's climate agenda back in 2021 was given the federal greenlight. The race to launch a floating wind farm began and companies are backing researchers to experiment with their designs. California and Maine have made the most headway toward officially



Figure 1: Construction worker placing IoT sensors [7].



Figure 2: Design of the VoltturnUS [9].

launching farms along their respective coastlines. In May 2024, Maine received approval to lease out coastal waters 45 miles from Portland with 12 turbines with 144 MW of energy [1]. This will allow researchers to not only study the area but interactions with the marine environment, fishing industry, and navigation routes. The University of Maine is at the forefront of design with their patented technology known as the VoltturnUS. This design was based on the shape of an upside-down bridge shown in Figure 2 [1].

In June 2024, RWE-backed survey work began off the coast of Northern California [2]. UV (autonomous underwater vehicles) were used to conduct the surveys including the determination of where anchors, cables, and the actual turbines will be placed [2]. The site is 28 miles off the coast of Humboldt County and has the potential to power 65,000 homes with 1.6 GW of clean energy [2].

END-OF-LIFE PHASE FOR TURBINES

As progress is being made for the beginning stages of a life cycle for FOWT, end-of-life has been looked at as a phase for the future. This leaves a wide door open to massive experi-



Digital twin technology has the potential to increase the lifespan of floating offshore wind turbines. (Courtesy: Shutterstock)

mentation with potential end-of-life extension and disposal. The United States currently does not have a fleshed-out plan for decommission or extension, but it has been described that NOAA would be the regulatory body. NOAA works as the consultant providing baseline data and analysis on ocean impacts and conditions to the Bureau of Ocean Energy Management [3]. In related renewable energy sectors (onshore wind), the United States uses a method coined re-powering, which can be compared to the idea of retrofitting [4].

The process can extend the life of a wind farm but must be spearheaded by project owners. An example of a successful re-powering can be found in Mendota Hills, Illinois [5]. The re-powering required the decommission of existing wind-turbine generators and the installation of new foundations [5]. This increased the capacity from 50 MW to 76 MW and generated 250 jobs. Re-powering policies for onshore wind can be translated into the floating offshore wind sector, helping to flesh out a plan for the end of life phase.

OPTIMIZING THE GRAVE PHASE

Digital twin technology has the potential to increase the lifespan of a FOSWT. Optimizing the grave phase can help clear a path toward a brighter future for the energy source. The digital twin technology coupled with the U.S.-known re-powering methods would allow FOSWT farms to extend past the standard 25-year life span. This would not only help run the farm efficiently but create jobs through the re-powering program and lower the annual O&M. This can be seen as a one-sided benefit leaning toward the owners; however, the extension expands the lifecycle of the farm producing more renewable energy. With a combination of these two elements alongside the strides in U.S. policy, the future of FOSWT full LCA analysis is more tangible than ever. ✨

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ABOUT THE AUTHOR

Payton Maddaloni is a recent graduate from the University of New Hampshire who balanced an honors civil engineering curriculum and a Division 1 sport. Maddaloni started her career as a project engineer at Gilbane Building Company in its Boston office while also researching for her alma mater part time.

PROTECTING THE LIFESPAN OF TURBINE BLADES

It is critical that wind farms are maintained to an excellent standard, otherwise, damaged wind-power assets may needlessly be decommissioned and replaced. (Courtesy: Shutterstock)

With the use of polymeric leading edge protection, the lifespan of wind-turbine blades at a wind farm was extended more quickly and efficiently.

By CHLOE HIRST

There has been considerable growth in the wind-power industry over the past few years. However, further exponential growth of the industry is required in order to ensure that the net-zero by 2050 pathway (outlined in the Paris Agreement) is successfully reached.

In order to support this seismic growth, polymeric repair and protection technology has an important part to play. Designed to safeguard the integrity of wind-turbine blade leading edges for the long term, this technology plays a critical role in supporting this burgeoning industry.

RENEWABLE ENERGY ELECTRICITY GENERATION NEEDS TO REACH 79-96 PERCENT BY 2050

In order to achieve net-zero by 2050, according to a 2023 report from the world-leading authority on climate science, Climate Action Tracker: “Wind and solar sources in electricity generation will need to reach 57-78 percent by 2030, and 79-96 percent by 2050.”

In 2022, this figure sat at 12 percent. Needless to say, a colossal scale-up of these industries is anticipated over the upcoming decades.

HOW IS THE SCALE-UP OF THE WIND INDUSTRY BEING FINANCED?

According to the International Energy Association: “Policy support remains the principal driver of wind deployment in the majority of the world.” Indeed, over the past few years, several policies have been launched designed to drive forward the roll-out of renewables.

For example, in August 2022, the U.S. brought in the Inflation Reduction Act (IRA), which includes \$369 billion of investment; in the European Commission’s Green Deal Industrial Plan, \$270 billion was pledged, and since the U.K. government’s Ten Point Plan was launched in November 2020, more than 26 billion pounds of government capital investment has been mobilized.

POLYMERIC TECHNOLOGY SUPPORTS TRANSITION TO NET ZERO

Given the critical role wind power plays in the transition to a net-zero future, as well as the significant amount of capital being invested into the renewables industry, the

wind-power sector is poised to experience considerable exponential growth in the upcoming decades. In order to support this growth, it is absolutely critical that windfarms are maintained to an excellent standard. Otherwise, damaged wind-power assets may needlessly be decommissioned and replaced. This process comes with a hefty carbon footprint as well as considerable financial expenditure.

As such, asset owners are investing in a simple yet extremely beneficial (both from a cost and environmental perspective) solution to extend the lifespan of wind turbines. This solution involves the use of polymeric repair composites and high-performance protective coatings to repair and protect key assets in the wind industry. This includes turbine blades, nacelles and generating components, turbine bases, towers and transformers, among other assets.



Figure 1: Leading edge protection of wind turbine blade using polymeric technology. (Courtesy: Belzona).

The use of this technology is based on a circular economic business model: repairing damaged assets rather than replacing them. In turn, not only does this mitigate the carbon footprint incurred during the replacement process, but it is also enables the asset owner to make significant financial savings as well.

LEADING EDGE PROTECTION

Polymeric systems such as the blade filler material, Belzona 5711 and the leading-edge protection coating, Belzona 5721,



Figure 3: Damaged wind-turbine leading edge. (Courtesy: Belzona)

are specially designed to repair damaged leading edges and protect them against rain erosion and impact damage for the long term.

In addition to the performance capabilities of these systems, maintenance engineers are investing in this technology due to the simple, in-situ application method and fast cure times the cold-curing systems facilitate.

In turn, this helps to keep downtime to a minimum and allows the turbine to be returned to service in the same day.

Belzona 5711, which is now supplied in a larger unit and more robust side-by-side cartridge, can be directly overcoated with Belzona 5721 in as little as 30 minutes at 20°C/68°F without the need for any additional surface preparation. At the same temperature, Belzona 5721 will be fully cured within five hours.

CASE STUDY: 42 WIND TURBINE BLADES REPAIRED AND PROTECTED

At an onshore windfarm in Denmark, 42 wind-turbine blades were exhibiting signs of severe erosion on the leading edges. Previously, the customer had used pre-formed shells bonded onto the substrate to provide leading edge protection. However, this process proved to be extremely

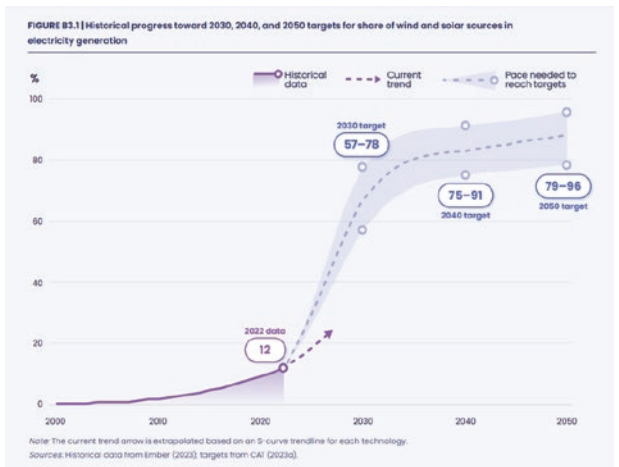


Figure 2: Historical progress toward 2030, 2040, and 2050 targets for share of wind and solar sources in electricity generation. (Courtesy: State of Climate Action 2023).

time-consuming and expensive.

Therefore, the customer was seeking an alternative solution that would be financially viable and also ensure optimal operation for many years to come.



Figure 4: Leading edge repaired and protected with Belzona 5711 and Belzona 5721. (Courtesy: Belzona)

SPECIFICATION OF POLYMERIC LEADING EDGE PROTECTION SYSTEM

Based on test results, the ease of application as well as the high-quality finish that can be achieved, the customer decided to repair and protect the leading edges with a combination of Belzona 5711 and Belzona 5721.

The thixotropic paste, Belzona 5711, is specially designed to be applied in conjunction with the Belzona 5721 protective coating. This solvent-free LEP system is formulated for the in-situ repair and rebuilding of leading-edge erosion and impact damage on wind turbine blades.

SIMPLE APPLICATION METHOD

“Surface preparation was carried out on each of the 42 blades, followed by the direct application of 90 kilograms (198.4 pounds) of Belzona 5711 from self-mixing cartridges onto the blade,” said Morten Sivertsen, general manager at AESSEAL Danmark A/S. “The repair area was then contoured using a piece of Belzona mixing board. Once cured, a visual inspection was conducted to ensure the application’s readiness for overcoating with 144 kilograms (317.5 pounds) of Belzona 5721.

Using a short-bristled brush, this system was then applied to the leading edge and left to cure for 30-60 minutes. With three rope-access technicians carrying out the applications, on average, six to nine turbine blades were completed each day.”

AESSEAL DANMARK A/S is a subsidiary owned by AESSEAL Plc and is the authorized Belzona distributor for the Denmark territory.

IN-SITU REPAIR ENSURED MINIMUM DOWNTIME WAS INCURRED

As the polymeric systems were applied in situ without the

need for specialist tools or equipment, this ensured a fast and seamless application was carried out. Thus, this enabled the customer to make considerable financial savings as it mitigated the profit loss that can be incurred through lengthy periods of downtime.

SAFEGUARDING KEY WIND POWER ASSETS FOR THE LONG TERM

The scaling up of the wind power industry is absolutely critical in order to support the transition to renewable energy in keeping with the net zero by 2050 pathway.

By safeguarding key assets within this industry through the use of polymeric technology, asset owners can successfully bypass the environmental and financial costs associated with asset replacement.

Therefore, it could be argued that polymeric technology can play an intrinsic role in supporting this energy transition. ✨

ABOUT THE AUTHOR

Chloe Hirst is the senior copywriter at Belzona Limited and is based in Harrogate, England. She gained a Bachelor’s Degree (with Hons.) in media and communications (specializing in journalism) at Goldsmiths College, University of London. Hirst regularly writes case studies and thought leadership content featuring a variety of different industries, with a special focus on the renewables sector. In both 2023 and 2024, she won the Best Manufacturing Content Creation Specialist (U.K.) award as part of Acquisition International’s Influential Businesswoman Awards. Established in 1952, Belzona is a leading company in the design and manufacture of polymer repair composites and industrial protective coatings for the repair, protection and improvement of machinery, equipment, buildings and structures. For more information, go to [belzona.dk/en](https://www.belzona.dk/en)

RENEWABLE ENERGY RECYCLING

A KEY TO SUSTAINABLE POWER GENERATION

The challenge with wind-turbine blades lies in their composite structure. Fiberglass and carbon fiber are notoriously difficult to recycle through conventional methods due to the complexity of separating their components. (Courtesy: Pitbull Shredding Solutions)

As wind turbines, solar panels, and lithium-ion batteries become more widespread, the need for effective end-of-life management solutions becomes increasingly important.

By **CODY EARLE**

As the world shifts toward a future powered by clean energy, technologies such as wind turbines, solar panels, and battery storage are pivotal in mitigating climate change and reducing greenhouse gas emissions. These innovations are fundamentally transforming the global-energy landscape by offering sustainable alternatives to fossil fuels. However, the materials used in renewable energy systems pose a significant challenge once they reach the end of their operational lifecycle. Without proper end-of-life solutions, wind-turbine blades, solar panels, and lithium-ion batteries risk becoming the next environmental crisis.

Fortunately, recent advances in renewable energy recycling are paving the way toward a sustainable, circular economy. By focusing on reclaiming valuable materials, reducing waste, and minimizing environmental impact, the recycling of renewable-energy technologies offers a pathway to ensuring green-energy generation not only addresses today's energy needs but also prevents tomorrow's environmental problems.

WIND TURBINE BLADES: THE COMPOSITE CONUNDRUM

Wind energy is one of the fastest-growing renewable power sources globally, with wind farms now a common sight in many countries. Central to these wind farms are wind turbines, whose blades are typically made from composite materials such as fiberglass and carbon fiber. These materials offer a combination of strength, durability, and lightweight properties, making them ideal for withstanding the rigors of wind-power generation. However, their very durability presents a challenge when the blades need to be decommissioned after their typical lifespan of 20 to 25 years.

The challenge with wind-turbine blades lies in their composite structure. Fiberglass and carbon fiber are notoriously difficult to recycle through conventional methods due to

the complexity of separating their components. As a result, many decommissioned blades end up in landfills, where they can take decades to degrade, contributing to growing environmental concerns about "blade graveyards."

In response, companies like Pitbull Shredding Solutions, in partnership with Regen Fiber and Renewablade, are developing innovative solutions to tackle this problem. Advanced

shredding technology is employed to break down these large blades into smaller, manageable pieces. These fragments can then undergo specialized recycling processes that recover valuable fibers, which can be reused in new products. For example, recycled fiberglass from wind-turbine blades can be repurposed into construction materials, providing an alternative to virgin raw materials and reducing the overall waste footprint of the wind energy industry.

Additionally, some companies are exploring thermal and chemical processes to decompose the composite materials in turbine blades into reusable components. Pyrolysis, for example, involves heating the blades in the absence of oxygen to break down the resins and fibers, which can then be processed into new composite materials. These innovations in blade recycling are crucial to creating a sustainable lifecycle for wind turbines, ensuring the environmental benefits of wind energy are not undermined by end-of-life waste challenges.

SOLAR PANELS: MANAGING THE PHOTOVOLTAIC (PV) BOOM

Solar energy has become one of the most widely adopted renewable energy sources globally, with millions of photovoltaic (PV) panels installed to harness the power of the sun. However, like wind turbines, solar panels have a finite operational life, typically lasting 25 to 30 years. As early solar installations approach the end of their useful lives, the question of what happens

to these panels once they are decommissioned is becoming increasingly urgent.

PV panels are composed of valuable materials such as silver, copper, and silicon, which are essential for their energy-conversion capabilities. These materials can be recovered and reused in new solar panels, helping to reduce the de-

▼ **The challenge with wind-turbine blades lies in their composite structure. Fiberglass and carbon fiber are notoriously difficult to recycle through conventional methods due to the complexity of separating their components. As a result, many decommissioned blades end up in landfills, where they can take decades to degrade, contributing to growing environmental concerns about "blade graveyards."** ▼



Recycled fiberglass from wind-turbine blades can be repurposed into construction materials. (Courtesy: Pitbull Shredding Solutions)

mand for virgin materials and lowering the environmental impact of solar manufacturing. However, solar panels also contain potentially hazardous substances such as cadmium and lead, which pose environmental risks if they are not properly managed during disposal.

The recycling of solar panels requires specialized processes that can safely separate and extract the valuable components while ensuring that hazardous materials are contained and neutralized. Companies like Quality Metals and Zephyr Wind are at the forefront of this effort, employing state-of-the-art technologies to disassemble solar panels and recover their constituent materials. These firms use techniques such as thermal treatment and chemical separation to extract precious metals and silicon, which can then be reintroduced into the supply chain for the production of new PV modules.

In addition to the recovery of valuable metals, solar panel recycling also plays a critical role in mitigating the environmental risks associated with hazardous waste. By safely disposing of or neutralizing substances such as cadmium and lead, solar panel recyclers ensure these harmful materials do not leach into the environment, protecting soil and water resources.

As the solar-energy industry continues to grow, large-scale solar recycling plants are beginning to emerge, providing a sustainable solution for the end-of-life management of PV modules. These facilities not only help reduce the environmental impact of decommissioned solar panels but also contribute to the development of a circular economy, where valuable materials are continuously repurposed and reused, rather than discarded.

LITHIUM-ION BATTERIES: THE NEXT FRONTIER OF RECYCLING

As renewable energy sources such as wind and solar become more prevalent, energy-storage solutions are becoming increasingly important to stabilize power grids and ensure a reliable energy supply. Lithium-ion batteries, which are widely used in electric vehicles (EVs) and grid-scale energy storage systems, are essential for storing renewable energy. However, these batteries also have a limited lifespan, typically lasting eight to 15 years, and their disposal presents significant environmental and safety challenges.

Lithium-ion batteries contain a range of valuable metals, including lithium, cobalt, nickel, and manganese, which are critical for the production of new batteries. However, improper disposal of these batteries can lead to serious environmental hazards, such as fires caused by chemical reactions within the batteries and the leaching of toxic substances into soil and water. Given the rapid growth of the EV market and the increasing reliance on battery storage for renewable energy, finding effective recycling solutions for lithium-ion batteries is a top priority.

Leading companies like Redwood Materials and Li-Cycle are pioneering new recycling technologies that focus on recovering the valuable metals from used batteries. Through

processes such as hydrometallurgy and pyrometallurgy, these companies can separate and extract lithium, cobalt, nickel, and other metals from spent batteries. These recovered materials can then be reused in the production of new batteries, reducing the need for virgin mining and helping to stabilize the supply chain for critical minerals.

In addition to reducing the environmental impact of battery disposal, recycling lithium-ion batteries has important economic and strategic benefits. As demand for electric vehicles and renewable energy storage continues to rise, securing a reliable supply of lithium, cobalt, and other essential materials will be critical to meeting the needs of the clean energy economy. By recycling used batteries, companies can reduce dependence on foreign sources of raw materials and help build a more resilient and sustainable supply chain.

THE CIRCULAR ECONOMY OF RENEWABLE ENERGY

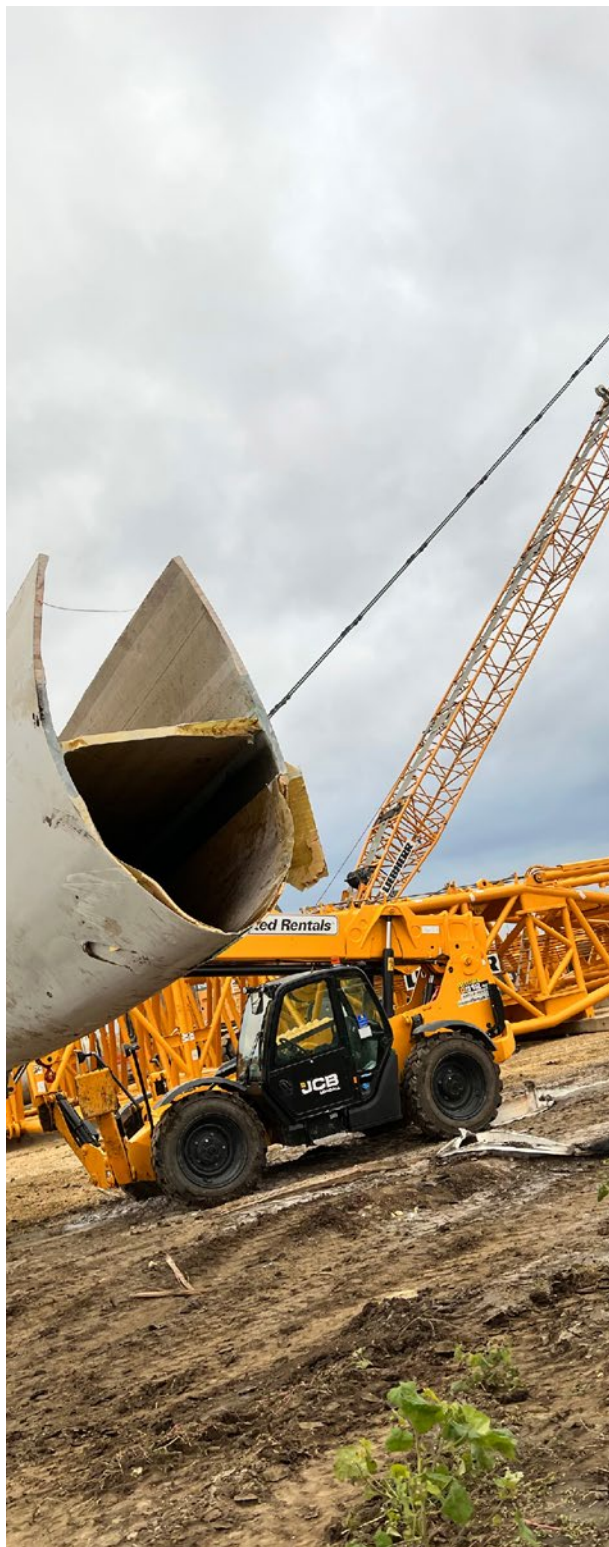
The rapid expansion of renewable energy infrastructure presents an undeniable opportunity to decarbonize the global energy system and reduce the reliance on fossil fuels. However, as wind turbines, solar panels, and lithium-ion batteries become more widespread, the need for effective end-of-life management solutions becomes increasingly important. Without proper recycling and disposal methods, these technologies could contribute to a new wave of environmental problems, undermining the very goals they were designed to achieve.

Recycling initiatives across the wind, solar, and battery industries are essential to closing the loop on renewable energy. By turning waste into valuable resources, these efforts help reduce the need for raw material extraction, decrease energy consumption in manufacturing, and minimize the environmental impact of clean energy technologies. As recycling technologies continue to advance, they will play a crucial role in creating a truly circular economy, where renewable energy systems are not only sustainable during their operational lives but also at the end of their lifecycles.

The future of renewable energy lies not only in innovation but also in responsibility. By ensuring the materials used to power the clean-energy revolution are repurposed and reused, a more sustainable, resilient, and circular energy economy can be created — one that supports both the planet and future generations. ↴

ABOUT THE AUTHOR

Cody Earle is a seasoned professional with more than a decade of experience in the renewable-energy sector. As vice president at Pitbull Shredding Solutions, he leads a dedicated team of technicians providing cutting-edge blade recycling and wind-turbine decommissioning services. Additionally, as a veteran, he advocates for advancing veterans' employment and promoting U.S. leadership in advanced energy. Before his current role, Earle held senior-level management positions within the renewable industry, overseeing operations and maintenance of more than 500 wind turbines in Texas and Oklahoma.



Recycling initiatives across the wind, solar, and battery industries are essential to closing the loop on renewable energy. (Courtesy: Pitbull Shredding Solutions)



Anna Rivera

CEO and Co-Founder ▸ Youwind Renewables

“With Pixel+, we’ve streamlined the early-stage screening process – where to develop offshore wind farms – by integrating layout optimization and yield analysis into a single, more intuitive interface.”

▸ Why is there an urgent need to meet these ambitious environmental targets that everyone’s set so far?

At Youwind, we believe that there’s no alternative — no “Planet B.” The scientific community has made it clear that we are on track to surpass the 1.5°C warming threshold agreed upon in the 2015 Paris Agreement. And we also want to consider: What is the world we want to leave to our children? In Europe, the targets for the green transition by 2030 are particularly ambitious, with countries mandated to play their part. There are already several measures in place to ensure these goals are met, and we see ourselves as an essential piece of that larger puzzle.

▸ Why are developers under that pressure to optimize all aspects of their projects at this point?

Developers are under increased pressure to optimize every aspect of their projects due to a shift in market dynamics. Before 2020, the industry was already highly competitive, with a strong focus on managing CapEx and OpEx. However, in recent years, competition has intensified with the entry of new players, including oil and gas companies transitioning into offshore wind.

More recently, project costs have surged by 30 to 35 percent, causing developers to become much more cautious. Some have even had to step back, reconsider, or renegotiate agreements with governments due to the heightened pressure to ensure profitability. On top of that, supply-chain challenges are placing additional strain, making it essential for developers to carefully assess their capacity, manage contingencies, and distribute risks from the earliest stages of their projects.

▸ Tools are needed for the early stages of offshore development. What is Youwind doing to address these challenges?

Youwind exists to help developers and consultancy companies to make informed decisions during the early stages of offshore-wind projects, where billions of euros are at stake. Offshore wind development is a complex, multi-variable optimization process, and while tools like Excel have their place, they simply can’t keep up with the intricate demands of this sector.

Youwind’s platform is designed to address both the technical and financial dimensions simultaneously. There’s a lot of investment at stake, so the earlier developers have control on these optimizations in both dimensions — engineering, and financial — the more confidence they can have on the options available to them.

▸ What aspects of Youwind’s Pixel+ will help developers to specifically streamline their workflows?

Youwind’s Pixel+ release is a major upgrade, designed with both current and future challenges in mind. We’ve listened closely to user feedback, addressing not just past issues, but also anticipating the evolving needs of the industry. With Pixel+, we’ve streamlined the early-stage screening process — where to develop offshore wind farms — by integrating layout optimization and yield analysis into a single, more intuitive interface.

At Youwind, our team of wind-industry experts has built the tools we wish we had back in the 2010s, and now we’re making them accessible to a broader range of users. Usability was a key focus for this update, making workflows clearer

and more efficient. In addition, every offshore wind project is unique, and Pixel+ allows for an unprecedented level of customization, enabling developers to tailor their projects with greater precision and ease.

► How can Pixel+ help to accelerate project timelines?

With Pixel+, we have improved the process, usability, and speed of calculation, apart from adding numerous new features. Our tools allow users to develop more complex scenarios, increasing their industry knowledge. Pixel+ accelerates project timelines by dramatically improving the speed of calculations, allowing for more advanced sensitivity analyses. Offshore-wind development involves optimizing hundreds of technical and financial variables, all of which need to align for the best business case and technical feasibility.

With Pixel+, users can efficiently make the right decisions without compromising on accuracy. Again, there is a lot of money at stake. The platform combines both engineering and financial modeling in a single tool, enabling users to streamline their workflows and confidently move projects forward, knowing they have comprehensive insights at their fingertips.

► Can you give some examples of Pixel+'s modeling capabilities and what makes this aspect of the software so powerful?

Pixel+ delivers some of the most advanced modeling capabilities available for offshore-wind development. With highly accurate yield calculations and unique wind-resource data through our integration with Vortex, we provide users with precise wind speeds for each turbine position — something that has generated great feedback from the industry. Another standout feature is the extensive GIS database, with more than 350 publicly available layers worldwide, allowing users to perform constraint analysis with just a few clicks.

This data, combined with the ability to upload and integrate custom information under strict confidentiality protocols, makes Pixel+ both powerful and secure. The platform also significantly enhances computational speed for wake modeling, enabling users to run multiple sensitivity analyses in parallel — key for assessing yield and wake losses.

Moreover, Pixel+ offers flexibility with water-depth inputs, allowing users to integrate more accurate bathymetric data, while our improved electrical modeling increases accuracy in grid losses and export system optimization. These enhanced capabilities are crucial, as export losses represent a significant portion of overall production losses in real projects after wake related ones. With Pixel+, users can seamlessly move from shallow calculations to deep-dive assessments of bankability yield.

► What are the differences in how Pixel+ works with fixed bottom vs. floating wind farm development?

When it comes to fixed-bottom wind development, Pixel+ aligns with the maturity of the industry, offering robust

capabilities to calculate foundation weights and optimize layouts. These well-established methods allow us to transparently meet the industry's high standards for fixed-bottom projects.

For floating wind, Pixel+ brings additional sophistication, modeling floater sizes in terms of tonnage based on the selected technology for first CAPEX estimations. It also integrates mooring and anchor system modeling, helping users understand the footprint and optimize strings' lengths. This allows for more precise layout designs, ensuring mooring systems don't cross paths. On the electrical side, Pixel+ accounts for the unique challenges of floating wind, such as dynamic cables accounting for their buoyancy, and additional cable lengths, all while optimizing for array cabling and minimizing production losses.

► What has been the market response so far? What are you seeing out there based on what you can offer?

Prior to the official launch, we offered exclusive access to our existing clients, allowing them to experience Pixel+ firsthand and provide feedback.

This feedback helped us fine-tune the platform, and the improvements have been so impactful that many clients have expanded the number of users on their teams. Pixel+ isn't just for engineering experts — finance professionals, logistics teams, and managers are also benefiting from its strong traceability and communication features, which help ensure everyone stays informed.

Since the broader rollout, we've seen a surge in demo requests, reflecting the excitement around the new platform. In fact, we've launched a limited free trial promotion and currently have a waiting list of users eager to try Pixel+. Overall, the market's response has been beyond our expectations, and we're thrilled to share Pixel+ with the world.

► Is there anything else you'd like to mention that we didn't talk about?

One of the unique values that Youwind brings to the table is that our team truly understands the offshore wind industry from the inside out. Many of us have been in the same shoes as developers, consultancies, and turbine suppliers, so when new players want to enter this space, we're able to offer more than just a software tool. We provide structured support from industry experts who have been through the process, in order to make the experience of using our platform the most fruitful.

Additionally, our involvement in six R&D funded projects across Europe, alongside prestigious research institutes and universities, such as DTU (Denmark), TU Delft (Netherlands), or TMU (Germany), further sets us apart. These collaborations ensure that, not only are we solving today's challenges, but we are also looking ahead to future needs in the offshore wind sector. ↵

MORE INFO youwindrenewables.com



EQ-Piling helps to achieve noise-compliant monopile installation. (Courtesy: IQIP)

► CONSTRUCTION

IQIP's new piling technique, EQ-Piling, now in action

EQ-Piling, a newly developed piling technique, is now in action. This development showcases the success of the investment in this technology. Thanks to IQIP's EQ-Piling, noise-compliant installation of even the largest monopiles is now achievable.

Conventional impact piling has long been a proven and unparalleled method for installing large monopile foundations at the required depths. However, it comes with a significant drawback: The noise generated during the process can be harmful to marine

life. The challenge was to deliver the necessary force to overcome soil resistance while significantly reducing noise levels.

EQ-Piling employs a technique featuring a substantially prolonged impact force characteristic. This method uses the impact of a falling mass, in this case, contained water, over an extended period, resulting in a smooth energy transfer to the pile. Unlike conventional methods that rely on impact force, EQ-Piling generates a pushing force.

This technology ensures that developers, governments, and contractors can now work in full compliance with environmental regulations. EQ-Piling offers advantages including noise reduction without the need for additional mitigation measures, lower project

costs, decreased carbon emissions, and enhanced efficiency.

MORE INFO www.iqip.com

► CONSTRUCTION

Sarens aids in construction of U.K.'s Sofia Wind Farm

Sarens has been actively involved in the construction of the Sofia Offshore Wind plant by successfully carrying out the Sofia OCP Jacket and Topside Weighing and Loadout project. The plant — owned by RWE and on Dogger Bank in the North Sea, 195 kilometers off the coast of the U.K. — will have

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The Sarens project Asia team. (Courtesy: Sarens)

100 turbines and a power generation capacity of 1.4 GW reaching the coast through an extensive inter-array cable network. It will provide green electricity to 1.2 million homes in the U.K. The turbines will be mounted on monopiles, reaching heights of 252 meters.

Sarens provided a complete package of services, including manpower, engineering, mooring winches, weighing equipment, and 524 axles with 18 PPU self-propelled modular transporters (SPMTs) for the weighing and loadout.

Sarens, a global leader and reference in crane rental services, heavy lifting, and engineered transport, has been actively involved in the construction of the plant, successfully completing the Sofia OCP jacket and topside weighing and loadout project. This work, carried out in collaboration with RWE & GE and managed by Seatrium, took place at Seatrium’s shipyard in Batam, Indonesia, from May 25, 2024 to June 15, 2024.

The project involved the offshore converter platform (OCP), a crucial element for the HVDC electrical system of the offshore wind farm. This tool is responsible for converting the energy into direct current (DC) and then transmitting it to land. Thanks to this system, the electricity generated by the rotation of the wind turbines is converted from 66kV alternating current to 320kV direct current. Two seven-kilometer-long cables carry the electricity to the Lazenby converter station.

The main part of the project consisted of transporting and loading the gigantic OCP topside, which weighs 14,000 tons and is 57 meters high, as well as the OCP Jacket, weighing 5,250 tons and 51 meters high. This complex job marks the heaviest topside move in Southeast Asia, and historically, one of the heaviest ever undertaken in the world.

Although the weight and size of the parts posed a major challenge, Sarens’



Combilift achieved two wins at the UK Engineering and Manufacturing Awards. (Courtesy: Combilift)

logistics team ensured punctual delivery and maintenance of the OCP units. To make this possible, Sarens provided a complete package of services, including manpower, engineering, mooring winches, weighing equipment, and 524 axles with 18 PPU Self-Propelled Modular Transporters (SPMTs) for the weighing and loadout. At the peak of the work, there were 28 Sarens members who had to deal with adverse conditions, including the impact of the rainy season on site preparation.

The Sofia offshore wind plant will be commissioned in 2026, at which time it will begin generating clean energy that will reach hundreds of thousands of homes in the United Kingdom by making use of a network of approximately 360 kilometers of inter-array cables from the turbines to the platform.

Sarens has extensive international experience in the assembly and maintenance of wind farms. It has participated in various installations around

the world and particularly in Europe, as in France (Saint Nazaire and Saint Briec) and the U.K., where its last project is now successfully completed. Recently, Sarens worked in the marshaling of 62 of the monopiles, each weighing 2,000 metric tons, the largest and heaviest XXL monopiles ever to be handled in the U.K., and now the 882 MW Moray West offshore wind farm, is well on its way to contribute to the Scottish renewable energy network.

MORE INFO www.sarens.com

► CONSTRUCTION

Combilift wins two engineering, manufacturing awards

Combilift, a global innovator in material handling solutions, has achieved

dual recognition at the 2024 UK Engineering & Manufacturing Awards 2024, securing two prestigious awards.

The Design Team of the Year award was presented to Combilift's Heavy Equipment Team for their work on the 12-Wheel "Combi-LC Blade." This machine has been engineered to handle offshore wind turbine blades, which can reach up to 115 meters in length and weigh as much as 70 tons. The design significantly enhances the ability to transport these large, non-uniform loads safely and efficiently from manufacturing sites to storage and deployment locations.

This innovative solution addresses the growing needs of the renewable energy sector, where the demand for efficient logistics systems is increasing as the size and scale of offshore wind turbines continue to grow.

Combilift's Heavy Equipment Design Team drew upon their extensive experience in engineering complex transport systems, previously creating the renowned Combi-SC Straddle Carrier and Combi-MG Mobile Gantry ranges.

Combilift's co-founder and CEO, Martin McVicar, received the Industry Leader Award, sponsored by Menzies. This accolade honored McVicar's leadership and commitment to innovation, which have played a pivotal role in transforming Combilift from a small Irish manufacturer into a leader in the material handling sector.

Beyond business success, McVicar is deeply committed to fostering a strong corporate culture. Combilift's headquarters, the largest factory under one roof in Ireland, serves as a manufacturing hub and as an ambassador for corporate social responsibility. The company regularly hosts apprenticeship schemes, charity events, family days, and educational visits, further solidifying its role within the local community.

Combilift also sponsors the local Ladies GAA team, demonstrating McVicar's commitment to supporting gender equality in sports.

MORE INFO www.combilift.com

Northern Offshore Services has unveiled the new I-Class Crew Transfer Vessel powered by the first commercial application of Volvo Penta's IPS Professional Platform. (Courtesy: Volvo Penta)

INNOVATION

Volvo Penta powers Northern Offshore vessel

Northern Offshore Services recently unveiled the new I-Class Crew Transfer Vessel powered by the first commercial application of Volvo Penta's IPS Professional Platform. The vessel began operating in a U.K. wind farm September 1, 2024. N-O-S and Volvo Penta collaborated for almost two decades on ongoing efforts to decarbonize the marine industry and reach zero emissions by 2050. To help achieve these goals, N-O-S designed the future-proof CTV that will adapt to and accommodate new technologies and energy solutions while it is in service over the next 25 years and more.

Volvo Penta's IPS Professional Platform brings efficiency, maneuverability, and versatility that will enable the I-Class vessel to transform over its life cycle. This is made possible through propulsion conversions that allow the vessel to adapt to hybrid, fully electric, and renewable or future alternative fuel solutions without having to rebuild. The I-Class vessel is also equipped with a remote diagnostics package, which will capture more than 6,000 hours of data that will be incorporated into optimization and future Volvo Penta propulsion design.

"Northern Offshore Services and Volvo Penta share an innovative spirit that drives us both. Today that resulted in the first vessel powered by Volvo Penta's IPS Professional Platform entering real-world commercial operations," said Johan Inden, president of Volvo Penta Marine. "N-O-S' deep experience in building vessels for some of the most demanding environments challenged us to develop new ways to improve our propulsion systems and adapt to emerging technologies. Together, we



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From left, Konstantinos Papadakis from DNV, Eleanor Taylor and Baiqian Jiang from Anemoi Marine Technologies, Rasmus Stute and Hasso Hoffmeister from DNV. (Courtesy: Anemoi)

are showing the industry what the incredible maneuverability, ease of use and precision of the Volvo Penta IPS Professional Platform can accomplish in combination with the expertise of a partner like N-O-S.”

In addition to the Volvo Penta IPS Professional Platform’s flexibility to adapt to future technologies and energy solutions, it is designed for outstanding maneuverability. The enhanced maneuverability and thrust from the system make it ideal for the challenging conditions typically seen at offshore wind farms.

The I-Class vessel leverages four engines connected to two drives to meet specific needs at every stage of operation, providing dual power on demand. Eco Mode will automatically start or stop individual engines in each situa-

tion, optimizing fuel consumption and engine running hours.

Recognizing the challenging environment and long operations at sea, N-O-S designed the I-Class vessel with comfort in mind through high-quality interior outfitting and furnishing.

The Volvo Penta IPS Professional Platform unlocks efficiency gains with available Internal Combustion Engine solutions leveraging alternative or renewable fuel sources. Equipped I-Class vessel engines could potentially see up to 30 percent total fuel savings and emissions through the Eco Mode feature. These engines are approved to run hydrotreated vegetable oil (HVO) and have the potential to reduce emissions by up to 90 percent.

MORE INFO www.volvopenta.com/en-us

INNOVATION

Anemoi wins design approval for rotor sail

Anemoi Marine Technologies Ltd (“Anemoi”), a leader in wind-assisted propulsion systems, was awarded a Type Approval Design Certificate from classification society DNV for its Rotor Sail design measuring 5 meters in diameter and 35 meters in height.

“We are delighted to have received this important Type Approval from DNV, which is a testament to the rigorous design and engineering work undertaken by our team,” said Kim Diederichsen, CEO of Anemoi. “This certification provides shipowners and

operators with the assurance they need to invest in our 5x35m Rotor Sail solution, which has already been selected for upcoming installations on several vessels.”

Rotor Sails, also referred to as “Flettner Rotors,” are vertical cylinders that, when driven to rotate, harness the renewable power of the wind to propel ships. These mechanical sails capitalize on the aerodynamic phenomenon known as the Magnus Effect to provide additional thrust to vessels. By leveraging wind energy, Berge Neblina will see increased efficiency by reducing the power required from the main engine while maintaining speed, therefore substantially reducing fuel consumption and resulting in less greenhouse gas emissions.

The type approval design certificate (TADC) was retrospectively presented to Anemoi during a special ceremony at SMM in Hamburg, Germany, September 5. The certificate validates that Anemoi’s 5x35m Rotor Sail design com-

plies with DNV’s technical standard (ST-0511) for wind assisted propulsion systems (WAPS).

“We are very pleased to build on the excellent collaboration with Anemoi with the presentation of this certificate,” said Hasso Hoffmeister, Senior Principal Engineer at DNV Maritime. “Together we are continuing to develop the technical standards and class notations that will enable the momentum behind WAPS to continue to build and enhance shipping’s drive to greater sustainability.”

The technology is being increasingly embraced by ship owners, primarily in the bulker and tanker sectors, who are aiming to achieve net-zero shipping emissions. Rotor sails have emerged as a preferred technology to augment and enhance the energy performance of vessels. Rotor sails are a compact technology, which offer a large thrust force to propel ships with minimal impact on visibility, stability, and port operations, helping them comply with

pivotal international emission reduction benchmarks such as the Carbon Intensity Indicator (CII) and EEDI/EEXI.

MORE INFO anemoimarine.com

INNOVATION

Seaonics readies Ocean Charger for wind farms

Following successful in-port and offshore prototype testing, Norwegian lifting and handling specialist Seaonics is on track to commercialize its Ocean Charger solution for electric SOVs amid strong interest from wind farm developers.

High-voltage charging tests were conducted in port to charge the batteries on the Rem Offshore-owned diesel-electric hybrid CSOV (construction service operation vessel) REM Power as

ColdSnap Towers

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Prototype testing of the Ocean Charger charging the CSOV newbuilding Rem Power from an offshore wind turbine. (Courtesy: Seaonics)

well as offshore from a charging point (cable reel, winch, and control system) mounted on a wind turbine.

“At 10 years old, the turbine is one of the smallest offshore but the prototype proved it is possible to install the Ocean Charger on an existing turbine and charge an SOV from Day 1, using 11 kilovolt (KV) current delivering 6 MW of charge,” said Bjørnar Huse, Sales Manager, Offshore Energy at Seaonics. “Apart from a handful of improvement points to fix, the concept and control system are complete and the product is available for sale as is. We’re first in the market and already in talks with wind farm owners.”

Because power current varies between wind parks and wind turbines, the commercial version will have to be customized for each project, Huse said.

The ability to charge vessels offshore in a cost-effective way is a central enabler for shipbuilders to deliver zero-emission SOVs to the offshore wind industry.

“Connecting vessels to the power grid in the wind farm and charging batteries regularly is a big step toward increasing sustainable operations without using any additional energy sources,” Huse said. “It saves the time and energy needed to return to port to charge, while the operating cost of

electric SOVs versus diesel and alternative fuels is much lower, because both the energy is cheaper and you reduce engine maintenance demands. You still need diesels for back-up power, but quite a lot smaller than for a full diesel operation, with lower Capex.”

A large, 60-person SOV consumes 20 to 25 MW hours per day, so at 6 MW, an operator can potentially charge for a full day’s operation in three to four hours.

“But it’s better for the lifetime of the battery pack to never be completely depleted nor fully charged – between 50 and 80 percent is best,” Huse said. “You could charge for six hours at night, say, then do ad-hoc charging during the day.”

The product can be fitted to any structure and vessel and the power integrated with the vessel switchboard and the chosen charging voltage.

Huse said it would take a few months to customize the configuration and get approvals for a specific wind park and vessel.

“For wind farms that will be installed in two to four years’ time, there is ample time to do final integration design, fabrication, and installation on a new chartered SOV or retrofit an existing one,” he said. “Fitting the charging points to turbines before they are installed also streamlines the operation.”

MORE INFO www.seaonics.com

MAINTENANCE

Zelim launches remote-control water rescue vessel

Zelim, an Edinburgh-based sea survival innovator, recently launched an unmanned/manned remote-control rescue vessel for persons who have fallen into water.

Guardian, an 8.4-meter long, 2.5-meter wide aluminum-hulled Next Generation Fast Rescue Craft, was unveiled to the maritime industry at the SMM Trade Fair in Hamburg, Germany.

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Giving Wind Direction

WIND
SYSTEMS



Guardian, an 8.4-meter long, 2.5-meter wide aluminum-hulled Next Generation Fast Rescue Craft, was unveiled to the international maritime industry at the SMM Trade Fair. (Courtesy: Zelim)

Designed for rapid deployment to recover both conscious and unconscious man-overboard casualties, the Guardian can operate in conditions that conventional solutions might find challenging or too dangerous.

As it nears the person in the water, the vessel heads toward the casualty, who is then recovered from the water by the rescue conveyor, which is designed to grip and recover immersed casualties, while minimizing the risk to casualties from the loss of hydrostatic pressure. The conveyor can pull two survivors to safety at the same time.

“Sea survival is hugely dependent on the time it takes to retrieve individuals from the water, but inclement weather can prohibit the launch of manned rescue craft and lives are needlessly lost,” said Zelim founder and innovator Sam Mayall. “Ship crews have little time to carry out an effective rescue before maritime conditions prevent the casualty from assisting in their own rescue. When rescue vessels ap-

proach, many survivors simply don’t have the strength to pull themselves to safety. This is even more difficult when they are unconscious or unresponsive. Guardian has been designed to ensure more people can be rescued in the harshest of weather conditions.”

MORE INFO www.zelim.com

► MAINTENANCE

Vestdavit: Offshore wind calls for more service boat solutions

Rapid expansion of offshore wind development worldwide is posing operation and maintenance challenges as turbines are installed in increasingly remote locations, harsh environments, and deeper waters. This demands Service Operation Vessels (SOVs) are equipped with flexible solutions for

secure transfer of maintenance crews in difficult operating conditions, according to Vestdavit.

This requirement has resulted in an increasing level of orders for the Norwegian supplier of boat-handling systems on the strength of its capability to develop versatile davits for heavy-duty workboats able to safely transport personnel and equipment in variable sea states, with deliveries to the likes of Norwind Offshore, Esvagt, and Rem Offshore.

According to research firm Rystad Energy, investments in global offshore wind are set to more than double over this decade from \$46 billion in 2021 to \$102 billion by 2030.

Europe is leading the way as the largest offshore wind region with 8,500 turbines expected to be operational by 2030, based on projected investments of \$53 billion by countries including the U.K., Spain, Norway, Denmark, and Poland. As well as an increase in project volume, offshore wind farms

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Giving Wind Direction

WIND SYSTEMS



Norwind Offshore, with its vessel Norwind Gale, and other wind support vessel operators are realizing the benefits of workboat davits for efficient wind farm maintenance. (Courtesy: Vestdavit)

are expanding both in scale and the size of turbines (15-22 MW).

This, combined with potential turbine reliability issues due to rapid technological evolution of new models every few years, raises the requirement for regular maintenance of multiple turbines across an extensive wind farm to ensure continued uptime.

At the same time, wind-farm owners need to minimize operation and maintenance costs and maximize turbine reliability and project revenue over a typical project lifetime of 20-25 years.

“Consequently, there is a requirement for SOV operators to be able to provide safe and efficient deployment of work crews and equipment to perform effective maintenance on several turbines simultaneously across a wide sea area within a tight operational win-

dow,” said Vestdavit Managing Director Rolf Andreas Wigand.

An SOV can serve as a self-supporting mother vessel for many service engineers while being stationed over an extended period a long distance from shore, with some wind farms over 100 kilometers offshore.

This results in savings in cost and energy used for maintenance, a need for fewer SOVs, reduction of non-operational downtime, and increased turbine availability.

Vestdavit has bolstered its market position in offshore wind after both gaining new customers and winning repeat orders with existing customers, and its systems are now being used by about 80 percent of all offshore wind vessel operators.

MORE INFO www.vestdavit.com

MAINTENANCE

Drone provider Nearthlab teams with Axess Group

Nearthlab, a provider of autonomous drone solutions, recently signed a memorandum of understanding (MoU) with Axess Group.

Axess Group, which began as an inspection company for the Norwegian oil and gas industry, expanded into the renewable energy sector in 2018 and has since completed more than 150 projects for clients in this sector worldwide. The organization now serves the global wind market through its 28 offices in 22 countries and is on track to achieve its goal of generating 25 percent of its annual revenue from

renewables within the next five years.

Under the MoU, Axess Group will deploy Nearthlab's drones to conduct inspections across both onshore and offshore sites in Scandinavia and Africa, regions where Nearthlab has yet to expand.

The inspection data will be managed through Zoomable, Nearthlab's cloud-based analytics platform.

"Efficient inspections are crucial for maintaining wind turbines that endure significant fatigue loads," said Jay Choi, CEO and co-founder of Nearthlab. "Through this partnership, our drones will be able to help numerous wind farms operate at their peak efficiency."

This partnership broadens Nearthlab's market reach into Scandinavia and Africa as well as showcases its technology to a wider audience.

"Nearthlab and Axess Group share a common vision of contributing toward a sustainable future," said Hvard Sletvold, Group Director - AIM at Axess Group. "We are confident that our collaboration will support many clean energy producers in progressing toward a sustainable future."

MORE INFO www.nearthlab.com

MANUFACTURING

Vestas secures Equinor order for New York offshore

Vestas recently secured an 810 MW offshore order from Equinor to power New York's Empire Wind 1 offshore wind project. The order includes 54 V236-15.0 MW turbines and marks Vestas' first order in the U.S. for an offshore platform and its industry-leading, type-certified V236-15.0 MW turbine.

The order includes supply, delivery, and commissioning of the turbines, as well as a five-year comprehensive service agreement designed to ensure performance of the asset followed by a long-term service support agreement.

"We are privileged to partner with



A partnership With Axess Group will broaden Nearthlab's market reach into Scandinavia and Africa. (Courtesy: Nearthlab)

Equinor on this momentous U.S. project and provide them with our flagship offshore technology. Reaching this major milestone is a testament to the vigorous dedication of our entire team, who continuously strive to advance clean energy solutions and build the long-term future of the U.S. offshore market," said Laura Beane, President, Vestas North America.

"Offshore wind is set to play a pivotal role in expanding America's energy landscape, and with today's announcement, we are moving closer to building out a robust U.S. offshore market," said Josh Irwin, senior vice president of Offshore Sales, Vestas North America. "This is a significant moment for New York and the U.S. offshore industry, and we're excited to deliver a proven, reliable product to help New York achieve its ambitious offshore wind energy goals and provide resilient wind energy to its communities."

Vestas' flagship offshore wind turbine, the V236-15.0 MW, is built on proven technology and received its type certification last year ensuring type safety and quality. Since its launch,

Vestas has secured more than 13 GW of firm orders and preferred supplier agreements globally, proving its competitiveness across offshore markets.

"Delivering our commercially ready V236-15.0 MW for our first U.S. offshore project is a moment of huge pride for Vestas North America, and we're poised to continue leading the build-out of U.S. offshore wind with our industry-leading technology at the forefront of it," said John Eggers, chief technology officer, Vestas North America.

The Empire Wind 1 project also includes the continued transformation of the South Brooklyn Marine Terminal (SBMT) in Sunset Park, New York, which is set to become one of the nation's largest dedicated port facilities for offshore wind and a world-class offshore wind hub. The SBMT will provide the infrastructure to deploy the V236-15.0 MW offshore wind turbines, including the staging and pre-assembly activities such as load-in, load-out, and transportation of wind turbine components, tools, and containers before progressing toward offshore wind turbine



The South Brooklyn Marine Terminal (SBMT) in Sunset Park will be rebuilt using union labor and serve as the primary staging and assembly area for Empire Wind 1. (Courtesy: Vestas)

installation and commissioning.

Turbine delivery is expected to begin in 2026 with completion scheduled for 2027.

MORE INFO www.vestas.com

MANUFACTURING

Vestas gets 46-turbine order from CS Energy

Vestas has received an order for the supply and installation of 46 V162-6.2 MW wind turbines from Vestas' EnVentus platform for CS Energy's Lotus Creek Wind Farm, in Central Queensland. With a generation capacity of 285 MW, Vestas will also deliver a long-term Active Output Management 5000 (AOM 5000) service agreement, ensuring optimal energy production

to the Australian grid.

Lotus Creek Wind Farm is the first project developed by Vestas Development in Australia to reach financial close and construction readiness.

"Together with CS Energy and Zenviron, Vestas is delighted to provide our best-in-class people, wind turbines, and capabilities for this landmark project," said Danny Nielsen, country head and senior vice president, Australia and New Zealand Vestas. "As the world's largest provider of wind energy, we have always been committed to Australia's sustainable future and we thank the Lotus Creek project partners for joining us in this world-changing mission."

Vestas' efforts to expand its presence in renewable energy development are highlighted through securing all key land access, planning and environmental approvals, grid connection, and delivering the overall wind-farm design. Included in this was collabo-

rating with Lotus Creek Wind Farm landholders and the traditional owners Barada Barna and Barada Kabalbara Yetimarala people. Vestas also worked closely with Ark Energy in the project's early stage.

"Lotus Creek Wind Farm showcases Vestas Development Australia's ability to bring greenfield projects to commercial and planning maturity, hence accelerating the uptake of essential clean energy projects across Australia," said Evan Carless, vice president, Vestas Development Australia. "A key to this project's success has been nurturing valuable relationships with the traditional owners, landholders, the local community and our dedicated team of consultants."

"The Lotus Creek Wind Farm will be CS Energy's first 100-percent-owned wind asset and is a key part of our strategy to develop up to 700 MW of wind generation in Central Queensland," said Darren Busine, Chief Executive

Officer CS Energy. “This project will support the growing demand for renewable energy from our large commercial and industrial customers and demonstrates our ongoing commitment to the region.”

By developing new renewable energy projects, Vestas continues to advance the energy transition while bringing value and benefits to local communities. Delivery of Vestas’ wind turbines is expected to begin in the first quarter of 2026, with commissioning to commence in the fourth quarter of 2026.

During the peak of construction, Lotus Creek Wind Farm will involve an on-site workforce of up to 400 people and create 10 to 15 long-term regional service roles once operational.

The 285 MW generated by this wind farm will power the equivalent of 150,000 average Queensland homes. ↴



Vestas has received an order for the supply and installation of 46 wind turbines for CS Energy's Lotus Creek wind farm in Central Queensland. (Courtesy: Vestas)

MORE INFO www.vestas.com

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WINDS OF CHANGE - NEW TECH STEERING SHIPPING TO A MORE SUSTAINABLE FUTURE

Pyxis Ocean retrofitted with WindWings setting sail for its maiden voyage, August 2023. (Courtesy: © 2024 Cargill, Incorporated)

Cargo ships and cruise liners may soon be harnessing the power of wind and waves to reduce their carbon emissions — thanks to EU-funded researchers.

By TOM CASSAUWERS

In August 2023, a 5-year-old cargo ship, Pyxis Ocean, made history when it set sail from Shanghai, China, heading toward the southern Brazilian port of Paranaguá — a journey of nearly 25,000 kilometers.

What was historic about the journey was that, instead of running solely on heavily polluting bunker fuel, the Pyxis Ocean would be the first ship of its kind to supplement fuel power with wind power. It was testing out the pioneering WindWings® — 37.5-meter-high, foldable steel and fiberglass “sails” able to harness energy from the wind to propel the immense bulk carrier through the water.

BACK TO THE FUTURE

Designed by the U.K. company, BAR Technologies, built by Norway-based Manta Marine Technologies, and fitted in China to a ship chartered by international company Cargill, WindWings are the result of an ambitious international collaboration — the CHEK project — that received funding from the EU to help commercial shipping chart a course toward a lower carbon future.

“It was quite a challenge at the time,” said Suvi Karirinne, director of the Vaasa Energy Business Innovation Center (VEBIC) at the University of Vaasa, Finland, who coordinated the endeavor.

The Pyxis Ocean’s maiden journey provided the first real-world test of WindWings — and an opportunity to assess whether a return to this traditional method of propelling ships could be the way forward for moving cargo at sea.

In May 2024, DNV Maritime Advisory, an internationally recognized certification and testing authority, confirmed that, when sailing in favorable conditions, the two WindWings installed on the Pyxis Ocean reduced the energy consumption of the main engine by 32 percent per nautical mile.

The WindWings technology is expected to be widely adopted over time and is already set to be incorporated into 20 new vessels lined up for installation in 2025 and beyond.

CLEANER SHIPPING

As much as 90 percent of the world’s goods and raw materials are transported by sea — which is not as clean a means of transportation as one might think. A loaded container ship

can burn as much as 150 metric tons of heavy fuel per day, which is unsustainable from an environmental perspective.

Shipping is a major source of carbon emissions — about 2 percent of the global total, according to the International Energy Agency. In April 2018, the International Maritime Organization agreed to reduce emissions by at least 50 percent by 2050 compared with a 2008 baseline.

To help achieve this goal, CHEK experts have been working together to come up with innovative design solutions that could be integrated into existing commercial vessels. Their ultimate goal is to create zero-emission vessels by synergistically combining different options.

SYNERGISTIC INTEGRATION

The team of experts set out to integrate a range of different technologies and concepts into two vessel types: a bulk carrier and a cruise ship. Some of these designs were tested in re-



The two WindWings installed on the Pyxis Ocean reduced the energy consumption of the main engine by 32 percent per nautical mile. (Courtesy: © 2024 Cargill, Incorporated)

al-world conditions on the Pyxis Ocean and a passenger cruise ship belonging to MSC Cruises, a global cruise line company.

By harnessing the synergies between different operational, power supply, and drag reduction technologies, they have come up with a range of solutions that can be adapted for use in other vessel types such as tankers, container ships, general cargo ships, and ferries.

Proposed innovations include, among others, hydro-



WindWings being retrofitted on Pyxis Ocean at the COSCO shipyard in Shanghai, China, in August 2023. (Courtesy: © 2024 Cargill, Incorporated)

gen-powered engines, ultrasonic anti-fouling devices, and advanced route planning systems that consider the prevailing atmospheric and maritime conditions to provide the most energy-efficient route.

If applied together, the CHEK experts believe the advances they have developed and tested could reduce ships' energy use by 50 percent and their greenhouse gas emissions by 99 percent.

"There is no silver-bullet technology for maritime decarbonization," Karirinne said, who believes the progress can best be achieved through the integration of both new and already existing innovative technologies.

IMPROVING EFFICIENCY

"Shipping needs to reduce its emissions," said Anders Öster, research manager at Wärtsilä, a Finnish engineering company. "That's why we need to find solutions to make ships more efficient, and to decarbonize their propulsion."

In addition to taking part in CHEK, Öster coordinated another international research project called SeaTech, which also received funding from the EU to improve the efficiency of commercial shipping.

The SeaTech research, conducted between 2020 and late 2023, included both shipping companies and academic partners such as the University of Southampton in the U.K., the National Technical University of Athens and the University of Tromsø in Norway. It developed two key technologies that can be retrofitted to existing ships and thereby have a rapid impact on the sector's emissions.

WAVE POWER

Inspired by the movement of whales and dolphins through water, the researchers attached a dynamic underwater wing, similar to the front fins of a hammerhead shark, to the front of the 10-meter-long model ship.

The wing, which harnesses wave power to help drive the

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The WindWings technology is expected to be widely adopted over time and is already set to be incorporated into 20 new vessels lined up for installation in 2025 and beyond. (Courtesy: © 2024 Cargill, Incorporated)

ship forward, was tested both in wave tanks and in the Aegean Sea. The researchers found it generates thrust, particularly in choppy seas, allowing engines to reduce their output.

“These wings take the energy from waves and thrust the ship forward,” Öster said. “They also stabilize the ship’s movements.”

In addition, the SeaTech team used sensors and software to control the combustion process in a ship’s gas-powered engine, improving its efficiency.

“Compared to diesel engines, our gas engine emitted one-third less CO₂,” Öster said.

The two innovations work particularly well together, he said, because the engine control software can respond quickly to the same conditions that determine the power output of the wings. The result is more than the sum of its parts.

“One plus one equals three when we combine these technologies,” Öster said. “By taking different technologies and combining them, we strengthen their performance.”

The researchers found that, taken together, the two technologies could reduce diesel-powered ships’ CO₂ emissions by 46 percent.

ECONOMIC ADVANTAGE

The next challenge will be to persuade the shipping industry to adopt these innovations. Karirinne believes the results will speak for themselves.

Although the shipping industry can be quite conservative, according to Karirinne, it is also very competitive. In addition, the extension of the EU’s Emissions Trading System (EU ETS) in January 2024 to cover CO₂ emissions from all large ships has provided further impetus for change.

She expects that CHEK technologies will be welcomed by shipping operators as they can significantly reduce costs thanks to reductions in fuel consumption — and thus CO₂ emissions.

“These technologies aren’t just attractive because they reduce emissions, there’s also a societal and economic need for them,” she said.

The rate of adoption will depend both on the perceived economic advantage and on how easily the respective innovations can be implemented. It may be some time before all cargo ships are fitted with giant sails, but SeaTech’s engine developments are being retrofitted to ships already.

“Shipping is considered a hard-to-decarbonize sector,” Karirinne said. “But we have shown examples of how to do it. It is possible, and there are options. We just need to use them.”

ABOUT THE AUTHOR

Tom Cassauwers is a freelance journalist from Belgium. He writes about science, technology, and politics for outlets such as Trends, BBC, Al Jazeera, and Horizon Magazine. This article was originally published in Horizon, the EU Research and Innovation Magazine. Research in this article was funded by the EU’s Horizon Programme. The views of the interviewees don’t necessarily reflect those of the European Commission.



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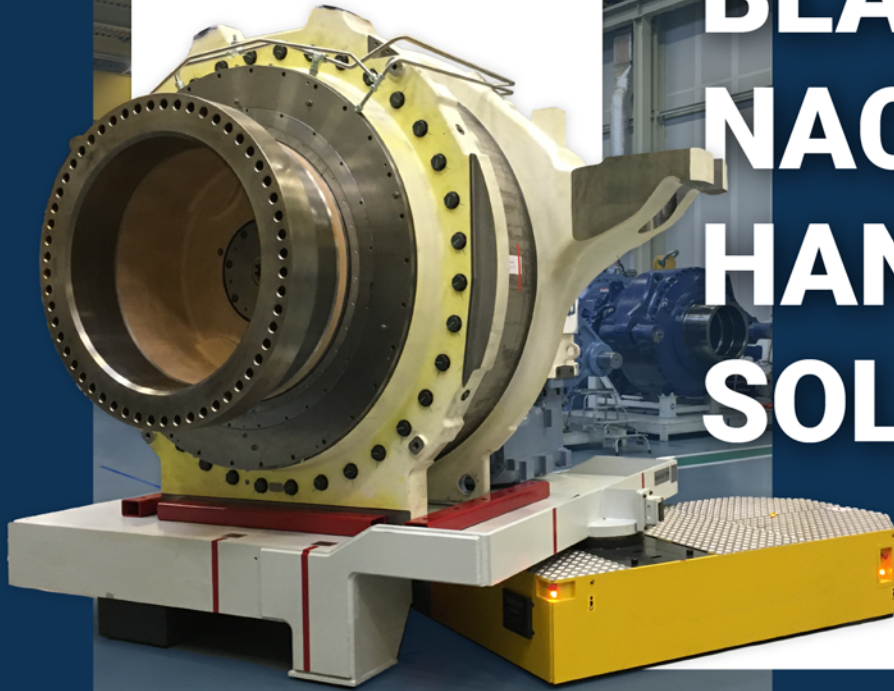
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