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Floating Production

Riding the Bull Run

Green Rigs Insights
Erik Rønsberg, CEO, Stena Drilling

Carbon Capture
Digitalization Draws a New Learning Curve

Floating Wind
Gazelle Powers Ahead

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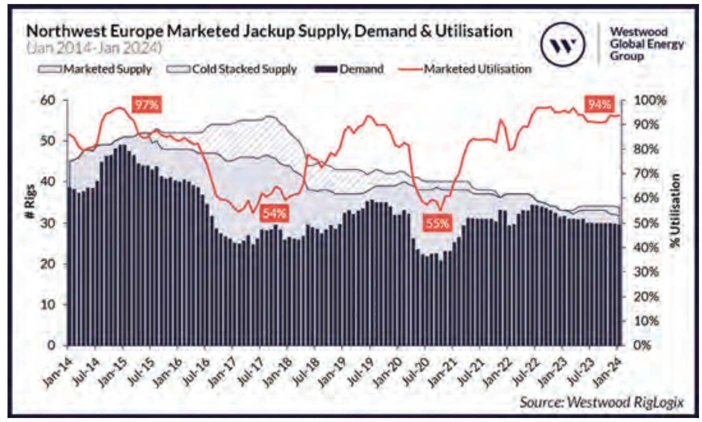
DEPARTMENTS



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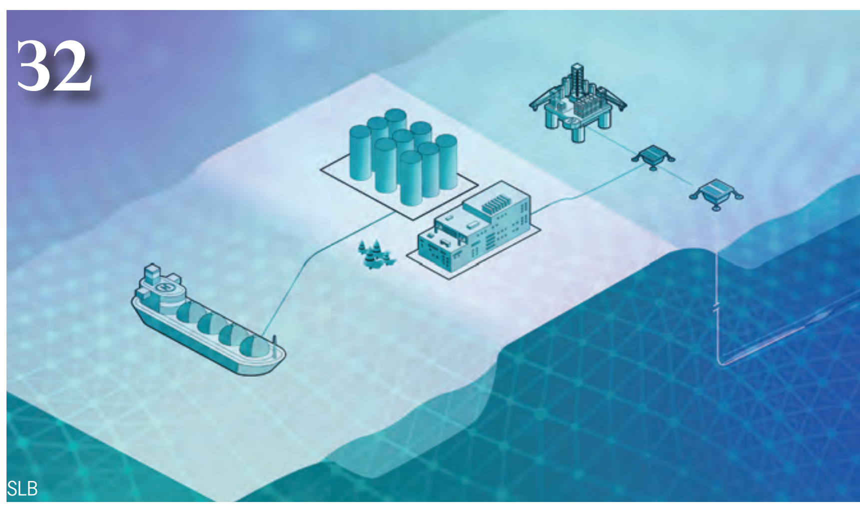

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Stena Drilling

FLOATING'S FUTURE

Welcome to 2024 and the continued geopolitical quagmire that will define the year. And while there are as many questions as answers, one thing that seems a lock is the continued bull run of the Floating Production sector.

According to the latest deepwater floating production forecast from Intelatus, floating production activity in the oil & gas sector is set to grow at an average 25 floaters per year through 2030, and the foundations are in place for continued activity through the next decade.

There will be more than 260 floating production systems installed globally by the end of 2023. ***More than 185 new floaters will be installed by the end of 2030, of which 70% will be FPSOs, close to 20% FLNGs and floating production units without storage (semi-subs, TLPs and spars) over 10%.***

While niche, the floating production projects are mammoth, capital-intensive engineering endeavors. While hot, the sector faces plenty of headwinds, from a dearth of qualified contractors and shipyards to bid and take the projects to completion; the continued supply chain spasms that have all industries looking for a 'plan b'; and last, but certainly not least, the difficulty and expense of financing these multi-billion dollar endeavors in today's high interest rate environment.

Another challenge, though admittedly one further down the line, centers on the emerging floating offshore wind sector, as this emerging technology and industry will share many of the same resources, technologies and techniques as the traditional floater sector. Earlier this month I was in Houston for Floating Wind Solutions 2024, as small but well-attended conference and exposition that brought in high-level executive from across the offshore energy and maritime markets. Though this was my first Floating Wind Solutions event, I've already made plans to put the 2025 event on my calendar.

Looking more broadly, this month **Wendy Laursen** takes a deep dive into Carbon Capture and Storage technologies, an area of keen interest to offshore operators today in the continued push to manage and reduce the carbon footprint of offshore oil and gas operations. In this edition, Laursen looks specifically at Digital solutions that are accelerating the progress required to ensure CCS earns its place in climate change mitigation history.

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Check out the 2024 Media Kit via the QR Code Below

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OE WRITERS


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Gammack


Garanovic


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David Cole is a seasoned energy professional with 30+ years of experience in manufacturing, oil and gas, and renewables. With a passion for innovation, team building, and digital technologies, he strives to create sustainable solutions across diverse energy sectors.

Kathleen Gammack is Senior Rig Analyst at Westwood Global Energy. Kath joined Westwood Global Energy in 2020 as a Rig Market Analyst. As part of the RigLogix team, she is responsible for tracking the offshore rig market, predominantly the European region. For the 18 years prior to this role, she worked for Diamond Offshore and ended her career there as the Contracts Manager responsible for tendering and negotiating drilling contracts.

Amir Garanović is managing editor of ***Offshore Engineer***. He has covered offshore energy and maritime industry since 2014, with a special focus on renewable energy sector and emerging clean energy technologies.

Wendy Laursen has 20 years of experience as a journalist. In that time, she has written news and features for a range of maritime, engineering and science publications. She has completed a Master of Science research degree in marine ecology as well as diplomas in journalism, communication and subediting.

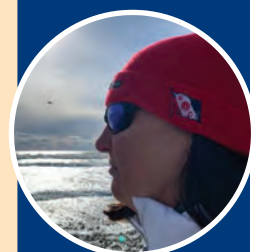
Philip Lewis is Director Research at Intelatus Global Partners. He has extensive market analysis and strategic planning experience in the global energy, maritime and offshore oil and gas sectors. Intelatus Global Partners has been formed from the merger of International Maritime Associates and World Energy Reports.

Rhonda J. Moniz is a highly accomplished and renowned underwater forensics expert specializing in diving technologies and subsea systems. She has more than 25 years of experience as a remotely operated vehicle pilot, master dive instructor, scientific diver, and dive safety officer. She is the president of the board of directors for the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS). She is on the U. S. Integrated Ocean Observing System (IOOS) board of directors.

Barry Parker of bdp1 Consulting Ltd provides strategic and tactical support, including analytics and communications, to businesses across the maritime spectrum. He is a freelance writer and regular contributor to this magazine.

Michelle Yeo is a Market Analyst at Fearnley Offshore Supply, covering the offshore support vessel market, including both O&G and renewables.


Lewis


Moniz


Parker


Yeo

Supporting Innovations in Offshore Wind

Global installed offshore wind capacity is forecast to reach nearly 450 gigawatts (GW) by 2032, up significantly from roughly 65 GW today . While the industry's growth is promising given the urgent need to decarbonize the world's energy system, offshore wind developments still face headwinds, including high engineering and construction costs, difficult market conditions and regulatory hurdles. These challenges, and others, are spurring rapid innovation across the industry, as operators seek to reduce costs, mitigate risks and improve sustainability.

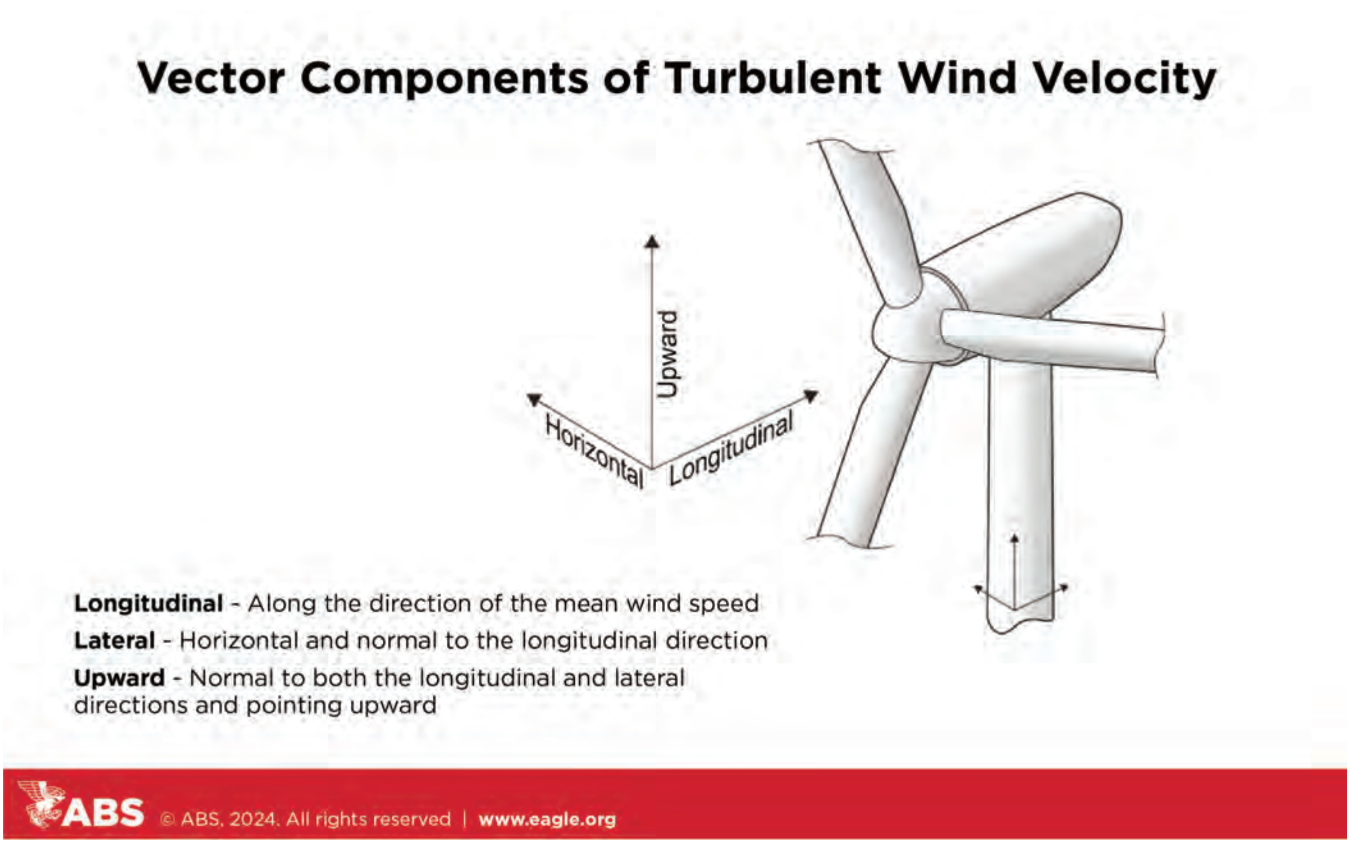
Identifying and mitigating risks in offshore wind projects

In recent years, the industry has seen the development of several new fixed and floating concepts that promise to lower the levelized cost of energy (LCoE) and improve manufacturing economies of scale. However, progress on commercial-scale developments has been slower than expected.

Given the long duration from concept design to final installation of wind technologies, along with the complexities associated with manufacturing, installation, regulatory approval, etc., working with an independent third party to perform comprehensive design reviews and certification, verification related services is often highly beneficial.

ABS has classed 80 megawatts (MW) of floating wind installations and delivers advisory and technical review solutions that help minimize risk and enhance safety for offshore projects. Recently, we updated our *"Guide for Building and Classing Floating Offshore Wind Turbines."* The document incorporates revisions in several key areas, including corrosion protection, intact and damage stability, mooring strength, as well as automatic and remote-control systems.

We also support wind projects by providing Preliminary Planning and Advice (PPA), workshops/HAZOPs, approval in principle (AIP), and new technology qualification (NTQ). These services enable wind technology providers to better identify and mitigate issues and risks that could potentially lead to cost overruns or delays during design, permitting, manufacturing, installation, or commissioning. The services also help to expedite certification. By certifying concepts, providers can establish credibility and instill confidence in their technology among key project stakeholders, including developers, finance/insurance institutions and the relevant authorities.



The ABS *Guide For Building and Classing Floating Offshore Wind Turbines* includes analysis on environmental conditions such as steady and dynamic wind forces exerted on exposed components of a floating support structure.

Classing wind farm support vessels

ABS classification services also extend to a range of offshore wind farm support vessels, including wind turbine installation vessels (WTIVs), service operation vessels (SOVs), cable laying vessels (CLVs) and crew transfer vessels (CTVs).

In January, we published updates for *"Requirements for Building and Classing Offshore Wind Farm Support Vessels."* The new edition incorporates:

- A reduction factor for superstructure and deckhouse pressures for external bulkheads on limited-service craft based on vessel type;
- Requirements for window bonding and testing for bonded windows;
- Requirements for testing for laminated windows;
- Optional Ⓔ for Wind-SC(A) vessels; and
- A new Section 11 to consolidate all wind farm vessel survey requirements

Keeping pace with industry developments

Both the Offshore Floating Wind Turbine and Wind Farm Support Vessel guides were updated in response to feedback received from multiple 2023 workshops held by ABS. The documents incorporate input from a wide range of stakeholders. ABS will continue to advance our Rules and Guides to meet the evolving needs of the industry and support developers, operators, and original equipment manufacturers (OEMs) as they seek to reduce costs, improve safety, and mitigate execution risk challenges in the most safe, sustainable and efficient ways.

With Utilization Peak Reached in 2023, North Sea Jack-Ups Set for Flat 2024?

Global jack-up marketed utilization has been on an upward trajectory since 2017, reaching its peak of 94% at the end of 2023. However, the outlook for the year ahead looks somewhat flat, though there is still time for new demand.

By Kathleen Gammack, Senior Rig Market Analyst, Westwood Global Energy

The North Sea jack-up market has improved year-on-year since 2017, except for a blip in 2020 when the pandemic kicked in. However, booming demand isn't the main driver behind this but instead a shrinking fleet.

According to RigLogix data, North Sea committed utilization of the marketed fleet was at a low of 54% in February 2017, which was represented by a supply of 46 units with only 25 units committed.

Committed utilization steadily increased to 89% for the full year of 2019, however plunged 23% during the pandemic, with 25 units committed of a total 40 supply units, reaching a trough of 66% on average for 2020, with the lowest point of 55% marked during October of that year.

By year-end 2023, utilization hit 93%, represented by 30 committed rigs out of a marketed supply of 32 units.

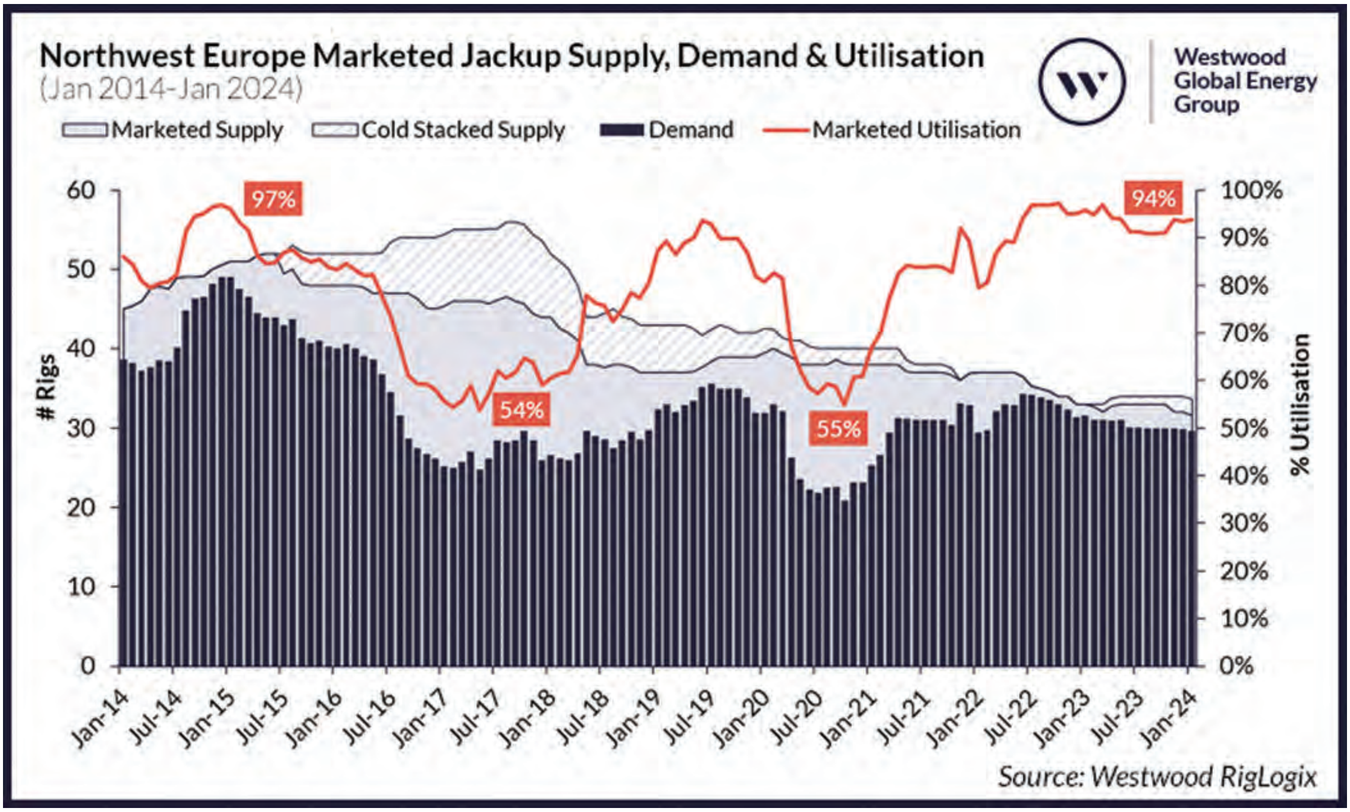
Shrinking Supply Follows Lower Demand

Between January 2018 and October 2021, a total of 18 units left the fleet and were either sold for non-drilling purposes, converted to Mobile Offshore Production Units (MOPUs) or scrapped.

Additionally, during December 2021, Noble Highlander became idle. In July 2022, Borr Drilling's Ran relocated to Mexican waters, and in February 2023 Valaris took the decision to preservation stack Valaris Viking 'due to ongoing weakness and uncertainty being seen in North Sea jack-up market over the next year'.

Between the last quarter of 2023 and the time of writing, five units completed offshore campaigns.

All of these units have future work in place, however, two have or will leave the region in the first quarter of 2024 – the Shelf Drilling Perseverance (Vietnam) and Valaris 247 (Australia).



During 2017, there was a total of 16,700 days of contract backlog awarded, with the lion's share coming from Norway (10,816 days), followed by the UK (5,407 days) and only 477 days of work awarded in the Netherlands.

Contract backlog plummeted in 2020 to a mere 2,737 days awarded in total, however a strong recovery in 2021 saw awarded backlog more than triple to 9,424 days.

Fast forward to 2023 and this figure again declined to only 4,927 awarded days, with the UK sector awarding the largest proportion (3,807 days) and Norway awarding the least (303 days).

North Sea drilling activity has mimicked the peaks and troughs of the offshore industry over the past decade but has been in decline since the first quarter of 2015 by 50% to 60%.

Meanwhile, plug and abandonment work has increased, which helped to cover some of the shortfall in new drilling activity.

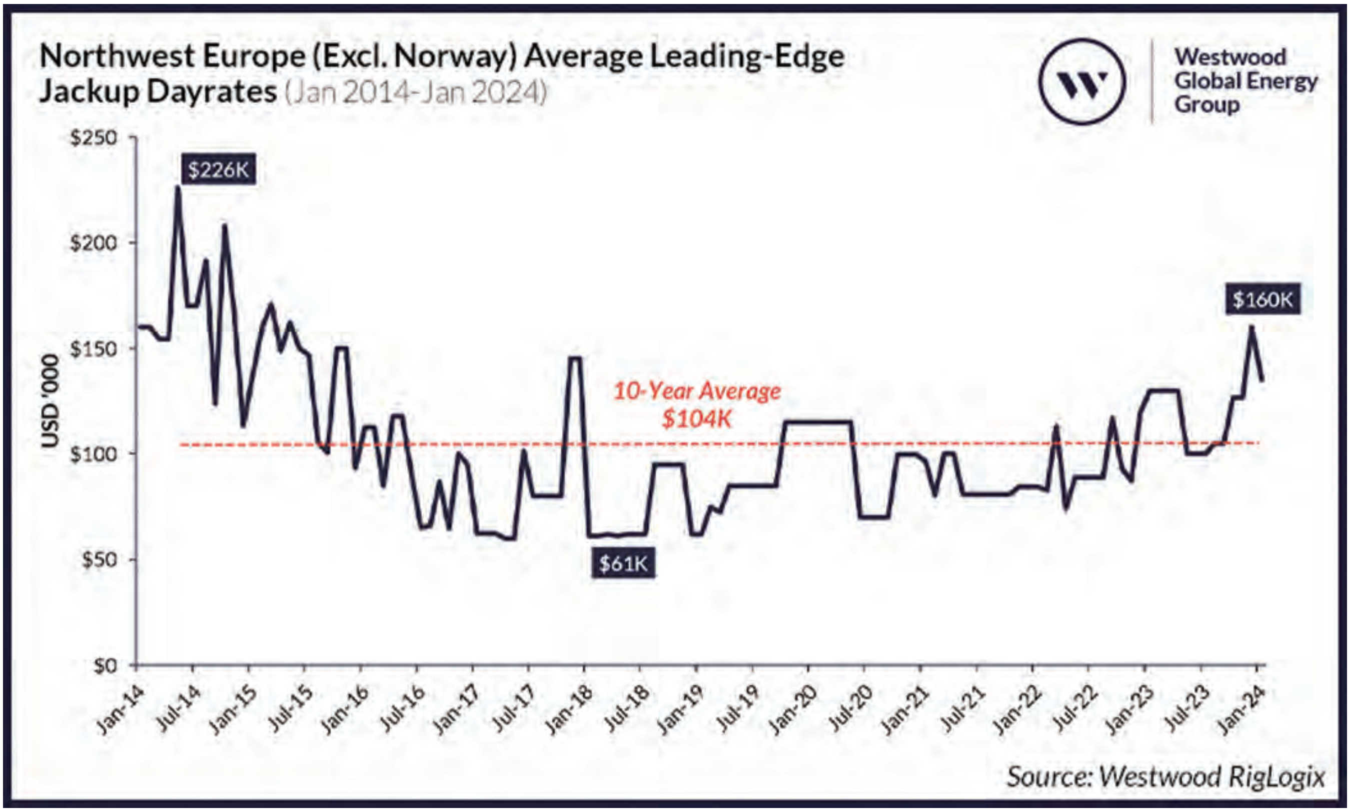
Dayrates Moving North, But More Lucrative Deals Lurk Elsewhere

Dayrates replicate where the market is in the cycle. When it comes to the North Sea, rates have been lagging behind some other regions.

Due to this and other contributing factors, including challenging tax regimes, the lack of certainty in the North Sea has driven drilling contractors to bid into regions offering longer duration programs, often with higher dayrates.

Westwood estimates that there are eight tenders yet to be awarded for work set to commence during 2024, totaling some 1,178 days.

Market sources suggest that three or possibly four campaigns, such as Shell's UK Southern North Sea two-well



program for exploration and appraisal drilling (targeting the Selene and Pensacola prospects), along with ONE-Dyas' two-well development drilling program offshore the Netherlands, are close to being awarded.

Meanwhile, one campaign is now being pushed into 2025 with the potential for two more to also be deferred.

There is only one unit that has free and clear availability from late first quarter 2024. However, the unit is allegedly a frontrunner for one of the outstanding 2024 requirements. Should extension declarations not materialize, or no new work get secured, a further seven units could become available but, for the most part, not until the second half of 2024.

RigLogix records one tender for work in 2025 (yet-to-be-awarded) and a total of 16 prospects that could equate to just shy of 12 rig years.

Demand covers all types of activity: exploration (135 days), appraisal (225 days), development drilling (2,147 days), CCS (140 days) and P&A (1,699 days).

A Flat Near-Term Outlook in 2024

North Sea jack-up utilization is showing strength once again, however this is largely due to supply leaving the market rather than a recovery in demand. The outlook for the year ahead looks somewhat flat but there is still time for new demand with a 2024 start date to come to the fore.

Drilling contractors, though keen to keep their harsh-environment units in the region, will undoubtedly be considering moving more rigs elsewhere if the contract term and economics make sense to do so.

However, if further rigs leave for multi-year campaigns elsewhere there may not be enough capacity to fulfil some of the longer-term CCS and P&A campaigns, which could come to fruition from 2025 onwards.

Subsequently, the tightened supply and demand balance could result in a smaller pool of rigs to choose from and higher dayrates that could result in some of these campaigns becoming uneconomical.

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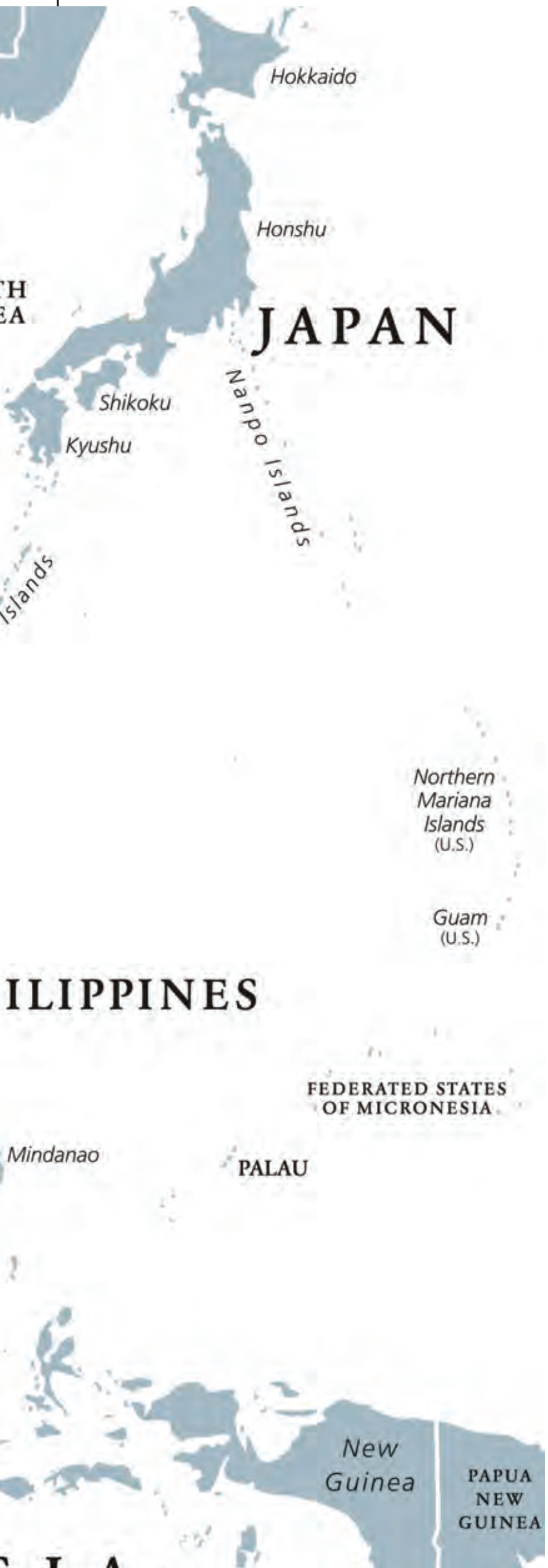
THE APAC OFFSHORE MARKET:

Riding the Wave of Success into 2024 and Beyond

By Michelle Yeo, Market Analyst, Fearnley Offshore Supply



2023 was the first year of real recovery for owners in the offshore supply market and yet we have barely skimmed the surface of what's to come. The market is still on an upward trajectory with charter rates accelerating month-by-month, availability changing day-by-day, leading to earnings doubling and, in some segments, tripling since the lows of 2020. Current rates will remind many of the glory days of pre-2014 with the demand for OSVs projected to remain elevated for years to come.

In general, offshore deepwater economics have improved and the increasing pace of FID announcements indicates confidence in the market upcycle, with exploration sentiments also rising alongside the uptick in drilling activities. For the APAC region, Rystad Energy expects E&P vessel spending to grow by 17% this year, towards $2.2 billion. In Australia, this figure is set to surge by 62% to $184 million. This wider trend is in alignment with the strategy plans announced by the various NOCs in the region, as new projects offer strong economic fundamentals. Petronas and ONGC have declared their continued focus on domestic exploration, while PTTEP has allocated $6.7 billion for E&P activities in 2024.

Demand for OSVs

The APAC region is poised to see an increase in activities this year. Current market developments suggest that OSV demand in Asia will peak in 2026, recording overall demand of more than 600 vessel years. Currently, Asia's active OSV fleet stands slightly above 500, with vessels increasingly tied to long-term contracts, further limiting availability. The lack of new supply influx also spells good news for owners, albeit an increasingly older age profile of existing vessels finds themselves in high demand, with Charterers scrambling to secure vessel days in advance. As opposed to the period from 2015 onwards, early commitment from charterers is now key to securing the correct tonnage.

In 2023, we witnessed a flurry of significant S&P transactions, hinting at a very busy second-hand market on the horizon where sellers have the upper hand. Demand from other regions such as the Middle East is also seeing an upswing, leading to strong S&P interest across the high-end APAC fleet.

Turning our focus to specific regions, Australia is poised to become a significant market for decommissioning, with projections from the Center of Decommissioning Australia estimating a value of $40 billion for upcoming work, particularly in the Bass Strait region. Moreover, in Southeast Asia, numerous offshore wells are nearing the end of their production life, with projections indicating a considerable number will cease operation by 2030. This trend is mirrored in the Brunei market, where plans are underway to decommission 60 platforms between 2026 and 2032.

In Malaysia, Petronas reported 19 exploration discoveries last year, totalling more than 1 billion barrels of oil equivalent (boe). This series of successful discoveries highlights the untapped potential in Malaysia. With Petronas remaining committed to E&P investments in the region, Malaysia is expected to remain one of the largest markets for support vessels in the coming years. From decommissioning projects to new oil discoveries, there is no shortage of opportunities in APAC.

Asia Offshore Wind Taking Off?

While commercial-scale projects have been slow to take shape in Asia, we are gradually transitioning from demonstration and pilot projects to large-scale commercial projects. Turbine sizes are expected to double from 8 MW today to 15 MW towards the end of the decade. We are also seeing interest from developers within the floating wind segment, which tends to see projects moving further away from shore. Notable projects on the horizon include the Holim 1.5GW project in Korea, Formosa 5 1.5GW and Winds of September 1GW project in Taiwan, as well as the Wakayama 1GW project in Japan.

According to forecasts by Rystad Energy, offshore wind installation spending in Asia (excl. China) is set to grow by 115% this year, recording $1.1 billion. With Asia contributing a high share of the global installation activity in the coming years, expecting to reach close to 60% of overall turbine additions from 2024 to 2028, this would mean traditional offshore vessels see demand and competition for work in both the O&G as well as the renewable sector.

From Taiwan to Japan, Korea, and Vietnam, these new frontiers all have ambitious offshore wind targets towards the end of the decade, driving demand for installation as well as support vessels. Moreover, following the recent announcement of the proposed expansion of its territorial waters in the larger economic zone (EEZ), Japan is expected to see a rise in its floating offshore wind presence, particularly in the deeper waters of the EEZ. Australia is another promising offshore wind player, with an estimated 200 turbines planned for installation by the end of the decade. All these developments would mean higher demand for installation vessels such as the cable lay vessels and service operation vessels, which we have already seen being translated into newbuild orders in recent years.

What about newbuilding prospects?

OSV newbuilding is now at a record low after years of challenging market conditions, while the fleet is now moving towards to healthy market balance in favor of owners. Furthermore, of the working OSV fleet, around 15% are above the age of 20, indicating that the supply of working vessels will be further reduced in the coming years. Furthermore, when we look at the present tonnage in the market, we are recording an all-time high number of working vessels, with limited potential for fleet renewals in the coming two years. As of early 2024, charter rates are increasing at a healthy pace, and we are nearing levels where newbuilds could be justified financially.

We are seeing some interest as owners are again approaching yards to price new tonnage on the basis of securing long-term charters. However, there are several impeding factors when we speak about newbuilds. Firstly, yards are currently occupied with limited slot capacity to handle offshore newbuilds. The priorities of the yards have also shifted from what was observed a decade ago. There are currently less than a handful of yards focusing on the OSV segment as traditional builders have either changed their market focus or gone completely out of business.

The remaining ones are occupied with a heavy workload from the conventional shipping fleet orders, with many of the leading APAC yards claiming full orderbooks towards 2026. Newbuilding prices have climbed steeply in the past couple of years, making it more profitable for yards to focus on the larger commercial shipping segments. Yet, newbuilding prices are expected to remain firm with strong backlogs and yards not willing to offer back heavy payment structures as of today, as the downturn led to significant losses and discipline is now back in the sector.

The timeline for newbuild deliveries currently ranges from 24 months to 36 months given the limited technical capability and slot availability. Lead time of key equipment is contributing to these construction periods, as the supply chain is still not ready to handle significant volume. We believe that a surge in orderbook for offshore vessels is unlikely to happen in the next 12 to 18 months despite the recovering market condition and confidence, as financing will continue to be a key challenge for traditional OSV owners. Liquidity and lack of retained earnings remain a challenge for owners as the terms laid out by yards require substantial equity early in the instalment schedule. Adding fuel to the fire, many traditional OSV lenders are not willing to finance O&G newbuilds even with a contract in place upon delivery.

While rates have increased significantly since 2020, most segments have yet to reach a level that would justify a newbuild. We do see speculative orders placed this year with alternative capital sources, while the volume in newbuilding during the previous upcycle is highly unlikely to be repeated. With that being said, it is likely that we will see a prolonged cycle due to rising demand, static supply and a challenging market for newbuilding. These factors are shaping up to be an exciting time for the offshore industry, and those with existing tonnage in the game will need to stay nimble to capitalize on the opportunities ahead.

OSV Owners Reap the Rewards of Data Sharing

*A 'Connected Future' seminar, organized by Inmarsat in collaboration with **OE** sister publication **Maritime Reporter & Engineering News** and moderated by **Greg Trauthwein**, encapsulated the critical roles technology and data sharing play in enabling more efficient and sustainable workboat operations, and in improving conditions for crew.*

L to R: Greg Trauthwein, President, New Wave Media; Eric Griffin, Vice President, Offshore Energy & Fishing, Inmarsat Maritime; Ron Welles, C-Comm Manager, Marine Technologies; Kyle Pemberton, Manager of Engineering, SEACOR; Dain Detillier, Executive Vice President – LNG Operations, Harvey Gulf International Marine.

Insights from leading Offshore Supply Vessel owners and operators capture the extent to which technology and data sharing are driving greater efficiency, sustainability and profitability in operations while enhancing working conditions for onboard personnel.

Harvey Gulf recently offered evidence of the gains it secured after introducing a digital platform to measure emissions from an offshore support vessel (OSV) capable of running on LNG, diesel, and a combination of LNG, diesel, and batteries.

"We get tons of data – the question is how to use it," **Dain Detillier, Executive Vice President – LNG Operations, Harvey Gulf International Marine** told a recent Inmarsat Maritime 'Connected Future' seminar staged in collaboration with *Maritime Reporter & Engineering News* and moderated by Editor, Greg Trauthwein.

"You have to pinpoint your ultimate goal; what you want to achieve. That's something we try to do – narrow our focus so we're concentrating on smaller goals, and then we can expand from there," said Detillier.

The preliminary remarks caught the mood of panellists of the seminar, which coincided with the International Workboat Show 2023 in New Orleans and went on to explore the gains operators are already realising.

Detillier explained that while OSVs spend most of their time in dynamic positioning mode, running multiple engines at low loads, digitalised emissions-monitoring had helped Harvey Gulf to identify opportunities to use supplementary battery power to run engines singly at energy efficient 80% loads. This, Detillier said, could decrease fuel consumption by around 30% and significantly reduce emissions as a result.

Fellow seminar panellist **SEACOR Marine** is also pursuing a data-driven decarbonisation strategy. Using a smart fleet management solution, the company transfers data to shore in real time to facilitate analysis and gain meaningful insights. **Kyle Pemberton, Manager of Engineering, SEACOR**, said that this has provided the basis for internal discussions about fuel efficiency that can "help crew to make better decisions".

Pemberton also paraphrased **ABS CEO Christopher J. Wiernicki** to observe that, "Operational efficiency is your best fuel right now" – a mantra that shapes SEACOR's approach to decarbonization. "Digitalization is high on our list

of priorities – even ahead of alternative fuels," he said. "If we do decide to adopt alternative fuels, we need to know how to use them efficiently." Data, here, will be crucial.

For **Edison Chouest Offshore (ECO)**, data analytics is a familiar practice. In 2022, the company established Marine Technologies to provide customers with complete vessel control solutions. Drawing on experience gained collecting and analysing data to improve its systems, ECO applied a similar data-driven approach to monitor emissions and support remote service across its fleet.

Joining the 'Connected Future' panel was **Ron Welles, C-Comm Manager, Marine Technologies**. He described the "centralization of management and organization" as a priority for the ECO fleet. Referring to a "central management system" that makes the same information available to every vessel, allowing personnel to learn from incidents in the fleet, he said: "We're looking at how we can use this to cut down on administrative overheads, support information sharing, and get all the vessels running as a single unit."

In his opening speech to the seminar, **Eric Griffin, Vice President, Offshore Energy & Fishing, Inmarsat Maritime**, described connectivity as "the oxygen that gives life to these digitalisation initiatives". Yet the role of connectivity extends beyond enabling data-backed digitalisation and decarbonisation; it also helps companies to promote a happy, healthy working environment for mariners, he said.

With each of the panellists drawing on personal experience to stress the importance of fast and reliable crew internet, Welles recalled a fuel resupply run to Antarctica. "Before the mission, we received a call saying we couldn't get crew on board unless we could provide them with the facility to keep in touch with their families," he explained. "We installed Inmarsat connectivity on the vessel, and two and a half years later, this is one of the most successful jobs we've ever done in Antarctica."

In a concluding recommendation, Welles added: "If you don't provide crew with the means to connect, you'll have a difficult time in today's world."

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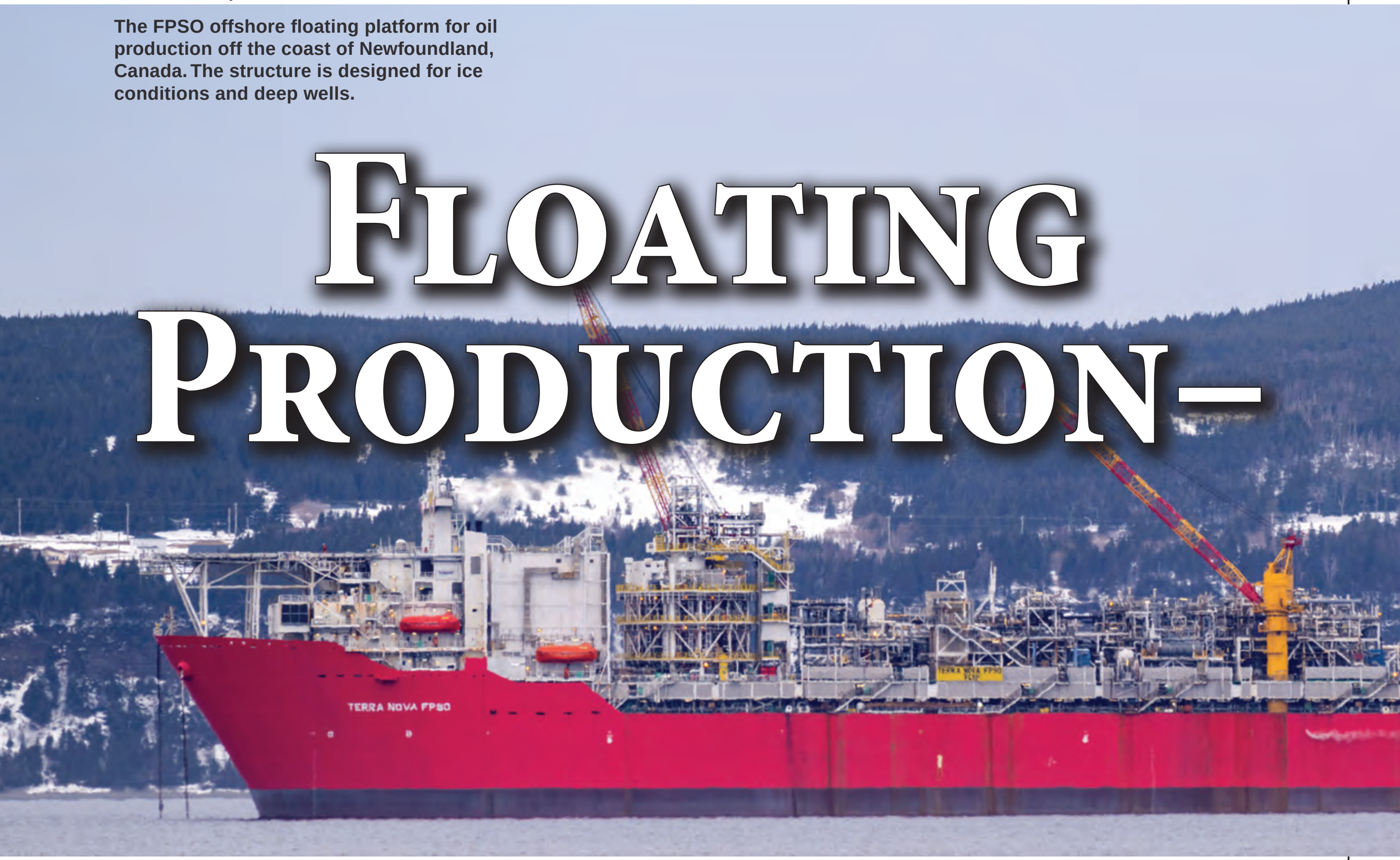
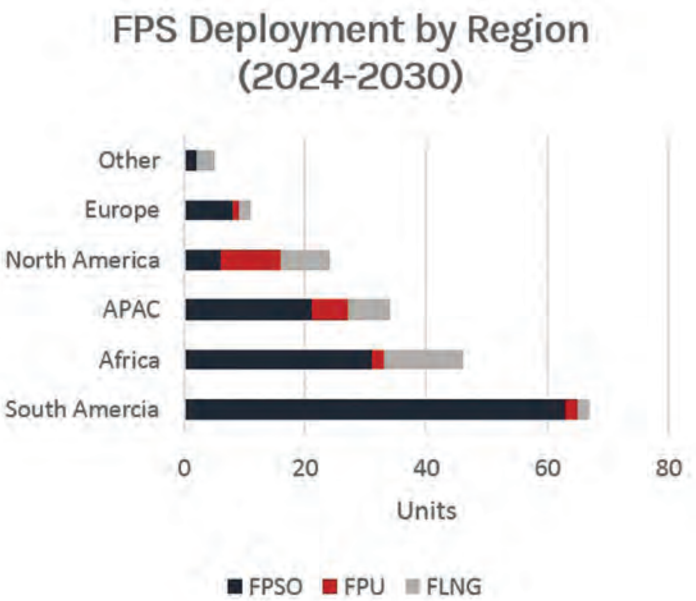


The FPSO offshore floating platform for oil production off the coast of Newfoundland, Canada. The structure is designed for ice conditions and deep wells.

Floating Production– A growing segment in transition

The specialized deepwater oil & gas and floating offshore wind segments will share many of the same stakeholders and supply chains, competing for increasingly scarce resources.

By Philip Lewis, Director of Research, Intelatus



Source: Intelatus

The established floating production segment is forecast to experience continued growth through this decade, driving demand for, among other things, moorings, subsea systems, umbilicals, risers, flowlines and the large anchor handlers and subsea support vessels that will install and maintain the elements.

At the same time, the floating wind segment will move from demonstration and pilot-scale projects to pre-commercial and commercial-scale arrays and will consume large amounts of mooring components and dynamic electrical cables as well as the large anchor handler and subsea support vessel capacity that will install and maintain the elements.

Much of the new floating wind supply chain will leverage the existing floating oil & gas supply chains. Players experienced in deepwater oil & gas operations, whether developers, EPCI contractors or component and service suppliers, will find a growing opportunity to leverage their skills in the emerging floating wind segment.

These are the findings of a new whitepaper produced by Intelatus Global partners entitled “Floating Production and Floating Wind – increasingly close segments”.

A Growing Floating Production Segment

According to the latest Intelatus deepwater floating production forecast, floating production activity in the oil & gas sector is set to grow at an average 25 floaters per year through 2030, and the foundations are in place for continued activity through the next decade.

There will be over 260 floating production systems installed globally by the end of 2023. Over 185 new floaters will be installed by the end of 2030, of which 70% will be FPSOs, close to 20% FLNGs and floating production units without storage (semi-subs, TLPs and spars) over 10%.

We forecast that more than two thirds of new floating production units installed between 2024 and 2030 will be located in South and Central American countries, of which Brazil and Guyana will account for around 90% of the share of units. FPSO technology dominates the region’s FPS demand.

In all, 18 countries in West and East Africa are expected to receive new FPSOs, FLNGs and FPUs between 2024 and 2030. Africa is forecast to be home to the largest number of FLNGs in our forecast, accounting for over 35% of global installations.

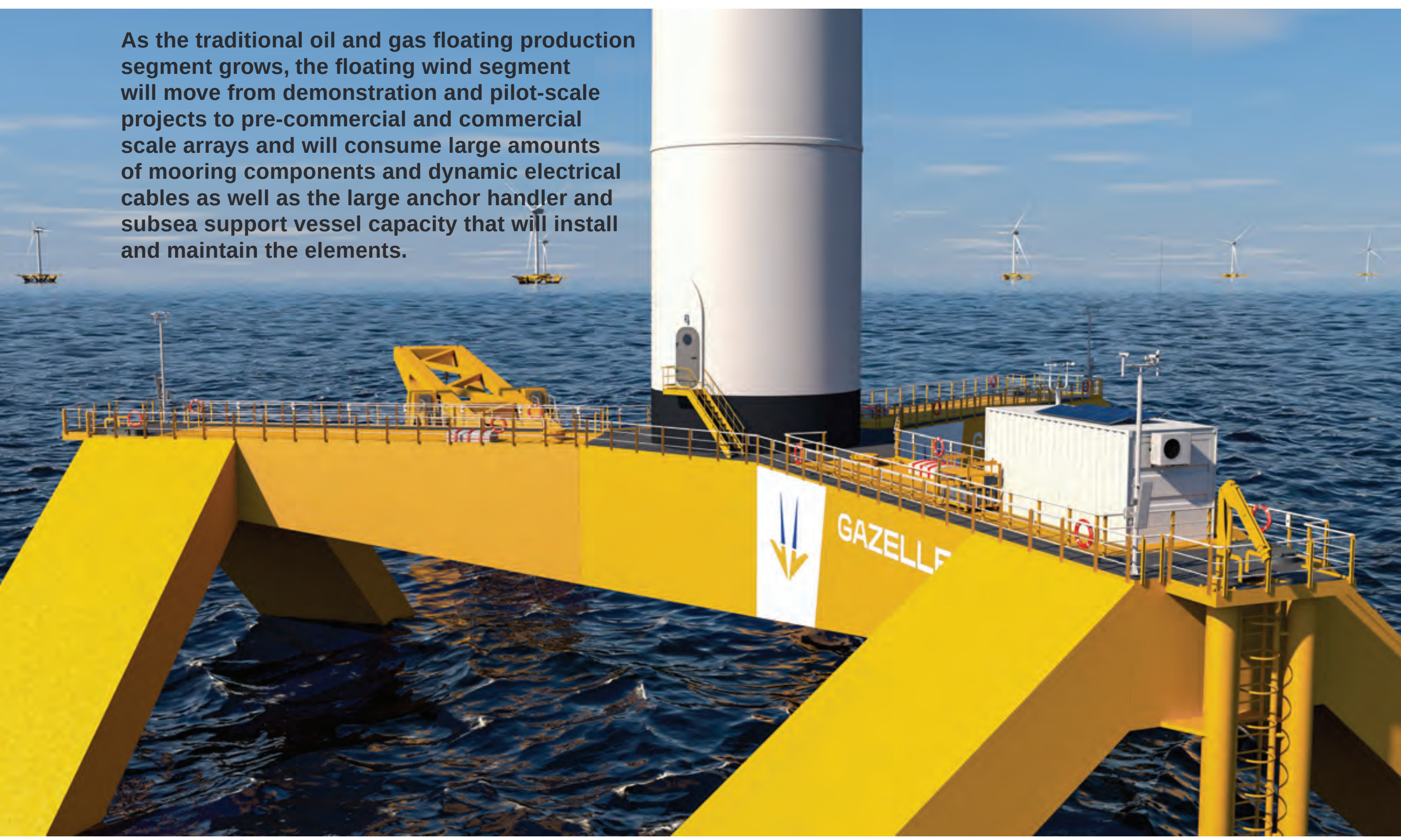
The third most active floating production region from 2024-2030 is forecast to be Asia Pacific. Over 60% of the activity in the region is anticipated to come from FPSOs, with FLNGs and FPUs each accounting for around 20% of the units.

Over 80% of the activity forecast for North America will be located in the U.S and Mexican Gulf of Mexico. The region will be home to the largest number of FPUs, accounting for close to half of our global forecast.

A Segment in Transition

We are noting a transition in the business models of many floating production system owners. Changes include deploying the latest technologies to decarbonize floating production operations and transition floating production activity into a wider floating energy business that leverages the skills and lessons learnt from deepwater oil & gas projects into the emerging floating wind segment, with measures including:

- The use of gas and reduction in routine flaring, whether through liquefaction or pipeline export.
- The increased deployment of carbon capture technologies coupled with the reinjection of carbon dioxide into wells (e.g. Petrobras plans to inject CO2 into pre-salt storage).
- The wider scale adoption of combined cycle power generation and topside electrification by several leading FPSO owners. Sources of power investigated by some developers for floating production systems include renewable energy, such as offshore wind.
- Leveraging Industry 4.0 technologies to improve production unit operations and maintenance performance, including IoT connectivity, digital twins and autonomous operations.
- An emerging floating production segment – the production and storage of low and zero emission energy carriers, such as methanol and ammonia. One exciting development leverages Generation IV small modular nuclear reactors to provide the power and heat required to desalinate seawater, power electrolyzers and other production, storage and offloading systems. Concepts are being developed in South Korea and Europe.



As the traditional oil and gas floating production segment grows, the floating wind segment will move from demonstration and pilot-scale projects to pre-commercial and commercial scale arrays and will consume large amounts of mooring components and dynamic electrical cables as well as the large anchor handler and subsea support vessel capacity that will install and maintain the elements.

Image courtesy Gazelle Wind Power

- Finally, we are seeing a trend of certain key players in the floating production segment to leverage their expertise for executing challenging and large projects in deep water into the floating wind space, including Petrobras, Shell, TotalEnergies, Equinor, CNOOC, SBM Offshore, MODEC and BW Offshore.

Competing for the Same Supply Chains

The growth in activity in both the floating production and the floating wind segments will drive increased demand for engineering services, shipyard and port capacity, mooring system supply, dynamic subsea cables and specialist installation vessels. We are forecasting some potential supply chain bottlenecks as a result of the increased activity.

To show how floating production and floating wind projects will compete for similar resources, we will use a high-level simple example, comparing a "typical" FPSO with a "typical" floating wind project deploying conventional moorings.

If we apply this simple "rule of thumb" approach to our floating production and floating wind mooring pre-lay forecast through 2030, floating wind accounts for around 30% of the total mooring line quantity required and nearly 50% of the anchor volume. This will be a challenge for the existing higher spec vessel supply side to accommodate, given its current high utilization. The Intelatus Floating Wind Installation Vessel Forecast analyses the commercial and technical potential vessel capacity and capability gaps in detail as well as why the commercial conditions don't yet really exist for sustained new building activity.

Floating wind is a new technology where engineers continue to search for innovative ways to deliver commercial-scale projects. However, at least in the short- to mid-term, developers will need to rely on existing technologies and supply chain capabilities to deliver commercial-scale wind farms, technologies that have been developed over years in the deepwater floating production segment.

Players experienced in deepwater oil & gas operations, whether developers, EPCI contractors or component and service suppliers, will find a growing opportunity to leverage their skills in the emerging floating wind segment.

However, the stakeholders in both segments should be aware of a forecast shortage and therefore increased competition for supply chain resources.

To receive a full version of Inteletus analysis, click here
https://fpso.intelatus.com/

COMPARING DEEP WATER OIL & GAS AND FLOATING WIND MOORING DEMAND DRIVERS

Example Project Comparison	1 GW Floating Wind Farm	Deepwater FPSO
Units	66	1
Mooring line/ unit (m)	1,000	2,500
Line/floater	≥3	16
Mooring lines (m)	198,000	40,000
Anchors	≥198	16

Source: Intelatus interpretation of information from Equinor and Shell

Three Questions: MATT TREMBLAY,

VP, Global Offshore Markets, ABS

*The American Bureau of Shipping dominates the global market in the classification of Floating Production. **Offshore Engineer** recently sat with **Matt Tremblay**, ABS' Vice President of Global Offshore Markets, at American Bureau of Shipping HQ in Houston for his insights on market drivers and technical trends in this dynamic market.*

By Greg Trauthwein

Matt, big picture, how do you see the Floating Production market developing in the coming years?

At a macro level, I think we're going to be supply limited over the next five years. While there is a demand for increasing capacity, there is no capacity to [expand immediately] based on the supply chain of shipyards and equipment manufacturers. The other challenge is financing, as the cost of capital is significantly higher than it was during the last boom. Another thing that's challenging the capacity side of things is the activity in the marine market, as per square meter, a dry dock is going to make more money building six gas carriers [for example] than it will building one FPSO. The number of shipyards and EPC companies capable of handling the large FPSO projects is a small list.

Can you put in perspective the importance of floating production to ABS as a whole?

The floating production market is the cornerstone of ABS' leading position in the offshore side of classification. ABS classes almost 38% of the global offshore production fleet, more than 50% of [the fleet] in the Americas, where South America is the central focus of the world right now on offshore production. ABS is class more than 50% of that fleet in South America and 100% of the new activity in Guyana.

We have people all over the world that work on these projects, distributed through dozens of different offices. ABS is the only class society with a fully staffed, fully capable engineering office in Brazil, and we've got large engineering offices in Singapore, Shanghai and Houston that support the local clients in the offshore space and specifically the FPSO space. They have capabilities to do everything from your bread-and-butter work to high-end technical analysis, where we're [deploying] many PhDs and supercomputers. We set ourselves up that way to be able to make local decisions, support local customers, and make decisions quickly.

What are the technology trends in the floating production sector that are challenging industry?

Broadly speaking, the technology trends are in three buckets:

- Energy Transition
- Digitalization, and
- Asset Integrity of Aging Fleet

Taking the last one first, in asset integrity the main challenge is aging assets. There's a lot of really old steel out there; it's been 40 years since their keel laying date for 25% of the FPSOs; it's been more than 25 years since their keel laying date for 50% of the FPSO fleet.

A challenge with older FPSOs is getting all of the inspections done, as the hardest part of doing the inspection from an operator's perspective is cleaning the tank so you can get in and look at it. That, in turn, is impacting future design, and one of the design changes that's happening most recently is full double bottoms, where the framing of the structure is in the double bottom, not in the cargo tank. This gives you a smooth side and a smooth bottom; it actually looks almost like a gas carrier tank now. It's easier to clean because now you don't need a crew with shovels and five-gallon buckets shoveling the muck out of the bottom between the stiffeners.

Digitalization also comes back to asset integrity. The digitization and our understanding of the asset condition is allowing us to forecast maintenance needs, equipment failures, allowing us to use machine learning and AI tools to analyze that condition data and help us make better plans, more efficient plans, safer plans around the maintenance. So applying these new big data, AI-type tools to the maintenance and condition data, we're now able to track electronically and to build more efficient plans to maintain and operate these vessels more safely. We are trying to apply it in a number of ways to existing structures, but more so we're seeing it built into the new assets. A great example: there are strain gauges in the hull that measure the load that the hull is subjected to, allowing us to measure and calculate remaining fatigue life via sensors within the hull.

here's new R&D that we're doing on remote inspection technology, remote gauging technology, measuring the thickness of the remaining steel. We're working on a project with a national oil company where we're permanently installing sensors inside one of the tanks, then instead of having to get in and mechanically scan each of these locations, you just take the data off of these RFID tag stickers that tells you what the remaining thicknesses of the steel.

Last, but certainly not least, the biggest thing is change around sustainability and its impact on the design of FPSOs. The application of technologies like carbon capture to the power generation package, and a technology called combined cycle where you're using the heat from the power generation system as a heat source that you may need within the hydrocarbon production system, so you're not having to make this energy twice.

Also, we're looking at how we're actually powering the FPSO. The newest designs we're working with today are working toward electrification of the larger asset, and ideally someday that power's coming from off the asset.

Traditionally, FPSOs use gas turbines as the main source of power, with a number of diesel engines that supply power loads across the asset. Those diesel engines are coming out and more high voltage power distribution is being used. From an efficiency perspective, from a CO2 emissions perspective, the bigger the engine is, the less CO2 it emits per kilowatt. So having five or six really big gas turbines versus three or four medium-sized gas turbines and a bunch of diesel engines is emitting less CO2 per kilowatt. One national oil company, for example, is forecasting a 20% reduction in CO2 emissions based on this new electrification project that they're working on … it's not contracted yet, but it's coming.

[Other interesting developments include developments around the use of renewable energy and alternative fuels to supplement power]. The Norwegians are doing some really good things right now, powering some of their offshore production assets from land. If you can operate a green thermo powerplant on land and then run that electricity out to the offshore production, all of the sudden you've got new oil with a zero CO2 cost to produce.

FLOATING PRODUC

Liza Unity sail away

Photo by Charlie Xia/© SBM Offshore

CTION'S BULL RUN

Offshore floating energy production is on a growth path, with two important energy production milestones hit in the 'Golden Triangle' of Latin America, Africa and the U.S. Gulf in late 2023. One is linked to oil production, 120 miles offshore Guyana, while the other is tied to gas production off the coast of West Africa.

By Barry Parker

Offshore floating energy production is on a growth path, with two important energy production milestones hit in the 'Golden Triangle' of Latin America, Africa and the U.S. Gulf in late 2023. One is linked to oil production, 120 miles offshore Guyana, while the other is tied to gas production off the coast of West Africa.

Guyana has been in the news as oil behemoth ExxonMobil started production in mid-November 2023 at Payara, its third offshore oil development on the Stabroek Block at Guyana which it operates, with co-investors Hess Petroleum and CNOOC. This brought the company's total production capacity in the country to approximately 620,000 barrels per day. "The Prosperity floating, production, storage and offloading (FPSO) vessel is expected to reach initial production of approximately 220,000 barrels per day over the first half of 2024 as new wells come online," ExxonMobil said.

Two other FPSO's – Liza Destiny and Liza Unity – similarly owned by Amsterdam-based SBM Offshore, have already been producing roughly 200,000 b/d each for ExxonMobil offshore Guyana. A fourth FPSO, One Guyana, capable of producing 250,000 b/d, will be coming onstream in 2025.

As always, geopolitics casts a cloud on energy production. In late 2023, Venezuela, drawing on a treaty from the late 1800s, was claiming title to the oil-rich Essequibo region of Guyana. ExxonMobil's Global Energy Outlook published in August 2023 suggested that offshore Latin America production, presently at circa 3 mB/day, could ratchet upwards to 5 mB/day by the mid-2030s.

West Africa Looms Large

BP, another energy giant, will soon be deploying FLNG Gimi, a floating liquefied natural gas production vessel (FLNG), with a nameplate output potential of 2.7 million tons/year (mtpa) to work on its Greater Tortue Ahmeyim project, offshore Mauritania and Senegal, under a 20-year charter deal. The FLNG was originally a 125,000 cbm LNG carrier built in the mid 1970's that underwent a conversion and was delivered in late November 2023 to owner Golar LNG from the Seatrium yard in Singapore, which absorbed the Keppel yard, where the work was done.

Its FLNG Hilli, also a conversion from the Keppel yard, has been working offshore Cameroon since 2018, with discussions

FPSO Prosperity working offshore Guyana since late 2023.

Image courtesy SBM

Liza Destiny

Photo by Lim Weixiang/© SBM Offshore

for re-chartering underway as the current contract expires in mid-2026. Meanwhile, Golar LNG, which is actively pursuing opportunities offshore Nigeria, has acquired a 2004-built LNG carrier for conversion into a 3.5 mtpa FLNG.

Golar LNG's 2023 third quarter results presentation indicates that its share of overall capitalization for FLNG Hilli has exceeded $1 billion. Following the financial results update, shares analyst Chris Robertson from Deutsche Bank wrote: "Once Hilli is re-contracted, it will undergo a period of significant downtime of between 6 to 12 months and depending on the location and duration of the next contract. Additionally, it could cost between $150 to $200 MM in incremental CAPEX to prepare Hilli for redeployment."

Phil Lewis, Director of Research at Intelatus reports in a recently released White Paper on Floating Production that "more than 185 new floaters will be installed by the end of 2030, of which 70% will be FPSOs close to 20% FLNGs and floating production units without storage (semi-subs, TLPs and spars) over 10%."

Besides being expensive, FPSO and FLNG deals have lengthy timelines, like Shell's Prelude LNG which shipped its first cargo of the gas produced offshore Australia in 2019, eight years after the company took final investment decision (FID) on the unit.

Discussing a vessel coming of its present charter in 2026, Golar LNG explained to its investors that "a fully utilized FLNG Hilli has annual revenue potential in excess of $1 billion based on current LNG forward curves, to be shared between gas resource owners and Golar. Concluding a new charter for FLNG Hilli is therefore a commercial priority for the company." This FLNG, with a capacity of 2.4 million tons/year, has been working offshore Cameroon since 2018. in late 2023, it loaded up its 100th LNG carrier. Discussing the potential conversion of its LNG carrier LNG Fuji into 3.5 million tons/year, Golar LNG told investors the following: "The cost of a converted FLNG Fuji is expected to be around $2 billion, equivalent to approximately $570 per ton. Financing proposals for between $1.2 to $1.5 billion… are being discussed."

The "pipeline" for FPSO projects could be extensive. In its 2022 annual report, the owners of the vessels producing at Guyana SBM Offshore stated opinion that looking ahead, around 35 FPSO projects could reach FID between 2023-2025.

Liza Unity

Photo by Lim Weixiang/© SBM Offshore

Image courtesy MODEC

FPSO Anita Garibaldi

Not surprisingly, major hydrocarbon producers including ExxonMobil, Shell, Petrobras, CNOOC and Equinor, are providing the largest financial support for FPSO projects. One recent Petrobras deal shows their lengthy nature. Namely, in summer 2023, Japanese FPSO builder MODEC began production in the Campos Basin, under a 25-year charter on its newbuild Anita GaribaldiI MV33. According to MODEC "…the FPSO is capable of processing 80,000 barrels of crude oil and 7,000,000 cubic meters of gas per day and has a storage capacity of up to 1 million barrels of crude oil."

The FLNG marketplace also offers tremendous potential. Earlier in 2023, analysts at Westwood Energy had pegged the size of the market, including projects gaining FID thru 2027, at $35 billion. More than half of these are in African waters. A relatively new entrant to the FLNG segment, New Fortress Energy, which describes itself as an LNG infrastructure provider, spun out of from infrastructure investor Fortress, is in the final stages of deploying its first FLNG as part of its "Fast LNG" program, which is essentially a modular approach to equipment construction.

The new unit, dubbed appropriately FLNG1, is capable of producing 1.4 million tons/year, off the coast of Altamira in Mexico and near Tampico. Soon to be online, the unit will be receiving gas from the Sur de Texas-Tuxpan pipeline, for export after reliquification. New Fortress Energy linked up with private investment funds run by Apollo to form vessel owner Energos Infrastructure, which acquired a fleet from a Golar LNG affiliate Golar Master Limited Partners. Up until early 2023, New Fortress Energy had also held a stake in FLNG Hilli.

Show Me the (LNG) Money

To financiers, LNG production projects are attractive as institutional capital providers. With lengthy contracts, a hefty portion of the cost can be "leveraged" with debt finance. Consider SBM's activities in Guyana. Explaining the financing, lined up for its Prosperity in 2021, SBM Offshore said that "...it completed the project financing of FPSO Prosperity for a total of $1.05 billion … secured by a consortium of 11 international banks. The company expects to draw the loan in full, phased over the construction period of the FPSO. The financing will become non-recourse once the FPSO is completed and the pre-completion guarantee has been released. The project loan has a tenor of two years post completion, in line with the duration of the charter, and carries a variable interest rate plus 1.60%."

Image courtesy MODEC

The upcoming One Guyana unit has recently garnered an even larger project loan, $1.75 billion, secured by a consortium of 15 international banks. Taking advantage of a similar structure, it becomes non-recourse to SBM two years after it enters into service, through a structure known as a "Completion Guarantee", with the project's loan then repaid from its cash flows. Besides ExxonMobil, major FPSO users include Petrobras, producing oil offshore Brazil, China's CNOOC and Equinor, which is active in the North Sea.

It is no surprise that institutional money packagers such as Apollo and Fortress, with long-term time horizons, are funding maritime projects. At a Marine Money event in New York held mid-2023, Energos Infrastructure CEO Art Regan, who has a lengthy tenure handling Apollo's varied shipping investments, said: "The development of infrastructure funding into the shipping industry is a very good thing," suggesting also that the energy transition, where long-term arrangements will be more of the norm, is bringing shipping into the "infrastructure realm," along with utilities.

The roster of debt providers to Energos shows that the crossover from long-term project financiers to shipping assets, is real. Its debt financing, organized through an Apollo affiliate, was led by Brookfield Infrastructure Debt and also included a syndicate of other credit funds managed by Global Infrastructure Partners, HPS Investment Partners, and Carlyle Global Credit, along with Investec. Infrastructure type finance was also highlighted by Anastassia Tcherneva, Head of Shipping Finance at the ABN Amro bank, in a recent Maritime Impact webinar hosted by DNV. When asked about the shifting finance landscape, Tcherneva commented: "… for debt, you need to have also different sources of capital. That of seed capital, thinking that you mentioned that also infrastructure investors are getting increasingly interested in this sector. And the reason is that the energy transition is very much going to be there for time to come and people are looking for good yield versus the risk that they're willing to take."

Production platforms have been gaining FIDs from the big oil companies, with their mega balance sheets. In the U.S. Gulf of Mexico, Shell Offshore is moving ahead with its Sparta deepwater development in the Garden Banks field, 180 miles offshore Louisiana. The oil giant awarded Seatrium a contract to build the hull and topside for a semi-submersible Floating Production Unit (FPU) that will eventually produce 90,000 barrels/day.

Image courtesy Seadrill

Gen. 6 Drillship West Auriga

With production forecasts pointing upwards, the market for drillships and deepwater semi-submersibles has also brightened. In a late 2023 regulatory filing, Valaris, a top participant in the deepwater and ultra-deepwater sectors-formed from a 2019 combination of Rowan and Ensco, explained: “In recent years, the more constructive oil price environment has led to an improvement in contracting and tendering activity for floaters. The number of contracted benign environment floaters has increased to 120 at September 30, 2023 from a low of 101 in early 2021, contributing to a 13% increase in global utilization… for the industry's active fleet over the same period. This increase in activity is particularly evident for 6th and 7th generation drillships, such as those included in our floater fleet. Utilization for the global active 6th and 7th generation drillship fleet is currently at 94% and has, on average, exceeded 90% for more than 12 months, resulting in a meaningful improvement in day rates for this class of assets.”

Securities analyst James West for Evercore ISI, who covers offshore drillers, including Valaris and competitors Transocean and Noble Energy, wrote in his end 2023 Offshore Oracle report: “Ultra-deepwater (UDW) marketed utilization is at its highest level since May 2015. UDW day rates have more than doubled off the bottom ... Incremental rig demand from key geographies has pulled idle assets from markets that have been slower to recover. Contract terms have lengthened and rigs are being contracted up to a year in advance.”

In the report, analyst West pointed to UDW day rates more than doubling to $500,000/day. On a January, 2024 webinar hosted by brokers BTIG, Simon Johnson, the CEO of Seadrill that boasts a diverse fleet of semisubmersibles and drillships, said: “The pricing has got so far to run. We are at the very beginning of the [cycle]”. In late December, SDRL booked two of its 6th generation drillships, West Auriga and West Polaris, on three-year contracts in Brazil, commencing later in 2024, at day-rates working back to levels around $500,000/day.

Market participants have been active - Valaris made a deal, worth around $390 million when mobilization costs are figured in, to acquire two high-spec drillships Valaris DS-13 and Valaris DS-14 from a South Korean yard. Showing the optimism pulsing through, Valaris will move the units to a shipyard in Spain - readily accessible to projects in the Golden Triangle - where it will “stack” them, while seeking out employment contracts. A few months earlier, in the third quarter of 2023, Valaris had lined up $400 million in 8.75% “add-on senior secured second lien notes” due in 2030. Investors’ optimism is palpable as this debt raise was “upsized” from the originally announced issue size of $350 million.

Concept of Shell's Sparta production platform

Perdido Production platform US Gulf

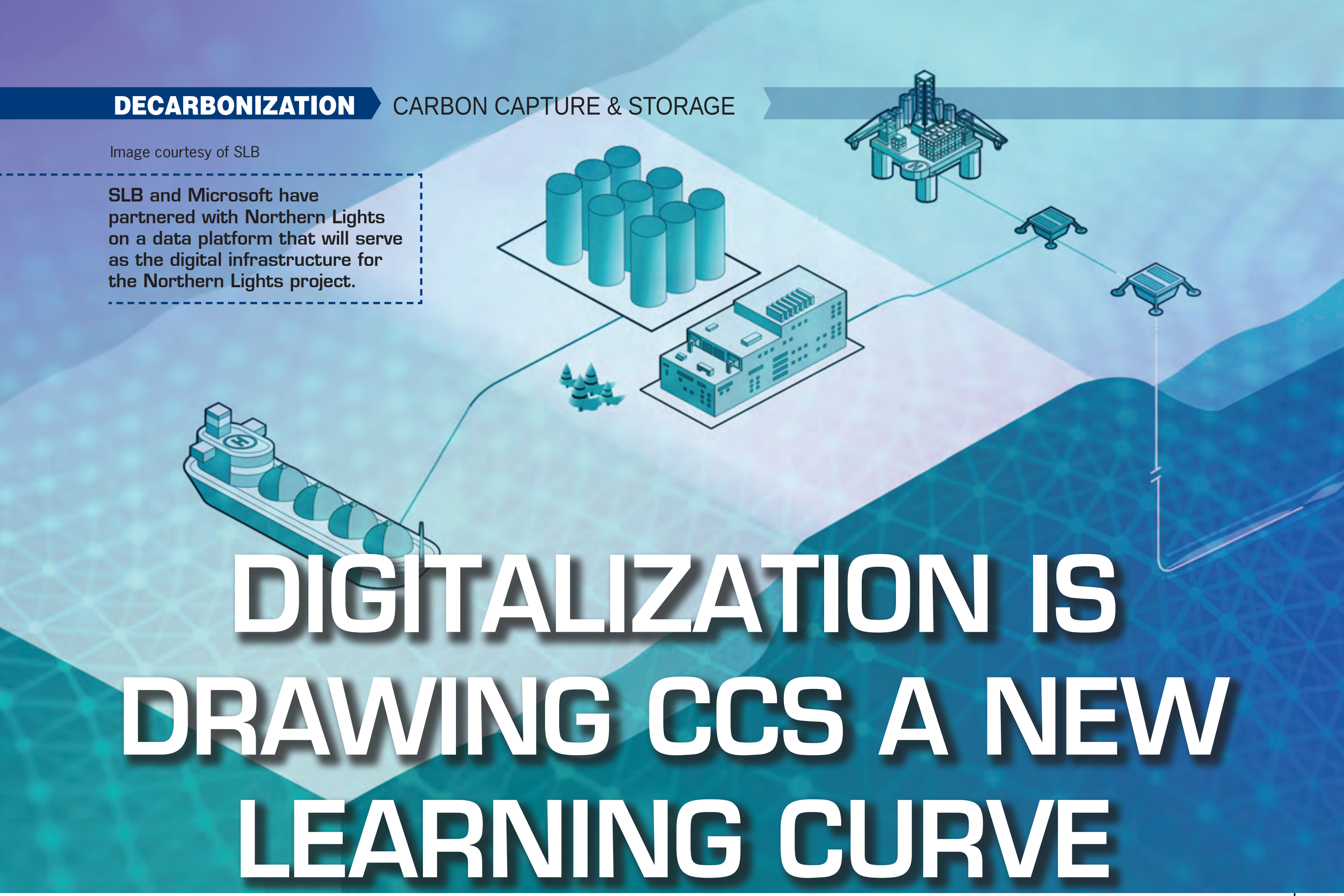


Image courtesy of SLB

SLB and Microsoft have partnered with Northern Lights on a data platform that will serve as the digital infrastructure for the Northern Lights project.

DIGITALIZATION IS DRAWING CCS A NEW LEARNING CURVE

Digital solutions are accelerating the progress required to ensure CCS earns its place in climate change mitigation history.

By Wendy Laursen

Carbon capture has been around since the 90s, but the behavior of CO2 in pipelines is still not that well understood. A lack of suitable multiphase flow assurance models has meant that past CCS projects have had to apply large, costly safety margins to transport and injection systems. Between 2020 and 2022, the CO2FACT project addressed the shortfalls, and along with the development of the LedaFlow simulator, the knowledge gaps are being closed. LedaFlow will come with an improved module for pure CO2 in the spring of 2024. A module for CO2 with impurities will follow shortly afterwards.

"This is what I think of as action science: experimental physics to deliver commercial software is happening on the fly," says Jan Gerhard Norstrøm, Managing Director of the Ledaflow Joint Venture at Kongsberg Digital. Simulation is key to de-risking expensive infrastructure. "The big decisions and cost savings happen on the drawing board," he says. If you simulate before you build, you could save millions.

Gary LeMaire, Senior Director, CCUS at Worley, says project data harvesting under a 'design one, build many' strategy can help reduce total installed cost by >20%. It can also accelerate delivery schedules, because it increases replication and re-use of the entire value chain of project data

Image courtesy of Kongsberg Digital

"Experimental physics to deliver commercial software is happening on the fly."

– Jan Gerhard Norstrøm,
Managing Director of the Ledaflow Joint Venture at Kongsberg Digital

Image courtesy of Worley

"Project data harvesting under a 'design one, build many' strategy will see increasing levels of replication and re-use of the entire value chain of project data."

– Gary LeMaire,
Senior Director, CCUS at Worley

from engineering design through procurement, fabrication, construction and commissioning. It also enables closer partnerships to be formed between supply chain partners.

Partnership deals are booming. In 2023, Carbon Clean signed an agreement with Samsung Engineering to explore onboard carbon capture opportunities for its CycloneCC technology and another for technology for Ørsted's FlagshipONE eMethanol project in Sweden. Carbon Clean is developing a proprietary digital platform for its operations. "Our priority is working with customers to understand how digital technology can be applied to their operations," says Prateek Bumb, Carbon Clean co-founder and CTO.

Northern Lights

SLB and Microsoft have partnered with Northern Lights on the development of an Azure-compliant open-source data platform that will serve as the digital infrastructure for the Northern Lights project. Digital solutions are essential for designing, deploying and operating CCS projects safely and economically at scale, says Trygve Randen, Senior Vice President of Digital Products and Solutions, SLB.

The company's Delfi digital platform is designed to augment and connect multiple workflows with data, artificial intelligence and machine learning. The platform is open, so while it can handle reservoir modeling for carbon storage site selection and the ongoing modeling of stored CO_2, it can also integrate with other digital technologies to provide end-to-end solutions for CCS.

This value-chain view will be critical. The CO_2 being sequestered by CCS projects such as Northern Lights is not being sold as such, but it will require end-to-end tracking, because its value will be in green credits. Per Jahre-Nilsen, Energy Consultant at DNV, points to the need for maintaining a digital footprint of individual streams of CO_2 in large, multi-stakeholder projects for the certification of credits.

It's important to think of CCS as a system consisting renewable energy production, carbon processing and CO_2 storage, says Ron Beck, Sr. Industry Marketing Director, Aspen Technology. Digital twins may have been an optional optimization tool in the past, but they are essential now and should span the entire system. Digital twins enable process optimization such as cutting energy consumption and improving capture rates and solvent efficiency, each of which could improve project economics substantially. They also enable optimization of system-wide processes such as energy delivery. Only then will CCS economics really work in the long term, for everybody, said Beck.

He cites 1PointFive which plans to build around 100 capture facilities over the next 15 years. "You want to learn very quickly," he says, so that the optimization can be carried

Image courtesy of Carbon Clean

"Carbon Clean is developing a proprietary digital platform for its operations to maximize data value."

– Prateek Bumb,
Carbon Clean co-founder and CTO

Image courtesy of SLB

"Digital solutions are essential for designing, deploying and operating CCS projects safely and economically at scale."

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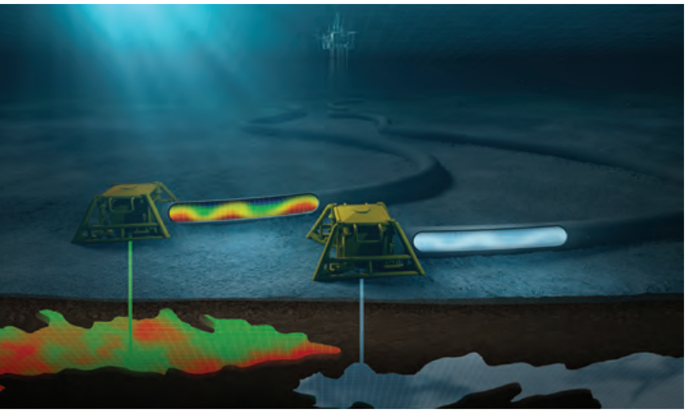
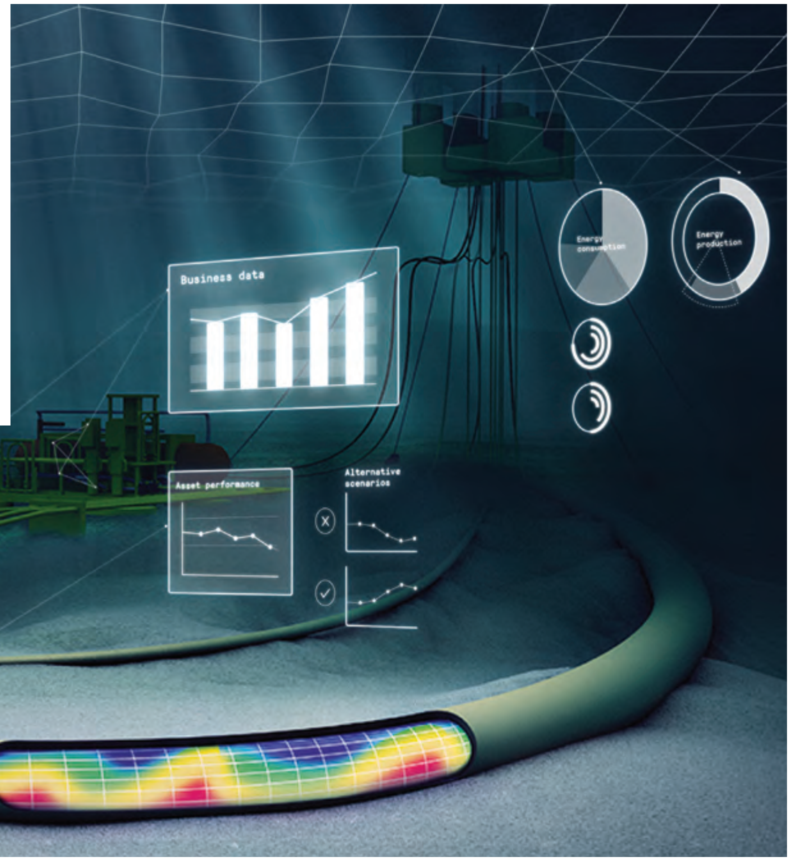




The behavior of CO2 in pipelines is still not that well understood.

Images courtesy of Kongsberg Maritime

Image courtesy of DNV

"There is a need for maintaining a digital footprint of individual streams of CO2 in large, multi-stakeholder projects."

– Per Jahre-Nilsen,
Energy Consultant at DNV

Image courtesy of ABB

"...a lack of operational experience is a major hurdle to mainstream adoption of CCS."

– Nigel Greatorex,
Global Industry Business Manager for CCS at ABB Energy Industries

forward fast. The sensors and digital solutions that enable this should be put in place during construction. It's what he calls being 'born' digital. "When we design the plant, we also design in the sensors to get the right data to understand how it's performing so we can improve the next one."

Nigel Greatorex, Global Industry Business Manager for CCS at ABB Energy Industries, says a lack of operational experience is a major hurdle to mainstream adoption of CCS. The impurities found in CO2 streams will differ between projects and could impact OPEX. CO2, especially from post combustion applications, comes with impurities which can form strong acids making corrosion a major operational risk.

"By understanding the fluid, a digital twin can be developed that takes into account those impurities and can also monitor and reduce the amount of power needed to pressurize and heat the CO2," says Greatorex. "This is important because energy is not always easy to get to on a CCS network. There is not always a source of power at the point of injection or the midpoint of a pipeline or even excess power at the capture source. By deploying a digital twin, operators can be sure the plant is not over-compressing or overheating, resulting in significant OPEX savings."

ABB's automation, electrical and digital solutions are being integrated into the Northern Lights project which is due to be operational by mid-2024. They will enable the remote operation of the carbon capture terminal and ensure that the facility runs at optimum efficiency.

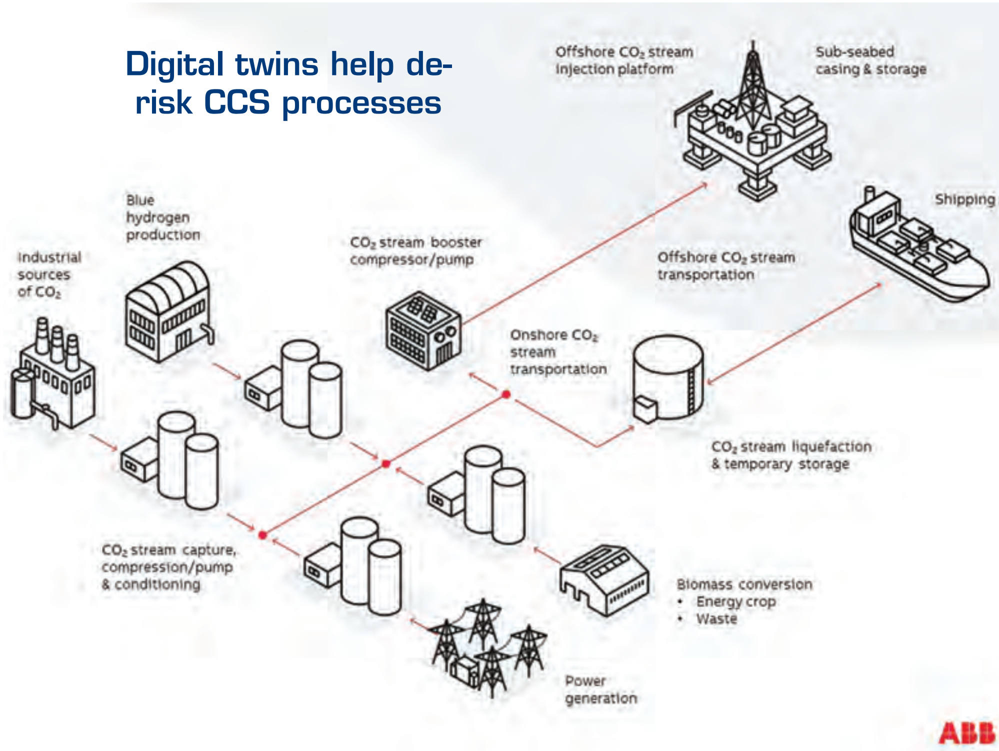
Remote operation promises reduced OPEX, as do unmanned platforms - something being pioneered in the Aker BP-operated production platforms Hugin A and Munin, expected to be operational in 2027 and which are built without accommodation space or helipad. MAN Energy Solutions' scope of work on that project includes a digital solution for remote operation of its multi-stage compressors. The experience gained will be transferrable to CCS, says Jörg Massopust, Head of Digital Sales & Alliances.

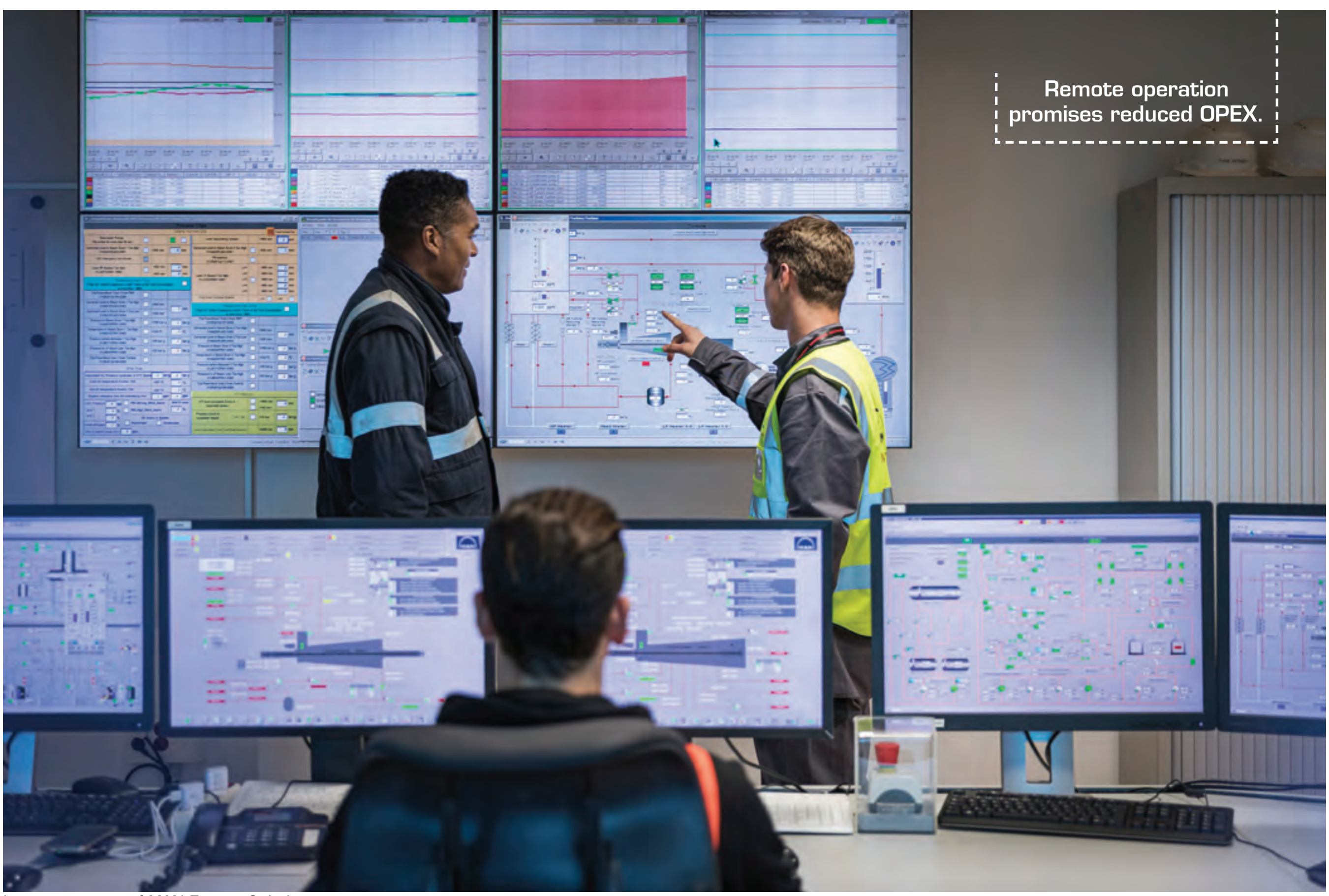
AI solutions will enable predictive maintenance to extend the time between inspections and overhaul. Then autonomous operation with completely computerized operation of the equipment will come with robotic surveillance for visual, leakage and noise inspections. Robots will do the normal daily maintenance and report to a remote operations management center.

Next will be humanization of those digital systems where human-like avatars will report proactively to human operators. "This will come in the next decade: maybe even in this decade."

Image courtesy of MAN Energy Solutions

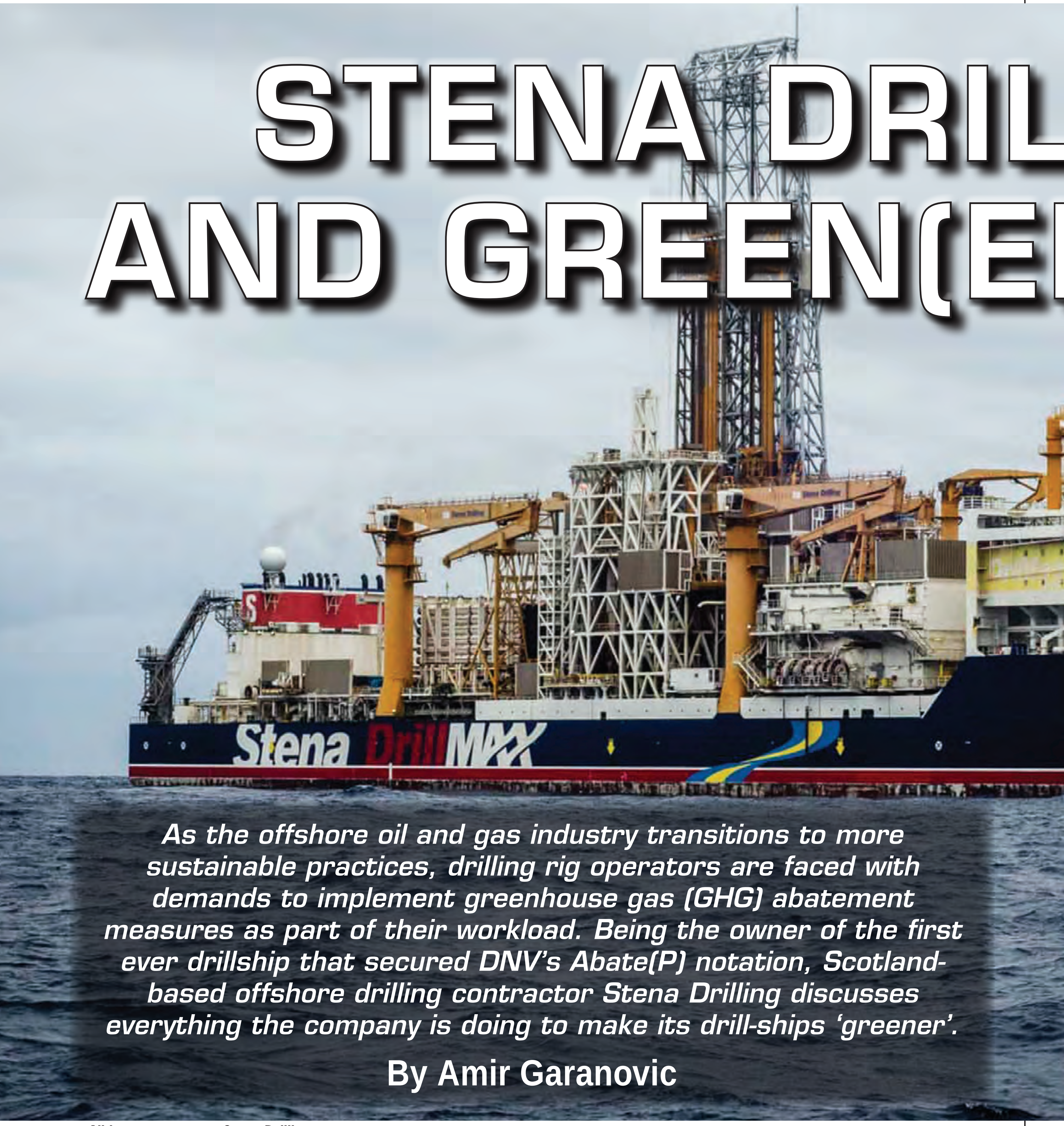
MAN Energy Solutions provide multi-stage compressors for CCS applications.





Remote operation promises reduced OPEX.

Image courtesy of MAN Energy Solutions



STENA DRIL
AND GREEN(E

As the offshore oil and gas industry transitions to more sustainable practices, drilling rig operators are faced with demands to implement greenhouse gas (GHG) abatement measures as part of their workload. Being the owner of the first ever drillship that secured DNV's Abate(P) notation, Scotland-based offshore drilling contractor Stena Drilling discusses everything the company is doing to make its drill-ships 'greener'.

By Amir Garanovic

All images courtesy Stena Drilling

The first step to reducing its carbon footprint for Stena Drilling is to follow the ISO 50001 standard guide for assessing the impacts its energy use and the resources could be conserved.

ISO 50001 is a voluntary international standard, applying to organizations of any size, which provides requirements for establishing, managing and improving their energy consumption and efficiency.

In January 2022, Stena Drilling received ISO 50001 certification, covering all of its rigs and the company's Aberdeen support facility. "We believe we were the first international driller at the time to receive this certification across the fleet and office. An energy team was set up at our Aberdeen headquarters to develop an Energy Management System (EnMS) and how the system could be adopted into our operations. We needed to establish where energy saving improvements could be made and each rig contributed to this by developing their own Energy Efficiency Management Plans (EEMPS). We knew for our energy campaign to be a success, it would require the support of all of our employees," said Erik Rønsberg, CEO of Stena Drilling.

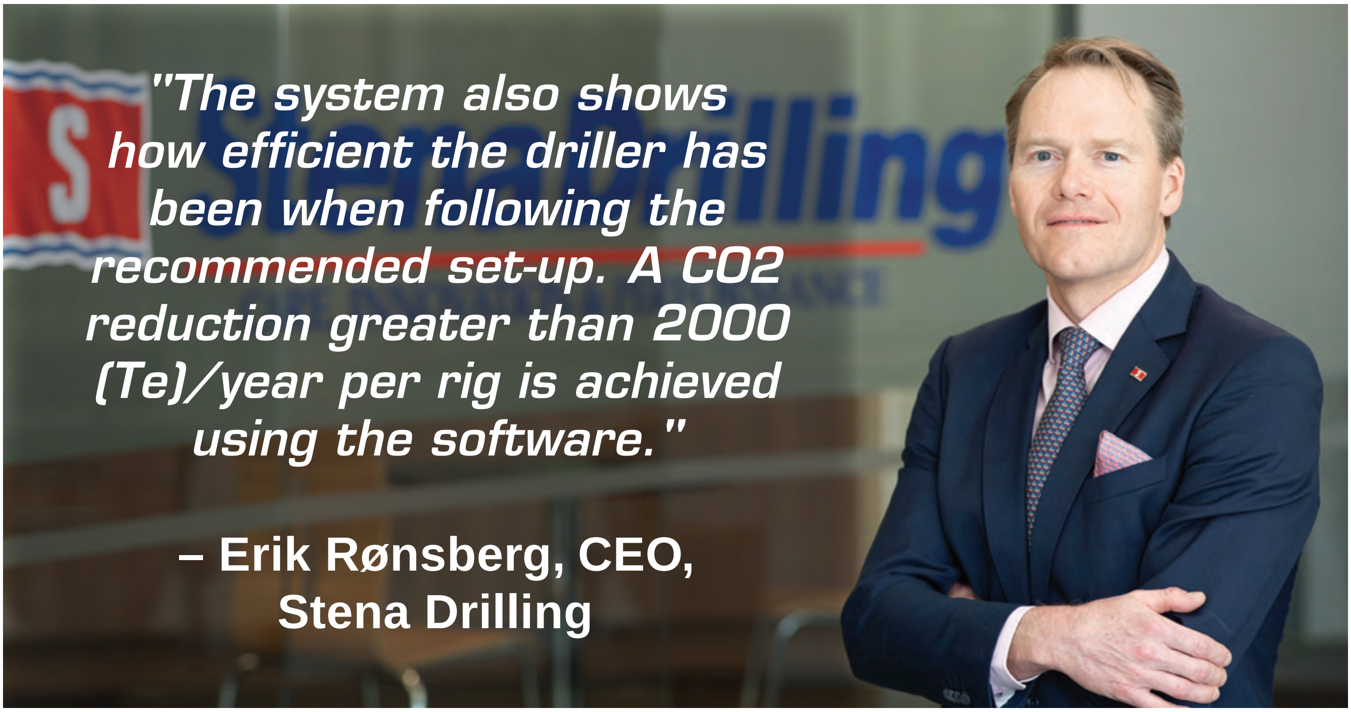
Stena Drilling developed digital smart meters, using data received from tags on the vessels. Using the meters, the company was able to monitor the fuel consumption and emissions in real time or over a pre-determined time period or activity. The collected data was then fed to Power Bi software, which identifies the areas for improvement.

"The data guides us to areas where we can improve our energy efficiency and reduce our emissions which in turn ensures that we comply with, and often exceed, the requirements of the ISO standard," said Rønsberg.

To further its energy saving plans, Stena Drilling installed new reverse osmosis units on its rigs to produce fresh water and reduce the boiler fuel consumption on each drillship by approximately 3m3, which resulted in reducing the company overall fleet fuel consumption and emissions by approximately 8%.

Also, the hydraulic lifting system on Stena Drilling's drill-ships was identified in the EEMPs as one of the key areas where the company could improve efficiency. The software was then developed and installed on its DrillMAX series drill-ships to calculate the number of hydraulic pumps required to perform various drilling operations.

"The system also shows how efficient the driller has been when following the recommended set-up. A CO2 reduction greater than 2000 (Te)/year per rig is achieved using the software," added Rønsberg.



All images courtesy Stena Drilling

Also, the company installed variable frequency drives (VFDs) for its high load marine cooling pumps, which resulted in the reduction of annual emissions by 1800 (te) along with a boost accumulator for the hydraulic ringline system which contributed further 1,300 (te) to the overall result.

"We have also commissioned a feasibility study on the use of alternative fuels. The alternatives were green methanol and ammonia. A detailed report has been received and this is now being studied by our engineering team," Rønsberg pointed out, noting also the company is exploring the use of 'synthetic diesel' produced variety of vegetable and animal sources which could reduce CO2 emissions by as much as 90%.

"HVO can be used as an additive without any modification to engines and the CO2 reduction is almost equal to the percentage of HVO used, i.e., 10% HVO in supply ≈ 9% reduction in CO2 emissions," said Rønsberg.

All of this, together with the joint work with certification society DNV, contributed to the company's Stena DrillMAX drillship being awarded DNV's Abate(P) notation – a first drill-ship to receive such classification.

The classification serves as a testament to Stena Drilling's rigorous monitoring of energy consumption and the implementation of both operational and technical measures to notably reduce emissions.

"The blue-chip companies that we're working with are very interested in what we're doing to cut fuel consumption and lower our emissions.

"We're also seeing co-investment with our clients into fuel saving technology and exploring alternative fuels. For new tenders, there is usually a question about environmental performance, but so far usually not prescriptive requirements.

"The most modern rigs are often best, but our DrillMAX class units with the hydraulic lifting systems still appear to be very efficient when we've had the opportunity to measure against our peers.

"I want to future proof as much as possible, so that's a key driver in continued investment in environmental performance on our rigs as ultimately, this could be the winning combination for getting the best contract, while fulfilling our own company environmental objectives at the same time," Rønsberg concluded.

All images courtesy Mocean Energy

MOCEAN ENERGY

AIMS TO CREATE AN OFFSHORE RENEWABLE MICROGRID

*Garnering power from ocean waves is a generation behind the progress of offshore wind, but Mocean Energy, led by founder and managing director **Cameron McNatt**, is aiming to help offshore companies power up it's offshore and seafloor assets with its Blue Star system. A 10kW Blue Star prototype now has more than 14 months of operational experience under its belt, and the goal for 2024 is completion of that trial and continuing the path toward commercialization.*

By Greg Trauthwein

To start us off, can you give us a by the numbers look at Mocean Energy today?

Mocean Energy has been operating since 2016, today we have 23 people. We have built a 10-kW prototype that's been tested at sea for more than 14 months. Our first product, Blue Star, will be 20 kW of wave energy and five kW of solar and that will be about saving money and CO2 in offshore operations.

What attracted you to this business and when did you know that yours would be a career in ocean technology?

Like most careers, it's a bit of a winding journey. I grew up in Maryland going out on the water and sailing. My first job was with a company that developed software for naval architecture applications, and I ran with that and earned a Master's in Ocean Engineering at Oregon State University, which is where I first started working on Wave Energy. Next I went to the University of Edinburgh to do my PhD in Hydrodynamics and Wave Energy. And then the funding opportunity came up and my co-founder Chris Retzler and I started Mocean.

Before we dig into BlueStar and its application in helping to electrify the sea floor, can you give us the overview of the Mocean wave energy converter technology?

Conceptually, our wave energy devices is very simple mechanically: we have a big hinge and waves cause a flexing about that hinge that drives a generator. But what we've brought to the table is innovations around the shape of the machine. Our prototype has these big scoops on the front and the back that we call wave channels. They do a number of somewhat nuanced and complex hydrodynamic things, but basically they cause the machine to move a lot more in waves. And if you move more in waves, you generate more power. (To develop the machine) we developed a software optimization program that created tens of thousands of different shape concepts, we ran them through a simulation and competed them against one another to find the best.

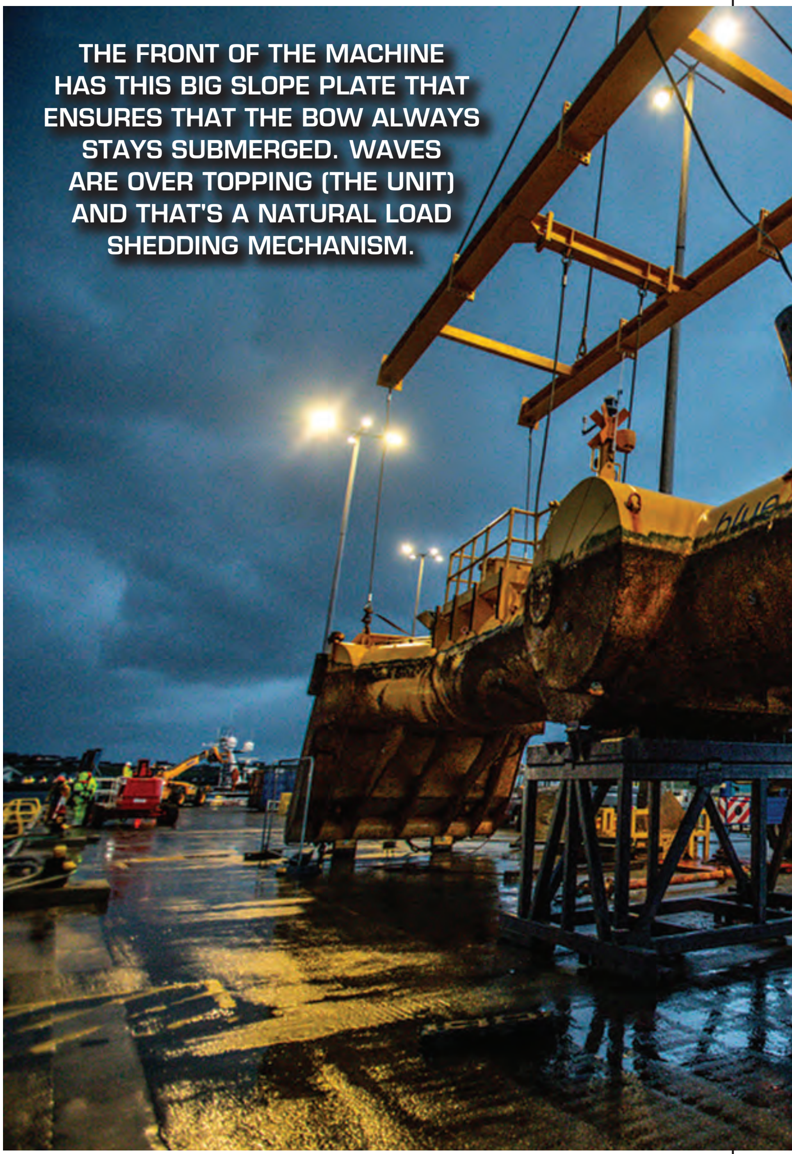
What are the biggest maintenance considerations of the unit?

Mechanically it's very simple, it's a hinge that moves back and forth and drives a generator. I think some of the more challenging aspects of that are converting that low speed, high torque mechanical power into electrical power. Generators typically want to run fast, whereas what we have is a very slow speed power and we're using a gearbox to convert that into electricity. So that's something that needs special consideration, but we are generating more and more data around that.

Is there a 'fail safe' mode for when the waves get too big?

We designed the system to be fail safe; it doesn't need to enter any survival mode. That's intentional because if something breaks and you can't enter (or exit) that survival mode of operation, you're in trouble. We've seen some big storms this past year, we have some great videos on YouTube from cameras on the machine. The front of the machine has this big slope plate that ensures that the bow always stays submerged. Waves are over topping (the unit) and that's a

MOCEAN ENERGY DEVELOPED A SOFTWARE OPTIMIZATION PROGRAM THAT CREATED TENS OF THOUSANDS OF DIFFERENT SHAPE CONCEPTS.



THE FRONT OF THE MACHINE HAS THIS BIG SLOPE PLATE THAT ENSURES THAT THE BOW ALWAYS STAYS SUBMERGED. WAVES ARE OVER TOPPING (THE UNIT) AND THAT'S A NATURAL LOAD SHEDDING MECHANISM.

natural load shedding mechanism. On the hinge side, what would be a concern is what's called an end stop.

If you have the hinge rotate so far around that you get a metal on metal impact, that's a bad thing. But we've designed the hinge to be able to accommodate greater than plus or minus 90 degrees of rotation. In all of the testing we've done offshore and in wave tanks, we've never seen that happen.

What do you see as the primary challenges or hurdles to bring WEC technology from the fringe to the mainstream?

We found an interesting market and application where we're deploying the technology: decarbonizing oil and gas. I'm talking about powering sub-sea equipment in the oil and gas sector where the traditional way that the equipment gets power is by running a cable along the seabed, either from a platform or from shore, and installing that cable is expensive. So I liken it to a traditional electrical grid model. You have a central power station, you distribute that power by cables, and what we're proposing is the distributed renewable model. So instead of running a cable, we provide renewable energy where it's needed. We're trying to change the narrative and say, yes, we use wave energy, but our product is also going to have solar panels and battery storage is a really important part of it.

We're providing an offshore renewable microgrid solution, power and communication. So we can link up to various wireless communications including the growing

low orbit satellite network, Starlink and others. Within that we can offer a cost savings CO2 savings and it's really low hanging fruit in this decarbonization challenge. It's much faster and less expensive to install these kinds of systems than, say, powering an entire offshore platform with a wind farm. And there is a substantial CO2 savings. So with one of our small machines, we estimate that we can save as much CO2 as a machine that generates 10 times as much power in a traditional renewables market.

You talked about decarbonizing oil and gas, but where else do you see potential for this Blue Star technology?

Besides pulling hydrocarbons out of the ground, the industry is very keen to sequester CO2 into the ground. There are projects that are being developed where you're going to put very similar technology offshore to put CO2 into the ground. You have [the push for residency for] autonomous subsea vehicles, [a subsea docking station that needs power]. There's emerging things like subsea data centers, direct water CO2 capture from the oceans, rather than pulling it out of the air, people are talking about pulling it out of the ocean, and that kind of technology needs power.

Let's look at the Blue Star technology today. Can you discuss where it's at in its development cycle and what's your timeline for its commercialization?

2024 is all about commercializing Blue Star. We have had our prototype out at sea for 14 months, cumulatively it'll be tested through next spring. And we feel that that gives us enough confidence in the performance of the technology that we can roll it out as a product. Certainly things have not gone perfectly, but if they went perfectly, we wouldn't learn anything. We're taking all of those learnings and we're applying them along with the kind of commercial design into the product. So that product is being designed and we're doing studies for customers right now, front-end engineering, design studies, feasibility studies, things like that towards getting the first Blue Star orders in 2024 and 2025.

When you look at 2024, what are the key milestones you hope to achieve?

It's completing that trial next spring and demonstrating this as success of the technology. It's getting that substantial commercial traction from a customer, really towards getting a system offshore. And then we're also working on scaling up, so we're working on the larger scale technology, the Blue Horizon. So we have a project to get that in the water in a couple of years.

GAZELLE PREPAR
FLOATING WIND

All images courtesy Gazelle Wind Power

ES FOR A FUTURE

As offshore wind power spreads globally, it's widely acknowledged that the maturing of floating wind power platforms will exponentially increase the availability of resources, as the majority of wind power lies outside the installation zone of fixed systems. Enter Gazelle Wind Power, which offers a compelling, modular engineered solution and value proposition to the market. Newly minted Gazelle CFO ***Alvaro Ortega*** *discusses the outlook for Gazelle in the offshore floating wind sector.*

By Greg Trauthwein

Today, it's acknowledged that the vast potential for offshore wind extends beyond the reach of traditional fixed-bottom units, and conservative estimates call for 300 GW of floating offshore wind by 2050, according to Gazelle CFO Alvaro Ortega. "This is just floating, so that is the massive opportunity for Gazelle."

As the advent of fixed offshore wind is still in its adolescence, talk increasingly turns toward floating offshore wind, a technology and market that was, for the most part, only recently born.

"Waters more than 60 meters deep require [a floating wind solution], said Ortega, "it cannot be bottom-fixed [at that depth]."

When talk turns to floating wind, there are many long-established technologies and companies in the floating offshore oil and gas industry that will translate to floating wind. However, it's not an exact match, and the key will be to maximize efficiencies of the platform and its foundation, which account for 30 - 40% of the cost.

Gazelle is banking on its modular solution, which Ortega says should represent a 30% reduced platform cost versus the semi-submersibles on the market today. "We are targeting 75% less of mooring length compared. So less mooring length, less materials will be used."

GAZELLE TODAY

By Ortega's estimation, Gazelle is racing to bring its solution to bear, as it is currently in its fourth round of funding and just completing prototype, small-scale basin tests at the Imperial College in London, in Plymouth, England as well as in Northern Spain. "So far, the results at a very small scale have been successful. So our next steps is to develop and to deploy the pilot, and we are already working on that, aiming for deployment by the end of 2024 off the coast of Portugal, using private equity but also looking for public grants, too."

Gazelle is banking on its design as the key differentiator in the floating wind sector, a design that is modular – making it easier to build, transport and deploy – as well as a design that offers significant reductions in some critical cost and environmental impact areas.

Last year Gazelle unveiled its next generation technology, an enhanced design that further refined the company's solution to address the primary challenges facing the offshore wind industry – cost, supply chain bottlenecks and

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Alvaro Ortega, CFO, Gazelle Wind Power

sustainability – by providing a lightweight, cheaper technology that minimizes the impact on fragile marine environments while using existing port infrastructure.

As a third-generation technology, the platform is designed to deliver enhanced mooring innovation that enables serial production. The platform makes first generation technology — which was primarily designed to float and survive harsh ocean conditions — obsolete and improves on second generation designs that are focused on industrialization.

Central to Gazelle's long-term play is 'reduction': reducing costs by 30% compared to conventional semi-submersible designs; reducing the time to assemble and install the units at project sites via a modular assembly process; reducing environmental impact by using less steel and materials, while also helping to eliminate seabed scouring and installation impact.

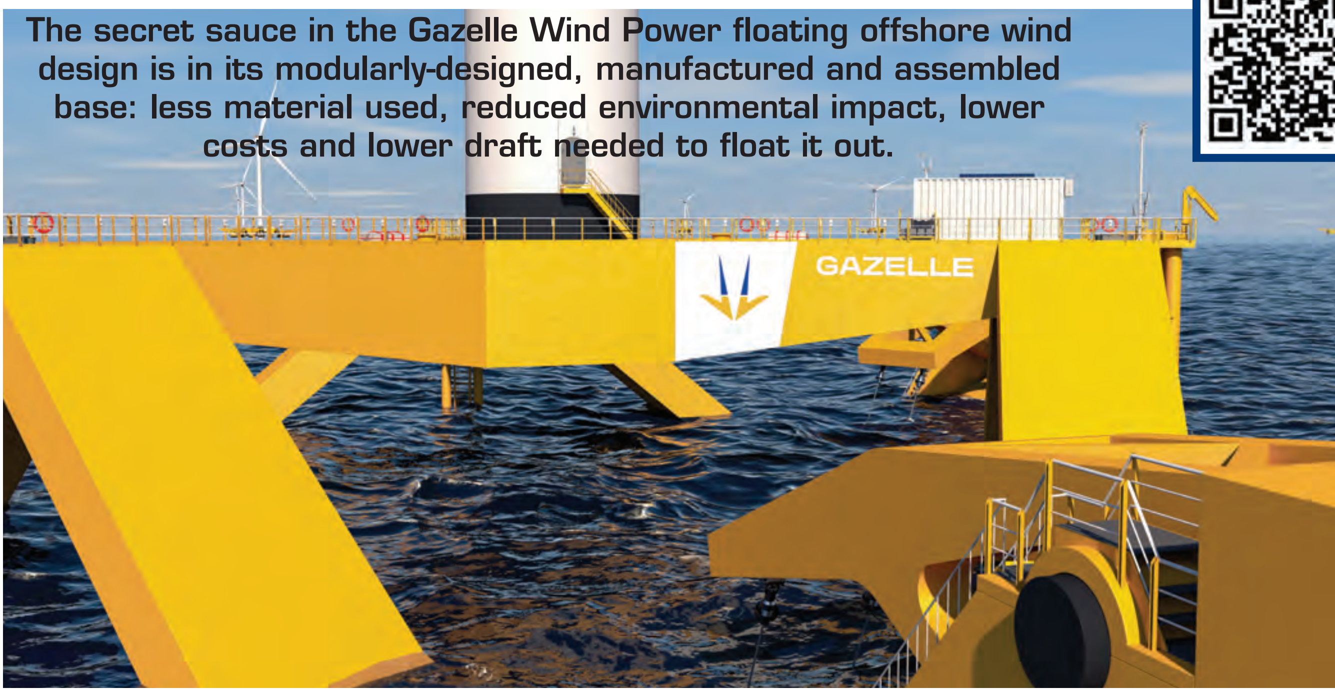
The Gazelle platform's unique geometry provides reduced draft in port, which means it floats higher in the water enabling the use of shallow ports with high stability in towing and wet storage. Pivoting arms allow the platform to move with the wind, waves, and tides that result in lower forces, enabling a lighter—and therefore cheaper—structure.

Further, the Gazelle platform uses a dynamic mooring system representing a paradigm shift from an active ballast to a natural, passive system that balances forces and motions through a counterweight, keeping the turbine pitch low and improving operational efficiency. Vertical mooring lines attached to the pivoting arms reduce the platform's environmental footprint by minimizing impact and allowing for a 75% reduction in mooring length when compared to semi-submersibles with catenary mooring in depths of 100 meters or more.

PROVING THE CONCEPT

Small-scale model testing and computer simulation are all nice and necessary parts of the development process, but Ortega and the entire Gazelle team know that the future depends on developing and proving the system works in one of the world's harshest and unrelenting atmospheres.

"Developing the prototype is our main goal, and we are planning to have the prototype in the water by the end of 2026. We're already working on the pre-FEED, and now we're going to be working on the engineering portion. Our main goal is to prove the concept," said Ortega. Apart from the technical, Gazelle is actively seeking partnerships – from developers to shipping companies to technology providers – as well as strategic investors that "come in not only to bring



The secret sauce in the Gazelle Wind Power floating offshore wind design is in its modularly-designed, manufactured and assembled base: less material used, reduced environmental impact, lower costs and lower draft needed to float it out.

MARINE TECHNOLOGY TV

Watch the full interview with **Alvaro Ortega**, CTO, Gazelle Wind Power

equity, but also to participate with us on the deployment."

The opportunities for Gazelle, and in fact all players in the floating wind sector are literally boundless as the market evolves. "80% of the wind resources are in places where only offshore floating wind can be deployed," said Ortega. "When we look at the map, the three main areas where we are planning include Europe, which represents 60GW of potential;. Asia Pacific and its 81GW of potential; and then North America, where we're talking about 31GW," Ortega said.

While envisioning market potential is the end game, Ortega and the Gazelle team are firmly planted in the here and now, focusing first on the pilot test, plus the most recent news where Gazelle were preselected for a project seeking to deploy 1GW of floating wind on the Italy's side of Adriatic Sea by the end of 2028.

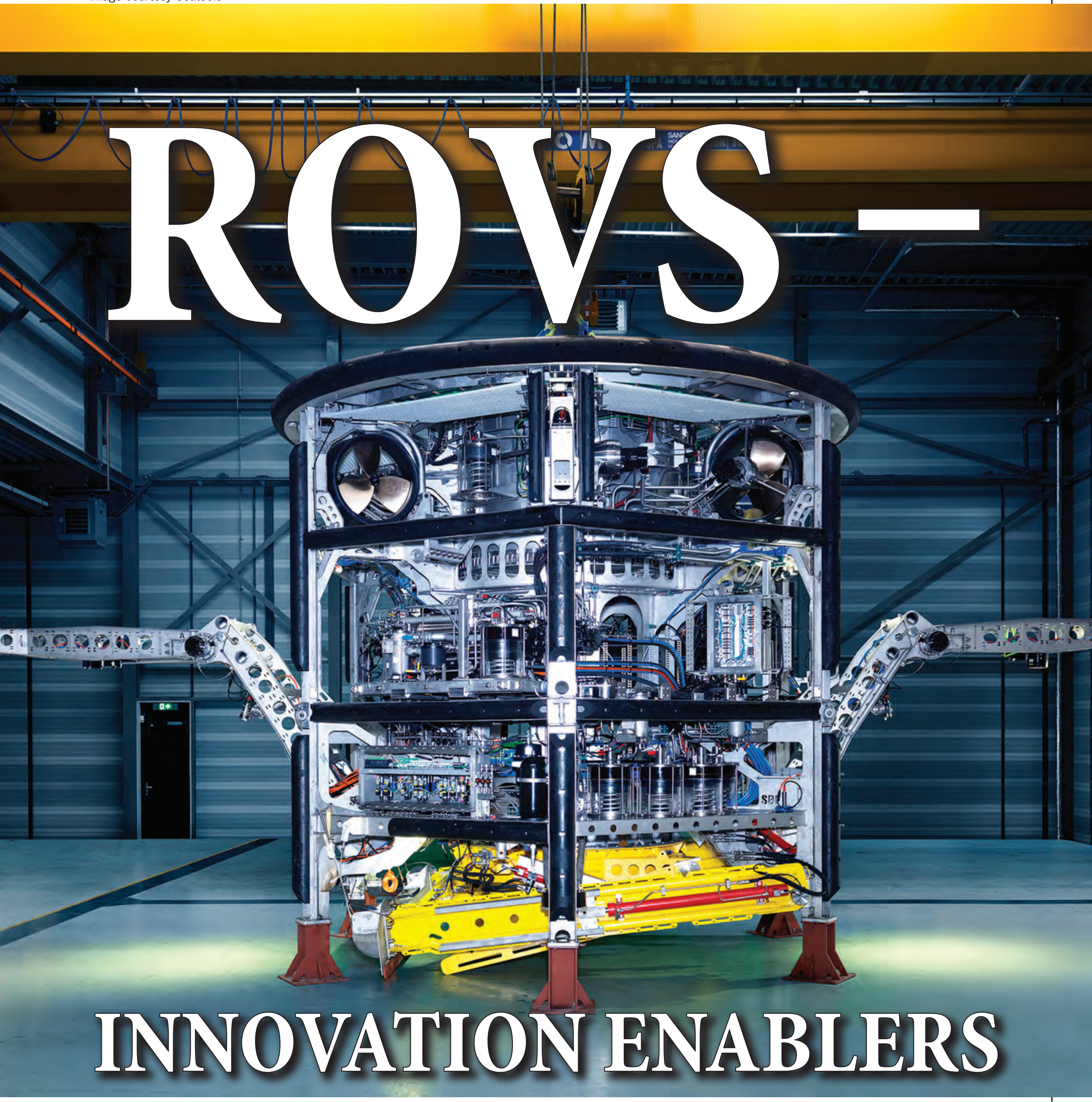
"The developer is Maverick, controlled by Green Bridge, and it released plans for this wind farm, that will include 70 turbines of 15MW each, and has preselected Gazelle as one of the providers for the offshore wind platform. So, we're not only talking about a pilot; we're also talking about some specific projects that we're planning to use our offshore wind platforms."

Armed with an innovative design that offers much promise, Ortega nonetheless sees many hurdles to clear.

"I think one of the main challenges is bringing this third generation of turbines to place. [Phase one was] to float, being able to deploy platforms to float and survive, but not to be industrialized. The second is where we are right now, looking to solve the main issues of fabrication, assembly, as well as the issues with very deep waters on the West Coast of the United States where we have one kilometer or more. [The third generation] is innovation in the supply chain, improving the assembly process to make it scalable and easy to attach. As in our case, manufacturing different modules that attach to each other rather than having to produce the whole platform in a manufacturing facility and then transferring that massive [structure]. And, being able to do this without having to make major infrastructure investments, which can be in the billions of dollars," Ortega concluded.

Image courtesy Seatools

ROVS – INNOVATION ENABLERS



By Rhonda Moniz

The world beneath the ocean's surface remains one of the last frontiers of exploration, where the mysteries of the deep beckon to be uncovered. In this realm, Remotely Operated Vehicles (ROVs) are indispensable pioneers, venturing into the abyss to conduct critical tasks in industries ranging from offshore oil and gas to marine research and underwater construction. Work class ROVs and other ROVs differ primarily in their capabilities, design, and intended applications. They are a class of remotely operated vehicles designed for heavy-duty tasks in demanding underwater environments. They are larger, more robust, and capable of performing complex operations at significant depths, making them essential tools in various industries. As technology advances, work class ROVs experience significant trends and innovations. The work class ROV market is dynamic, characterized by continuous innovation and adaptation to industry needs. Several notable trends are shaping the work class landscape.

- **Advancements in Automation and Autonomy:** Autonomous and semi-autonomous work class ROV technology has developed significantly in recent years. These systems have advanced computer vision, machine learning, and artificial intelligence (AI) capabilities, allowing them to perform tasks more autonomously. Automation reduces the workload on human operators and improves efficiency and safety.
- **Enhanced Maneuverability and Versatility:** Work class ROVs are becoming more agile and versatile. Innovations in thruster technology and control systems enable them to navigate complex underwater environments, making them well-suited for a wider range of tasks. Enhanced maneuverability is particularly valuable in confined spaces and subsea infrastructure inspections.
- **Data-Driven Insights:** Data is king in the modern world, and work class ROVs are no exception. These vehicles have advanced sensors, cameras, and imaging systems that capture real-time high-resolution data. This data is invaluable for immediate decision-making during operations and post-mission analysis, predictive maintenance, and trend analysis.
- **Compact and Portable Solutions:** While traditional work class ROVs are often large and require dedicated launch and recovery systems, there is a growing trend toward developing compact and portable work class ROVs. These systems are easier to transport, deploy, and operate, making them suitable for a broader range of applications and reducing overall costs.

Image courtesy Saab

Saab UK's new electric work class vehicle, the Seaeye eWROV.

The Future of Work Class ROVs: Navigating Uncharted Waters

As work class ROVs continue to evolve, several emerging trends offer a glimpse into the future of underwater operations:

Deep Sea Exploration: Work class ROVs will continue to play a pivotal role in exploring the Earth's most remote and extreme environments, including the deepest parts of the ocean, venturing into uncharted territories, and discovering new species and geological phenomena.

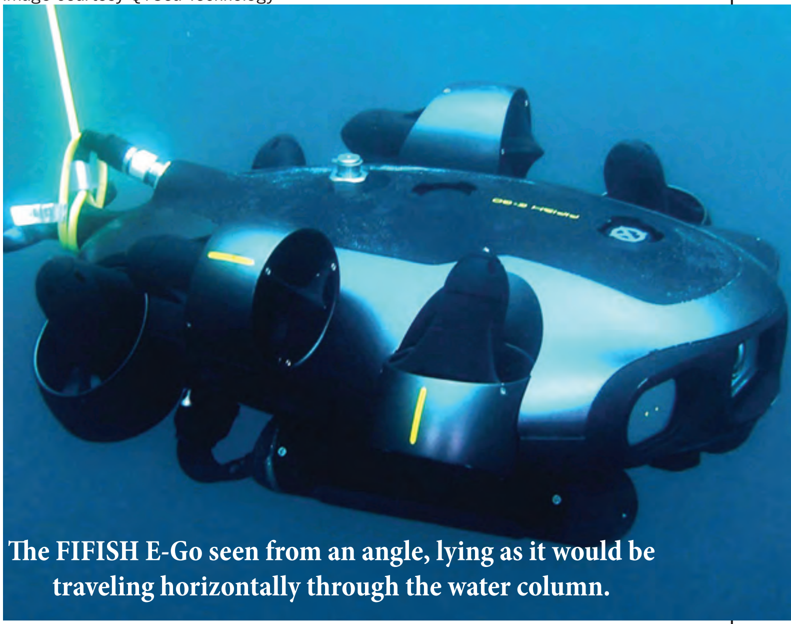
Renewable Energy: With the growth of offshore wind and tidal energy projects, work class ROVs will be instrumental in the installation, maintenance, and repair of renewable energy infrastructure.

Advanced Materials and Durability: Future work class ROVs will likely incorporate innovative materials and construction techniques to enhance durability and longevity, enabling longer missions at greater depths.

Artificial Intelligence and Analytics: AI-driven analytics will become more sophisticated, allowing ROVs to process and analyze vast amounts of data. Autonomous navigation and operation using AI algorithms will enable ROVs to

Image courtesy Seamor

Image courtesy QYSea Technology



The FIFISH E-Go seen from an angle, lying as it would be traveling horizontally through the water column.

navigate autonomously, while AI-driven navigation systems will help with obstacle avoidance, enabling the ROV to follow pre-defined transects and mission parameters while adapting to changing conditions.

AI will also improve imaging and data analysis using machine learning algorithms to process and analyze images and sensor data in real time, helping pilots and scientists make informed decisions during missions. Data transmissions from the ROV to the surface can be optimized by prioritizing and compressing the most relevant data for faster and more efficient communication. AI will also assist in predictive maintenance when ROV components may require maintenance or replacement based on historical performance, minimizing downtime and reducing maintenance costs. AI will revolutionize ROV technology by enhancing their autonomy, data processing capabilities, and efficiency. These advancements will enable ROVs to perform a wider range of tasks in underwater environments more effectively while reducing risks to human operators.

As AI advances, the potential for ROVs to contribute to scientific research, industry, and environmental monitoring in marine and aquatic ecosystems will only increase. Overall, the convergence of technological breakthroughs, scientific curiosity, environmental concerns, and economic opportunities is making this an incredibly exciting time in subsea technology. As we continue to push the boundaries of what is possible in underwater exploration and operations, the potential for new discoveries and innovations is virtually limitless, and the impact on various industries and our understanding of the underwater world is profound.

Updates on the Latest Vehicles and Capabilities

SEAMOR and Voyis have partnered together to combine the SEAMOR Mako ROV with Voyis' Discovery Stereo Camera, transforming the applications and abilities of both and reimagining what can be done in underwater inspection and exploration. The portable Mako ROV is rated up to 600 meters and can be remotely operated on umbilical lengths of up to 950 meters. Its size and build make it ideal for pipe inspection, aquaculture, port security monitoring and various marine research operations. Likewise, the Voyis Discovery Stereo Camera is a widely applicable piece of technology offering high level clarity and precision in visual captures of underwater environments and immediate creation of real-time 3D models. The integration of both opens up unparalleled capacities in aquaculture management and hydroelectric applications, offering an efficient, cost-effective and reliable house for the stunning visual capturing capabilities of the Voyis Camera. Applications that look to be significantly improved in the ease and accuracy of data collection and monitoring include routine net inspections, equipment recovery, and surveying and sampling of the seabed.

Seatools' new Fall Pipe ROV, the Yellowstone PLC, introduces unique and innovative features that offer high levels of precision in navigation and movement, advanced data collection and processing, and efficient workability and task execution. Featuring an integrated rotator which allows for the offsetting of the ROV's heading relative to vessel heading, the Yellowstone can save significant power compared to conventional Fall Pipe ROVs and offer vastly

Image courtesy Copenhagen Subsea

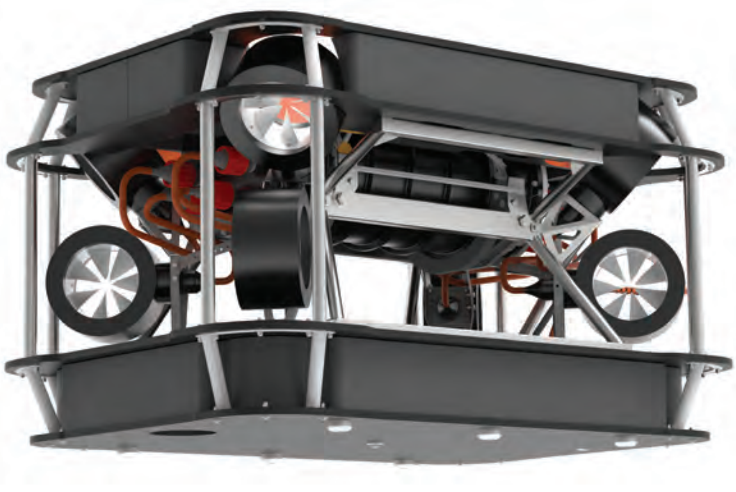
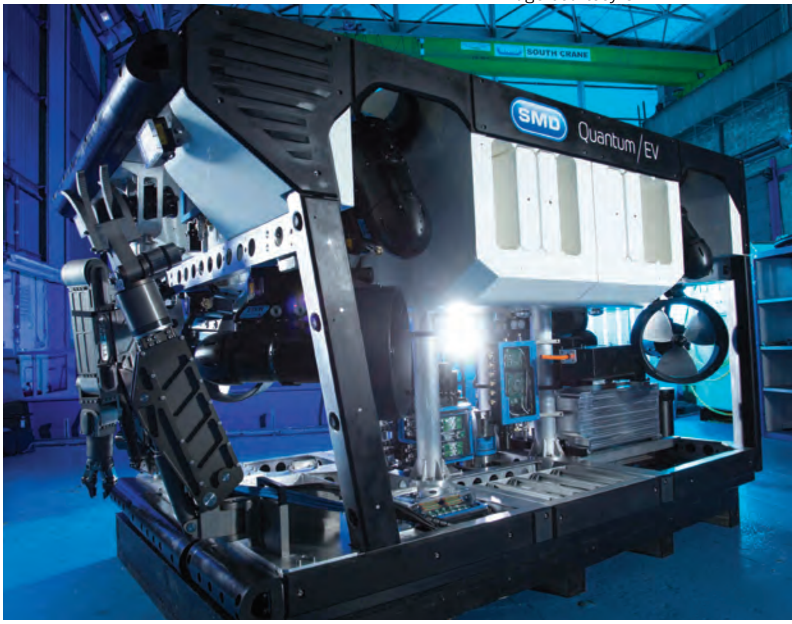


Image courtesy SMD



enhanced workability or rock installation operations. The vehicle has an expansive on-board survey equipment suite developed for optimal positioning and operations management, as well as for prime ability to monitor the environment and conduct pre- and post-surveys with Seatools' specially developed multicore processing technology.

Some companies have recognized the strong potential for autonomy optimization in the recent advancements in AI technology, and this includes underwater robotics company QYSea Technology and their newly modular, AI-powered advanced imaging and observational marine robot, the FIFISH E-GO. The E-GO offers a range of advanced capabilities not often seen in the subsea tech market. With a detachable motor, lighting, camera, and battery, module replacements can easily and quickly restore operability. This feature also allows for extensive expansion and customization of components. The E-GO has integrated AI into almost all operational aspects of their vehicle. With AI Vision Lock, it has high-level adaptive stabilization and can lock onto target objects with ease. Its plankton filtering algorithm is also AI bolstered, automatically optimizing visuals, monitoring tasks across aquaculture, search and rescue, hull check-ups and more, and even its laser scaling and measurement systems use AI automation for increased accuracy and the ability to identify damage in underwater structures. The FIFISH E-Go is QYSea's most powerful professional-class underwater robot and is now available across all QYSea platforms.

Latest innovation from Copenhagen Subsea is the enhanced Gorilla ROV, now equipped with an advanced 3D camera system. By integrating a 3D camera from Danish UVision, we have unlocked a new level of subsea exploration and inspection capabilities. With this cutting-edge technology, the Gorilla ROV now has the ability to capture highly accurate and detailed 3D scans of underwater environments. The 3D camera, mounted on the Gorilla, enables the creation of precise 3D models, providing invaluable insights for various applications. The 3D camera delivers exceptional image quality and resolution. Its advanced scanning capabilities allow for rapid data acquisition and precise measurements, ensuring accuracy in subsea mapping and inspection tasks. With the Gorilla ROV and its integrated 3D camera, subsea operators can now visualize underwater structures, assess damages, and plan interventions with greater precision than ever before.

Seatools completed Factory Acceptance Tests (FAT) for a Fall Pipe ROV developed for DEME, to be deployed on DEME's upcoming subsea rock installation vessel Yellowstone, scheduled to join the fleet in the first half of 2024.

The new Fall Pipe ROV introduces several unique features, including the integrated rotator, allowing for the offsetting of the ROV's heading relative to the vessel heading. This helps to ensure an optimal vessel heading, enhancing the workability level of rock installation operations while saving significant power compared to conventional Fall Pipe ROVs.

Another feature of the ROV is its expansive on-board survey equipment suite, employed for precise ROV positioning, monitoring operations and the environment, as well as conducting comprehensive pre- and post-surveys. To handle the vast amounts of data and complex control

Image courtesy SMD

Atom WROV and LARS in SMD workshop.

algorithms related to dynamic positioning, the ROV is equipped with Seatools' in-house developed multicore processing technology. The Yellowstone ROV PLC, featuring a quad-core processor, efficiently distributes tasks among individual cores, resulting in improved control task execution, particularly beneficial in complex control loops like electro-hydraulically driven dynamic positioning (DP) systems.

SMD has been developing work-class ROVs for more than three decades. In 2023, the company's latest products were the electric Quantum EV and Atom EV ROVs, which are more compact than previous generations, help reduce CO2 emissions, and can even operate autonomously when equipped properly. According to SMD, Quantum EV is a 270hp heavy construction vehicle with a high payload and powerful thrust output. Atom EV is a 130hp light construction vehicle suited to shallow-water, high-current work in offshore renewables. The ROVs feature a new DC power transmission system that is said to be far more efficient and environmentally friendly than previous generations. Further, the ROVs employ advanced flight control computers to help complete operations faster and maintain control in arduous conditions, such as high currents, SMD explains. The flight control system can also link to other SMART systems unlocking autonomous functionality. They use unique electric propulsion technology that offers extreme performance in fast-moving water, but not at the expense of fine control. "All this adds up to a range that can work where current generation vehicles can't, that opens up the operating weather window and delivers higher quality results. All while being more environmentally friendly," SMD says. Looking to the future of work class ROVs, SMD shared, "Work class ROVs are a multipurpose tool. And as with any tool there is always a focus on how well it does the job, its reliability, and its dependability. But the offshore energy mix is changing. And we are also seeing changes to the way people work (and go to sea) with much more emphasis on work-life balance and the environment. So, the robotic tools that construct and maintain energy infrastructure need to evolve. In the future, the tools we today call work class ROVs will need to be suitable for uncrewed vessel and resident work; we may see less cabled connections to the surface and onboard power systems; we will probably see AI start performing tasks, with a move from person in loop to person on loop-command to control. It will be easier and faster to undertake tasks and see the results, with real-time information at the fingertips of stakeholders anywhere in the world."

Image courtesy KBR

ENHANCING ENVIRONMENTAL ACCOUNTABILITY IN OFFSHORE OPERATIONS VIA DATA ANALYTICS

As an industry, the offshore energy sector continues to evolve its approach to reducing environmental impact. Looking beyond the mandatory reporting of scope 1 and 2 carbon emissions, focus is now shifting to scope 3 emissions where many global energy leaders are starting to commit to targets despite reporting not yet being obligatory. But this is a complex, challenging step that requires expert support to achieve. **David Cole, Director at KBR Project Solutions,** *discusses how best to implement a comprehensive system of emissions reporting and analysis across the lifecycle of offshore assets.*

The Complex Nature of Carbon Emissions Reporting in Offshore Environments

The path to getting an accurate, standardised picture of carbon emissions has not been a smooth one. Any such exercise relies on the dependability of the data used, but historically data collection efforts have been inconsistent, in part due to the absence of a precise model for offshore installations. This has impeded opportunities to undertake comparative analysis across the industry. Furthermore, existing models, such as the Greenhouse Gas Protocol and the US' Generally Accepted Accounting Principles, do not adequately address the wider scope 3 emissions associated with large offshore infrastructure projects, including critical aspects like equipment manufacture, fabrication, and transportation and installation.

In short, the industry's efforts in reporting have been uneven, often relying on a qualitative approach or methods which have been designed for other sectors such as building and infrastructure construction projects. With tightening regulations, there's a pressing need for a shift towards an analytical, data-centric approach for predicting carbon emissions. This move will not only enhance transparency but also enable targeted and effective emission reduction strategies.

More rigor is needed in how the right data, particularly focusing on the design phase and embodied emissions, is collected systematically. This data should then be subjected to high standards of analysis that can unlock the most effective ways to make reductions and in parallel support the most efficient operation of the asset. To achieve this, we focus on five key steps.

Five Key Steps to Reduce Emissions Through Data Analysis

1. Hindsight – what has happened - Looking back at past developments and their lifecycle carbon emissions is crucial. It establishes a benchmark from which future offshore projects can aim to reduce emissions. This historical perspective is key to setting achievable reduction targets.

2. Oversight – why has it happened - Once we set the benchmark, diagnostic analytics clarifies the broader context of the lifecycle emissions. By leveraging various data sources and employing graphical visualizations, companies gain a clearer understanding of embodied and operational emission trends and patterns in offshore execution.

3. Foresight – what will happen - Predictive analytics, particularly those augmented by machine learning, offer insights into potential future scenarios. They enable assessment of the environmental impact of offshore designs, informing more sustainable development paths.

4. Insight – what should be done - Using prescriptive analytics creates actionable insights to fine-tune project designs to minimize future carbon outturns. Simulations and data-driven suggestions lay the groundwork for effective decarbonization strategies, leading to quantifiable carbon reductions.

5. Right sight – 'what if' - Exploring 'what if' scenarios is fundamental. Cognitive analytics facilitate this exploration, allowing companies to consider alternative strategies and solutions, fostering a deeper understanding, and guiding the adoption of sustainable, low-carbon energy practices.

Being able to accurately analyze the different levels and types of data analysis, from descriptive through to cognitive, however, requires tools, software, and a proven methodology to become universally accepted.

KBR's commitment to developing a solution for accurate carbon accounting and analysis is vital in enabling in-

Image courtesy KBR

formed, data-driven decisions in the offshore sector. And, while our solution is not a compliance tool, we help estimate emissions from components and materials. This aids in adopting carbon-efficient alternatives, in line with the global shift towards including scope 3 emissions.

The Future of Emissions Reporting in Offshore Projects

Simple statistics deliver descriptive results, telling the reader what happened. This is the realm of most carbon emission calculations available today, providing retrospective reporting of the carbon emissions that have already been emitted to the atmosphere. The above analytical approach allows us to go further than this. It enables the identification of trends and implications related to both traditional and alternative execution strategies, allowing for a more comprehensive and standardized understanding of carbon performance.

We expect this to increase in importance as shareholder pressure builds to achieve more ambitious corporate sustainability goals. Adopting advanced data analysis techniques, from benchmarking historical projects to predictive modelling and cognitive analysis, is crucial to understand the full lifecycle of carbon emissions. This comprehensive approach enables accurate and detailed assessments of emissions, incorporating wider scope 3 emissions of the project, thereby enhancing decision-making throughout the lifecycle of offshore projects.

To learn more about carbon footprint calculation, download KBR's offshore-focused white paper, Carbon cognitive; turning guesswork into quantitative emissions modelling and representation, which also details KBR's solution, CleanSPENDSM.

RIGS

Worldwide

Rig Type	Available	Contracted	Total	Utilization
Drillship	7	76	83	92%
Jackup	178	293	471	62%
Semisub	27	47	74	64%

Africa

Rig Type	Available	Contracted	Total	Utilization
Drillship		15	15	100%
Jackup	13	16	29	55%
Semisub		5	5	100%

Asia

Rig Type	Available	Contracted	Total	Utilization
Drillship	3	7	10	70%
Jackup	84	70	154	45%
Semisub	17	5	22	23%

Europe

Rig Type	Available	Contracted	Total	Utilization
Drillship	2	6	8	75%
Jackup	14	28	42	67%
Semisub	5	20	25	80%

Latin America & the Caribbean

Rig Type	Available	Contracted	Total	Utilization
Drillship	1	27	28	96%
Jackup	3	4	7	57%
Semisub	2	8	10	80%

Middle East

Rig Type	Available	Contracted	Total	Utilization
Jackup	33	140	173	81%
Drillship				

North America

Rig Type	Available	Contracted	Total	Utilization
Drillship	1	21	22	95%
Jackup	22	29	51	57%
Semisub	2	2	4	50%

Oceania

Rig Type	Available	Contracted	Total	Utilization
Drillship				
Jackup		1	1	100%
Semisub		5	5	100%

Russia & Caspian

Rig Type	Available	Contracted	Total	Utilization
Jackup	8	2	10	20%
Semisub	1	2	3	67%

Global Average Dayrates

Floaters		Jackups	
Ultradeep water	489.7	High-spec	147.2
Deepwater	325.0	Premium	141.9
Midwater	407.3	Standard	98.1

This data focuses on the marketed rig fleet and excludes assets that are under construction, retired, destroyed, deemed noncompetitive or cold stacked.

Data as of February 2024
Source: Wood Mackenzie Offshore Rig Tracker

DISCOVERIES & RESERVES

Offshore New Discoveries

Water Depth	2019	2020	2021	2022	2023	2024
Deepwater	20	13	13	22	13	
Shallow water	86	47	59	35	53	
Ultra-deepwater	18	12	7	18	10	1
Grand Total	**124**	**72**	**79**	**75**	**76**	**1**

Shallow water (1-399m) Deepwater (400-1,499m) Ultra-deepwater (1,500m+)

Offshore Undeveloped Recoverable Reserves

Water Depth	Number of fields	Recoverable reserves gas mboe	Recoverable reserves liquids mbl
Deepwater	586	49,820	22,468
Shallow water	3,256	413,375	142,896
Ultra-deepwater	346	44,081	27,542
Grand Total	**4,188**	**507,276**	**192,906**

Contingent, good technical, probable development.

The total proven and probably (2P) reserves which are deemed recoverable from the reservoir.

Offshore Onstream & Under Development Remaining Reserves

Region	Number of fields	Remaining reserves gas mboe	Remaining reserves liquids mbl
Africa	585	18,658	11,256
Asia	830	14,852	7,470
Europe	759	12,627	11,493
Latin America and the Caribbean	193	6,630	39,954
Middle East	138	87,762	152,297
North America	467	2,570	12,812
Oceania	87	11,027	1,086
Russia and the Caspian	60	17,078	12,753
Grand Total	**3,119**	**171,204**	**249,121**

Onstream and under development.

The portion of commercially recoverable 2P reserves yet to be recovered from the reservoir.

Source: Wood Mackenzie Lens Direct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