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NEW POLICY BLOWS NEW LIFE INTO WIND

Despite a down year, wind power prospects improve significantly with the passage of the Inflation Reduction Act.

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WIND, SOLAR, STORAGE

Association canadienne
de l'énergie renouvelable
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Wind
EUROPE

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FROM THE EDITOR

Powering up for CLEANPOWER 2023

The wind is definitely blowing through New Orleans, Louisiana, this month, as the home of Mardi Gras, the French Quarter, and beignets plays host to this year's CLEANPOWER 2023.

This is the first time the trade show has been in New Orleans since 2016, when it was still WINDPOWER. A few years ago, the wind, solar, and energy storage industries merged to form American Clean Power, so this year's show will continue to bring together many diverse companies under one roof to highlight the amazing expertise that makes up the many facets of renewable energy.

As you might expect, an incredible amount of planning and coordination goes into this annual event, and the 2023 show has a lot in store for attendees and exhibitors alike.

In last month's issue, we talked with Rosanna Maietta, ACP's chief communications officer and sr. counselor to the CEO, on what attendees can get out of this year's show.

She said attendees can expect to hear a dynamic lineup of speakers throughout the conference, as well as having constant opportunities to network.

Even though several sectors of the renewable-energy industry will be represented, there still will be a lot of specific focus on wind.

To that end, it makes a lot of sense for New Orleans to host the event since Louisiana recently announced an offshore wind goal of 5 GW installed by 2035 as part of the state's first ever Climate Action Plan.

And as a primer for the show, our May inFocus topic shines a spotlight on the wind part of CLEANPOWER 2023. Make sure and check out our cover article by John Hensley. In it, he discusses how the wind industry is powering forward now that the Inflation Reduction Act has passed, despite a down year.

And with CLEANPOWER in mind, this issue also includes a bonus. Now that CLEANPOWER is made up of many renewable-energy sectors, shuffling through the wind-only exhibitors might be a challenge.

To help with that, inside you'll find a list of all the wind-only exhibitors and their booth numbers. And, if the company is part of *Wind Systems'* online community, we've added those companies' wind expertise, website address, and a phone number contact.

I am excited about renewing industry relationships in New Orleans, as well as meeting some new industry insiders and experts.

Be sure and stop by the *Wind Systems* booth (#2958) and say hi. I hope to meet all of you at the show and discuss opportunities for editorial content.

See you in New Orleans, and as always, thanks for reading!



Kenneth Carter, editor

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

Giving Wind Direction

WIND SYSTEMS

David C. Cooper
Publisher

EDITORIAL

Kenneth Carter
Editor

Jennifer Jacobson
Associate Editor

Joe Crowe
Associate Editor | Social Media

SALES

David Gomez
National Sales Manager

Kendall DeVane
Regional Sales Manager

CIRCULATION

Teresa Cooper
Manager

Jamie Willett
Assistant

DESIGN

Rick Frennea
Creative Director

Michele Hall
Graphic Designer

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(800) 366-2185 • (205) 380-1580 fax
info@msimktg.com

David C. Cooper
President

Teresa Cooper
Operations Director

Jennifer McIvor receives Andrew Linehan Award

From American Clean Power

The American Clean Power Association recently awarded Jennifer A. McIvor, vice president and chief environmental officer for Berkshire Hathaway Energy, with the Andrew Linehan Award for Environmental Excellence.

This award recognizes leaders in the permitting and environmental community who demonstrate exceptional dedication to improving the siting practices of the clean-energy industry, supporting innovative conservation opportunities for clean-energy projects, and fostering communication and collaboration among clean energy and wildlife stakeholders.

"Jenny's leadership and commitment to the clean energy industry is remarkable," said Jason Grumet, ACP CEO. "Her innovative thinking inspires industry peers and demonstrates the opportunity to align clean-energy development with habitat preservation and wildlife protection. We are thrilled to present this year's Andrew Linehan Award to Jenny for her outstanding contributions."

McIvor's career spans numerous roles in environmental policy, strategy, and management. As a devoted advocate for renewable energy and wildlife, McIvor has held key leadership positions representing Berkshire Hathaway Energy in a number of organizations, serving as the current secretary and prior chair of the Renewable Energy Wildlife Institute, current chair of the Energy and Wildlife Action Coalition policy committee, and current chair of ACP's Federal Wildlife and Permitting committee. In her nomination and throughout her career, she has received praise from her peers for her outstanding expertise in the field, enthusiasm, and creativity while possessing a deep commitment to environmental protection and responsible development.

"I am incredibly honored to receive the Andrew Linehan Award and am grateful to my colleagues for their support and recognition," McIvor said.

The Andrew Linehan Award for Environmental Excellence commemorates the late Andrew "Andy" Linehan, a clean-energy industry champion who left a legacy through his innovative contributions to siting issues and wildlife protection.



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



US Wind's Sparrows Point Steel has the potential to be one of the largest offshore wind staging ports in the U.S. (Courtesy: US Wind)

Maryland looks to expand offshore wind-energy goal to 8.5 GW

Baltimore-based US Wind and other Maryland leaders applauded Maryland Gov. Wes Moore's announcement of major offshore wind-energy initiatives during the 2023 International Partnering Forum in Baltimore.

"Our administration is serious about offshore wind, and Maryland is ready to lead," Moore said. "We need all hands on deck in this crucial moment — so we can strengthen Maryland's supply chain, leverage our state's assets, and put Marylanders to work in clean-energy jobs centered on logistics and manufacturing. If we join together in partnership, we can make Maryland the offshore wind capital of the United States."

Moore announced Maryland will aim to quadruple the amount of energy produced by offshore wind from about 2 GW to 8.5 GW, which is enough to power nearly 3 million homes. The governor said the state has plans to increase its offshore wind output and prioritize wind energy partnerships, creating significant economic and job creation opportunities in the state.

"Governor Moore's announcement is a homerun for the people of Maryland," said Jeff Grybowski, US Wind CEO. "He has a big and bold vision that aims to make Maryland the national leader in this new industry and will create thousands of jobs in the process. Governor Moore is the person we need right now to achieve a clean-energy future for Maryland."

"Maryland can — and will be — a national leader for offshore wind and Governor Moore's announcement is a major win for Baltimore County as we continue transforming into a premier hub for renewable energy projects," said Baltimore County executive Johnny Olszewski. "These projects will help combat climate change while creating hundreds of high-quality jobs in our communities, and we look forward to working with our partners at the State, US Wind, Tradepoint Atlantic, and beyond to ensure the future of America's

green economy continues to be built — literally — at Sparrows Point."

"Governor Moore's record-shattering announcement means so much to so many across the state, especially minority-owned businesses like Strum Contracting," said Teamera Strum, CEO of Strum Contracting Company, Inc. "Offshore wind will not only improve air quality and combat climate change but also uplift under-served communities while creating career opportunities and economic vitality. Strum Contracting is thrilled for Governor Moore's leadership and for US Wind's commitment to delivering offshore wind and good paying jobs to Marylanders."

"The Steelworkers couldn't be happier to hear Governor Moore's commitment to make Maryland a leader in offshore wind manufacturing," said Jim Strong, United Steelworkers offshore wind assistant. "Sparrows Point Steel, Maryland's first permanent offshore wind facility, is being built on Steelworkers' hallowed ground at the site of the former Bethlehem Steel. Our partnership with US Wind will create good union jobs for this new renewable energy industry right here in Baltimore County. Governor Moore's announcement and the work of the Maryland state legislature will position Maryland as a leader in offshore wind manufacturing for decades to come."

"The future of offshore wind energy presents an incredible opportunity for minorities to get into the energy industry and make a difference in their communities," said Pamela Minor, president of the Southern Maryland Minority Chamber of Commerce. "The potential of offshore wind power is immense, with massive potential for job creation and economic growth. As we move forward in achieving Governor Moore's history-making goal of 8.5 GW for Maryland, it is essential that we work together to ensure that all people have access to the opportunities presented by offshore wind energy. We're

proud to be working with US Wind on this effort."

"IBEW Local 24 is thrilled to hear Governor Moore's new offshore wind goal for Maryland," said Mike McHale, business manager, Local 24. "Our partnership with US Wind is a top priority for our union. This announcement solidifies the governor's commitment, along with the commitment of the Maryland state legislature, to clean energy and union jobs in the state."

The governor also announced the administration is working to establish new lease areas and strengthen the offshore wind supply chain in the state. Meanwhile, the Maryland General Assembly is set to pass the complementary Promoting Offshore Wind Energy Resources (POWER) Act of 2023, which also calls for Maryland to boost its offshore wind generation goals to 8.5 GW, improve its transmission infrastructure, and provide a pathway to future procurement of offshore wind energy in the state.

MORE INFO uswindinc.com

Clir Renewables on list of fastest growing companies

Clir Renewables, the market intelligence platform for wind and solar, has secured a ranking of 210 in a list of the fastest growing companies in the Americas, published by the Financial Times. Clir's absolute growth rate was 274 percent between 2018 and 2021.

To be eligible for inclusion in the list, companies must be headquartered on the continents of North or South America, have generated a revenue of at least \$100,000 in 2018 and \$1.5 million in 2021. The business must be independent, and revenue growth between both 2018 and 2021 must be primarily organic.

Clir combines the world's largest renewable energy operational dataset



Clir detects market-wide, project-related, and site-specific issues for wind and solar projects. (Courtesy: Clir Renewables)

with software and analytics to provide renewable energy power generators, investors, and asset managers with actionable insights into the production, health, risk, and financing of assets.

Over the last four years, Clir has secured more than 200 GW of project data, 29 new clients including Glenmont Partners and Northleaf Capital Partners, and expanded into 12 new territories. The business supports the fundamentals of renewable energy project growth and development, working with developers, lenders, and investors through project development, operations, and subsequent mergers and acquisitions.

Leveraging advanced AI and 200-plus GW of data from decades of project experience, Clir detects market-wide, project-related, and site-specific issues for wind and solar projects.

“To be recognized by The Financial Times as one of the Americas’ fastest growing companies is an achievement we’re all hugely proud of,” said Gareth

Brown, Clir’s chief executive and founder. “Over the past six years since our formation, we’ve been able to grow rapidly by continually listening to and recognizing the needs of the market. As the industry increases in competition, we’re looking forward to the continued growth of our company, and to further incentivizing the shift toward clean energy through deeper intelligence into performance and risk.”

MORE INFO www.clir.eco

Business Network for Offshore Wind celebrates 10 years

The Business Network for Offshore Wind, a nonprofit working to accelerate offshore wind development and build a dedicated manufacturing supply chain in the United States, is marking its 10th anniversary by launching a campaign that celebrates the remark-

able growth of the American offshore wind industry over the last decade.

The Business Network for Offshore Wind works to unlock opportunities to harness the potential of offshore wind energy and grow America’s domestic supply chain capacity.

What began in 2013 as a small group of Maryland businesses with a shared vision has transformed into a diverse coalition of nearly 600 member groups and businesses working collectively to increase coordination and reduce barriers to offshore wind deployment.

The Network brings together businesses, developers, policymakers, international experts, and economic development agencies to increase coordination and reduce barriers to offshore wind deployment for the benefit of America’s economy, environment, and workforce. From the International Offshore Wind Partnering Forum, the Network’s annual signature event and the largest offshore wind conference in the Americas, taking place in Baltimore, to creating critical industry products such as the Supply Chain Connect registry, OSW Market Dashboard, and Foundation 2 Blade trainings, the Network is committed to meeting the dynamic needs of a fast-evolving industry.

“Ten years ago, we started the Business Network for Offshore Wind with the shared mission to break down the barriers that have held back the U.S. offshore wind industry for far too long,” said Liz Burdock, President and CEO of Business Network for Offshore Wind. “Today, we are at an inflection point as the market transitions from demonstration to commercialization-at-scale, and we have a visible pipeline of construction-ready projects for the first time. Offshore wind is the tip of the spear for renewable ocean energy — not only can it power our homes and businesses, but it can be the foundation for new technologies, new innovations, and breakthrough climate solutions. As we celebrate the progress we have made, we also have an opportunity to reflect on how far we have come and look forward to the next 10 years because our work is far

from complete — we know that working together, a future powered by offshore wind is possible.”

MORE INFO www.offshorewindus.org/10th-anniversary

Crowley names new VP of project management

Crowley recently named Mark Coplen as vice president of project management for Crowley Wind Services, where he will be a key leader in advancing the company's growth and market leadership in the offshore wind industry.

In his role, Coplen will expand Crowley Wind Services' project management capabilities to support customers in its offering of engineering, procurement, and construction management for the offshore wind market. Coplen joins Crowley with extensive expertise in the sustainable energy

sector leading offshore wind services, operations, and technology. “Mark has decades of leadership experience in complex operational environments,” said Bob Karl, senior vice president and general manager of Crowley Wind Services.

Crowley is under way with development and planning for wind terminals in California, Louisiana, and Massachusetts. In addition, the company's CREST Wind joint venture with ESVAGT recently announced the construction of a service operations vessel for Coastal Virginia's major wind-energy project, in addition to Crowley providing feedering vessel services and other supply chain solutions. The company's growth in wind-energy solutions led to the launch of Wind Services as a stand-alone business unit in 2021.

Coplen previously served as president of Ventolines, an offshore wind consulting company, and as vice president of AdBm Technologies, a company that patented an underwater noise

abatement solution for the foundations of fixed-base turbines to reduce impacts on marine life.

Coplen also served as a colonel in the U.S. Army. He is a graduate of the United States Military Academy at West Point, where he earned a bachelor's degree in engineering and holds a master's in business administration from the Texas McCombs School of Business.

Crowley is a privately held, U.S.-owned maritime, energy, and logistics solutions company serving commercial and government sectors with \$3.4 billion in annual revenues, more than 170 vessels mostly in the Jones Act fleet and about 7,000 employees around the world. The company serves customers in 36 nations and island territories through five business units: Crowley Logistics, Crowley Shipping, Crowley Solutions, Crowley Wind Services, and Crowley Fuels. ✈

MORE INFO www.crowley.com

The advertisement features a background image of several white wind turbine blades against a clear sky. In the upper left, there is a circular logo containing a detailed illustration of a bulldog's head with its mouth open, showing sharp teeth and a spiked collar. Below the logo, a white semi-truck is shown from a side profile, pulling a large, dark-colored mobile shredding unit. The truck has an American flag graphic on its side. The shredding unit is a complex piece of machinery with a hopper for blades and a processing area.

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A large offshore wind turbine stands in the ocean under a blue sky with white clouds. The turbine has three long blades and a tall tower supported by a red lattice structure. The water is dark blue with some ripples.

IN FOCUS

CLEANPOWER 2023

NEW POLICY BLOWS NEW LIFE INTO WIND

Ørsted's 30 MW Block Island Wind Farm off Rhode Island was the first U.S. offshore wind project to become operational (Courtesy: Shutterstock)



Despite a down year, wind power prospects improve significantly with the passage of the Inflation Reduction Act.

By JOHN HENSLEY

Long-awaited policy certainty provides a critical shot-in-the arm for the wind industry, leading to a growing pipeline and reinvigorated domestic supply chain.

Last year will go down as a transition year for the wind industry. Build volumes slowed considerably from record levels set in 2020 and 2021. Project delays plagued developers as supply chain challenges, escalating costs, and interconnection delays slowed timelines. And project economics were stressed from elevated commodity prices and general inflationary pressures. But — and it is a big but — the year was punctuated emphatically with the enactment of the Inflation Reduction Act (IRA).

This once-in-a-generation legislation brings 10-plus years of policy certainty to an industry that has been battered by shifts in the political winds. On its heels, expectations for wind development this decade has increased at least 25 percent, and manufacturers are actively expanding or adding to their domestic manufacturing capabilities. Fold in growing demand for renewable energy, and the stars are aligning for a decade-plus of growth.

Before we get to the outlook, let's examine how the year unfolded for the wind market:

■ The U.S. wind market installed 2,696 wind turbines with a total capacity of 8,511 MW, down from 13,400 MW installed in 2021. Although the land-based wind market finished 2022 with its strongest quarter, the annual decline in wind-capacity installation was primarily due to sluggish growth in the middle of the year.

■ The 8,511 MW installed in 2022 brings the U.S. to 144,132 MW of cumulative operating capacity. Many of these wind projects are concentrated in the central plains of the U.S., one of the best regions anywhere for locating wind turbines. Texas vastly exceeds all other states' operating wind capacity with 40,151 MW operating. The next closest state for total operating capacity is Iowa with 12,783 MW, less than half of Texas. A total of 23 states now belong to the gigawatt-club, with seven states containing more than 5 GW of operating wind power. There is commercial wind operating in 41 U.S. states and Puerto Rico.

■ The offshore wind market saw signs of progress. Twelve new lease areas across the NY Bight, Carolina Long Bay, and California were auctioned during the year while state targets for offshore wind soared to 81 GW. In total, there are now 51 GW of offshore wind projects in the pipeline, including



These two wind turbines, currently in operation, were the first installed as part of the Coastal Virginia Offshore Wind commercial project. (Courtesy: Dominion Energy)

17.5 GW of projects that have power purchase agreements in place.

IRA BRINGS MUCH NEEDED BOOST TO THE INDUSTRY

The Inflation Reduction Act represents the single largest investment in renewable power in the history of the country and the largest investment in climate action to date. After years of policy uncertainty — on-again, off-again tax credits, phase down regimes, and pandemic-era policy band aids — the wind industry finally has the long-term policy certainty it has been pursuing for nearly two decades. The policy not only focuses on incentivizing renewable projects, it seeks to drive investment in domestic clean-power manufacturing.

It's clear this policy is working. In the last eight months, more than \$150 billion in domestic utility-scale clean-energy investments has been announced, including 46 new or expanded manufacturing facilities. While much of the focus has been on solar manufacturing, the wind industry is making moves, too. At least 10 wind-power manufacturing facilities have been announced, including eight focused on the land-based market and two geared toward offshore wind.

A TRANSITION YEAR FOR LAND-BASED WIND

Last year saw a significant decrease in wind capacity installations compared to both 2020 and 2021. Rising commodity prices, increased supply chain costs, the phase-down of the PTC, and the on-going effort to rebuild development pipelines following record activity at the start of the decade, all contributed. Developers commissioned nearly 4.9 GW less wind power in 2022 compared to 2021, which itself was a down year compared to a record 2020. Year-over-year, wind installations declined by nearly 37 percent in 2022.

Wind developers delivered 40 project phases online, including repowers, totaling 8.5GW in 2022. These projects were spread across 14 states, including nine states that added 500 MW or more. Texas and Oklahoma once again led all states in new wind power, installing 4.2 GW and 1.4 GW

respectively. The largest project built in 2022 is the 1,029 MW Great Prairie Wind project spread over both Oklahoma and Texas. The Traverse Wind project was close behind at 996 MW.

Despite a down year, the market shows early signs of improving. Developers are currently pursuing 20.8 GW of projects that are either under construction or in advanced development.

BOEM ACTIVE ON THE AUCTION BLOCK

The Bureau of Ocean Energy Management (BOEM) had a busy year as the agency auctioned off 12 offshore wind project leases. The action is part of BOEM's Offshore Wind Leasing Path Forward 2021-2025, which details the agency's goal to hold lease auctions in seven regions across the United States. These auctions are critical as the industry seeks to deliver 30 GW of offshore wind power by 2030.

In February 2022, six lease areas in the New York Bight were awarded in the BOEM's largest single offshore wind lease auction to date. The auction raised \$4.4 billion in revenue, and leases went for between \$6,147/acre to \$9,933/acre. This record-breaking offshore wind lease auction highlights the strong opportunities for developers in the region. New York and New Jersey both have ambitious offshore wind goals and detailed procurement schedules.

In May, BOEM auctioned two leases, this time in Carolina Long Bay. Combined, the lease areas total 110,091 acres and fetched \$315 million in the auction. BOEM concluded the year with the much-anticipated auctioning of five lease areas off the California coast. These first lease areas on the West Coast include two near Humboldt Bay in Northern California and three near Morro Bay in Central California. Bidders paid a combined \$757 million for 373,268 acres.

BOEM plans to hold lease auctions in the Gulf of Mexico (2023), Central Atlantic (2023), Oregon (2023), and the Gulf of Maine (2024) to complete its Path Forward plans.

A major milestone was achieved in November 2022 as the first commercial-scale offshore wind project, Avangrid and

Copenhagen Infrastructure Partners' 806 MW Vineyard Wind project started offshore construction. The project is expected to be operational this year.

Offshore construction has also commenced at South Fork Wind, a 132 MW Ørsted and Eversource project. After receiving a ROD in November 2021, started onshore construction in 2022 and moved to offshore construction in March 2023.

There are two offshore wind projects online in the United States — Ørsted's 30 MW Block Island Wind Farm off Rhode Island and Dominion Energy's 12 MW Coastal Virginia Offshore Wind Pilot off Virginia, the latter of which came online in early 2021. There are 18 projects in development that have secured offtake, totaling nearly 17.5 GW, and a further 33.8 GW of projects are in early development.

STATE OFFSHORE WIND TARGETS BALLOONED TO 81,000 MW

States continue to be the main drivers of offshore wind development in the United States. Kicking off the year, Louisiana announced an offshore wind goal of 5 GW installed by 2035 as part of the state's first ever Climate Action Plan. California added to the mix by establishing a short-term goal of 2 to 5 GW by 2030 and a long-term goal of 25 GW by 2045. Maryland is the latest state to join the crowd after lawmakers passed a bill in April 2023 establishing an 8.5 GW by 2031 offshore wind target. In total, 10 states have combined to set offshore wind procurement targets of more than 81,000 MW.

A MAJOR IMPROVEMENT IN THE WIND OUTLOOK

As a result of the passage of the IRA, market consultants significantly revised their land-based wind outlook for the rest of the decade. In fact, forecasts improved 25 percent on average. The additional 20 GW this decade brings total expectations for 2023-2030 to 102 GW. Forecasts range from a low of 87 GW to a high of 120 GW.

Development volumes will grow each year through the end of the decade and will eventually reach nearly 16 GW on average in 2030, with one consultant predicting 19 GW in that year. But the road ahead is not without obstacles. High interconnection costs, long transmission study wait times, congestion in wind-rich regions, and difficult permitting regimes all stand to slow wind-power development. New transmission lines coming online in the middle of the decade will help, but slow progress overall in long-haul transmission expansion puts an upper limit on the market.



A major milestone was achieved in November 2022 as the first commercial-scale offshore wind project, Avangrid and Copenhagen Infrastructure Partners' 806 MW Vineyard Wind project started offshore construction. The project is expected to be operational this year. (Courtesy: Vineyard Wind)

In the offshore market, the outlook has also improved. It's still not to the level of the industry's nor the Biden administration's expectations, but consultant forecasts are heading in the right direction. Bloomberg, S&P Global, and Wood Mackenzie anticipate, on average, 26 GW of offshore wind to be operating in 2030, a 2-GW improvement over last year's forecast.

The most optimistic forecast projects offshore installations to hit 28 GW by the end of the decade, within reach of the 30-GW goal.

The offshore wind market is largely driven by state policy support, solicitation schedules, and seabed leasing availability. Chief among forecasters' concerns are long development timelines, anticipated delays, supply chain bottlenecks, and other factors. Multi-gigawatt annual installations are expected starting in 2025, while 2030 is anticipated to be the peak year for new offshore wind additions at nearly 5 GW.

All-in-all, there are many reasons to be optimistic about the future of offshore wind. After many years of promise, this industry is now poised to deliver. ✌

ABOUT THE AUTHOR

John Hensley is vice president for Research and Analytics for the American Clean Power Association.

COMBATING CREW CHALLENGES IN OFFSHORE DEVELOPMENTS

Offshore wind projects can take several years to materialize from conception to full operation. (Courtesy: GAC)

The United States has ambitious plans to develop a world-leading offshore energy sector; however, regulations to embolden its domestic capabilities could limit its progress to increasing offshore wind footprint.

By ERLAND EBBERSTEN

In 2021, several key pledges were made to revolutionize the United States' offshore wind-energy sector in the first weeks of the Biden administration, including new targets to generate 30 GW of offshore wind energy by 2030 ("30 by 2030") and 110 GW by 2050 to catch up with expansive offshore wind development projects in Europe and Asia.

More than \$12 billion of funding per year was promised to support offshore wind projects, potentially creating tens of thousands of jobs and powering 10 million homes each year. However, while the finances and the general will are in place, regulations governing workers for such projects have left people in the industry scratching their heads.

To generate more American jobs and reduce the sector's dependence on foreign labor, the National Defense Authorization Act (NDAA) was amended in 2022 to mandate that those operating and manning offshore vessels and platforms in U.S. waters should be U.S. nationals. The bill also called for an expansion of the Jones Act to deny foreign-flagged offshore vessels from operating in U.S. waters.

While the regulation looks to level the playing field between U.S. and foreign vessels and crews, it could also stymie the country's wider offshore wind ambitions.

Heather Zichal, former chief executive officer of the American Clean Power Association, called the move "a gut punch to offshore wind projects" that would halt or delay domestic offshore wind-farm installations and affect thousands of U.S. jobs. Crucially, it came at a time where access to a skilled and large-enough workforce is one of the main hurdles for the sector globally.

PREPARATION IS KEY

The Global Wind Organisation and Global Wind Energy Council anticipate that 568,800 technicians will be needed to build and maintain a global onshore and offshore wind fleet by 2026 — up 33 percent from 426,700 in 2021. In the U.S. alone, up to 58,000 full-time workers will be needed to support the offshore wind-energy industry between now and 2030.

Building a large, competent workforce takes time. Many in the oil and gas sector are starting to reskill and transition into renewables. To date, the industry has addressed the skills and knowledge gap by relying on foreign crews and vessels that already have the infrastructure and know-how to get wind turbines up and running — something the amended NDAA would stymie.

An offshore wind farm can take up to 11 years to build from development, pre-construction to construction, or just seven years with the right equipment and skilled workforce. To meet its "30 for 2030" vision, the U.S. must make provisions, including legislative frameworks, to support offshore wind development.

Offshore wind projects can take several years to materialize from conception to full operation. Across the numerous offshore wind-farm projects GAC has worked on around the world, a common theme stands out: Preparation is key. Offshore wind-farm developers must have the right suppliers, partners, and crew in place to support the construction of their projects.

Shortages of skilled labor and equipment have exacerbated global supply chain challenges, with a knock-on impact on the number and scope of offshore wind-energy projects. GAC offers a range of integrated shipping, logistics, and marine services to provide stability amid the uncertainty the sector faces, including agency and husbandry services, supply chain, barge and tug support, and emergency response capabilities.

Its global footprint and more than six decades of experience in offshore support services have given the group a deep understanding of the challenges its customers face in accessing skilled crew.

GAC's role as a ship agent and its involvement with crew change operations globally has made it an eyewitness to the struggle to accessing skilled labor in recent years, especially during the COVID-19 pandemic.

Port authorities and governments introduced special requirements for crew-change operations, which reduced the frequency and number of offshore crew changes that we could carry out for almost two years. Now most those restrictions have been lifted, crew change operations have become easier, as have the smaller but equally important aspects of the crew change process such as visas, seaman's books, and airport and hotel bookings and transfers.

As the U.S. looks to reduce dependence on foreign crews, uncertainties remain over how to build the necessary offshore infrastructure at the pace needed without them, or at least until there are enough U.S. workers trained in this sector.

TURNING TO TECHNOLOGY

Increasingly, major stakeholders in offshore wind projects are turning to emerging technologies to mitigate labor shortages, reduce overheads, minimize environmental impact, and improve operational safety.

Unmanned survey vessels (USVs) are staking their claim as a core component in offshore renewable energy projects, enabling operations and maintenance players to collect a vast amount of on-site data to aid faster and smarter decision making. Information gathered related to weather patterns, water currents, seabed conditions, and more are valuable when planning other offshore wind-farm projects. And they can reduce the number of on-site specialists required during technical operations.



GAC's role as a ship agent and its involvement with crew change operations globally has made it an eyewitness to the struggle to accessing skilled labor in recent years. (Courtesy: GAC)

USV technology could set a new precedent for supporting offshore projects. Unlike a traditional platform at sea, which requires regular crew changes, USVs can reduce the on-site work force and manpower costs, while minimizing the need for technical experts and diving teams to operate in high-risk situations.

However, regulations governing such technology could throw obstacles up so long as legislation surrounding the use of USVs in offshore operations remains embryonic. But with USVs already operating and developing at pace in the offshore sector, it is likely the technology will define the legislation, rather than the other way around.

Advancing technologies could plug the gap as the U.S.



The Global Wind Organisation and Global Wind Energy Council anticipate that 568,800 technicians will be needed to build and maintain a global onshore and offshore wind fleet by 2026. (Courtesy: GAC)

looks to shore up its domestic capabilities. And even with a competent local workforce in place, USVs could still play a critical part in the construction, operation, and management of offshore wind farms.

LEVERAGING EXPERIENCE

Some of the world's largest offshore wind-farm developments have been multinational and multicultural projects that involve dozens of companies, suppliers, and logistics partners from all over the world.

Asia and Europe are both prominent players in the off-

shore wind industry looking to harness the power of greener energy amid surging regional demand. To meet its ambitious wind-energy goals, the U.S. should look to leverage the experience gained elsewhere, particularly when it comes to technology, innovation, and regulation.

These two regions have invested heavily into technology to improve the efficiency and safety of the various offshore operations for wind-farm projects. This investment has resulted in the development of state-of-the-art vessels, equipment, and technology, such as USVs, that have greatly improved the sector's capabilities.

The U.S. is currently looking to build Jones Act-compliant vessels to support the installation of offshore wind turbines that continue to grow in size. And, as Green noted, it can apply lessons learned from Asia and Europe in deciding what best to invest in and develop regulatory frameworks to support its offshore goals, particularly in crew safety.

A robust regulatory framework has been shown to ensure safe and responsible offshore operational conditions, which boosts confidence in the industry, attracts further investment, and enhances the sector's growth.

By leveraging these lessons, the U.S. can develop a thriving offshore wind segment that contributes to the country's economic growth and development, while significantly reducing carbon emissions.

SHORT-TERM CONCERN

The U.S.'s current lack of skilled crew to support its offshore wind energy ambitions is a significant cause for concern — one that will grow as changes to the NDAA take hold. At its core, the U.S. must look to build a domestic workforce that is skilled, trained, and in place to reap the benefits of renewable offshore energy.

While the U.S. Department of Energy estimates more than 43,000 new jobs will be created in the offshore wind market by 2030, with wind-turbine technicians looking to be the fastest growing job in the U.S. market in the coming years, the specialized nature of the offshore sector means a significant investment must be made in local capabilities sooner rather than later. In the meantime, the sector can look to advancements in technology and investments made in offshore wind energy around the world to keep the U.S.'s "30 by 2030" vision alive, at least until domestic capabilities for crewing have caught up. ↘

ABOUT THE AUTHOR

Born in Stockholm, Erland Ebbersten became interested in the maritime world at an early age and was a skipper in the navy by the age of 20. He joined GAC in 1993 and has been a group vice president since 2006. He is responsible for the Marine & Energy portfolios.



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GE is partnering with customers
and governments to scale
breakthrough technologies
for a lower-carbon

END beyond



A list of wind-related businesses exhibiting at the premier clean-energy trade show.

With CLEANPOWER 2023 focusing on wind energy, solar energy, and battery storage, looking for wind-only or wind-hybrid businesses might be challenging.

To help with your show decisions, *Wind Systems* offers this list of wind-related businesses exhibiting at the show along with their booth numbers.

The highlighted companies are part of the *Wind Systems* community, our online resource for locating products and services that are exclusive to the wind-energy industry. These companies also have their wind-focused expertise and contact information included here.

For any late booth additions or changes, please refer to the floorplan at cleanpower.org/expo. ↗

3S Lift

Booth #: 4041

ABB

Booth #: 4253

AABL A/S

Booth #: 1237

ABS Wind

Booth #: 2322

ACS - Apprenticeship

Booth #: 3720

Acuren

Booth #: 1752

Adolf Thies GmbH and Co. KG

Booth #: 3923

Aegis Onshore, Inc.

Booth #: 540

AES

Booth #: 1915

Aggreko, LLC

Booth #: 4433

Alltite, Inc.

Booth #: 1449

Altura, a division of IRISNDT

Booth #: 535

American Clean Power - ACP

Booth #: 1941

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Booth #: 3122

Applied High Voltage

Booth #: 4233

Ascend Analytics

Booth #: 1417

ArcVera Renewables

Booth #: 2451

Atlas Copco Tools & Assembly Systems

Booth #: 1747

AUGE Industrial Fasteners LLC

Booth #: 1616

Avid Controls, Inc.

Booth #: 1041

Bachmann electronic GmbH

Booth #: 2123

Barnhart Renewables

Booth #: 3733

Barr Engineering Co.

Booth #: 2520

BayWa r.e. USA LLC

Booth #: 2541

BazeField AS

Booth #: 2247

Bennett Family of Companies

Booth #: 3248

BGB Technology Inc

Booth #: 2058

BHE Renewables

Booth #: 4453

BHI Energy

Booth #: 3420

Bishop Lifting Products, Inc.

Booth #: 617

Bladefence

Booth #: 1859

Blue Wind Technology LLC

Booth #: 3049

Bragg Companies

Booth #: 3715

Brownsville TX/ Matamoros MX

Booth #: 914

Bureau Veritas North America

Booth #: 2427

Burns & McDonnell Engineering Company, Inc.

Booth #: 1127

Campbell Scientific, Inc.

Booth #: 2623

Capps Van & Truck Rental

Booth #: 2433

Castrol / ONYX Insight

Booth #: 3241, 3341

C.C. Jensen A/S

Booth #: 1332

CEJN North America

Booth #: 1758

Clobotics Corporation

Booth #: 1852

CNC Foundations

Booth #: 3421

Composites One

Booth #: 3033

Consertek USA Inc

Booth #: 3921

ConverterTec Service GmbH

Booth #: 1661

Cornerstone Systems

Booth #: 3621

Cotton GDS

Booth #: 1250

CSA Group Testing & Certification Inc.

Booth #: 1415

Dakota Riggers & Tool

Booth #: 2722

Danish Wind Export

Booth #: 1445, 1230, 1547

Dansk Gummi Industri A/S

Booth #: 1241

DEIF A/S

Booth #: 1646

Dellner Bubenzer

Booth #: 2650

DeTect, Inc (ADLS)

Booth #: 3115

Deutsche Windtechnik

Booth #: 3333

DEX

Booth #: 2354

DNV

Booth #: 1841

DSV Road Inc.

Booth #: 3160

Dyson Corp.

Booth #: 4320

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Booth #: 3860

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**Fibre Glast
Developments Corp,
LLC**

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Firetrace International

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Fischer Block, Inc.

Booth #: 1533

Five Star Products Inc.

Booth #: 3954

Fluence Energy

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FORCE Technology

Booth #: 1133

FUCHS Lubricants Co.

Booth #: 735

Fulcrum3D

Booth #: 3125

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Booth #: 2352

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Booth #: 621

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Booth #: 2446

**Global Wind
Organisation**

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Booth #: 1355

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Booth #: 3817

Ground Control

Booth #: 3217

Grupo Alava

Booth #: 2957

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Systems USA**

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Hanes Supply, Inc.

Booth #: 2820

**Helwig Carbon
Products, Inc.**

Booth #: 2755

**Heraeus Deutschland
GmbH & Co. KG**

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Hindsight LLC

Booth #: 912

**Hine Hydraulics
Corp.**

Booth #: 2347

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Renewables**

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TGM Wind Services
Company**

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PROFILE

ALL METALS & FORGE GROUP

MANUFACTURER OF OPEN DIE FORGINGS AND SEAMLESS ROLLED RINGS

All Metals & Forge Group is an ISO 9001:2015 and AS9100D manufacturer of custom and standard open die forgings and seamless rolled rings. (Courtesy: All Metals & Forge Group)

For more than 50 years, All Metals & Forge Group has produced custom and standard open die forgings and seamless rolled rings in a host of different alloys for a wide range of industries.

By KENNETH CARTER ▀ Wind Systems editor

It's no small testament to be able to say a business has been going strong for more than half a century, but All Metals & Forge Group has been manufacturing and selling open die forgings and seamless rolled rings to a variety of industries for 51 years.

And if Lewis Weiss, the company president and CEO, has anything to say about it, that success will continue for another 50 years.

All Metals & Forge Group is an ISO 9001:2015 and AS9100D manufacturer of custom and standard open die forgings and seamless rolled rings in carbon steel, alloy steel, stainless steel, tool steel, nickel alloys, cobalt, aluminum, copper, and titanium. Forged shapes include large flat and hex bars, blocks, gear blanks, all flange shapes, flanged shafts, step shafts, discs, hubs, rings, cylinders, and sleeves. Industries that use the company's services include aircraft, aerospace, automotive, chemical, construction, defense, energy, engine and turbine, food processing, hydro, metalworking, mining, oil and gas, petroleum and power generation, pulp and paper, and shipbuilding.

SERVING GEAR-RELATED BUSINESSES

To that end, about 60 percent of All Metals & Forge Group's business is gear related, according to Weiss.

"Seamless rolled rings is a primary product and is used in the gear industry for manufacturers to produce gears," he said. "We can make rings up to a 200-inch diameter and down to about a 4-inch diameter. We do some things that other forge shops don't do. We always supply rough machines parts with an RMS finish — sometimes designated by the customer. But typically, we do a 250 RMS or 125 RMS. Sometimes, if a customer wants 64 RMS, we'll do that. We drill holes; we can do contour forgings."

When it comes to the gear industry, those businesses typically want a clean finish, according to Weiss.

"Some of the forge shops don't do this; they'll give them a raw unmachined part," he said. "We give them a rough machine part. It saves them time, and it saves them wear and tear on their equipment because we've already taken off the first rough cut of the ring. All-inclusive in our pricing is that we will do ultrasonic testing, which obviously is checking the parts internally for cracks, pits, voids, and so on. We do that as a matter of course. If somebody buys 1,000 rings from us, every part gets ultrasonically tested, and we don't charge extra for it. It's in the price, but our price is so competitive that we can give them a machine-ultrasonically-tested part for less money than a raw forged ring."

UNIQUE CUSTOMER APPROACH

That extra mile of service has made All Metals & Forge Group quite competitive in the industry, according to Weiss.

But the company offers an even more unique approach with its customers. With every new customer, Weiss and his team sends them a sample, but it's not just any sample. It is a physical, hands-on example that is able to demonstrate a variety of All Metals & Forge Group's skills.

"We send this out to a new customer who knows nothing about us and maybe doesn't understand or can't appreciate what we supply," he said. "This is clearly rough machined with drill holes and with every one of the corners, the chamfer is all different."

The chamfered edge examples serve to show how fine that can be. The sample is also engraved with heat numbers (and the company's name and phone number, obviously). It also includes several RMS finish examples — 250 RMS on one side and 125 RMS on another, according to Weiss.

"The customer gets a real good idea of what they're going to get," he said. "This has been a very successful tool for us to send out to our clients. I like doing things that are different."

MORE THAN JUST CUSTOMERS

All Metals & Forge Group takes a vested interest in its customers, so much so that Weiss said he sees them as more than just customers.

"We like to partner with our customers; I don't just want a client; I want a partner," he said. "I want to help them get an order so that we can get an order; 80 percent of our business is legacy business."

And as the company's business continues to grow, that means that the 20 percent of those new customers end up being legacy accounts as well, according to Weiss.

"That's been our philosophy, and it's worked extremely well for us," he said.

All Metals & Forge Group has been registered as an ISO company since 1994, which includes an ISO 9000 rating. Since 1998, the company has achieved its AS 9100 rating, which is the aerospace version of ISO.

RENEWABLES SECTOR

Another growing industry that All Metals & Forge Group supplies products to is the wind-energy industry, according to Weiss.

"We are also involved with wind, and with wind, there are turbines, and inside the turbines are gears that are forged," he said. "We supply those parts for wind energy as well."

Weiss is quick to point out that his company has always been an early adopter in a variety of ventures, which makes renewable energy customers a foregone conclusion.

"For example, All Metals and Forge Group was the first metals company in the United States that had its ISO registration in 1994," he said. "I got a lot of pushback from employees, but the day that we got our certificate in the mail, one of the



All Metals & Forge Group open die forgings and seamless rolled rings can be manufactured with carbon steel, alloy steel, stainless steel, tool steel, nickel alloys, cobalt, aluminum, copper, or titanium. (Courtesy: All Metals & Forge Group)



Forgings are a custom-made product with specific ultrasonic and machining requirements and made of different alloys. (Courtesy: All Metals & Forge Group)

salesmen got a phone call from a company in Wisconsin, and they said, 'I have an inquiry. I need to buy this product; however, my customer has required that I only buy it from an ISO-registered company, and I can't find anybody.' And that was the first order — the first day that we got the registration. Once that one salesman got it, we got a \$60,000 order. And I never got pushback after that. Everybody got it."

So what started out as a marketing tool became an integral part of the company's essential offerings as industries eventually made ISO certifications standard operating procedures, according to Weiss.

That's just one example of how Weiss and his team have tried to stay ahead and competitive throughout its long history.

'MANUFACTURING TALK RADIO'

All Metals & Forge Group's recent history has pushed the company into the popular podcast space.

"I come from, as my age indicates, the radio era, and I constantly listen to radio; I love radio," Weiss said, who recently turned 80. "In 2013, I came up with an idea about getting more of a message out to the manufacturing sector about manufacturing. So, we created a podcast called 'Manufacturing Talk Radio.'"

Since its inception, "Manufacturing Talk Radio" has done more than 750 shows, and at the beginning of the year, Weiss said they started syndicating AM and FM radio stations

throughout the country.

"We are on one radio station in upstate New York, and the numbers are amazing of the people that we are reaching, as well as the messages that we are getting out to the audience — the audience mainly being manufacturing, including a lot of students, universities, research labs, and publications such as yourself," he said.

All Metals & Forge Group's podcast is just one way Weiss said the company is embracing technology and staying at the forefront of the latest innovations.

"AI is the big thing now — machine learning," he said. "We're involved in all of these things, and from two aspects: We're a supplier of parts forgings involved in these various industries as well as supplying to other companies and manufacturers about how to improve, how to run your business, how to deal with the skills gap, how to deal with new technology, and software."

MANUFACTURING OUTLOOK E-ZINE

In addition to the "Manufacturing Talk Radio," All Metals & Forge Group has been publishing a monthly e-zine for the past several years to replace its email newsletter established in 1988.

Manufacturing Outlook is a publication educating, informing, and alerting its subscriber base about the "outlook" for all things manufacturing in a looking forward approach, according to Weiss.



All Metals & Forge Group has been registered as an ISO company since 1994. (Courtesy: All Metals & Forge Group)

CHALLENGING WORK

Even with all the company offers, Weiss said every job is still a challenge — one that he welcomes.

“Forgings are a custom-made product: They have specifications; they have ultrasonic requirements; they have machining requirements; they’re different alloys,” he said. “The past three years have been particularly a challenge with regards to COVID disruption in the supply chain. Now we have issues with inflation, which has really gotten out of hand but seems to be improving a bit. And there are other issues that don’t necessarily directly involve the customer, but we do have geopolitical issues, China issues, Russia issues, and all of these things in one way or another do affect us. And not only us at All Metals & Forge Group, but us as in our manufacturing sector in this country. So, to that extent, we do work with, talk to, and engage with our customers.”

With all its offerings, both physical and virtual, All Metals & Forge Group has been able to carve out quite a significant niche within the forging industry and the manufacturing sectors that need its products, according to Weiss. And that success always comes back to keeping an eye on the future.

“We sometimes have our customers on our show,” he said. “It’s a video podcast, and it can be seen on YouTube, Spotify, and all the rest of the platforms, and the numbers that we’re seeing are of people who are interested in manufacturing, including kids. The college thing is getting to be old

school almost; 40 percent of college kids don’t graduate, but they still wind up with a \$200,000 debt. But with manufacturing, three years ago, four years ago, you never heard about manufacturing in the news media — never heard of it. Now you hear about it pretty regular.”

To be sure, Weiss’ tenacity also plays a large part in his company’s success, as well at what comes next.

“As an early adopter, I’ll be there; I’ll be 90, but I’ll be there,” he said. “I love dealing with people in the manufacturing sector, and I’ve been doing it for over 50 years. It’s extremely educational. The people are really terrific. They’re hard workers, particularly the people who own businesses. They appreciate things like (our podcast), which is educational to them.”

MORE INFO

steelforge.com



Every new customer receives a physical, hands-on example that is able to demonstrate a variety of All Metals & Forge Group’s skills. (Courtesy: All Metals & Forge Group)

Valery Godinez-Azcuaga, Ph.D.

Vice President, Engineering & Product Development ▀ MISTRAS Group



Obdulia Ley, Ph.D.

Subject Matter Expert, Acoustic Emission ▀ MISTRAS Group



“Sensoria enables operators to more effectively guide and plan their inspection and maintenance strategy.”

▀ What does MISTRAS Group do for the wind-energy sector?

MISTRAS helps to maximize the performance and uptime of renewable wind-energy assets through a unique, integrated approach to wind-turbine protection. This encompasses real-time monitoring, data services, inspections, maintenance and repair, at-height access solutions, and lab testing on newly-fabricated and existing components.

▀ What is Sensoria™, and how can it be an industry game changer?

Sensoria is a 24/7/365 wind-blade monitor that remotely detects and reports blade damages and makes blade integrity data immediately available for viewing through the Sensoria Insights web data portal. It uses acoustic emission (AE) technology to “listen” for the onset and proliferation of active blade damages, allowing our experts to analyze trends that could indicate active or worsening issues.

With the world moving more and more toward renewable-energy solutions, wind-turbine installations continue to grow worldwide. Innovative technologies, such as Sensoria, will help operators maximize the uptime, performance, and safety of their wind-turbine blades as the farm’s assets grow.

▀ Why is it important to be able to check the status of a turbine blade’s condition at any given time?

Unfortunately, the industry norm of conducting inspections roughly once per year leaves site operators unaware of the true condition of their blades and often allows damage to worsen and grow. Damage can occur right after inspection, often getting overlooked and continuing to degrade until the next regularly scheduled review.

This damage affects onshore and offshore blades (especially larger blades), raising operating and maintenance costs while reducing generating capacity. Offshore turbines are particularly susceptible to inspection and repair delays due to their positioning in areas that are not easily accessible and frequently unpredictable weather conditions, further increasing the need for operators to be able to rapidly identify and mitigate damages. Because of this, turbine blades require an efficient, real-time monitoring system to identify potential damage before a costly breakdown occurs.

▀ How does Sensoria differ from other methods of blade condition monitoring?

Sensoria, unlike most other blade condition monitors, utilizes proven acoustic emission technology for detecting the presence of defects quickly and reliably. Thanks to sensor and data acquisition technology advances, AE sensors can detect internal and external damage growth on a single blade, making Sensoria easy to install and retrofit, and a sensitive technology for detecting damage evolution.

In addition, Sensoria’s data analysis technology allows us to extract actionable information for the customer. This means the customer can use the information displayed in the Sensoria Insights web portal to direct valuable resources to only the blades that need immediate attention. In the end, this helps the operator optimize inspection and maintenance operations and maximize wind turbine uptime.

▀ Do you see annual blade inspections becoming unnecessary as more wind farms incorporate Sensoria into their assets, or is Sensoria more of a complementary resource to established protocol?



Sensoria enables operators to more effectively guide and plan their inspection and maintenance strategy by providing early warnings of cracking, delamination, high-energy impacts, lightning strikes, and more.

While Sensoria shouldn't be seen as completely replacing traditional inspection methods, it acts as a valuable complement by offering an efficient, insightful means of identifying damages with optimized use of resources and minimum disruption of production. For example, operators could use drones to complete targeted inspections of only those blades displaying concerning trends based on Sensoria's monitoring data, completing the job in a fraction of the typical time and with far fewer resources than traditional, full-site inspections require.

► What necessitated the development of Sensoria?

Wind-energy producers simply needed a better solution. The driving force behind Sensoria is ensuring that wind-turbine rotor blades function correctly and do not fail prematurely. Nearly half of wind-turbine insurance claims are due to blade failures, so we recognized that current inspection and blade integrity practices simply weren't as informative, insightful, and timely as wind-turbine operators need them to be. Since MISTRAS installed our first Research and Development (R&D) monitoring system for wind blades in 2012, technological improvements have led to a more cost-efficient and reliable monitoring system. With recent improvements that allow more economical and secure data transfer and communication, plus advancements in sensor technology, Sensoria is fully capable of meeting the technical and commercial requirements of the market.

► What has been the industry response to Sensoria?

Most players in the wind industry understand the value of a blade condition monitoring system like Sensoria and know real-time monitoring is a must if they want to reach the current growth projections of 9 percent of world ener-

gy output by 2030 and 33 percent by mid-century. Because of that, many are engaging with Sensoria more and more through trial projects with potential large installations at the end of these trials.

► Where do you see the future of blade condition monitoring and Sensoria's effect on that future?

Sensoria's technology will be especially helpful in improving the reliability of large offshore wind blades (100 million-plus), which typically carry far greater blade inspection and maintenance costs than their onshore counterparts. Further, the large-scale instrumentation of blade condition monitors like Sensoria will only allow the technology to continue evolving and improving. This might allow us to think beyond just blades, possibly integrating nacelles, drive trains, towers, foundations, weather, and operational data into Sensoria's data, eventually creating digital twins of each wind turbine. With a complete digital view of a wind turbine, operators could run a truly digital wind farm, operating nearly automatically.

► What should attendees expect to see when they visit the MISTRAS Group booth at CLEANPOWER 2023?

This event is an opportunity for attendees to discover innovative technologies, such as Sensoria, that will help them maximize their wind-turbine blades' uptime, performance, and safety. Visitors to booth #1948 will learn more about using a blade monitor to make their blade integrity programs more informed and data-driven than ever. They can also be introduced to MISTRAS' other wind energy protection solutions including turbine inspection and maintenance services. We can help show them how an integrated approach to blade management reduces downtime, increases efficiency, saves money, and creates a more organic working relationship for sustained wind operations. ✌

MORE INFO

www.sensoria.com



Over the course of the project, Collett handled and transported 150 tower sections, 50 nacelles, 50 hubs, 50 drive trains and 150 blades to South Kyle Wind Farm. (Courtesy: Collett and Sons)

CONSTRUCTION

Collett delivers 50 turbines to South Kyle Wind Farm

Collett has completed the delivery of 50 Nordex N133 wind turbines to South Kyle Wind Farm. Under construction by Swedish multi-national power generation company Vattenfall, South Kyle's 50-turbine site is the company's largest onshore wind farm in the U.K. in terms of power generation.

Appointed to undertake the delivery of the 450 components required to construct the 50 84-meter height Nordex N133 turbines, both the Port of Ayr and King George V Dock were used to store and handle components.

The heavier of the components, namely the 68-ton nacelles, 73-ton drive trains, and the 63-ton hubs, arrived at King George V Dock, with the lighter components, including the 18-ton blades and the 150 individual tower sections, arriving at the Port of Ayr. At both ports, each of the components was discharged from the vessel to a precise laydown plan, allowing Collett Team to access each in line with the wind farm's construction schedule.

With a combination of 6-axle trailers, 7-axle trailers, 8-axle trailers, 2x tower transporter clamp trailers, and 3x super wing carriers from across the Collett fleet, the team transported the components to site, approximately five kilometers east of Dalmellington town. On site, Collett had an additional team to undertake tower transport operations across the 50-turbine site,

delivering each tower section to its respective crane pads in time for installation service.

With six heavy haulage tractor units and six steersman/escort vehicles in operation throughout, each of the 67, 48, and 50 ton tower sections, along with the 65-meter blades traveled in overnight convoys to minimize road traffic congestion from both ports and in surrounding areas.

Traveling under Police Scotland and Collett private escort from both ports of entry, Collett planned and executed 450 abnormal load movements. Operating seven days a week (as required), and with police escort resources high in demand and low in frequency, Collett requested double runs in order to maximize deliveries with the limited resources available. The team alternated between tower convoys, blades, and



Havfram Wind's work will start in spring 2027. (Courtesy: Vattenfall)

nacelle sets per demand required on site, until all 450 wind turbine components were successfully delivered.

Over the course of the project, Collett handled and transported 150 tower sections, 50 nacelles, 50 hubs, 50 drive trains, and 150 blades to South Kyle Wind Farm.

Expected to be operational in 2023, the 50 Nordex N133 turbines feature a 133.2-meter rotor with a swept area of 13,935 square meters. With a capacity of 240 MW, South Kyle Wind Farm is expected to generate enough electricity to meet the demands of about 170,000 homes annually, while offsetting up to 300,000 metric tons of carbon dioxide emissions per year.

MORE INFO www.collett.co.uk

CONSTRUCTION

Vattenfall signs Havfram Wind for turbine installs in U.K.

Vattenfall has appointed Havfram Wind as preferred supplier for the installation of wind turbines for Vattenfall's Norfolk projects in the United Kingdom. The agreement covers transport and installation works over a period of three years, using one of Havfram Wind's newbuild NG20000X Jack-Up Wind Turbine Installation Vessels (WTIV) with a 3,200-ton crane. The works will start in the spring of 2027.

"Our collaboration with Vattenfall is of great importance for us as an ambitious and fast-growing offshore wind

construction company," said Even Larsen, Havfram Wind CEO. "Vattenfall is one of the largest players in the industry and already provides millions of European households with clean renewable energy. The Norfolk Boreas and Norfolk Vanguard projects are of particular interest, because of their multi-GW size and their important contribution to the U.K. renewable energy market, the largest in Europe."

"We are extremely proud to be trusted by Vattenfall for such prestigious projects," said Martin Degan, Havfram Wind commercial director and vice president. "Vattenfall is a very experienced developer and has carried a thorough selection process with a high focus on quality and details. This clearly indicates that we, at Havfram Wind, have the right team onboard and have made the right choice for vessel capacity and time to market."

Havfram Wind is an offshore wind construction company focused on transport and installation services for both bottom-fixed and floating projects in the offshore wind sector.

MORE INFO havfram.com

CONSTRUCTION

OEG Offshore renews Lubbers partnership for renewables

Global offshore services company OEG Offshore UK (OEG) has signed a new partnership agreement with logistics provider Lubbers Logistics Group to



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TAILWINDS

THE BUSINESS OF WIND



Andre Mulder, director of renewable energy for Lubbers Logistics Group and Rob Goodall, OEG Offshore VP of business development, sign a partnership deal in the Netherlands. (Courtesy: OEG Offshore)

strengthen service capabilities in their move to support the renewables sector.

New aspects of the agreement will focus on the provision of OEG's expanded portfolio of services with both subsea and topside capabilities, in conjunction with a growing fleet of vessels.

"We've partnered with Lubbers for more than 14 years and look forward to continuing an excellent working relationship to provide the highest quality products and services throughout Europe for large scale projects," said Rob Goodall, VP of Business Development for OEG Offshore.

The enhanced partnership will continue to enable OEG and Lubbers to deliver on customers' requirements quickly, safely, and sustainably on a range of energy projects, from engineering and construction to operations and maintenance both for oil and gas and offshore renewables projects.

"The expansion of our collaboration will have a strong focus on the renewable energy sector," said Andre Mulder,

director of renewable energy for Lubbers. "Customers within the wind and power industry can therefore make local use of the joint offshore services of OEG and Lubbers. As an example, a stock of offshore units is currently being placed in offshore port Eemshaven."

Lubbers' strategic network spans key European energy hubs in the Netherlands, Denmark, Norway, Germany, Italy, and Romania.

MORE INFO www.oegoffshore.com

INNOVATION

Saildrone announces new model for uncrewed vehicles

Saildrone, a leader in providing near real-time maritime intelligence using small uncrewed systems, recently announced a new mid-size class of uncrewed surface vehicles (USVs). The



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33-foot (10 meter) Voyager is designed for near-shore ocean and lakebed mapping, and to meet the challenges of IUU (illegal, unreported, and unregulated fishing), ISR (intelligence, surveillance, reconnaissance), law enforcement and maritime safety, drug interdiction, and border and harbor security.

“With our Voyager platform, Saildrone helps to eliminate maritime gaps above and below the ocean surface, reducing risk to mission and risk to force,” said Richard Jenkins, Saildrone founder and CEO. “We want to be a force-multiplier for our partners and allies when it comes to ISR capabilities.” Saildrone’s three USV models — the Voyager along with the 23-foot (seven meter) Explorer and 65-foot (20 meter) Surveyor — have been developed to balance mission payload flexibility and endurance. The Voyager’s larger size, compared to the Explorer, allows for a more persistent datalink, increased power available for ocean mapping and ISR payloads, and versa-

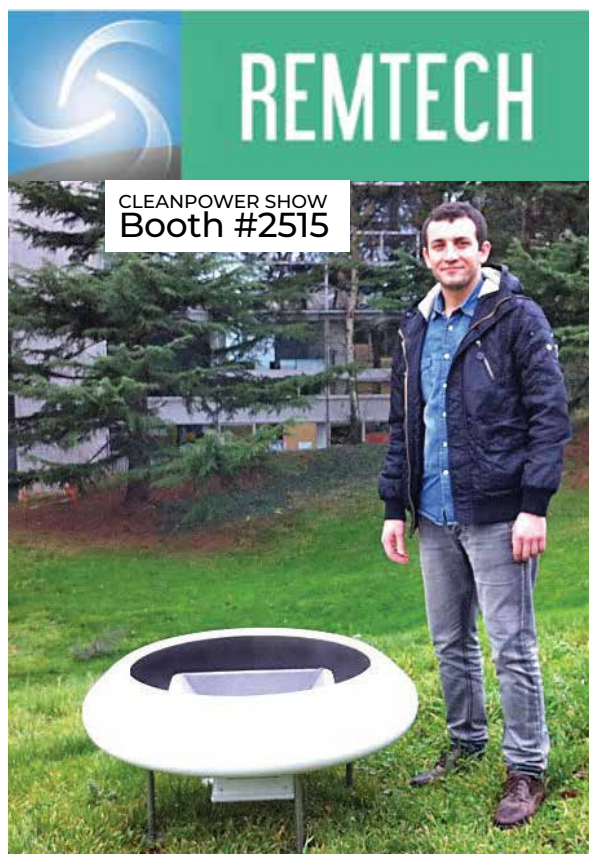
tile payload integration options.

The ocean mapping sensor suite includes multibeam sonar equipment capable of seafloor mapping of depths to 900 feet (300 meter), and the ISR sensor suite includes a smart camera array, digital radar, and sub-surface passive acoustics. Primarily powered by wind and solar, the Voyager also features an electric propulsion alternative, useful for low-wind and near-shore operations.

Saildrone has built 100 23-foot Explorer-class USVs at its headquarters in Alameda, California. To meet the increasing demand for the new Voyager platform, Saildrone has elected to outsource the production of the wing, hull, and keel to composite specialists: Janicki Industries will manufacture the wing and keel in Washington, and Seemann Composites will manufacture the hull in Mississippi. Saildrone will continue to produce, install, and service internal components in Alameda. “One of the truly exceptional aspects of working at a company like Saildrone

is the fact that hardware and software engineering, manufacturing, mission operations, and G&A are all housed under one roof — in a former airplane hangar on a site known for aviation and naval innovation,” said Saildrone COO Mark Cuyler. “But with the rapidly increasing demand for ocean data collection across the fleet, it is necessary to outsource some of our production. Saildrone is proud to work with great U.S.-based companies like Janicki and Seemann, whose expertise in the marine composites industry will help us to more rapidly meet the demanding challenges of the world’s oceans.”

Saildrone has been conducting sea trials of the Voyager in the San Francisco Bay and offshore of California since late 2022, and the first operational maritime security and ocean mapping missions will begin this spring. The company is producing new Voyagers at a rate of one per week. The data collection capabilities of Saildrone’s autonomous vehicles have been proven in nu-



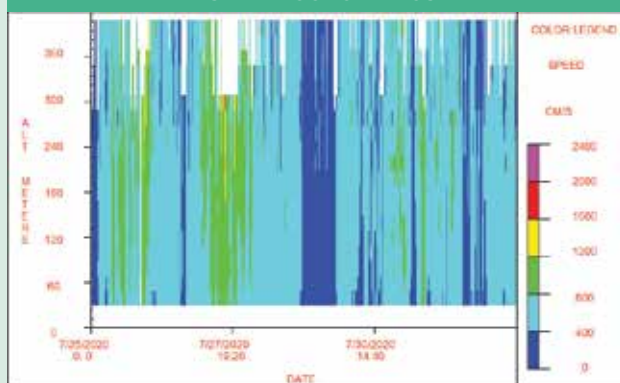
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MORE INFO www.saildrone.com

INNOVATION

Xodus, Daymark to team up on North America offshore wind

Global energy consultancy Xodus has signed a memorandum of understanding with Daymark Energy Advisors to collaborate on advancing the development and deployment of projects in the rapidly growing North American offshore wind industry.

The partnership is the first of its kind for the offshore wind consultancy market in North America. Daymark brings an integrated view of onshore energy infrastructure, regulation, and markets while Xodus is a leader in techno-commercial offshore wind development. Under the agreement's terms, Xodus and Daymark will collaborate to answer questions from developers and state agencies as activity ramps up.

In combining strengths and expertise, the "surf-and-turf" offering will carve out a leadership presence in the offshore wind consulting market by providing understanding of the delivery of electricity from an offshore wind turbine through to the ratepayer. "Having gained a strong reputation for our work in architecting, developing, and supporting offshore renewables and energy transition projects around the world, we have now firmly established ourselves in the North American market," said Stephen Swindell, Xodus' managing director.

"We have a long track record of activities in the global offshore wind, oil and gas, cables, and interconnectors sectors. Both parties bring different — but complementary — knowledge and skillsets to the energy market and infrastructure project consultancy. We look forward to working with the Daymark team to bring additional

and combined expertise to the market."

"This is an exciting opportunity to combine our expertise — on land and at sea — to offer clients more complete solutions to the challenges they face and the questions they have about this growing industry," said Marc D. Montalvo, Daymark president and CEO.

MORE INFO www.xodusgroup.com
www.daymarkea.com

INNOVATION

ONYX, Nearthlab team up for predictive maintenance

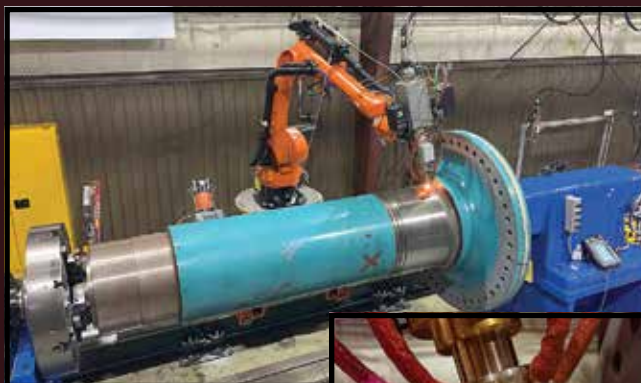
ONYX Insight, a global provider of predictive maintenance solutions and Nearthlab, an autonomous drone solution company, have entered into



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Nearthlab's autonomous drone takes 15 minutes of flight time to finish the inspection for one wind turbine. (Courtesy: ONYX Insight)

partnership to deliver a whole turbine predictive maintenance solution for wind farm operators.

ONYX Insight will use Nearthlab's experience with mobile drone technology, reducing reliance on the availability of trained drone pilots and enabling self-performing operators to perform visual inspections of their turbine blades for substantially lower costs.

"After two years of collaboration with Nearthlab across a large fleet of assets, we've identified strong benefits to turbine health management by combining our technologies into one unified offer," said Ashley Crowther, ONYX Insight's chief commercial officer.

"For major components in a fleet, the damage cases can be managed efficiently, end-to-end, from detection through to repair and QAQC." The partnership will cover North America, with ONYX Insight licensed to use Nearthlab's Zoomable software to assess the health of wind turbines.

"NearthWIND Mobile, our latest plug-and-play solution, is proving to be a game-changer in the world of drone inspections," said Jay Choi, Nearthlab's

co-founder and CEO. "Now, dubbed with ONYX Insight's expertise and reach within the predictive maintenance market, Nearthlab will come to spread its wings wide across industries and regions."

Nearthlab's use of autonomous drone technology combined with ONYX Insight's market leadership in wind-turbine predictive maintenance can help wind operators reduce the costs of maintaining their turbines.

With ONYX Insight now able to monitor 85 percent of major component failures, an all-in-one turbine health management provider delivers the confidence to self-perform sooner, enabling owner/operators to identify problems earlier, manage them with fewer resources, and ultimately bring down the overall cost of wind-farm operations.

The partnership will enable wind operators full predictive data maintenance for their wind turbines with consistent reporting from a single



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ecosystem while bringing drone operations in-house.

Founded in 2015, Nearthlab provides AI-powered O&M solutions for the infrastructure inspection market. With extensive experience in wind-turbine blade inspection, Nearthlab's autonomous drone takes 15 minutes of flight time to finish the inspection for one wind turbine. Data collected from the inspection is uploaded onto Nearthlab's data management platform, Zoomable, to be analyzed into insights assisting companies to optimize their operation and maintenance procedure.

MORE INFO onyxinsight.com

MAINTENANCE

TÜV NORD and COWI to take over Owner's Engineering Services

Together with the international consulting group COWI, TÜV NORD will provide Owner's Engineering services for the Egyptian wind farm Gulf of Suez on the Red Sea Coast.

In this project, COWI will perform project management and design review while TÜV NORD will be responsible for all site services such as civil, mechanical, and electrical quality supervision. With a capacity of 500 MW, the project, which is being led by renewable energy developer AMEA Power in collaboration with Sumitomo Corporation of Japan, will be the largest wind farm in Africa.

"We are very pleased about the cooperation of COWI and TÜV NORD in this particular project, which the combined team in Denmark, Germany, and Egypt from both companies have jointly been driving forward," said Alexander Ohff, executive vice president, Renewables at TÜV NORD. "Together with COWI and the Sponsors, we will ensure the highest international technical quality and safety standards to make this flagship wind-energy project in Egypt a success."



Executives from TÜV NORD and COWI. (Courtesy: TÜV NORD)

"Being a part of developing clean renewable energy solutions is at the heart of our business," said Holger Hahn, COWI's project director. "With TÜV NORD, we get a strong partner for this important onshore wind project and can complement each other's expertise and strengths in delivering the best possible solution to our customer and their customers. I see this as a start of a long and successful cooperation."

MORE INFO www.tuev-nord-group.com/en/home

MAINTENANCE

Firetrace report: Proactive steps can manage fire risk

Offshore wind developers and operators can take steps to proactively manage fire risk on their assets to protect the huge levels of public investment coming into the sector to support ambitious U.S. offshore capacity targets, according to a report from Firetrace International, a supplier of fire suppression technology to the global renewable energy industry.

The U.S. is embarking on a buildout of offshore wind that will cost billions. It is expected that \$12 billion in capital investment will be allocated to offshore wind expansion in an aim to increase offshore wind power capacity, with a target to reach 30 GW by 2030

as opposed to 42 MW today. A significant proportion of this investment will come from public money. The report strengthens looks at insurance data, which estimates one in every 2,000 wind turbines will have a fire in its lifespan. The report also addresses the increased fire risks on an offshore asset due to the sheer size, location, and the conditions these assets are exposed to, as well as the costs and complexity for routine operations and maintenance, and lack of access to traditional fire-fighting methods.

A fire on an offshore wind asset also has more far-reaching consequences, some of which may not be considered by developers and owner/operators. The report draws out four key impacts of a fire incident on an offshore turbine: risk to personnel, negative environmental repercussions, financial costs, and reputational damage.

The risk to personnel on an offshore asset is higher due to the remote location and complexity of a potential evacuation. Also due to asset location, a fire incident on an offshore turbine can have detrimental effects on the surrounding environment such as debris from an asset falling into and polluting the water, which can harm marine life. Such environmental events cause significant reputational damage as well.

In terms of financial costs, for onshore turbines, the replacement of one turbine can cost up to \$9 million, including the revenue loss of up to 18 months of down-time. This estimate

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Firetrace's report looks at insurance data, which estimates one in every 2,000 wind turbines will have a fire in its lifespan. (Courtesy: Firetrace)

approaches twice as much for an offshore asset.

"Speed is everything when it comes to tackling fires in a wind turbine," said Ross Paznokas, Global Business Development Manager — Clean Energy, Fire-

trace. "A faulty electrical component, for example, can, in a matter of minutes, ignite a fire that leads to the total destruction of the turbine. With the level of investment on the line, much of which will be public money, developers

and operators cannot afford to overlook the risk of fire."

"At the moment, 75 percent of the inquiries we have for our fire suppression technology come from organizations that have already experienced a fire event," he said.

"With so much money at play, protecting assets should be a key priority. We need to start proactively installing automatic fire suppression technology, which cost less than the rounding error in a renewable project budget, to prevent the impacts of fire incidents in offshore wind."

MORE INFO www.firetrace.com/wind-turbine-fire-suppression-systems

MANUFACTURING

Vestas secures 370 MW order for 2 U.S. repowering projects

Vestas has received an order for two wind projects totaling 370 MW to re-power the Pleasant Valley and Border Winds projects owned by Xcel Energy in the U.S. The order for the 213 MW Pleasant Valley project in Minnesota consists of 97 V110-2.0 MW wind turbines delivered in 2.2 MW operating mode, while the 156 MW Border Winds

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project in North Dakota, consists of 71 V110-2.0 MW wind turbines delivered in 2.2 MW operating, which will update the current V100-2.0 MW technology at both sites.

“Vestas and Xcel Energy have a strong history of bringing wind energy to local communities across the U.S., and we look forward to continuing this partnership by extending the longevity and increasing the energy projection of current wind projects like Pleasant Valley in Minnesota and Border Winds in North Dakota,” said Laura Beane, president of Vestas North America.

“Upgrading the site’s current technology will not only extend the lifespan of the project and bring clean energy to thousands of households, it will also provide needed economic opportunities to these communities.”

“As a national leader in wind energy, we’re pleased to work with Vestas on repowering two Upper Midwest wind farms which have long provided clean,

affordable energy to our customers as well as economic benefits to surrounding communities,” said Chris Clark, president, Xcel Energy Minnesota, North Dakota and South Dakota. “Advancing the technology at Pleasant Valley in Minnesota and Border Winds in North Dakota is important to our plan for achieving 85 percent carbon-free energy by 2030 in the region while keeping energy costs as low as possible.”

Both projects include supply, delivery, and commissioning of the turbines, and Vestas will continue to service the turbines and provide an energy-based availability guarantee, designed to ensure optimized performance of the asset.

Turbine delivery for both projects will begin in the second quarter of 2025 with commissioning scheduled for completion in the fourth quarter of 2025.

MORE INFO www.vestas.com/en

MANUFACTURING

Dominion selects K2M for Virginia offshore wind oversight

K2 Management, a global renewable energy consultancy, recently announced a four-year partnership with Dominion Energy, an energy company with 7 million customers in 16 states, to provide quality oversight services for the Coastal Virginia Offshore Wind (CVOW) project, to be located 27 miles off the coast of Virginia. With a capacity of 2.6 GW via 176 offshore wind turbines, the project is a step forward in the growth of the offshore wind industry in the U.S., which has set a target of 30 GW of installed offshore wind capacity by 2030.

“We’re thrilled to be partnering with Dominion Energy on such a ground-breaking project,” said Lars Andersen, president — Americas at K2 Management. “Our expert knowledge and experience ensured we were successful in a highly competitive tender and will enable us to bring Dominion Energy advice and insights from more than 500 accumulated offshore wind engagements around the world.” K2M will serve as Dominion Energy’s owner’s quality assurance representative, and among other services, will provide quality oversight at suppliers’ manufacturing facilities for all major components. The manufacturing stage began in Q4 of 2022, and K2M’s involvement recently began with an expected completion date of April 2027.

“Given its wealth of experience, K2M is the clear partner to oversee the day-to-day fabrication at our suppliers’ facilities, as well as the delivery of major components to the Portsmouth Marine Terminal,” said Joshua Bennett, Dominion Energy vice president of offshore wind. “We are at the forefront of delivering reliable, affordable, and increasingly clean energy to our customers, and this partnership is going to help us meet those expectations with our offshore wind project.”

MORE INFO www.dominionenergy.com

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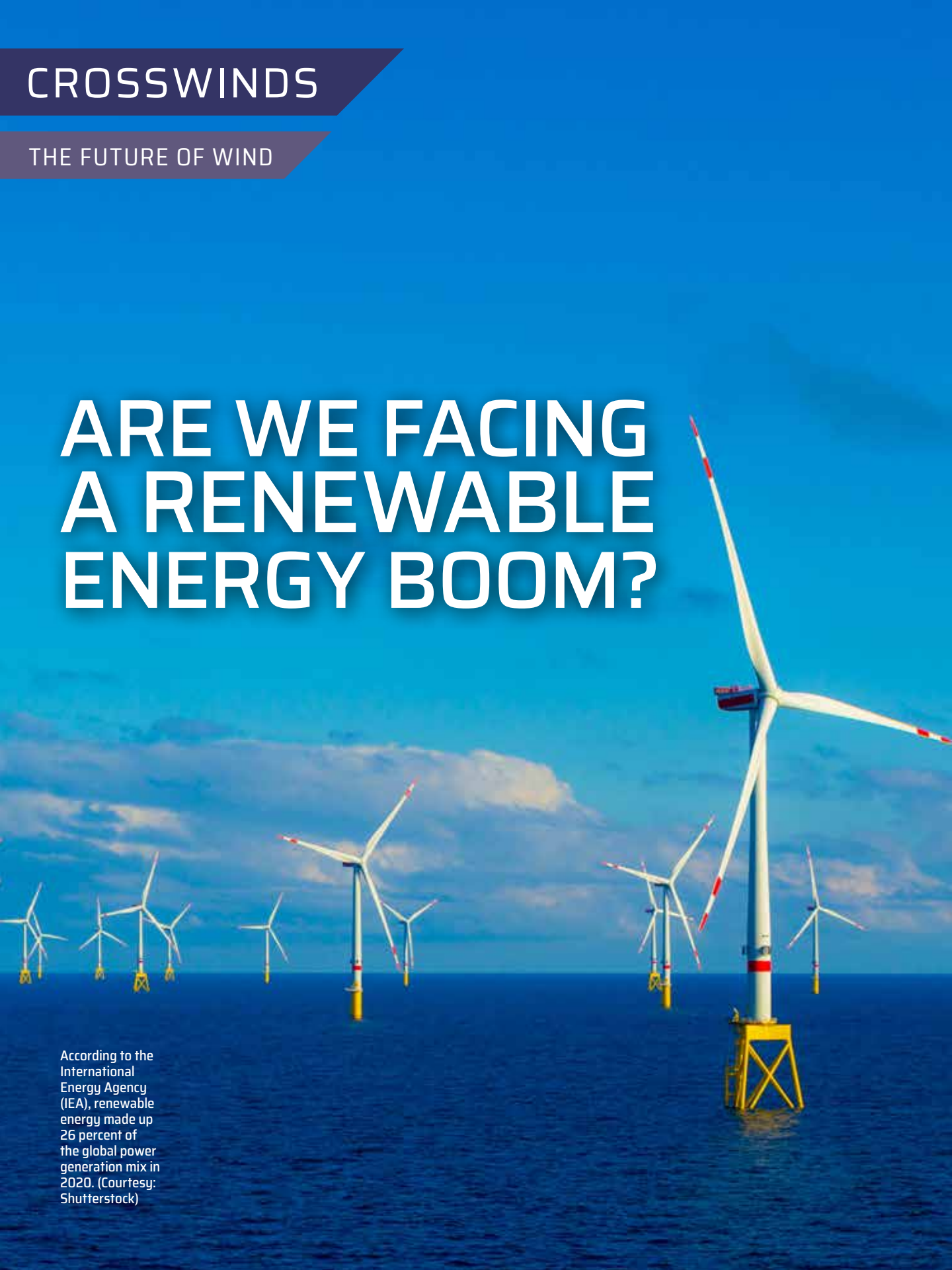


CROSSWINDS

THE FUTURE OF WIND

ARE WE FACING A RENEWABLE ENERGY BOOM?

According to the International Energy Agency (IEA), renewable energy made up 26 percent of the global power generation mix in 2020. (Courtesy: Shutterstock)



With decreasing costs, government incentives, and environmental concerns driving the use of renewable energy, there are still potential challenges to be faced in order to meet global net-zero goals.

By KATIE COLLINS

Renewable energy has been gaining momentum in recent years as a viable alternative to traditional fossil fuels. From solar and wind power to hydro and geothermal energy, more and more countries are turning to renewable sources to meet their energy needs. The use of renewable energy has been growing at a rapid pace, and many experts believe we are experiencing a renewable energy boom.

The current state of renewable energy can be seen in the increasing percentage of renewable energy in the global-energy mix.

What does this mean? It means we are indeed facing a renewable energy boom, and the increasing demand for renewable energy, cost decreases, government incentives, and environmental concerns are the main drivers of this boom. What is the impact of this boom on the economy, and what does it mean for the future?

THE GROWTH OF RENEWABLE ENERGY

The growth of renewable energy can be seen in the increasing amount of renewable energy being produced and used around the world. According to the International Energy Agency (IEA), renewable energy made up 26 percent of the global power generation mix in 2020. This means 26 percent of the energy used to power homes, businesses, and factories came from renewable sources such as solar and wind power. This is an increase from 24 percent in 2019. The IEA also predicts the use of renewable energy will continue to grow, reaching 30 percent by 2025 and 35 percent by 2030.

There are several factors driving this growth in renewable energy. One of the main factors is renewable energy is becoming less expensive to produce. This is especially true for solar and wind energy. As technology improves and economies of scale are achieved, it becomes cheaper to produce and install solar panels and wind turbines.

Another factor driving the growth of renewable energy is government incentives. Many governments around the world are offering financial incentives to encourage the use of renewable energy. This can include tax breaks, subsidies, and other financial incentives.

Finally, environmental concerns are also playing a role in the growth of renewable energy. Climate change and air pollution are serious concerns, and many people and organizations are choosing to use renewable energy as a way to reduce their carbon footprint and help the environment.

THE IMPACT OF RENEWABLE ENERGY ON THE ECONOMY

The growth of renewable energy is having a positive impact

on the economy. One of the main benefits is job creation. The installation and maintenance of renewable energy systems, such as solar panels and wind turbines, creates jobs in engineering, construction, and manufacturing. Furthermore, the development of renewable energy sources can also lead to regional economic development, as it can attract investment and create jobs in areas where renewable energy is being produced.

In addition to job creation, renewable energy can also lead to economic growth. As more renewable energy is produced, it can help reduce the cost of energy, which can in turn lead to increased economic activity. This can be especially beneficial for businesses and industries that are energy-intensive.

Another factor driving the growth of renewable energy is government incentives. Many governments are offering financial incentives to encourage the use of renewable energy. This can include tax breaks, subsidies, and other financial incentives. For example, in Missouri, there are several solar incentives available for residents and businesses to install these systems, such as a state tax credit, grants, and net metering policies. Also, in Germany, the government provides feed-in tariffs for wind energy, which guarantee a fixed price for electricity generated by wind power; this has been a key factor in the country's success in developing wind energy.

While there are many economic benefits to renewable energy, there are also potential challenges. One of the main challenges is the need for investment in infrastructure. To meet the growing demand for renewable energy, significant investments in new renewable energy systems and infrastructure will be required. This can be a significant cost, especially for countries and regions just starting to develop their renewable-energy systems.

Another potential challenge is the impact on traditional energy industries. As renewable energy grows, it can lead to a decline in demand for fossil fuels and nuclear energy. This can have a negative impact on industries heavily dependent on these energy sources.

The impact of renewable energy on the economy is mostly positive, but it is important to keep in mind the need for investment in new infrastructure and the potential impact on traditional energy industries. Also, government incentives play a major role in promoting the use of renewable energy and it varies from country-to-country and state-to-state.

THE FUTURE OF RENEWABLE ENERGY

The future of renewable energy is bright, with many advances in technology and research taking place. One of the most promising areas of research is in the field of energy storage.



The growth of renewable energy is having a positive impact on the economy. One of the main benefits is job creation. (Courtesy: Shutterstock)

As renewable energy sources such as solar and wind are intermittent, energy storage systems are needed to ensure a stable and reliable energy supply. Advancements in battery technology, such as the development of lithium-ion batteries, have made energy storage more efficient and cost-effective. Another area of research that holds promise is the development of new renewable energy sources. For example, researchers are working on developing new ways to harness the power of the ocean, such as wave and tidal energy. Additionally, advances in bioenergy, using biomass, are being made to produce electricity, heat, and biofuels.

Overall, the future of renewable energy is promising, with many new technologies and research developments taking place that will help to make renewable energy even more efficient, cost-effective, and reliable.

The use of renewable energy is expected to keep increasing. Furthermore, many countries are committing to achieve net-zero emissions by the middle of this century, which means a significant increase in renewable energy is required to reach this goal. This will also lead to a greater demand for energy storage systems, which will be crucial to make renewable energy reliable and more accessible.

CONCLUSION

We have seen that the use of renewable energy is increas-

ing globally, driven by a combination of decreasing costs, government incentives, and increasing concern for the environment. The impact of renewable energy on the economy has been mostly positive, with job creation and economic growth being some of the main benefits. However, there are also potential challenges such as the need for investment in new infrastructure and the potential impact on traditional energy industries.

The future of renewable energy is bright, with many new technologies and research developments taking place that will help to make renewable energy even more efficient, cost-effective, and reliable. Governments play a crucial role in promoting the use of renewable energy, and different incentives and regulations are in place in various countries and states.

The renewable energy boom is a positive development that has the potential to bring many benefits to the economy and environment. It is important to continue to support the growth of renewable energy and invest in new technologies to ensure a sustainable and reliable energy future. ✈

ABOUT THE AUTHOR

Katie Collins is with EcoWatch.com, a site focused on publishing science-based content on environmental issues, causes, and solutions.



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