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July/August 2024

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MAERSK DETOURS FROM ANTI-LNG STANCE

By **Daniel Johnson**

As any journalist will tell you, the months of July and August can be slow-moving in terms of newsworthy events. It's a time when many people choose to take holidays, and accordingly there is a marked deceleration of the news cycle as organisations and institutions reduce their activity. Despite this, these sleepy dog days of summer can throw up a number of major stories that grab the attention.

Perhaps the most eye-catching of such news coming out of the shipping world in recent weeks has been the suggestion that Maersk is expected to announce an order of at least 12 container ships with dual-fuel LNG propulsion. The development has been described in the maritime press as "jaw-dropping" and "coffee-spitting", which should come as no surprise: so far on its journey to be net zero in greenhouse gas emissions by 2040 the Danish shipping giant has been an aggressive leader in the adoption of green methanol and had previously said that it would not use transitional marine fuels such as LNG but instead leapfrog to net-zero fuels. "I think it is borderline greenwashing to call LNG a transition fuel towards the decarbonisation of shipping," stated Jacob Sterling, former head of decarbonisation innovation and business development at Maersk, in 2021.

Maersk's potential investment in the 16,000TEU LNG-fuelled newbuilds, added to reports that the company has postponed an order for 15 methanol-powered container ships from China State Shipbuilding Corporation and is planning to take a similar number of LNG-fuelled vessels on charter, does indicate an awkward and sharp change in tack for the company and its decarbonisation strategy. In the ever-evolving realm of marine fuels, it also thrusts LNG back into the spotlight.

The controversial alternative fuel appears to be gaining traction once again with shipowners and operators as they look to meet emissions reduction targets. While last year was seen as a breakout year for methanol as a future-fuel, with the orderbook for dual-fuelled methanol-powered ships hitting 200 ships and accounting for 8.3% of the global orderbook in gross tonnage (gt) terms, the first half of 2024 has seen a significant shift in the types of vessels being ordered.

According to the latest Clarksons Research Green Technology Tracker, released towards the end of July, the opening six months of 2024 saw orders placed for 310 alternative dual-fuel ships of 17.2 million gt, equivalent to 41% of tonnage contracted. This included 109 LNG dual-fuel ships (11.5 million gt), 49 for methanol (2.7 million gt), 42 for LPG (1.7 million gt), 15 for ammonia and four for hydrogen. Summarising the figures, Steve Gordon, global head of Clarksons Research, noted: "Excluding LNG carriers, the relative share of ordering of LNG fuel-capable tonnage increased relative to methanol-capable tonnage in the first half compared to 2023 levels."

SOURCE: MAERSK

Other figures in the Tracker give a clue to this growth in preference for LNG and suggest that it will continue for the foreseeable future. Investments in port infrastructure and the availability of 'green' fuels continue to lag, with the Tracker detailing 273 ports with LNG bunkering but just 29 ports with methanol bunkering available or planned.

Elsewhere, new data released by Bloomberg New Energy Finance (BNEF) indicates that demand for green methanol (as opposed to versions of the fuel that do not significantly reduce well-to-wake CO_2 emissions) for use in shipping could outstrip supply to the tune of three million tonnes per year. "As of early 2024, low-carbon methanol production capacity is negligible and currently makes up less than 1% of the 110 million tonnes of methanol production today," the research house warns in its report.

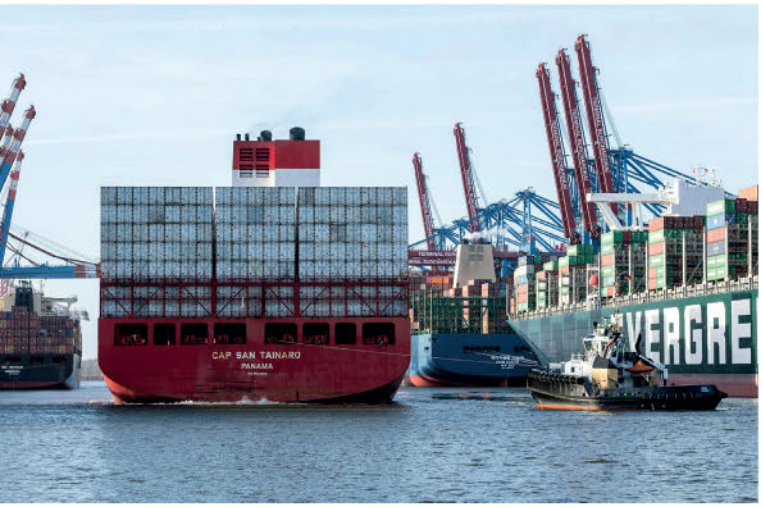
Given these concerns over the lack of availability of green methanol, and the implication that many new methanol dual-fuel ships will be forced to use polluting fossil fuels instead, plus the uncertainty surrounding IMO's upcoming carbon pricing regulations and the lower cost and greater availability of LNG, Maersk's decision to expand its fleet of LNG container ships makes great sense from an economic and competitive point of view. Nonetheless it is a surprising strategic shift for the shipping company which has raised the ire of environmental groups. In a press release addressing the news, global shipping campaign coalition Say No to LNG stated: "This investment represents an obvious detour from climate leadership and towards short-term financial gains at the expense of people and climate."

LNG's advocates, however, will argue that it is the practical, realistic solution to decarbonise shipping and point to the growth of bio-LNG and ongoing technological advancements to tackle methane slip, such as Daphne Technologies' SlipSure methane abatement solution (see page 12). Maersk's decision to invest in the fuel will doubtless help keep it firmly on the marine fuel mix menu as shipping's energy transition continues to evolve. ■

NEWS

CONTAINER SHIPS

WORLD SHIPPING COUNCIL REPORTS RECORD LOW FOR CONTAINERS LOST AT SEA



NEW MANDATORY REPORTING REQUIREMENTS FOR LOST CONTAINERS WILL TAKE EFFECT IN 2026. SOURCE: WOLFGANG WEISER/UNSPLASH

The World Shipping Council (WSC) has announced a historic low in the number of containers lost at sea, with only 221 containers reported missing in 2023. This figure marks a significant decrease from the previous record low of 661 containers in 2022, amidst the transportation of 250 million containers globally.

Key findings from WSC's report reveal that 33% of the lost containers in 2023 were successfully recovered. Despite the substantial progress, WSC emphasises the ongoing necessity for stringent safety measures and unwavering vigilance.

Several initiatives are underway to further mitigate container loss. The MARIN TopTier joint industry project (JIP) has yielded valuable insights into preventing containers from going overboard, with comprehensive recommendations and training materials. The project's final report, slated for release later this year, will include best practices, updated safety standards and guidelines for regulatory updates.

Starting 1 January 2026, new mandatory reporting requirements for lost containers will take effect, as adopted by IMO's Maritime Safety Committee (MSC 108). These requirements, developed with significant input from the WSC, aim to enhance navigational safety and mitigate environmental risks through prompt and detailed reporting.

WSC continues to advocate for improvements to safety guidelines, including the SOLAS Convention and the CTU Code. John Butler, CEO of WSC, says: "The reduction in containers lost at sea in 2023 is a positive development, but it does not diminish the urgency of our work. Every container lost at sea represents a potential hazard, and our commitment to preventing these incidents must be unwavering."

TANKERS

CLASSNK ISSUES 'WORLD-FIRST' AIP FOR HYDROGEN-FUELLED OIL TANKER

Classification society ClassNK has awarded approval in principle (AiP) for a design concept of a hydrogen-fuelled engine compatible oil tanker with an electric propulsion system.

The design has been developed by Uyeno Transtech, Yanmar Power Technology and Mitsui E&S Shipbuilding as part of the 'Development of Large-scale Hydrogen-fuelled Domestic Tanker and Demonstration of Zero-Emission Ships' project by the Nippon Foundation.

According to ClassNK, this is the world's first AiP certification for the design of an oil tanker using liquefied hydrogen as a fuel.

Prior to issuing an approval, the classification society conducted a review of the design concept based on its 'Rules and Guidance for the Survey and Construction of Steel Ships' incorporating the IGF Code, Part D of 'Guidelines for Ships Using Alternative Fuels; Guidelines for Ships Using Hydrogen as Fuel (Edition 3.0)', and 'Guidelines for Fuel Cell Power Systems On Board Ships (Second Edition)'.

The AiP is also the first awarded by ClassNK through the review based on Part D of 'Guidelines for Ships Using Alternative Fuels', released in May 2024.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FERRIES

FORESHIP OPTIMISES ENERGY EFFICIENCY FOR NEW RO-PAX FERRIES

RENDER OF THE NEW RO-PAX FERRY DESIGN. SOURCE: FORESHIP

Ship design and engineering company Foreship reports it will enhance the performance of two new ro-pax ferries set for service between Marseille and Corsica in 2027.

The ferries, commissioned by CMA CGM subsidiary La Méridionale, will feature dual-fuel engines for low-carbon operations and substantial battery capacity for zero-emission port stays.

Each 180m vessel will accommodate 1,000 passengers and 2,500lane-metres of freight, marking a significant upgrade in the Marseille-Corsica route. Foreship, tasked with concept design, developed the general arrangement and specifications for the ships and aided CMA CGM in shipyard negotiations.

"These ships will feature state-of-the-art dual-fuel engines, but their large 13MWh battery energy storage system is especially significant for their immediate environmental impact," says Joonatan Haukilehto, Foreship's head of new technologies. "This system will support hotel loads during Corsica port calls, with shore charging available in Marseille."

Haukilehto adds that Foreship's experience, including over 40 shipboard battery projects, has informed detailed guidance on the necessary battery pack specifications to meet zero-emission port performance for La Méridionale's vessels.

Additionally, Foreship will provide naval architecture services throughout the design and construction phases, focusing on stability, energy efficiency and compliance with Safe Return to Port (SRtP) regulations.

CMA CGM aims for net-zero carbon by 2050 and is investing in advanced energy efficiency technologies to decarbonise its fleet. Xavier Leclercq, vice president of CMA Ships, notes that the new ships will consume 50% less energy compared to the fleet's reference ship, *Piana*, while enhancing passenger experience.

BALLAST WATER TREATMENT

INCREASE IN BWTS INSPECTIONS EXPECTED FROM SEPTEMBER

Starting this September, inspections of ballast water treatment systems (BWTS) on vessels are set to rise as Port State Control (PSC) inspectors ensure compliance with the Ballast Water Management (BWM) Convention.

BIO-UV Group, a specialist in UV-based water treatment solutions, anticipates heightened scrutiny on machinery installations, crew competencies and BWM plans.

All vessels must now have a D-2 compliant ballast water treatment system, limiting viable organisms in discharged water. While operators have a grace period until 2026, non-compliance in system maintenance, operation and documentation could lead to ship detentions.

"We are aware of increased Port State Control inspections in China, Australia and the USA as they implement Focus Campaigns on ship machinery and electrical systems. Although ballast water treatment systems are not being singled out specifically, the Focus Campaigns aim to prevent any mechanical or electrical systems failure on board," says BIO-UV Group's BWT project manager, Charlène Ceresola.

"We expect the Paris and Tokyo MoUs to follow suit. If there are clear grounds crews are incorrectly operating and maintaining the BWM system or if record keeping is lackadaisical, ships could be penalised," Ceresola adds.

To assist operators of its BIO-SEA ballast water system, BIO-UV Group has introduced a BWTS Compliancy & Performance service. This includes thorough system inspections, repairs, calibrations, performance tests and crew training to ensure systems meet discharge standards.

BLUE CRAB (*CALLINECTES SAPIDUS*) IS ONE INVASIVE SPECIES MIGRATING VIA BALLAST WATER. SOURCE: JAREK TUSZYŃSK/CREATIVE COMMONS

DECARBONISATION

UECC COLLABORATES WITH TITAN FOR MAJOR LIQUEFIED BIOMETHANE DELIVERIES

United European Car Carriers (UECC) has partnered with Titan Clean Fuels for significant liquefied biomethane (LBM) bunkering operations at the Port of Zeebrugge.

Titan has supplied ISCC-EU certified LBM, also known as bio-LNG, to UECC's LNG dual-fuel car carriers throughout July as part of UECC's 'Green Gas Month'.

The initiative, supporting UECC's broader 'Sail for Change' sustainability programme, involved 100% LBM usage by UECC's pure car and truck carriers (PCTCs), three of which also feature battery hybrid technology. The effort aimed to significantly reduce greenhouse gas (GHG) emissions, with UECC estimating a reduction of over 8,000tonnes of CO_2e during Green Gas Month alone.

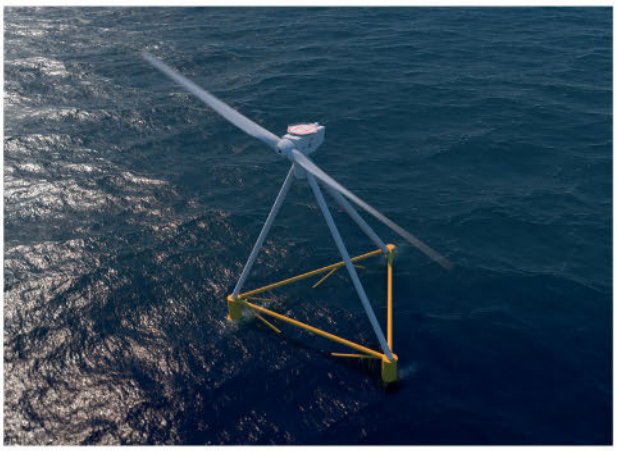
According to UECC, its customers can benefit from these reductions via a CO_2 registry established in January 2024. The registry allows transparent, traceable and verified transfer of environmental benefits across UECC's supply chain, the company says.

Daniel Gent, energy & sustainability manager at UECC, comments: "Through the use of biomethane, Green Gas Month, and Sail for Change more broadly, we are providing our customers with a great springboard to further their own decarbonisation strategies. With progressive automakers focusing on cleaner cars, we expect them to want to reduce their scope three emissions and ship those cars sustainably – which is what we can deliver."

SOURCE: UECC

OFFSHORE WIND

FRENCH PARTNERS COMMENCE OFFSHORE FLOATING WIND R&D PROGRAMME



RENDER OF THE X90 PRE-COMMERCIAL FLOATING WIND PLATFORM. SOURCE: X1 WIND

French engineering company Technip Energies and compatriot organisations Université Gustave Eiffel, Valeco and the OPEN-C Foundation have launched the PAREF project, an R&D programme aimed at accelerating industrial-scale development of offshore floating wind.

The project is funded by the French state as part of France 2030 operated by ADEME, the French agency for ecological transition. It aims to design, fabricate and test a reusable anchoring system, high and low connectors, and tendons for a tension line system, all while minimising the impact on the marine environment in real offshore conditions.

PAREF will provide the anchoring system for the NextFloat project. In 2022, Technip Energies, X1 Wind and a consortium of 10 international entities were chosen by the European Commission to deliver the NextFloat project.

The integrated system includes X1 Wind's X90 floating wind technology, featuring a lighter floater design with a reduced steel requirement, plus a compact mooring system minimising seabed impact. The 6MW prototype will be deployed at a test site in the Mediterranean Sea to operate the concept in open-sea operational conditions.

Christelle Abadie, research fellow at the Université Gustave Eiffel, says: "This project and partnership will help optimise anchor geometry and reduce mooring system costs, facilitating the large-scale deployment of innovative floating wind farm technologies."

NEWS ANALYSIS

RED SEA BACK IN FOCUS AS RATES AND NEWBUILDING ORDERS SOAR

By **Malcolm Latarche**

After a relatively relaxed session of partying and debating the technology challenges for shipping at Posidonia in early June, reality returned to the industry over the rest of the month and into July as the Red Sea crisis refused to fade away. In mid-June hopes rose because of a US ceasefire initiative but as both Hamas and Israel declined to fully embrace the proposals, the action in the Gaza strip has not abated and a month further along the conflict appears rather to be escalating.

In late June, BIMCO published its second quarter *Container Shipping Market Overview & Outlook* report in which it revised its assumption that the crisis in the Red Sea caused by Houthi militia targeting international shipping would be over by mid-2024. It now believes the whole of 2024 will be expected with things returning to normal starting in 2025.

BIMCO was saying nothing the liner sector did not know when it said in the report, "combined with estimated global volume growth of 5.0-6.0% and growth in head-haul and regional trades of 5.5-6.5%, demand for ships is growing very fast in 2024, whereas volume growth in 2025 will not be enough to counter the drop in ship demand caused by the assumed return to normal routings".

The report also pointed out that although growing slower than demand, supply will also grow fast in 2024 as deliveries of new ships are expected to hit a new record high of 2.8 million TEU. In addition, ships using the Cape of Good Hope are speeding up to maintain schedules, but this is countered by growing congestion at major hubs.

The longer routing around Africa has brought with it a very similar effect on the liner sector to that caused by the Covid pandemic. Congestion in ports has pushed up freight rates and immediate demand for additional shipping space. Charter rates are up and other vessel types such as MPPs are being pressed into service.

Despite many of the new box ships ordered in the newbuilding surge that followed Covid yet to be delivered, and BIMCO's assessment that trade growth next year will not be sufficient to counter a return to more normal circumstances, operators have resumed fleet renewal with a new surge in orders. Greece-based Xclusiv Shipbrokers said in early July that the orderbook-to-fleet ratio for container ships stood at 20.3% in June compared to 27.9% a year ago. Although a decline it should be remembered that several ships have been delivered in the 12 months.

THE *CMA CGM BENJAMIN FRANKLIN* SUFFERED THE LOSS OR DAMAGE OF 74 CONTAINERS IN ROUGH SEAS OFF SOUTH AFRICA. SOURCE: PORT OF LONG BEACH

The uptick in newbuilding orders over 2023 is even more pronounced in other sectors. In deadweight terms, the fleet-to-orderbook ratio is now 9.3% (7.1%) for bulkers, and 10% (4.6%) for tankers. Gas carriers are up in terms of M3 from 41.8% to 47.7%.

Although there are some positive impacts for operators by way of higher freights and for yards in newbuildings, there are some negative impacts as well.

While it may be high summer in the Northern hemisphere, it is mid-winter around the Capes and that means storms and bad weather. A series of storms has caused many vessels to seek shelter but the Ultrabulk-controlled *Ultra Galaxy*, a 13,000dwt MPP general cargo ship, took on a severe list in the second week of July during a voyage from Spain to Tanzania. On 8 July the crew of 18 Filipino seafarers abandoned the ship on the west coast of South Africa and were rescued by other vessels. The vessel has since run aground at Brand se Baai northwest of Cape Town.

Another vessel affected by the storms was the 18,000TEU *CMA CGM Benjamin Franklin* which lost 44 containers overboard with a further 30 boxes damaged. The vessel has diverted to Cape Town to assess the situation and secure the cargo. No injuries to crew were reported and the boxes are not thought to contain hazardous cargo.

Ports have also been affected negatively by the need to reroute ships. COSCO Ports has reported container throughput at its Piraeus terminal is down 13.5% over last year as cargo for Mediterranean destinations is now being discharged in Spain. The Suez Canal has seen revenue and transits down by half and the Israeli Red Sea port of Eilat is seeking government financial assistance after an 85% drop in cargo volumes. ■

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NEWS EQUIPMENT

METHANE SLIP

ENHANCED METHANE ABATEMENT SOLUTION GAINS LLOYD'S REGISTER APPROVAL

AIP SIGNING CEREMONY. SOURCE: LLOYD'S REGISTER

Daphne Technology's methane abatement solution, SlipPure, has been granted approval in principle (AiP) from Lloyd's Register (LR) for its plasma-catalytic technology.

The SlipPure system had previously received an AiP for its plasma-only configuration. The upgrade to incorporate advanced plasma-catalytic technology enhances efficiency by reducing plasma power consumption, allowing significant methane slip reduction at lower exhaust temperatures compared to traditional catalyst-only solutions.

The system has also been awarded an AiP by DNV.

Methane slip, with a global warming potential 28 times that of CO_2, is responsible for a substantial portion of current global warming. Daphne Technology's SlipPure system addresses this critical issue by integrating patented wavelet pulse power (WPP) supply technology and a proprietary catalyst, ensuring unmatched performance and efficiency, according to the company.

"This approval validates our innovative approach, and the witnessed results are a testament to the efficacy and reliability of our SlipPure system," says Dr Mario Michan, CEO of Daphne Technology.

Extensive testing at the Maritime Center of the University of Applied Science in Flensburg, Germany, validated the system's effectiveness. The plasma-catalytic process demonstrated a 62% reduction in methane slip at 75% load, even at exhaust temperatures as low as 380°C.

"Daphne Technology's plasma-catalytic technology is setting new standards in mitigating methane slip in maritime and land-based industries," says Panos Mitrou, director of LR's Global Gas segment.

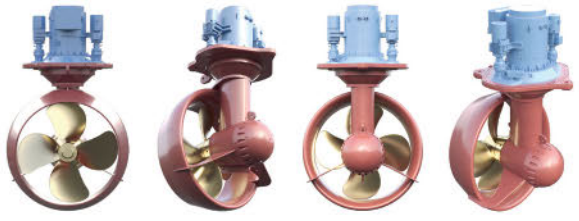
PROPULSION

KONGSBERG MARITIME LAUNCHES NEW UNDERWATER MOUNTABLE THRUSTER WITH PM MOTOR

Kongsberg Maritime has introduced a new size of underwater mountable azimuth thruster with a 3.7m propeller and 4.2MW power output model joining its range.

Suited to a variety of vessels including drill ships, wind farm vessels and production vessels, the UUC PM 355 features a permanent magnet (PM) motor, delivering 81tonnes of bollard pull.

The new thruster has a compact design with less space required in the machine room thanks to the integrated PM motor. Other features include low-noise operation, less lubricating oil volume and no oil-to-sea interfaces, according to Kongsberg Maritime.



THE UUC PM 355 FEATURES A PM MOTOR, DELIVERING 81TONNES OF BOLLARD PULL. SOURCE: KONGSBERG MARITIME

The underwater mountable thrusters can be exchanged without the need for drydocking, while the vessel remains in the water. Installation of the UUC range can be done at depths up to 50m.

Kongsberg Maritime product line manager Pasi Villanen says: "Our UUC range of underwater mountable thrusters remains a popular choice across a range of offshore applications where minimising downtime is a priority. With this new UUC PM 355 thruster, we can offer increased thrust and simple installation, while reducing the amount of space required inside the vessel.

"The permanent magnet motor is common across much of our propulsion portfolio, and for this type of thruster its responsiveness and efficiency make it the ideal choice for dynamic positioning operations."

FUEL SUPPLY SYSTEMS

MAN CRYO SUPPLIES FUEL SYSTEM FOR WORLD'S FIRST HYDROGEN-POWERED SUPERYACHT

THE HYDROGEN-FUELLED PROJECT 821 SUPERYACHT PICTURED IN AMSTERDAM WATERS. SOURCE: FEADSHIP

MAN Cryo, a division of MAN Energy Solutions, has supplied a liquid-hydrogen gas-fuel supply system to a 118.8m superyacht constructed by Netherlands motor yacht specialist Feadship.

Known as Project 821, the newbuilding is the world's first hydrogen fuel cell superyacht.

MAN Cryo's fuel-gas system will store the hydrogen in liquid form, evaporate and heat it, and supply gaseous hydrogen to the fuel cell enabling the zero-emission propulsion of the vessel.

Henrik Malm, managing director of MAN Energy Solutions Sweden, says: "This notable project showcases MAN Energy Solutions' leadership within the development of future-fuel systems for the maritime sector. In particular, MAN Cryo is setting new standards in sustainability and engineering with its system design and the innovative positioning of the vessel's fuel tanks below deck."

Project 821's fuel cell technology can provide an entire week's worth of silent operation at anchor, or emissions-free navigation at 10knots when departing harbours or cruising in protected marine zones with pure water being the only emission.

MAN Cryo says it faced a number of challenges during the project, in great part owing to the lack of existing design codes and standards to follow in order to get approval for its tank design. Normally, Type-C LNG tanks are designed according to IGF code, but this is not fully applicable to hydrogen.

Instead, MAN Cryo approached Lloyd's Register with a risk assessment-based design that is considered safe and approved for placement below deck, a first of its kind in the world and just the second ever for a marine liquid-hydrogen project.

PROPULSION

BERG SECURES PROPULSION PACKAGE FOR WIND-ASSISTED RO-RO VESSELS

Berg Propulsion has won a contract covering the hybrid propulsion solution that will ensure three wind-assisted Louis Dreyfus Armateurs (LDA) ro-ro vessels maximise efficiency regardless of their mode of operation.

The vessels are scheduled for delivery from 2026 onwards and will carry Airbus A320 Family jetliner subassemblies from France to the final assembly line in the USA.

LDA says wind power drawn from six Norsepower rotor sails on each ship's deck will make a strong contribution to reduced emissions, with weather routing optimisation software also in place to maximise wind-assisted time and minimise drag. In conventional mode, the ships will run on dual-fuel methanol engines.

Besides the complete propulsion train to work with each ship's main engines, Berg will supply controllable pitch propellers with feathering capability.

According to Amrita Singh, account manager at Berg Propulsion, Berg's hybrid solution allows main engines and electric motors to drive propulsion either independently or simultaneously so that the most efficient power option is used as a vessel's operational needs change.

SOURCE: LOUIS DREYFUS ARMATEURS

"The system works with alternative power sources, including wind," says Singh. "It's key when integrating sails that they work seamlessly with propulsion controls so that adjustments can be made to thrust in any given weather and sea condition. In Berg's solution, Dynamic Drive is integrated into the MPC800 control system, which delivers this capability without the operational complexity of additional hardware."

Dynamic Drive is an adaptive thrust and fuel optimisation software, offered for inclusion with the Berg Propulsion MPC 800 control system. The software automatically and dynamically identifies the most energy efficient settings for propeller pitch/rpm to produce the thrust to maintain the required speed.

OPINION

BREAKING DOWN BARRIERS TO VESSEL EFFICIENCY

Verifying efficiency technology performance and including the wider technical and economic context are key to progressing maritime decarbonisation, says **Jonathan Strachan**, chief technical officer of independent design, engineering and sustainability strategy consultancy Houlder

University College London (UCL) estimates that every year of inaction this decade will add an extra US$100 billion to the cost of shipping's decarbonisation, so what sustainability solutions can the industry be focusing on now? Our industry must not miss a huge opportunity to reduce greenhouse gas (GHG) emissions today by investing in energy efficiency technologies.

To some extent, shipowners and their purchasers have been adopting energy efficiency technologies, but this needs to be significantly and quickly scaled to align the industry with the International Maritime Organisation's (IMO) revised GHG strategy. In a nutshell, the updated strategy targets net-zero GHG emissions by or around 2050 with the indicative checkpoints of a 20-30% reduction by 2030 and a 70-80% reduction by 2040 (both compared to 2008 levels).

Many shipowners are starting to pick the 'low hanging fruit' and secure quick efficiency wins – which is positive. But it is time that the industry starts to take efficiency technology adoption to the next level, to start analysing real-world performance data in depth, identifying fleet-wide trends and assessing technologies in combination with each other and with operational optimisations. This level of thinking will be required to meet those IMO targets.

According to Clarksons' latest Green Technology Tracker, 33.5% of fleet tonnage has at least one 'energy-saving technology' fitted. That's over 8,713 ships with some form of efficiency technology – including 493 vessels with air lubrication and 116 with wind propulsion in the fleet and orderbook. This is progress, however, don't forget how massive the commercial fleet is. There are still thousands of ships on the water and on the shipyards' orderbooks that have not adopted efficiency solutions yet, and there is a plethora of efficiency solutions on the market.

Recognising the efficiency opportunity

So, what are the main energy efficiency technologies touted today? The list is long and increasing by the day, but it includes rigid wing sails, Flettner rotors, kite sails, suction wings, waste heat recovery solutions, Mewis ducts, propeller boss cap fins, rudder bulbs, pre-swirl stators, wake equalising ducts, air lubrication, bow enhancement, hull fins, hull appendages and coating technologies and so on. Vessel optimisations such as

hull form optimisation, engine and speed optimisation and propeller optimisation all also present strong opportunities for energy efficiency gains.

The efficiency opportunity these technologies offer is well understood; if you save fuel, you save money and emissions. If you save emissions, you help combat climate change. It's a virtuous circle in that regard that also makes commercial sense. Many efficiency technologies can also be retrofitted to existing ships, extending the lifespan of the current fleet and helping shipowners maintain the value of their assets as they navigate shipping's decarbonisation transition. Efficiency technologies can also, often efficiently, be installed on board newbuild vessels at shipyards during construction.

While the technologies available and the rationale for adopting them is quite clear, not all shipowners and their purchasers immediately recognise the technological readiness level (TRL) of the equipment. Many solutions already commercially available today offer a strong return on investment – both in terms of cash and carbon – while others are still in the concept phase. Supporting the commercialisation of concepts may gain shipowners a first-mover competitive advantage and could help steer the industry towards viable solutions, while proven technologies should be considered for more standardised widespread adoption if suitable for the specific ship.

JONATHAN STACHAN

The shipping industry has grown used to adopting solutions with a TRL of 9 (proven in operations), but the industry must take a more proactive and collaborative approach to decarbonisation. There are a precious few 'out of the box' solutions and no silver bullets. There is a selection of commercially minded industry leaders that are already proactively collaborating to develop and better understand their technology options, but for the average shipowner that cannot afford to back the wrong horse, uncertainty on efficiency technology performance,

and the many technical and economic variables in play, remain key barriers to final investment decisions.

Continually verifying technology performance

The main barrier recognised to efficiency technology commercialisation is verified performance data. In Houlder's recent qualitative decarbonisation whitepaper, shipowners identified a lack of good quality and relevant operating data as a key barrier to the uptake of efficiency technologies. There was also a perceived shortage of independent corroboration for the claims made by some technology vendors. None of the participants accused technology providers of suggesting deliberately misleading results, but reflected that the data in a brochure will inevitably relate to another ship.

Verified and accurate performance data is in the best interest of efficiency technology providers as well as ship owners and operators. It should be seen as a win-win, as technology providers generally want case studies of their technology performing well on a suitable vessel and route to build trust with their customers, meanwhile shipowners want technology performance that meets their expectations.

For shipowners, it is important to make sure the data conversation is not one-sided. Many efficiency technology providers may be reluctant to share their performance data, and so having an independent expert intermediary who manages both relationships and is an ally to the shipowner can be useful. Essentially, shipowners need to develop their own reference library for performance data too, so that they are not overly dependent on the data of the technology provider.

The key when analysing efficiency technologies is to start with the ship and its unique operating profile, not the technology being offered; emissions performance will vary depending on the ship, route, cargo, vessel speed, sea state and the vessel's loading condition (draught and trim), fuel, and so on. Once you have collected enough data in the latest analysis tools, you can then gather broader insights for ship types and spot fleet-wide trends.

Other important considerations include whether performance data has been provided across the entire operational range of the vessel, rather than just a single point of optimisation; whether operational data is from a typical voyage on a standard vessel; and whether the emissions data has been independently verified. Having access to the right technical expertise and strategic advice from the outset of a project is key.

Overcoming technical, economic and regulatory uncertainty

Another barrier causing hesitancy on energy efficiency technology adoption is the ever more complex technical, economic and regulatory operating environment. Efficiency technologies are constantly evolving, as are the incentives, carrots and sticks, for their adoption. It is important to revaluate the green investments assessed in the past; the chances are they now have a much stronger business case, and that green funding is more readily available.

With the level of complexity and fragmentation in the market, even those with in-house expertise and a strong sustainability strategy would be smart to regularly get a second opinion – confirming whether their pathway is the best choice to optimise efficiency, and checking if any technical or economic variables need to be reprioritised.

Technical variables to consider include whether there is any impact on manoeuvring or electrical safety of the vessel, how new technology will interact with other equipment on board, and whether the technology represents a long-term solution for the entire lifespan of the ship. Individual clean technology providers are unlikely to be able to detail how their system will interact with equipment already on board or with a technology planned for adoption in the future. These insights may alter key elements of that ship's sustainability plan, such as the order in which efficiency technologies and optimisations are adopted.

Looking at the costs of compliance in more detail, the European Union's Emissions Trading System (EU ETS), for example, is expected to become increasingly impactful on efficiency technology purchasing decisions. The EU ETS adds a progressive cost to carbon emissions, improving the payback equation for energy and fuel efficiency technologies over time. With the EU ETS quite rapidly ramping up, there is also a cost to not acting now. In addition, FuelEU Maritime promotes installation of certain abatement methods and the use of low carbon fuels, by setting out progressively more stringent GHG emission targets. These variables can all be calculated to provide a strong data-centric basis for any efficiency technology investment decisions.

Adding to the many push and pull decarbonisation drivers, access to Poseidon Principles-aligned funding for new vessels relies on a clear and long-term sustainability and vessel efficiency strategy. Efficiency technologies that offer some alignment with the IMO's revised GHG strategy should form a key part of any green newbuild plans. Plus, asset values are increasingly becoming linked to environmental rating. Within vessel classification systems such as Rightship's and the IMO's Carbon Intensity Indicator (CII), a programme of ongoing investments, innovations and efficiency improvements will be required to maintain superior rankings over time.

To an extent, it remains to be seen how a powerful charterer, customer, ESG, funder and even regulator pressure to decarbonise is going to be, but what matters most is that the direction of travel is clear – and that is certainly towards cleaner and more efficient vessels. The good news is that there are a range of efficiency technologies available, many of these solutions make commercial and environmental sense, and the barriers to widespread adoption of these solutions are not insurmountable. The tools for vessel owners to make informed and data-led efficiency technology purchasing decisions are available today; these decisions and actions will ultimately determine how well shipping progresses towards its decarbonisation destination. ■

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In December 2024, the International Maritime Organization (IMO) will host the 109th session of the Maritime Safety Committee (MSC) where the Maritime Autonomous Surface Ships (MASS) group will meet again. The Royal Institution of Naval Architects and the Danish Society of Engineers (IDA Maritime) are organising the 3rd Autonomous ship conference on 20-21 November 2024 ahead of the IMO meeting.

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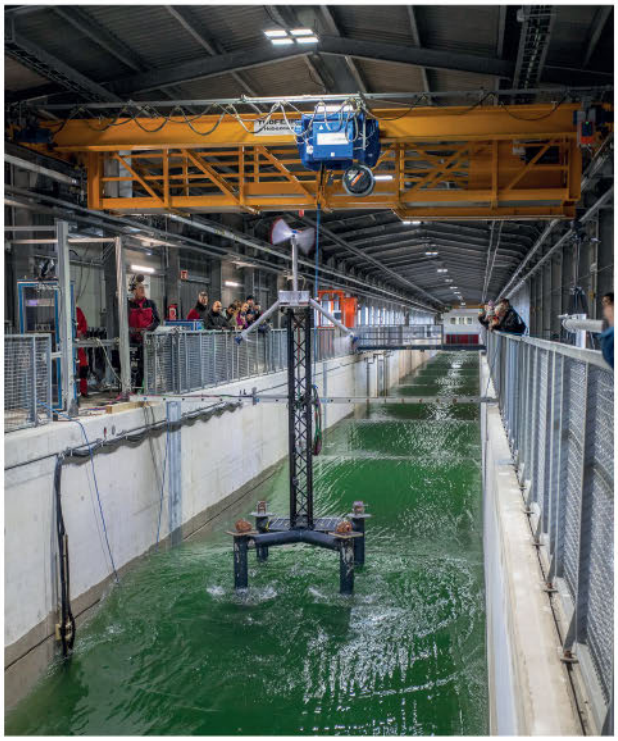
GERMANY

UNIQUE RESEARCH TO GUIDE DESIGN OPTIMISATIONS FOR FLOATING OFFSHORE WIND TURBINES

By **Daniel Johnson**

As society moves away from fossil fuels and towards clean energy, the North Sea holds huge potential to deliver great increases in offshore wind energy and is considered the "power station" of Europe's energy transition. The countries bordering it plan to build 120GW of offshore wind power by 2030 so that wind energy can make a significant contribution to the continent's electricity supply in the future.

Floating offshore wind turbines are seen as an essential component in delivering this policy. However, their use poses a number of challenges, including changes to the seabed around the turbines. Researchers in the international collaborative project NuLIMAS, coordinated by Germany's Leichtweiß Institute of Hydraulic Engineering at Technische Universität (TU) Braunschweig, are investigating what is known as soil liquefaction. To this end, the researchers have carried out a series of unique experiments with a floating wind turbine in the Large Wave Current Channel (GWK+) at the Coastal Research Centre in Hannover.



THE 1:15 SCALE FLOATING WIND TURBINE WAS CUSTOM MADE FROM ALUMINIUM AND IS BASED ON A REAL WIND TURBINE FROM PROJECT PARTNER GICON. SOURCE: MAX FUHRMANN/TU BRAUNSCHWEIG

"If the turbines are to withstand extreme conditions, they must also be optimally adapted to conditions under water and on the seabed," explains Dr Christian Windt of the Leichtweiß Institute of Hydraulic Engineering. This is where NuLIMAS, a joint project of TU Braunschweig and partners in Germany, Poland and Turkey, comes in, he tells *TNA*.

The research team is analysing the processes of soil liquefaction, a phenomenon by which the seabed soil can temporarily act as a liquid, depending on the wave, loading and soil conditions. The phenomenon can cause even large structures – such as breakwaters – to sink into the ground during storms and lose their function. If strong wave movements affect the foundations of floating wind turbines, soil liquefaction can occur, leading to a complete loss of load-bearing capacity. In a worst-case scenario, the entire turbine can slide away.

"One of the main goals of the project is to develop an accurate and efficient numerical model of wave-soil and wave-structure-soil interaction, capturing the close coupling between the hydrodynamic, structural and geotechnical processes, so as to enable optimised development of marine infrastructure such as the gravity anchors of floating offshore wind turbines," says Windt, who is project coordinator for NuLIMAS.

Upping the scale

The research team had already collected the first comparative data sets through small-scale experiments with project partners in Poland at the Institute of Hydro-Engineering. For the experiments at GWK+, the researchers used a 1:15 scale floating offshore wind turbine specially manufactured from aluminium and based on a real-world turbine from Dresden-headquartered NuLIMAS participant GICON. The model floating structure, known as GICON-TLP, is connected to the foundation – a 2m by 2m, 50cm-high concrete element – via four mooring lines.

"Experiments of this kind on this scale have never been carried out on floating structures before," points out Windt, adding that they were extremely complex, laborious and time consuming. "The whole flume is 300m long, 5m wide and 7m deep", he notes. "The water depth that we were testing was 4.5m and the sand pit 6m by 5m by 1m, so quite a substantial amount of soil."

For each experiment, the soil that the researchers wanted to liquefy had to be loosened up with what Windt describes as a "high-pressure cleaner". "That procedure took seven hours, so basically a whole working day," he says.

Sixteen sensors were installed along the sandy bottom of the channel and then the channel was filled with around 6,750m³ of water, another seven-hour procedure.

Experiments under realistic conditions

Initially, the research team only looked at the effects of wave action on the seabed. However, to achieve a realistic load on the structure, not only wave loads but also wind loads had to be considered. This meant that in addition to waves up to 60cm high – representing a height of 9m in reality – wind was added in further tests, with an average speed of up to 6m per second on a real scale. To achieve this, the research partners worked with German wind energy engineering consultancy sowento GmBH to develop a novel hardware-in-the-loop system that calculates the wind loads on the structure in real time and can apply them using four propellers.

In one of the experiments in the GWK+, the effects of extreme combinations of wave and wind loads, as well as the liquefaction effect in the soil, were observed as in nature. After a short time, the wind turbine was seen moving in the channel, then drifting towards the wave channel wall and finally turning 90°. The movements were recorded by four cameras and the displacement of the foundation was also measured by echo sounders.

"The ground started to liquefy relatively quickly. We expected that," says Windt. "It's a scenario that could also occur in the North Sea during stormy weather and affect the operation of the wind turbine."

He adds: "I think the big take home messages from the work [at GWK+] are, firstly, we can actually do these liquefaction experiments in large scale and, secondly, we've been able to demonstrate that a combination of high wave and wind loads support the triggering of liquefaction. From an industry point of view, that's quite important to know."

According to Windt, the data sets from the tests will now allow important design optimisations for floating offshore wind turbines, which the industry urgently needs to remain competitive. With the experiments and analysis of the results complete, the team is currently finalising an associated research paper, to be published towards the end of this year. An open-source numerical modelling framework for liquefaction, using the computational fluid dynamics (CFD) software OpenFOAM, will also be published online for future use by interested professionals.

DR CHRISTIAN WINDT IS COORDINATING THE NULIMAS PROJECT. SOURCE: MAX FUHRMANN/TU BRAUNSCHWEIG

"The computer model will help engineers with issues such as anchor design, soil type and site selection without the whole laborious process of setting up the experiments," says Windt. "For example, when testing anchor designs you can run the simulations that you want to do, but then have the freedom to change the design by adding things like side skirts or suction buckets or change design parameters such as weight and see how that affects your liquefaction potential."

From the work carried out through NuLIMAS, the research team has been able to secure follow-up funding from the European Union for an Integrated Designs for Future Floating Offshore Wind Farm Technology (INF4INiTY) project. The 48-month venture will look to develop nature-inclusive designs for subsea components of floating offshore wind installations.

"We hope to find solutions that will balance human needs, such as clean energy, with nature's and society's demands of decreased negative environmental and social impact," concludes Windt. ■

MAKING WAVES... AND CURRENTS AT THE SAME TIME

The Large Wave Current Channel (GWK+) in the Marienwerder district of Hannover was opened in 1983 as part of the German Research Foundation (DFG)-funded Collaborative Research Centre SFB 79. With a usable length of 300m, a width of 5m and a depth of 7m, it is still one of the largest wave flumes in the world. Since its construction, it has served national and international research interests dedicated to the development of waves and their interaction with a wide variety of structures.

Until recently, only waves could be generated in GWK+. With the expansion of renewable energy generators on the sea, foundation aspects of such structures and the influence of tidal currents came more into focus and in 2017 Germany's Federal Ministry for Economic Affairs and Energy approved a research project called marTech (Testing and Development of Renewable Maritime Technologies for Reliable and Sustainable Energy Supply) at the request of the participating universities, Leibniz Universität Hannover and TU Braunschweig. Since then, more than €35 million has been invested in upgrading the wave flume with a powerful current system, a deep section for investigating foundation structures of offshore wind turbines and a more powerful wave maker. The construction work was completed in the summer of 2023 and thanks to the modifications GWK+ now has the unique capability of creating waves and currents at the same time.

CARNIVAL JUBILEE UNDER CONSTRUCTION AT MEYER WERFT. SOURCE: MEYER GROUP

GERMAN SHIPBUILDER BOUNCES BACK FROM PANDEMIC WITH NOVEL DESIGNS AND NEWBUILDS

By **Tom Barlow-Brown**

The Meyer Group has faced significant challenges of late, stemming largely from a lack of orders during the Covid-19 pandemic. The crisis, which led to an overall slowdown in production, forced the company to reduce its output and confront economic hurdles such as inflation, high energy costs, and labour prices. However, lately the old stalwart of the German shipbuilding industry has recently rejuvenated itself through strategic innovation and new cruise ship orders, heralding a promising turnaround.

The renowned shipbuilding company Meyer Weft, based in Papenburg, Germany, has long been a significant player in the maritime industry, known for its innovation and high-quality vessels. Established in 1795, the family-owned company has a rich history of delivering cutting-edge ships, including luxury cruise liners, research vessels and specialised marine structures. Recently, Meyer Werft has been making headlines with its impressive recovery from the Covid-19 pandemic, marked by groundbreaking designs and newbuilds that are set to redefine the future of cruising. This article delves into the latest developments at Meyer Werft, including its ongoing partnership with Carnival Corporation, the introduction of state-of-the-art technologies, and its ambitious plans for climate-neutral cruise ships.

Continuing success story

The company recently announced an agreement to build another state-of-the-art Excel class cruise ship for Carnival Cruise Line, part of Carnival Corporation, which is scheduled for delivery in 2027. This new vessel will be a sister ship to the *Carnival Jubilee*, delivered in 2023. Bernd Eikens, CEO of Meyer Group, expressed his satisfaction with this continued partnership, stating: "The Excel class from Meyer Werft and Meyer Turku has been contributing to Carnival Corporation's success for several years now. We look forward to continuing this success story together."

Since 2018 the two parts of the Meyer Group have jointly built nine cruise ships with LNG propulsion on a shared technical platform for various lines within Carnival Corporation's portfolio. The new ship, adhering to this successful platform, will measure approximately 344m in length and have a gross tonnage of around 180,000, providing accommodations for over 6,400 guests.

According to Thomas Weigend, chief sales officer of Meyer Group, this new order is a clear indicator of the cruise market's recovery and the increasing demand for sea voyages. Josh Weinstein, CEO of Carnival Corporation, echoed this sentiment, emphasising the company's

excitement to enhance its global fleet with another cutting-edge ship from Meyer Werft. The newbuild not only symbolises the rejuvenation of the cruise industry post-pandemic but also ensures job security for local and partner company employees.

Carnival Corporation had previously placed another order with Meyer Werft for an Excel class vessel in mid-February which is slated for delivery in 2028. This order is contingent upon securing financing, expected to be finalised later this year. Eikens remarked on the long-standing success of the Excel class ships, which have significantly contributed to Carnival Corporation's prosperity. The upcoming ships will continue the trend of the previous vessels, matching their predecessors in size and capacity.

Christine Duffy, president of Carnival Cruise Line, pointed out that the Excel class ships, including *Mardi Gras*, *Carnival Celebration* and *Carnival Jubilee*, have been highly anticipated.

"Carnival's Excel class fleet will soon consist of a quintet of these highly popular ships that offer outstanding guest amenities and tremendous operational efficiencies," stated Duffy. "Since the introduction of *Mardi Gras* in 2021 and the subsequent expansion with *Carnival Celebration* in 2022 and *Carnival Jubilee* in 2023, these Excel class ships have generated excitement, demand and high guest satisfaction," she added.

The recent orders from Carnival Corporation underscore a significant turnaround in the cruise market, which has not only recovered but, in some areas, surpassed pre-pandemic levels. Weigend emphasised that the success of Meyer Group's ships in operation validates the continuation of its ship platform. Currently, Meyer Werft's order book is robust, featuring six cruise ships, a research vessel and steel constructions for four offshore converter platforms.

Climate-neutral cruising

At Seatrade Cruise Global in Miami in April 2024, Meyer Group showcased its new ideas and other maritime products, reaffirming its technical leadership in the industry. Among the highlights were initiatives towards a climate-neutral cruise ship concept under development in the NEcOLEAP research project at Meyer Group-owned Meyer Turku in Finland. Additionally, ALFRED Maritime, Meyer Group's digital venture, introduced the AI-based Meyer Energy Management System. This platform, developed by ALFRED's IoT and data experts in conjunction with Meyer's Energy Efficiency team, aims to boost operational efficiency on ships. It assists ship operators and crews in understanding and analysing ship performance, providing actionable insights to optimise energy efficiency and reduce fuel consumption. By offering accurate performance predictions and forecasts, the system also helps in reducing emissions.

A significant aspect of Meyer Turku's innovation is the climate-neutral AVATAR cruise ship concept, part of the NEcOLEAP project funded by Business Finland. Meyer Turku aims to develop this climate-neutral cruise ship by the end of 2025, with construction starting around 2030. Tim Meyer, CEO of Meyer Turku, discussed this ambitious project at Seatrade Cruise Global, detailing its holistic approach. The AVATAR concept includes new galley designs with automated logistics, alternative materials, sustainable stateroom designs, and numerous energy efficiency optimisations. The project extends to the end of the product life cycle, emphasising material selections, recycling and circular economy principles.

Meyer Werft also highlighted its unique product portfolio at Seatrade Cruise Global. Meyer Floating Solutions presented innovative floating piers and cruise terminal designs, while a model of the *Icon of the Seas*, delivered by Meyer Turku in December 2023, was displayed. The *Icon of the Seas* is noted for its innovation and efficiency,

THE AVATAR CONCEPT. SOURCE: MEYER GROUP

featuring the largest AquaDome, an unprecedented glass and steel structure, and record-breaking waterslides among other attractions. Thomas Weigend emphasised that Meyer is the only shipyard capable of offering a complete range from river cruise ships to large ocean-going vessels like the *Icon of the Seas*. Meyer's tradition of innovation, coupled with new products like floating piers and terminals, creates additional value for shipowners and port operators.

The company's plans for the future were also showcased in the ORIGIN concept, addressing future living needs and global trends with weather-independent features and innovative passenger flow designs. The asymmetric superstructure, advanced transportation system and decentralised public areas promise to redefine passenger experiences, moving away from the traditional ship-like appearance.

Streamlined operations

Despite the challenges brought by the Covid-19 pandemic, Meyer Werft has managed to secure its future through strategic innovations and restructuring efforts. The appointment of restructuring expert Ralf Schmitz as chief restructuring officer for the Papenburg yard and Rostock's Meyer Neptun highlights the company's commitment to overcoming economic hurdles. Schmitz, known for his extensive experience across various sectors, is expected to streamline operations and ensure financial stability, aiding Meyer Werft in meeting a €550 million loan due in November.

The pandemic had forced Meyer Werft to reduce its output due to delayed orders and a dearth of new orders. Coupled with inflation and additional costs in Germany, the shipyard faced significant challenges. However, recent new orders signal a strong rebound for the company. These developments not only highlight the company's resilience but also its ability to help innovating in the cruise industry.

Meyer Werft's collaboration with Carnival Corporation, highlighted by the construction of new Excel class ships, underscores a significant recovery in the cruise market. The company's focus on innovation, sustainability and operational efficiency could position it as a leader in the maritime industry. With strategic restructuring and a robust order book the company is poised to navigate post-pandemic challenges and continue its legacy of maritime excellence. ■

GERMAN SHIPPING COMPANIES LEAD THE WAY WITH MAJOR SUSTAINABLE FLEET EXPANSIONS

By **Tom Barlow-Brown**

The global maritime industry continues to evolve as leading shipping companies invest heavily in innovative and environmentally sustainable technologies. This trend is particularly evident in Germany, where companies are making significant strides to modernise their fleets.

Two prominent players, GEFO Shipping Group and German Tanker Shipping (GTS), are at the forefront of this transformation through substantial investments in newbuild orders from Chinese shipyards. These investments not only signify an expansion of their fleets but also underscore a commitment to reducing environmental impact and enhancing operational efficiency.

GEFO Shipping Group, founded in 1961 and based in Hamburg, operates a fleet of 150 tankers, including chemical, gas and mineral oil tankers, primarily on the Rhine and in the Antwerp/Rotterdam/Amsterdam (ARA) chemical triangle. With an annual turnover of €500 million to €600 million, GEFO is a medium-sized, family-owned company known for its commitment to safety and sustainability. Its latest move to order 10 new 3,850dwt tankers from the Xiangyu Shipyard in Nantong, China, marks the completion of a significant €400 million investment programme. This investment will be followed by a new programme, involving an as yet undisclosed three-digit million euro amount, to build another 10 special tankers equipped with stainless steel tanks for chemical cargoes.

These new vessels, scheduled for delivery between 2026 and 2028, are designed to be more fuel efficient and produce lower emissions compared to their predecessors. The state-of-the-art design of the tankers allows for future retrofitting with various environmentally friendly configurations and innovative fuel options, aligning with the company's goal of achieving a carbon-neutral fleet by 2045. The delivery of these vessels will help expand GEFO's fleet while replacing older ships expected to reach their 20-year maximum service life between 2028 and 2030.

Elsewhere in the German shipping industry, other significant developments are underway. Hapag-Lloyd, one of the world's leading container shipping companies, has been investing in liquefied natural gas (LNG) technology for its fleet, aiming to reduce greenhouse gas emissions significantly. Similarly, Hamburg Süd is incorporating advanced digital solutions to optimise its shipping routes, thereby improving fuel efficiency and reducing its carbon footprint. These initiatives highlight a broader industry trend towards sustainability and innovation, reflecting the

GTS'S PRODUCT TANKER *SEACONGER* ON THE KIEL CANAL. SOURCE: DIRK FRANKE/CREATIVE COMMONS

growing importance of environmental stewardship and technological advancement in maritime operations.

Meanwhile, German Tanker Shipping has expanded its orderbook for product carriers from China to six vessels. Founded in 1998 and headquartered in Bremen, GTS manages a fleet of 14 oil product tankers, all built in Germany, with nine vessels sailing under the German flag and the other five under the Seychelles flag. The company has opted to build its new tankers at China's Fujian Mawei Shipbuilding and Xiamen Shipbuilding Industry shipyards, with deliveries starting from mid-2025.

Cutting-edge propulsion systems

GTS's newbuilds, designed by Swedish Fartygskonstruktioner AB, will feature cutting-edge MAN Energy Solutions propulsion systems. The quartet of 41,000dwt tankers will be powered by MAN 10L32/44CR main engines, capable of burning both conventional and biodiesel fuels, with the option to retrofit for methanol operation in the future. Each engine will have a power output of 600kW per cylinder and will drive a MAN Alpha VBS1260 CP propeller via a Flender GUCK-1560 gearbox. This combination ensures the vessels meet the International Maritime Organization's Energy Efficiency Design Index (EEDI) regulations, as well as optimising fuel efficiency and reducing emissions.

The MAN engines will be integrated with low-pressure selective catalytic reduction (SCR) systems, achieving NOx-reduction rates of up to 90%. Christian Kamm, MAN's Europe sales manager, notes the high efficiency of the 32/44CR engine, even when operating the SCR system, which does not incur a fuel penalty or derating, particularly with heavy fuel oil (HFO). Additionally, these engines will include the SaCoS 5000 automation system, ensuring compliance with cybersecurity standards and enabling remote technical support.

Each GTS vessel will also feature MAN auxiliary engines, including two 8L23/30H Mk2 900rpm and one 6L23/30H Mk2 720rpm gensets. The engines, built by MAN licensee CSSC Marine Power Co., Ltd in China, will be equipped with water-lubricated stern tubes, eliminating any risk of oil leaks and ensuring an environmentally friendly interface.

The recent decisions made by GEFO and GTS provide a glimpse into the future of maritime logistics and highlight the critical role of innovative engineering and strategic planning in navigating the challenges and opportunities of modern shipping. The substantial investments made by the two companies in newbuild tankers from Chinese shipyards highlight the industry's shift towards sustainable and technologically advanced maritime solutions. The substantial newbuild orders by GEFO and GTS from Chinese shipyards signify a need to meet global sustainability goals and a proactive approach to future-proofing their operations. More than just fleet expansions; they also represent a shift in strategic alignment a further increase in the prominence of China in the shipbuilding sector.

By incorporating new technology and prioritising environmental considerations, the two companies along with those of other major German shipping companies, are setting new standards in the maritime shipping industry by highlighting the critical role of innovative engineering, strategic planning, and a commitment to sustainability in navigating the challenges and opportunities of modern shipping. As the industry continues to evolve, the actions of GEFO and GTS will likely serve as a benchmark for others striving to balance operational excellence with environmental stewardship. ■

OFFSHORE & SUBSEA

NORTH SEA DECOMMISSIONING: A COMPLEX CHALLENGE BUT A HUGE OPPORTUNITY

By **Richard Halfhide**

It's nearly 50 years since the first British North Sea oil began coming ashore, an industry that at its height brought tens of billions annually into the UK economy. Although not quite a 'sunset industry' the changing energy market and the inconvenient reality that many older assets are reaching the end of their operational lives means there is a growing emphasis on tackling the decommissioning of that offshore infrastructure.

Oil and gas (O&G) decommissioning is a burgeoning market, valued at around US$300 billion globally overall. In 2022, the UK North Sea sector spent around £1.6 billion, but the figure is likely to rise significantly in the next few years as topsides (the surface deck) and subsea decommissioning of the UK Continental Shelf gathers momentum, potentially more than doubling its current expenditure.

But decommissioning is an expensive and complicated task for asset owners; while opportunities may emerge from new sectors such as carbon sequestration for the present at least it brings little in the way of financial recompense. A significant factor is the safety of those workers undertaking the decommissioning work on ageing infrastructure that has spent decades at the mercy of the elements.

The engineering of modern-day structures, be they rigs, ships or wind turbines, are mandated at least in part to give due consideration to end-of-life management, but the same wasn't true for these older structures and each project brings with it a litany of problems with regard to disposing of hazardous materials to ensure compliance with modern environmental legislation.

SOURCE: SHUTTERSTOCK

None of this will be possible without skilled decommissioning experts, including marine engineers and naval architects, with the expertise and experience to undertake such projects. But with the energy sector already struggling with a staffing shortage, how best to attract young talent to a niche sector that's often perceived as 'unsexy' compared to the alternatives?

Bureau Veritas

It's a multifaceted challenge very much on the radar of classification society Bureau Veritas (BV), which has taken on an increasingly central role in shaping the future of decommissioning. As a company that had grown and expanded in large part through acquisitions, a number of BV's subsidiaries were already providing consultancy services in a variety of offshore activities – such as warranties, risk assessments and structural analysis – some of which was already related to decommissioning.

What it lacked, at least until a few years ago, was a defined strategy towards decommissioning, according to Dawn Robertson, BV's global director for exploration and production.

She explains: "We held workshops bringing together a lot of parties together to frame exactly what decommissioning is, where BV could provide a service, and where we already offered a service and perhaps didn't realise it. When we joined together all the dots we were able to draw together a full value proposition of services and take that to market."

It was a journey that involved BV becoming an active member of trade organisation Decom North Sea, today known as Decom Mission, with Robertson becoming the chair of its Decommissioning Leadership Group and later joining its board of directors. Entering what was already a developed market has allowed BV to spot the gaps and tailor its UK-centred decommissioning services accordingly.

Developed market

Although other markets are now rapidly emerging for offshore decommissioning, such as the Gulf of Mexico and South Asia, also demanding decommissioning services, the North Sea and Australia (BV has been heavily involved in the decommissioning process for the FPSO

Northern Endeavour) remain the most developed, with an established O&G skills pool.

This is due to the very specific challenges it poses; as well as being significantly older the North Sea assets are often located in much shallower waters, meaning that it's not considered viable for these assets to be deliberately sunk under a 'rigs to reef' scheme.

But North Sea decommissioning projects also struggle financially; operators benefit from the British government's tax relief scheme, but with skilled project engineers and managers at a premium there is the risk that the best of them will be lured overseas to lead projects elsewhere. There is additional competition in the form of offshore wind farms, with a growing number of older turbines now being decommissioned to make way for newer models.

Decommissioning must also grapple with the stigma of being perceived as waste management rather than the cutting-edge of engineering, something that belies the growing sophistication of the technology being employed. Typically around half the cost of any project is accounted for by the plugging and abandonment part of the operation, with a host of new solutions gaining reaction in recent years, ranging from fusion-based alloy plugs for wells to underwater drone surveillance for potential leakages.

Meanwhile above the waterline, topside removal is being improved by advances such as laser cutting and the fact that no two projects are ever quite the same places a strong emphasis on innovation.

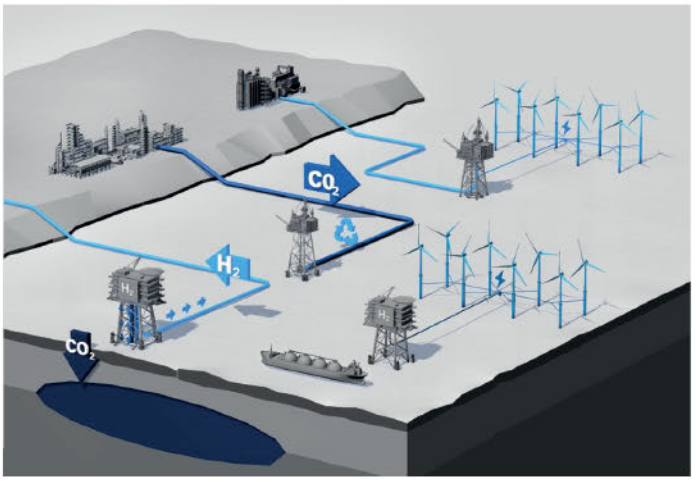
"People think that decom is about end of life and not even engineering, but disposal is really complex. It's a real challenge for people that are up for things like that and generally, engineers like solving problems," says Robertson.

Energy transition

Given the importance that North Sea O&G has had to Scotland's economy, in particular over the last half century, there is a conspicuous reluctance by the British and Scottish governments to address its legacy as newer, cleaner alternatives become the focus. Robertson says that one of the biggest problems is reframing the narrative as newer, cleaner alternatives take the stage.

She comments: "I've had meetings at Hollyrood where if people were looking for funding as part of the energy transition deal then decommissioning wasn't included in the money coming from the government to support it.

DAWN ROBERTSON, DIRECTOR – EXPLORATION & PRODUCTION, BUREAU VERITAS



A NUMBER OF NOTH SEA RIG LOCATIONS HAVE ALREADY BEEN EARMARKED FOR CARBON SEQUESTRATION PROJECTS. SOURCE: THE NORTH SEA TRANSITION AUTHORITY

"When [companies involved in decommissioning] asked to be a part of this they have been told it's not on the list; rather it's hydrogen, carbon capture, and electrification of assets. But from a decom point of view, the actual removal of the asset has the biggest impact on carbon emissions reduction."

From a regulatory perspective it's generally accepted that carbon emissions measurement and management needs a clearer definition of when a decommissioning project starts and ends, particularly with regard to so-called Scope 3 emissions (those resulting from assets not owned or controlled by the reporting organisation, but part of its value chain).

There remain deeper questions about whether obligatory decommissioning is really serving the greater good of the environment; under the OSPAR Convention operators of decommissioned assets are meant to ensure the seabed is restored to something like its original condition, but many are sceptical about whether attempting to do so actually causes more harm than good.

Notwithstanding this, BV is encouraging its clients to adopt the '10 R's' approach to the Circular Economy – refuse, rethink, reduce, reuse, recycle, repair, refurbish, remanufacture, repurpose, recycle, and recover – and use this mindset to rethink the discussion around decommissioning.

Robertson says: "Speaking personally, something I'm quite passionate about is making sure we're thinking about all of the circular economy potentials when it comes to these assets and actually changing their purpose.

"Some of these assets are structurally quite sound and The North Sea Transition Authority did a study that identified certain areas that are suitable for carbon capture pipelines... But the assets themselves could potentially serve as operations and maintenance hubs for offshore wind farms." ■

BULK CARRIERS

SCALING DECARBONISATION SOLUTIONS FOR THE DRY BULK SHIPPING SECTOR

By **Vasileios Gkikas**, director of business development and global dry bulk lead, ABS

The dry bulk sector accounts for a substantial part of the global shipping industry and faces unique challenges in achieving decarbonisation. The sector's trading structure, with vessels serving an extensive and diverse array of ports and anchorages, makes the transition to low- or zero-carbon fuels more complex than other sectors.

Dual fuel projects using LNG are already in the water and methanol and ammonia projects are also in progress. The potential of the increased use of biofuels is also becoming a focus for the segment. Several energy-saving technologies like fitting of hull appendages for optimisation, low-friction coatings, wind-assisted propulsion and carbon capture technology are progressing as well.

From a practical point of view however, bulk carriers present both technical and economical hurdles in adopting alternative fuels at scale. The design of bulk carriers, particularly smaller ones, present technical hurdles in adding tanks for alternative fuels such as LNG. These characteristics and attributes have perhaps created a tag of a "less-sophisticated" segment, which nevertheless is the backbone of the global commodity transportation.

From a business case perspective and compared to container shipping, for instance, there are fundamental differences when running the project de-risking exercise for any new innovative investment. Container shipping is dominated by large operator groups which in many cases have extended control of the wider supply chain, trade largely on fixed routes, operate on longer-term agreements and under the umbrella of alliances.

As a result, they have easier access to financing and can more easily mobilise other key stakeholders into entering collaborations, partnerships and large investment agreements. They are considered among the shipping industry's leaders, driving innovation in the shipping industry. These conditions are not the case for the average bulk carrier owner.

However, the segment is active with significant and notable decarbonisation work, with projects running that may not make headlines as often or as easily as in other segments. In addition to utilisation of new fuels, are several projects to apply energy saving technologies including wind-assisted propulsion, hull air lubrication and carbon capture – an area the dry bulk segment is particularly looking at.

THE DRY BULK SECTOR FACES UNIQUE CHALLENGES IN ACHIEVING DECARBONISATION. SOURCE: SHUTTERSTOCK

In all the above, there is one key parameter that sometimes is understated. That is the human factor, which presents challenges in terms of the new competencies, skills, knowledge and expertise that need to be added into the equation both aboard the vessels and ashore to ensure safe operations.

This requirement was a key driver to the creation of the ABS Hellenic Ship Safety Center to act as a location where the future of safety meets the future of learning. The Hellenic Ship Safety Center is designed to prepare seafarers to handle a multi-dimensional industry presented by alternative fuels and emerging technologies, recognising that advances in decarbonisation that do not prioritise safety are not sustainable.

Commodity-driven change

In the latest ABS Outlook, *Beyond the Horizon: View of the Emerging Value Chains*, we make the important point that the speed and extent of decarbonisation will to a large extent be commodity-driven.

Cargoes for which we are expecting demand to decline including major bulks like coal, will likely see a lower fleet renewal rate and thus owners will focus mainly on retrofitting energy efficiency technologies to comply with the regulations. The adoption of alternative fuels might therefore be lower in these sectors.

Achieving targeted carbon reduction targets that have been set for shipping means that existing ships must become much more efficient. It will not be possible to completely renew the existing fleet to use alternative fuels by 2050, which means the need to retrofit a large percentage of the existing bulk carrier fleet becomes essential.

Critically, the industry will need carbon capture rolled out across much of the oil-burning fleet, reducing onboard CO_2 emissions by 70%. Those that do not or cannot adopt carbon capture will need to switch to e-diesel or zero-carbon biofuels.

Carbon capture is a technology that will play a significant role in the transition until 2050. Some major names in the industry have plans for millions of tons of carbon capture for their onboard emissions and the technology is scaling up to provide that capability.

There is a huge amount of collaborative work taking place between vendors and shipowners to understand how this emerging technology can be safely adopted and efficiently absorbed into the maritime industry, its implications for vessel design and operations and its likely impact on carbon emission reduction.

Scaling energy efficiency technologies

We have seen that it is possible to achieve greater efficiency than that which has been so far reported and the increase in the number of energy efficiency technologies (EETs) available is a clear demonstration that owners are responding to the need to lower carbon emissions in line with regulatory targets.

The updated ABS Outlook notes that the adoption rate for EETs within the current fleet remains relatively low, but it is growing fast in the orderbook. Compared to last year's EET uptake, the latest rate for global fleet orderbook has jumped from 28% to 37.4%.

The highest EET uptake by ship type for the existing fleet is bulk carriers, followed by container ships, LNG carriers and liquefied petroleum gas carriers, while bulk carriers come in fourth position in EET uptake in the newbuilding orderbook.

By analysing their energy-saving potential, ABS has concluded that EETs are still considered short-term options since, in most cases, they cannot serve as the primary decarbonisation solutions to meet long-term emission reduction targets.

However, the Outlook also concludes that onboard carbon capture rates of 80% and higher are achievable, making OCCS applicable for meeting the IMO's long-term decarbonisation strategy. However, disproportionately more energy and equipment may be required for its operation, making it less economically attractive.

Industry projects

ABS has worked closely with industry stakeholders to support the process of lowering carbon emissions from dry bulk shipping, participating in numerous joint development projects (JDPs). These include an innovative methanol-fuelled 85,000dwt bulk carrier designed in a JDP between ABS, SDTR Marine and the Shanghai Merchant Ship Design & Research Institute (SDARI).

SDTR supplied key operational data and SDARI developed the design with ABS support and review. ABS also provided an analysis and outlook of methanol as a marine fuel, including a vessel performance evaluation in various operating scenarios, including under the European Union Emissions Trading System (EU ETS).

ABS also granted approval in principle (AiP) for the design of a 65,000dwt methanol-fuelled ultramax bulk carrier designed by SDARI for Lemissoler Navigation, the first such methanol-fuelled vessel for China's shipbuilding industry.

The design explores the feasibility of using methanol as fuel to accelerate the reduction of carbon emissions to reach the IMO's net-zero target by 2050. With the implementation of EU ETS and FuelEU regulations, the vessel, when burning green methanol, will have a greater potential to reduce the cost related to carbon emissions.

The vessel has been thoroughly optimised and its preliminary Energy Efficiency Design Index (EEDI) was reviewed. This indicated that the vessel exceeds EEDI Phase 3 standards. ABS completed design reviews based on class and statutory requirements.

ABS applies deep technical knowledge and extensive practical experience when establishing standards for the safe operation and performance efficiency of bulk carriers.

Conscious of the challenges facing the bulker sector, ABS engineers together with key industry stakeholders continue to pioneer solutions to serve today's fleet, while preparing for the next-gen vessels, aiming at a safe transition while improving the overall efficiency of the fleet. ■

ROTOR SAIL DESIGN FOR UNIMPEDED CARGO OPERATIONS

By **Luke McEwen**, technical director, Anemoi

ANEMOI ROTOR SAILS FOLDING DEPLOYMENT SYSTEM. SOURCE: ANEMOI

Wind-assisted propulsion systems are gaining momentum as effective strategies to help vessels meet greenhouse gas (GHG) reduction targets through improving overall operational efficiency. In the realm of wind auxiliary propulsion, rotor sails are coming out on top as a simple, unobtrusive option that is turning a lot of heads across the industry.

The commercial benefits of rotor sails have long been argued and are clear: significant reductions in fuel use can be seen through a lower reliance on main engines and utilising rotor sails as an auxiliary source of forward propulsion, slashing GHG emissions and reducing fuel use. This sounds like a win-win, but a concern that often echoes is that this deck-mounted wind-propulsion technology will impact cargo operations when the vessel is at berth. Of course, in the commercial reality of shipping, maintaining smooth cargo operations is vital.

With innovative deployment systems and smart vessel design, rotor sails can very realistically be integrated into vessels while minimising impact on cargo operations.

This can be circumstantial based on different vessel types. Bulk carriers have large areas of unused deck space, and, for this reason, we are seeing significant interest from the bulk sector, with some of the largest fleets integrating rotor sail technology.

Smooth cargo operations

Commercial operations are king for vessel owners. This means that efficiency gains and decarbonisation solutions are difficult pills to swallow if they come with cumbersome pieces of technology that could impede the cargo operations of vessels by interfering with cranes while in port.

Smart integration of rotor sails using different deployment systems can largely eliminate any kind of interruption. Readers are likely familiar with rotor sails in their upright position, which come in a range of heights, up to the largest at 35m, depending on the vessel, making them appear substantial. However, as well as fixed mounts, alternative deployment options exist, namely in a folding system and a rail deployment system – in the case of Anemoi's systems, at least – which have been meticulously engineered to cater to varying vessel configurations and operational requirements.

The folding deployment system is a pragmatic solution for bulk carriers seeking an unobtrusive deployment and integration of rotor sails. In this configuration, the sails are lowered horizontally to the deck using hydraulic systems, ensuring minimal interference with cranes and overall cargo operations. This streamlined approach facilitates swift deployment and retraction of rotor sails while at berth, allowing vessels to navigate port facilities with ease while maintaining operational efficiency.

Alternatively, a rail deployment system offers unparalleled flexibility and manoeuvrability, particularly during portside operations. By mounting rotor sails on rails that enable lateral or longitudinal movement across the deck, it's a simple process to move the sails out of the way, allowing crane access for loading and unloading.

Real-world implications play a pivotal role in determining the optimal rotor sail configuration for individual vessels. For instance, if the vessel intends to transit the Panama Canal, it's important to understand that the Canal only accepts vessels 32m wide, meaning folding systems for sails taller than this – such as 35m – may not be

practical as the new vessel width may be beyond the operating limit, meaning rail systems could be more appropriate. If the vessel does not plan on transiting the canal, the vessel width restrictions are now much looser, again impacting which solutions are pragmatic for that particular vessel. By analysing factors such as crane accessibility and loading procedures, as well as intended operating routes, solutions can be designed pragmatically based on real challenges experienced by owners and operators, helping align with specific vessel requirements and environments, minimising disruptions and maximising efficiency.

Solutions are great, but this brings us back to the question of simplicity, both in installation, maintenance and overall reliability, which are paramount considerations. Adding to their commercial viability, rotor sails are a relatively plug-and-play solution.

Additionally, they are an inherently robust structure. Their cylindrical shape ensures stability even in adverse weather conditions, with the ability to deactivate automatically in cases of strong winds, mitigating the risk of excessive force and the resulting safety concerns. This is versus alternative wind propulsion systems which may require folding down in adverse weather conditions or present a hazard. What this ultimately means is that rotor sails can be installed with minimal supporting structures and steelworks, both above and below the deck, reducing the intrusiveness of the installation process.

In November 2023, Vale, a global mining giant, announced plans to equip the 400,000dwt *Sohar Max*, the world's largest ore carrier, with five rotor sails from Anemoi Marine Technologies. These sails, featuring advanced folding deployment systems, are designed to reduce carbon emissions and fuel consumption without interfering with cargo operations. By utilising these innovative folding rotor sails, the *Sohar Max* is expected to cut its carbon dioxide emissions by up to 3,000tonnes annually and achieve a 6% reduction in fuel use, demonstrating significant environmental and commercial benefits for bulk carrier operations while maintaining operational efficiency.

Singapore-based dry bulk owner Berge Bulk similarly launched a strategic initiative to install four rotor sails with folding mechanisms on a 388,000dwt Valemax. This initiative aims to realise annual fuel savings of 1,200 to 1,500tonnes, significantly contributing to the company's goal of reducing emissions. The innovative folding design ensures that these sustainability measures do not disrupt cargo operations, underscoring the commitment to both environmental responsibility and operational efficiency.

Why are owners opting for rotor sails?

Rotor sails can reduce the load on main engines, lowering fuel consumption and emissions to meet International Maritime Organization (IMO) mandates. With regulations like the Carbon Intensity Indicator (CII) and the Energy Efficiency Existing Ship Index (EEXI) tightening, owners face pressure to adopt solutions that curb emissions while maintaining vessel efficiency. Rotor sails stand out as a versatile solution for improving vessel efficiency, adaptable for various vessel types and suitable for both newbuilds and retrofits.

The technology is also relatively small in comparison to the overall length and tonnage of a vessel – a benefit which is even more impressive when it comes to energy return of the compact technology. For instance, with a rotor sail, for the small amount of power put in, owners can roughly expect eight to 10 times as much power back through renewable wind energy.

Similarly, in order to provide similar thrust to what a rotor sail can produce, other wind-propulsion systems need to be much larger which of course may present additional challenges on cargo operations, the movement of port cranes, and crew and bridge visibility.

These technologies have size limits beyond which they become inefficient. Doubling the height and width of a sail quadruples its area, but increases the weight and material needed eightfold if the thickness also scales up, resulting in four times the thrust but closer to eight times the cost. Modern rotor sails are optimised to provide maximum thrust and energy savings while maintaining a relatively small size.

Rotor sails, particularly those with advanced folding and rail deployment systems, present a transformative solution for integrating wind-propulsion technology into vessel design while maintaining smooth cargo operations. Especially advantageous for bulk carriers, these innovative deployment mechanisms, such as those developed by Anemoi, mitigate concerns of cargo unloading by minimising or eliminating entirely any interfere with cranes or other cargo-handling equipment during port operations. This approach not only maintains but enhances operational efficiency by reducing the reliance on main engines, thereby cutting fuel consumption and GHG emissions significantly.

These systems highlight the feasibility of integrating rotor sails into various vessel types, offering a pragmatic and scalable solution to meet decarbonisation goals without compromising key commercial cargo operations. By adopting such technologies, shipowners and operators can achieve substantial environmental benefits while ensuring the seamless functionality of their commercial activities, demonstrating a balanced approach to sustainability and operational efficiency is a reality. ■

ANEMOI TECHNICAL DIRECTOR LUKE MCEWEN. SOURCE: ANEMOI

CASUALTY REPORT HIGHLIGHTS IMPROVEMENT IN SAFETY OF DRY BULK SHIPPING

Significant safety improvements have been achieved despite the dry bulk fleet growing by 20% more in tonnage over the past decade

A CONTRIBUTING FACTOR TO THE SAFETY PERFORMANCE OF BULK CARRIERS IS THE DEVELOPMENT AND IMPLEMENTATION OF AN IMPROVED INTERNATIONAL REGULATORY FRAMEWORK

Annual casualty figures from Intercargo, the International Association of Dry Cargo Shipowners, highlight continuing improvement in the safety performance of the sector. The Association's *Bulk Carrier Casualty Report* records the yearly loss of vessels over 10,000dwt and lives across the dry bulk sector, with the intention of monitoring the impact of safety measures in the sector across the globe.

The bulk carrier fleet has grown significantly in recent years to cater for the world's growing economy. Between 2014 and 2023 the number of vessels increased by 20% (to 12,200 according to the statistics used for the purposes of the report), with today's bulk fleet representing more than 40% of world tonnage and carrying an estimated 55% of the global transport work. Despite the fleet growth, encouraging statistics show that the loss of vessels continues to fall.

Naturally, areas of concern remain including cargo liquefaction or other moisture related cargo failure mechanisms, which pose the greatest risk to life, contributing to the loss of 55 lives or 61.8% of the total loss of life over the past 10 years. Groundings remain the biggest cause of ship losses. Enhancement of safety awareness by all parties, and especially the need for stakeholders to provide ships' crews with the correct cargo characteristics details, remains a priority to reduce casualties even further.

The reduction of incidents, as revealed in the report, can be attributed to continual safety improvements implemented by ship operators in tandem with enhanced legislation within the sector. A significant contributing factor to the safety performance of bulk carriers is the development and implementation of an improved international regulatory framework. As a non-governmental organisation (NGO) within the International Maritime Organization (IMO), Intercargo says it is proud to have played an important part in the development of this legislation. The adoption of new technology to improve ship design is also a major causal factor.

Dimitris Fafalios, Intercargo chairman, comments: "Bulk carrier safety must never be overlooked. We have come a long way since the 'dark days' of the 1980s, when we experienced many tragic losses of lives and vessels. Since then, safety performance of the sector has steadily improved, thanks in large part to concerted efforts by Intercargo with other industry stakeholders. These latest statistics reveal an impressive achievement, especially when considering the significant rise in the number of bulk carriers during this period."

Fafalios adds: "There is, however, definitely no room for complacency. Any loss of life is tragic, and the shipping industry must pay close attention to the contributing causes analysed in this report. Intercargo believes the dry bulk sector should be proud of its achievement and recognise that improved safety is largely thanks to continuous crew and shore-staff training, improved ship design, new technology and stronger regulatory compliance."

Intercargo stresses that it will continue to work tirelessly with all stakeholders in order to improve bulk carrier safety and ultimately to strive for the day where there are zero losses of dry bulk ships and seafarers every year. It also points out that the pandemic and recent geopolitical events have generated new challenges for ship and crew safety which the organisation is closely monitoring and voicing its members' concerns in all available fora. ■

The full Intercargo Bulk Carrier Casualty Report 2014-2023 can be found on Intercargo's website at www.intercargo.org/bulk-carrier-casualty-report-2014-2023.

INTERCARGO CHAIRMAN DIMITRIS FAFALIOS

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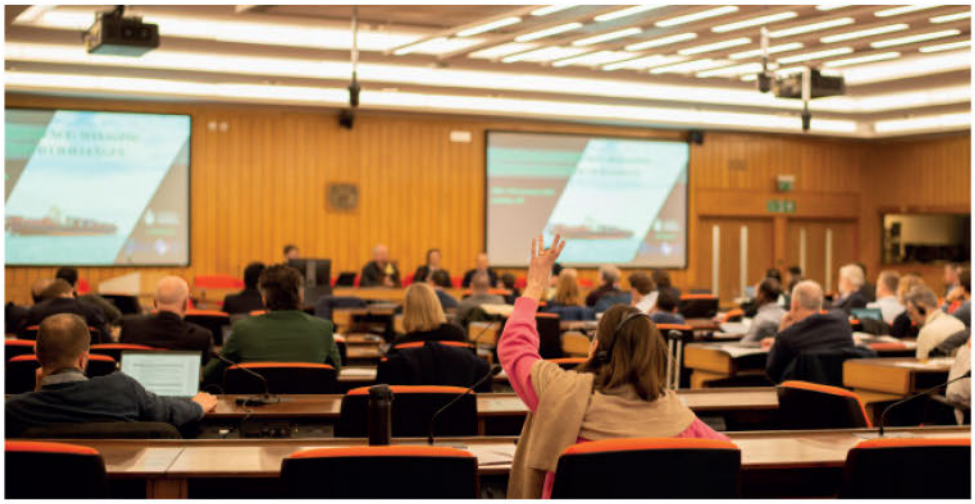

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Keynote Speakers

Job Brüggen, LVNL

Job Brüggen holds a masters degree from Delft University of Technology in Aerospace Engineering. In 1986 he started working for the National Aerospace Laboratory where he later became the head of the Air Transport Division. His particular interest in safety led him to Air Traffic Control the Netherlands, to become their first safety manager in 2002. He is particularly known for his activities in Just Culture developments and was one of the first to demonstrate the detrimental effect of prosecution of air traffic controllers on incident reporting. In 2003 he re-created the CANSO Safety Standing Committee and chaired it for six years. He also advises in the health care industry on safety matters with a particular focus on safety leadership. From November 2014 he was co-chairman of the Eurocontrol Safety Team, until 2019. For the Air Traffic Controllers academy of LVNL, he is the chairman of the examinations committee.

Dr Rafet Emek Kurt, Reader, in Maritime Safety and Human Factors, Department of Naval Architecture Ocean and Marine Engineering, University of Strathclyde

Dr. Kurt also serves as the Director of the Maritime Human Factors Centre, further demonstrating his commitment to advancing research in this field. Additionally, he holds the position of Associate Editor in Ships and Offshore Structures, showcasing his dedication to the dissemination of knowledge within the maritime community. Dr. Kurt is also a member of the International Ship and Offshore Structures Congress (ISSC), where he collaborates with peers to develop ship design criteria informed by human factors, further highlighting his commitment to the advancement of maritime safety practices.

Over the years, Dr. Kurt has worked on many research projects aimed at integrating human factors, safety, and risk into maritime practices. His work has been published in respected journals and conferences, igniting essential discussions in the maritime community.

https://rina.org.uk/events/events-programme/human-factors-2024/

ECO SHIP TECHNOLOGY

CARBON CAPTURE COULD PROVE CRUCIAL TO FUTURE OF MARITIME EMISSIONS REDUCTION, SAYS STUDY

By **Tom Barlow-Brown**

DNV HAS LAUNCHED NEW GUIDELINES FOR OCC SYSTEMS. SOURCE: DNV

Today's maritime industry is exploring numerous innovative solutions towards reducing greenhouse gas (GHG) emissions. However, amidst the increasing interest in renewable and alternative fuels, carbon capture has been somewhat overlooked. Despite this new research shows that it could prove to be a crucial lynchpin in the efforts of the sector to move toward net zero.

The latest white paper from DNV, titled *The Potential of Onboard Carbon Capture in Shipping*, delves into the feasibility, commercial viability and regulatory landscape of onboard carbon capture (OCC) technology. This emerging approach could offer shipowners a viable path to decarbonise while continuing to use carbon-based fuels.

Onboard carbon capture involves the installation of systems on ships to capture CO_2 emissions before they are released into the atmosphere. This captured CO_2 can then be stored or utilised in various applications. According to the white paper, initial studies indicate that the technology is safe for maritime use, but significant development and optimisation are still required.

"The technical feasibility of onboard carbon capture varies depending on several factors," the report states. "These include the ship's size, operational profile, trading pattern, machinery capacity for power and heat production, and the available space for installing capture equipment." The document emphasises the need for shipowners to assess whether OCC is a practical option for their specific vessels. For newbuilds, adopting an OCCS-ready approach could reduce future retrofitting costs, making it a strategic consideration during the planning stage.

Commercially competitive?

For onboard carbon capture to gain widespread adoption, it must prove commercially competitive with other decarbonisation methods. The white paper highlights the importance of various cost elements, including the system's installation and operational expenses, regulatory incentives and the competitive landscape.

Chara Georgopoulou, head of Maritime R&D and advisory Greece at DNV, notes: "The commercial attractiveness of OCC will depend on the terms under which regulations can credit the removal of carbon emissions, and how smoothly it can be integrated into the growing CCUS value chain."

She adds: "OCC could become a key method for shipowners to comply with decarbonisation regulations while reducing the reliance on alternative fuels."

The adoption of OCC is closely tied to regulatory frameworks that incentivise the capture of CO_2 emissions. Currently, the EU Emissions Trading System (EU ETS) is the only regulatory framework providing commercial incentives for onboard carbon capture, aligning with the EU's broader strategy on land-based CCS. The International Maritime Organization (IMO) has also initiated discussions on incorporating OCC into new GHG emission regulations.

"Appropriate emission regulations that credit captured carbon dioxide are crucial for shipowners to consider adopting onboard carbon capture," the

white paper asserts. "A continued push to develop these regulations quickly will reduce uncertainties and support further technological advancement."

The successful implementation of onboard carbon capture technology relies on its integration into the wider carbon capture, utilisation and storage (CCUS) value chain. This infrastructure includes facilities and networks for transporting, storing and utilising captured CO_2.

"The scaling of the CCUS infrastructure network, across geographies and nations, is essential for the uptake of onboard carbon capture technology," the report emphasises. It calls for the maritime industry to engage with relevant CCUS development projects near major shipping hubs to facilitate this integration.

DNV has been heavily active in the field of onboard carbon capture, working on the technology since 2009. This means the organisation is well-positioned to support stakeholders in investigating the feasibility of OCC and its connection to the broader CCUS value chain.

Success hinges on continued technological development

Despite its promise, onboard carbon capture faces several challenges. The technology must achieve high capture rates, low fuel penalties and minimal CO_2 deposit costs to be commercially attractive. Moreover, operational considerations such as space availability and the machinery's capacity for power and heat generation need careful evaluation.

"The main parameters affecting the commercial viability of OCC projects include the cost of CO_2 emissions (CO_2 tax) and fuel prices," the white paper outlines. "Striking the optimal balance between capture rate, fuel penalty, and other operational considerations is key to making onboard carbon capture a feasible and effective solution."

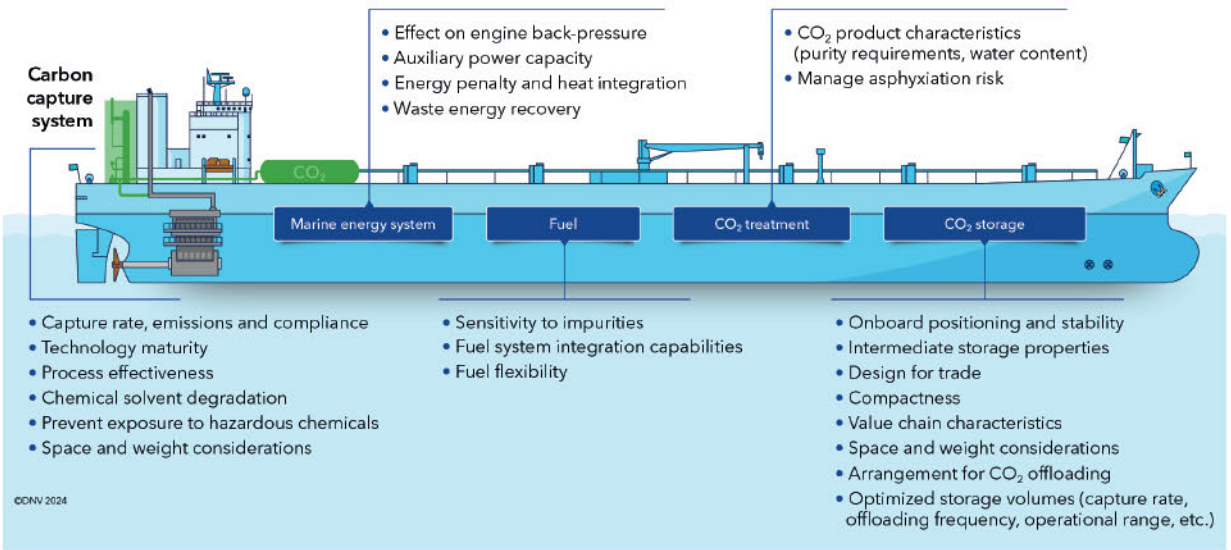
CHARA GEORGOPOULOU, DNV'S HEAD OF MARITIME R&D AND ADVISORY GREECE. SOURCE: DNV

Onboard carbon capture represents a promising avenue for the maritime industry to achieve its decarbonisation goals while continuing to operate on conventional fuels. However, its success hinges on continued technological development, regulatory support and integration into the wider CCUS value chain. Collaboration among industry stakeholders, regulators and policymakers will be crucial in overcoming the challenges and realising the full potential of this innovative technology.

As Chara Georgopoulou summarises: "If we are to achieve IMO decarbonisation targets, we must leave no stone unturned in continuing to investigate OCC and other potential technologies that can accelerate shipping's decarbonisation journey." With the right support and continued innovation, onboard carbon capture could become a cornerstone of maritime emissions reduction strategies in the years to come.

A copy of DNV's white paper *The Potential of Onboard Carbon Capture in Shipping* is available to download at www.dnv.com/maritime/publications/the-potential-of-onboard-carbon-capture-in-shipping-download. ■

Key parameters worth investigating when considering onboard carbon capture



SOURCE: DNV

UK CARBON CAPTURE STARTUP BOUND FOR GROWTH

By **Richard Halfhide**

There is growing acceptance that onboard carbon capture (OCC) is likely to form a component in shipping's mandate to achieve net-zero GHG emissions by 2050, many of the technologies being explored also have significant energy requirements that could increase fuel consumption by as much as 45%, according to a 2022 study by the Maersk McKinney Moller Center for Zero Carbon Shipping.

One company that believes it may have found the answer is UK-based startup Seabound, which has developed a passive containerised OCC system using calcium oxide – otherwise known as quicklime – with a recent pilot project indicating it could reduce CO_2 emissions by nearly 80%. The company is backed by several ship operators – among them Eastern Pacific Shipping – as well as private equity financing and has also benefited from funding from the UK government's Clean Maritime Demonstration Competition.

Seabound is now aiming to commercialise the technology with a target of installation onboard 1,000 ships by the end of this decade. Alisha Fredriksson, Seabound's CEO and co-founder, says the idea of developing an onboard carbon capture solution arose during Covid when, like many others, she found herself with a lot of time on her hands.

She tells *TNA*: "I reached a point where I just couldn't stop thinking about the climate crisis and was trying to figure out what I could do to have a big impact on mitigating that. I became interested in these hard-to-abate sectors, because of my experience working with another startup making e-fuel for shipping.

"As we looked into it we had two insights: one that the e-fuel industry that's trying to make methanol is struggling to access captured CO_2 for methanol production, creating this ironic bottleneck. That's when we thought about whether we could capture the CO_2 on board the vessels themselves and sell that for methanol production and eventually facilitate a circular fuel system?"

While Seabound's system could be used on methanol-fuelled ships the larger market is those powered by conventional fuels, with around 50,000 vessels incompatible with any of the alternatives currently in development. Fredriksson explains that her team explored a number of land-based technologies developed for power plants to determine which might be effectively adapted for sea, building models to compare and contrast.

"Typically onboard carbon capture uses an amine-based system, essentially miniaturising the system that's used on land and transferring it on board. But you have a lot of complicated equipment with a large footprint, high CAPEX and high energy consumption to first separate the CO_2, then compress and liquefy it. It's also difficult to scale because ports don't have CO_2 handling facilities. So owners are rightly worried they'll be stranded with captured CO_2 on board."

SEABOUND'S CONTAINERISED SOLUTION CAN BE EASILY INSTALLED ON BOARD VESSELS

Instead Seabound opted to decouple the process. Calcium oxide, supplied in the form of small pebbles, requires no compression or liquefaction, instead capturing the CO_2 from exhaust gas and storing it as calcium carbonate. When the ship arrives at a port with the requisite facilities, the CO_2 is released through heating in a kiln and transformed back into calcium oxide for reuse. The captured CO_2 can be sold for methanol production or sequestration, depending on the location.

In April this year, Seabound demonstrated a containerised version of the technology on board Lomar Shipping's 3,200TEU boxship *Sounion Trader*. Fredriksson says the solution is completely scalable – i.e. multiple units could be installed – comprising around one to two percent of the vessel's overall cargo capacity. Retrofitting a vessel would be largely a matter of installing the pipework for the exhaust gas processing.

Seabound isn't expecting shipowners to become limestone traders so will offer a full logistics service coupled with the OCC equipment. Initially the focus will be on higher traffic ports that serve as bunkering hubs or on significant trade routes.

Although much of the publicity is around the technology's carbon-capturing potential, Fredriksson was also keen to highlight a secondary benefit; the Seabound system also captures sulphur with 90% efficiency, potentially negating the need for scrubbers. With further development it is hoped to raise this close to the theoretical maximum of 95%.

As a small company, Fredrickson is confident Seabound can maintain a competitive edge over some of the larger companies exploring carbon capture, noting how much it has achieved in just a few years. "We're just much nimbler than they are, and I think there are a lot of potential process improvements for our technology as well, like making the calcium oxide more reactant. If we can provide exemplary service, and get better at providing that, we have a lead," she concludes. ■

CARBON FIT FOR PURPOSE: ERMA FIRST SECURES CCS SUPPLY CONTRACT FOR LCO_2 CARRIERS

By **Richard Halfhide**

Although best known for its electrolysis-based ballast water treatment system (BWTS), like other equipment providers in this sector Greek company Erma First has of late been seeking to diversify its portfolio of solutions.

In June, in partnership with operator Capital Gas Ship Management and supply systems specialists Babcock, the company announced it had signed a letter of intent to install its onboard carbon capture and storage (CCS) solution, Carbon Fit, on four new liquified carbon dioxide (LCO_2) carriers being built by Hyundai Mipo Dockyard for delivery in 2026. Carbon Fit, which has received approval in principle (AiP) from both Lloyd's Register and DNV, utilises an amine solvent to absorb CO_2 from flue gases.

According to Dr Stelios Kyriacou, Erma First's chief technical officer, the adoption of amine-absorption technology was a pragmatic choice. He explains: "[It] came down to the maturity of chemical absorption-based solutions, which have been used successfully on land for many years and are very well understood.

"To verify the technology, we examined it in great detail – with our own internal experts but also in consultation with Technology Centre Mongstad in Norway. After assessing it in different scenarios, we were satisfied that it was the best option for our CCS system."

As an emerging technology, the expectations for CCS technology are still relatively low, with most systems typically capturing in the region of 15-30% of CO_2, but it's estimated the Carbon Fit will capture closer to 70%, something Kyriacou says is due to Erma First's proprietary solvent that can perform to high efficiency at relatively low temperatures of 40-60°C. It also deploys a rotating packed bed (RPB), a novel technology reckoned to significantly enhance the mass transfer of CO_2 in the amine while minimising the footprint.

Separating the CO_2 from the amine and channelling it away for further processing is typically an energy-intensive process requiring significant thermal energy using steam from the ship's boilers that can also have a deleterious effect on the amine. For this reason, Erma First opted for a thermally resistant amine blend which requires a relatively low amount of externally supplied steam for regeneration.

Asked by *TNA* about the dimensions of the system, Kyriacou explains that this is largely dependent upon the quantity of CO_2 that needs to be absorbed. He adds: "Our 200kg-per-hour prototype has the equivalent footprint of two 40-foot containers, but this is by no means definitive. We also need to consider that the plant itself is only one part of the total installation; liquefaction plant and storage facilities on board are also required.

STELIOS KYRIACOU, CHIEF TECHNICAL OFFICER,, ERMA FIRST

"Nevertheless, the system is suited to a variety of projects thanks to its modular design, which allows flexible installation. Furthermore, in a CCS system, components can be installed in separate locations on board to make best use of available space."

The LCO_2 carriers, which will incorporate IMO Type-C tanks and a state-of-the-art cargo handling system from Babcock also capable of carrying LPG or ammonia, are likely to be at least partly deployed in transporting CO_2 for sequestration purposes. In those scenarios, Kyriacou points out that the CO_2 generated by the CCS will need to be of equal or superior quality to that which has been agreed for the main cargo, although it's not yet been determined whether the CO_2 generated during the transit of the ship will be pumped into onboard cargo tanks or stored in external tanks.

LCO_2 carriers are ideally suited for this CCS solution but other ship types would require modifications to the vessel for it to become feasible. "While LNG carriers and tankers can usually provide the steam required, in bulk carriers steam is limited and this would require further consideration. However, in most cases the CCS capacity can be tailored to the ship's steam availability," says Kyriacou.

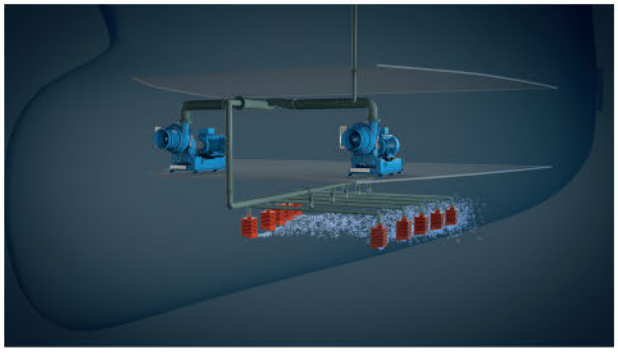
He adds that Erma First has received numerous enquiries from shipowners eager to be seen as early adopters and that: "Capital Gas is a shining example of a company that wants to lead the pack". However, he cautions that a lack of regulation means many remain reluctant to adopt CCS.

"The inclusion of carbon capture in the IMO regulatory framework would go a long way towards overcoming this reluctance – as would its acceptance as a means of improving CII and EEXI ratings and as a tool for EU ETS.

"On a positive note, all signs indicate that action is being taken to address these requirements relatively swiftly – perhaps within the next three to five years," he concludes. ■

THE FORESHIP ALS: A NUANCED APPROACH TO AIR LUBRICATION

By **Richard Halfhide**



THE FORESHIP ALS HAS BEEN INSTALLED ON MANY RCCL CRUISE SHIPS

Despite the recent high level of uptake for air lubrication systems (ALS), both as newbuildings and retrofits, it's an evolving technology. One company that understands the challenges of developing an ALS that delivers what is promised is Finnish naval architects and engineering consultancy Foreship. In 2011, Foreship partnered with Royal Caribbean Cruise Line (RCCL) to develop an ALS that, if successful, could be introduced across the RCCL's entire fleet.

"One of the targets was that whatever we came up with needed to be able to be retrofitted for existing ships, not only newbuildings. Another was that when the system was not in operation, it should not have additional drag or resistance to the hull," Jan-Erik Räsänen, Foreship's chief technology officer, tells *TNA*.

Like other Bubble Drag Reduction solutions, the Foreship ALS delivers a bubble carpet to the viscous boundary layer interface to realise a net power reduction. But during development Foreship was keen to ensure that any claims about the performance and efficiency potential of its ALS were based on careful analysis. Model scale testing cannot produce equivalent-sized air bubbles, meaning full-scale CFD was required to identify the optimal locations for air distribution.

It was decided these distribution points (plenum chambers) should be positioned along the bottom centreline of the ship, with the nozzles plate bolted flush with the ship bottom. Unlike ALS that focus on the flat-bottomed area of the ship – with the larger the flat bottom translating into the potential for greater efficiencies – Foreship favoured a more nuanced approach.

Räsänen explains: "We put the air boxes in places where it actually made sense, including the bow part. Because it needed to be retrofittable the number of boxes had to be limited. We work with six to 10 box pairs and with larger ships, such as *Oasis of the Seas*, we installed three compressors, although normally it would just be two.

"Some of our competitors use multiple screw compressors but to limit the scope of the installation [for retrofits] we took a different approach to the piping required. Typically it's in the forward part of the ship, we never go to the aft end."

A notable facet of the Foreship ALS is that because its system follows the streamlines of the hull flow, while the volume of bubbles is lower than other ALS, meaning there is less deviation in the bubble stream that can affect systems generating larger bubbles. It also means that large vessels can benefit from a low mass flow even without a large flat-bottomed hull. Moreover, modelling and verification work have shown that there are no additional benefits in adjusting the volume, flow and pressure of the ALS when it is activated in the 12-14knots range, making operating the system a relatively passive exercise for the crew.

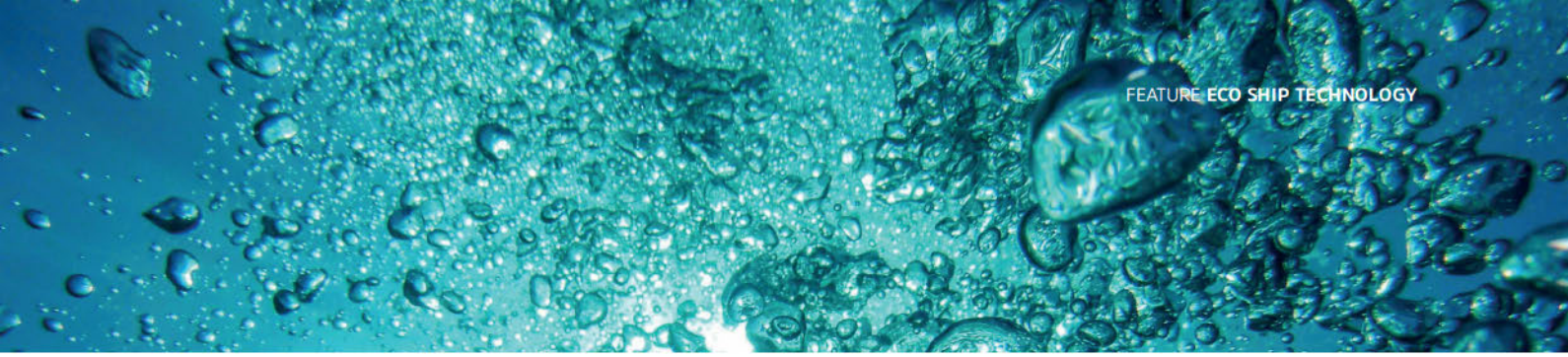
Today, the Foreship ALS is installed on around 20 vessels, all of them cruise ships. Unlike some ALS providers, the company purely undertakes design of the system, taking the project through CFD to basic or classification design status, before handing it over to the customer to source the necessary components and build the ALS.

Last year, Foreship signed a Memorandum of Understanding (MoU) with Glasgow-based engineering company Howden, under the terms of which Howden's HV-TURBO compressors will be used for the Foreship ALS. The agreement also licences Howden to provide the Foreship ALS for merchant vessels, with Foreship retaining control of the cruise segment. However, Howden has yet to announce any contracts for the system. Räsänen reflects that despite the significant uptake of ALS during the past few years it remains a difficult market for any new player to break into.

"A key element for us has been delivering on the promises," he says. "In general, if you have a layer of air under the hull you will most certainly have noise and vibration, which nobody wants on a cruise ship. The number of air distribution boxes, allocation of those boxes and amount of air that is propagated under the hull will have an effect. In general there will be more vibration, although we have examples where it actually helps. It depends on the ship size and design."

Although perhaps overshadowed by other ALS, it remains an active service and Räsänen is keen to remind shipowners of Foreship's expertise, particularly those looking for a realistic idea of whether ALS is a worthwhile investment.

"If you come to us, give us the hull, and ask us to do a full scale CFD analysis we are pretty much spot on with saving," he concludes. ■



ALTHOUGH THERE ARE ENCOURAGING SIGNS AIR LUBRICATION REDUCES SHIP UNDERWATER NOISE THERE REMAINS LITTLE PUBLISHED RESEARCH. SOURCE: PIXABAY

NOISE IMPACT OF AIR LUBRICATION SYSTEMS NEEDS MORE RESEARCH, SAYS ABS

By **Richard Halfhide**

Classification society ABS says that more work is needed to better understand the effects of air lubrication systems (ALS) on the underwater radiated noise (URN) generated by a vessel.

In recent years ALS manufacturers, such as industry leader Silverstream, have been keen to promote the URN-reducing benefits of ALS in addition to their energy saving potential. Last year, a study by the University of Southampton, sponsored by the International Chamber of Shipping, suggested that ALS could help reduce vessel noise by more than 10dB.

"The general understanding is that the microbubble air lubrication has the potential to attenuate the URN [and] create a speed of sound mismatch between the bubble curtain and the surrounding water," ABS tells *TNA*.

"One of the main assumptions behind this understanding is that the air bubble curtain can be maintained to such an extent that effective sound impedance can be formed around the main noise sources. This can be challenging as the main noise sources (propeller and machinery) are typically located near the aft body, while existing designs of air lubrication systems do not intend to maintain the air bubble curtain near the aft body, let alone beyond the vessel length."

Because bubbly water could reduce propulsion efficiency the air bubble curtain coverage for ALS typically avoids getting close to the propeller, which is one of the primary sources of ship URN. Another thing not fully understood is the URN that's generated by the ALS itself. While the components – pumps, compressors and air injectors – will increase URN, the magnitude is small compared to the propeller and other onboard machinery. However, this would increase relative to the overall URN when the propeller is operating at lower speeds.

More uncertain is the noise generated by the actual bubbles. ABS explains: "One of the main sources of URN from ships comes from the collapse of cavities formed by vapourised water due to local low pressures on a rotating propeller. The injected microbubbles or air layers are believed to behave differently than propeller cavitation, and their burst in water and pulsation may not generate loud broadband radiated noise."

ALS are designed with the intention of maintaining the integrity of an air layer underneath the vessel bottom, minimising the opportunity for those bubbles to escape and the air layer collapse. The best way to confirm this would be through a dedicated sea trial measurement of a vessel equipped with ALS, however this falls outside the remit of class Type Approval of a system, which is primarily concerned with safety factors, such as the potential of the air bubble layer to compromise the manoeuvring and stability of a ship (although no such incidents have been reported at this time).

Although it will clearly impact upon a vessel's EEDI/EEXI and CII ratings, determining the energy saving potential of an ALS is likewise not a requirement for type approval, although ABS does offer this as an additional commercial service for interested parties. Nevertheless, ABS comments that more recent ALS are using markedly less energy during operation than earlier models by the same providers.

One of the challenges in improving understanding of the energy-saving potential of ALS is the complexity in developing accurate numerical simulations. ABS comments: "The current IACS Rec. 173 guideline on using CFD for EEXI excludes coverage on using CFD for air lubrication. However, progress has been made in recent years in numerical modelling of the frictional drag reduction [and] validation against sea trials and model tests has shown a promising trend. Further validation of the modelling approach for each specific type of ALS is still needed."

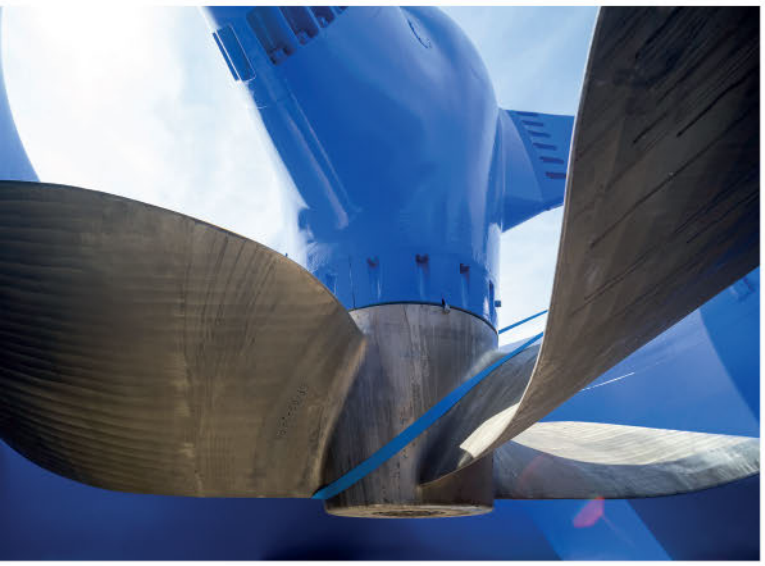
Large flat bottom vessels are far better suited for air bubble technology, while vessels operating in deeper drafts require a higher head pressure and therefore more energy for the compressed air. In the case of LNG carriers, container ships and cruise vessels, ABS notes that there is a critical draft/speed range that should be evaluated during sea trials.

No two ALS systems are the same and ABS advises shipowners to contact the equipment provider to determine whether the performance characteristics – meaning the net propulsion power savings – will suit the ship type and its operating profile. ■

Thanks to Qing Yu, ABS, director, technology, and Lefteris Karaminas, ABS, manager, sustainability, for their cooperation with this article.

DRIVING EFFICIENCY THROUGH THRUSTER INNOVATION

By **Lauri Tiainen**, director of Thrusters & Propulsion Control Systems, Wärtsilä Marine



WST-65 THRUSTER

As maritime's drive for energy efficiency and emissions reductions becomes ever more urgent, a growing number of vessels are turning to all-electric or hybrid-electric propulsion. Electric propulsion offers the potential for significant fuel and emissions savings, but applying the right technologies in the right way, depending on the demands on the individual vessel, is critical if operators want to maximise efficiency gains. And that is particularly important for vessels that rely on thrusters.

There is a great deal of difference between an optimised thruster configuration and one that is inefficient. Depending on the vessel operating profile, thruster configuration, power arrangement and propulsion control solution used, the difference in fuel consumption can be significant. Potential inefficiencies translate into huge increases in fuel use, operating costs and emissions during the lifetime of a thruster-dependent vessel.

Vessels that require high station-keeping capabilities, where engine load and thruster speed or angle need to be changed dynamically to maintain positioning, are particularly susceptible to these inefficiencies. And demand for those types of vessels is increasing, for example in the growing market for offshore support, wind turbine installation, offshore construction and heavy lift vessels deployed to a rising number of offshore energy projects. Tugs and ferries are also among the main users of thrusters for added power and manoeuvrability during port operations.

Holistic optimisation

While thruster technology, power and control solutions and vessel designs have evolved over the years, there is one constant factor in delivering an efficient vessel. Just applying the best thrusters to an existing hull form is not the solution. Instead, a holistic approach is needed to identify the best combination of a thruster configuration and control solution for each vessel. And that holistic approach means not only starting out with the ideal configuration, but also maintaining optimal efficiency over the life of the vessel.

Wärtsilä achieves this from the start thanks to its hydrodynamic expertise. Using computational fluid dynamics (CFD), it identifies the exact power requirements and ideal thruster configuration for a vessel's unique operating profile. Two examples of this approach are Wärtsilä's OPTI Design and OPTI-DP tools, which take into account losses from thruster hull interactions to analyse actual vessel performance in both transit and DP modes. Thruster and hull interaction efficiency is examined over 360°, using full-scale thrust performance.

Analysing thruster-hull interaction in this way allows operators to optimise their whole thruster system to minimise weight while maximising performance. In the design phase, Wärtsilä can also make sure the main and retractable thrusters are the same size to ensure a high level of exchangeability with components, supporting spare parts and maintenance procedures.

Because of this detailed insight, power requirements can be calculated instead of only estimated. As well as optimising fuel consumption, this can reduce the cost of the total power train configuration – for example by reducing the number of engine cylinders installed – saving ship operators money in both the initial investment and also, operating expenses.

Advancing thruster and DP operations

Combined with Wärtsilä's unique hydrodynamic and vessel design expertise, new advances in thruster technology represent a significant step up in the efficiency of thruster and dynamic positioning (DP) operations.

A key development is the introduction of the first embedded electric thruster in the Wärtsilä Steerable

LAURI TIAINEN, WÄRTSILÄ MARINE'S DIRECTOR OF THRUSTERS & PROPULSION CONTROL SYSTEMS

WÄRTSILÄ RETRACTABLE THRUSTER ON VESSEL

Thruster (WST) range. The WST-18E thruster, the first in the range features a permanent magnet or asynchronous electric motor embedded in the thruster. This allows for around 7% more power than the mechanical counterpart while maintaining similar propeller and body dimensions, enabling installation in height-restricted spaces such as below the working deck of a vessel.

The WST-E's optional tilted propeller gearbox reduces the thrust loss caused by interactions with the vessel hull and other thrusters. Combined with options for fast electric steering and optimised gears for rapid power ramp-up, the electric thrusters deliver excellent dynamic positioning and station keeping capabilities.

By reducing thrust losses and improving thruster responsiveness, vessels can maintain their position more accurately using less energy. The environmental credentials of the range are boosted by US Vessel General Permit 2013-compliant (or optional zero-pollution) sealing systems.

The new electric thruster range is designed to deliver a new efficient and flexible power option for vessels that already frequently deploy at least partially electrified power and propulsion systems. This allows thruster operations to benefit from the low losses and high efficiency of diesel-electric or fully electric power configurations. And to deliver more flexibility to the design of conventionally powered vessels with the need for smaller thrusters, Wärtsilä has also extended its range of retractable thrusters, adding three models with lower power output to its established WST-R series.

Compact efficiency

More than 20 years ago, Wärtsilä introduced a revolutionary 8° downwards tilt on the propeller shaft of its retractable thrusters and has since applied the tilt across its thruster portfolio. This minimises thruster-hull interaction, increasing available thrust by 15–20% compared to non-tilted thrusters, meaning less installed

PROTOUCH REMOTE PROPULSION SYSTEM. THE SYSTEM REDUCES THE NEED FOR MULTIPLE SMALL DISPLAYS, STREAMLINING THE NUMBER OF TOUCH SCREENS USED AND MAKING EACH SCREEN LARGER

power is needed for the same DP capability. This makes the unit more efficient by helping to reduce emissions and fuel consumption. It also increases DP capability and gives a wider working envelope. Because of the 8° tilted propeller shaft – along with an optimised nozzle, hydrodynamic design and electric steering and retraction – these thrusters demonstrate the efficiency that can be gained through recent technology advances.

As with all Wärtsilä thrusters, the new WST-R models feature compact dimensions and a high level of integration, with fieldbus technology reducing the cabling and complexity associated with monitoring, integration and installation. Reliability of propeller shafts and steering seals is secured with dedicated monitoring, while the maintenance-friendly design ensures minimal downtime when service is needed.

Enhanced control and awareness

All Wärtsilä thrusters are controlled using a ProTouch remote propulsion control system, which makes controlling the propulsion systems on board easy, ensuring smooth and efficient sailing.

The newly updated Wärtsilä ProTouch system further simplifies and improves the original concept. It does this by reducing the need for multiple small displays, streamlining the number of touch screens used and making each screen larger. This enhances ease of use and improves situational awareness for navigators and chiefs. For shipbuilders, ProTouch is an ideal choice because its modular design makes installation even easier. One ProTouch display will be able to control the whole propulsor system, so there are fewer components to install.

Lifetime performance

Monitoring and maintenance are particularly crucial for complex propulsion like thrusters to ensure that efficiency does not fall as they age. It is also a statutory requirement. Classification societies demand a five- and 10-year thruster inspection, with the five-year docking including a general inspection and cleaning, condition evaluation and preventive replacement of critical parts, as well as flushing of lubricants and other hydraulic systems. After 10 years or 40,000 hours, a more extensive inspection is needed.

Wärtsilä's thruster services make sure that the efficiency of thrusters does not slip over the years. Using a class-approved propulsion condition monitoring service, the condition of propulsion equipment can be determined without the need for internal visual inspections. This maximises vessel availability by ensuring that maintenance and overhauls are performed only when needed. By combining this monitoring with an optimised lifecycle maintenance agreement, operators can schedule maintenance according to actual needs instead of relying on a fixed schedule.

Sustainability is not only about efficiency, and this is especially true for control systems and other electronics components. Around the world, the speed of development in electronic components is accelerating. As a result, the lifecycle of these types of components is becoming shorter. In some cases, it may even be less than five years. This is far from ideal for ships designed to be in service for more than 20 years and which have restricted opportunities to perform maintenance and parts replacements. If not managed properly, it can also cause problems where whole systems have to be replaced due to the unavailability of components.

To address this emerging challenge of parts obsolescence given the speed of technological advancements, Wärtsilä has developed a lifecycle roadmap that seeks to guarantee a lifecycle of at least 15 years on its propulsion control systems, including ProTouch. Initially, for component replacements Wärtsilä aims to provide solutions up to a product lifecycle age of 10 years. When this is no longer possible, an upgrade kit, containing the most recent available technology, is made available. After 15 years, the customer will have the option to purchase a replacement control system with equivalent or customised functionality.

Addressing the efficiency challenge

Ultimately, for vessels that require dynamic positioning or frequent thruster use, ensuring efficiency across the operating profile is crucial. That starts from optimised vessel design and propulsion configuration as well as the deployment of the best-suited technologies, continues with the efficient control of thrusters in operation and is secured by maintaining their performance and reliability across the vessel lifecycle. ■

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VOYAGE OPTIMISATION

THE FUTURE OF VOYAGE OPTIMISATION

By **Konstantinos Kyriakopoulos**, CEO, DeepSea Technologies

It's a particularly interesting time to be discussing voyage optimisation. As a problem, it is as old as shipping. However, its newest iteration as a discreet field of technology-enabled solutions propelled by the urgency of decarbonisation is only a few years old – with a small handful of companies like DeepSea Technologies having led the charge to define it.

Perfecting an old craft

From an engineering perspective, much of what 'voyage optimisation' has entailed until now concerns addressing the same challenges that naval architects, operators and technicians have grappled with for decades.

For example, a state-of-the art approach to voyage optimisation in 2024 must be built on two primary pillars: (1) a highly accurate understanding of individual vessel behaviour, and (2) the ability to interpret these models in light of the evolving context of the journey (i.e. weather, oceanographic data and commercial data) to achieve a specified outcome for the operator.

These are both problems which industry experts have been attempting to tackle – with varying degrees of success – over entire careers (the former predominantly by technical departments, and the latter by traditional weather routing companies and operators).

This is not to say that these are now fully solved problems – particularly when it comes to the accuracy of global weather data (which, as we all know, can still be less-than-perfect). But we can certainly say that 'voyage optimisation' is a precision art, and a new breed of tools and approaches (perhaps most significantly, AI) has meant that we're now far closer to the 'right answer' – and we're seeing the results in major fuel savings.

KONSTANTINOS KYRIAKOPOULOS. SOURCE: DEEPSEA TECHNOLOGIES

So, the real question is – what's next for voyage optimisation?

Automation... for automation's sake?

As you will know, 'automation' is fast becoming one of the hot topics in shipping, generating new headlines every week. However, it is a buzzword often spoken of in very general terms.

In 2014, Tesla first announced that it was on a mission to create 'self-driving cars'. For the next five-or-so years, 'driver automation' was probably the characteristic most synonymous with the brand, particularly appealing to tech enthusiasts (including many of us, I imagine).

Whilst that vision has not yet come fully to fruition for several reasons, the fact is that it doesn't matter. The narrative has shifted. It transpires that, whilst 'automation' is an intriguing marketing angle which captures people's attention, what they actually want is a comfortable, attractive, green and economical-to-run car: which is what Tesla has latterly become known for.

A similar trend can be seen in the 'home automation' field. While initially the idea of controlling your heating from afar gained major attention, in the end what people are really interested in is security, cost-effectiveness and convenience. The Nest smart-thermostat is now "designed to keep you comfortable and help save energy" (taken from the company's website) rather than "to control your boiler with your phone".

All this is to say that 'automation' as a term might initially capture attention – but fails to sustain interest unless it communicates clear, tangible benefits. It's not an end in its own right.

We are already witnessing this transition in the shipping industry. In the coming years, certain key benefits of automation will become evident, while other anticipated advantages may not materialise. Automation will increasingly integrate into specific problem areas, with voyage optimisation emerging as a leading contender.

Automation for pure efficiency

This summer, DeepSea received DNV's first ever type approval for a system that provides automatic speed adjustment to a propulsion control system. The HyperPilot automatically and precisely controls the change of speeds across a voyage to achieve maximum fuel savings.

This solution was a natural development of our teams' pioneering work in voyage optimisation. Seeing how our software solutions were being adopted aboard ships, we observed two things to be true: the

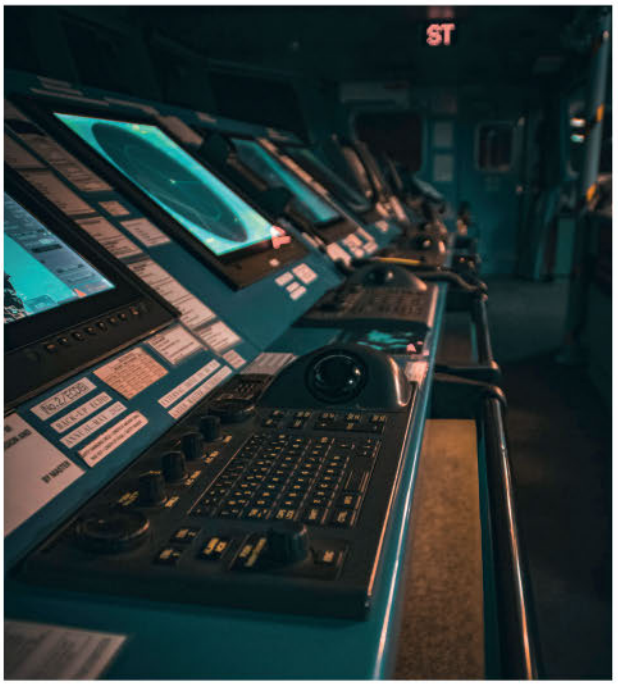
more precise a ship can be when following a set of (sometimes subtle) speed changes (1) the more fuel could be saved, and (2) the more attention it required from the bridge crew.

Automating that one specific task saves the crew from a repetitive job, and simultaneously increases voyage efficiency – so it became an urgent priority for us to develop. Yes, it's automation – but, more meaningfully, it's a facet of advanced voyage optimisation.

Voyage optimisation: the future

'Voyage optimisation' is a very broad concept: one that can include almost every aspect of sailing. After all, the 'voyage' is the sole medium through which a ship actually performs its function – and optimising that function should be the natural objective of any operator. It is already clear that this will be one of the primary lenses through which the industry will define how the next generation of 'smart ships' looks.

The burgeoning integration of automation into this mix is not driven by any 'grand plan' from a boardroom or think-tank, but rather by the need to address specific efficiency constraints identified aboard ships already employing state-of-the-art voyage optimisation tools. The age of 'automation' is already upon us: the results on vessel efficiency will be dramatic, and voyage optimisation is the driver. ■



AUTOMATION IS A KEY COMPONENT OF ADVANCED VOYAGE OPTIMISATION. SOURCE: ISAWRED/UNSPLASH

CHARTING NEW WATERS: HOW WEATHER ROUTING TECHNOLOGY IS EVOLVING TO MEET NEW CHALLENGES

By **Tom Barlow-Brown**

The maritime industry faces an increasingly unpredictable and volatile ocean climate due to the ongoing impacts of climate change. As weather patterns become more erratic, the importance of advanced weather routing and voyage optimisation technologies is growing. These technologies must continually evolve to ensure the safety of maritime operations.

"We have seen unprecedented weather events in recent years due to climate change, and we have also observed that weather models are having more difficulty with accuracy, in particular, becoming less accurate in the middle to longer range periods of the forecast," says Amy Buhl, the Marine Group operations general manager (Europe and Americas) at Weathernews Inc.

"To cope with this reality, in our view, the target is to understand the risk of forecast change using probabilistic forecasting," she explains. The company is adapting its weather routing strategies in response to climate change. Buhl states that the key to dealing with unpredictable weather patterns lies in the accuracy of weather models over both short- and long-term forecast periods. She notes that climate change has led to unprecedented weather events, which has made this more difficult. WeatherNews hopes that by probabilistic forecasting, a method that uses ensemble models to generate multiple iterations of weather forecasts based on slightly different initial conditions, it can address this challenge.

This mode of forecasting, while not new to meteorology, is relatively novel in the context of voyage optimisation. This approach involves running numerous iterations of weather models to create a range of possible outcomes, which can then be analysed to determine the likelihood of specific weather events occurring.

"We can then use statistical analysis to understand from the output the likelihood of certain weather events occurring," states Buhl. "We can also understand from the output if there is good agreement among the ensemble members, and use that information to determine our confidence in the forecast, as well as how the forecast may change."

Better-informed decisions

This method helps Weathernews understand forecast volatility and make more informed decisions about route optimisation. For example, probabilistic forecasts can calculate the likelihood of wave conditions exceeding certain thresholds, allowing the company to create optimised routes based on different risk tolerance levels. This approach not only addresses the volatility in forecasts but also empowers ship operators to tailor routes according to their specific risk preferences.

Weathernews Inc. was founded in 1986 by Hiro Ishibashi, inspired by a tragic incident in 1970 at the port of Onahama, Japan, where a cargo vessel sank due to an explosive low-pressure system, resulting in the loss of 15 crew members. Reflecting on this event, Ishibashi believed that better weather information could have prevented the accident.

Since its inception, the company has expanded its services to cover various industries, but its core mission remains focused on safeguarding sailors' lives. The company's growth trajectory includes significant milestones such as the establishment of the Global Ice Center in 2006 to support Arctic Ocean routing and the launch of the 'AI Disaster Prevention Council' in 2019 to enhance disaster preparedness through artificial intelligence. Weathernews has also played a pivotal role

WITH WEATHER PATTERNS BECOMING MORE ERRATIC, THE IMPORTANCE OF ADVANCED WEATHER ROUTING AND VOYAGE OPTIMISATION TECHNOLOGIES CONTINUES TO GROW. SOURCE: VLADIMIR OPRISKO/UNSPLASH

in various sectors, from aviation weather services to real-time satellite imagery for TV stations.

Algorithms challenged by climate change

Climate change poses numerous challenges for weather routing, particularly due to increased volatility and the occurrence of extreme weather events. Traditional optimisation algorithms often struggle with these changes, as they cannot anticipate forecast fluctuations and produce inconsistent outputs with each update. "Many existing optimisation algorithms fail in this respect – they can only optimise based on the forecast data they have in front of them, they cannot anticipate how the forecast will change, and therefore produce a different output with each forecast update," says Buhl.

"Understanding how forecasts can change can help the meteorologists developing voyage optimisations, and also lays a foundation for more automated voyage optimisation algorithms, that can account for forecast change, which we have developed," she adds.

Weathernews runs its own global weather model, incorporating data from weather balloons, aircraft reconnaissance, proprietary observation networks and reports from vessels and aircraft. This comprehensive data integration helps mitigate the impact of data scarcity in certain regions and enhances the precision of weather forecasts. By assimilating a wide range of observational data, Weathernews can produce more accurate and reliable forecasts, which are crucial for effective weather routing.

As vessel automation progresses, the company is also adapting its services to meet the evolving needs of the maritime industry. "One of the important things we provide to our users is risk communication – we want to give as much information to our users in order to help them make a decision about the operation of their vessels as easily as possible," says Buhl. "In this respect, sharing data and scenarios so that the ship master or operator can see the possible outcomes that both ensure the safety of the vessel and match an outcome to their business needs in the simplest way possible, but also using tools, such as probabilistic forecast data, to quantify risk in order to make good decisions."

Weathernews has also joined an initiative by The Nippon Foundation's Autonomous Ship Programme to develop technology to support autonomous vessels. This combines AI with probabilistic forecast data to quantify risks and optimise routes. This ongoing collaboration is part the Nippon Foundation's MEGURI2040 Fully Autonomous Ship Project, which aims to understand the realities of vessel automation and upgrade the types of services provided to support these advancements.

The regulatory landscape in the maritime industry is continually evolving, particularly with the push towards decarbonisation. The company hopes to assist its customers in understanding and improving their environmental impact, ensuring compliance with regulations and optimising for specific outcomes, such as the Carbon Intensity Indicator (CII). Buhl points out

AMY BUHL. SOURCE: WEATHERNEWS INC.

that data quality is a significant challenge in this context, and Weathernews is focused on enhancing reporting and data collection to support regulatory compliance and environmental sustainability.

Wind-assisted propulsion: new opportunities and challenges

The rise of wind-assisted propulsion technologies in the maritime industry also presents new opportunities and challenges for weather routing. These technologies alter the dynamics of route optimisation, requiring a deep understanding of how they are deployed and their practical effects on vessel performance. According to Buhl, this challenge is one of the most interesting that the weather routing sector faces today, as it challenges many preconceived notions of how voyages are efficiently optimised.

"Voyage optimisation has always tried to balance placing a vessel in favourable conditions versus adding distance to a voyage, this changes the dynamic effect of those favourable conditions, and changes how those factors can and should be balanced," Buhl states. "One important point is to understand deeply how wind-assisted propulsion is utilised practically on board, and from there, identifying what kind of tactics and strategies should supplement the voyage optimisation process to get the best effect."

As a result of this Weathernews is exploring ways to integrate these factors into its routing algorithms, working with collaborators to model the performance of wind-assisted vessels and optimise sailing conditions to maximise their benefits.

The future of weather routing technology in the maritime sector will be ultimately be shaped by several key factors. The increasing volatility of weather patterns due to climate change will necessitate more advanced and adaptable forecasting methods. Probabilistic forecasting, as employed by Weathernews, could become more prevalent, allowing for more accurate and reliable route optimisations. The progression of vessel automation will likewise require weather routing services to provide more detailed risk communication and support for autonomous navigation.

The push towards decarbonisation and the adoption of wind-assisted propulsion technologies will drive the need for innovative routing algorithms that can balance environmental sustainability with operational efficiency. Weathernews is positioning itself well to lead these advancements, leveraging expertise in weather forecasting and data integration to develop novel solutions for the maritime industry. ■

WE NEED DATA TO PUT WIND IN THOSE SAILS

By **Daniel Karlberg**, naval architect and senior customer success manager, NAPA

Harnessing wind power for shipping is about more than fitting sails, rotors, wings and kites on ships. To maximise their emissions-saving impact, those systems must work hand-in-hand with digital technology that enables vessels to adapt their routes to catch optimal wind conditions. But data can also enable wind propulsion in other fundamental ways: by enabling safe operations on board, and by helping naval architects optimise their designs for wind-assisted vessels. Here's how it works.

By their very nature, wind-assisted vessels are more sensitive to weather conditions than their fossil-fuelled counterparts. To state the obvious, they need wind – but not just any wind. It must blow within the range of wind speeds and angles in which the system can be operated safely and optimally, which varies depending on the type of wind propulsion technology used.

Therefore, the ability to find favourable winds and avoid unfavourable ones becomes even more central to operations. So does the need for voyage optimisation.

In a nutshell, weather routing software uses algorithms to automatically simulate different potential route variations and speed profiles between point A and B, and model the impact of each option on the ship's fuel consumption and greenhouse gas emissions. The system then recommends the optimal route for the sea passage to meet specific criteria, such as the need to meet a given estimated time of arrival (ETA) or maximising cost savings, among others.

While voyage optimisation can save fuel and emissions on any ship, its implementation is essential for wind-assisted vessels, because choosing the optimal route for such vessels is much more complex than for ships propelled solely by conventional engines. Fast-evolving wind speeds and direction, as well as waves and currents, must be assessed (and constantly re-assessed) throughout the voyage to determine the best possible route and adapt the ship's course accordingly. Relying on traditional means will leave a lot of potential savings on the table – but where manual methods fall short, digital tools can support captains' decision-making in real time.

DANIEL KARLBERG

In short, weather routing is indispensable to realising the full emissions-saving potential of wind propulsion.

Validating potential savings

Putting theory to the test, a recent joint study between Sumitomo Heavy Industries, Norsepower and NAPA has set out to validate a critical question for the wider implementation of wind propulsion in shipping: what levels of emissions reductions can actually be achieved by combining wind propulsion and voyage optimisation?

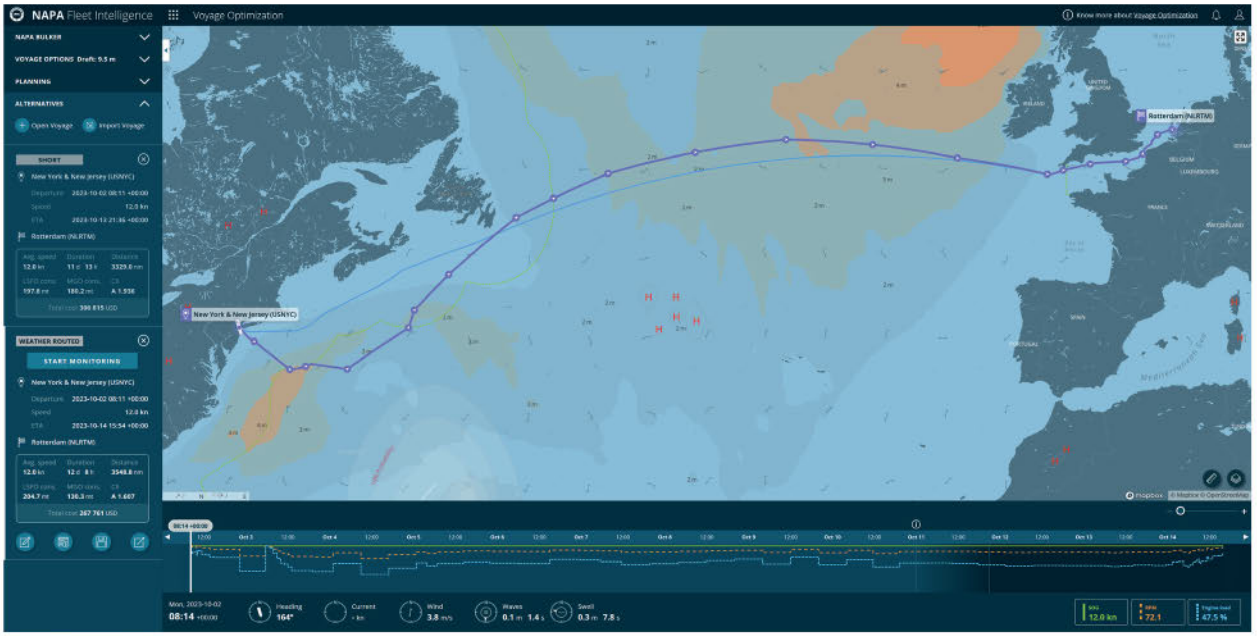
Using nowcast weather data from 2022, the digital twins developed by NAPA were able to simulate the fuel savings that could be delivered by the Norsepower rotor sail on a Sumitomo Heavy Industries Marine & Engineering (SHI-ME) tanker. The project examined six routes typically sailed by the vessel: between Australia and Japan, the United States and the Netherlands, and Singapore, Angola and Nigeria.

The most impressive results were recorded for the transatlantic route between New York and Amsterdam, where the combination of four rotor sails and voyage optimisation can deliver average emissions reductions of 28%. The contribution of weather routing to this result was estimated at 12%. Looking at results across all six routes included in the study, the simulations showed an average CO_2 reduction of 19%, with NAPA Voyage Optimization contributing 10% of these emissions reductions.

For shipowners and operators, this joint study brings much-needed clarity on the tangible savings that can be achieved by wind propulsion on the different routes where their vessels may be operated. It provides data to back cost-benefit analysis, strengthening the business case for investing in wind-assist technology at a time when the industry is under increasing pressure to decarbonise.

Turning winds from unfavourable to suitable

Further evidence comes from a 2023 study by the University of Manchester [1], which found that voyage optimisation amplifies carbon savings delivered by wind propulsion systems to over 30% on ideal routes where wind speed and angle are particularly favourable. The research examined over 100,000 simulated departures for a Panamax bulk carrier on 14 international shipping routes. When averaged across all routes, carbon savings increase from 10.8% using wind propulsion alone to 17.7% when supported by voyage optimisation. The authors describe this phenomenon



VOYAGE OPTIMISATION BETWEEN THE USA AND THE NETHERLANDS

as the "synergistic potential" of combining wind propulsion with voyage optimisation.

The study also revealed a potentially game-changing finding for the operation of wind-assisted ships: voyage optimisation can turn routes from unfavourable to suitable for wind propulsion technology. This is because weather routing allows ships to adjust their course to alter detrimental wind angles and instead catch winds within the range of angles that are suitable for the system. This significantly increases the benefits of wind propulsion technology on routes that would have relatively low savings with sails alone – boosting savings from 7.79% to 19.3% on a route between the UK and the US, for example.

Recent NAPA simulations on a standard oil tanker sailing between Sri Lanka and Bangladesh show how this works in practice. The vessel faces strong headwinds, but using weather routing allows it to deviate from the shortest route to catch winds at the right angle for the wind propulsion system. Furthermore, voyage optimisation enables the ship to vary its speed profile – in other words, adopt a wider range of speeds – to catch favourable winds and avoid unfavourable ones.

Using data to guide decisions

Beyond maximising fuel and emissions savings, digital technology can aid wind propulsion in two crucial ways: by ensuring the ship's safety, and by providing a tool to support decisions at the design stage.

Wind propulsion systems typically add weight to the upper part of the ship, which impacts its centre of gravity and stability profile more generally. Moreover, the forces induced by the sails must be accounted for in voyage planning. Advanced stability software plays a key role in making vital calculations smoothly and accurately to ensure safety at sea.

For naval architects, accounting for the same parameters at the design stage is imperative. Integrating wind propulsion on the ship with the right foundations and potential structural reinforcement is also critical. Further considerations include how the sail structures will affect visibility from the bridge, which also sets boundaries for their size and positioning. 3D models and simulation tools can play a key role here, by giving more clarity at the design stage. In short, they enable naval architects and structural engineers to model the impact of wind propulsion on the ship's structure, stability and configuration, helping them optimise their concepts, both for newbuilds and retrofit projects.

With a growing number of technologies reaching maturity, decisions around the use of wind propulsion must be based on a holistic approach, to proactively assess how those systems will transform a wide range of aspects, from vessel designs to operational parameters and safety on board. It is also essential to consider other business-critical implications, including a potential loss of cargo space, as well as crew training requirements.

In this fast-moving technology renaissance, shipowners want to be able to confidently assess whether there is a strong business case for installing wind propulsion systems on their fleets, and choose the right technology adapted to their vessel types and operations. And once installed, they want to maximise the fuel and emissions savings delivered by their investment. Data and simulation tools can provide them with what they need most: an objective picture of what the wind can achieve for their unique vessels and operations, enabling them to sail ahead of the competition. ■

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REGULATION & CLASSIFICATION

RWO HELPS KEEP *STATSRAAD LEHMKUHL* COMPLIANT 110 YEARS AFTER DELIVERY

The compact dimensions and simple design of RWO's OWS-COM make it the ideal oily water separator for *Statsraad Lehmkuhl*, helping the unique vessel to comply with latest environmental regulations as it voyages worldwide

Built in Bremerhaven, Germany, in 1914, *Statsraad Lehmkuhl* is a three-masted steel barque owned and operated by the Statsraad Lehmkuhl Foundation in Bergen, Norway. While the vessel primarily serves as a sail-training ship, it is increasingly used for research purposes.

From August 2021 to April 2023, the tall ship engaged in the One Ocean Expedition, circumnavigating the globe to "share knowledge and raise awareness about the importance of the ocean for our common, sustainable future". Following the success of the first voyage, the vessel will embark on its second One Ocean Expedition from April 2025 to April 2026, this time traversing the Northwest Passage before returning to Europe via the Panama Canal.

With regular training and sightseeing trips keeping it occupied between worldwide voyages, *Statsraad Lehmkuhl* operates in a variety of sensitive environments and emission control areas – and must therefore adhere to the strictest environmental regulations.

Hybrid battery power has been installed to help drive propellers when wind power alone is not enough, but the barque must also rely on diesel generators part of the time. Accordingly, the vessel is equipped with a state-of-the-art oily water separator (OWS) from RWO to minimise the impact of wastewater discharge.

OWS-COM: compact and efficient

When the old OWS on board *Statsraad Lehmkuhl* had to be replaced, it was clear to the operators that they would again opt for RWO equipment. The positive experience with the company and its technology as well as its global service network convinced the Statsraad Lehmkuhl Foundation to choose OWS-COM. The new separator was installed under the guidance of RWO's Norwegian service partner IRRSEA during the ship's overhaul in 2023.

Tested and approved in line with IMO Resolution MEPC. 107(49) and Clean Design class rules, RWO's OWS-COM uses a two-stage process to treat a ship's bilge water prior to its discharge overboard. By minimising turbulence, the system's suction-based operation achieves more efficient separation than comparable technologies and helps to keep components in working order for longer.

RWO is a leading supplier of intelligent water management solutions across commercial shipping, but the use of its technology on such an iconic vessel has not been based solely on the need for reliability and compliance alone. Built for a different era, there is little room to spare on board *Statsraad Lehmkuhl*, meaning that the size and configuration of the OWS were crucial considerations.

THE 1914-BUILT TALL SHIP *STATSRAAD LEHMKUHL* IS NOW USED AS A SAIL-TRAINING AND RESEARCH VESSEL

"As maritime regulations evolve, vessels require more and more onboard equipment to maintain compliance, but vintage vessels like *Statsraad Lehmkuhl* simply weren't designed to accommodate the complex technology that is required today," explains Per Sivertsen, project manager, Statsraad Lehmkuhl Foundation. "Installing and maintaining new systems including OWS can therefore be challenging and time consuming."

According to Ron Dijkgraaf, area sales manager, RWO, OWS-COM addresses this issue with its compact dimensions and straightforward design.

"OWS-COM is the ideal system for *Statsraad Lehmkuhl* as it not only achieves the highest standards for water treatment but also meets the vessel's highly specific requirements regarding the size and configuration of onboard installations," says Dijkgraaf. "It is a privilege to install our system on board such a beautiful and storied vessel and to thereby contribute to its vital training and research activities."

Beyond supply and installation, RWO offers after-sales services and training to ensure that *Statsraad Lehmkuhl*'s crew can continue to use the OWS-COM safely and effectively, with local support provided by Norway-based marine service provider IRRSEA. Part of RWO's global network, IRRSEA and its team of skilled engineers supported the onboard integration of the OWS and designed a solution for an additional settling tank for enhanced bilge water management. ■

SOURCE: SHUTTERSTOCK

IF YOU THOUGHT EU ETS COMPLICATED, MEET FEMREG – EUROPE'S NEW LOW-CARBON FUELS LAW FOR SHIPPING

By **Nick Walker**, partner, and **Valentina Keys**, counsel, Watson Farley & Williams

The Fuel EU Maritime Regulation (FEMREG) looms large as shipping companies must decide their fuel compliance strategy and submit their monitoring plans before September. Slow steaming will not be enough to make 'shipping companies' compliant and below we explain why. In this article we discuss the basics and offer our expert steer on how best to prepare rather than react.

Background

FEMREG's overarching purpose is to accelerate the use of renewable and low-carbon fuels in shipping. It forms part of the EU's Fit for 55 Package, aimed at reducing the greenhouse gas (GHG) intensity of energy used by ships above 5,000gt by at least 55% by 2030 (compared to 1990 levels). FEMREG is intended to complement the EU Emissions Trading Scheme (EU ETS) for maritime which came into force on 1 January 2024 and is specifically structured to promote reduction of GHG intensity of ships arriving at, staying in or departing from an EU/ European Economic Area (EEA) port.

Scope and applicability

FEMREG is even more pernickety than EU ETS due to its highly technical and mathematical nature. It applies to ships over 5,000gt, arriving at or departing from EU/EEA ports and regulates fuel consumption as follows:

- voyages between EU/EEA and non-EU/EEA ports: 50% of consumption;
- voyages within the EU/EEA ports: 100% of consumption; and
- berthing in EU/EEA ports: 100% of consumption.

Container ships stopping in transshipment ports outside the EU/EEA, which are less than 300nm from an EU/EEA port will also be obliged to include 50% of the energy of the voyage to that port.

What are the key obligations?

FEMREG places obligations on shipping companies to reduce the GHG intensity of energy used on board their ships on the following phased basis:

- 2% by 2025;
- 6% by 2030;
- 14.5% by 2035;
- 31% by 2040;
- 62% by 2045; and
- 80% by 2050.

GHG emissions are calculated on a well-to-wake basis: this means emissions related to fuel cultivation, production, transportation, extraction and usage on board. The reduction required in the lifecycle GHG intensity of fuels will be measured based on reported fuel consumption similar to EU MRV. There will be a financial penalty for each quantum of energy used above the reference level. The revenues obtained from the penalties will be used in support of renewable and low carbon fuel usage.

'Shipping company' is defined in Article 3 (13) of FEMREG as either the registered owner or the ISM Company which

has been contractually mandated to comply.[1] While this definition is the same as the ETS, the key difference is that there is no obligation to register a shipping company under FEMREG as there is under EU ETS.

Furthermore, FEMREG contains an express reference to the right of the "shipping company" to pass on compliance and penalty costs not only to commercial operators (e.g. ISM Company) but also to fuel suppliers, if it should choose to do so. This is a watered-down aspect of the regulation since initial proposals contained a direct obligation on fuel suppliers to supply a certain amount of low-carbon fuel. As things stand, any recourse shipping companies would now have against fuel suppliers would be no more than contractual, and it remains to be seen how effective this right will be in reality.

Key obligations and compliance deadlines falling on 'shipping companies' include:

- by 31 August 2024 shipping companies are obliged to submit a standardised monitoring plan (the Fuel EU Monitoring Plan) per vessel to verifiers demonstrating what fuels and methodologies will be used to meet the GHG intensity targets listed above. The methodology is set out in Annex I of FEMREG. (For any new shipping companies falling under FEMREG after the 31 August deadline the requirement to submit the Fuel EU Monitoring Plan will have to be met within two months of the first port of call in the EEA);
- from 1 January 2025 shipping companies will be required to start monitoring emissions from each ship arriving at or departing from a port of call in accordance with the independently verified Fuel EU Monitoring Plan and will be required to record prescribed information as set out in Article 15 of the regulation. This includes recording well-to-wake carbon equivalent emissions per megajoule of energy for all energy used on board;
- by 31 January 2026 and thereafter, shipping companies will be required to provide to the verifier a ship-specific report (the FuelEU Report) containing prescribed information set out in Article 15 as well as prescribed monitoring data and supporting technical documentation; and
- from 30 June 2026 and thereafter, shipping companies will be obliged to carry on board each ship a FuelEU Document of compliance which is issued annually by the verifier.

NICK WALKER

VALENTINA KEYS

Who will be responsible for compliance?

As with the EU ETS, the shipping company will be responsible for compliance with FEMREG.

There has been some suggestion that the responsible entity under FEMREG is different from the responsible entity under EU ETS, and that responsibility for compliance with FEMREG falls on the entity responsible for the vessel's ISM obligations, whereas pursuant to EU ETS it can be either the shipowner or any other organisation that has agreed to be responsible for the ISM obligations. This is not the case. Under both laws the default responsible party will always be the registered owner unless it has been mandated to the ISM. The key difference however is that under EU ETS the registered Participant will be the regulated entity, and the first (or the last, as the case may be, if the ISM registered participant goes insolvent) to face any enforcement action and penalty orders. Under FEMREG however, it will always be the registered owner that faces the regulator, regardless of its contractual arrangements with others.

Renewable fuels of non-biological origin

FEMREG purports to encourage the use of Renewable Fuels of Non-Biological Origin (RFNBOs), such as e-ammonia and e-methanol. The regulation incentivises the use of RFNBOs with a bespoke reward factor of '2' included in the calculation of the GHG intensity of energy used on board. This can be used from 1 January 2025 to 31 December. The methodology for this calculation is set out in Annex 1.[2]

If RFNBO usage equals less than 1% of the overall fuel mix during 2031 and less than 2% in 2033, then a new sub-target will be introduced from 2034 so that they make up a minimum 2% of yearly energy used on board a ship. Using equivalent non-RFNBO fuels (for example, biofuels), with a similar or higher potential to decarbonise, may also count towards this sub-target. However, biofuels produced from food or feed crops are considered to have the same emission factors as the least favourable fossil fuels and are, therefore, not included as part of RFNBOs. FEMREG's treatment of biofuels from food and feed crops is currently subject to legal challenge by European ethanol producers.[3]

Banking, borrowing and 'pooling' of emissions

FEMREG allows banking and borrowing of compliance surplus for each ship between reporting periods. Any compliance surplus may be banked until the following reporting period. Any compliance deficit may borrow

an advance compliance surplus from the subsequent reporting period. However, it will be subtracted from the subsequent reporting period at a punitive rate. FEMREG also gives shipping companies the option to pool their compliance balance with other ships even with those outside of their shipping company. However, the pool as a whole must meet the GHG intensity limit as well as other specific requirements. Once a FuelEU Document of Compliance (DoC) is issued, surplus banking or use of an advanced surplus may not be changed.

Pooling emissions penalties and surplus 'credits' may allow for huge cost savings. Further, it means that companies investing in a ship that runs on low-carbon fuel can reduce their exposure and increase their bargaining power by offering to pool with other non-compliant vessels. According to a Finish consultancy, one methanol powered vessel in a pool can make 75 vessels running on HFO compliant.[4] However, parties must remain vigilant, as depending on the type of charter party agreement and particularly where charterers are responsible for buying the fuel, the regulation does not define whether it is the shipowner or charterer who owns the surplus associated with a vessel. This is something that will have to be agreed commercially between the parties. Similar to EU ETS, the FEMREG regime offers potential commercial opportunities for shipowners to trade emissions allowances as well as FEMREG surplus credits.

Further detail awaited

Much like maritime EU ETS, FEMREG is only partially implemented. Partial implementation of EU ETS has meant that very few shipping companies have been able to register so far and very few registries are currently in position to open Maritime Operator Holding Accounts (MOHAs) due to being inundated with applications and thin on time and resources. This lack of preparedness is having a knock-on effect on shipping, particularly when it comes to effective transfer of ETS responsibility. Furthermore, only a handful of member states have implemented the EU ETS costs and enforcement provisions thus creating further uncertainty as to the level of risk that ETS potentially presents in the long term. FEMREG will likely be even more chaotic. Delays and implementation challenges are likely, given that the EU is still preparing FAQs specific to FEMREG and consultations on essential detail have only just closed for the following:

- the draft implementing act on verification activities;
- the draft implementing act on the template for standard monitoring plans; and
- the draft delegated act on methods and criteria for the accreditation of verifiers.

Consequences of non-compliance

Compliance penalties will be applied from 1 May 2026 which is the first reporting year. These will be calculated in accordance with prescribed formulas included in the annexes to the regulation. Failure to comply with the regulation's requirement to have a DoC for two or more consecutive reporting years, starting from June 2026, will result in the competent authority of the EEA Member State of the port issuing an expulsion order or refusing entry to any ship that is subject to an expulsion order until the shipping company fulfils its obligations. Further detail on how Fuel EU penalty calculations will work in practice and guidance on enforcement is expected to be published in due course.

How can shipping companies prepare?

We would recommend shipping companies focus on these top four priorities when formulating a compliance strategy for FEMREG.

- start preparing fuel compliance strategies now;
- start reviewing existing as well as any new contractual arrangements with charterers, ship managers and fuel suppliers, to ensure that the roles for sourcing and supplying low-carbon fuels or for picking up any penalty costs when there are non-compliances, are clearly demarcated contractually and provided for;
- consider either investing (or co-investing) in low-carbon vessels that could offset non-compliant emissions from the rest of the company's fleet and could potentially also make some money through 'pooling' or trading of the company's 'surplus' credits to the poorly performing FEMREG participants; and
- lastly, we recommend including bespoke collaborative and cost sharing provisions in charterparties which enable future compliance with the mandated GHG intensity reductions through reduced use of fossil fuels and greater use of qualifying biofuels, RFNBOs and of wind-assisted propulsion equipment. Slow steaming will not be enough to achieve this.

Conclusion

FEMREG is built to bolster a collaborative approach between shipowners, charterers, ship managers and fuel suppliers to meet new fuel standards. This will involve sharing the burden of compliance through new partnerships and novel business models as well as through balanced and proportionate cost sharing. The cost of compliance, particularly when factoring in highly technical and complex formulas for calculating non-compliance penalties or well-to-wake greenhouse gas intensity of fuels are set to strike the maritime sector hard, particularly at a time when it is already grappling with the challenges presented by the EU ETS and the Red Sea crisis. It remains to be seen whether FEMREG will achieve its decarbonisation objectives. ■

Footnotes

1. *Defined in Article 3 (13) of FEMREG as either the registered owner or the ISM Company which has been contractually mandated to comply: "'company' means the shipowner or any other organisation or person such as the manager or the bareboat charterer, which has assumed the responsibility for the operation of the ship from the shipowner and has agreed to take over all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention".*
2. *Annex 1 provides that where the fuel is of non-biological origin, a reward factor of 2 from 1 January 2025 to 31 December 2033 can be applied. Otherwise, the reward factor is 1.*
3. *www.epure.org/press-release/european-ethanol-producers-raise-legal-challenge-to-eu-maritime-legislation*
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MARITIME HISTORY & HERITAGE

SIR CHARLES ALGERNON PARSONS: DEVELOPMENT OF THE MARINE STEAM TURBINE AND SY *TURBINIA*

In 1894 Sir Charles Parsons, one of Tyneside's most famous engineers, filed his patents for the marine steam turbine and, as part of his development strategy, also designed, constructed, launched and trialled the steam yacht *Turbinia*. Over the next decade the marine steam turbine revolutionised naval and merchant ship propulsion and was the predominant prime mover for most of the next century. To mark this 130th anniversary, **Keith Hutchinson** of Safinah Group on Tyneside discusses Sir Charles's early career and the development of the marine steam turbine

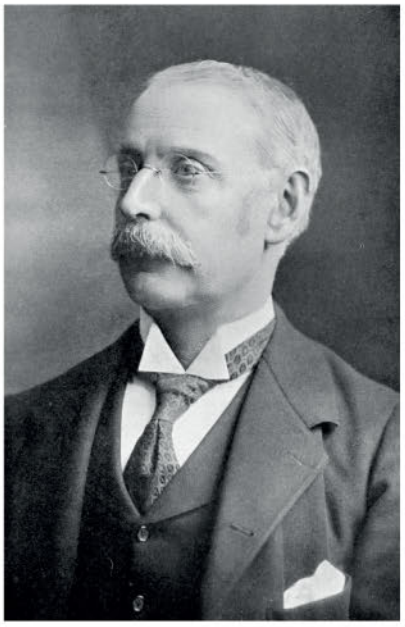

FIGURE 1. THE HON SIR CHARLES ALGERNON PARSONS OM KCB FRS MA DSc LLD. PORTRAIT AS PRESIDENT FROM 1912 TO 1913 OF THE NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (NECIES)

The Hon Sir Charles Algernon Parsons OM KCB FRS MA DSc LLD (Figure 1) is without doubt one of the greatest engineers that the United Kingdom has ever produced, as illustrated by the fact that he took out over 300 patents and that in 1927 he became the first engineer to be admitted to the Order of Merit (OM). He was born in London on the 13 June 1854, the sixth and youngest son of the famous astronomer William Parsons, 3rd Earl of Rosse KP PRS HonFRSE.

He was home tutored by the scientific assistants of his father, many of whom would become eminent and distinguished scientists in their own rights, at his seat of Birr Castle near the town of Birr (formerly Parsonstown, until 1901), County Offaly in the, now, Republic of Ireland. The grounds of the castle contained his father's giant telescope (the 72inch/1.83m 'Leviathan of Parsonstown' built between 1842 and 1846 – the largest in the world for over 70 years) and the associated workshops, containing both engineering and chemical equipment which, from his earliest years, provided the opportunity for Parsons to develop his considerable manual and engineering skills.

At the age of 17 he was sent to study at Trinity College in Dublin and two years later, in 1873, went on to its sister St John's College at the University of Cambridge to study applied mechanics and mathematics from where he graduated in 1877 with first-class honours in mathematics – as at this time it was not possible to study engineering at Cambridge. Parsons' daughter Rachel later continued in his shoes, studying mechanical sciences at the University of Cambridge and was admitted as one of the first three female members of the, then, Institution of Naval Architects (INA, now RINA – the Royal Institution of Naval Architects) in 1919.

Upon graduation, the 23-year-old Parsons began a premium engineering apprenticeship at W.G. Armstrong and Company based on the north bank of the River Tyne at Elswick, just west of the centre of Newcastle-upon-Tyne – this company being founded in 1847 by another great Tyneside engineer and industrialist, Sir William George Armstrong CB Kt FRS, who was later raised to the peerage in 1887 as the 1st Baron Armstrong of Cragside in the County of Northumberland. The premium for his apprenticeship was £600, which equated to about 10 years' wages for an Elswick worker, and gave him an invaluable understanding of the shop floor craftsmen and production conditions, enhanced his manual dexterity and facilitated his learning of Armstrong and his staff's methods and approaches. Whilst at Cambridge, he had described Brotherhood's three-cylinder rotary engine as a

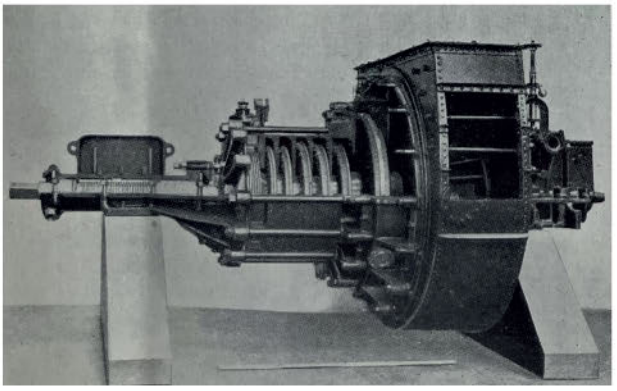

FIGURE 2. RADIAL-FLOW STEAM TURBINE FIRST FITTED TO SY *TURBINIA* IN 1894

FIGURE 3. 6FT MODEL OF SY *TURBINIA*

'masterpiece of design', and in 1878 patented his four-cylinder design and the first engine was constructed at Elswick, a further two further patents followed before he finished his apprenticeship.

In 1881, Parsons entered a cost-sharing partnership with Kitson and Company of Leeds in Yorkshire. For more than two years he carried out systematic experiments on impulse gas turbine engines utilising rocket propellant to propel torpedoes. This was a commercial success with many hundreds being built but his attention was focussed elsewhere. During this time the works also built about 40 of his four-cylinder high-speed epicycloidal steam engines, however, the concept was not ideal. He began making models of pure rotary turbines from cotton reels, with cardboard blades and sealing wax and investigated new methods of winding dynamos – the genesis of the steam turbine, as a smaller and more efficient alternative to the steam reciprocating engine, which was also significantly quieter, an aspect that was increasingly becoming an issue with the larger land-based power stations.

Axial flow steam turbine

At the beginning of 1884, at the age of 29, Parsons invested £20,000 to become a junior partner in the well-established Tyneside engineering company Clarke, Chapman & Company of Gateshead – founded in 1864 by William Clarke, with Abel Chapman becoming a partner in 1865. The company supplied cranes and other mechanical handling equipment for ships and, hence, wanted to expand into the provision of the newly emerging requirement for electric lighting. Therefore, Parsons was appointed chief electrical engineer in the newly created electrical department.

Within four months of his appointment, in April 1884, he had filed two patents describing his ideas for a steam turbine driven electric generator, and within only six months the first working experimental prototype turbo-dynamo was constructed – which is preserved at the Science Museum in London. This prototype multi-stage axial flow reaction steam turbine and associated generator, both of which he developed, produced 10hp (7.5kWe) at around 1,000V at 18,000rpm, which was typically 900 times faster than a reciprocating steam engine and 15 times faster than the highest speed dynamos of the period, and only had an efficiency of 1.6%!

During the five years that Parsons was with Clarke, Chapman, Parsons & Company, 288 turbine generating sets were constructed. The majority of sets were supplied to provide electric lighting on ships, the first commercial unit being for the SS *Earl Percy* of 1885 which produced 2.7hp (2kWe) at 10,000rpm – this is preserved at the Kelham Island Museum in Sheffield. During this period powers increased to 100hp (75kWe), which is a tenfold increase in five years over Parsons' prototype, and efficiencies also improved with both size and technological developments. In 1888 Parsons designed a 670hp (500kW) two-cylinder axial flow steam turbine, but Clarke and Chapman did not want to build such a unit as the power was in excess of that required for ships and, hence, only suitable for land-based power stations.

Radial-flow steam turbine

In 1889 Parsons founded C.A. Parsons & Company in Heaton just east of the centre of Newcastle-upon-Tyne employing about 50 workers, about a dozen following him from Gateshead. In the same year he founded the Newcastle and District Electric Lighting Company.

As Clarke, Chapman & Company owned his patents for the axial-flow steam turbine, he therefore began experimenting again and subsequently developed, patented and built the world's first radial-flow steam turbine in 1889 – producing 43hp (32kW) at 6,000rpm. One hundred and twenty radial-flow steam turbines were built between 1889 and 1894, with the largest for a power station being 270hp (200kW) and built in 1893.

In December 1893, after agreeing a value with his former partners, Parsons regained his earlier patents for axial-flow turbines. Since axial-flow steam turbines were typically 12% more efficient than the radial-flow type, the development of the radial-flow steam turbine was immediately terminated and effort focused back on the axial-flow type.

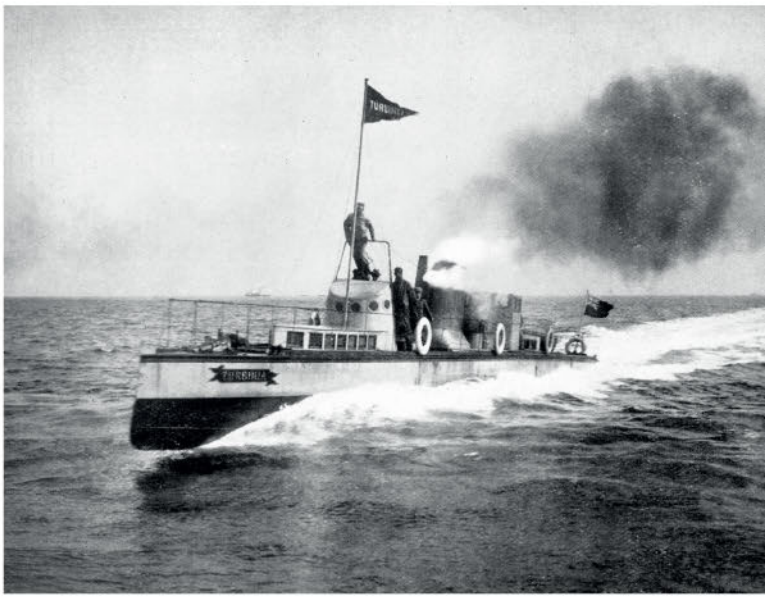

FIGURE 4. SY *TURBINIA* AT 34KNOTS IN THE NORTH SEA

Steam turbines for marine propulsion

By the time Parsons had regained his axial-flow turbine patents he had already begun applying the steam turbine to marine propulsion. Hence, his largest radial-flow steam turbine of 2,000shp (1,491kW), which was completed in 1894, was not designed for power generation but rather marine propulsion. As shown in Figure 2, this was the first engine installed in record breaking and first-ever steam turbine propelled ship SY *Turbinia* and was almost 200 times more powerful than Parsons' 1884 prototype, a tremendous advance in only a decade. This first marine steam turbine is preserved at the Science Museum in London.

In 1894, Parsons filed a patent for 'Propelling a vessel by means of a steam turbine, which turbine actuates the propeller or paddle shaft directly or through gearing', and in the same year founded the Marine Steam Turbine Company in Wallsend on the north bank of the River Tyne to exploit the marine applications of his steam turbine and to construct the SY *Turbinia*.

Design of the steam yacht *Turbinia*

Parsons combined his interest in steam turbine technology with his passion for the sea and ships to design, construct, develop and demonstrate, in the remarkably short period of just five years, a prototype ship that was a first in terms of prime mover power source and propulsor technology. The ship in question is the first-ever turbine steamer SY *Turbinia*, which is arguably one of the most famous and influential ships in the world as she set the standard for the next generation of steamships that directly followed her, the majority of which were steam turbine powered.

SY *Turbinia* was designed by Parsons purely as an experimental ship to demonstrate the superiority of his steam turbines for marine propulsion. Few if any naval architects, not to mention marine engineers, will have had such freedom to design a ship with dimensions and hull form optimised purely for the purpose of demonstrating the potential of a prime mover machinery package.

The principal particulars for SY *Turbinia* are given in Table 1, and it should be noted that her dimensions, ratios and form are extreme even for ships from the late 19th century. While the L_{WL}/B_{MLD} ratio would today be considered extreme it was not untypical of motor yachts and naval torpedo boats of the late Victorian era. The principal dimensions selected by Parsons for SY *Turbinia* demonstrated his understanding that for $V_S/\sqrt{L_{WL}}$ ratios above 1.34 (wavelength, λ, equal to L_{WL}) the wave making resistance of a displacement form increases dramatically for a fuller hull form, and therefore for a speed, V_S, of 30knots ($V_S/\sqrt{L_{WL}} = 3.0$) the narrowest possible form would be necessary.

The fine waterline entry forward, the filling out of the waterlines aft to reduce squat and the clean flow into the propellers will have been adopted from typical launch designs of the late Victorian era. The hull form would have been optimised during the series of scale model tests using 2ft and 6ft models (see Figure 3) which Parsons, sometimes assisted by his friend Professor Sir James Alfred Ewing, carried out during 1892 and 1893 at a pond near his home in Ryton-on-Tyne using fishing line and a stopwatch. Modern designs would typically place the LCB further aft, however, Parsons had the considerable weight of the amidships boiler and stokeholds to contend with which therefore would have, to a great extent, driven the location of LCB. The flat plate stern lines adopted were to reduce the running trim while it appears that the counter was incorporated solely for aesthetic purposes. As Parsons anticipated a running stern trim when at speed, he intentionally kept the bow lines very fine to avoid the raised stem slamming in a seaway.

Trials and modifications of steam yacht *Turbinia*

The hull of SY *Turbinia* was built at Brown & Hood, not a shipbuilder, at Wallsend on the north bank of River Tyne. Originally, she was simply called *Experimental Launch* and launched without publicity on 2 August 1894.

As mentioned previously, as originally configured SY *Turbinia* was fitted with a single radial-flow steam turbine directly driving a single shaft turning a single 30inch propeller, and trials commenced on 14 November 1894. After trying several different designs and numbers of propellers, to the disappointment of Parsons the best

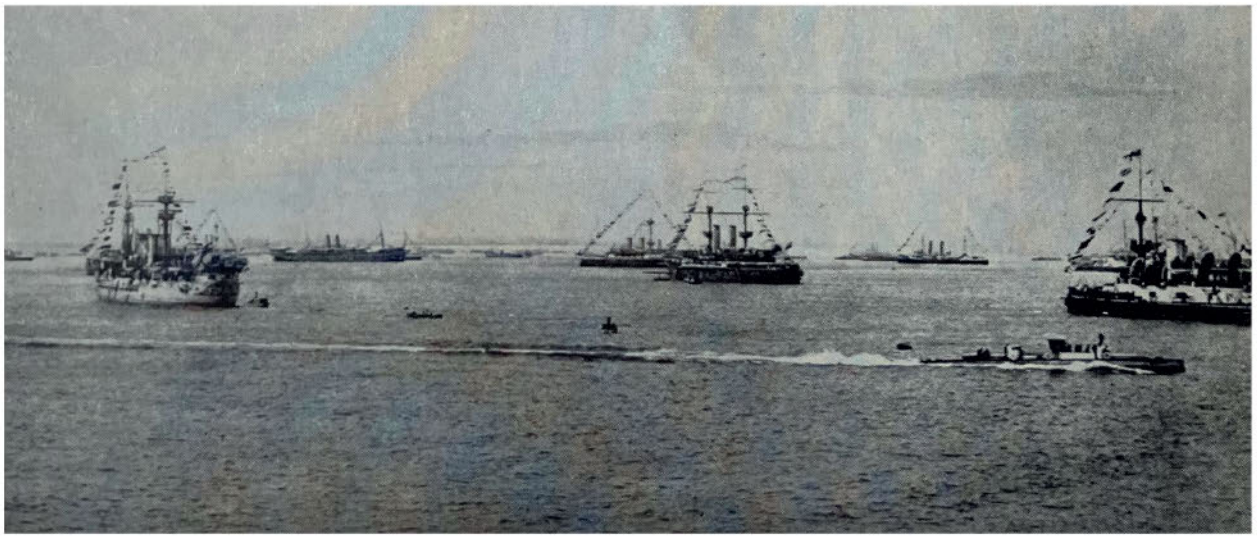

FIGURE 5. SY *TURBINIA* AT THE SPITHEAD REVIEW FOR QUEEN VICTORIA'S DIAMOND JUBILEE ON 26 JUNE 1897

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Technical Conference:
Managing CII and Associated Challenges 2025

21-22 January 2025, IMO HQ, London, United Kingdom

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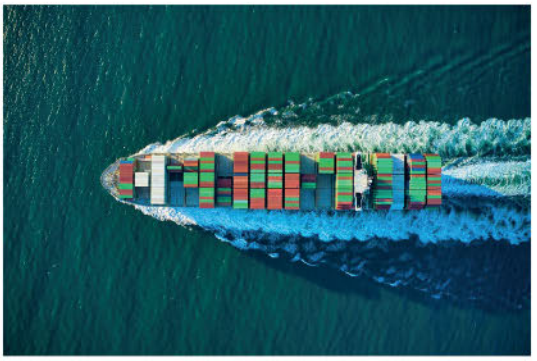
Carbon Intensity Indicator (CII) – What is it?

The Carbon Intensity Indicator (CII) is a mandatory rating measure for ships, developed by the International Maritime Organization (IMO), that came into effect on 1st January 2023.

As part of its commitment to addressing climate change, the IMO has been working on the development of a Carbon Intensity Indicator (CII) for international shipping. The CII is intended to measure the carbon efficiency of ships and assess their relative carbon emissions performance. The concept of the CII was introduced in the IMO's Initial Strategy on Reduction of GHG Emissions from Ships, adopted in 2018. The strategy sets out a vision to reduce total annual greenhouse gas emissions from international shipping.

The CII is intended to be a key tool to assess and monitor the carbon intensity of ships, providing a standardized and transparent measure for evaluating their energy efficiency and emissions performance. It is expected to be a dynamic indicator that can be updated periodically to reflect technological advancements and best practices. However many sectors of the maritime industry have expressed concerns regarding the unintended consequences of implementation of CII.



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In January 2024, the Royal Institution of Naval Architects (RINA) hosted the first Technical Conference on Managing CII and Associated Challenges at the IMO Headquarters in London. The conference resulted in bringing together 90+ industry stakeholders who exchanged feedback and insight on CII's first year. The 2024 conference, supported by SPNL and the Nautical Institute, allowed the delegates an opportunity to hear from two keynote speakers – Mr. Tianbing Huang, Deputy Director, Sub-Division of Protective Measures, Marine Environment Division, IMO and Julien Boulland, Global market leader for sustainable shipping within Bureau Veritas Marine & Offshore, head-office commercial team, among many other presentations including from companies such as Ardmore Shipping; d'amico società di navigazione spa; MSC Cruise Management (UK) Ltd; DNV; Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping; International Chamber of Shipping; Royal Caribbean Group; and many more.

The IMO must conduct a review of the CII before 1 January 2026, and following initial feedback, changes are expected to CII, though it is not yet clear on what the final outcome will be. The Royal Institution of Naval Architects is proposing a follow up conference in January 2025, and is inviting companies to share how they manage performance as a system, and to explain how continuous improvement in energy efficiency may be achieved.

Conference Topics:

- Experience with managing and complying with CII
- Challenges with implementation of corrective actions
- Experience with effectiveness of corrective actions
- Lessons learnt
- Intersection with commercial and contractual issues
- Best practice energy efficiency management approaches

https://rina.org.uk/events/events-programme/technical-conference-managing-cii-and-associated-challenges-2025/

PRINCIPAL PARTICULARS OF SY *TURBINIA*		
Length Overall, L_{OA}	103ft 3inches	31.471m
Length waterline, L_{WL}	100ft 0inches	30.480m
Stem Overhang	0ft 0inches	0.000m
Stem Overhang	3ft 3inches	0.991m
Breadth (moulded), B_{MLD}	9ft 0inches	2.743m
Depth (moulded), D_{MLD}	7ft 0inches	2.134m
Draught (moulded), T_{MLD}	3ft 4.5inches	1.029m
Displacement, Δ	42.27tons	42.95tonnes
Length / Breadth ratio, L_{WL}/B_{WL}	11.111	
Block Coefficient, C_B	0.487	
Prismatic Coefficient, C_P	0.603	
LCB (%L_{WL} aft of ⊗)	4.56%	

TABLE 1: PRINCIPAL PARTICULARS OF SY *TURBINIA*

speed achieved on trials was only 19.75knots – this was with three propellers on the single shaft rotating at 1,750rpm. Following the development of a simple, ingenious torque meter he quite rightly identified that the fault lay not with the single radial-flow steam turbine, which it is believed delivered a shaft power, P_S, of approximately 2,000shp (1,491kW), but with poor propeller efficiency due to cavitation.

This led Parsons to develop and construct the world's first experimental cavitation tunnel in 1895 to investigate these 'vacuous cavities' which formed behind the rapidly turning propeller blades and, hence, overcome this phenomena and design propellers to transmit the huge power produced by the steam turbine via the shafts to the water. In the previous year Sydney Walker Barnaby and John Isaac Thornycroft had also identified cavitation as a problem on the destroyer HMS *Daring* but Parsons was the first engineer to investigate this phenomenon scientifically. This cavitation tunnel is preserved and on display at Newcastle-upon-Tyne's Discovery Museum.

The eventual solution adopted by Parsons in 1896 was to install three axial-flow steam turbines, which in total delivered about 1,975shp (1,474kW) at about 2,200rpm, although the output may have been as high as 2,200shp (1,640kW). Each steam turbine was connected directly to a propeller shaft, each fitted with three equally sized propellers, so totalling nine propellers over three shafts. The propellers are all identical and have a diameter, DP, of 18inches (0.457m), a pitch, P, of 24inches (0.610m) and a blade area ratio, BAR (projected) of 0.5. This propulsion arrangement boosted the speed up to a confirmed trial speed of 32.76knots and an unofficial top speed of 34.5knots, see Figure 4, making SY *Turbinia* the fastest ship in the world until 1899 – this due to the success of Parsons' two innovations, the steam turbine and also SY *Turbinia*'s dimensions and hull form.

Demonstrations of the steam yacht *Turbinia*

SY *Turbinia*'s ground-breaking speed performance was most famously demonstrated when she arrived unannounced at the Navy Review for Queen Victoria's

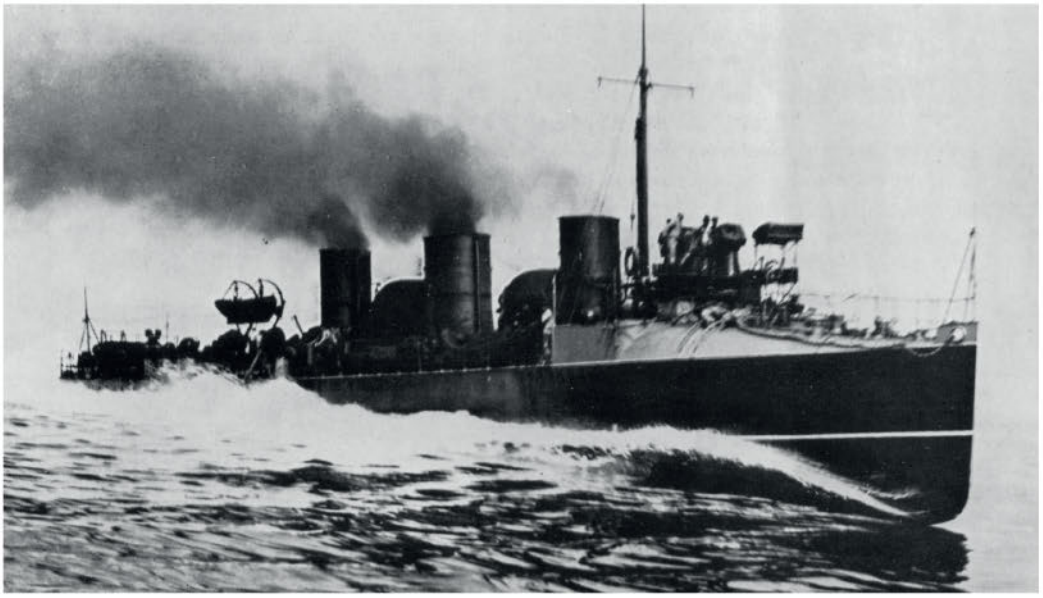

FIGURE 6. HMS *VIPER* AT SPEED IN 1900

FIGURE 7. RMS *MAURETANIA* AT THE OUTFITTING QUAY OF SWAN HUNTER & WIGHAM RICHARDSON AT WALLSEND ON THE RIVER TYNE ON 22 OCTOBER 1907 WITH SY *TURBINIA* OF 1894 ALONGSIDE

Diamond Jubilee at Spithead on 26 June 1897 – Engineer-in-Chief of the Fleet Sir John Durston had proposed such a demonstration. In attendance were the Prince of Wales, the Lords of the Admiralty and foreign dignitaries such as premiers and ambassadors and including Prince Henry of Prussia, the brother of Kaiser Wilhelm II, and of course the world's press. Captained by Christopher John Leyland, Parsons as chief engineer and supposedly crewed by fellow directors Alan Archibald Campbell-Swinton FRS and Dr George Gerald Stoney FRS, as shown in Figure 5, SY *Turbinia* famously raced at up to 34knots between the assembled lines of over 150 naval warships and steamed up and down in front of the crowd evading a Royal Navy picket boat that endeavoured to pursue her with ease and almost swamping it with her wake, noting that at the time the fastest destroyers could only achieve 27knots.

SY *Turbinia* also performed high-speed demonstrations on the River Seine during the Paris Exhibition of 1900, including to the French Navy. 1902 saw the final modifications to the propulsion train with the fitting of single 28inch diameter and pitch propellers on each shaft but by this time the vessel's job was done as the marine steam turbine had been accepted by the shipping world.

Subsequent marine steam turbine adoption

In 1897 Parsons founded the Parsons Marine Steam Turbine Company with £500,000 of capital, to acquire the assets and licences of the Marine Steam Turbine Company and to specifically build steam turbines for marine propulsion. Following SY *Turbinia*'s performance at the 1897 Spithead Review and further trials attended by the Admiralty, Sir Charles Parsons proposed building two torpedo boat destroyers powered by his steam turbines rather than steam reciprocating engines – noting that in 1895 the French torpedo boat *Forban* had achieved a speed of 31knots and, as discussed above, no British destroyers of the period could match such a speed.

On 4 March 1898, the Royal Navy ordered a three-funnelled, 210ft 3.5inch (64.099m) long by 21ft (6.401m) beam and 344tons/395tons (350tonnes normal/399tonnes deep) displacement torpedo boat destroyer HMS *Viper* from Parsons Marine Steam Turbine Company. As with the SY *Turbinia*, the construction of the hull had to be subcontracted, hence the ship was built by R. & W. Hawthorn Leslie & Company. She was launched from their Hebburn-on-Tyne shipyard on the south bank of the Tyne on 6 September 1899 and commissioned in 1900 (see Figure 6). The turbines produced 10,600shp (7,904kW) driving four shafts directly at 1,000rpm with two propellers per shaft. The vessel achieved 12,300shp and 33.57knots on trials, comfortably in excess of contract speed of 31knots. The two high-pressure (HP) turbines drove the outer shafts and two low-pressure (LP) turbines (and astern turbines) the inner shafts – the exact configuration used on RMS *Mauretania* later that decade.

Armstrong Whitworth speculatively built, as yard number 674, a four-funnelled, 223ft (67.970m) long, 400tons (410tonnes) torpedo boat destroyer with 11,500shp (8,576kW) Parsons turbines directly driving four shafts, and launched on 28 June 1899 from their Elswick shipyard on the north bank of the River Tyne upriver of Newcastle. *Ship 674* was subsequently purchased by the Royal Navy on 8 May 1900 and named HMS *Cobra*. The ship had her first steam trials in June 1900 and was completed by September 1901 achieving 34.6knots.

Tragically, both ships were lost in 1901 but not before convincing the Admiralty as to the merits of steam turbine propulsion, and from 1904 all major British warships used steam turbine propulsion – with many other navies also quickly adopting steam turbine propulsion, much being Parsons machinery.

The first steam turbine propelled merchant ship was laid down in 1900, and only four years later one of the most famous trans-Atlantic liners ever built, the 31,938grt, 2,165 passenger RMS *Mauretania*, was laid down for Cunard. The RMS *Mauretania* was 787ft (239.87m) long, 87ft 6inch (26.670 m) beam, 33ft 6inch (10.211m)

FIGURE 8. STERN VIEW OF SY *TURBINIA* IN THE DISCOVERY MUSEUM, NEWCASTLE-UPON-TYNE, IN 2024 SHOWING THE FINAL THREE-SHAFT AND NINE-PROPELLER CONFIGURATION AND PERSPEX HULL PANELS ALLOWING VIEWING OF THE THREE AXIAL-FLOW STEAM TURBINES AND OTHER MACHINERY

draught and displaced 37,960tons (38,571tonnes) and was laid down at Swan Hunter & Wigham Richardson's Wallsend shipyard on the north bank of the River Tyne on 18 August 1904. The RMS *Mauretania* was launched on 20 September 1906 by the Duchess of Roxburghe, completed on 22 October 1907 (see Figure 7) and was commissioned into Cunard's fleet on 11 November 1907 – remaining the world's largest ship until the commissioning of White Star Line's RMS *Olympic* in 1911. The four direct-drive Parsons steam turbines produced 76,000shp (56,673kW) at 180rpm, a more than 25-fold increase over SY *Turbinia* in only a decade. This was, with sister RMS *Lusitania*, by some margin the largest turbine installation at the time, and the machinery was constructed by the Wallsend Slipway & Engineering Company located just down river from the builders. Upon completion of trials on 6 November 1907, RMS *Mauretania* achieved 25.73knots and went on to capture and hold the Blue Ribband for over two decades.

Epitaph

The Hon Sir Charles Algernon Parsons died on the 11 February 1931 aged 76, on board the SS *Duchess of Richmond* while on a cruise in the Caribbean with his wife. A memorial service was held at Westminster Abbey on 3 March 1931, and he was buried in the parish church of St Bartholomew's in Kirkwhelpington, Northumberland.

Unfortunately, but understandably, SY *Turbinia* is no longer operational or afloat. However, she is still in existence, with her axial-flow turbines intact and fitted with the 'classic' three-shaft, nine-propeller propulsion train. Since 1994, as shown in Figure 8, SY *Turbinia* has taken pride of place as the principal exhibit in a purpose-built gallery at Newcastle-upon-Tyne's Discovery Museum, along with Parsons' original cavitation tunnel.

Interestingly, the SY *Turbinia* does virtually exist as an operational ship on the ship simulator at South Shields Marine School (see Figure 9). Therefore, 130 years after she was built and changed the world of marine propulsion forever, the ground-breaking performance of the SY *Turbinia* can still be experienced 'first hand'.

Disclaimer

The views expressed in this article are those of the author and do not necessarily represent those of the organisations with which he is affiliated or the professional institutions of which he is a member. ■

FIGURE 9. 2024 SIMULATION OF THE 1897 CONFIGURED SY *TURBINIA* AT SPEED IN THE RIVER TYNE WITH THE SWAN HUNTER-BUILT 1907 RMS *MAURETANIA* AND MS *SAGA RUBY*, EX 1973 MS *VISTAFJORD*, THE LAST CRUISE LINER BUILT IN THE UK, MOORED AT THE FORMER SMITH'S DOCKS AT NORTH SHIELDS

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OFFSHORE NORTHERN SEAS (ONS) 2024
International exhibition
Stavanger, Norway
www.ons.no

SEPTEMBER 3-6, 2024
SMM 2024
International exhibition
Hamburg, Germany
www.smm-hamburg.com

SEPTEMBER 16-20, 2024
IMO SUB-COMMITTEE ON CARRIAGE OF CARGOES AND CONTAINERS (CCC 10)
IMO meeting
London, UK
www.imo.org

SEPTEMBER 30 – OCTOBER 4, 2024
IMO MARINE ENVIRONMENT PROTECTION COMMITTEE (MEPC 82)
IMO meeting
London, UK
www.imo.org

OCTOBER 14-16, 2024
SNAME MARITIME CONVENTION
International convention
Norfolk, Virginia, USA
www.sname.org/smc-2024

NOVEMBER 4-7, 2024
EURONAVAL 2024
International exhibition
Paris-Nord Villepinte, France
www.euronaval.fr

NOVEMBER 6-7, 2024
ARCTIC SHIPPING SUMMIT 2024
International summit
Montreal, Canada
www.wplgroup.com/aci/event/arctic-shipping-summit

NOVEMBER 18-22, 2024
IMO COUNCIL
IMO meeting
London, UK
www.imo.org

NOVEMBER 19-21, 2024
METSTRADE 2024
International exhibition
Amsterdam, the Netherlands
www.metstrade.com

DECEMBER 2-6, 2024
IMO MARITIME SAFETY COMMITTEE (MSC 109)
IMO meeting
London, UK
www.imo.org

DECEMBER 3-6, 2024
EXPONAVAL 2024
International exposition
Port of Valparaíso, Chile
www.exponaval.cl/en

2025

MARCH 25-27, 2025
SEA ASIA 2025
International exhibition
Singapore
www.sea-asia.com/en

APRIL 8-10, 2025
OCEAN BUSINESS 2025
International exhibition
Southampton, UK
www.oceanbusiness.com

JUNE 2-6, 2025
NOR-SHIPPING 2025
International exhibition
Oslo, Norway
https://nor-shipping.com

IF YOU HAVE A CONFERENCE OR EVENT YOU WOULD LIKE TO BE CONSIDERED FOR THIS PAGE PLEASE CONTACT: TNA@RINA.ORG.UK


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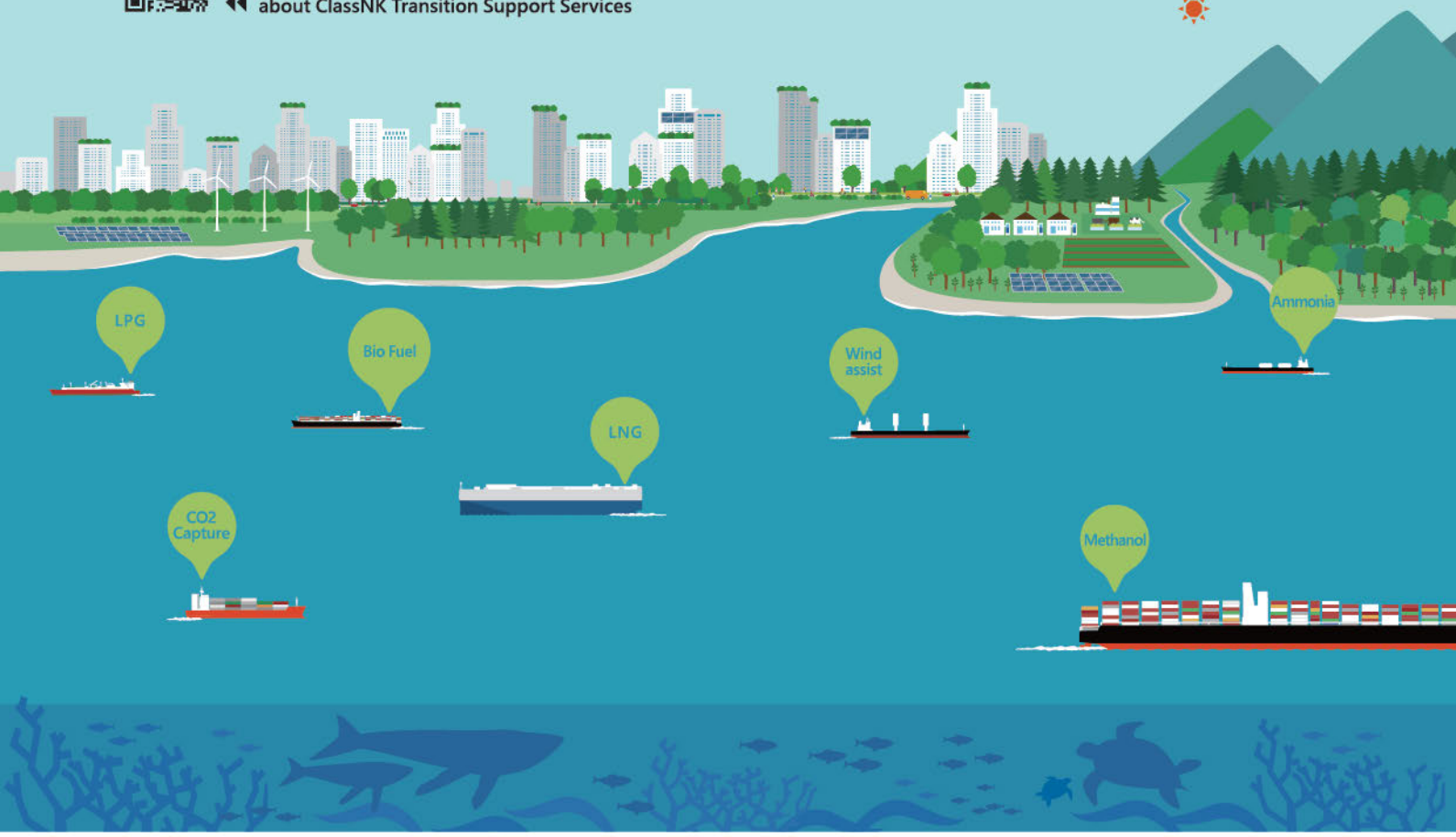
Charting Transition to Zero-Emission

Revised IMO targets to reduce GHG emissions and the EU's expanded climate policy package are driving increasingly stringent regulations for shipping. In the meantime, the infrastructure for supplying zero-emission fuels is still under development. In the immediate term, shipping stakeholders seeking to make progress towards zero-emission need to select GHG reduction measures based on their circumstances and the specifics of their individual vessels.
To support its clients' ongoing efforts to reduce GHG emissions, ClassNK is extending its "ClassNK Transition Support Services." Based on a holistic assessment of customer needs and implementation strategies to achieve optimal solutions, the expanded service focuses on three types of GHG emissions reduction measures: the introduction of alternative fuels for ships; energy efficiency improvement technologies; and the use of onboard CCS.

ClassNK is committed to making a full contribution to charting a course towards zero-emission for our clients and society.

For more infomation
about ClassNK Transition Support Services



ClassNK CHARTING THE FUTURE

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