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SEPTEMBER 2024

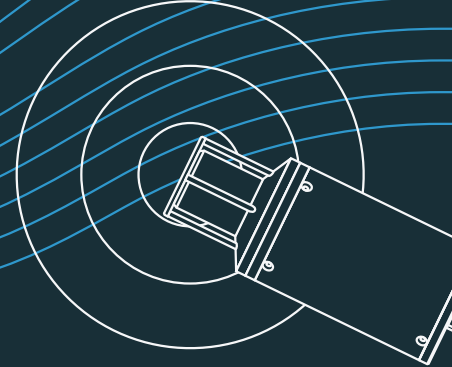
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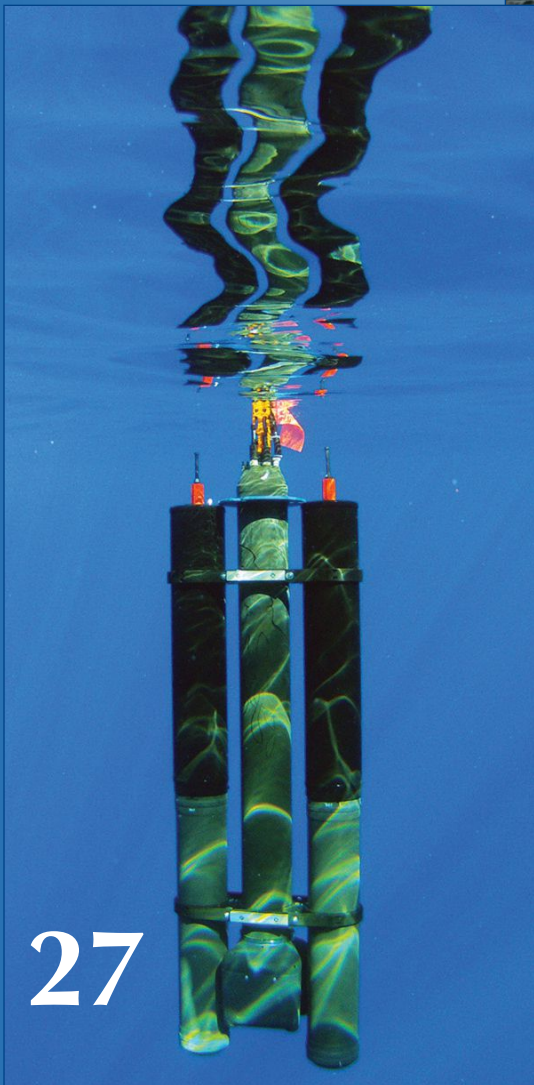


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)) 'The Paradox of Petroleum' Report. Despite unprecedented energy challenges, 68 percent of oil and gas industry leaders have expressed optimism for sector growth in the coming year, according to the new DNV survey "The Paradox of Petroleum - How the oil and gas sector is transforming through uncertainty," which gathered insights from nearly 450 senior oil and gas professionals to examine rapidly evolving trends and the near-term outlook for the sector. The survey highlights the sector's confidence following the 2020 downturn. The industry is heavily investing in alternative energy sources such as wind; solar; hydrogen; carbon capture, utilization and storage (CCUS); and biofuels. These investments are paving the way for new revenue streams, despite challenges, such as higher interest rates and supply chain disruptions. The sector's positive outlook is driven by recovery and a renewed focus on energy security, partly due to geopolitical events, such as the conflict in Ukraine. However, there are significant concerns within the industry: 51 percent of executives believe global investment in new oil and gas capacity is insufficient, with 70 percent of North American executives particularly concerned, compared to 40 percent in Europe. Furthermore, 82 percent of respondents recognize the need for new operating models to achieve efficiencies. Profitability continues to be a challenge due to the high-risk nature of oil and gas investments. Attracting young, skilled workers is critical, with 66 percent of executives prioritizing it to support expansion, decarbonization and modernization efforts. The sector is also deeply committed to environmental impact reduction, with 61 percent of executives planning increased investment in decarbonization. The future of the sector hinges on its ability to meet the demand from consumers and businesses in balance with decarbonization targets. By leveraging digital tools, new workforce strategies and increased decarbonization efforts, the industry is poised for a structural transition.

)) Viable 'Antacid' Technique to Address Ocean Acidification. Scientists from Plymouth Marine Laboratory (PML) and its commercial subsidiary PML Applications, have confirmed the viability, and potential scalability, of a novel "ocean" or "marine" carbon dioxide removal (oCDR or mCDR) technique designed to remove carbon dioxide from the atmosphere by enhancing the alkalinity of treated wastewater before it is discharged out at sea. In a first-of-its-kind study, the PML team was commissioned to provide independent and impartial monitoring and analysis of a field trial carried out off St. Ives Bay (Cornwall, U.K.) in September 2022 by Canada-based carbon removal specialists Planetary Technologies. The trial, which followed a series of lab-based tests and modeling, involved adding a diluted form of the alkaline mineral magnesium hydroxide to the wastewater flow at the nearby wastewater treatment plant in St. Erth. The treated water was then released 4 mi. offshore through the existing outflow. Planetary Technologies was seeking to investigate whether this form of ocean alkalinity enhancement (OAE), which is likened to adding an "antacid" to seawater, is a safe and effective way of deacidifying seawater, which will then draw down atmospheric CO₂. Seawater naturally absorbs CO₂, so the process, which changes the pH of the water, is designed to enhance its carbon removal capacity. While emissions reduction remains paramount in terms of tackling global warming and mitigating climate change, ocean alkalinity enhancement and other carbon removal solutions can have a key part to play.

)) Marine Energy Tech Legislation. Congresswomen Nanette Barragán (D-Calif.) and Suzanne Bonamici (D-Ore.) have introduced the Marine Energy Technologies Acceleration Act, legislation that would invest \$1 billion to advance marine energy toward full-scale commercialization. This federal legislation comes at a time when there will be a wave energy demonstration project to be implemented by Eco Wave Power and Shell MRE at Altasea at the Port of Los Angeles, where Eco Wave Power is set to install the first U.S. onshore wave energy pilot station in the coming months.

)) New Catalyst Converts CO₂ to Methane. To address carbon in the atmosphere as a major driver of climate change, researchers from McGill University have designed a new catalyst for converting CO₂ into methane, a cleaner source of energy, using tiny bits of copper called nanoclusters. While the traditional method of producing methane from fossil fuels introduces more CO₂ into the atmosphere, the new process, electrocatalysis, does not. "On sunny days you can use solar power, or when it's a windy day you can use that wind to produce renewable electricity, but as soon as you produce that electricity you need to use it," said Mahdi Salehi, Ph.D. candidate at the Electrocatalysis Lab at McGill University. "But in our case, we can use that renewable but intermittent electricity to store the energy in chemicals like methane." By using copper nanoclusters, carbon dioxide from the atmosphere can be transformed into methane, and once the methane is used, any carbon dioxide released can be captured and "recycled" back into methane. This would create a closed "carbon loop" that does not emit new carbon dioxide into the atmosphere. The research, published in the journal *Applied Catalysis B: Environment and Energy*, was enabled by the Canadian Light Source (CLS) at the University of Saskatchewan. "Our top finding was that extremely small copper nanoclusters are very effective at producing methane," said Salehi. "This was a significant discovery, indicating that the size and structure of the copper nanoclusters play a crucial role in the reaction's outcome." The team will refine the catalyst for efficiency and scaling. They hope their findings will open new avenues to produce clean, sustainable energy. **ST**

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Deep-Sea Mining Needs Robust Regulations

In the race to transition to a low-carbon future, the global demand for minerals is surging, driving increased commercial interest in deep-sea mining for manufacturing renewable energy technologies, electric vehicles, semiconductors, and aerospace and defense components. Collecting minerals from the deep sea is controversial because of the environmental risks. Many are calling for a precautionary pause on mining activities to enable the gathering of more scientific data to better inform decision making.

Polymetallic nodules (potato-size rocks containing valuable metals) were first collected at 4,500-m depth in the Atlantic Ocean over 150 years ago. Since then, cobalt-rich crusts on seamounts and polymetallic sulphides near mid-ocean ridges and in back-arc basins have also been discovered.

Only recently has commercial mining become technically feasible. It involves dredging or picking for polymetallic nodules, or cutting for cobalt-rich crusts and polymetallic sulphides; all work at extreme pressure, under thousands of meters of water, in complete darkness, at low temperatures.

Despite these challenges, approaches to deep-sea mining beyond national waters are being developed without a comprehensive regulatory framework. Regulations are being negotiated by the International Seabed Authority (ISA) and its member countries. The ISA seeks to finalize regulations in 2025.

In national waters, the extraction of mineral resources falls under the individual authority of national governments, and there is a great diversity of opinion on deep-sea mining among nation-states.

Although mineral extraction would occur offshore, deep-sea mining will have socioeconomic impacts. While possibly providing jobs, the risks include: impact of onshore processing facilities construction on local communities; health and safety risks to workers; and a loss of the cultural or spiritual values associated with the existence of pristine ocean habitats, a concern particularly felt by indigenous populations. Under the UN Law of the Sea (UNCLOS), mineral deposits in the high seas are designated "the common heritage of [hu] mankind," and no one individual, company or state owns them. Any profit from their mining must be shared equitably to foster balanced development; it is unclear how this can be achieved in practice.

Proponents of deep-sea mining argue that it could have a lower environmental impact than terrestrial mining, but the deep sea is the largest habitable space on Earth and home to a dazzling array of species and habitats. The full ecological impacts are yet to be understood, but available science suggests they will be significant. Organisms could be killed by heavy mining equipment, or overwhelmed by the sediment plumes from the harvesting process. Wastewater could kill marine life through overheating and poisoning. Intense noise and light pollution could impair feeding and reproduction. Some species dependent on minerals deposits for habitat could face risk of extinction.

Environmental impacts may extend beyond the deep sea, too; sediment-laden waste discharge could disrupt pelagic food webs crucial to international fisheries. Mining activity could impact the carbon cycle and reduce the ocean's ability to mitigate global temperature rise.

Deep-sea mining is technically highly demanding, lacks regulation and poses risks on a planetary scale. The smart move would be a precautionary approach, along with a push for global collaborative efforts to strengthen the knowledge base to support the drafting of robust regulations. We have a unique opportunity to develop a rigorous governance system *before* significant impacts occur. We must not squander this opportunity. **ST**

SEA TECHNOLOGY® 2024

JANUARY

Annual Review & Forecast

****EUROMARITIME 2024**, January 30-February 1, Marseille, France

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****Oceanology International 2024**, March 12-14, ExCel, London, U.K.

MARCH

Electronic Charting/Vessel Management/ Ports & Harbors/Dredging/Homeland Security

****UDT 2024**, April 9-11, ExCel, London, U.K.

****OCEANS 2024 Singapore**, April 14-18, Singapore

****XPONENTIAL 2024**, April 22-25, San Diego, CA

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

MAY

Communications, Telemetry, Data Processing

JUNE

Seafloor Mapping/Sonar Systems/Vessels

****Sea Technology supports these shows**

BONUS INFORMATION

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****IMAGE 2024**, August 25-30, Houston, TX

AUGUST

Ocean Resources Development & Coastal Zone Management

****OCEANS 2024 Halifax**, September 23-26, Halifax, Canada

SEPTEMBER

Geophysical Exploration/Seafloor Engineering

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

****EURONAVAL 2024**, November 4-7, Paris, France

****CLEAN GULF**, November 18-20, San Antonio, TX

****MAST Australia 2024**, November 19-21, Adelaide, Australia

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The Future Is Now

Advanced USVs Carrying ROVs Enhance Marine Operations

By Ivar de Josselin de Jong • Lex Veerhuis • Joppe Born

Imagine a world where marine operations are not only safer but also more sustainable and efficient. This vision is increasingly becoming a reality as the industry adopts cutting-edge technology to address longstanding challenges. One such innovation making waves is Fugro's deployment of advanced uncrewed surface vessels.

Fugro, a global leader in geodata acquisition and analysis, is leveraging USVs to revolutionize marine science. These sophisticated vessels perform critical tasks,

such as seabed mapping and subsea inspections, with remarkable precision and minimal environmental impact.

By integrating USVs into their operations, Fugro is setting new standards for marine science, driven by a purpose to create a safe and livable world.

Evolution of USV Operations

Fugro's focus on USVs stems from a commitment to making operations more efficient, safe and sustainable.

The Fugro Pegasus is a Blue Essence USV that can be controlled from anywhere in the world to inspect subsea assets. The 12-m Fugro Pegasus has received full navigation licensing from the UAE Ministry of Energy and Infrastructure.





One of Fugro's ROCs, from which USVs can be controlled remotely.

The company's development of a USV for surveying purposes began in 2016, focusing on creating a robust ship-to-shore connectivity link that eventually allowed Fugro to become comfortable with remotely controlling and operating assets over large distances. Fugro's extensive experience in remote positioning laid the foundation for the successful implementation of USV technology.

A key aspect of this transformation is that entire survey scopes can now be performed without sending a single person offshore. Instead, teams acquire vital geodata from onshore facilities using USV technology. Over the years, Fugro has strategically expanded its global network of remote operations centers (ROC) to support USV operations worldwide. These onshore ROCs serve as command hubs for real-time monitoring and control of USVs, enabling continuous data collection and analysis without the constraints of crew rotations or weather conditions.

By centralizing command and data management, Fugro optimizes resource allocation and operational logistics, ensuring seamless integration of USVs into their broader suite of geodata acquisition services. Furthermore, the collected data are processed, analyzed and swiftly shared with clients through cloud-based solutions, enhancing efficiency and client satisfaction.

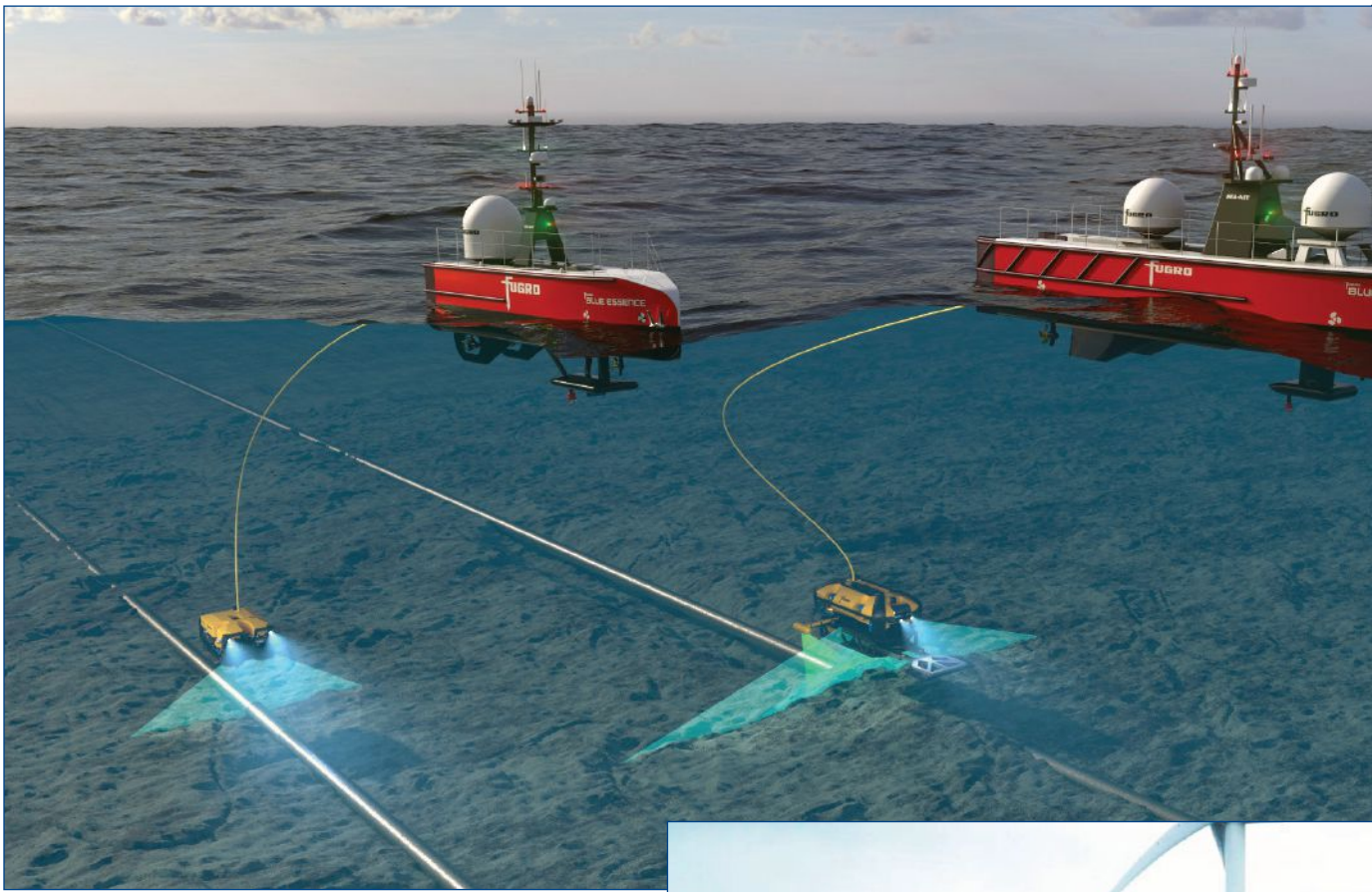
Fugro's journey in developing USVs began through

strategic partnerships and a strong commitment to innovation in maritime technologies. These partnerships marked the beginning of a significant transformation in Fugro's approach to marine surveying. A transformation that has led to entire survey scopes being performed without sending a single person offshore.

Types of USVs

Around 2019, Fugro introduced its first USV, named "Blue Shadow." Specifically designed for marine site characterization services, the Blue Shadow excels in high-speed hydrographic and bathymetric surveys, providing detailed mapping of the seabed. Its compact, 9-m wave-piercing design ensures greater weather tolerance, allowing it to operate in high-sea conditions for multiple days without interruption. It can operate in full autonomy, semi-autonomy, or by remote control, making it ideal for coastal and offshore projects where efficient and accurate data collection are essential. The Blue Shadow is also highly flexible and can be configured with other payloads to meet different operational needs, and it is suited to operate as a force multiplier with a parent vessel (with one or more USVs) to increase data collection efficiency.

Building on this foundation, Fugro has expanded its fleet with the Blue Essence, a 12-m USV designed spe-



cifically for marine asset integrity services. Its modular design features advanced sensors and communication systems, allowing it to perform a wide range of tasks. Primarily used for subsea inspections, it also supports construction projects and conducts geophysical surveys. Operated from Fugro's ROCs, the Blue Essence enables 24/7 monitoring and real-time geodata transfer. Unlike the Blue Shadow, the Blue Essence can be deployed independently, without the need for a parent vessel.

The Blue Essence features the Blue Volta, a compact and powerful electric ROV (eROV) designed for subsea inspections. Capable of operating to depths of 450 m when deployed from a USV, it can capture both high-definition video and detailed multibeam echosounder (MBES) data of subsea structures.

The latest USV addition, the 18-m Blue Eclipse, further advances Fugro's capabilities. It is built for over-the-horizon operations and is equipped with a 360° camera with night vision, radar, and advanced situational awareness software. It ensures efficient data acquisition and real-time transfer for rapid decision making.

The Blue Eclipse will be equipped with the Blue Amp eROV, a fully electric ROV that is bigger, more powerful and has a larger payload capacity compared to the Blue Volta. It uses over 30 kW of power for remote inspections and light interventions. Operating to depths of 500 m, it features advanced sensors and a 4K smart vision system, enhancing offshore operational efficiency.

Fugro's fleet of USVs and advanced eROVs offers efficient, flexible, and sustainable solutions for offshore



and nearshore operations, reducing risks associated with human involvement, thus promoting safer and more environmentally friendly marine operations.

Engagement with Regulatory Bodies And Industry Stakeholders

Fugro prioritizes engaging with regulatory bodies and industry stakeholders to advocate for the development of



Left: Fugro's Blue Essence USV with Blue Volta ROV. Right: Fugro's Blue Eclipse USV with Blue Amp ROV. (Below) The Fugro Orca, a Blue Essence USV, operating in the North Sea for an offshore wind farm inspection.



Essence has already obtained clearance to operate fully remotely in U.K. waters, which significantly aids in gaining acceptance in other countries, though it is not yet a universally recognized standard. Nevertheless, the Blue Essence is now the largest USV to operate with unrestricted access, supporting marine projects further offshore and enhancing safety and environmental performance. This achievement highlights the need for standardized regulations to facilitate consistent operational conditions worldwide.

The Role of USVs in Seabed Mapping and Inspection

Seabed mapping is crucial for offshore energy development, infrastructure planning and risk management. Traditionally, geophysical vessels have been used for this purpose, but the introduction of USVs marks a significant leap forward. USVs deliver the same quality high-resolution bathymetric data and detailed seabed imagery as traditional vessels while offering numerous advantages.

USVs can eliminate the need for large geophysical vessels in various projects, reducing carbon footprints and enhancing efficiency and safety. USVs can also execute inspection surveys, traditionally conducted by divers, and operate in harsher environments compared to traditional geophysical vessels, positively impacting project schedules.

The acquired geodata from USVs are essential for the safe and efficient installation of subsea infrastructure, such as offshore wind turbines and carbon capture, utilization, and storage (CCUS) related pipelines.

A notable example is Fugro's operation in the North Sea, where a USV has remotely inspected over 40 km of pipeline. Utilizing advanced multibeam and sub-bottom profilers, Fugro provided critical insights into seabed conditions, supporting the maintenance of the subsea infrastructure.

Furthermore, USVs, coupled with eROVs, offer optimized solutions for inspection and survey tasks, with real-time data transfer to onshore teams. This integration allows for faster decision making and efficient project management.

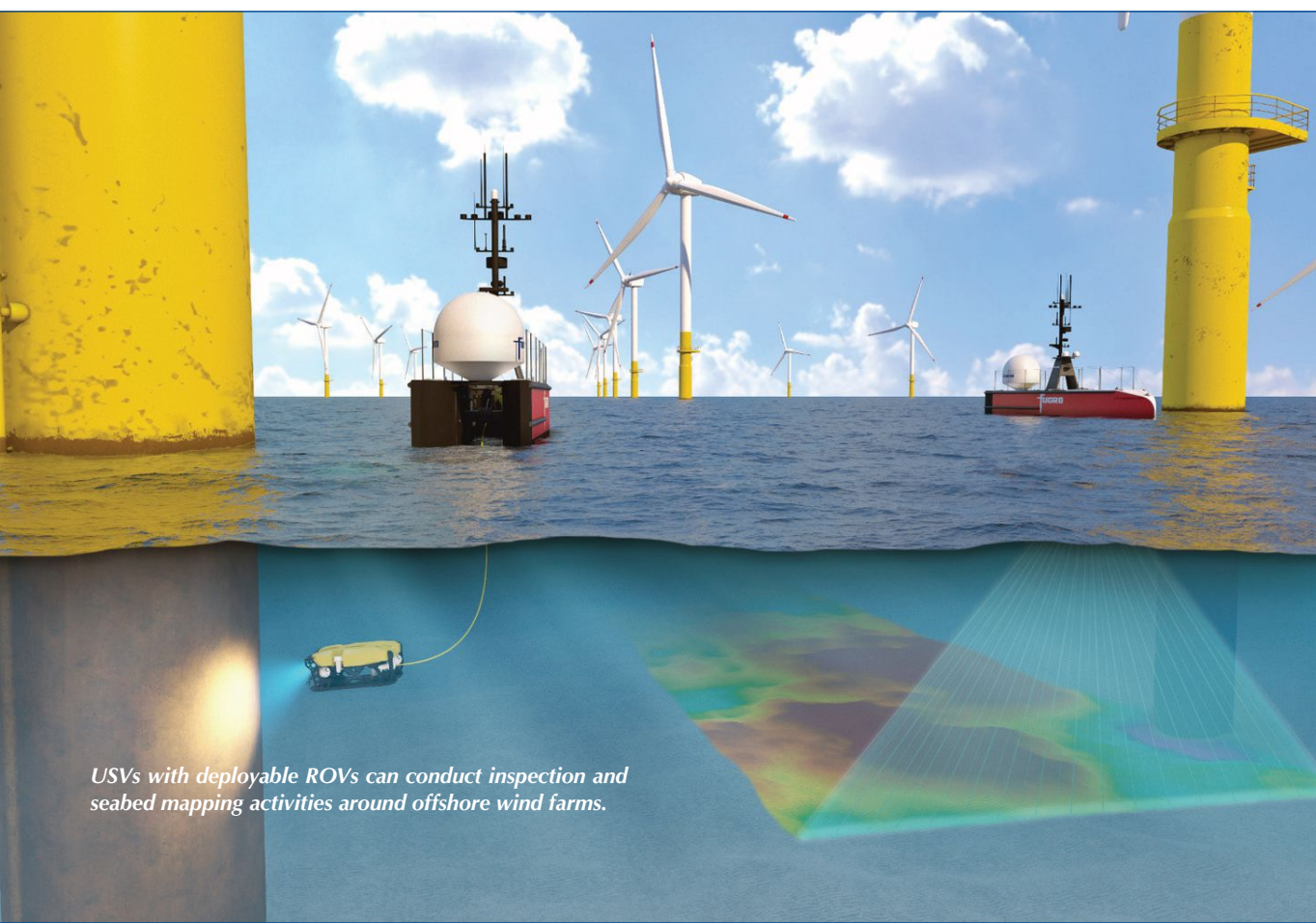
In 2023, Fugro's Blue Essence USV, equipped with the Blue Volta eROV, successfully completed the first-ever fully remote inspection of wind farm assets. This project highlighted the capability of USVs to perform operations and maintenance surveys in harsh marine environments, providing real-time data to clients while reducing carbon emissions.

Innovation in Data Management

Fugro's USVs are equipped with real-time data transmission capabilities, enabling continuous updates and immediate access to survey results from remote locations. This capability not only streamlines operational workflows with the client but also improves crew collaboration, as the captain, data processors and surveyors are all located in the same office. This facilitates faster response times and adaptive survey planning. As the demand for high-resolution geodata continues to grow, Fugro remains dedicated to advancing sensor technology

standards and protocols that ensure the safe and responsible deployment of uncrewed surface vessels. This proactive and collaborative engagement benefits operational readiness and underscores Fugro's expertise in shaping the future of marine surveying and exploration.

Despite the absence of a unified regulatory framework, Fugro works diligently to obtain necessary approvals from various governmental authorities. The Blue



USVs with deployable ROVs can conduct inspection and seabed mapping activities around offshore wind farms.

and data processing methodologies to meet the evolving needs of global marine industries.

The adoption of a cloud-based data management and engagement platform, Fugro's VirGeo, significantly enhances the ease of data management for clients. VirGeo offers a single source for accessing and organizing various data streams throughout a project's life cycle. This platform enables real-time access to geodata, facilitating seamless collaboration among geoscientists, engineers and project managers. By leveraging VirGeo, clients benefit from enhanced data security, scalability and accessibility, ensuring they receive accurate, actionable insights promptly to make informed decisions.

Environmental Stewardship

In 2020, Fugro introduced a net-zero roadmap, aiming for net-zero carbon emission operations by 2035 for Scope 1 and 2 (direct vessel emissions and indirect emissions, e.g., from purchased electricity). A significant step in this direction is the ongoing rollout of USVs.

Data acquisition through USVs from remote operation centers contribute up to 95 percent less carbon emissions than traditional vessel operations while significantly reducing human exposure to hazardous environments. This initiative highlights Fugro's dedication to sustainability and its commitment to advancing the science of the oceans, affirming its role as a leader in sustainable maritime operations.

Prospects and Industry Leadership

Looking ahead, Fugro remains committed to pushing the boundaries of remote and autonomous technology through ongoing research and development initiatives. Emerging technologies such as underwater LiDAR and hyperspectral imaging are poised to further enhance Fugro's remote capability to capture detailed subsurface data and conduct comprehensive environmental assessments, such as environmental DNA (eDNA) sampling. By staying at the forefront of technological innovation, Fugro aims to continuously improve the accuracy, efficiency, safety and sustainability of marine survey operations. **ST**

Ivar Josselin de Jong is the strategy and commercial director for Blue Robotics at Fugro. With decades of maritime sector experience, including more than 15 years with Fugro, he's focused on delivering USV-based robotic solutions that will enable faster, safer, and more sustainable offshore survey data acquisition and analysis.

Lex Veerhuis is the commercial manager for USV and Remote Working at Fugro, responsible for the commercial success of Fugro's fleet of USVs in Europe. A civil engineer with a master's degree in flood risk, he's worked in numerous operations, business development and commercial roles since joining Fugro in 2016.

Joppe Born is the global PR manager at Fugro, specializing in strategic communications and corporate messaging. A civil engineer with a master's in aerospace engineering, he leverages his expertise to highlight Fugro's innovations in geodata intelligence and sustainable marine operations.

Uncharted Waters

Revolutionizing Geophysical Surveys with Autonomous USVs

By Dave Jones • Emma Grant

SELKIE is available in 7- and 9-m configurations, powered by diesel engines.



In the world of geophysical surveying, the exploration and mapping of underwater features have traditionally been fraught with challenges. Dangerous conditions, high costs, and the limitations of manned missions have often hampered efforts to uncover the secrets beneath our planet's vast oceans, rivers, and lakes. However, recent advancements in unmanned surface vehicles (USVs) are revolutionizing the field, offering new opportunities for comprehensive and efficient geophysical surveys.

A New Era of Surveying

Traditional geophysical surveys rely heavily on manned vessels, which are expensive to operate and often limited by weather conditions and the availability of skilled crew members. The advent of USVs addresses these challenges head-on. These unmanned platforms can operate continuously, navigate through rough seas, and access areas that are too dangerous or difficult for manned vessels to reach.

***“One major advantage of USVs is their ability to act as force multipliers ...
This is critically important when weather is a factor”***

SELKIE: Autonomous Unmanned Survey

The SELKIE class is a new series of cutting-edge USV. These state-of-the-art vehicles, developed by Sea Machines Robotics, are revolutionizing marine geophysical surveys. Equipped with advanced multibeam sonar systems, GNSS navigation and a suite of environmental sensors, SELKIE can conduct detailed surveys of underwater environments autonomously. SELKIE is available in 7- and 9-m configurations, powered by diesel engines. Both SELKIE sizes are survey ready, designed to support a wide range of geophysical survey equipment and sensors, including multibeam echosounders, side scan sonars, magnetometers, and sub-bottom profilers.

At the heart of SELKIE is the SM300 Autonomous Command and Control System. With over 20,000 hr. of on-water testing and real customer usage hours, the SM300 is a proven autonomous solution deployed globally. SM300 integration grants SELKIE robust collision avoidance capabilities, allowing it to operate in dynamic waterways and maneuver around other vessels that pose a hazard to navigation according to COLREG rules 13 to 17, as well as following pre-planned missions autonomously without the need for human intervention. SELKIE can also be optionally manned for traditional survey operations, providing maximum operational flexibility. SELKIE includes another element of marine technology, enabling higher quality of survey work: Each SELKIE is outfitted with a Seakeeper anti-roll gyro stabilization to ensure smooth operations in rough seas. The gyro stabilization effect offers over 90 percent reduction in vessel roll, which benefits survey data quality and operability in adverse sea conditions.

Advantages of USVs

Risk Mitigation for Survey Personnel. One of the primary applications of SELKIE is mapping underwater geological features. Whether identifying potential oil and gas reserves, studying the seafloor for placement of offshore wind turbines and export cables, or assessing channel and harbor depths for safe navigation, the data collected by this USV is invaluable. The vehicle's high-resolution multibeam sonar provides detailed images of the seabed, revealing structures and formations with unprecedented clarity.

Safety is another critical concern in survey operations. Hazardous marine environments, whether it be extreme weather patterns, high-flow currents, or dangerous bod-

ies of water, such as hydroelectric plants or toxic waters, can hinder survey operations and put survey personnel at unnecessary risk. More and more clients are mandating the use of USVs to limit exposure of personnel to marine hazards. By letting autonomous technology perform the “dull, dirty and dangerous” tasks that humans would otherwise have to do, USVs can mitigate risks and keep survey personnel safe.

Efficient Mobilization. Preparing the vessel and equipment for a new survey operation requires time and extensive effort. If mobilizing a vessel of opportunity, the specific arrangement of the boat must be accommodated for and detailed measurements taken to provide offsets from a central reference point. This process is known as dimensional control. By employing USVs such as SELKIE, the craft can be transported in a standard shipping container to a local port and be ready to go to work almost immediately. (SELKIE can be mobilized on a road-worthy trailer that fits within a standard 40-ft. CONEX box.) The ability to get to work quickly saves many days of sourcing components, fabricating specialized mounts, and interfacing various systems. This rapid mobilization process results in significant cost savings. Sensor manufacturers are also building systems that are more autonomous friendly, for example, by eliminating switches that must be manipulated by hand.

Reducing Costs via Force Multiplication. Survey companies often participate in a competitive bidding process to win work. Technology such as SELKIE enables them to bid more efficient operations by reducing personnel costs and saving time, enabling them to gain an advantage when preparing proposals.

One major advantage of USVs is their ability to act as force multipliers. By having a mothership and one or more USVs, or just multiple USVs operating autonomously, survey time is drastically reduced. This is critically important when weather is a factor, such as in the Arctic where seasonal weather conditions allow a short window in which to conduct surveys, or during the fall and winter in the mid-latitudes where frequent frontal systems produce sea conditions that limit on-water operations. By multiplying the sensors in the water collecting data, total project time can be cut in half.

Regulations and Safety

While there is not yet a single unified global structure for the deployment of USVs, the IMO is on track to

develop a MASS (Maritime Autonomous Surface Ships) Code to safely integrate USVs into global maritime operations by 2028.

Meanwhile, operation of unmanned vessels is still being successfully and legally carried out worldwide in close coordination with local authorities as USVs gain popularity as a safer and more efficient method of survey.

Beyond Geophysical Surveys

While geophysical surveys remain a primary focus, the versatility of USVs such as SELKIE extends to a range of other applications.

Environmental monitoring, marine biology studies and even underwater archaeology can all benefit from the capabilities of these autonomous vehicles. By equipping USVs with specialized sensors, researchers can gather data on water quality, track marine life, and explore submerged cultural heritage sites.

Additionally, USVs have defense applications, such as security and surveillance operations, for instance, monitoring waterways for human trafficking and the transportation of illegal drugs.

The use of USVs also aligns with global efforts to protect marine environments. By minimizing the need for large, intrusive vessels, these unmanned systems reduce the environmental footprint of research missions. Moreover, their ability to operate in remote and sensitive areas without disturbing the ecosystem makes them an ideal tool for conservation projects.

Looking Ahead

The future of geophysical surveys is undoubtedly being shaped by the advent of USVs. As technology continues to advance, these platforms will become even more capable and accessible, opening new frontiers for exploration and research. For geophysicists working for survey companies or energy developers, the possibilities are limitless.

The integration of unmanned surface vehicles into geophysical survey operations represents a significant leap forward for marine science. By overcoming traditional limitations and offering new avenues for research, USVs are unlocking the mysteries of the deep, one survey at a time. As we continue to push the boundaries of exploration, these remarkable vehicles stand at the forefront, guiding us toward a deeper understanding of the world beneath the waves. **ST**

Dave Jones has more than a decade of experience working in hydrography, both in the field and as a project manager, spending the last six years in business development for the autonomous surface vehicle market. Jones served 22 years on active duty in the U.S. Navy's oceanography community.

Emma Grant holds a bachelor's in communication arts from Chulalongkorn University. Starting in media and entertainment, she transitioned to marketing and is now the marketing lead at Sea Machines Robotics, overseeing all activities, with a specialization in blending data-driven and creative digital marketing strategies.



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Photo and 3D Bathyscape courtesy of SimpleUnmanned, LLC

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Ocean Sensing Micro-Vessels

Fully Autonomous, Wind-Driven Surface Drones Gather Data

By Anahita Laverack

The vastness of our oceans poses significant challenges for continuous and comprehensive monitoring. Traditional methods, such as moored buoys, have been instrumental in collecting oceanographic data but come with limitations in terms of mobility, deployment complexity and cost.

Oshen's fully autonomous, wind-driven micro-vessels, with their advanced sensing capabilities, offer a flexible and cost-effective solution for ocean data collection and exploration, enabling environmental monitoring over vast oceanic regions.

Moored and drifting buoys have long been the standard for ocean data collection, providing valuable information on wave heights, sea surface temperatures and meteorological conditions. However, they are either stationary, limited by their fixed positions, or simply drift off and become redundant. Both are expensive to deploy, and moored buoys are costly to maintain.

In contrast, Oshen's micro-vessels offer many advantages and solutions to these challenges. They are self-deployed, able to cover large areas and can station-keep when needed.

Micro-vessel in Plymouth Sound, where Oshen is based.





Changing the Status Quo

Unlike moored buoys, which are anchored to a specific location, Oshen's micro-vessels integrate cutting-edge technology to ensure efficient and reliable data collection. The use of wind for propulsion and solar panels for powering onboard sensors ensures sustainable and environmentally friendly operation. The vessels are equipped with sensors for meteorological data, oceanographic measurements, visual monitoring and passive acoustic monitoring (PAM).

Designed for simplicity, a single person can deploy the vessel from a small boat or even from shore, enabling rapid, cost-effective and flexible deployment. Compared to the large ships required for moored buoys, this is a significant advantage.

The micro-vessels have undergone rigorous testing to ensure they can withstand harsh ocean conditions and deliver reliable performance. They have been successfully tested in conditions with sustained winds of 25 kt, gusts up to 40 kt. and in steep 2.5-m-high waves. The micro-vessels can transit to various waypoints on their missions and then return back to be collected. Additionally, they are capable of completing missions exceeding 100 km with zero intervention, demonstrating robustness and endurance.

Typical Mission

To illustrate the capabilities of our micro-vessels, let's follow a typical mission from planning to data collection. We embark with defining the mission objectives. Collaborating closely with our clients, we determine the optimal sensor payload and mission duration. For instance, a research team interested in studying wave patterns and meteorological conditions in a marine protected area might choose a suite of metocean sensors. Alternatively,

an organization monitoring marine mammal populations might opt for a keel-mounted hydrophone to capture acoustic data. This initial stage ensures the mission aligns perfectly with the client's research goals.

Next, clients select how they wish to use our micro-vessels. We offer three options: purchase, lease or data as a service. Regardless of the chosen method, our team ensures a smooth onboarding process, including a short training course and introduction to our user-friendly mission planning software.

Once the mission is set, the micro-vessel is deployed. The vessel performs a series of pre-planned waypoints, collecting data in real time. Equipped with advanced GPS and communication systems, the vessel sends data back to the client through our online dashboard. This real-time data transmission enables researchers to monitor the progress of the mission, make adjustments if necessary, and analyze data as they are collected. This capability is especially valuable for long-term monitoring projects, where immediate access to data can inform ongoing research and decision-making processes.

Future Directions and Innovations

The versatility and advanced capabilities of Oshen's micro-vessels open up a wide array of applications in ocean sensing and seafloor engineering. Continuous monitoring of ocean temperatures, salinity, and other parameters provides critical data for understanding climate change and the impact it is having on marine ecosystems. Passive acoustic monitoring enables the detection and tracking of marine mammals, aiding in the conservation of endangered species and understanding their behaviors and migration patterns. Additionally, data collected by our vessels can support sustainable fisheries management by providing real-time information on

Deployment of micro-vessel.



fish stocks, breeding grounds, and environmental conditions affecting fisheries, as well as giving live weather data for forecasting.

As we look to the future, Oshen is committed to continuous innovation and expanding the capabilities of our micro-vessels. One area of focus is enhanced data analytics, leveraging artificial intelligence and machine learning to provide deeper insights from the collected data, enabling predictive analytics and more informed decision making. Developing strategies for deploying large fleets of micro-vessels to create extensive sensor networks, thus providing unprecedented coverage and resolution of ocean data, is another key area of focus. Incorporating new sensors and technologies to expand the range of data collected will further enhance the utility of our micro-vessels.

Conclusion

Oshen's fully autonomous, wind-driven robotic vessels represent a significant advancement in ocean sensing technology. By overcoming the limitations of traditional moored buoys, our micro-vessels provide a flexible, cost-effective, and powerful solution for continuous monitoring of oceanic and meteorological conditions. Through detailed planning, versatile deployment options, and real-time data transmission, we empower researchers and organizations to gain deeper insights into the marine environment. As we continue to refine and expand our technology, Oshen is committed to transforming ocean monitoring and contributing to the preservation and understanding of our oceans.

In summary, Oshen's wind-driven robotic vessels are ready to alter ocean sensing, offering a robust, sustainable, and versatile solution for a wide range of applications. Whether for climate change research, marine mammal monitoring, or live weather data for forecasting, our technology provides the tools needed to gather critical data and make informed decisions. As we navigate the complexities of the marine environment, Oshen's micro-vessels will be at the forefront, leading the way toward a deeper understanding and better stewardship of our oceans. **ST**

Holding a degree in aeronautical engineering from Imperial College London, Anahita Laverack completed her master's in the design and navigation of transatlantic autonomous micro-vessels. In early 2022, she founded Oshen, a startup focused on the mass deployment of autonomous micro-vessels for ocean data collection. Oshen's micro-ASVs offer the potential for persistent, low-cost monitoring in various applications, from meteorological data to marine conservation. She currently oversees Oshen's strategic development and hardware design, applying her specialized knowledge to advance autonomous marine sensing technologies.



Offshore Wind Safety

Improved Weather Intelligence Facilitates Operations

By Mikko Nikkanen

With offshore wind installations surging to meet ambitious renewable energy goals, the wind power industry is experiencing unprecedented growth across maritime environments.

In the U.S. alone, offshore wind capacity approved for construction by the federal government grew 800 percent: from 0.93 gigawatts to 8.3 GW in 2023. In Europe, the volume of new offshore installations is growing: Last year, it was a record 3.8 GW. Plus, a significant

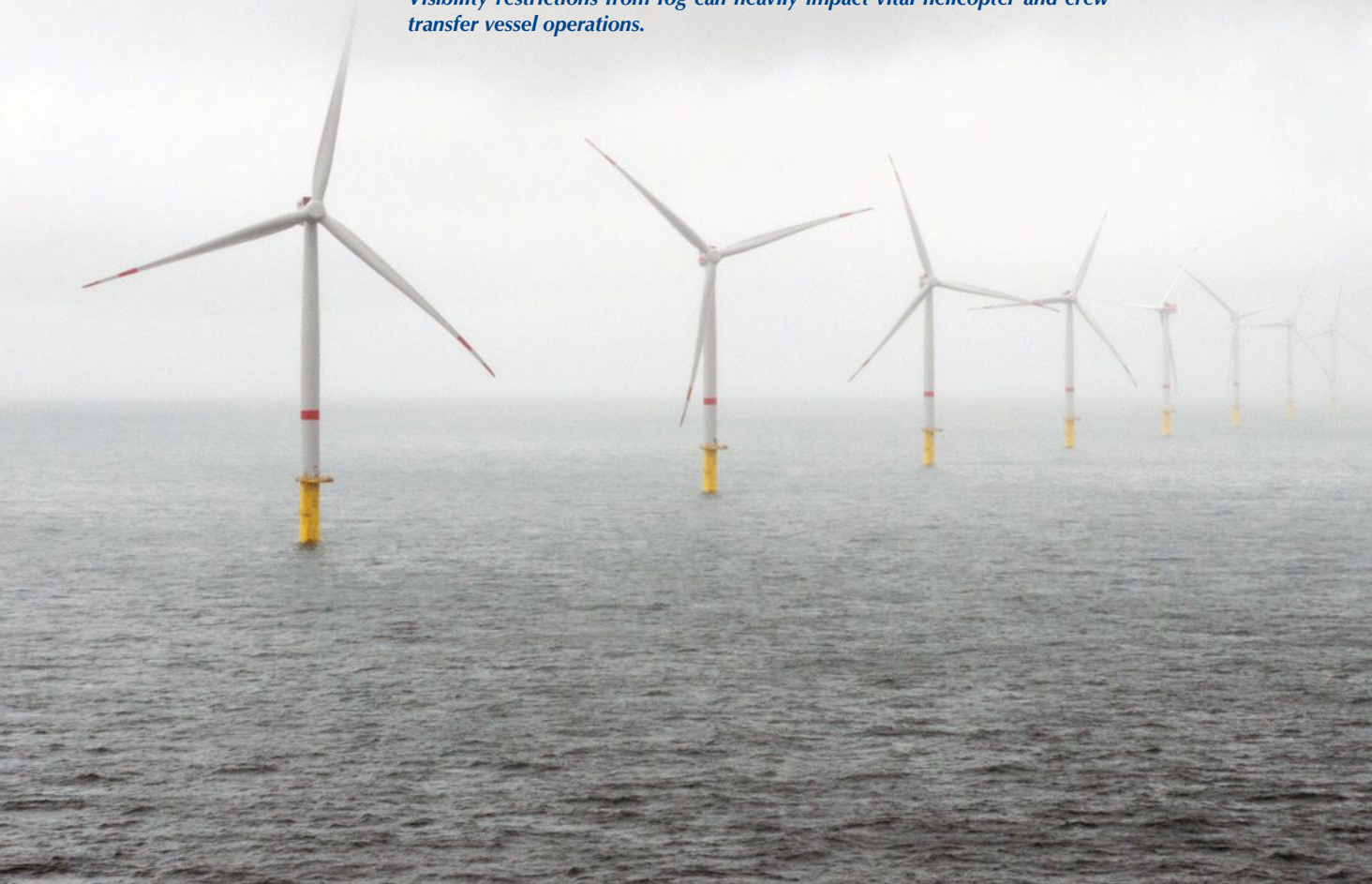
amount of the global offshore capacity will come from the Asia-Pacific region, with southeast Asian countries having almost five times more prospective offshore wind power than prospective onshore wind in the ASEAN region.

As developers push farther offshore to access better wind resources, they venture into increasingly harsh marine environments. Consequently, the offshore wind industry carries substantial safety risks that must be pro-

Proactive weather safety planning facilitates technicians' access to offshore wind turbines by helicopter or crew transfer vessel, both of which are highly exposed to winds, waves, poor visibility and lightning.



Visibility restrictions from fog can heavily impact vital helicopter and crew transfer vessel operations.



actively managed to avoid accidents, expensive delays or canceling operations altogether.

A recent study reviewing health and safety in the offshore wind sector revealed some alarming findings. The researchers found that injury rates for offshore wind workers are four times higher than in the mature offshore oil and gas industry. Many of these incidents are directly tied to hazardous weather exposures during transfers, maintenance operations and emergency response scenarios. Even worse, risk exposure to workers is expected to increase due to the industry's growth and advancing technology.

However, technology can also help improve safety across offshore operations. By reducing the "forecast accuracy gap" in remote maritime areas via enhanced weather monitoring, alerting and forecasting capabilities, operators can make better informed decisions that protect personnel working in an inherently dangerous environment. Advancements in weather data collection, modeling and decision support tools provide a viable pathway to mitigate the industry's weather vulnerabilities.

Current State of Offshore Safety Challenges

Inclement weather conditions constantly threaten

offshore energy operations and employee safety. High winds, turbulence, towering waves, storms, sea fog, and lightning can derail critical activities and endanger human lives. The remote nature of these operations, often nearly 30 mi. from shore, compounds the risks by hindering emergency response.

A recent study, published in *Renewable and Sustainable Energy Reviews*, identified several key challenges making the sector more susceptible to weather hazards compared to oil and gas. One is remote work sites: Offshore wind turbines are often installed in clusters far from land, complicating routine maintenance access and urgent medical evacuations when incidents occur. Any weather-related delays can prove catastrophic.

Second is data scarcity: There is a lack of robust weather observation networks or weather radars covering prime offshore wind areas. With few offshore buoys and prominent gaps in satellite coverage, meteorological model accuracy suffers.

Third is personnel transfers: Technicians access turbines by helicopter or crew transfer vessel, both of which are highly exposed to winds, waves, poor visibility and lightning. Any adverse weather events can quickly make crew transfers unsafe.

Fourth is harsh marine conditions: Wind farms are



pushed into progressively deeper waters with unobstructed fetches, exposing infrastructure to unprecedented extreme wind, waves, currents and other punishing elements, such as Arctic icing.

Fifth is localized effects: Microscale low-level jets, turbulence, fog and thunderstorm patterns vary substantially in areas just a few miles apart, making blanket forecasts unreliable for specific sites, especially as projects inch farther away from coastlines.

Sixth is profit pressures: As a still maturing sector, offshore wind has lower profit margins compared to offshore oil and gas, increasing the temptation to “push operational limits” in unfavorable weather that could compromise safety.

Overall, these significant offshore challenges elevate the need for better weather intelligence to facilitate proactive planning and real-time decision making to ensure safety.

The Importance of Comprehensive Offshore Weather Awareness

Reliable weather monitoring and forecasting underpins safe and successful offshore wind operations. Every critical offshore wind activity—from construction to turbine maintenance to crew changes—requires precise

weather awareness to proceed safely. Comprehensive meteorological data allows operators to make informed decisions that avoid unnecessary risks to personnel and assets.

On the construction and maintenance front, accurate short-term nowcasts and wind gust alerts help plan crane operations and ensure worker safety on turbine decks and platforms. Visibility restrictions from fog can heavily impact vital helicopter and crew transfer vessel operations. Lightning nowcasts are critical for temporarily halting external work and keeping helicopters grounded to prevent dangerous strikes. Longer-range temperature, humidity and wind forecasts enable efficient scheduling by pinpointing ideal takeoff and landing windows for helicopters and optimal times for crane lifting.

Once an offshore wind farm is active, constantly updating wind speed, wind shear, and wind direction data is paramount for safe helicopter approaches and departures to helidecks and helipads. Met ocean parameters such as wave height, wave direction, and other marine conditions must be closely monitored to facilitate safe boat crew transfers and vessel movements.

Additionally, meteorological data integration with monitoring and control systems allows for automated safety procedures to be triggered. For example, a computerized shutdown and evacuation process could be initiated if a lightning or severe thunderstorm track was detected within a predefined radius. Accurate meteorological data feeds based on real-time situational awareness permit these protective measures well before manual intervention.

Avoiding costly downtime from overconservative “safety stand-downs” is another significant benefit of higher weather forecasting accuracy. With comprehensive atmospheric intelligence, operators can ensure their safety practices are soundly based on actual threats—not overly broad precautions that unnecessarily disrupt operations.

While the offshore wind industry has made great strides in technological innovation for energy production, the need for dedicated research into improving operational meteorology and safety capabilities represents a critical gap. Closing the offshore “forecast accuracy gap” through enhanced on-site observations, improved modeling and real-time decision support tools can pay immense dividends in preventing safety incidents, unplanned downtime and associated costs.

Boosting Offshore Safety with Weather Information

To elevate safety, the offshore wind sector must evolve beyond simply relying on generalized public weather forecasts intended for coastal areas. These regional forecasts lack the high-resolution, localized insight required for secure offshore operations amid rapidly evolving microclimates around each wind farm. Shrinking the forecast accuracy gap necessitates more observational data points and advanced modeling focused on the unique offshore environment.

Comprehensive technology solutions, such as Vaisala’s Offshore Weather Awareness, can deliver that miss-

Vaisala's WindCube offers flexible and accurate wind measurement.



ing weather intelligence. The turnkey system combines robust weather sensors and monitoring equipment installed directly on offshore platforms, collecting, integrating, and visualizing hyperlocal meteorological and environmental measurements of all atmospheric parameters crucial for maritime operations to support critical safety practices. Designed to include complete sensor integration, data collection and storage, the full-scale solution can also be equipped with modern weather forecast and lightning data APIs for more holistic situational weather and environmental insights. Plus, a wide range of wireless and cable communication options enables flexible positioning of the instruments, interfacing with vessel information systems and data transmission to offshore and onshore users over web interface.

In addition to traditional sensors for wind, temperature, pressure, humidity, precipitation and cloud data, the system includes LiDAR-based remote wind sensing technology. This pulsed laser-based sensing provides continuous high-definition wind profile data that can reveal microscale phenomena and atmospheric boundary layers missed by more coarse weather models. Lightning detection and weather radar also identify and track potential convective threats as they develop over the larger areas of ocean.

This high-fidelity data originating at offshore sites powers substantial safety enhancements through improved forecasts and real-time weather monitoring. Local forecasts calibrated from on-site observations replace the general guidance with turbine-specific intelligence on approaching weather hazards, their severity, timing and anticipated duration. This unprecedented level of foresight for offshore conditions allows proactive planning to mitigate risks before threats arise.

Weather Insights Strengthen Offshore Operations

The benefits of hyperlocal meteorological data tailored for offshore wind operations are clearly illustrated by a recent project in France's burgeoning offshore sector. The engineering firm Wärtsilä selected an advanced Environmental Monitoring System (EMS) for its client's new 480-MW Saint-Nazaire offshore wind farm substation.

To achieve comprehensive environmental awareness, Wärtsilä integrated the rack-mounted Vaisala Maritime Observation System AWS430 with associated sensors and Vaisala Helideck Monitoring Software for data reporting, alarms, and weather and environmental data display. Combining the system's hyperlocal multiparameter data with meteorological modeling produces a continuous high-resolution depiction of evolving conditions at the offshore site.

Real-time monitoring of winds, gusts, wind shear, cloud ceilings, precipitation timing and intensity, and wave period and height alerts operators to threats, such as low clouds, heavy precipitation, lightning, wind shifts and storm system approaches, well in advance. This forewarning facilitates intelligent risk mitigation: from ceasing exposed maintenance activities to initiating full evacuation procedures if needed before severe weather strikes.

The result is that the French offshore wind farm maintains safe operating practices and high productivity by harnessing the power of targeted weather intelligence to close the forecast accuracy gap in these remote, data-sparse areas. As the industry grows, implementing dedicated offshore meteorological systems will be paramount to maintaining a strong safety posture amid the harsh offshore climate realities.

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“While the offshore wind industry has made great strides in technological innovation for energy production, the need for dedicated research into improving operational meteorology and safety capabilities represents a critical gap.”

Weather Data for Safer Offshore Environments

Proactive weather safety planning will only become more critical with the offshore wind sector continuing its rapid growth into higher winds, deeper waters and harsher conditions. Addressing the industry's elevated injury rates and adverse weather vulnerabilities must be a top priority.

The good news is that solutions already exist to enhance offshore wind farm safety through targeted weather intelligence. Offshore operators can substantially strengthen safety practices and operational decision making by deploying robust observational weather networks and integrating hyperlocal high-resolution weather modeling.

Investing in dedicated offshore meteorological monitoring and prediction systems is essential since general forecasts cannot provide the granular, site-specific weather intelligence required for secure operations amid rapidly evolving marine weather patterns around each wind farm.

While the offshore wind industry is established as a trailblazer in sustainable energy production, it must now also lead the way in enhancing safety and efficiency in operational capabilities.

Closing the forecast accuracy gap offshore through advanced hyperlocal weather detection and prediction will bolster its operational safety posture and pay immense dividends by preventing injuries, saving lives, and mitigating weather disruptions that can spoil ambitious renewable energy objectives. **ST**

Mikko Nikkanen leads strategy and development for Vaisala's Maritime and Ports segment. He established Vaisala's maritime focus in modern weather awareness solutions, bringing 20 years of global sales and business development experience to build innovative solutions with various partner ecosystems.



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Powering Subsea Robots

Ocean Temperatures Unlock Energy for Sensors at Sea

By Mike DiCicco

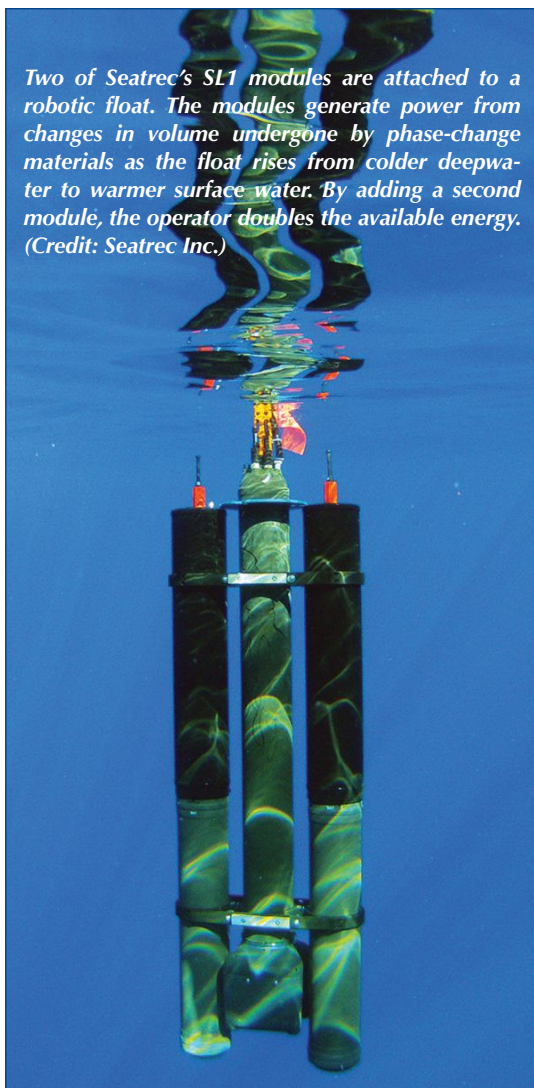
When it comes to mapping new territory, NASA's record swamps Lewis and Clark's. And the space agency doesn't only chart other stars and planets—a vantage point from space also allows a great view of Earth.

Now, a recent NASA invention could allow robots to map our planet's entire seafloor, helping to unlock valuable resources while protecting marine habitats. While the aquatic sonar devices for such an operation are not new, they've been severely hampered by batteries that leave them dead in the water.

Based on technology created at NASA's Jet Propulsion Laboratory (JPL) in Southern California and licensed from the California Institute of Technology, Seatrec Inc. of Vista, California, now offers the first energy source for subsea robots that are powered entirely by their environment, allowing devices to work in the open ocean indefinitely, without any intervention.

After earning his doctorate in ocean sciences, Yi Chao took a job at JPL to dedicate himself to ocean studies. His choice might seem counterintuitive, but the space agency has made the study of Earth, including its oceans and ice caps, a major priority, launching dozens of satellites with hundreds of sensors to measure sea levels, tempera-

Two of Seatrec's SL1 modules are attached to a robotic float. The modules generate power from changes in volume undergone by phase-change materials as the float rises from colder deepwater to warmer surface water. By adding a second module, the operator doubles the available energy. (Credit: Seatrec Inc.)



tures, salinity and much more.

"I spent the first 15 years or so at JPL studying the ocean from space," said Chao, including a career highlight as project scientist for the Aquarius satellite mission that measured the salinity of ocean water. One challenge of the mission was to calibrate the satellite's instrument against direct measurements of salt content from sensors that Chao and his team had to distribute across the oceans. While the satellite effortlessly whipped around Earth many times a day gathering readings, those oceanic distances remained stubbornly vast for researchers crossing them by boat.

"We went out to sea for 30 days," he said. "We deployed—and we asked our colleagues in universities to deploy—all kinds of robotic platforms to collect data in the middle of the Atlantic Ocean, not only near the surface but also below the surface, so we can calibrate and interpret what we're measuring from space."

The experience showed him how difficult it remains to access many of the world's open oceans, which may lie more than a week from the nearest major ports, and it taught him about the robots that monitor conditions

there. Their most limiting factor, he learned, is energy, especially for underwater sensors that can't rely on the



(From left) Michael Zedelmaier and Miles Mallinger, both of Seatrec, deploy a float with one of the company's SL1 power modules in the Gulf of Mexico before the 2022 hurricane season to collect data that could improve hurricane predictions. (Credit: Seatrec Inc.)

renewable energy that's available at the surface from the Sun, wind and waves. All subsea robots are currently battery operated, and when the battery dies, the owner can either leave the sensor to become pollution or charge the battery on a ship. In the open ocean, that ship costs around \$50,000 a day and burns tons of diesel fuel.

"I really had an opportunity to know the challenges of underwater robotics, and especially energy, and settled on this particular bottleneck that I want to address," Chao said.

Generating Power from Phase-Change Materials

He recruited two JPL colleagues, and they set out to build a different kind of power source for subsea robots, with funding first from JPL and then from a JPL contract with the Navy, which was also interested.

To generate power, they settled on phase-change materials, substances that transition between phases—usually between solid and liquid—at certain desirable temperatures. NASA often uses phase-change materials to blunt temperature extremes in space, but Chao's team wanted to generate power by taking advantage of the change in volume that accompanies a change in phase. Most substances, with the exceptions of water and metals, expand when they melt and contract when they freeze.

"We use the kinetic energy from that volume expansion to spin the motor and then turn the mechanical energy into electricity, and now you can recharge your battery," Chao said. It's an old concept, and it's basically the way a steam engine works, using water's expansion into steam to turn a motor. But the solid-to-liquid transition creates only about a 10 percent expansion. The challenge, therefore, is to make the most of the small amount of energy it generates. "So every component has to be super-efficient," Chao said. "That's why people have tried

this and didn't think it's enough energy to convert. We are the first to go through the process end to end and pick the highest-efficiency components, and eventually we can generate a sufficient amount of energy for an underwater robot."

The robots cause the material's temperature to change simply by rising and falling through the ocean, something they typically have to do anyway, surfacing to determine their position via GPS and transmit the data they've collected to satellites. The team selected a common industry-grade paraffin-family material with a melting point around 50° F, right between the typical deep ocean temperature of about 40° F and surface temperature around 70° F. But that material can be swapped for one with a higher or lower melting point depending on the environment.

At JPL, the team built and demonstrated a prototype float in 2011, followed by an underwater glider that operated on the same principle but could also move horizontally. Over the next few years, Chao worked on exclusively licensing the invention from the California Institute of Technology, which manages JPL, and founding Seatrec.

Applications for Power Modules

The company now sells its first power module for diving floats, called SL1, to research labs, universities, government researchers and the military. But Chao envisions a much larger market in the near future, starting with efforts to map the 80 percent of the seafloor that remains uncharted today. The military is interested in seafloor mapping, he said, especially for submarine navigation, but so are companies that drill for oil and gas or build wind farms offshore, as well as communications companies laying transoceanic internet cables and environmental conservation groups that want to learn more about the locations of marine habitats.

Mapping all that seafloor by ship would cost billions of dollars and require a fleet of hundreds of huge, global-class vessels, Chao said, noting that only about a dozen such ships are actually available for this sort of work. Mapping the ocean floor from the surface also requires high-powered sonar to cut through noise in the upper ocean, whereas a float can dive down to 500 m or deeper to map the seafloor with much less energy and little disturbance to marine wildlife. "So, we are enabling mapping the ocean floor from a subsea platform for the first time," Chao said.

Other markets include companies managing offshore operations, from oil wells and wind turbines to fish farms, which need underwater sensors to monitor conditions and equipment. And anyone laying cables or mining for rare Earth elements on the seafloor needs to assess the local environment and wildlife.

Weather and climate studies will be another important application, especially improving hurricane predictions, whose accuracy and timeliness save lives and property. It's the water temperature 30 or 50 m deep that will ultimately fuel or starve a tropical storm, Chao said, but it's not monitored in real time because current

international

European MCM Project

Exail has been selected to participate in the European Extended Mine Counter Measures (E=MCM) project. The objective of this consortium project, led by Naval Group Belgium, is to establish a future European sovereign capacity in mine warfare.

Thanks to these new developments, the Toolbox 2.0 will go beyond the current new generation stand-off MCM Toolbox that Exail is developing and will be delivering as part of the replacement of the current MCM capabilities for the Belgian and Dutch navies. Leveraging scalable unmanned autonomous systems and intelligent platforms developed by Exail's teams in both France and Belgium, the new functionalities and improvements will be smoothly integrated into Exail's MCM ToolBox offer, enhancing operational efficiency and optimizing MCM operations.

Greensea IQ Adds Japan Rep

Greensea IQ has signed on Nippon Kaiyo Co. Ltd. as its new international representative for Japan. This strategic partnership aims to expand the reach of Greensea IQ's Bayonet autonomous underwater ground vehicles (AUGV) product line in the Japanese market.

AUGVs are the only vehicles designed to work in the surf zone and to depths up to 100 m.

Equinor to Explore CCS in Denmark

Equinor has been awarded its first carbon capture and storage (CCS) exploration permit in Denmark as an operator, together with partners Ørsted and Nordsøfonden. The partnership will start surveys to assess if the onshore license in the North West Zealand can be developed into a safe CO₂ storage facility.

Subsea Infrastructure for INGV

MacArtney has partnered with Elettra Tlc to deliver critical subsea infrastructure for the Italian National Institute of Geophysics and Volcanology (INGV), enhancing its capacity for environmental monitoring and research.

The scope of this collaboration involves installing and connecting a new subsea power, communication and data transmission network located 2,200 m deep and 35 km offshore from Catania, Italy, where INGV will strongly enforce its existing marine site as part of the ITINERIS project (Italian Integrated Environmental Research Infrastructures System).

HydroSurv Partners with Blue Armada Robotics

Blue Armada Robotics, a Polish marine data company recognized among European Leaders of Offshore Renewable Energy by ELBE Alliance, has announced a partnership with U.K.-based USV producer HydroSurv (*Sea Technology*, July 2024). As part of this collaboration, Blue Armada has acquired its first USV, a REAV-60, marking a strategic move to capture the uncrewed marine data collection market in the Baltic Sea, with further

aims to address emerging opportunities through international expansion and the ELBE strategic cluster network for North America and Asia.

CCS System Retrofit for Cargo Vessels

Value Maritime (VM) is collaborating with ForestWave to retrofit two 10,600 dwt general cargo vessels with VM's advanced emission reducing Filtree EGCS system and integrated carbon capture unit. This marks the first contract between Value Maritime and ForestWave.

The Filtree system with CCS technology, capable of capturing up to 10 percent of CO₂ emissions, will be installed on the FWN Sea and FWN Sun at the Value Maritime quay in Rotterdam, the Netherlands.

New CMT Distributor in Singapore

CM Technologies (CMT) has strengthened its global sales and distribution network with the appointment of Singapore's Junma Services, a marine engine sales, repair and services company, to facilitate increasing demand for CMT's machinery and fluids testing, measuring and analysis solutions. Junma Services joins an established CMT network of 10 distributors across the Asia-Pacific region, with specific responsibility for increasing the Germany-headquartered company's presence across the Lion City's maritime cluster.

The development is part of a wider strategy to ensure that all major maritime hubs are stocked with CMT's PREMET range of diesel engine performance optimizers to help shipowners and managers curtail their ships' CO₂ emissions in line with carbon reduction requirements.

Two Tugboat Additions to Port of Halifax

Atlantic Towing Ltd., a member of the J.D. Irving Ltd. family of companies, and Svitzer have made a joint investment in the Port of Halifax fleet by acquiring two new escort tugboats from the Rastar 3200 series, each with 85-ton bollard pull.

The Port of Halifax has seen substantial growth over the past decade, with a marked increase in both the number of tug jobs and the size of vessels. The new tugboats were selected to accommodate the expanded volume.

Currently, three tugs are permanently stationed in Halifax, supplemented by two on-call vessels. The new Rastar 3200 vessels will replace the on-call tugs and are currently under construction at the Uzmar Shipyard. Operation is expected later this year.

Panama Canal Continues to Grow

The Panama Canal has celebrated the eighth anniversary of its expansion program by announcing an increase to its draft and daily transits, all while continuing to manage the impact of climate variability and the challenge of securing water for the future.

Through an Advisory to Shipping, the Panama Canal announced that the maximum authorized draft has been raised from 46 to 47 ft. (14.33 m), and increased to 48 ft. (14.063 m) in July.

Additionally, a new booking slot for the Neopanamax locks will be added August 5, bringing the total number

of transits to 35 ships per day. The Canal's continued progression is informed by the current and projected water levels of Gatun Lake and the arrival of the rainy season.

Berth Reno at Port Canaveral

Work is progressing well on an extensive \$39 million capital improvement project to rebuild Port Canaveral's North Cargo Berth 4 (NCB4). This ambitious project included removing the existing functionally obsolete over-the-water pier, which has been out of service for nearly 10 years, to replace it with a 981-ft.-long multipurpose, multi-user wharf.

North Cargo Berth 4 is located next to the port's newly rebuilt NCB3, an 880-ft.-long multipurpose berth, which went into service June 2023.

Phoenix Assists with Baltimore Bridge Collapse

In March 2024, Phoenix International Holdings Inc. was contracted by DonJon Marine shortly after the collapse of the Francis Scott Key Bridge in Baltimore, Maryland, for diving support in cleanup and salvage operations. Phoenix Bayou Vista quickly mobilized a 10-man dive team and dispatched its containerized diving systems with chambers and various required equipment to Baltimore to aid in this endeavor. As the only diving contractor with chambers on site, Phoenix was able to offer its decompression resources to the other diving contractors. Phoenix provided post-bridge collapse inspection and worked closely with DonJon's engineers and Sal-

vage Master to determine key cut-point locations prior to shearing and diamond wire saw operations.

Phoenix also collaborated with the Maryland State Police to assist with recovery operations when remains were discovered during these inspections.

AST Networks Expands into NavCom

AST Networks, a provider of advanced maritime IT solutions, has expanded into the navigation and communication (NavCom) system sector.

As maritime operations become increasingly complex, the need for integrated and reliable navigation and communication systems has become more critical. AST Networks will integrate state-of-the-art NavCom technologies with its existing suite of maritime IT solutions.

Svitzer Invests in Brazil Tugboats

Svitzer has signed a contract with Shipyard Rio Maguari for the construction of three new tugboats.

Brazil plays an essential role in the global economy, particularly in the trade of grains, oil and metals. As enablers of trade, Svitzer is committed to supporting this growth by investing in additional tugboats for its Brazilian fleet.

The three vessels currently under construction are part of the 2300 Rampart Series. They have a top speed of 13 kt., an overall length of 23.2 m and a bollard pull of more than 70 tonnes. The vessels will be equipped with Fifi-1 firefighting capabilities. **ST**



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Flowmeter for Ship Fuel



OPTIMASS 1400 Coriolis mass flowmeter reliably measures mass and volume flow, density, and temperature for fuel consumption monitoring of MGO, MDO, and other liquids. The OPTIMASS 1400 features innovative twin measuring tubes, which leverage the Coriolis effect to provide highly accurate readings across a range of flow conditions and fluid types. KROHNE Inc.

High-Amp Electrical Connection

As superyachts and commercial vessels continue to increase in size and complexity, so do their onboard power requirements. To meet these requirements, this 200-A ship-to-shore device is listed to UL 1682 standards and UL classified. The four-pole, five-wire system is 600 V AC/250 V DC and 50 to 400 Hz. Hubbell Marine Electrical Products.

Vessel Management Data

Frugal Propulsion is a cost-, fuel- and emissions-saving system for large vessels that provides ship-owners and technicians with data on engine performance, emissions, and hull efficiency using IoT tech, big data, learning algorithms, and data visualization. With the software upgrade, the system now also uses historical data to comprehend and contrast the engine's current condition with its initial state to get ahead of possible problems. Frugal Technologies ApS.

New Voyage Map Features

Nobeltec TIMEZERO's version 5.1 for PC software and the iOS app

includes the most requested features: Route Assist, Marine Forecast Zones and Rain Radar. Route Assist will automatically complete a route with set start and end waypoints, ensuring it avoids obstructions and adheres to safety depths. Marine Forecast Zones provide U.S. users with comprehensive, meteorologist-prepared bulletins. Rain Radar enables monitoring of the evolution of precipitation and storms in near real time directly on your chart. MaxSea Naval S.L.

Energy Storage for Large Vessels



DNV type-approved Blue Whale marine ESS is a large-scale system that complies with the most stringent rules, regulations and safety requirements in the industry. Blue Whale ESS is designed specifically for large vessels, such as cruise ships, Ro-Pax, service operation vessels, and vessels that require a large amount of energy. It features optimized energy density and a flexible, modular design architecture. Corvus Energy.

All-Electric Work-Class ROV

The Seaeye eWROV competes with traditional hydraulic ROVs by delivering performance equivalent to a 250-hp undersea vehicle. The eWROV uses limited hydraulic systems with minimal oil, which reduces the risk of accidentally discharging pollutants into the ocean that can harm the surrounding ecosystem. Vicor power modules enable efficient power distribution to various eWROV subsystems, such as thrusters, manipulators and onboard electronics. Saab UK.

Onboard Data Gateway

eSync is a revolutionary onboard data gateway designed to meet the growing cybersecurity demands of a more connected global shipping fleet. eSync eliminates the need for AVCS-based media on board vessels, removing the necessity for manual data transfers to the bridge. The eSync box, once installed and connected to the vessel's communication system and to the bridge's ECDIS (regardless of its brand), streamlines data management and the system's exposure to manual risk. ChartWorld GmbH.

Emissions Data Verification



Trust-Ocean is now integrated with Veracity, the maritime emissions cloud from DNV. This partnership will deliver optimal maritime emissions data verification to ensure compliance with evolving environmental regulations. Dynamic dashboards enable real-time monitoring of vessel operational efficiency. Through the centralized platform, ship data are transmitted to shore,

stored in the cloud, and analyzed via a secure web-based application, offering deeper insights and analytics. Chris-Marine AB and DNV.

ROV Control from Any Device

BRIDGE technology is now available on any device to enable remote operation of an ROV from a permanently stationed location, such as a work van, control room or office, without the need to be physically connected to the tether. You can control your ROV with a traditional console, a gamepad controller and laptop, or any other device with customizable controls. Deep Trekker Inc.

Fish Sonar

Eagle Eye live sonar offers anglers the same resolution as seen on ActiveTarget 2 in a more focused setting, with down and forward views. Four sonar views can be seen from a single transducer with no module needed. Detailed C-MAP charts feature Genesis Live, and an enhanced IPS screen is visible from all angles. FishReveal mode helps separate fish from structures. Lowrance of Navico Group, a division of Brunswick Corp.

Compact Weather Stations

MaxiMet Marine GMX260 is the latest in the range of Gill MaxiMet compact, integrated, multi-parameter weather stations. Typical applications include: buoys, USVs,

helidecks and offshore wind farms. MaxiMet Marine has enhanced marine performance, including: environmental protection to IP68 and IP66 (water resistant, including temporary submersion); six-axis compass that compensates for tilt and provides pitch and roll data; and high-quality, solid-state sensors that provide reliable, accurate measurement with no moving parts. Gill Instruments Ltd.

High-Resolution LiDAR

Galaxy Edge airborne LiDAR delivers high-resolution data with straight and parallel scan lines and an acceleration in scan speed. It optimizes for wire detection and reduces atmospheric noise and processing labor. Galaxy Edge is compatible with fixed-wing, pressurized aircraft, drone and helicopter platforms. Real-time processing delivers point clouds for immediate use upon landing. Teledyne Geospatial.

EU Stage V Certified Engine

D16 is a marine engine and after-treatment system based on the Volvo Penta D16 IMO II. It features low fuel consumption and SO_x, NO_x, CO₂, and noise reduction in one unit, with a flexible layout. The engine can also operate on biomass-based hydrotreated vegetable oil, which offers even greater reductions in CO₂ emissions. Damen Sustainable Solutions. **ST**



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Bridge, Engine Simulators

Kongsberg Digital has a new simulator contract with Höegh Autoliners, a player in the transportation and logistics sector. The agreement involves the delivery of K-Sim Navigation and K-Sim Engine simulator models, specifically designed for training crew on Höegh's *Aurora*-class vessels.

The contract underscores the two companies' commitment to support sustainability and the energy transition in the maritime sector.

Höegh claims its new vessels will be the largest and most environmentally friendly pure car and truck carriers ever built and will set a new standard for more sustainable deep-sea transportation.

Kongsberg Digital will develop a customized bridge simulation model of the *Aurora* vessel, including a new engine simulator model for crew training in future sustainable and hybrid fuel types.

200-kW PEM Fuel Cell Testing

Blue World Technologies has successfully tested the world's first 200-kW high-temperature PEM fuel cell module. The test was completed at the newly established test facilities in connection to the Blue Aalborg Factory, where the fuel cells for the system are produced. The initial testing results have exceeded performance expectations.

With an electrical efficiency of up to 55 percent when reaching a commercial stage, the fuel cell system will typically provide a fuel savings of 20 to 30 percent. Additionally, the system allows for up to 100 percent carbon capture for utilization in green fuel production and storage.

Hybrid Fast Ferry in Sicily

The Italian shipping company Liberty Lines has launched a hybrid fast ferry in Trapani, Sicily, powered by an mtu hybrid propulsion system from Rolls-Royce. The 39.5-m-long ship has a capacity of 251 passengers, reaches a speed of over 30 kt. and will significantly reduce the

impact of ship operations on the environment. The *Vittorio Morace*, built by the Spanish shipyard Astilleros Armon, has been classified as a "Green Plus" ship by RINA.

The new member of the fleet, named after the founder of the shipping company, is the first of nine ferries that will operate between Sicily and the neighboring Aeolian and Egadi islands, as well as between the Italian mainland, Croatia and Slovenia.

The battery-electric part of the drive is used for local emission-free driving in the harbor area and as a booster. Carbon dioxide emissions are reduced by the mtu Series 4000 diesel engines, which can also run on the renewable diesel hydrotreated vegetable oil (HVO). Its use can lower the CO₂ footprint by up to 90 percent. Furthermore, the comparatively low overall weight of both the engines and the hybrid drive system contributes to high vessel propulsion efficiency, thereby reducing fuel consumption and emissions.

Digital Ship Inspection Report Program Goes Live

The Oil Companies International Marine Forum (OCIMF) has confirmed that its digitalized Ship Inspection Report Programme (SIRE 2.0) is scheduled to go live September 2, 2024 and become the standard tanker inspection tool for the marine industry.

The move to the digitalized inspection program means that every tanker inspection will be bespoke and tailored to the individual vessel and its risk profile and will require vessel operators and their crew to be prepared to respond to any potential inspection question from the SIRE 2.0 Question Library.

Using their intrinsically safe tablet devices, SIRE 2.0 inspectors will provide a response to each question in the inspection's Compiled Vessel Inspection Questionnaire (CVIQ) in relation to Hardware, Processes and Human Factors. This will provide program recipients with inspection reports that contain marine assur-

ance data, information and feedback with greater detail than the existing SIRE reports.

Dual-Fuel Engine Simulator

Wärtsilä has supplied its new dual-fuel engine simulator technology for Wavelink Maritime Institute (WMI), the maritime training arm of the Singapore Maritime Officer's Union (SMOU). The navigational and technological simulators are a central feature of the simulation suite at WMI.

Sustainable fuels will play an integral role in the maritime industry's goal of achieving net zero in shipping by 2050. An important part of this transition requires crew to be upskilled to handle these new and alternative fuels.

The Wärtsilä simulator technology is specifically designed to train seafarers in the latest efficiency concepts and prepare them for operating with the next generation of marine fuels. The dual-fuel simulators include a virtual reality element to replicate realistic scenarios with different fuels and engine types. They also incorporate cloud-based simulation combined with WMI's learning management system to provide blended learning experiences.

Collaboration to Utilize USV For Data as a Service

BMT is collaborating with Ocius to revolutionize maritime data collection and management. With the aim of deploying a fleet of 1,000 autonomous vessels globally within the next 10 years, BMT and Ocius seek to provide a persistent and networked system of remote sensors.

The goal is to develop and demonstrate the effectiveness of the Bluebottle USV for providing data as a service (DaaS). The companies will focus on codeveloping a commercial data collection and management model, initially targeting environmental monitoring for offshore wind development projects.

The Bluebottle USV offers sustained and persistent operations. Its novel propulsion system leverages renewable energy sources and supports long-term operations without physical intervention. **ST**

Propulsion, Power for Polish Navy Frigates

The mtu propulsion engines and four marine gensets for the propulsion and power supply of the first of three new *Miecznik* multipurpose frigates for the Polish Navy are currently being built at Rolls-Royce in Friedrichshafen, Germany. Four mtu 20V8000 main propulsion engines with 8,200 kW each and four mtu 12V4000 onboard generators with 1,650 kW mechanical power each will be installed per ship.

The four main propulsion engines of the CODAD propulsion system, two per propeller, can be used flexibly in different combinations: from single-engine operation for slow patrols to high-speed operation at over 20 kt. (37 km/h) with all four engines. At a cruising speed of 12 kt. (about 22 km/h), the *Miecznik*-class ships have a range of around 8,000 nautical mi. (almost 15,000 km).

The four mtu onboard power generators feed the electrical power grid for ship and mission operations independently of the propulsion engines.

The first ship of the *Miecznik* (swordfish) class is scheduled to launch in 2026 and be commissioned in 2030, with the other two ships to be delivered to the Polish Navy by 2031.

Resilient Autonomous Systems and Workforce Diversity Program

The U.S. Office of Naval Research (ONR) has awarded a \$7.9 million contract to Benedict College, a historically black college, and Integer Technologies to increase the cyber resilience of autonomous systems and enhance the workforce supporting the defense research enterprise.

There are two main components of the Resilient Autonomous Systems and Workforce Diversity program. One is research into automated cyber-physical security to improve the resilience of intelligent autonomous systems against cyberattacks. The other is enhancing the defense research capacity and STEM curriculum at Benedict College to support the development of a highly skilled, technical workforce trained to meet the specialized technology needs of the U.S. Department of Defense.

Funding from this contract will support the develop-

ment of a master's degree program in computer science and engineering at Benedict College.

German Navy Procures Two More Frigates

The German Navy will receive an additional procurement of two F126 frigates, a fifth and sixth vessel, from Damen Naval. The first frigate is due to be delivered in 2028. Ships five and six will be delivered in 2033 and 2034, respectively.

The construction of the two additional F126 frigates will also take place entirely in Germany. Work will begin in parallel at the German Naval Yards shipyard in Kiel and at the Blohm+Voss NVL site in Hamburg. The stern will be built at the Peene-Werft shipyard in Wolgast, while the foreship will be manufactured in Kiel and joined to the stern there. The vessels will then ship to Hamburg for final outfitting, commissioning and testing.

MCM Vessel Launch for Belgium

The *Tournai*, third of the 12 mine countermeasure vessels (MCM) in the Belgian-Dutch rMCM program, intended for the Belgian Navy, has launched. The launching was carried out by Kership, the program's industrial prime contractor, on behalf of Naval Group, the overall prime contractor. The *Tournai* will be delivered to Belgium in 2026.

Delivery of the MCM vessels is scheduled from summer 2025 to mid-2030, at a rate of two a year.

The rMCM program is led by Belgium Naval & Robotics, a consortium formed by Naval Group and Exail, and involves Kership (a joint venture between Piriou and Naval Group) as industrial prime contractor.

The first of the vessels, the *Oostende*, began sea trials in July 2024.

USCG Detects China Ships in Bering Sea

The U.S. Coast Guard (USCG) has encountered Chinese military ships in the Bering Sea this summer. The crew of the USCG Cutter *Kimball* detected three vessels about 124 mi. north of Amchitka Pass in the Aleutian Islands, and an HC-130J air crew from USCG Air Station Kodiak detected another vessel about 84 mi. north of Amukta Pass.

All four vessels were transiting in international waters but inside the U.S. Exclusive Economic Zone. **ST**



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First Unannounced Exercise for Offshore Wind

As the lead federal agency for the development of workplace safety and environmental compliance strategies for offshore conventional and renewable energy projects on the federal Outer Continental Shelf, the U.S. Bureau of Safety and Environmental Enforcement (BSEE) has conducted the first-ever government-initiated unannounced exercise (GIUE) of an offshore renewable energy facility. The GIUE at Vineyard Wind's Marine Coordination Center in New Bedford, Massachusetts, successfully evaluated Vineyard Wind's ability to activate an incident management team and carry out the procedures in its approved oil spill response plans.

"While there is no risk of a major blowout, offshore wind farms use significant amounts of oil and other fluids, so the ability to respond quickly to a spill is just as important as it is for oil and gas operations," said BSEE Director Kevin Sligh.

The exercise simulated a diesel spill from a 700-gallon-capacity fuel tank on a Vineyard Wind electrical service platform located about 18 mi. offshore. In the scenario, a fisherman pulling nets contacted the National Response Center after observing a sheen in the water. While there is no minimum volume that triggers the deployment of response equipment, federal regulations mandate reporting even a single drop of spilled oil.

BSEE, the U.S. Coast Guard, NOAA, Massachusetts Department of Environmental Protection, the Mashpee Wampanoag Tribe, the Wampanoag Tribe of Gay Head, and the Shinnecock Indian Nation participated in assessing Vineyard Wind's ability to make timely notifications to the National Response Center and BSEE. They also evaluated Vineyard Wind's ability to mobilize and organize staff to operate within a unified command, plan for the protection of the environment, develop recovery strategies, and establish effective communications.

The Vineyard Wind facility, which started delivering power in January 2024, is one of the nation's first commercial utility-scale offshore wind projects, and is capable of generating energy for more than 400,000 homes and businesses across Massachusetts while reducing carbon emissions by over 1.6 million tons per year.

US Strategy for Aquatic eDNA

The White House Office of Science, Technology, and Policy (OSTP) has released the National Strategy for Aquatic Environmental DNA. The Environmental DNA (eDNA) Task Team had 10 federal agencies participating in drafting the strategy and included significant scoping and engagement of the private sector, academia and nonprofit organizations.

"There is an urgent need for improved biological survey tools to meet the scale, scope and management/monitoring needs in the U.S., and eDNA is an exciting tool that has come of age and can meet the need," said

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Michael Weise of the U.S. Office of Naval Research (ONR), who serves as co-chair of the federal eDNA Task Team.

To properly monitor and support national aquatic biodiversity requires timely and trusted information. Through eDNA analysis, the simple act of collecting water can lead to critical insights into the nation's aquatic biodiversity, from microbes to whales—with a tool that is non-invasive and can be scaled to meet the demands of large-scale surveys. This powerful new technology is revolutionizing how we explore, measure and monitor biodiversity in ecosystems across the national and international landscape.

The National Aquatic eDNA Strategy lays out a plan to harness the power of eDNA to explore, map, monitor, and better understand aquatic life to sustain and restore biological resources now and in the future. The strategy is a call to action for federal agencies and nonfederal partners to build a national eDNA enterprise through coordinated and collaborative efforts that unite scientific inquiry, entrepreneurial enterprise, philanthropic endeavor, and public and private investment.

\$220 Million for Coastal Restoration, Resilience

NOAA Fisheries has recommended 32 new transformational habitat restoration and coastal resilience projects for funding under the Bipartisan Infrastructure Law and Inflation Reduction Act. Nearly \$220 million will facilitate projects that will have a transformative impact across the U.S. through capstone projects that build on decades of work in priority watersheds, innovative projects that implement cutting-edge restoration techniques, and groundbreaking efforts that restore habitat in urban ecosystems to benefit underserved communities. The projects will also help protect coastal communities and ecosystems from the impacts of climate change, and make significant strides in the recovery of threatened and endangered species.

Collaboration for Ocean Exploration

NOAA and the U.S. Defense POW/MIA Accounting Agency (DPAA) have signed a memorandum of understanding (MOU) to share data and scientific information and collaborate on ocean exploration work.

The five-year MOU outlines areas of collaboration to: undertake joint expeditions, personnel exchanges and engagements between personnel to share methods of operation related to missions; share data and scientific information resulting from research cruises, expeditions and campaigns; share relevant updates and meet at least annually to share objectives, plans, and needs; provide DPAA with access to subject matter experts, vessels and other equipment, mission results and technology expeditions, as well as shoreside facilities and programs throughout NOAA's ocean, weather, climate, and coastal science mission; provide NOAA and its sponsored scientists with access to vessels, technology, and other equipment for participation in expeditions; and advance the public understanding of both agencies' missions and the new partnership. **ST**

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The advertisement features a collage of images showing various offshore and subsea equipment, including a large oil rig, a smaller vessel, a submersible, and several types of battery systems (Energy Storage Systems, String Batteries, Subsea UPS) and vehicle batteries. The background is a deep blue ocean scene.

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environmental monitoring

USVs to Monitor UK Waters

A consortium of British marine technology companies has secured Innovate UK funding to deploy non-invasive USVs for water quality monitoring in three key southwest regional ports: Dartmouth, Falmouth and Plymouth. Led by MSeis, the Smart Ports, Clean Waters project partners aim to transform public understanding of water ecosystems in ports and harbors in the southwest England by providing broad-range, accessible data relating to pollution in the region's rivers and estuaries. MSeis will be supported by technical partners HydroSurv and Chelsea Technologies.

Water quality standards have become a pressing concern in the U.K. Under the Water Framework Directive, just 14 percent of U.K. rivers currently meet the criteria for "good ecological status." A sustainable water quality monitoring solution is needed to detect potential issues related to agricultural run-off, untreated sewage and hydrocarbon contamination.

The Smart Ports, Clean Waters end-to-end solution will see a specialist sensor payload from Chelsea Technologies integrated into MSeis' three battery-electric HydroSurv REAV-16 uncrewed vessels. The USVs will be controlled by onshore personnel to harvest a range of water quality and eutrophication data within inland waters on weekly deployments by MSeis from stations in Dartmouth, Falmouth and Plymouth, with the results widely accessible to regional stakeholders via a cloud-based, geospatial data viewing platform developed by HydroSurv.

The consortium is committed to serving public interest, operating independently from other public and private monitoring efforts, with the goal of providing accurate and unbiased information to the community. During the 12-month test and demonstration campaign, which will showcase the cloud-based visualization platform, other expected outputs include detailed week-

ly data sets per harbor, evaluation workshops involving the port partners and enhancement of integration and survey tactics knowledge.

On-Demand Ocean Bottom Node Project in Brazil

Sonardyne has announced the next phase of the pioneering On Demand Ocean Bottom Node (OD OBN) development project in Brazil. The project, which began in 2018, involves a collaboration between industry partners, including Shell Brasil Petróleo Ltda, Petrobras and SENAI CIMATEC, and is supported under the Research Development and Infrastructure funding clause of the Brazilian National Agency for Petroleum, Natural Gas and Biofuels (ANP). These nodes could lead to the next generation of geophysical monitoring systems in the offshore oil and gas industry.

Using Sonardyne's proprietary optical and acoustic communications technologies, and drawing on its extensive experience of seabed monitoring, OD OBN expects to provide a versatile, lower cost, more resilient solution for time-lapse seismic and subsidence monitoring of producing reservoirs with better data and the capacity to be placed on the ocean floor for up to five years without human intervention. The idea is that data from these nodes can be extracted using Sonardyne's through-water optical communications system to a nearby AUV, such as Flatfish, which was developed by Saipem and SENAI CIMATEC under another ANP-funded program sponsored by Shell and Petrobras. A pilot array of 600 prototype nodes is expected to be deployed toward the end of 2025 at a preselected field offshore Brazil.

Shell and Petrobras have been trialling OD OBN prototypes during conventional OBN seismic campaigns in over 2,000 m of water off the coast of Brazil.

Collaboration to Protect MPAs

Voyis has announced its latest venture: the OASIS project. Funded

by Canada's Ocean Supercluster's UK Collaborative Ocean Innovation Solutions program, in partnership with Innovate UK, this initiative aims to revolutionize marine environmental surveys through the collaboration of Canadian and U.K. ocean technology experts.

The OASIS Project, short for Over-horizon Awareness of Seafloor Imaging Surveys, addresses the pressing need for efficient and cost-effective monitoring solutions in the face of escalating demands for sustainable ocean resource management. With both Canadian and U.K. governments committed to defining marine protected areas (MPAs) and bolstering environmental regulations, the need for advanced monitoring technologies has never been more urgent.

The project consortium comprises Voyis, the University of Southampton, AutoNaut and the National Oceanography Center (NOC). In partnership with the University of Southampton, Voyis will enhance its imaging products with onboard machine learning and remote survey awareness capabilities, to be integrated into the NOC's Autosub AUV, enabling remote over-the-horizon seafloor image surveys via the AutoNaut wave-powered USV.

By harnessing the power of long-duration AUVs and advanced imaging sensors with data automation technologies, the project seeks to reduce costs, minimize environmental impact and enhance survey scalability.

Seabed 2030 Progress Report

The Nippon Foundation-GECO Seabed 2030 Project, a flagship program of the UN Ocean Decade, has reported that 26.1 percent of the global ocean floor has been mapped so far, marking an increase of 4.34 million km² of new data, equal to an area the size of the European Union.

In the past year alone, this ocean research project has led to the characterization of the largest known deep-sea coral reef habitat off the southeast U.S. coast, spanning more than 6.4 million acres on the Blake Plateau. **ST**

offshore oil & ocean engineering

Microbubble Tech Reduces Oil in Water

Adaptive Process Solutions (APS), a produced water treatment specialist, has completed a successful field trial of its new Microbubble Infusion Unit (MiFU) technology, achieving a near five-fold reduction in oil in water (OiW) levels in combination with a synergistic production chemical. The full-scale trial was conducted aboard an FPSO in the North Sea over a six-month period and involved a retrofittable add-on to existing water treatment systems.

APS developed MiFU to address the industry-wide issue faced by operators to efficiently and effectively clean produced water so that it meets strict regulatory standards before discharge back into the sea.

The North Sea is a mature oil and gas province and the industry discharges millions of tons of water there each year. The existing separation systems were designed to process smaller volumes of produced water, resulting in a bottleneck that slows production.

MiFU boosts overall environmental performance and productivity by using infused microbubbles that attach to very minute particles of oil and fine solids in the produced water, which can then be easily removed by the asset's existing separator process. MiFU's patented multi-pass process directly injects size and quantity-controlled gas microbubbles into target points in a contaminated water stream.

MiFU can process 1,000 to 100,000 barrels of water a day, reducing up to 90 percent of oil and contaminants and eliminating the requirement for further costly downstream filtration and material management.

APS is beginning construction of a second MiFU rental skid.

Vessel Monitoring in Guyana

Viridien, formerly CGG, has announced that its Sensing & Monitoring business line, marketed under the Sercel brand, has made a sale

of its Marlin vessel monitoring and alert system to ExxonMobil Guyana Ltd. to support its offshore operations in Guyana.

As part of the wider Sercel Marlin software suite for optimizing offshore operations, Marlin is designed to protect FPSOs and other high-value assets against a wide range of marine risks, even in the most challenging environments. The solution's real-time monitoring and proactive intelligence capabilities deliver comprehensive insights into vessel movements, operational parameters, and potential risks, enabling operators to make more informed decisions and enhance operational safety.

Offshore Charging Concept

Damen Shipyards Group has developed a new concept for offshore charging that will dramatically reduce emissions during the operational phase of an offshore wind farm. The system envisages a fully electric crew transfer vessel (CTV) that can charge at either a turbine or one of Damen's commissioning service operations vessels (CSOVs) outfitted with a charger.

With the infrastructure for turbine-mounted chargers not yet widely available, vessel-to-vessel charging offers CTV owners and operators an opportunity to invest in the sustainable technology of the future, right now.

Damen's unique position as builders of both CTVs and CSOVs led to the idea of placing the charging scope within its assets. This can be done with both a conventional, diesel-powered CSOV or with a fully electric version. Such a solution makes it possible for CTV operators to invest today, in preparation for the wider distribution of fully electric CSOVs tomorrow. Installing a large battery system on board a CTV is a challenge, given the weight and space restrictions. Installing the system to the much larger, less space sensitive CSOV gives the smaller vessel access to the energy it requires without com-

promising on capabilities. Using the CSOV as a charger host offers further advantages. For one, the stern of the vessel is lower than a turbine, which provides the vessel with easier access to the charger. Additionally, unlike the turbine, the CSOV is able to change its position, enabling the CTV to charge in the most sheltered position with regard to wave conditions.

The charging system that Damen has applied to its concept is developed by U.K.-based MJR, a specialist in offshore charging systems.

The CTV would connect via a bell mouth that catches the charger that is lowered from a reel on the aft deck of the CSOV. Following personnel disembarkation, the vessel could connect using a highly automated, safe process. It is expected that charging could take place in 2 to 3 hr., depending on the operational profile.

Development of CO₂ Transport Infrastructure in France

Equinor and main French gas transmission operator GRTgaz have signed a project development agreement for captured CO₂ from industrial emitters in France to safe and permanent storage offshore Norway via the planned CO₂ Highway Europe pipeline project.

The development will comprise a network of onshore CO₂ pipelines, to be developed by GRTgaz, which will connect France's Dunkirk industrial area to Equinor's CO₂ Highway Europe, a large-scale CO₂ pipeline being planned by Equinor that will also connect Zeebrugge, Belgium, to a portfolio of storage sites under the seabed offshore Norway.

The project aims to help decarbonize the Dunkirk industrial area, which accounts for 20 percent of France's industrial CO₂ emissions.

GRTgaz will develop a 30 km onshore pipeline network in Dunkirk, a compressor station in Dunkirk sending the CO₂ into the offshore pipeline connecting to the CO₂ Highway Europe. Initial capacity will be 3 to 5.5 million tonnes of CO₂ per year and can be expanded to include CO₂ captured at other industrial clusters in France. **ST**

contracts

Lloyd's Register, London, U.K., will jointly assess the feasibility of a green hydrogen (H₂) infrastructure project in the U.K., including floating production and transport of H₂ and identification of regulatory requirements for the development of an offshore island and supply chain that will provide green power to businesses on the Thames Estuary and River. H2Terminals Ltd., HIDROGEN and D3IM.

Saab AB, Linköping, Sweden, has sold a Seaeye Cougar-XTi ROV intended for daily offshore inspection services. The ROV will enable the buyer to bid on tenders that were previously inaccessible due to payload constraints, particularly in the offshore wind sector. HBC Group.

Strategic Marine, Singapore, will deliver an additional pair of newly built 27-m crew transfer vessels (CTVs), expanding the buyer's fleet from five to seven. The CTVs will enable expansion of the buyer's offshore renewables business in France and beyond in Europe. Louis Dreyfus Armateurs.

Spire Global Inc., Vienna, Virginia, has been awarded a \$1.41 million CA contract to provide global AIS ship tracking data for various government agencies and departments, including the Canadian Space Agency, the Department of National Defense, Transport Canada, and the Canadian Coast Guard. Government of Canada.

Damen Shipyards, Gorinchem, Netherlands, has secured the contract to build a sixth commissioning service operation vessel (CSOV) for an offshore personnel transfer provider, thus completing the six-ship "Elevation Series" of future-proof CSOVs. Windcat.

Wärtsilä, Helsinki, Finland, will supply a fully integrated mechanical drive propulsion package for new 6,000-dwt LNG-fueled tankers being built for a British fleet opera-

tor. The package includes the 25DF dual-fuel main engine. James Fisher Everard Ltd.

ABB, Zürich, Switzerland, has been awarded a contract to serve as the propulsion single-source vendor for new hybrid electric 160-auto ferries. ABB will play a pivotal role in the development and delivery of the five newbuild vessels. Washington State Ferries.

ClassNK, Tokyo, Japan, has signed a memorandum of understanding to jointly study the design and safety specifications of ammonia-fueled ships. ITOCHU Corp., Nihon Shipyard Co. Ltd., and Maritime and Port Authority of Singapore. **ST**

meetings

OCTOBER

October 2-3—Sustainable Marine Fuel Fest, Porto, Portugal. <https://ship.energy/events/smf-fest-2024>.

October 7-10—Marine Imaging Workshop, Monterey, California. <https://miw2024.org>.

October 9-10—Water, Wastewater and Environmental Monitoring (WWEM), Birmingham, U.K. www.ilmexhibitions.com/wwem.

October 9-11—NOIA Fall Meeting, Colorado Springs, Colorado. www.noia.org/event/2024-noia-fall-meeting.

October 9-11—WISTA International AGM and Conference, Limassol, Cyprus. <https://wistainternational.com/event/wista-international-agm-and-conference-2024>.

October 21-22—Blue Future Conference, Plymouth, Massachusetts. www.plymouth-ma.biz/conference-2024.

October 27-30—AAPA Annual Convention, Boston, Massachusetts. <https://aapa.getregistered.net/2024-annual-convention-and-expo>.

NOVEMBER

November 4-7—EURONAVAL, Paris-Nord Villepinte, France. www.euronaval.fr.

November 5-7—Deepwater Operations and Topsides, Platforms & Hulls Conference and Exhibition, Galveston, Texas. offshore-event.com.

November 7-10—Europort, Rotterdam, Netherlands. www.europort.nl.

November 12-14—International WorkBoat Show, New Orleans, Louisiana. www.workboatshow.com.

November 18-20—CLEAN GULF, Houston, Texas. www.cleangulf.org.

November 18-21—BlueTech Week, San Diego, California. bluetechweek.org.

November 19-21—Marine Renewables Canada Conference, Halifax, Canada. <https://marinerenewables.conference.ca>.

November 19-21—MAST Australia, Adelaide, Australia. Mastconfex.org.

November 20-21—Decarbonisation in Shipping Europe, Hamburg, Germany. www.wplgroup.com/aci/event/decarbonisation-shipping-europe.

November 26-27—Offshore Energy, Amsterdam, Netherlands. www.offshore-energy.biz.

2025

JANUARY

January 15-17—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

APRIL

April 8-10—Interspill, London, U.K. www.interspill.org.

For more industry meetings, visit sea-technology.com/meetings. **ST**

Marcos Salido is the environmental project manager for strategy and advanced services at Bureau Veritas Marine & Offshore (BV). He is the lead author of the report “Onboard Carbon Capture: An Overview of Technologies to Capture CO₂ Onboard Ships.” This is the second report to be issued by BV’s Future Shipping Team initiative: <https://marine-offshore.bureauveritas.com/newsroom/onboard-carbon-capture>.



In the global fight against climate change, the maritime industry is increasingly focusing on the potential for carbon capture and storage (CCS) technologies to reduce greenhouse gas (GHG) emissions. Bureau Veritas Marine & Offshore (BV), in a new report, highlights these developments, emphasizing how carbon capture can play a key role in shipping’s decarbonization journey.

According to the International Maritime Organization (IMO), shipping emissions could increase by 50 to 250 percent by 2050 if left unchecked. Effective strategies are urgently needed to reduce the carbon footprint of the existing fleet. This will involve a range of solutions, from energy-saving devices to voyage optimization. While alternative fuels are yet to be available at scale, the potential of carbon capture needs to be understood.

Recent studies have shown promising results on the potential of carbon capture technology to reduce emissions from commercial ships, with achievable capture rates reaching 82 to 90 percent. For instance, a research project undertaken by BV and Wah Kwong has confirmed the technical viability of integrating a CCS system on two in-service bulk carriers. While those results are encouraging, carbon capture technology also presents challenges. Technologies that are available to capture CO₂ include

pre-combustion methods that remove the carbon molecules from fossil fuels before they are burnt, and post-combustion methods that remove it from the exhaust gases after the fuel has been burnt. Even within the range of post-combustion technologies, there are major differences between systems, depending on the means used to remove CO₂ from the exhaust gases, whether this involves solvents, sorbents, membranes or cryogenics.

Post-combustion carbon capture, using amine-based solvents, is the most mature and extensively studied method for maritime applications. It offers a retrofit option for existing vessels, promising over 90 percent capture efficiency in ideal scenarios. However, the energy-intensive nature of this process, especially the regeneration of solvents, can significantly increase the vessel’s overall fuel consumption, depending on the desired capture rate.

For example, a 2022 study by the Maersk Mc-Kinney Moller Center for Zero Carbon Shipping showed that while the maximum achievable capture rate was considered to be 82 percent, actual CO₂ savings were lower when considering the rise in fuel consumption—up to 45 percent—caused by the CCS system itself.

Additional challenges are linked to the physical footprint of CCS equipment on ships, which may reduce cargo space, as well as the handling of liquid CO₂ and solvents, which will degrade over time.

While the safe integration of carbon capture is addressed by BV rules, challenges remain concerning the readiness of infrastructure to offload the captured carbon in ports. Constructing comprehensive CCS infrastructure is crucial, particularly the facilities to offload the captured CO₂ from ships, which are often the missing link to ensure seamless transport of the captured CO₂ to storage sites or utilization hubs. In

short, we need to ensure that ships are connected to the broader CO₂ value chain.

Another focal point is the way CO₂ will be incorporated into the overall IMO regulatory framework. While carbon capture has been considered during the development of the Life Cycle Assessment (LCA) guidelines, it is still missing in other important regulations. In this regard, a correspondence group has been created to develop a work plan on the development of a regulatory framework for onboard carbon capture systems.

From a CCUS value chain perspective, shipping has the potential to play a significant role in its development, particularly given the growing interest in offshore storage sites. About 230 million metric tonnes of CO₂ are already used every year in industrial applications, such as fertilizer, steel, and food and beverage production.

The successful integration of CCS technologies on board ships will require a collaborative approach that blends technological innovation with robust international cooperation and regulatory support. Moreover, investing in the education and training of the maritime workforce is crucial to ensure proficient management of CCS technologies.

Pilot projects and collaborative initiatives between shipping companies, technology providers, and regulatory bodies will be crucial to the success of onboard carbon capture by serving as critical testing grounds. The data will shape more effective regulatory frameworks and facilitate technological scalability.

CCS is a vital tool in the decarbonization toolkit, but it is not a silver bullet and must be used in conjunction with other decarbonization measures. By developing technological advancements and a coherent regulatory framework, the maritime industry will be well positioned in the journey to net zero. **ST**

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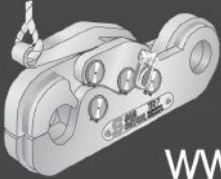
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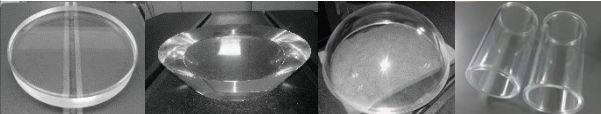
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