

ENERGY at SEA

The German Offshore Wind Compendium | 2022



GERMANY'S POTENTIAL

Offshore wind is now central to national energy strategy

ENERGY TRANSITION

The importance of green hydrogen and alternative fuels

LOGISTICS

Complex coordination of various industry segments and stakeholders

Bundled competence in marine technology for exploration, protection and sustainable use of the oceans



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Showcase for German expertise in the world

The "Overview Paper Easter Package" drafted by the German Federal Ministry of Economics and Climate Protection in the spring presented the cabinet with one of the biggest energy policy amendments in decades. Among other things, it states that offshore wind energy development should be in the "overriding public interest" in the future. This has not only symbolic value, but also concrete legal consequences, which should also accelerate and simplify the approval of new projects. As an important supplier of green hydrogen and the development of a hydrogen economy, this further expansion of offshore wind energy is indispensable.

Climate change is no longer a distant, theoretical construct – it has been felt, especially in the past few weeks of summer. The droughts, floods, fires and the high temperatures give us a real sense of what the consequences will be in the years and decades to come if we do nothing now.

There are many positive initiatives that are being taken. But there is also a stubborn indifference among some politicians and decision-makers who place the importance of a free market above the sensible use of resources. Without resorting to worn-out proverbs, but it really is now 5 past 12, and action needs to be taken. With combined forces.

With this new special publication "Energy at Sea" from the Schiff&Hafen | Ship&Offshore editorial team of the DVV Media Group, in cooperation with the German Offshore Wind Energy Foundation, the German Shipbuilding and Ocean Industries Association (VSM) and the German Association for Marine Technology (GMT), we aim to show the enormous technical and logistical potentials of the market and answer the most urgent questions. What goals can and must be achieved? What is needed to achieve them? Which technologies and developments are available, and how can we move forward most effectively?



Kathrin Lau
Editor in Chief
Schiff&Hafen | Ship&Offshore

In total, we would like to consider "Energy at Sea" as a showcase for the German offshore wind industry in the world.

This year, we will inaugurate the magazine in time for the WindEnergy trade fair at the end of September; in the future, this will become an annual English-language industry overview published in early autumn. ≈

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Source: VSM

Dr Reinhard Lüken,
Managing Director,
German Shipbuilding and Ocean
Industries Association (VSM)

"Climate neutrality can be achieved before 2050"

The role of energy at sea can hardly be overstated. Both in terms of production as well as consumption, energy is a key factor in the maritime industries. This has been the case for decades, with the offshore oil and gas sector being the largest maritime business segment and fuel costs being the single largest cost factor in shipping.

However, the reason why this issue is at the centre of attention of industry and policy makers alike is not the status quo. It is the sea change that lies ahead. Already in the 1960s, discussions started about the fact that oil and gas reserves will not last forever. While industry managed to push the famous peak oil forward for years, it was always evident that the era of fossil fuel would inevitably have to come to an end at some point. Now, with climate change being felt more painfully year by year all over the planet, the world has no choice but to fast-forward coming clean from its addiction on cheap energy. This will be a costly exercise, albeit not nearly as costly as moving on with business as usual.

Shipping is considered hard to abate. The fact that in 2022, 60% of newbuild tonnage on order worldwide will still be fully conventional is a case in point, especially taking into account that the remaining 40% will largely rely on LNG, a much cleaner but still fossil fuel alternative. Considering these vessels take three years to be built and will be in service for the next 25 years on average, the fleet of 2050 is already in the order books. The voyage to climate-neutral shipping is yet to begin.

It is important to emphasise that the shipping industry is struggling with this task not because of a lack of technology. It is the cost that is preventing the industry from taking up available solutions and scaling up the respective production. The current steep rise in shipping rates demonstrates that fleet renewal and shifting to renewable fuels would be affordable. The key obstacles for our global industry are of a commercial and regulatory nature.

The IMO is one of the most productive United Nations agencies. Nevertheless, aligning 175 nations is a cumbersome process. Currently, the IMO pathway falls far behind Europe's climate protection goal. Europe's vast maritime sector can demonstrate that climate neutrality can be achieved before 2050 and that this will open an array of opportunities:

- ~ The production of renewable energy offshore will require a lot of additional hardware and ships to build, connect, serve, maintain and, at some point, decommission.
 - ~ Carbon dioxide will become a commodity to be used for the production of renewable fuels and to be stored away safely offshore.
 - ~ With energy cost in shipping increasing substantially, energy saving requirements will push for an accelerated fleet renewal.
- Climate protection is therefore the greatest business opportunity for the maritime industry since the invention of the steam engine. Together we must ensure that this opportunity is turned into economic success for Europe. ≈

VSM

The German Shipbuilding and Ocean Industries Association (VSM) represents the political and commercial interests of the German maritime industry, comprising shipyards building oceangoing and inland waterway vessels as well as marine equipment suppliers, classification societies, ship model basins and engineering consultants. The VSM also promotes technical and commercial development in the shipbuilding and ocean industry in Germany and abroad.

"Offshore wind energy is indispensable for the future"

When the coalition agreement between SPD, BÜNDNIS 90/DIE GRÜNE and FDP was published in November 2021, it contained a surprise for the offshore wind energy sector: the development corridor announced therein, i.e., an installed capacity of 30 GW in 2030, 40 GW in 2035 and 70 GW in 2045, by far exceeded expectations. After past misjudgments which meant that no new wind energy installations were set up at all in German waters in 2021, this determined signal was all the more necessary and important. Offshore wind energy is indispensable for the future decarbonised supply of energy. The new objective was already included in the substantially amended Offshore Wind Energy Act (Windenergie-auf-See-Gesetz) as part of the Easter Package and backed up with the required instruments for acceleration. The anchors are now afloat. There are, in fact, well-founded doubts as to whether the revised auction design provides the appropriate incentives and focuses on the right aspects; it is expected that adjustments will be necessary in this regard. Nevertheless, Germany has thus finally set the ambitious targets which the industry, grid operators and the public administration require for accelerating the expansion. This concerns the availability of installations and all their components, the planning and implementation of grid connections as well as the determination of suitable marine areas of adequate extent – the draft of the updated site development plan of the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie – BSH) already takes into account the new law.

Furthermore, what is needed now is a strong focus on the implementation and accompanying policy measures for the industry. The high demand for skilled labour, the establishment of domestic and European production capacities as well as the availability of material and resources along the entire value chain are only a few of the critical areas which will be decisive for achieving the new expansion targets. Not least because in

the period up to 2030, within the next eight years three times the offshore wind capacity that was installed in the past 12 years shall be installed.

Moreover, technological developments in all associated areas still remain of crucial importance. Options for using the limited space available for multiple purposes (keyword: multi-use) must be tested and driven forward. In order to make the expansion as eco-friendly as possible, more research into the impact of offshore wind energy on marine ecosystems is required. It is also important to make the expansion of offshore wind energy as profitable and thus as economically efficient as possible through technological progress and a smart design of wind farms and their sites.

While onshore grid expansion remains a challenge for transmission system operators and the coastal federal states, a vision for an offshore interconnected grid across Europe is already being developed. Such a grid is to make a major contribution to energy security and can – as a European integration project – also be a strong political signal.

And last but not least, we have to make sure that the production of green hydrogen from offshore electricity contributes to the energy transition and our independence from energy imports. In this context, many exciting key aspects need to be discussed and further developed to allow for an economically efficient use of electrolyzers as part of a flexible, sustainable energy grid and of hydrogen as part of sector coupling. This concerns the locations of electrolyzers, the use of waste heat and oxygen, i.e., the by-products of electrolysis, as well as the further development of the technology for its offshore application.

The Board of Trustees of the German Offshore Wind Energy Foundation brings together all the stakeholders concerned with the implementation of the expansion targets and the further development. We look forward to continuing our purposeful collaboration in the future and wish you every success in all your endeavours. ≈

Source for both images: Stiftung Offshore Wind



Karina Würtz,
Managing Director, German Offshore Wind Energy Foundation



Dr Ursula Prall,
Chair of the Executive Board, German Offshore Wind Energy Foundation

German Offshore Wind Energy Foundation
The German Offshore Wind Energy Foundation (Stiftung der deutschen Wirtschaft zur Nutzung und Erforschung der Windenergie auf See) was founded in 2005 on the initiative of the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU). It serves as a communication platform for political decision-makers, for business, and for research. The Foundation serves as a platform to share expertise and as an initiator of new ideas. At the same time, it also represents and bundles the various stakeholders' interests, representing them towards politics, economy, and science, as well as to the general public.



Source:GMT

Dr Walter L. Kuehnlein,
Chairman of the Board
GMT - German Association
for Marine Technology

"The sea will provide new opportunities"

Germany's renewed commitment to offshore wind energy is an essential component in meeting the nation's climate targets and contributing to its energy security. The ambitious targets that lie ahead will require all of the maritime and energy sectors' expertise in the fields of exploration, design, construction, installation, maintenance, monitoring and decommissioning.

At the same time, new technologies will enable us to harness energy not only on the sea, but from the sea itself. As an enormous energy store, the sea will provide new opportunities for harnessing power from waves, tides, currents and ocean heat. Expertise developed in today's offshore wind and marine sectors will provide sound foundations for developing and harnessing these new sources of energy.

The exchange of information and networking between industry and science play a decisive role in initiating research and development priorities and identifying innovation and cooperation potential. The German Association for Marine Technology (GMT) provides a well-tried-and-tested platform for this, with its extensive and bundled competence in marine technology.

We are proud that GMT has supported offshore wind development since its early days some three decades ago. Even in those early years, we were never in doubt over the crucial role that marine technology and offshore expertise would play in the development and success of wind farms at sea. Today, this is more important than ever, with ever-larger offshore installations requiring a new generation of sophisticated installation vessels, and new technologies including floating wind facilities developing rapidly.

Electricity from renewable sources, including offshore wind, will play a key role in the energy transition, in some cases directly replacing fossil fuels by heating homes and providing a baseload of power for some industries. But we

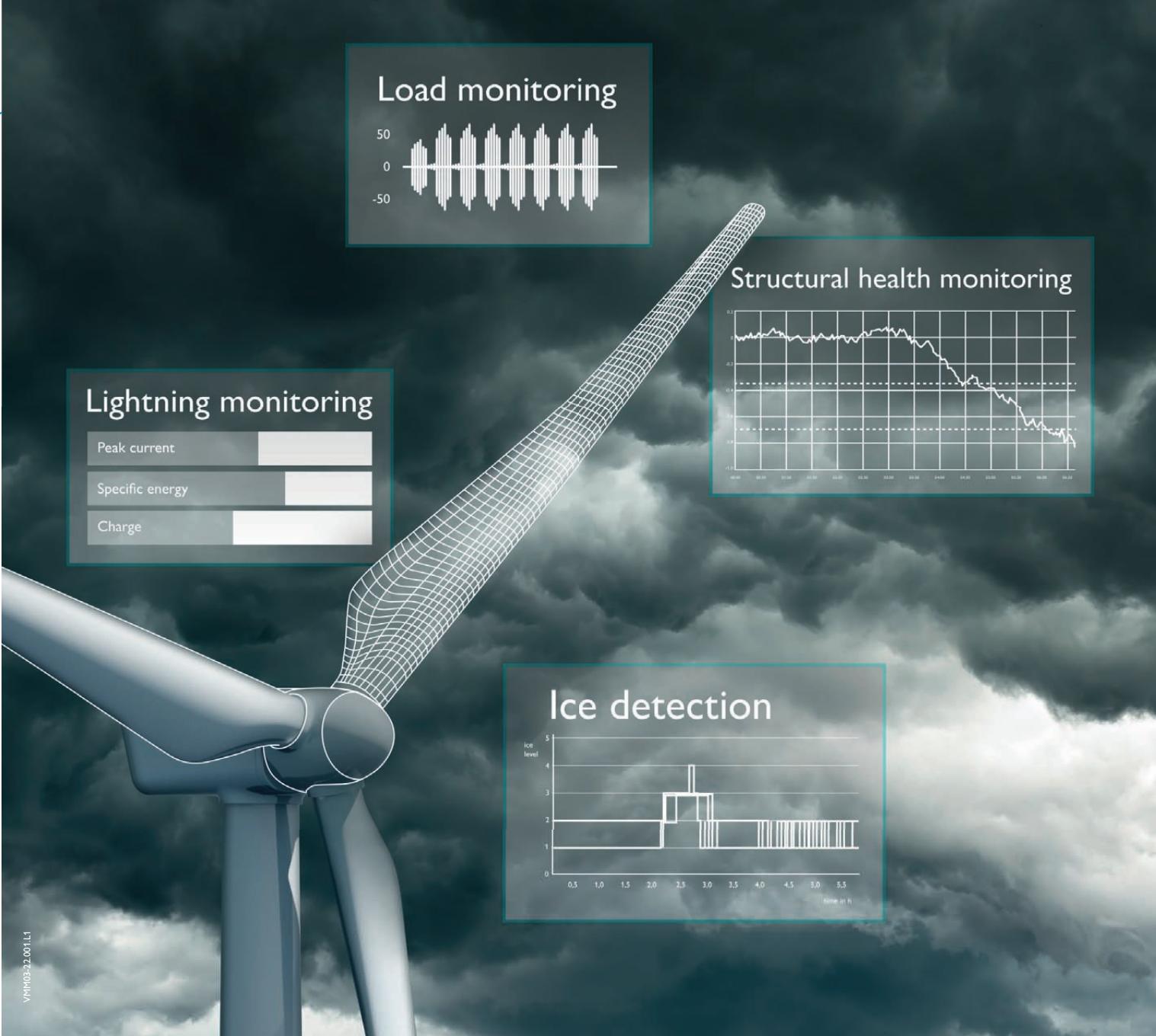
also need to focus on large-scale energy storage and the provision of sustainable energy for heavy industrial consumers such as the steel, cement, agriculture, and global transport sectors.

Power-to-X is a rapidly developing technology that, in due course, will meet these challenges. It will enable renewable electricity to provide energy for green hydrogen, synthetic methane, ammonia, and other sustainable energy carriers that are under development today. It will also enable the large-scale storage of carbon-free energy for some of the most intensive energy-consuming sectors.

In light of the latest energy disruption in Germany and across Europe more generally, I believe that we need a robust political framework to support the development of renewable fuels and reduce the pace of global warming. This framework should help us to evaluate how we can reduce carbon emissions most effectively and needs to be dynamic – monitored, measured and modified against objectives and in light of new technological developments.

In conclusion, I am confident that the marine and offshore sectors both have essential and far-reaching roles to play in driving global energy developments through energy transition to a smart and sustainable future. ≈

GMT
The German Association for Marine Technology (GMT) represents the interests of companies and research institutions in the area of marine technology towards the public and policy makers. The GMT is supporting the networking of its members from industry and science in order to initiate national and international research and development projects. Another focus is the design of innovative products and services to open up new market segments in Germany and abroad. Marine engineering develops, produces and uses technologies for the exploration, protection and sustainable use of the oceans.



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Offshore wind now central to Germany's energy strategy

STIFTUNG OFFSHORE WIND The first German offshore wind test site was commissioned in 2010 but, even so, the country has not become a forerunner in this segment so far. However, with coastlines along the North and Baltic Seas, as well as a technology supremacy, Germany's potential in this market – also worldwide – is huge. The current Government's coalition treaty has fortunately brought a "breath of fresh air" to further expansion. The German Offshore Wind Energy Foundation (Stiftung Offshore Wind) gives an overview about the eventful and not uncontroversial development of an entirely new industry in the shortest time.

2021 was the year when offshore wind expansion came to a halt. Eleven years earlier, Germany had embarked on its ambitious offshore endeavours by commissioning the test site *alpha ventus* in April 2010 (see page 10). Today, nearly 8 GW of offshore wind capacity is installed in the German North and Baltic Seas, supplying up to ten million households with green electricity. 2015 marked the record-breaking year so far when around 2.5 GW were installed and commissioned in the twelve months.

From promising to disastrous

Yet this record was already overshadowed by political decisions in the previous two years. A debate had arisen around the threat of exploding consumer electricity prices due to the increasing integration of renewables into the energy system.

The subsidy scheme for renewables was linked to the "EEG-Umlage" ("Renewable Energy Act surcharge") to mitigate differences between fixed feed-in tariffs for producers and market electricity prices. The idea was to make consumers collectively burden a share of the costs for the "Energiewende" ("energy transition"). In fact, it achieved the desired effect to boost green energy expansion very well.

However, expansion goals were cut in 2014. For offshore wind energy, this meant 15 GW instead of 20 GW by 2030. The

impact was huge and became obvious in the years that followed. Dozens of specialised companies along the supply chain went out of business due to the breakdown of a steady, high, and stable project pipeline over the one-and-a-half decades ahead.

One quarter of the skilled workforce in the industry was lost. A global offshore wind market to partially compensate was yet to emerge. So, 2021 was the year when offshore wind expansion came to a halt.

A whole new Wind Energy at Sea Act

The same year, Germany's Federal Constitutional Court admonished Germany's ruling coalition of Christian and Social Democrats for insufficient short-term ambition in the earlier passed climate act. The Government subsequently reset Germany's goal to reach climate neutrality from 2050 to 2045.

The coalition agreement between Social Democrats, Greens and Liberals in November 2021 after the federal election two months earlier held a further surprise – even for the industry. The new Government raised offshore wind expansion targets to at least 30 GW in 2030, 40 GW in 2035, and up to 70 GW in 2045.

In January 2022, the newly appointed Vice Chancellor and Minister of Economic Affairs – and now also Climate Protection – Robert Habeck from the Green Party, announced the initiation of



Offshore wind expansion targets have been increased by the German Government

Source: Stiftung Offshore Wind

the biggest ever legal amendment process in the energy sector ("Easter and Summer package") in the months to come. The Easter package passed the German parliament on July 7th.

Part of it was the offshore sector's most important bill – the Wind Energy at Sea Act. The politically announced expansion targets are now legally binding, the auctioning pipeline is massive: 8-9 GW in 2023/24, 3-5 GW in 2025/26, and then 4 GW annually starting in 2027. Furthermore, offshore wind energy is now considered as being of "paramount public interest", which is likely to have a considerable impact on decisions by authorities and courts. At the heart of the Act – and the debate in the previous month – stood the new "two-tiered" auctioning system, which even saw major alterations literally "on the last mile" in the parliamentary bargaining process shortly before July 7th.

Half the offshore wind sites, centrally pre-examined by the federal authority BSH, will be auctioned through five bidding criteria. An uncapped negative bid accounting for 60% in the evaluation and four further criteria (volume of PPA-Lols or contracts, noise mitigation measures for foundation installations of turbines, use of green electricity and green hydrogen in the production process for major components, and workforce-to-trainee ratio).

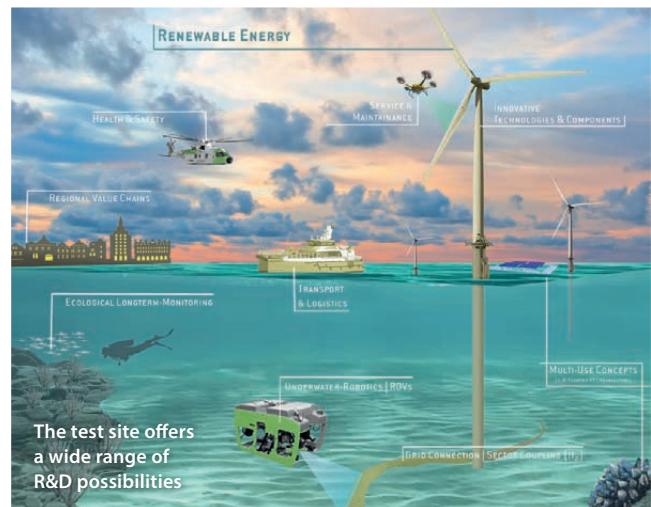
The other half of sites will be pre-examined by the private sector. Contracts for Differences, which were proposed by

the Ministry of Economic Affairs as a support scheme for this tier were scrapped due to the resistance of the Liberal Party. Instead, companies will now bid again for a sliding market premium as in the transition auctions of 2017/18. In case of more than one 0 ct/kWh bid, negative bidding is the choice once more. However, the uncapped negative bidding mechanisms have been heavily criticised by the industry, and are thought by some to pose a massive risk for rising energy prices.

From target setting to implementation

And while the discussions about the right regulatory framework and market design continue, not a single additional turbine has been built. While there is no lack in political target setting for the first time in years, the industry's overall starting point is challenging in the face of increasing global competition for scarce resources, production capacity, and a lack of the necessary infrastructure – for example, in ports.

The successful implementation of the ambitious expansion targets now depends on the right answers and joint efforts by the Government and private sector. There is a lot at stake – and obstacles as well as opportunities ahead. ≈



Source for both images: Stiftung Offshore Wind

Challenges of future installations

TEST SITES

TEST SITES Germany started its offshore wind endeavour with the commissioning of the test site *alpha ventus* in the North Sea back in 2010. The world's first deep sea offshore wind farm was small from today's perspective, yet a decisive milestone towards large-scale harvesting of offshore wind as a resource. The twelve turbines have a cumulative capacity of 60 MW. Today, nearly 8 GW of offshore wind capacity is installed in German waters, supplying around 10 million households with green electricity. The new ambitious expansion targets (30 GW in 2030 and up to 70 GW in 2045) will call for a joint effort by all stakeholders and broad innovation and out-of-the-box-thinking not only to reach the targets, but to reach them in time.

Even though the industry has matured, there are huge challenges to be tackled and opportunities to be seized. The next offshore wind farms will not only have to be more efficient by further scaling up in size but must address other challenges as well. From 2030 onwards, offshore wind farms are increasingly intended to provide not only electricity but further benefits to grid stability and flexibility. Examples could be direct linkage of the wind farm to electrolyzers or the integration of storage

technologies like batteries. Maximising the energy output on sites by integrating other renewable energy sources (e.g., floating PV) will be another key focus due to maritime space as a scarce resource in Germany. The development of smart multi-use solutions to reduce conflicts with other sea users represents another aspect of maritime space distribution issues. The move towards a circular economy (e.g., blade recycling) and finally the production of hydrogen to support other sectors on their way towards climate neutrality are areas with great innovation potential. The offshore sector will play a key role in the energy system of the future if it continues to develop sustainable solutions.

German offshore test site as an ecosystem for innovation

To accelerate this process and support the development of reliable business cases, Germany has decided to build a second offshore wind test site (after *alpha ventus*) in the Baltic Sea that will be commissioned around 2028. The offshore test site will be located around 12 km north of the coastal town of Warnemünde – near the Hanseatic port city of Rostock – in Mecklenburg Pomerania. It will have a total

capacity of around 180 MW. The test site stretches over an area of 15km² with water depth around 20m (see map above). It offers ideal conditions to test and demonstrate new technologies and concepts on a large scale with proximity to shore, and thus having the potential to become Germany's offshore innovation powerhouse. It will not only help solve big energy challenges like integrating offshore wind more efficiently into the system, but it will also serve as a playground to test and demonstrate new maritime systems and concepts. The test site offers the opportunity to test new logistic concepts and transport options such as remote operated vehicles, drones and other maritime technologies, under real conditions.

German Offshore Wind Energy Foundation calls for proposals

The Federal Ministry for Economic Affairs and Climate Action commissioned the German Offshore Wind Energy Foundation to develop the concept for the new test site. Via the project website, interested companies and research institutes can hand in a letter of interest and arrange a personal meeting to discuss their ideas and proposals. ≈

Green hydrogen from offshore wind energy

SHARE OF RENEWABLES Germany's goal to become largely greenhouse gas neutral by 2045 is a massive challenge. One step is the federal Government's aim to increase the share of renewable energy in electricity production to 80% by 2030. The Federal Ministry of Economic Affairs published figures in 2021 expecting a gross power consumption of 658 TWh by then. The share of renewables so far exceeds 40 %. Yet this figure might be misleading as direct electricity consumption only accounts for roughly one quarter of overall energy consumption. Fossil gas, oil, coal, biofuels etc. account for the other three quarters. In traffic, renewables accounted for only 1.8 % of energy used in 2020, while they delivered above 30% of energy for businesses, services, and the industry [1]. Then, the current share of renewables drops to only 12 – 15% when looking at gross energy consumption. Major factors, why some sectors lag behind, are the availability of green energy, costs of different energy sources, and the potential to substitute other energy sources with green power. While everyone agrees that the direct use of electricity is the most efficient scale, there are areas where this is not possible – at least not on a large and in an economically viable way. Batteries in aircrafts would simply be too big, and certain industrial processes cannot be run on electricity.

Green hydrogen (hydrogen from electrolyzers powered by renewable energy sources) has become a buzz word for these areas as a possible solution. Germany is not exempted from the "hydrogen hype". The country aims at boosting domestic hydrogen production, yet there is no doubt that it will also have to import hydrogen and its derivates. The current Government increased the expansion target for the installed capacity of electrolyzers from 5 to 10 GW by 2030. Offshore wind is supposed to play a major role in providing electricity. Yet, there is no specific target set so far for the sector's share.

The Government will nonetheless auction the first offshore site this year, dedicated to hydrogen production offshore. The 300-MW area SEN-1 in the North Sea is 27.5km² in size and 100 km off the coast. Offshore hydrogen production has become an increasingly interesting topic, posing a complete new set of challenges and questions to be answered ranging from the regulatory framework, the support scheme, technical solutions like seawater desalination, to the usage of by-products such as waste heat and oxygen.

Project "Green Hydrogen from Offshore Wind Energy"

The German coastal state of Lower Saxony – through its Ministry of Environmental Affairs, Energy, Building and Climate Protection (MU) – supports the Foundation's activities in the field via a flagship project set up in December 2020 to address these various questions.

Together, the Foundation and MU presented the first offshore wind and hydrogen production potential study in September 2021. The current work focuses on locational criteria for the allocation of electrolyzers from an economic perspective. Offshore wind and green hydrogen – as well as a combination of both – are of immense strategic importance for the state. Lower

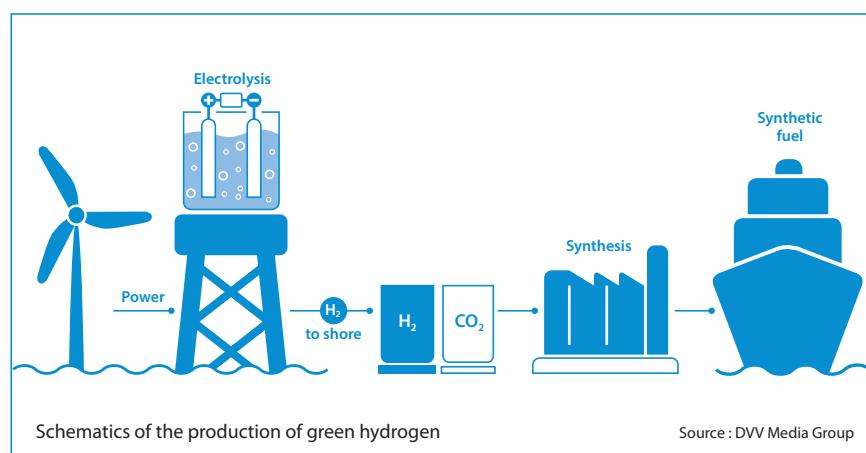
Saxony is decisive for reaching Germany's new ambitious offshore wind targets as well as a key region in the energy transition. 4.9 out of the 7.8 GW of installed offshore wind capacity are already connected to and via Lower Saxony. This trend will increase massively due to the allocation of most future wind sites in the North Sea and in a North-West to West direction. State authorities are responsible for the grid planning in the ecologically highly sensitive Wadden Sea as well as the supervision of health, safety, and emergency rescue measures. The state's land-based infrastructure and capacities (e.g., harbours, dockyards, production facilities, hinterland infrastructure, decommissioning sites etc.) are of major importance from planning, over construction, operation and maintenance, to decommissioning.

The proximity to the sea and availability of massive and increasing amounts of clean offshore wind energy in combination with strong industry hubs puts Lower Saxony in a prime seat to ramp up a green hydrogen economy.

The Foundation supports the state in its aim to implement the right measures and set the necessary incentives. ≈

Reference:

[1] Umweltbundesamt auf Basis Arbeitsgemeinschaft Energiebilanzen



Roadmap for the maritime energy transition

POWER-TO-X To accelerate the achievement of climate targets in shipping, the two German industry associations VDMA (Verband Deutscher Maschinen- und Anlagenbau e.V. – German Engineering Federation) and VSM (Verband für Schiffbau und Meerestechnik e.V. – German Shipbuilding and Ocean Industries Association) have jointly prepared a Power-to-X (PtX) roadmap

The immense fuel demand of shipping requires the industry to take a pioneering role in supporting and exploiting the market for synthetic, climate-neutral fuels and enabling their widespread use in other industrial sectors too. In particular, the industry can be a decisive enabler for the market ramp-up of hydrogen as the basis for all synthetic fuels (e-fuels) when produced from water and CO₂ using “green” electric power (power-to-X, PtX).

In technology terms, intra-European shipping could become climate-neutral by 2045, provided that the regulatory framework is set to achieve this. This is an ambitious timetable that could enable the European Union (EU) to act as a role model at an international level. With this PtX roadmap, the maritime industry presents a proposal describing the prerequisites.

A number of fuel options and production processes are available for shipping that will have to be scaled up industrially before the end of this decade. It is of critical importance that this is accompanied by an increased demand for renewable fuels. This should not take place at a project level, as has been the case to date, but systemically at the member state level.

In order for e-fuels to achieve the required energy density, carbon is usually required for production. This carbon should come from the air or biomass, or, initially, from unavoidable industrial emissions. The relevant technologies need to be scaled up industrially. At the same time, the EU must provide a legal framework that creates incentives for the market-wide use of CO₂ and the development of closed-loop systems.

To ensure that the EU lives up to its pioneering role and that intra-European ship-

ping becomes climate-neutral by 2045, the maritime industry believes the following regulatory levers to be of vital importance:

- ~ VSM and VDMA support an ambitious reduction path for fleet-wide GHG emissions. This can be achieved through the combined use of alternative fuels and measures to increase efficiency. In this context, the associations advocate an ambitious special path for intra-European shipping. From 2027, incremental GHG reduction steps could be implemented, starting at 10% and gradually increasing to 100% by 2045. The calculation method and reference year should be based on the approach described by the European FuelEU Maritime initiative.
- ~ The energy transition needs an effective CO₂ pricing scheme to make climate-neutral fuels competitive and to raise investment funding for restructuring the maritime economy. Including shipping in the EU Emissions Trading System (EU ETS) is an important building block towards this goal. However, the technical criteria for CO₂ pricing must be compatible with certification and operating regulations.
- ~ The maritime energy transition requires a legal framework to stimulate sustainable investments through a consistent orientation of financial products towards green technologies. The approach pursued in the EU taxonomy of assessing ship emissions exclusively at the smokestack instead of looking at the climate neutrality of a ship's entire propulsion concept is inadequate. Only a well-to-wake approach, which takes into account the greenhouse gases of the entire fuel value chain, as pursued in FuelEU Maritime, adequately promotes the use of climate-neutral fuels.
- ~ The EU Commission's revised Renewable Energy Directive II (RED II) provides for a binding increase in the share of renewable energies to at least 40% in order to meet the rising demand for renewable energies associated with sector coupling. However, to stimulate the necessary investment, the target quota for renewable fuels of non-biological origin (RFN-BOs) should be set at 2.6% for 2026 and – as specified in the REPowerEU plan – increased to 5% by 2030.
- ~ VSM and VDMA support the initiative to build up PtX production capacity as planned by the EU Commission in the industrial alliance to promote the supply of alternative fuels (Renewable and Low-Carbon Fuels Value Chain Industrial Alliance). In this context, the Alliance should set a quantitative minimum target of 5 to 6 GW of generation capacity for shipping by 2030 in order to make the success of the cooperation measurable.
- ~ Even in a climate-neutral economy, Germany and other European countries will remain permanent energy importers. The strategy for external engagement in the energy sector (External Energy Strategy) as part of REPowerEU to drive international hydrogen partnerships should therefore be supported. In this way, the EU can strengthen cooperation with its neighbours and increase export opportunities for European technology providers. ≈



The full Power-to-X roadmap for the maritime energy transition from VSM and VDMA can be downloaded with this QR code

A New Global Leader in Offshore Wind



Mainstream Renewable Power and Aker Offshore Wind combine to create global frontrunner in offshore wind. Mainstream now has a 27 GW global portfolio across solar, onshore wind as well as bottom-fixed and floating offshore wind.

Mainstream Renewable Power ("Mainstream") and Aker Offshore Wind entered an agreement in July to combine the two companies to create a stronger renewable company.



"The strong industrial logic for combining Aker Offshore Wind and Mainstream includes complementary footprint and capabilities, increased scale, and improved access to financing," said Mary Quaney, Chief Executive Officer of Mainstream. "Combining Aker Offshore Wind's strong technical and engineering

capabilities, and early mover position in floating offshore wind, with Mainstream's proven project development methodology, execution track record and global presence unlocks new opportunities worldwide."



"The consolidation of Aker Horizons' interests in renewable energy will accelerate Mainstream's transformation into a global renewable energy major with leading floating and fixed offshore wind capabilities," said Kristian Røkke, Chief Executive Officer of Aker Horizons and Chairman of Mainstream.



Tove Røskift has been appointed Head of Offshore Wind at Mainstream, reporting to Quaney. During her 25-year career at the Aker group, Røskift has held a range of executive leadership positions across offshore products and operations as well as corporate management, most recently as Chief Operating Officer of Aker Offshore Wind. She brings a deep knowledge of the offshore industry and extensive international leadership experience to the role.

The floating wind market is projected to grow rapidly in coming years, as several countries have launched ambitious targets to develop gigawatts of wind energy, with about 70-80 percent of offshore wind resources located at water depths only suitable for floating foundations.

Mainstream's offshore business will continue to develop existing project opportunities for fixed and floating wind in markets such as Norway, Sweden, Japan, South Korea, Vietnam, Ireland, the UK and the US, while exploring opportunities in new markets.

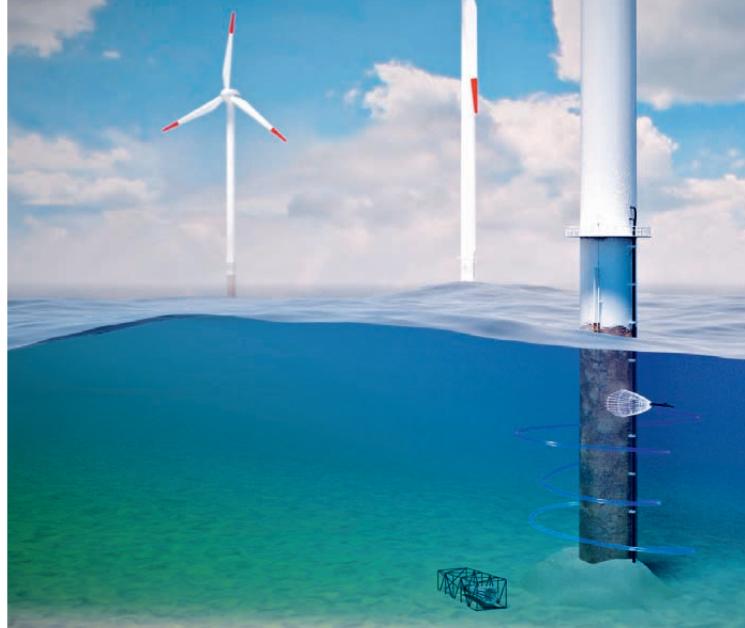
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MAINSTREAM
RENEWABLE
POWER



Source: Vattenfall Europe Windkraft GmbH



Marine technology is crucial for the

BLUE ECONOMY There are many good reasons why the oceans will be the next major area of business applications for the future. Innovation and investment are two sides of the same coin that drives economic activities in the oceans. To meet the growing global demand for more renewable energy, higher efficiency, resilient supply chains and other expanded commercial opportunities in a sustainable way, the development of the blue economy, especially marine technology, is crucial.

With 316 GW of installed capacity expected by the Global Wind Energy Council by 2030, offshore wind resources are imperative for the energy transition.

As offshore wind farms experience more challenges related to design, fabrication, installation, operation and maintenance, and lifetime extension compared to on-shore wind farms, the more integrated involvement of the marine technology industry will definitely be required. Three decades have passed since the first offshore wind farm was constructed. Today, offshore wind energy has been rapidly evolving with the aim of deploying larger wind turbines at increasing water depths and under complex external conditions.

Recently, floating wind power has attracted interest as part of the exploration

of deeper waters with undisturbed higher wind speeds. The installation of floating wind turbines brings additional degrees of freedom that affects the performance and safety of the turbines. Therefore, sustainable design, construction, and installation methods, hydrodynamics, aerodynamics, and controls of such structures are different from solid structures and require special attention and involvement of marine technology.

Due to the increased involvement of marine technology companies, there has been continuous progress in foundation



Source: PATTQauther und Bergungsbetrieb Rostock GmbH





Source: Atlas Elektronik GmbH

Source: Siemens Offshore Contractors GmbH

offshore wind industry

design, control strategy, transport and installation methods, marine operations execution, computational methods, and model testing, just to name a few.

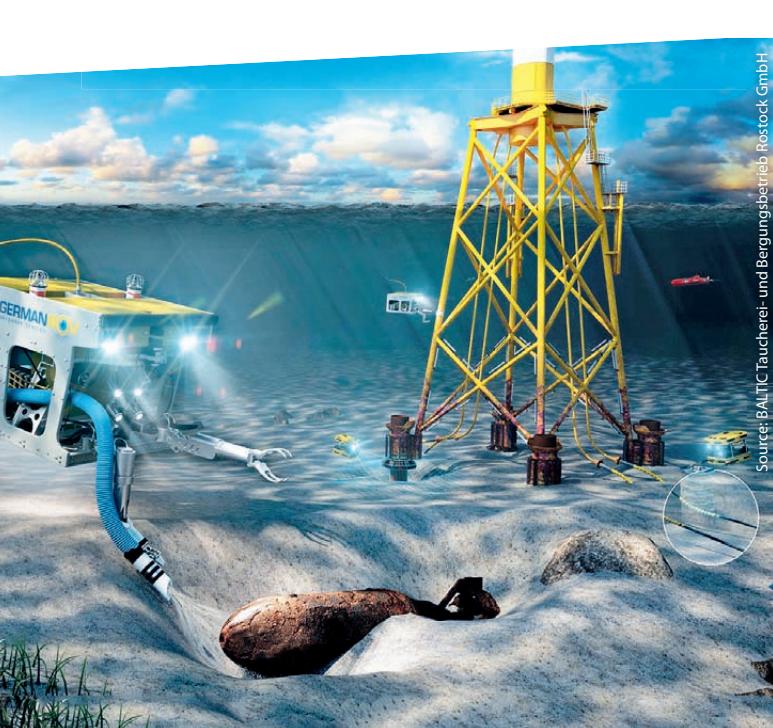
The global offshore wind market grew at almost 30% per year during the last decade, benefiting from rapid technological improvements, and much more than 100 new offshore wind projects are under active development worldwide. Europe was driving the development of the technology, led by the UK, Denmark, and Germany, but China added more ca-

pacities recently than any other country. Now the US and other Asian markets are also becoming more involved.

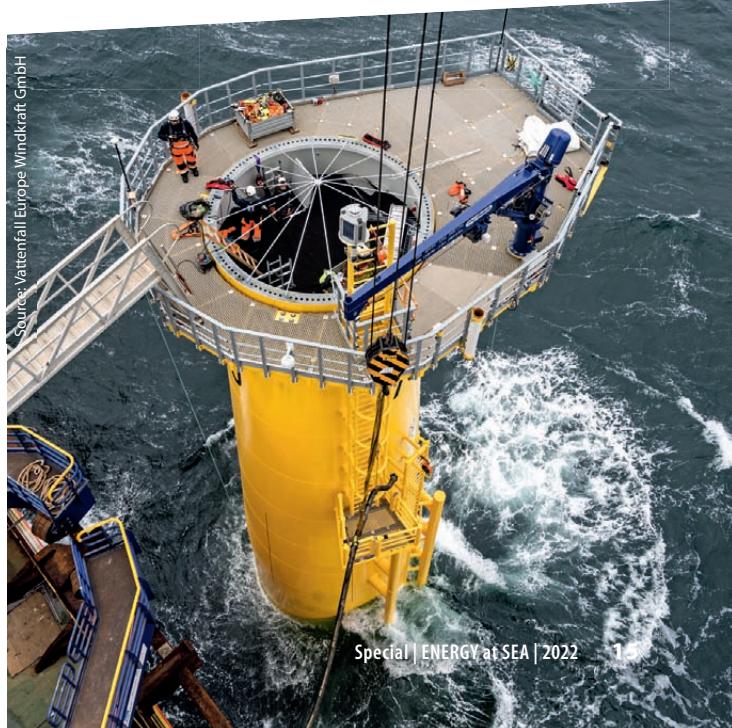
However, today's offshore wind market is far from realising its full potential – with high quality resources available in most major markets, offshore wind has the potential to generate more than 400,000 TWh per year globally. That's almost 20 times the world's electricity needs of today.

The German Association for Marine Technology (GMT) is already a major con-

tributor of a smart and sustainable energy transition toward offshore wind. Its members are heavily involved in offshore wind projects and operations, including bathymetric surveys, acquiring aero- and hydrodynamic data, design, fabrication, installation, inspection, decommissioning and repowering of offshore wind farms. Based on this, the GMT network creates continuously new opportunities to exchange and explore new horizons in research, development and business applications. ≈



Source: Baltic Taucherei- und Bergungsbetrieb Rostock GmbH





STARTING POINT for offshore wind farm expansion

BUSS TERMINAL EEMSHAVEN After two years of standstill in the expansion of German offshore wind farms, the first turbines of the new *Kaskasi* offshore wind farm, around 30km north of the German island Helgoland, started operating in August. By the end of the year, all 38 SG 8.0 - 167 DD wind turbines will be installed. The central hub for the construction of the offshore wind farm is the Buss Terminal Eemshaven in the Netherlands.

The Buss Energy Group is providing the entire infrastructure for the *Kaskasi* offshore project at its terminal on the Ems estuary west of Emden. This includes handling, storage and terminal logistics of the foundation sets and the Hamburg-based company is also responsible for the entire project and interface management of the base port logistics.

Around 100 employees are involved in the project in Eemshaven and are coordinated by Buss Energy. About a quarter of them belong to the company

itself; others come from external service providers.

The handling of the various components such as monopiles, tower segments, nacelles and rotor blades, some of which weigh up to 1,300 tonnes and are up to 80m long, is carried out with crawler cranes, SPMT axle lines (low-floor transport vehicles) and mobile harbour cranes and reach-stackers. For efficient storage and loading of the long monopiles, Buss is building sand dunes on the terminal that look like small dykes.

The company has been operating the terminal in Eemshaven since 2011, making it one of the pioneers of the German economy in the development of offshore wind power. Despite the difficult market situation, due to political instability and the resulting fluctuating utilisation of offshore projects, Buss Energy succeeded in maintaining the Eemshaven terminal and proving its efficient operation.

In recent years, the company has supported a large number of offshore projects from the 220,000m² terminal as a

base or supply port. For example, towers for offshore wind turbines were completely assembled at the heavy-lift terminal and then loaded upright on to transport ships.

The company's scope of services also includes full-service terminal concepts with the development of the entire port infrastructure, storage and transport systems, project management, 24/7 operation at the terminal and the installation and maintenance of wind turbines. Added to this is Buss' own QHSE service. Individually tailored to each project, the specialists develop special safety and rescue concepts, check protective equipment, safety facilities, workplace conditions as well as operating equipment and, if required,

also introduce entire quality and safety management systems.

"Meanwhile, we are established and have a good reputation for completing projects on time and professionally," said Johann Killinger, owner of the Buss Group. "This gives us a positive outlook for the future."

An advantage for many projects is also the strategically favourable location of the base port. From Eemshaven, it is possible to support German offshore wind power projects but also those of the Netherlands and UK.

Only a few terminals in Europe are capable of managing projects as large as the *Kaskasi* offshore wind farm. Es-

sential for the successful execution of such large-scale projects is detailed advance planning, a logistics concept coordinated with all participants, the engineering systems required for the specific project, and experienced project management.

This ensures that components are taken aboard jack-up vessels at the specified positions in the port on time. Each minute counts because any delays to these very expensive specialised vessels can quickly cause planned costs to skyrocket.

In addition to Eemshaven, Buss Energy also operates terminals in Stade, Sassnitz and Duisburg. ≈

Source for both images: Berthold Fabricius





Effective project management essential for complex logistics

HEAVY-CARGO VESSELS The coordination of the various components when planning, installing and operating an offshore wind farm requires complex collaboration between all the stakeholders. Switzerland-based project logistics specialist, deugro, has designed a customised approach that includes the deployment of two specialised heavy-cargo vessels.

The expansion of offshore wind energy has taken another step toward net-zero carbon emissions. Between 230 and 450 GW of offshore capacity will be installed in the EU before 2050, 112 GW of which will be bottom-fixed wind farms. The rest of the world is following suit.

There is currently a production bottleneck for critical wind farm assets due to current global demand. Traditional European steel producers have filled all of their order books for the next few years, and many of them are investing in

new facilities, particularly in places where there are more wind farm leases that have been approved or are pending approval, like Scotland, Poland, the United States, and South Korea. While this is happening, the producers are leveraging synergies by working together to solve hurdles posed by project requirements.

Additionally, the increasing size of wind turbines over the past ten years has necessitated an alteration of traditional transport equipment. Much greater crane capacity is now needed for larger and

heavier foundations and nacelle components, and the current market for heavy-lift, multi-purpose vessels is in part driving projects to find creative approaches.

Offshore energy from the Baltic Sea

As part of the *Baltic Eagle* offshore wind farm project, deugro and dteq Transport Engineering Solutions, a company of the deugro group, recently delivered eight pin piles from Bilbao, Spain, to Vlissingen in the Netherlands. Spanish energy company Iberdrola is constructing the 476-MW



Rotra Mare has been modified for the carriage of wind turbine components

Baltic Eagle offshore wind farm, 28km northeast of the German island of Rügen in the Mecklenburg-West Pomerania region of the Baltic Sea. The 77m-long pin piles, which weigh over 270 tonnes each, are the biggest piles that the Spanish manufacturer Haizea Wind has ever produced.

deugro created a sophisticated coordination of operations involving the vessel, local agents, and shore cranes. dteq

also made a contribution to the project by creating unique transport saddles and performing a 3D finite-element analysis of the payload before operations.

One of the main challenges was the operations at the destination. Due to the ongoing works at the receiving terminal, the hatch covers of the vessel had to be unloaded onto a pontoon moored next to the vessel instead of quay-side as had initially been planned. This was all arranged at short notice but with no incidents and at a minimum price impact.

The final delivery and installation of the wind turbines scheduled for the first quarter of 2024 will complete the construction phase. As soon as *Baltic Eagle* is connected to the German grid, carbon emissions will be reduced by around one million tonnes annually.

Innovative concepts

It has been more than five years since deugro launched its transportation concept involving custom-made vessels designed for the transportation of large offshore wind turbine components. The Rotra vessels have been successfully

moving nacelles, towers and rotor blades throughout Europe, with the vessels operating in both RoRo and LoLo modes, whilst storing cargo under deck during transit. In this way, operations can be optimised leading to cost savings of about 15 to 20%.

This was deugro's first project involving deployment of this type of custom-designed vessels. Ocean freight was approached in a way that was vastly different to conventional methods. To develop an optimised design, deugro had to study the entire offshore and shipping industries. Due to the scale of dimensions and weights, there were no off-the-shelf industrial concepts available on the market to meet the project's original requirements.

deugro's customised design allows for flexible, innovative, efficient and safe project execution. Minimal crane usage and fewer lifting operations enhance both safety and costs – deugro's strategy has helped to reduce transportation costs by approximately 20%.

Siemens Gamesa and deugro celebrated the delivery of the first vessel, .



▲ *Rotra Vente*, in Esbjerg, Denmark, in December 2016. The vessel then began connecting wind turbine components with installation harbours in the North and Baltic Seas.

Originally a container ship, *Rotra Vente* was converted into a heavy-cargo vessel with ramp by modifying its hull. In the forward section of the hull, there is a movable bow, and in the stern section a wheelhouse.

For moving large loads to or from the cargo deck, hydraulic systems move the bow and extendable ramp. Access to the restructured cargo deck is made possible by a large bow door. Additionally, a fully automated ballast system compensates for unequal load distribution.

Rotra Mare, the sistership, was completed in March 2017. This vessel was built and optimised for the transport of towers

and rotor blades—navigating between production facilities in the UK and Denmark and their respective installation sites.

Since their launch, both vessels have successfully supported the offshore logistics value chain, with total operations amounting to approximately 640 voyages in northern Europe and more than 1,300 port calls, transporting a huge number of offshore wind turbine components: 1,518 blades, 1,172 nacelles, 138 generators, 328 hubs and 2,347 tower sections totalling an impressive 7.8 million tonnes. The components transported correspond to 9 GW of wind power installed at sea.

In 2021 and 2022, both vessels went to the shipyard for a re-design and additional modifications. *Rotra Mare* has become wider and longer, and now features an overall length of 152.7m. This enables the vessel to transport twelve blades with

a maximum length of 97m or nine blades of 108m.

The modification of *Rotra Vente* was a larger undertaking: the garage was removed, and pontoons were welded to the vessel. The ship also has a new overall width of 23.6m, enabling it to transport seven of the latest nacelle types.

With the upgraded Rotra vessels, deugro Denmark continues to demonstrate its innovation and solution design. Transforming the current vessel configurations, deugro was able to ensure continuation of the winning concept in order to meet the current and future logistics needs of Siemens Gamesa's next generation offshore wind equipment. Modifying the current vessels substantially lowered costs and availability compared with constructing new vessels, while reducing carbon emissions. ≈

The *Rotra Vente* has a new overall width of 23.6m, which will enable the transport of seven next-generation nacelles



deugro and dteq recently completed the successful delivery of eight pin piles from Bilbao to Vlissingen





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A green energy revolution in the North Sea

AQUAVENTUS The AquaVentus initiative will be sending signals worldwide with climate-friendly green hydrogen technology. The overarching goal of the AquaVentus is to install 10 GW of electric wind generation capacity to produce one million tonnes of green hydrogen offshore in the North Sea by 2035, and to establish an associated pipeline transport infrastructure. The initiative is driven by a strong project and supporter family. The AquaVentus friends' association (in German: Förderverein) is made up of highly innovative organisations and research institutions as well as leading international companies which are declaring a new age of climate-friendly energy with the production of green hydrogen at sea.

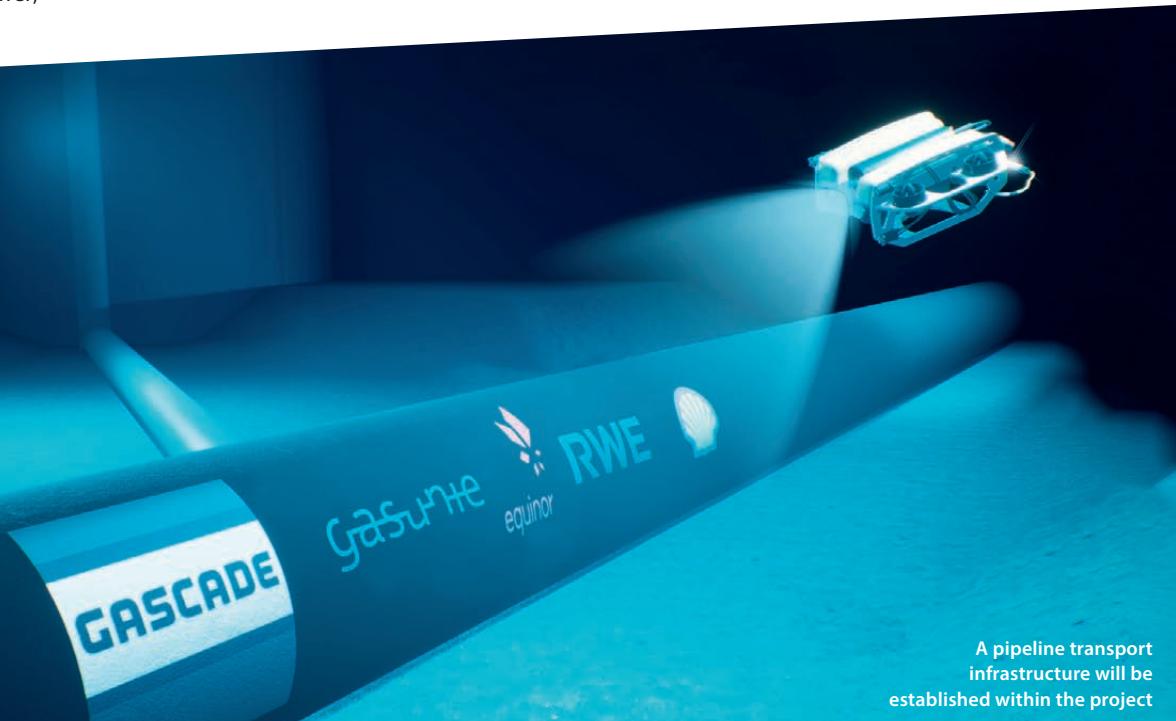
The benefits of electrolysis for green hydrogen production should already take place at sea for economic and ecological reasons. Transport of hydrogen via a pipeline has advantages compared with transporting electricity via a submarine cable:

- ~ investment and operating costs are significantly lower;

- ~ construction time is more than five years faster;
- ~ significantly fewer routes are needed in the North Sea creating a much lower ecological impact;
- ~ Transmission losses are minimised.

The main reason for a single hydrogen pipeline is that it can transmit ten GW of

energy, whereas otherwise modern HVDC submarine cables would be required. In addition, the pipeline provides storage capacity for the green hydrogen. These advantages increase as distance from the coast increases. They are relevant, therefore, to the far-flung areas of the German



Source for both images: AquaVentus

Exclusive Economic Zone in the North Sea with distances to the landing point of up to 300km.

Clear advantages of hydrogen production at sea

A study by AFRY Management Consulting confirms the clear advantages of hydrogen production at sea. It therefore supports the approach of the AquaVentus initiative in the German North Sea compared with other options in terms of costs, environmental compatibility and implementation time. Furthermore, the study confirms AquaVentus' target of one million metric tonnes of green hydrogen production in the waters north off Helgoland by 2035 and its shipment ashore by pipeline.

Within the scope of the study, the AquaVentus concept of green hydrogen offshore production with pipeline transport was compared with alternative options involving offshore electrolysis and transport by ship or offshore electricity generation and onshore electrolysis. The advantages and disadvantages of the options were evaluated based on cost, implementation time and environmental compatibility.

In all three possibilities, offshore electrolysis with pipeline transport emerged as the best option. According to the study, a pipeline for green hydrogen generated offshore can be commissioned up to five-and-a-half years faster than submarine cable connections for offshore electricity. As a result, energy developed in the remote areas of the German Exclusive Economic Zone could thus be brought to market faster. In addition, the investment would require up to EUR 6 billion less, reducing the production costs for green hydrogen.

From a permitting perspective and with a focus on environmental protection, 610km of pipeline versus 3,720km of high-voltage lines as well as the location of electrolysis on the high seas also means less environmental impact, particularly in

The supply chain of green hydrogen will play an important role in the energy transition



the sensitive German Wadden Sea ecosystem. Transport by ship was ruled out on the basis that more than 100 ships would be required.

Chairman of the association, Helgoland's Mayor Jörg Singer said: "Our member companies have been convinced of the AquaVentus vision and work is underway in projects to implement it. In this context, the study published impressively proves that the AquaVentus concept is faster, more environmentally friendly, and less expensive than the other investigated concepts."

The AquaVentus concept in numbers

In a first commissioning phase by 2030, AquaVentus proposes to commission about 2.5 GW of wind power and in a second phase, by 2035, to connect about another 7.5 GW of wind power in the far-flung areas of the German Exclusive Economic Zone to a hydrogen collection pipeline. In the final expansion with a total of 10 GW, approx. 700,000 tonnes per annum of hydrogen could be provided from the offshore wind setup. With the downstream connection to the electricity grid, annual hydrogen production of about one million tonnes is feasible.

As early as 2030, about 600km could be covered with about 4,000 MW of wind power and annual production of about 300,000 tonnes of hydrogen. This corresponds to 35% of the target for domestic electrolysis by 2030, according to the National Hydrogen Strategy and the

Coalition Agreement. The last phase of expansion could be completed before 2035. This would make it possible to meet significantly more than:

- ~ the total demand for ammonia and methanol synthesis (660,000 tonnes per annum);
- ~ one third of the demand for primary steel production;
- ~ one third of the demand for long-term electricity storage.

Robert Seehawer, managing director of AquaVentus Förderverein, concluded: "Climate neutrality requires the replacement of fossil carbon-based materials in all sectors of our economy. Green hydrogen plays a key role here. The Covid pandemic and the Ukraine war have shown that security of supply must be a central component of energy infrastructure. Relying predominantly on only cheap energy imports is a concept from the past."

"Energy companies which are active in Germany can and should also contribute to this and ideally take on a leading international role. Most of them are already members of the AquaVentus friends' association. With AquaVentus, domestic research institutes and companies will be able to test green hydrogen technologies in Germany, help them reach market maturity and use them commercially. This will have positive effects on the German economy, employment and prosperity." ≈

Opening up new horizons above and below water

UNDERWATER TECHNOLOGY Human exploitation of the oceans is intensifying year on year.

But how can marine resources be used responsibly and economically without damaging the environment? This is the urgent question which OceanTechnologies@Fraunhofer was set up to address. This competence network brings together the expertise of 14 separate Fraunhofer institutes and research laboratories in the field of underwater technology. Partners from science and industry are given the opportunity to test new technologies under real conditions in an underwater test facility for marine technology off the coast of Rostock.

Established in 2016, the OceanTechnologies@Fraunhofer competence network is one of Europe's leading consortia for applied research in underwater technology. OceanTechnologies@Fraunhofer covers the entire spectrum of marine and underwater technology. It is interdisciplinary in its setup, drawing on the knowledge and skills of experts in IT, materials science, engineering, electronics, sensor technology, energy technology, robotics and aquaculture, as well as automation and systems technology. It therefore offers optimal conditions for driving the sustainable use of the oceans and meeting

the complex challenges posed by the underwater environment, the member institutes said.

Thomas Rauschenbach, spokesperson for the OceanTechnologies@Fraunhofer competence network and head of Fraunhofer IOSB-AST, explained: "On the one hand, interference in the oceanic ecosystems should be kept to a bare minimum, but at the same time, answers are needed to a wide range of relevant questions which in turn reveal complex interrelationships." The marine researchers aim to master this balancing act in various research areas and fields of application.

Maintenance and repair of offshore wind turbines

Regular inspections and repairs are essential for the safe, long-term operation of offshore wind turbines. Due to the harsh environmental conditions and sheer quantity of turbines either already in place or planned for the future, this task will ultimately have to be performed by robotic systems, OceanTechnologies@Fraunhofer noted. These systems will be able to remove fouling, change components and perform welding, glueing and cutting activities, as well as collecting and transporting samples of all kinds.

Development of underwater robotics

To ensure that vehicles can be used purposefully and cost efficiently, a higher degree of automation of the technical systems is required. Robots should ideally be able to work autonomously, i.e., without the need for support vessels and personnel to be stationed nearby. The sort of tasks for which they are suited include mapping the seabed over large areas and inspecting, maintaining, or even dismantling infrastructure. Docking stations (underwater garages) are a key element here – AUVs (autonomous underwater vehicles) can find their own



Fraunhofer scientists on the offshore platform of the Rostock Digital Ocean Lab

way back to these stations, exchange data and recharge their batteries.

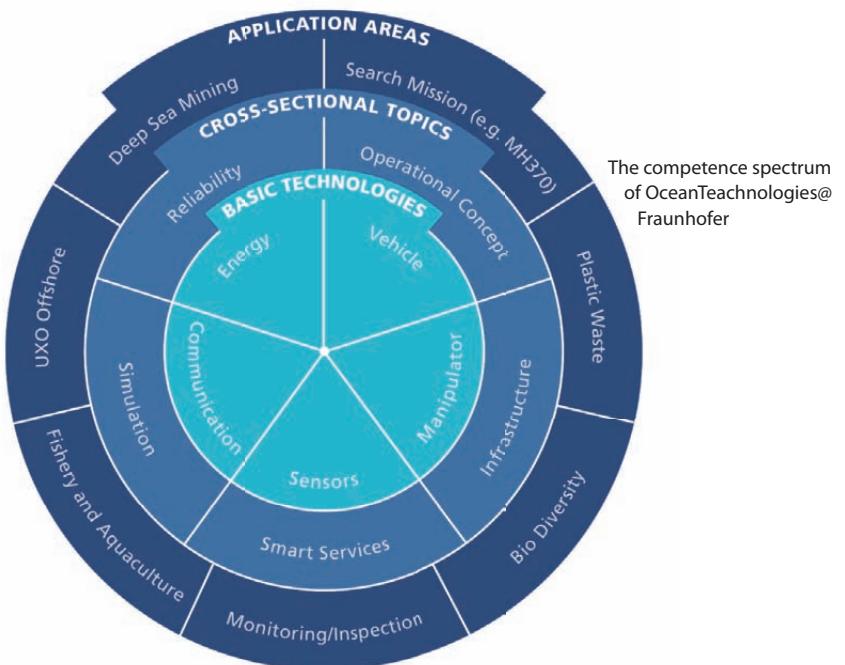
Battery efficiency is crucial to the long-term operation of these underwater vehicles. Their power not only limits operating times, but also the ability to carry additional sensors or manipulators. The challenge is to increase the capacity and energy density of battery devices while minimising charging times, weight and size.

Novel sensors make the difference

The accuracy and reliability of sensor technology also requires continuous improvement because, ultimately, this determines the success and quality of a mission, the consortium said. A major challenge will come in the development of novel sensors that can perform tasks previously considered impossible, for example probing deep into the seafloor, generating high-resolution 3D image data in harsh environments, detecting explosives electrochemically or measuring the concentration of microplastics – all without having to deliver samples to a land-based laboratory. Teams of researchers are currently working on combining the benefits of acoustic and optical imaging in a single integrated system.

Crossover technologies

However, it is not just the base technologies that are relevant here – crossover technologies are also indispensable for successful and sustainable use of the oceans. One example is the development of so-called ‘smart services’. With its expertise in information processing, Fraunhofer supports clients in managing raw data and preparing it in such a way that it can be used for rapid decision-making, and also accessed again at any time. The Fraunhofer portfolio covers the entire processing pipeline – from efficient data acquisition, storage and management to quality assurance, interactive visualisation



and fully automated data analysis. These services form the basis for new business models in the dawning age of digital underwater technology.

In the field of offshore technology, Fraunhofer also offers non-destructive methods and/or structural-mechanical simulations that help to increase the reliability of systems in locations that are remote from the mainland and therefore not accessible at all times of the year and in all weather conditions, making maintenance more difficult. Theories, models and simulations are the starting point for practical solutions of this kind. Fraunhofer researchers have the necessary expertise to solve problems arising from the propagation of sound in water or steel and from the hydrodynamic behaviour of vehicles in a current.

Science and business centre for underwater technologies

If components or complex systems of underwater technology are to be used on an industrial scale, they must first be put through their paces. However, efficient and comprehensive testing services have been lacking up to now. “That’s why OceanTechnologies@Fraunhofer is realising

this globally unique science and business centre for underwater technologies in the Baltic Sea,” said Professor Uwe Freiherr von Lukas, managing director of the OceanTechnologies@Fraunhofer competence network and site manager of Fraunhofer IGD in Rostock.

In future, the researchers at the Rostock Digital Ocean Lab will not only be working on a range of classic underwater engineering projects, but will also be developing and testing sensor technology, autonomous vehicles, underwater robotics, and methods for underwater image processing and visualisation. OceanTechnologies@Fraunhofer will furthermore bring together the previously separate infrastructures of other Fraunhofer sites to form a virtual test centre.

This is creating optimal conditions for research and development of underwater technology and closing an existing gap in provision. Fraunhofer not only sees itself as a developer of marine technology but is also assuming an important role as an innovation partner for the offshore wind industry, with its expert staff both initiating and supervising processes, and supporting companies engaged in complex research projects. ≈

Blue economy to enter digital age

DATA PLATFORM The maritime industry is facing an unprecedented decade: digital technologies promise progress in the development of offshore wind power and the protection of marine habitats. But the dawn of the data age may fail because of silo thinking and high costs. The Kiel-based start-up TrueOcean is aiming to overcome the biggest hurdles for the digitalisation of the blue economy with its own data platform, writes the company's co-founder and managing director Frithjof Hennemann.

In the face of species extinction and climate change, the United Nations has declared the current decade the Decade of Oceans for Sustainable Development. Mankind will only achieve its 1.5°C target by massively expanding offshore wind power and removing CO₂ from the atmosphere, for example by cultivating seagrass beds.

New technologies such as autonomous offshore drones and robotic ships promise to speed up site exploration and reduce project costs. But urgency and technological progress are coming up against an industry that has had little connectivity.

For many decades, the traditional players on the high seas kept to themselves: fishing fleets, resource companies, research institutes, navies and shipowners. They have been gathering knowledge about the oceans since time immemorial, but until now, each to his own.

Today, no region of the world is less explored. Only 20% of the sea floor has been mapped at all, and even less is sufficiently resolved for economic and scientific applications.

With a data platform in the cloud, TrueOcean, a start-up founded in 2019, aims to pave the way for the blue industry to enter the data age. The goal is not only to simplify and accelerate the storage, processing, analysis and exchange of data, but also to reduce the marginal costs per data set.

This is the only way to make modern approaches to robotics, artificial intelligence, and real-time processing economically viable. With its platform, TrueOcean addresses three central problems of big data in maritime projects.

The problem: high costs and huge volumes of data locked in silos

The five seas may all be connected, but the data of maritime industries is not. Their owners hoard data assets in isolated data lakes and on local servers. Exchange is carried out inefficiently over land, not infrequently still by mailing hard drives.

One reason for this is that collecting sensor data is expensive. To explore the seabed, wind farm operators send measurement engineers (geo surveyors) on special ships to the continental shelf. Such an undertaking costs several tens of thousands of euros per day.

Another reason is the sheer volume of data. Even for the basic model of the seabed beneath a wind farm site, ten terabytes of data are generated (1 terabyte corresponds to 1,024 gigabytes). Much more data is added during a turbine's life-cycle. To transfer constantly such volumes of data would be time-consuming and expensive, even with fibre optic lines.

This is especially true when the data is stored in the cloud, which is an excellent central storage location. However, without specialised applications, the data must be downloaded again from the cloud for pro-

cessing. Each data transfer incurs high fees from the cloud provider and time.

The answer: a central cloud for data management

TrueOcean has built a central data cloud for the blue economy. The platform offers industry-specific tools to store, manage and share sensor and metadata with partners. The goal is to break down data silos and make operational data available to all maritime project stakeholders on one platform.

The problem: poor data quality inhibits collaboration and drives up costs

To extract information from sensor data, the context and technical parameters of each measurement must be stored, such as the frequency range for sonar measurements (metadata). Until now, highly paid experts have reviewed and sorted raw and metadata by hand. Such refinement processes could not be automated until now.

Different sensor types produce different file formats. Reading them requires the appropriate specialised software, for which additional license fees are incurred. Most of these programs have to be installed on a local PC or can be used as web applications via the software manufacturer's website. The rapidly growing data volumes lead to computing times of days and sometimes weeks for these systems.

Because preparing the data is so time-consuming, each data owner only



TrueOcean's maritime data platform will make blue economy data available on the cloud

tailors inventories to his or her own specific needs and questions. The result: data quality is lacking for cooperative use, let alone for marketing to third parties.

The answer: data is prepared directly in the cloud

The TrueOcean platform creates a unified database by converting all raw data into a universal open-source format. This eliminates the need for expensive specialised software to read the data. Thanks to a uniform output format, processes for quality control and sorting can finally be automated.

The problem: lack of networking in specialist applications prevents innovation

The last and most important value creation stage extracts information from raw data: through analysis. Because each data format requires its own specialised software, the focus of analysis is necessarily limited to one or a few data sources. The

fragmented data management makes use of modern methods such as big data, real-time analyses and machine learning almost impossible. At the same time, innovation and surprising insights are only created by recombining data.

The answer: one platform for data and business applications

In the TrueOcean cloud, customers no longer need to transfer their raw data to local specialised software for analysis. In the future, the platform will deliver all necessary specialist applications at the same time. Analysis modules can be booked as software-as-a-service, for example generic statistics modules, visualisation filters or interactive maps with geolocations, right through to complex, AI-based processes that are becoming increasingly powerful as the volume and quality of data grows and can also be transferred to other use cases.

The platform will soon be able to integrate third-party analysis methods

via a marketplace. A so-called "WorkFlow Engine" enables users to contribute their own algorithms for data analysis and use them in the cloud.

Conclusion

With data platforms like TrueOcean, maritime players are not only reducing costs and time spent on internal project workflows. Industry-specific clouds also finally create the basis for data-based cooperation with business partners. Companies gain fast and cost-effective access to the latest software technology without having to buy licenses and operate their own systems for every use.

In the long term, TrueOcean's founders plan to expand their platform into a data marketplace, thus creating a basis for data-based business models. In the decade of the oceans, a shared data space could thus give a decisive boost to the digitisation of the entire maritime economy. ≈



The Deepsea Semi™ floating wind foundation design has been developed for use in floating wind farms and for off-grid applications including temporary electrification of oil and gas installations in harsh environments

Source: Odfjell

Scantling approval of floating wind foundation nears completion

DEEPSSEA SEMI DNV has confirmed that the main scantling approval of Odfjell Oceanwind's Deepsea Semi™ floating wind foundation design is close to completion. The design was awarded Approval in Principle (AiP) in January.

The main scantling approval is based on the SG 11.0-200 DD offshore turbine from Siemens Gamesa. The design has been developed for all areas where floating wind farms are at the planning stage including locations in the North Sea, the Norwegian Sea, the Barents Sea and prospective areas under assessment in the UK's Innovation and Targeted Oil and Gas (INTOG) process. Water depths range from 10 to 1,300m. The design is intended for use at floating wind facilities and also as mobile offshore wind units, which are intended for off-grid applications. The use of mobile units for

electrifying offshore oil and gas installations has significant potential, Odfjell Oceanwind said, for decarbonisation of the sector.

The Deepsea Semi foundation is intended for low cost, industrial mass production and is already designed for wind turbine generators of up to 15 MW. The company intends to pursue class approval for larger turbines that will soon become commercially available for floating applications.

DNV's director of Business Development – Offshore Classification, Erik Henriksen, said: "We are very pleased to be a close partner in this project and look forward to continuing to work with Odfjell Oceanwind and Siemens Gamesa on the classification and certification of the Deepsea Semi concept. Since the completion of the

Approval in Principle earlier this year, the concept has matured and the main scantling approval is progressing well."

Per Lund, Odfjell Oceanwind CEO, commented: "Class approval of the Deepsea Semi with the selected wind turbine will mark another important milestone for us. We continue building on the long-term relationship with DNV which we plan to extend also through full classification and certification of floating offshore wind units for wind park application as well as our own fleet of mobile offshore wind units for off-grid application. We now have a product readily available and very well suited for near term oil and gas electrification initiatives, innovation parks in northwest Europe, as well as wind park projects like *Utsira Nord*, *Celtic Sea* and *Scotwind*, including locations West of Shetland. ≈

Underwater inspection of wind farms

NORTH / BALTIC SEAS Deutsche Windtechnik AG, headquartered in Bremen, Germany, has received extensive orders for underwater inspections of wind farms in the North and Baltic seas. More than 300 surveys are to be carried out in 2022 and 2023 as part of a cluster concept focused on cost savings and sustainability for the offshore wind farms *Borkum I*, *DanTysk*, *Sandbank*, *Butendiek* and three other wind farms in the areas.

According to information from Deutsche Windtechnik, the inspection work has already begun. As part of this, the foundations of the wind turbines, the structure of the substations, the wind measurement masts, the corrosion protection

systems and the cables from the point of entry into the foundation to the point of entry into the ground will be examined and the condition documented, among other things.

By locating damage early, the company says it can minimise downtime and extend the life of the wind turbine. "The results and analyses of our underwater surveys provide our customers with detailed and reliable information about the condition of their turbines that goes far beyond the standard requirements of the authorities," said Niels Noordeloos, business development manager at Deutsche Windtechnik BV, the company's Dutch subsidiary.

Deutsche Windtechnik works with Dutch offshore service provider Bluestream and Glückstadt-based shipping company OS Energy on the inspections.

"Working with both partners allows Deutsche Windtechnik to have a highly efficient vessel including an ROV (remotely operated vehicle) with exactly the tools needed for the job: high-resolution cameras, cleaning tools, ultrasonic and laser measurement systems, and much more. All sides derive a benefit from cluster management, expertise, shared mobilisation costs, fuel-saving route bundling and very accurate documentation," added Geert Timmers, managing director of Deutsche Windtechnik BV. ≈

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New all-electric heavy lift ship crane



The LS 800 E has all-electric drives and offers a working radius of 39m

Source: Liebherr

LS 800 E Liebherr's heavy lift crane series is being expanded with an 800 tonnes crane. The aim is to position the company in the growth market for ever larger wind industry components. The LS 800 E is fully electrically powered and thus enables a reduction of CO₂ emissions on the ship side in scenarios typical for heavy lift vessels. It has a working radius of 39m.

The growth of wind turbines is leading to increasingly heavy individual component weights. In addition, the handling of large components requires a longer out-reach of the cranes used than is often the case in the market, Liebherr noted. The supply of heavy-lift vessels with cranes offering a maximum lifting capacity of 800 tonnes is lower than the expected future demand. Liebherr therefore sees a growth market in this crane segment and corresponding shipbuilding requirements. The Liebherr ship crane enters a new segment and expands the product portfolio of heavy lift ship cranes.

"The new cranes follow on from a long tradition and decades of experience in building ship cranes," said Gregor Levold, sales director for Liebherr Offshore, Ship and Port Cranes. "The first ship crane was delivered by Liebherr in 1958. The push into the 800 tonnes size segment does not represent new territory – Liebherr

has already supplied onshore and offshore cranes in the 3,000-5,000 tonnes category."

All-electric and CO₂ emission-free

In addition to the much larger dimensions of the crane, the LS 800 E is particularly impressive due to its all-electric drive concept. All sections of the crane are electrically driven. As a result, the machine achieves higher energy efficiency and thus significantly reduces the ship's CO₂ emissions. Liebherr is already prepared for future environmental requirements in the maritime industry. "We have many years of experience with all-electric drives from the port equipment sector, among others. As usual, the development of the crane is done completely in-house. We can also cover the procurement of individual components largely in-house at Liebherr. These are invaluable advantages for our customers, especially nowadays," Levold added.

In addition, all drive components are installed inside the crane. This facilitates the integration of the crane into the ship's design and enables better utilisation of the areas below deck.

The new "Master V" control unit offers the highest computing power. The accompanying faster data processing enables the integration of future assistance systems

and semi-automated process applications. All heavy-lift cranes are characterised by the Litronic control system developed in-house. It combines speed and precision and thus ensures a safe and at the same time efficient loading process.

New crane designation and design

During the design of the LS 800 E, the designation of the Liebherr ship cranes was furthermore adjusted. Instead of the previous CBB crane designation, the cranes will be called LS in the future. The new terms and the capital letters used allow a direct assignment as Liebherr (L) – ship crane (S). The number, as part of the designation, provides information about the maximum load capacity, which is 800 tonnes for the LS 800 E. The E stands for the electric drive and is supplemented by the suffix "All-electric" in the case of fully electric cranes such as the LS 800 E.

The exterior design of the crane has been renewed. The crane is factory coloured in white and grey and the designation of the crane is on the tower. The blue accent and the blue E symbol next to the crane type designation visually clarify the electric drive of the machine. This allows all future customers to communicate directly advanced and low-emission crane technology to their stakeholders. ≈

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Orion completes installation of undersea foundations at *Arcadis Ost 1*



The installation vessel *Orion* recently completed installation of the largest-ever monopiles at the *Arcadis Ost 1* wind farm

Source DEME

XXL MONOPILES DEME Offshore's installation vessel, *Orion*, recently completed installation of the largest-ever monopiles at Parkwind's *Arcadis Ost 1* wind farm off Germany's north-east coast. The Baltic Sea wind farm is due to be commissioned in 2023. Installation of the 28 monopiles, weighing more than 2,000 tonnes each, marked completion of the first project for the LNG-powered DP3 installation vessel, *Orion*, which has a 5,000-tonne crane and a tailor-made, motion-compensated pile gripper system. The setup enabled the crew to up-end the 110m-long monopiles, which were carried horizontally on deck during transit. The seabed conditions in the area are challenging, DEME Offshore noted, but the pile grip-

per kept the 9.5m-diameter monopiles vertical and stable, despite waves and vessel motions. They could then be driven into the seabed with pinpoint accuracy, using the ship's dynamic positioning system, in water depths of up to 45m.

A range of other specialist tools were used during the *Orion*'s maiden project. These included an adjustable monopile sea fastening system, a newly built automated monopile-lifting spreader beam to enable horizontal lifting, an automated quick-lifting tools to avoid manual handling on deck, and several noise mitigation systems.

DEME Offshore managing director, Hugo Bouvy, said: "We are extremely thrilled to see *Orion* and her motion-compensated pile grip-

per doing what the vessel has been created for, installing huge monopiles in extreme circumstances. This pushes the boundaries of the offshore wind industry over the horizon and shows that DEME's smart solutions and equipment are ready for the next generation of foundations and wind turbines.

"Many years of offshore experience and engineering by incredibly motivated people have resulted in the delivery of *Orion* and her installation tools," he continued. "Our persistent *Arcadis Ost 1* project and newbuild teams, and our experienced and extremely professional crew led to the commissioning of *Orion* in record times. Together they pushed technological boundaries with enormous

enthusiasm and drive. I am so proud to be part of this team!"

Speaking for the offshore wind developer, Parkwind's country manager Germany, Manfred Dittmer, said: "It feels good to see how it all comes together when installation works starts, the planning, the design, the certification, the manufacturing, and finally the installation itself."

"Thanks to the whole team and all partners involved who worked with great efforts and enthusiasm on the realisation of our first offshore wind farm outside Belgium. It underlines our capabilities to execute projects under challenging conditions and environments. With the monopiles in place, we will continue the installation of the secondary steel structures to complete the foundations."

The 257-MW *Arcadis Ost 1* will receive 27 Vestas V 174 wind turbines of 9.5 MW later this year. When commissioned, the facility will produce renewable electricity for up to 290,000 households. ≈

Offshore wind goes greener with first recyclable blades

CIRCULAR ECONOMY

Siemens Gamesa has celebrated the start of supplies of sustainable energy from RWE's *Kaskasi* wind farm 35km north of the island of Helgoland in the German North Sea, the first facility to adopt fully recyclable turbine blades. A number of the 38 turbines at the 342-MW wind farm will be equipped with 81m-long Siemens Gamesa B81 RecyclableBlades. The initiative comes at a time of mounting concern over the end-of-life disposal of wind turbine blades. Currently, single-use blades go to landfill. The company explained that blades consist of a combination of materials embedded in resin to form a strong, stiff structure. The new technology enables the full reclamation of components by using a mild acidic solution to separate resin, fibreglass, wood, and other materials. These then enter the circular economy to create new products like suitcases or flat-screen casings.

CEO of Siemens Gamesa's Offshore Business Unit, Marc Becker, said: "We are proving that as the leaders of the offshore revolution, we are committed to making disruptive technology innovation commercially viable with the pace that the climate emergency demands. We've brought the Siemens Gamesa RecyclableBlade technology to market in only ten months: from launch in September 2021 to instal-

lation at RWE's *Kaskasi* project in July 2022. "This is impressive and underlines the pace at which we all need to move to provide enough generating capacity to combat the global climate emergency," he declared. "This milestone marks a significant contribution to Siemens Gamesa's target of having fully recyclable turbines by 2040. With RecyclableBlade available for our customers, we can create a virtuous circular economy."

Becker also stressed that power generated from the first turbine using RecyclableBlades also underscores value created by the company in various countries. The recyclable technology was developed in Aalborg, Denmark; the blades were manufactured in Hull, UK; and the nacelles were produced in and installed from Cuxhaven in Germany.

RWE Renewables' Sven Utermöhlen, CEO Wind Offshore, commented: "That we are testing in our offshore wind farm *Kaskasi* the world's first recyclable wind turbine blades under operational conditions is a significant step in advancing the sustainability of wind turbines to the next level. The first turbine equipped with Siemens Gamesa's RecyclableBlades is generating electricity. Summarising the current situation, he declared that the expansion of renewable energies must be driven forward decisively. ≈



Source: Siemens Gamesa

The RecyclableBlade technology is also available for the company's 108m-long B108 blades and the larger 115m-long B115 blades



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New lifting technology to simplify rotor blade handling

ematec is currently developing the new RBT-C50 for the offshore market. This takes rotor blades in an upright position.

Source: ematec



Patent-pending technology: the automatic adaptive blade support of the RBC.

Source: Ingo Jensen/ematec

COST EFFICIENCY German wind sector lifting specialist, ematec AG, has unveiled two significant advances in rotor blade lifting technology, specifically for applications in the offshore wind sector. The developments will improve efficiency in both rotor blade assembly and maintenance, the company claimed.

In the first development, ematec is now offering rotor blade lifting beams that can handle all blade shapes without change-over times. Previously only available in land applications, the technology enables the crosshead to adapt automatically to rotor blade profile, saving time and raising efficiency. The company's RBC-D40 offshore can handle rotor blades of up to

40 tonnes, regardless of shape, simplifying both installation and maintenance procedures.

In a second initiative, the company is developing a system whereby the yoke not only provides adaptive rotor blade support, but also scope to pitch blades through 90 degrees before assembly. This advance has the potential to revolutionise offshore wind turbine assembly, the company said.

Manfred Eberhard, ematec CEO explained that rotor blades are usually shipped upright in racks, but a horizontal position is advantageous for single-blade assembly to minimise the wind attack area and lost days due to wind. To combine the advantages of an upright delivery of the blades

with those of horizontal assembly, the rotor blades have to be pitched 90 degrees before assembly.

"Especially concerning cost efficiency, this is an issue when considering that a transport vessel can cost a six-figure sum per day," he said. "Up to now, we have mainly asserted ourselves onshore and established our yokes as benchmarks. But we also want to make rotor blade assembly and maintenance at sea as efficient and safe as possible. So we have been working diligently. And in short: we can now also do offshore."

The company's latest rotor blade initiatives are due to be demonstrated at WindEnergy 2022 in Hamburg. ≈

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The German Offshore Wind Energy Foundation was founded in 2005 on the initiative of the industry and under the moderation of the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV). The foundation's overall purpose is to consolidate the role of offshore wind energy in the energy mix of the future in Germany and Europe and to promote its expansion in the interests of environmental and climate protection. It has established itself as a non-partisan, supra-regional and independent communication platform for the entire offshore wind energy sector. The foundation's board of trustees includes key federal and state ministries for offshore wind as well as operators, manufacturers, transmission system operators, suppliers, banks and insurance companies.

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