PORT GEAR

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DEAR READERS,

Przemysław Myszka

We are back for this year's round of trade fairs, especially TOC Europe 2025, with a new edition, full of reads on the various technological aspects of the transport sector, both soft- and hardware. There is also a special round-up of news specifically revolving around all things safety, courtesy of TT Club. To top things off, other news bits are very much venturing forth how the industry of transporting goods and people will change in the face of, e.g., the energy transition. Proven likewise pioneering technologies will certainly play an instrumental role in making the transport business more data-driven towards greater efficiency, be it performance-wise, for the sake of the environment, or to upgrade workforce skills (including those 'soft'). With that, I wish you nothing but a savvy read! May this special issue of the Baltic Transport Journal *kick whatever you're doing into high gear!*

DETAIL: *RUBY LOFTUS SCREWING A BREECH-RING* (1943) BY LAURA KNIGHT, PHOTO: WIKIMEDIA COMMONS

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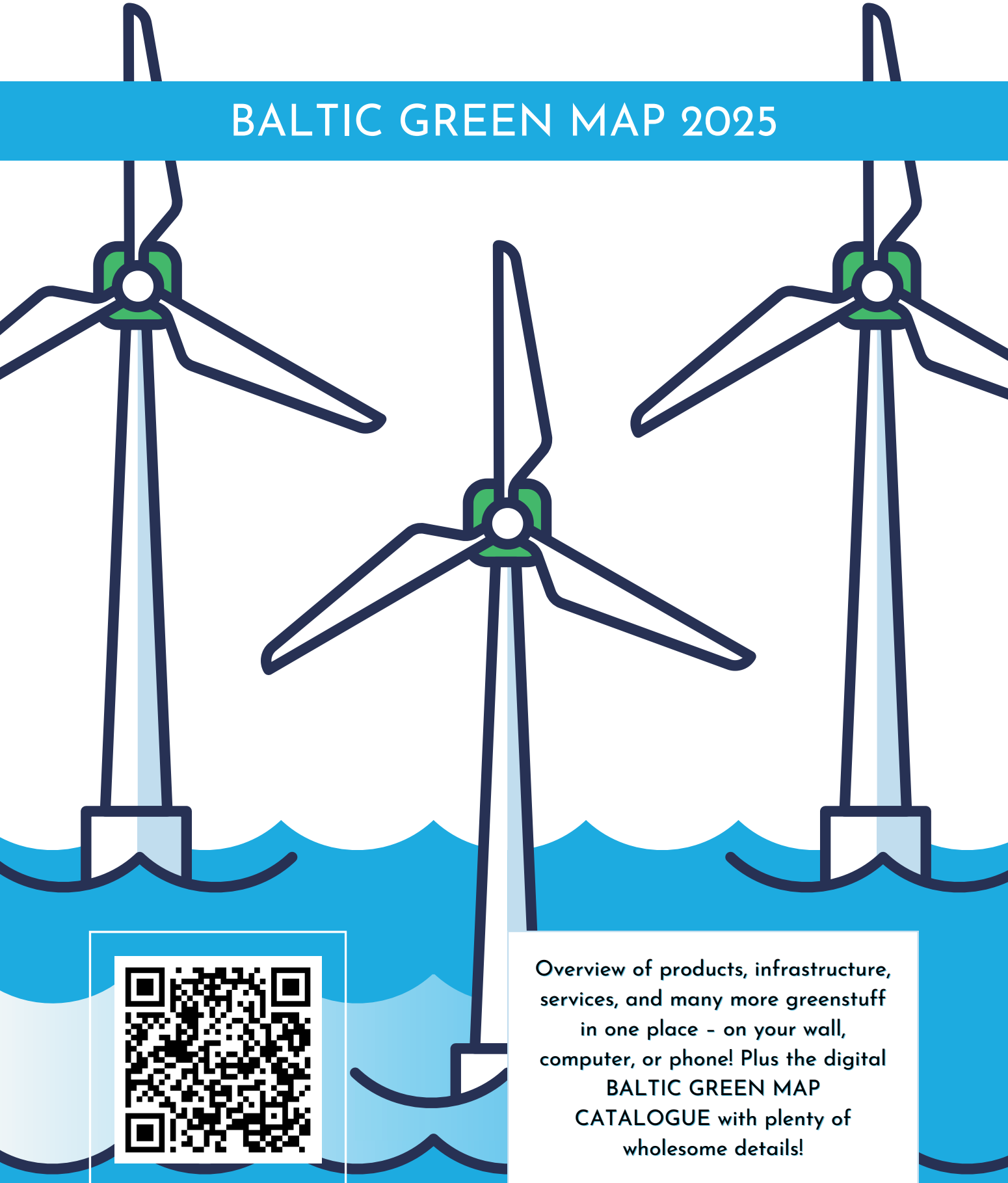
BALTIC GREEN MAP 2025



Overview of products, infrastructure, services, and many more greenstuff in one place – on your wall, computer, or phone! Plus the digital BALTIC GREEN MAP CATALOGUE with plenty of wholesome details!

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reads for (port) gearheads

THE TT INNOVATION IN SAFETY AWARD(S)

The latest handing was expanded to recognise the increasing depth and variety of projects and products meant to reduce accidents and damaging losses, with winners & highly recommended entrants in four categories. "Over the past 10 years since its inception, the ICHCA-hosted **TT Club Innovation in Safety Award** has seen entries marked by a significantly increased diversity of innovative products, services, and processes aimed at improving safety in the cargo handling industry," the **International Cargo Handling Coordination Association (ICHCA)** and **TT Club** said in a press brief. **Voxel** won the 'Turning data into insight' category for its artificial intelligence (AI)-powered worksite visibility platform, with **Pandora Intelligence** honoured for its Cargo Intelligence: data-driven risk assessment of shipments. **International Transport Workers' Federation (ITF) and ITF Seafarers' Trust** came first in the 'Learning and engagement' competition for its international app-based worker training programme. **Port Skills** and Safety was highly recommended for its Emergency Flash Cards. 'Making operations safer' saw **RAM Spreaders** winning for the company's automatic pipe handling spreader, with **CEPA** recognised for its ergonomic lashing tool. Permanent bollard with sensors won **Straatman Mooring Systems** the 'Segregating people and machine' category, with **SSA Marine's** AI-driven RTG camera system acclaiming a distinguishment. "As ever, the judging panel felt that all the original ideas were worthy of congratulations and further exposure. Such diversity of entries is truly welcomed. Safety innovation is an exciting element that complements wide-ranging industry work to establish a distinct safety culture throughout organisations. A well-run, safety-conscious operation is both efficient and sustainable. Running organisations successfully and doing safety well require truly visible and effective commitment from management at all levels," highlighted **Richard Steele**, ICHCA's CEO. **Mike Yarwood**, Managing Director, Loss Prevention at TT Club, added, "The excellence of these, and many of the other innovations put forward, deserve a greater degree of visibility. This is our prime aim in proliferating the Awards in order to encourage our innovators to seek scalability and by giving their ideas oxygen to stimulate their adoption and adaption by others within the global cargo handling environment." ICHCA and TT Club have also published the *Innovation in Safety Award Digest*, detailing all entries.

FIRE ONSHORE…

TT Club is warning cargo handling and terminal operators that fire remains a major cause of damage and loss to port and terminal equipment. The insurance specialist's analysis of a 10-year claims history shows that of the nearly 1,600 fire-related claims it has received over that period, some 19% have involved this equipment. "Fire risk not only poses a significant concern in terms of insured losses and obvious operational disruption, but it also presents a real and significant risk to the safety of the workforce, facility visitors/users, and indeed the general public. As a result, we strongly advise that fire detection and suppression systems in port equipment are considered by operators as critical safety measures," cautions **Neil Dalus**, Risk Assessment Manager at TT Club. As such, his organisation commends the white paper published by the **Port Equipment Manufacturing Association** titled *Fire Detection and Suppression Systems for Mobile Port Equipment*. "The paper is comprehensive in its coverage of fire safety measures and particularly emphasises the importance of regular maintenance, collaborative risk assessments, adherence to industry standards, and, of course, mandatory regulations," highlights TT Club.

…AND OFFSHORE

The **World Shipping Council** (WSC) reported that in response to a series of devastating fires caused by improperly handled charcoal, shippers should be ready to see carriers phase in new tighter regulations this year. These will require all charcoal shipments to be declared as dangerous goods under the **International Maritime Dangerous Goods Code**. There are also new treatment, packing, and stowage requirements for shipments of charcoal. "We are eager to see the new regulations implemented as the status quo hasn't been adequate at keeping crew, cargo, and vessels safe," shared **Joe Kramek**, WSC's President and CEO. He furthered, "Treating all charcoal as dangerous goods ensures uniform safety standards and gives everyone involved – from shippers to carriers – the tools and clarity needed to prevent future tragedies." With the help of the **International Group of P&I Clubs** and **TT Club**, WSC created a reference guide to ensure shippers are well-informed about the changes.

KNOW YOUR CUSTOMER!

Following a multi-year development project, **Baltic Exchange** has partnered with **Moody's** to launch the Know-Your-Customer (KYC) data platform for the maritime sector. The initiative utilises the latter's Orbis for Compliance database, which covers over 445 million entries both in shipping and non-shipping, along with its Global Regulatory Information Database (GRID) that provides 12m+ records on known or suspected corrupt private and public sector figures, fraudsters, illicit financiers, money launderers, and more. "KYC is a regulatory requirement in the banking and financial services sectors to ensure businesses do their due diligence on customers to prevent fraud, money laundering, and terrorism financing. With shipping a vital part of global commerce, the need to manage the risk of fraud and compliance with regulatory sanctions have become paramount, particularly surrounding reputational management and liability issues," Baltic Exchange said in a press release. KYC is available to both members and non-members who can purchase credits in order to undertake the required checks and scans (with the former receiving a discount when using the platform).

COULD CRIMINALS BE RECRUITING YOUR STAFF?

"Criminals acting in the supply chain target all stakeholders and modes of transport to conduct illicit activity, including theft and trafficking of contraband goods. All employees, full-time, part-time, and contract, are useful to criminal organisations as they seek to penetrate the defences against illicit activity," **TT Club** warns. "Although they may be directly involved in outright theft of goods, insiders are quite often most useful to criminal organisations as sources of information […] such as stockholding records, load and route plans, and even CCTV records," the insurer furthers. There are, fortunately, ways to tackle the insider threat, among others, discerning between legitimate and illegitimate recruiters (the former look for skills and strengths, the latter – for weaknesses that can be later leveraged), thoroughly vetting prospective employees, or considering whether systemic access should be limited (such as maintaining segregation between warehousing and transportation parts of the business). Having strong & trusted leadership, effective communication, and trustworthy whistle-blower policy are also key to mitigating the risk of insider collusion, TT Club says. "Criminals exploit workers through blackmail and intimidation to make them feel isolated and vulnerable. Businesses can counter this tactic by talking openly about the issue and offering workers understanding, protection, and even amnesty for past misdeeds. Workers who feel trapped in a cycle of blackmail and criminal action may struggle to see a way out of the trap in which they find themselves. Businesses may break this cycle by effectively showing a worker a way out," the insurer notes.

TOWARDS PEST-RESISTANT CONTAINERS

The **International Symposium on Optimising Container Design to Mitigate Risks of Pest Contamination** – organised by the **International Plant Protection Convention (IPPC)** Secretariat in partnership with the **Bureau International des Containers (BIC)**, the **Container Owners Association**, and the **World Shipping Council (WSC)** – gathered carriers, leasing companies, container manufacturers, biosecurity experts, and plant health stakeholders to discuss how to address the $423 billion global challenge posed by invasive pests every year. A study by the Australian government took centre stage, revealing that while 8% of standard containers showed signs of pest contamination, the rate dropped to just 1.45% in modified units. "Data from interceptions collected by several countries indicate that approximately 90% of pest contamination found on the external surfaces of sea containers is linked to the understructures, while contamination on internal surfaces is primarily associated with the floorboards," shared **Rama Karri**, Director at the **Australian Department of Agriculture, Fisheries and Forestry**. Practical anti-pest modifications, aimed at making containers less hospitable to invasive pests without compromising functionality or cost-efficiency, include floor designs that eliminate gaps and cracks and prevent nail holes, understructures with fewer horizontal ledge configurations, and the elimination of bitumastic under-coatings. **Mike Downes**, Senior Technical Expert at BIC and Chair of the **Container Cleanliness Industry Advisory Group** supporting the IPPC's **Sea Container Focus Group (SCFG)**, commented, "Container design has historically focused on production efficiency and durability, but in a global supply chain we must also prioritize pest resistance. By rethinking container design, we can mitigate the risks of invasive species and safeguard biodiversity, forests, and global food supplies." **Lars Kjaer**, Senior Vice President of WSC, added, "This is a critical societal issue, and collaborative efforts like this Symposium are helping broaden our industry's recognition of the problem and strengthen its commitment to accelerate efforts to create a pest-resistant supply chain." At the end of the meeting, a working group was established to move forward with the many promising ideas introduced. The group will present proposals for container design modifications to the IPPC's SCFG and ultimately to the Commission on Phytosanitary Measures that oversees the IPPC's activities in regard to container cleanliness.

THE BALTIC99 QUESTIONNAIRE

Baltic Exchange and **Veson Nautical** released the revamped standard designed to help owners and charterers share common data requirements to speed up the vetting process when a dry bulk carrier is put up for hire, facilitate faster trades, and ensure smarter pre-fixture decision-making. Importantly, "This latest revision includes several key developments linked to important emissions-related data and enhanced safety requirements to ensure charterers are hiring the right vessel for their needs and expedite the vessel acceptance process," underscored **Janet Sykes**, Chief Commercial Officer at Baltic Exchange.

YEAR IN FOCUS – 2024 EDITION PUBLISHED

TT Club released its latest publication that looks back over the full 12 months of 2024, covering key themes, events, and initiatives for the global provider of mutual insurance and related risk management services to the international transport & logistics industry. The release focusing on the past year includes topics such as climate change adaptation and energy transition, contractual management and theft trends, personal protective equipment, and safe mooring, plus expert insight from TT's Claims Executives on complex issues like nuclear verdicts in the US and freight forwarder liability in relation to recent events in the Red Sea.

NEW SUPPLY CHAIN SECURITY BULLETIN – ALSO OUT

TT Club also released a new edition of the publication in question, this time putting the spotlight on the latest advances in carrying equipment technology that can be considered to give supply chain stakeholders an advantage in the ongoing battle against the criminal fraternity. "A common theme when considering supply chain security is that the criminals behind the theft activity are getting smarter. They are leveraging technology to their advantage, and it appears continually gaining ground on legitimate stakeholders," warns the insurer. "There have been more extreme cases where those behind cargo theft have used technology to block or jam GPS tracking devices and even cases whereby a recruited insider has placed a covert GPS device for the criminals so that they have full visibility of their target as it transits through the supply chain, affording them the opportunity to choose an opportune moment to strike." The Bulletin focuses on smart containers and their promise of greater visibility, safety and compliance benefits, and real-time tracking – altogether a potential solution against illicit activity. The publication explores several solutions and the impact that they could deliver.

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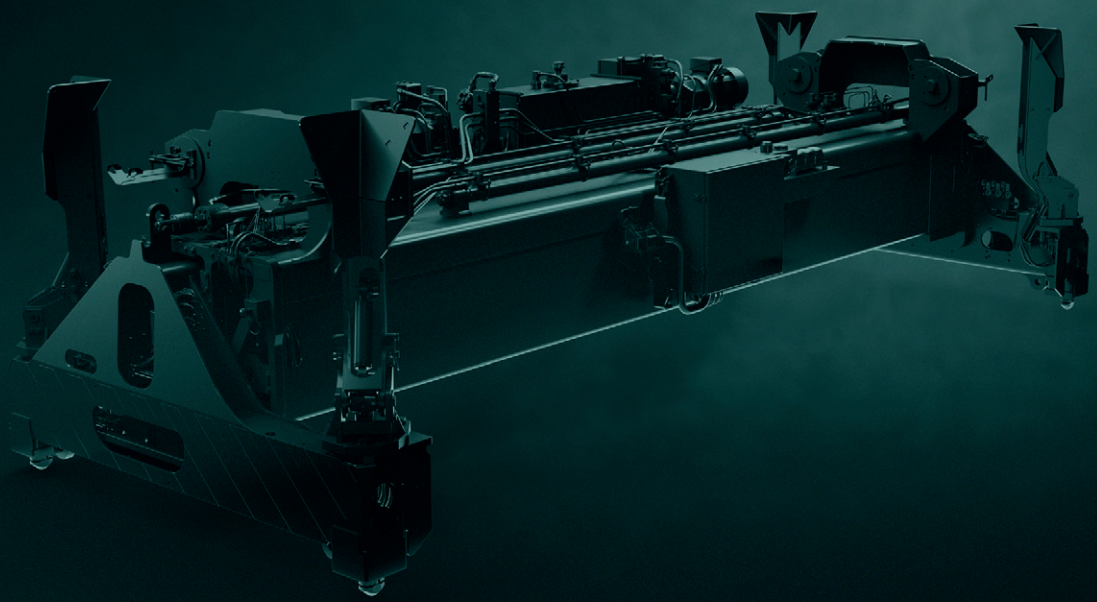

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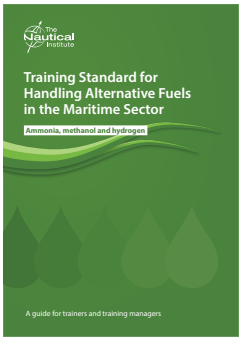
BMP MS – CONSOLIDATED & ENHANCED

BIMCO, **ICS**, **IMCA**, **INTERCARGO**, **INTERTANKO**, and **OCIMF** – further supported by over 40 maritime stakeholders – published the latest version of the *Best Management Practices (BMP) for Maritime Security (MS)*, an interactive online guidance to help all vessels plan voyages and to detect, avoid, deter, delay, and report attacks and incidents wherever they occur. This *BMP MS* consolidates previously published regional publications into a single, comprehensive source with actionable insights and advice. It focuses on providing a threat and risk management process and, recognising the dynamic nature of regional security situations, provides signposts to direct users to the most up-to-date security intelligence and risk assessment information. Additionally, the publication includes various diagrams that provide valuable learning opportunities; it also details global authorities and lists appropriate contacts & tools for seafarer welfare support. "2024 saw an unprecedented spike in attacks against merchant ships. Ships were attacked with weapons of war in the Black Sea and in the Southern Red Sea more than one hundred times, and four innocent seafarers lost their lives. Globally, 126 seafarers were held hostage during pirate attacks and armed robberies, and 12 seafarers were kidnapped. *BMP MS* will reduce risks and save lives. While we cannot control how the threats will develop in 2025 and beyond, we can make sure that we have the best tools available to help protect our seafarers and world trade," commented **David Loosley**, BIMCO's Secretary General & CEO.

SURVEY ON ENCLOSED SPACES

InterManager, **The Nautical Institute**, and **IMarEST** have partnered to gather up-to-date information on the risks faced by workers in enclosed spaces on ships. "Together [we] have launched an industry-wide survey which aims to collate feedback from those working on ships to delve deeper into what's going wrong and understand better what solutions are needed," the parties said in a press release. The detailed online survey, which can be completed anonymously, asks seafarers to identify what aspects of enclosed space entry present risks for them and how involved in safety procedures they have been. Captain **Kuba Szymański**, Secretary General of InterManager, shared, "Since 1998, InterManager has been collating statistics on behalf of the whole shipping industry and sharing them with partners and the International Maritime Organization. Sadly, from this information, we can see that workers are still dying in enclosed spaces on board ships despite numerous industry interventions." The statistics show that most enclosed-space accidents involve senior ranks or stevedores, and the highest percentage of incidents occur on bulk carriers (41%) and tankers (23%). The most frequent locations for life-threatening incidents or deaths are the hold and hold access areas (51%), with cargo oil tanks also presenting a significant risk (18%). Szymański added, "We have been discussing enclosed space safety at the highest levels for many years now and yet, despite the shipping industry producing a wealth of rules, procedures, guidelines, leaflets, etc., people are still dying in these confined spaces on ships. Please have your say on what needs to be done."

TRAINING STANDARD FOR HANDLING ALTERNATIVE FUELS IN THE MARITIME SECTOR – RELEASED



With a 10-part scheme of work, the Standard, published free of charge by **The Nautical Institute**, provides guidance to training providers to offer programmes of learning that ensure seafarers will have the knowledge to handle bunkering of alternative fuels safely and confidently. "As the first milestone in the IMO's [International Maritime Organization] 2023 GHG [greenhouse gas] strategy approaches with the requirement for between 5% and 10% of the world fleet expected to be powered by zero or near-zero GHG emission technologies, many shipowners have had to take a decision on how they will fuel their fleets before all the variables have been fully tested. The result is that we can expect vessels powered by a number of different fuels such as ammonia, methanol and hydrogen to be launching within the next few years before the IMO will be able to establish STCW [the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers] competency requirements," underscored The Nautical Institute in a press brief. "This standard doesn't replace the STCW requirements that will be established in the coming years. Rather, it seeks to offer interim support that bridges the gap until that time and, having been designed as a living document, it will be able to evolve with industry best practice," added Capt **John Lloyd** FNI, CEO of The Nautical Institute.

THE INTERNATIONAL MEDICAL GUIDE FOR SHIPS – IN NEED OF UPDATING

Marine Medical Solutions is calling on the **International Maritime Organization (IMO)** to update the May 2007-published Guide, which it sees as essential for providing medical care on board ships and that serves as the primary reference for pharmacies that supply the list of essential medicines for seafarers. The company has raised concerns about the outdated nature of the Guide, emphasising that advancements in medicine over the past 15 years have not been reflected in the current recommendations. "[…] without regular updates from the IMO, seafarers are at risk of not receiving the most effective care. A doctor's insight is crucial in ensuring that the medical supplies on board are not only adequate but also improved for current medical standards," underlined Doctor **Jens Tülsner**, CEO of Marine Medical Solutions. His company outlines that flag states and other organisations have become active in improving the situation, e.g., the *Maritime Medical Service* of the German Flag published a completely revised version of the Maritime Medical Handbook for ships flying the country's flag in 2019/2020 (German/English version), including adaptations of the medical equipment on board. In 2023, the **International Chamber of Shipping** provided a new handbook aimed at improving onboard medical care. However, Marine Medical Solutions notes that none of them have been adopted by the IMO. "By updating the Guide and ensuring that it reflects modern medical practices, we can provide better support and care for seafarers, who often face challenging and isolated conditions at sea," Doctor Tülsner urges the global body.

HORIZON X – ORDERED

Gotland Company has entrusted the shipbuilders from Austal to design & construct the 130-metre, combined cycle, multi-fuel, hydrogen-ready high-speed catamaran that will connect Gotland with the Swedish mainland (able to speed up to 29 knots to cover the distance in around three hours). The ship, to offer room for 1,500 passengers and 400 vehicles, will be the largest vessel ever constructed by Austal. Construction at the company's Philippines shipyard will commence in H1 2026 and will be completed in mid-2028. The contract is valued at A$265-275 million (€161.5-164.5m). The catamaran will feature a combined cycle propulsion system that includes both gas and steam turbines, a "[…] unique propulsion system arrangement that re-purposes engine exhaust to contribute to vessel propulsion and reduce emissions," the parties highlighted in a press brief. Horizon X will also be constructed with the use of 'green aluminium,' with around 60% of the metal produced using renewable energy. "Horizon X is an incredibly exciting project that is going to redefine commercial ferry capabilities, with a multi-fuel and hydrogen-capable combined cycle power plant and a class-leading, efficient hull design. The flexible fuel technology demonstrated in Horizon X is leading the transition to decarbonisation of commercial ferries, and we're proud to be at the forefront, partnering with Gotland Company, to deliver this industry-leading new ferry," commented Paddy Gregg, CEO, Austal. "We have set the ambition-bar high regarding further decreasing our impact on the environment and climate, and a multi-fuel catamaran presents big opportunities for us. Access to fossil-free bunkers will continue to be a challenge; likewise, there'll be high uncertainty concerning their prices. With this here type of technology, we can blend fuel depending on availability and price. At the same time, we're working on developing the concept for our passengers to even further improve and modernise the onboard experience," shared Marcus Risberg, CEO of Destination Gotland (the ferry subsidiary of Gotland Company).

FINNLINES ORDERS HANSA SUPERSTARS

In a deal worth €1.3 billion, the Grimaldi Group has entrusted China Merchants Jinling Shipyard (Weihai) with delivering nine brand-new ferries, six of the Next Generation Med and three of the Hansa Superstar class. All are scheduled for delivery in 2028-30, with four flying the Italian flag and plying for Grimaldi Lines, two under the Greek flag and working for Minoan Lines, and the remaining three sailing under the Finnish flag for Finnlines between Helsinki and Travemünde. Equipped with engines capable of running on methanol, as well as with a suite of eco-solutions (among others, optimised hull & propeller designs, onboard power management systems, cold ironing connectors, silicon-based hull coatings), the carbon footprint of the new ro-paxes per transported cargo unit will be axed by at least half vs the vessels currently operating on the same routes, says the Grimaldi Group. The Hansa Superstars will be 240-metre-long and offer 5,100 lane metres for cargo and room for 1,100 passengers. "Facilities include five bars and restaurants, a spa with a wide range of services and treatments, including the iconic Finnish sauna, shops, and two children's play areas designed for different age groups. One of the standout features is the main bar at the bow of deck 12, which will offer breathtaking views of the Baltic Sea during the crossing," Finnlines highlighted in a press brief. The Next Generation Meds will be 229-metre-long, offering 3,300 lm and accommodation for up to 2,500 travellers (in cabins and on reclining seats).

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KASKINEN-TAHKOLUOTO OWE CO-OP

The Port of Kaskinen and Tahkoluoto Offshore have signed a memorandum of understanding to scrutinise the former's role in developing logistics & infrastructure for the Tahkoluoto Offshore Wind Farm Extension Project. The project in question, the execution of which will take place in 2027-29, will see the addition of 40 turbines to the currently 42-megawatt-strong Tahkoluoto offshore wind energy (OWE) farm, adding to it up to 800MW of new capacity. "We are pleased with the memorandum of understanding with Tahkoluoto Offshore. This enables long-term planning and development to provide efficient port services for offshore wind projects. We want to ensure that expertise and jobs remain in Finland as renewable energy capacity expands," said Patrik Hellman, CEO of the Port of Kaskinen. Petri Mikola, Project Director of the Tahkoluoto Offshore Wind Farm Extension Project, added, "The extension of offshore wind power requires functional port solutions, and we believe that our cooperation with ports will benefit not only us but also Finland's renewable energy sector as a whole." His company entered into a similar co-op with another Finnish seaport, Pori, in mid-January 2025. The Port of Kaskinen is also involved in the two-year TRAF group project led by Arenso to advance offshore wind power projects as part of the Tahkoluoto Offshore Wind Farm Extension Project.

FREE BIOFUEL FROM GREENCARRIER

The Swedish logistics company has made 1,000 tonnes of green marine fuel available by launching its Shipping Made Fossil Free campaign, part of the Greencarrier Blue Initiative that supports concrete efforts to reduce the environmental impact of global shipping. The first-come, first-served insetting project offers biofuel – made from agricultural residues, upgraded, and converted into liquefied bio-natural gas – available to any client free for one shipment. Once the booking is completed, customers will also receive CO_2-reduction documentation. "Maritime Biofuel Insets allow companies to cut fossil CO_2 emissions by up to 100% by replacing conventional marine fuels with verified, renewable biofuels. Similar to how renewable electricity relies on the mass-balance principle, these insets ensure an equivalent amount of biofuel is used within the global shipping sector, even if it's not directly on the vessel transporting a company's goods. Switching to biofuels for a container shipment is an affordable investment. For example, applying Maritime Biofuel Insets to a route between Asia and Europe would cost around €250 for an average TEU," Greencarrier explained in a press brief.

HIRTSHALS TESTS A NEW SURVEILLANCE SYSTEM

The Danish seaport has teamed up with the also Danish AirPlate (from Odense) to carry out from February to May 2025 a pilot project with the use of flying drones. The solution identifies the position, route, and pilot information about drones in real-time, enabling system users to respond to potential security threats. "The first drone was detected by the system a few hours after we installed the sensors. It was incredible to see the technology delivering value so quickly," commented August Mader, CEO, AirPlate. He furthered, "We see the Port of Hirtshals as a strong case where our technology can play a key role in protecting and documenting drone activity in the airspace over port facilities. Our goal is to assist even more companies in the critical infrastructure sector in managing drone-related threats and to become a long-term partner in strengthening the security efforts at the Port of Hirtshals." The seaport's Head of Transport & Logistics and Port Security Officer, Michael R. Langballe, added, "Port security requirements are constantly evolving, and we must evolve with them. Port facility security has traditionally focused on land and water areas, but there are also increasing requirements for areas such as cyber security." The Port of Hirtshals has also shared in a press release that Denmark already experienced incidents where drones have unlawfully entered secured areas.

COLD IRONING IN GOTHENBURG'S ENERGY PORT

The Swedish seaport has become the third in the world and the second in the Baltic to enable tankers to draw electricity from the shore. Terntank's Tern Island was the first to plug in – while berthed at quay 520 (quays 519 and 521 also offer onshore power supply). "The connection is part of the Green Cable – OPS for Tankers project, a groundbreaking initiative in which the Port of Gothenburg, together with shipping companies and industry players in tanker shipping, has developed a safe and flexible solution tailored for vessels transporting energy products," the Port of Gothenburg underscored in a LinkedIn post. Back in November 2023, another Swedish seaport, Gävle, made it possible for tankers to cold iron (with the Port of Long Beach being the very first at BP Terminal's Pier T).

TRELLEBORG'S WIND TURBINES ARE IN FULL SWING

The Swedish seaport's two 120-metre-tall turbines have started producing energy, expected to generate some 15 million kilowatt-hours per year, i.e., three times more than the Port of Trelleborg consumes. "With the setup of our own wind farm, the Port of Trelleborg is self-sufficient in energy production, which will cover the seaport's future demand for, among others, shore power supply for berthed vessels," the Port of Trelleborg highlighted in a LinkedIn post. The excess energy will be fed to the grid. The Port of Trelleborg also houses a photovoltaic system that spans over 2,200 square metres, producing 0.5m kWh/year.

PHOTO: PORT OF TRELLEBORG

BUSINESS FINLAND BACKS P2X SOLUTIONS' E-FUEL PLANT PROJECT…

Targeting the marine & aviation sectors as its customer base, the 40-megawatt green methanol production facility, to be erected in the Iiksenvaara industrial area in Joensuu, has received an investment grant of €60 million. In 2022, the European Commission (COM) added the Joensuu plant to the Important Projects of Common European Interest (IPCEI) list, which now enabled providing the grant through the COM's Recovery and Resilience Facility (allocated by a national funding mechanism managed by Business Finland). If the project gets a green-light final investment decision, possibly this year, it'll be constructed next to a bio-power plant of Savon Voima, from which it'll source biogenic CO_2 for combining it with renewable hydrogen into e-methanol (in return, providing waste heat transferred to the Joensuu district heating network). "This investment grant will significantly promote the development of the European and Finnish synthetic fuels market and move us closer to the investment decision of the Joensuu plant. In addition, it is an important step in strengthening the vitality of Eastern Finland and the hydrogen value chain. We are proud to be pioneers in developing the production of e-methanol in Finland through a trailblazing circular economy cooperation with Savon Voima," commented Herkko Plit, P2X Solutions' CEO. Hos company, together with Oulun Energia, is also exploring the possibility of building a green hydrogen up-to-100MW-capacity production plant in Oulu.

…WHILE LIQUID WIND & ÖVIK ENERGI BRING BACK THE ÖRNSKÖLDSVIK E-FUEL PROJECT TO LIFE

The two have partnered to set up the production plant, formerly known as FlagshipONE (bought by the Danish Ørsted in December 2022 and shelved in the summer of last year), additionally doubling its yearly capacity to 100 thousand tonnes of e-methanol. Liquid Wind will start developing the project this spring, with Övik Energi tasked with supplying the biogenic carbon dioxide (130 thousand tonnes/year) for e-fuel production. Övik Energi's co-generation plant will also provide steam and water for the e-methanol production process, while excess heat will be fed back into Örnsköldsvik's district heating network.

THE PORT NATURE ROADMAP PROJECT

The Finnish Ports Association, its seven members (Helsinki, Kokkola, Naantali, Oulu, Pietarsaari, Pori, and Turku), and carbon footprint data experts from the Jyväskylä-based Green Carbon have partnered to create a port environmental planning tool. The results of the project, which will summarise the current state of environmental protection (including statutory & voluntary measures) in ports and their plans in this field from the biodiversity perspective, will be presented at the Finnish Port Days in Kokkola on 18-19 September 2025.

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EMSA'S SET ON ALTERNATIVE FUELS – WRAPPED

A consortium led by ABS – which also included CE Delft, Arcsilea, and Texas A&M University – published the last two reports in the series. "A 360-degree analysis of nuclear power and synthetic fuels, specifically the renewable e-fuels of e-diesel, e-methane and e-methanol, complete a project for EMSA designed to support the European Commission, the Member States, the shipping sector, and European ports in the transition to carbon-neutral shipping," highlighted ABS in a press brief. To this, the class' Senior Vice President, Global Business Development, Vassilios Kroustallis, added, "This set of six reports together represents a substantial body of work that advances the safe adoption of these fuels, which will be the foundation of the industry's move to low- and zero-carbon operations." Dagmar Nelissen, Senior Researcher and Consultant from CE Delft, also highlighted, "CE Delft is proud to have also contributed to the fifth study on potential future fuels, which covers the remaining set of fuels: e-diesel, e-LNG, and e-methanol. The study allows a consistent comparison with the previously studied fuel types and shows the challenges ahead as far as costs and up-scaling of the synthetic fuels are concerned. Regulatory measures seem to be indispensable for their further development and uptake."

MAJOR PORT UPGRADE IN OXELÖSUND

The Swedish seaport will invest around SEK700 million (€62.1m) in infrastructure development and equipment, including quay lengthening, a crane, dredging, and yard space, as well as in railways and a marshalling yard. The project is set to be completed in H1 2027. "The investment will strengthen our own as well as the region's competitiveness as we open up for new businesses and client cooperation. The Port of Oxelösund has the potential to be one of the Baltic Sea's most important transport nodes for numerous industries," commented Staffan Thelander, the Port of Oxelösund's CEO. He furthered, "With these investments, we're enabling faster and more environmentally friendly transports, remaining a part of a value chain that will noticeably lower carbon emissions in the steel industry. We see this as a model of how we can help more companies offer climate-smart and effective logistics solutions."

TILBURY'S THIRD LHM 550

Meriaura's heavy-load open deck carrier Meri transported the mobile harbour crane from Liebherr Rostock to Forth Ports Group's Port of Tilbury (London). The fully assembled machinery was unloaded with the help of another piece of Liebherr's heavy-duty gear, the LH 150 Port Litronic material handler. Tilbury's new LHM 550, offering an outreach of 54 metres and a 144-tonne configured lifting capacity, will be used for, among others, handling granulated blast furnace slag (GBFS) from the expected to start operating in 2026 Aggregate Industries' new cement grinding manufacturing facility and import terminal in the English seaport. Due to the aggressive nature of GBFS, an over-pressure system has been fitted to force-ventilate the crane's slewing platform to prevent product ingress into the machine rooms. Additionally, the LHM 550 has been covered in the same paint finish as Liebherr's offshore and ship cranes for corrosion control that goes beyond most port standards. The mobile harbour crane also features the LieGEN energy recovery system, can run on hydrotreated vegetable oil, and is ready to draw power from an electrical power supply.

'BLACK SAND' FACTORY IN MUKRAN

The Finnish Outokumpu will invest around €40 million in a plant for producing biocarbon, some 15 thousand tonnes per year, in the Mukran Port. The factory, slated for commissioning in H1 2026, will use secondary wood raw materials as feedstock. The end product, a fine granulate that looks like black sand, will be shipped to the Port of Tornio for further processing into biocoke pellets (with the pelletising plant ready in mid-2025). These, in turn, will be used by Outokumpu to replace coal and other fossil energy sources in various stages of stainless steel production (with biocoke specifically used as a reductant in ferrochrome smelting). The waste heat generated by the Mukran plant will be fed into the district heating network on the island of Rügen. The Finnish company says that approximately 50% of its direct emissions could be reduced by replacing fossil coke with biocoke. "Outokumpu's decision in favour of Mukran is the result of an intensive process. It shows how attractive our port is for companies that rely on multimodal transport chains. The planned delivery of raw materials by rail and shipment of the end product by ship will strengthen the site's logistics diversity. With Outokumpu, we are not only gaining a world-leading company in its sector but also increasing the attractiveness for other potential industrial customers and supporting the transformation of the location with regard to new energy sources," highlighted Fridjof Ostenberg, back then Mukran Port's Interim Managing Director. Outokumpu's Chief Technology Officer, Stefan Erdmann, also shared, "We are proud that our stainless steel has the lowest carbon footprint in the industry [1.52kg CO_{2e} per kg of stainless steel in 2023], and we are progressing steadily towards our target to reduce our emission intensity across our direct, indirect and supply chain emissions by 42% by 2030 from a 2016 base year. Currently, biocoke represents the best available technology to decrease our direct emissions, and we are also investigating other innovations as well as the use of carbon capture technology to achieve further reductions." To this, Timo Huhtala, General Manager at Outokumpu EvoCarbon, added, "Biomass-based raw materials offer exciting possibilities for Outokumpu to cut direct emissions. I am proud of our team's innovative thinking in developing an industrial concept that ensures technical readiness and financial viability for the new investment, driving progress in the green transition today. We want to take an active role in developing the biocoke market, which will give us scale-up and new business opportunities also going forward."


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WHARF OPTIMISATION PROJECT AT BALTIC HUB – COMPLETED

Visy, with the help of partners from the recently acquired Autepra, installed optical character recognition (OCR) equipment, alongside the TopView system, on 14 ship-to-shore cranes at the Baltic Sea region's largest container terminal. "The system goes beyond a traditional OCR solution, delivering a complete automation ecosystem with multiple applications that cover the entire load/discharge process – from ship to terminal tractor and yard – while providing razor-sharp recognition accuracy for container IDs, ISO codes, and other attributes," the company from the Finnish Tampere highlighted in a press release. The deployment also features Visy's newly developed Wharf App. This interface for crane operators includes a view of the ongoing operations (such as active work queues), a tool to browse and review ship's current situation (containers on board, planned loads and discharges), loading instructions to the ship (both in text and audio), as well as a view on terminal tractors with containers approaching the crane (the system informs the driver whether the box can be transferred onto the ship or if something else needs to be loaded first).

GREEN FUEL FROM NAANTALI

Liquid Wind and Turun Seudun Energiantuotanto (TSE) have signed a memorandum of understanding as a step towards establishing a 100 thousand tonnes per year e-methanol production plant to be located in the former Neste harbour area. The facility – for which the final investment decision is expected in 2026, ahead of operations commencing in 2029 – will sit next to TSE's Naantali 4 power plant, which will feed the e-fuel production with 160 thousand of biogenic CO_2 and which will, in return, receive process and waste heat for district heating. "Locally, in the City of Naantali, we will focus on carbon capture and utilization and the reuse of CO_2 and waste heat. Globally, we aim to support the transition by allowing our off-takers to shift from fossil fuels to low-carbon eFuel produced at this facility," Claes Fredriksson, CEO and Founder of Liquid Wind, highlighted.

PHOTO: TSE

KLAIPEDOS SMELTE UPGRADES ITS TOS

The container terminal operator from the Port of Klaipėda saw Realtime Business Solutions (RBS) migrating the terminal operating system (TOS) from TOPS Advance to TOPS Expert. The migration marked the last step of a project that took under eight months from the initial kick-off to the go-live stage. The transition itself was completed within four hours and without disruption to the daily activities of Klaipedos Smelte. "The new TOS version offers advanced capabilities for vessel operations, yard management, equipment control, and data analytics. Notably, it enhances automation and accelerates planning processes, enabling terminal planners to respond more effectively to dynamic situations while offering greater flexibility to customers such as MSC," RBS said in a press brief. The tech company also underscored, "This migration does not mark the end of the process but rather the beginning of new opportunities and possibilities to integrate additional modules and features in the future. The latest version of TOPS Expert can seamlessly integrate with RBS' new TOPX Intelligent Engine, which will further enhance the terminal's efficiency in scheduling, dispatch, and execution."

GOTLAND COMPANY TO PRODUCE ITS OWN BIOLNG

Together with Andion CH4 Renewables and Equitix New Generation Fund, Gotland Company will erect a biogas production plant near Eskilstuna, scheduled for commissioning in 2026. The bulk of the 5,400 tonnes/year output has been earmarked for Destination Gotland's two gas-run ferries, which currently sail on a blend of liquefied natural gas (LNG) and its bio version. Gotland Company said that it already secured the feedstock supply so that biogas production could start in Q2 2026. Within a decade, replacing LNG with bioLNG will reduce the ferry line's CO_2 footprint by some 100 thousand tonnes. Eskilstuna Biogas is responsible for constructing the production plant. "We are pleased that we could take another step towards our goal of offering climate-neutral transport between Gotland and the Swedish mainland by 2045 at the latest. Today, access to fossil-free bunker is far too limited for the transition of both sea shipping and other transport modes. Through this business, we're contributing to an increased production of high-quality biogas, securing up to 10% of Gotland traffic's demand," Håkan Johansson, CEO, Gotland Company, said. Destination Gotland's CEO, Marcus Risberg, added, "Bunker is the single biggest operational cost for our company, likewise stands as our largest impact on the environment, and we're securing a considerable volume of high-quality biogas for a 10-year period. The business forms part of our preparatory work for those regulations that are entering into force, such as FuelEU Maritime." Johansson also commented on the company's work on hydrogen-powered vessels (a ferry and a high-speed catamaran), "When working on the next-generation ships, we see immense challenges with access to bunker. Our long-term goal is to run the traffic on hydrogen and other fossil-free bunkers, but the required volumes will only come in the distant future. That is why it's important to invest in and secure the supply of other fossil-free fuels today."

SMALL = BIG INVESTMENT

by Fredrik Rönnqvist, *Key Account Manager & Segment Manager – Material Handling, Fogmaker International*

Ports bustle with activity from material handling equipment. An increasing number of that machinery is battery-electric, which removes many hot surfaces and liquid fuels that pose a fire hazard in machines with a combustion engine; yet other fire initiators, like heaters and hydraulics, are still there. Understandably, many worry about fires in the battery packs. Extinguishing a battery fire is very difficult: the chemical reactions happen quickly, the battery casing makes it very difficult to reach the blaze, and to make matters worse, a fire in a lithium-ion battery creates its own oxygen, making it, more or less, impossible to choke.

The good news is that it's rare for a fire to start inside a battery. Research presented at the Fires in Vehicles – FIVE 2023 conference shows that 50-60% of electric vehicle fires never involve the battery. Batteries may catch fire because of thermal runaway, but this is, too, uncommon. Collision or an external fire are the two main reasons for a battery to start burning.

Whereas no fire suppression system can protect against collisions, it can protect against external fires reaching the battery pack. An efficient fire suppression system should target fire initiators to prevent or delay an external fire from affecting the battery; it can also reduce flames from the battery in the unlikely event of it being on fire.

Myths, truths, and knowledge gaps

Recommendations for fire suppression for electrical vehicles and machines used to focus on dry or gaseous agents. This has changed over the last 10 years, and water-mist is now considered the best option, as it has a better cooling effect than other suppressants.

But wait a minute here! Isn't electricity and water an absolute no-no? After all, we've all seen this or that movie where someone is electrocuted by a radio or blow dryer falling into a tub. Electric vehicles and machines are, however, built to withstand humidity, rain, and road splash. They have high ingress protection for any high-voltage parts. A water-mist system like Fogmaker's will not penetrate components with an IP classification of IP66 or higher.

But what if the IP enclosure is damaged? It is every vehicle or machine owner's responsibility to make sure the equipment is safe. Broken parts should be replaced as soon as possible. A fire could damage the IP protection, too, but in that case, the problem is bigger than what can be caused by water.

Many also worry about water in an electric compartment leading to people being electrocuted. Fortunately, this is very unlikely because of several reasons. The components being protected aren't in the same compartment as people. You need to be part of the circuit to get current through your body, and that means you need to make physical contact with both the negative and positive terminals (birds don't get fried by sitting on power lines exactly because they're not part of the closed circuit). Moreover, the gear's battery management system has many safety features to protect from dangerous currents.

Ready to spring into action – now & in the PFAS-free future

Fogmaker's fire suppression system works with a water-based mist, where

PHOTOS: FOGMAKER

each single drop of water is split into circa 8,000 droplets. Practically, that means that Fogmaker has a great cooling effect, and this is imperative when dealing with fires in electric vehicles. Fogmaker has decades of experience in detecting and suppressing fires in engine rooms and other enclosed spaces, and the system will provide the best possible fire protection performance if there is an emergency. The system is tailored to each type, make, model, and energy source since they all have different risk areas.

The system developed by us springs into action when the compartment reaches a certain temperature. At this point, a fine water-based mist fills the compartment, displaces oxygen, and chokes the fire. Fogmaker's pressurised cylinders ensure the system will work regardless of position – even if the vehicle has toppled upside down – and our patented nozzles divide each drop of water into micro-droplets that have a great ability to choke the fire. Water-based mists also cool an area better than all other methods on the market. Cooling the area is important to prevent a blaze from flaring up again, and, depending on the application, Fogmaker systems are designed to keep cooling somewhere between 35 and 90 seconds.

Already in 2023, Fogmaker introduced Eco 1, a fluid that's 100% free of per- and polyfluoroalkyl substances (PFAS). Eco 1 is GreenScreen Certified® at the silver level, meaning a third party has verified all substances in the fluid from an environmental perspective. There is currently a proposal to ban 10,000 different PFAS chemicals, and Fogmaker is ready for the future by completely phasing out its liquids containing PFAS now.

We also work side-by-side with the Port Equipment Manufacturing Association (PEMA) and many of the OEMs in the material handling community to create guidelines and safety recommendations for the future (Fogmaker is proud to share that it co-authored PEMA's *Fire Detection and Suppression for Mobile Port Equipment* white paper, which is available for free on the Association's website).

Safety & peace of mind

A fire suppression system from Fogmaker is a small investment for a big enhancement of safety (and peace of mind). With a pronounced focus on safety in the industry, new electric technologies emerging for material handling, and increased demands for productivity and reduction of downtime, Fogmaker is here to support you in your quest for a safe and productive work environment in material handling. ■

FOGMAKER INTERNATIONAL AB

Since 1995, the Växjö-headquartered Fogmaker International has been developing, manufacturing, and marketing fire suppression systems with high-pressure water-based mist for engine compartments. Fogmaker's water-based mist chokes fires quickly and keeps cooling the area to prevent flare-ups. Now 100% PFAS-free with our new liquid, Fogmaker Eco 1! Visit fogmaker.com to discover more.

EFFICIENCY & RESILIENCE

by Alexa Ivy

Sitting atop the Northwestern tip of Denmark, the Port of Hirtshals is today one of Northern Europe's most significant transport and logistics hubs. The singular geographical position directly at the Skagerrak, where the North and Baltic seas meet, makes the Port of Hirtshals a vital link between Scandinavia, the Baltic region, and the rest of Europe. Over the past few decades, Hirtshals has transformed from a traditional fishing port into a modern logistics centre that effortlessly connects sea and road. Hirtshals' proximity to Scandinavia and the European continent provides an unmatched logistical advantage. Daily ferry connections to Norwegian destinations, such as Kristiansand, Larvik, Stavanger and Bergen, make the port one of the primary maritime links between mainland Europe and Norway. In addition, the Port of Hirtshals is uniquely linked to the Faroe Islands and Iceland.

All ferry crossings serve both passenger travel (almost 2.3 million in 2024) and a significant volume of freight, especially trailers that continue their journey inland by road (some 128 thousand ro-ro cargo units were handled altogether last year). Overall, the Danish seaport took care of 1.75 million tonnes in 2024.

The Port of Hirtshals is an integrated part of the EU's Trans-European Transport Network's Scan-Med Corridor, which highlights the port's crucial role in supporting European trade and mobility. With easy access to the E39 and E45 motorways, goods and passengers passing through Hirtshals can rapidly reach Central and Southern Europe, as well as major Scandinavian cities.

Intermodal infrastructure & green vision

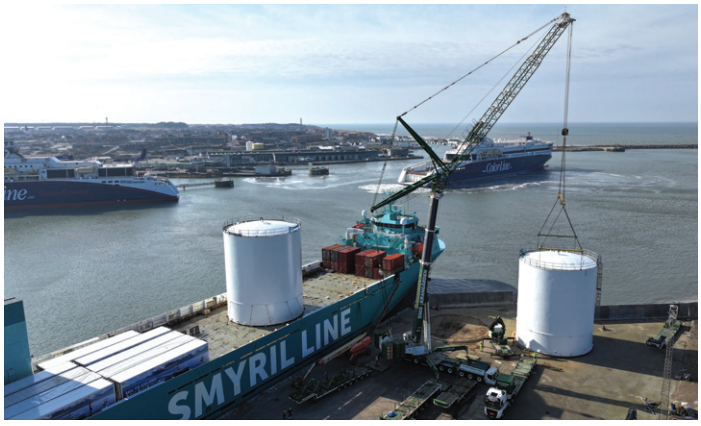
One of the port's strengths is the intermodal infrastructure. Hirtshals offers a continuous integration between sea and land transport, supported by modern cargo terminals and efficient logistics and customs handling. A nearby rail terminal offers the possibility of shipping goods by train, promoting sustainability in freight logistics. Furthermore, the Port of Hirtshals is home to a border inspection point that provides veterinary control of food imported into the EU from third countries.

In recent years, the Port of Hirtshals has pursued a green transformation agenda. The port actively works to reduce carbon emissions and promote renewable energy solutions. Initiatives, such as the Greenport North project, aim to establish the Danish seaport as a front-runner in climate-friendly logistics and green energy use. Preparations for the electrification of ferry terminals, providing access to alternative fuels, and supplying vessels with onshore power firmly stand behind this future-oriented commitment.

Economic importance & growth

The Port of Hirtshals' economic importance extends far beyond its local region, with activities around it supporting

PHOTOS: PORT OF HIRTSHALS



thousands of jobs, both directly and indirectly, in sectors like transport, fisheries, logistics, and maritime services. The seaport is also a key node for fish exports, with one of the biggest fish auctions in Denmark. Concurrently, the Port of Hirtshals is one of Northern Europe's largest receivers of salmon.

Ongoing expansion and modernisation projects are paving the way for future growth. Plans include a wider entrance, deeper port access channels, and upgraded quay facilities to accommodate larger vessels. These developments will enhance Hirtshals' ability to handle increasing volumes of cargo and passengers, further solidifying its role as a transport cornerstone of Northern Europe. "In an increasingly interconnected Europe, the Port of Hirtshals offers both efficiency and resilience. Our strategic location, sustainable development initiatives, and advanced infrastructure make us critical infrastructure – not only for Denmark but for the entire region. As global trade and mobility continue to evolve, Hirtshals is well-prepared to meet the challenges and opportunities ahead," highlights Per Holm Nørgaard, the Port of Hirtshals' CEO. ■

Interview with Elisa Rouhiainen, VP Sales, EMEA, IDENTEC SOLUTIONS

THE TREE OF TECHNOLOGY

by Przemysław Myszka

The transport business can come across as a mixed bag. On the one hand, newsfeeds speak of all sorts of shining new tech that will transform the industry into something known from sci-fi movies. On the other, it is still a labour-intensive sector, with a lot of foot- and paperwork. We are talking with IDENTEC SOLUTIONS' Elisa Rouhiainen about where we are with digitalisation, especially in container operations, and how step-by-step improvements can bring about big gains in productivity and, likewise, safety. Also, we confront the monster of waste and its many a shade, something that will require tech-courage.

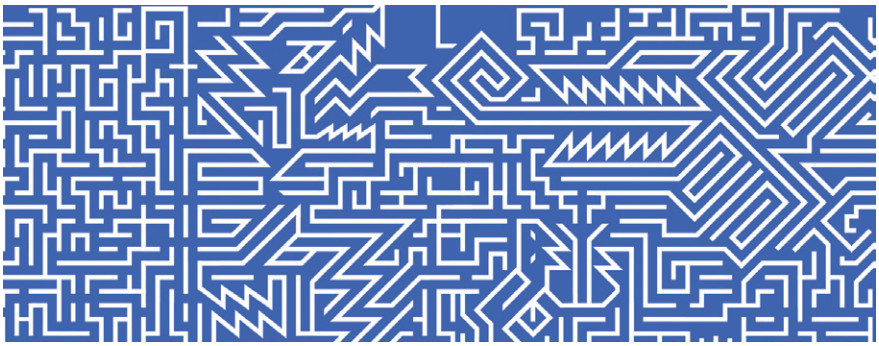
■ ***Could you introduce yourself and how you started working for IDENTEC SOLUTIONS?***

I have been with the container terminal industry for 20+ years. After finishing my master's thesis on automation in container handling at the Tampere University of Technology, I started working for Kalmar. I have been with IDENTEC SOLUTIONS for two years now, so (almost) all the time within this familiar customer space. After working for Navis nearly seven years, I worked for a little while in healthcare, but apparently, I'm drawn to the transport industry, in particular the automation part of it. I joined IDENTEC because I genuinely believe our products & services bring value to clients.

The sector in itself is very international but, above all, meaningful. It is a bit of a shame that the public eye sees transport & logistics when something goes wrong, like a container ship wedging into the side of the Suez Canal. Nowadays, global trade is under scrutiny, given all the political turmoil. But we know better – that shipping & ports make the world go round. With its solutions, IDENTEC is part of that puzzle.

■ ***When one enters your company's website, there's a big sign: "Waste: the killer of productivity. We call it MUDA." What is MUDA in detail?***

It is a Japanese term for wastefulness (無駄), be it time, money, effort, malfunctioning equipment, sub-optimal processes, injury, etc. MUDA is anything that doesn't smartly contribute to the outcome. We at IDENTEC are trying to reduce that waste to make things more efficient & safe – in a workable and pocket-friendly way. Whereas total elimination of waste isn't impossible, it would probably cost the earth. What we truly want is progress towards 'cleaner' operations, so to speak. Optimising processes would, therefore, be the overarching theme for our solutions. Today, to do that, a company needs a reliable digital footprint. So, it isn't a matter of not knowing to which port one is sailing, as the ancient wisdom would have it. We are, after all, heading for the Port of Efficiency & Safety. The thing is that you won't get there without data, that favourable wind of the 21st century. That may, naturally, mean different things for different companies. Take, for instance, the standard and 5G versions of IDENTEC's Reefer Runner. The latter, one of our latest developments, is tailored to suit somewhat smaller operations. Barge traffic is one sound example: a few reefers tightly stacked aboard a narrow vessel. Checking the container status in the middle of the night, in the rain, climbing up & down, noting things with a pen on paper – it sounds tedious, dangerous, and prone to errors. The 5G technology lets you automate this, including alerts if something goes wrong. The added benefit is that you can load more



reefers on a barge because now you don't need the extra space between them for all that manual humdrum. It is a clear gain, especially if you carry high-value goods in reefers, say pharmaceuticals or electronics. Reefer Runner 5G is essentially a plug & play, on-the-move solution – you stick the tag and get all the data via a digital platform. As such, it's also very mobile & flexible for an owner of a relatively small reefer fleet.

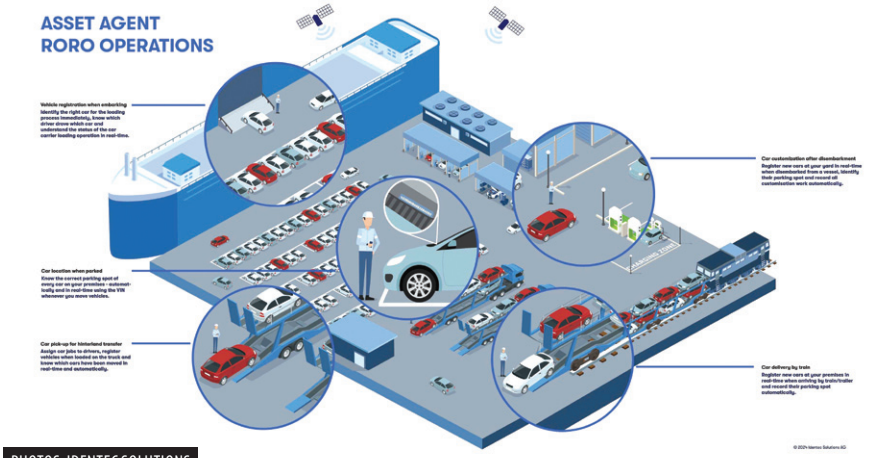
With the traditional version, suitable for operations counted in hundreds and thousands of reefers, there also comes the reader infrastructure in the yard, plus it typically runs on the customer server (on the premises or in the cloud). It has extended functionality, too, such as integration with a terminal operating system (TOS). This is especially handy when dealing with reefers: the system will automatically notify the terminal operator that a container arrived but wasn't plugged into the grid.

Terminal Tracker and Asset Agent provide other examples of operational gains. The latter, up to date used by the car & tyre manufacturing industries, has recently seen its spin-off into the port business (and vehicle depots). Take, for instance, Zeebrugge, the world's biggest seaport for handling new cars, some three million of them per year. These are driven to the yard according to the placement plan – and everybody trusts nothing will go wrong in this process; otherwise, you'll be looking for a needle in a haystack. Or, more precisely, a white roof in a sea of equally white roofs... Asset Agent Lite gives you a digital map of what's where. The extended version comes with a tracker so that you know exactly where a particular vehicle is placed.

Terminal Tracker does pretty much the same for manual handling container equipment. A neat and polished layout from a TOS is one thing; MUDA interference is another (whatever the reason behind it). One badly positioned box can ruin operations to the point that some containers just miss their ship (which also brings MUDA to the stowing arrangement, not to mention the shipper's import/export plans). So, having container-handling machinery that is traceable and knowing what it does and where can spare you the headache. Even if a box is misplaced, you know its location, which saves a lot of time if you need to scramble to get it onboard a carrier.

It also boosts safety. I remember one terminal that employed three people whose sole job was to physically find the missing containers. It wasn't only hard work (imagine sifting through a six-by-five-by-thirty stack...) but, most of all, a hazardous one, with all the heavy-duty gear operating on the quay and yard.

When talking with people out of the industry who nonetheless know what a twenty- or forty-foot container looks like, they are amazed that such big things get lost. But they do, amidst hundreds and thousands of their lookalikes. It is our job to either prevent that or find the right container slot before it's too late.



PHOTOS: IDENTEC SOLUTIONS

Whereas full automation of the container terminal business is thinkable, the current lay of the land is that manual/semi-automated facilities will need this type of tracking solutions to level up their productivity & safety, especially across yards. Importantly, our solution is also cyber-secure. It is this every-cloud-has-a-silver-lining benefit of serving customers who had the unfortunate opportunity to get a taste of the cyber underworld, so they know the importance of being on the safe side of things – and demand it from their vendors; that, and the fact that IDENTEC carries out internal cyber training. Nobody wants to be 'that' person who trusts the Internet-meme prince that oh-so-happens to have millions of dollars to spare, just a click from it... We adhere to the standards, have the certificates, and will, as soon as possible, adapt to the 11 December 2027 incoming EU Cyber Resilience Act Regulation.

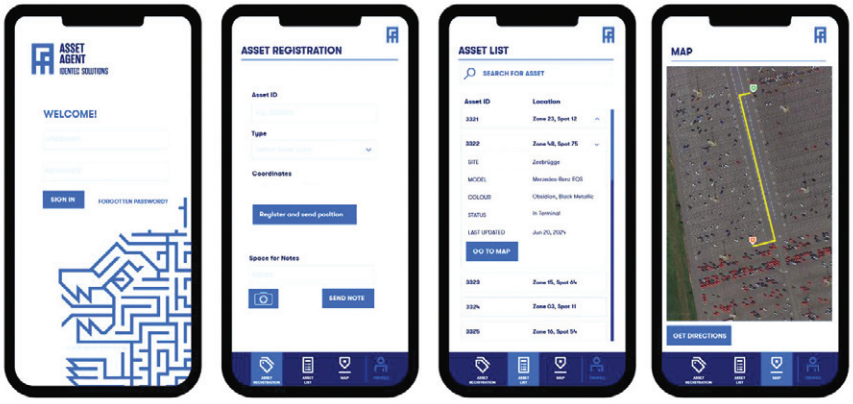
■ ***Your company has carried out projects all over the globe. How do you manage that, plus ensure your products fit different geographies and their sometimes more than demanding environments?***

IDENTEC – though a relatively small, Austria-headquartered organisation – is a company over which the sun never sets! We have offices in Norway, America, Australia, etc. As such, the 24/7 service comes naturally to us; as always, this or that branch is working.

That said, one just cannot underestimate the value of predictive maintenance. Avoiding machine breakdown in the first place is – or should be – the gold standard. Yet, to make that possible, one needs hardware data. Luckily, there are customers willing to share those data sets to get a better handle on the wear & tear of their equipment – and to act proactively to prevent failure. Apart from that, reliable data is key to improving one's operations. The more & better you know, the farther you can go, irrespective of whether your business is big or small.

As for IDENTECS' own products, they have continuously withheld the harshest conditions that can be only found on rigs, in the mines, or in ports – Northern and Southern Hemispheres included. We are also looking forward to the Antarctica itself proving the robustness of our reefer gear!

Naturally, IDENTEC doesn't only throw its products at customers – we're here for them in their digitalisation journey. A lot depends on whether we're dealing with a green- or a brownfield project. The former is easier, as you're building from scratch. There is no change in tools and processes, so to say, as everything is fresh and, as such, has to be learned. The latter is more tricky since the personnel are accustomed to the 'old way' of doing things and need to retrain their minds & bodies to the new equipment. Change management culture certainly plays a role here. There are places where the manager will just drop the new solution on the staff, while in other areas, there will be a dialogue so the workforce will know in advance what they'll have to embrace. That and pretty much everything else that falls in between this spectrum. That said, independently of where in the world your business is located, I believe that collaborating with the employees about what & how will change makes the transition smoother. Well-thought-out training material and user-friendly apps for sure make it easier, too.



But the buy-in can be quite fast – people do really appreciate that they don't have to run around the yard and check reefers anymore. That is even more beneficial to those terminals that don't find themselves under the ceaseless clockwork of time. Knowing that all is okay with the reefers when there's no one on the premises – so you don't need anybody on the spot – is a clear bonus.

■ ***If you could instantly change something in the industry, what would it be?***

I would like transport & logistics to have the courage to embrace new tech a little bit more. It is clear by now that the 'big automation bang' is behind us, and what the sector really needs are incremental upgrades, which all can do, not only the majors with state-like budgets and a throng of employees. The tree of technology is truly plentiful & democratic. ■

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EU's roadmap for ports navigating towards environmentally responsible future

SMALL IS GREEN

by Ewa Kochańska

The European Commission's Greening of European Sea Ports report addresses the environmental, logistical, and administrative challenges faced by ports across Europe. The study places particular emphasis on supporting smaller ports to improve their ecological footprint and thus progress towards long-term environmental sustainability for the maritime sector as a whole. By analysing real-world examples of successful green initiatives, the study provides practical guidance for implementing sustainable practices. It also highlights the importance of tailored strategies that consider the unique conditions and operational limitations of each port, ensuring more effective and adaptable solutions.

Large ports worldwide certainly enjoy considerably greater financial resources and risk-resilience compared to their smaller counterparts, which, along with better-established organisational structures, enables them to invest in more cutting-edge solutions and research & development projects. Their access to highly skilled professionals, considerable stakeholder influence, and ability to form strategic alliances position them as leaders in advancing sustainability initiatives.

In contrast, smaller ports often struggle with constrained budgets and a resulting cautious approach to risk, favouring instead proven, low-risk environmental solutions, which are usually less effective. Also, a lack of in-house expertise can make identifying and adopting sustainable practices challenging, necessitating costly external support and training.

Additionally, smaller ports often require assistance in securing funding and leveraging technical resources, as they may underutilise financial aid and have minimal involvement in research programmes. Collaborations with larger ports and industry partners can help bridge these gaps, allowing for knowledge sharing, creating alliances, and strengthening the ability to implement green initiatives effectively.

Balancing size and sustainability in regulated waters

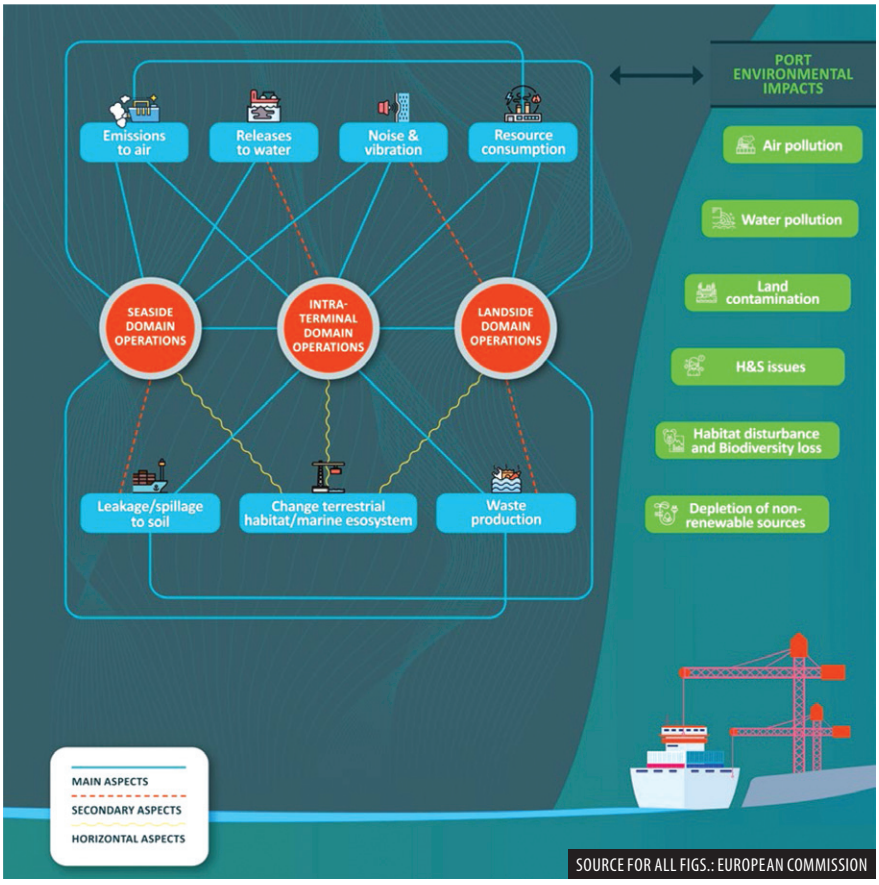
It is undeniable that ports are pivotal to achieving the EU's climate objectives, as they are central hubs for global trade and transport. The block's 2019 European Green Deal addresses this issue by aiming to achieve climate neutrality by the mid-century, with interim goals such as a 55% reduction in greenhouse gas emissions by 2030.

To support the Green Deal, the EU also came out with the Fit for 55 package, which targets key polluting sectors, including maritime. Specific regulations within this framework promote alternative fuel uptake, energy efficiency, and emission reduction in shipping. For example, the FuelEU Maritime and the Alternative Fuels Infrastructure Regulations incentivise sustainable practices, including the adoption of green energy technologies and zero-emission solutions.

However, the report also notes that the complexity of the EU environmental laws requires special attention to the legality of operations to ensure compliance and effective implementation. That is why legal advisors will play an increasingly critical role in helping port authorities through the regulatory maze, enabling them to align with sustainability targets.

Port operations encompass a wide range of activities, both on the water- and the landside, which have significant environmental implications. These include vessel handling, cargo and passenger services, and developing and maintaining port infrastructure. The current ecological situation and subsequent governmental directives have additionally expanded the role of ports with activities like renewable energy generation and logistics innovation. These operations are influenced by factors such as terminal scale, the types of cargo processed, and the availability of transport infrastructure connecting ports to hinterlands, which are related to geographical location, size, and traffic

Fig. 1. The cause-and-effect relation of environmental aspects and impacts related to port operations



SOURCE FOR ALL FIGS.: EUROPEAN COMMISSION

patterns. The environmental effects of these operations can, in turn, be classified into direct impacts, such as air emissions from bunkering, and indirect ones, like soil leakage and water pollution.

The report underscores four factors that affect the ability of the port to adopt environmentally sustainable measures: cargo and passenger handling capacities, financial capacity and administrative & management scale, geographical location, and multiplicity of activity.

Cargo and passenger handling capabilities are critical indicators, as the type and volume of traffic processed, including diverse freight and transit patterns, define the port's operational demands and potential environmental impacts.

The financial and administrative scale involves evaluating the port authority's decision-making framework, organisational structure, workforce expertise, and training programmes; investment capabilities in infrastructure modernisation, technological advancements, and sustainability projects are also vital. The management model adds another layer of complexity to how ports balance environmental goals with operational efficiency and governance structures.

Geographic positioning significantly affects a port's market reach and ability to integrate into transport networks; proximity to land and water routes enables efficient intermodal transport, reducing delays and improving logistics efficiency. Ports situated near industrial zones or with access to renewable energy resources can amplify their role in fostering economic and sustainable development through resource optimisation, energy production, and manufacturing synergies.

The multiplicity of activities can also be leveraged in ports to enhance operational and environmental performance. By ensuring seamless logistics, ports minimise downtime and handle diverse cargo types more efficiently. The integration of renewable energy infrastructure, such as wind and solar facilities, alongside industrial activities within or near the port reinforces their capacity for sustainable growth while promoting energy transition and environmental responsibility.

Analysing these factors provides actionable insights into how each port can address sustainability challenges, at the same time adapting to the dynamic maritime and logistics landscape. Strategic considerations, like land utilisation, throughput capabilities, and stakeholder collaboration determine a port's ability to implement green initiatives effectively. These assessments guide investment priorities and foster partnerships with stakeholders, including shipping lines, investors, and policymakers, to strengthen the port's competitive edge and environmental resilience.

Transferability of practices

Identifying and sharing best practices globally enhances the maritime sector's transition towards sustainability. The results of case studies analysed for the *Greening of European Sea Ports* report allowed for the development of a taxonomy of best green practices, which can serve as a valuable resource in enabling the successful adoption of sustainable practices across ports of varying sizes and capacities.

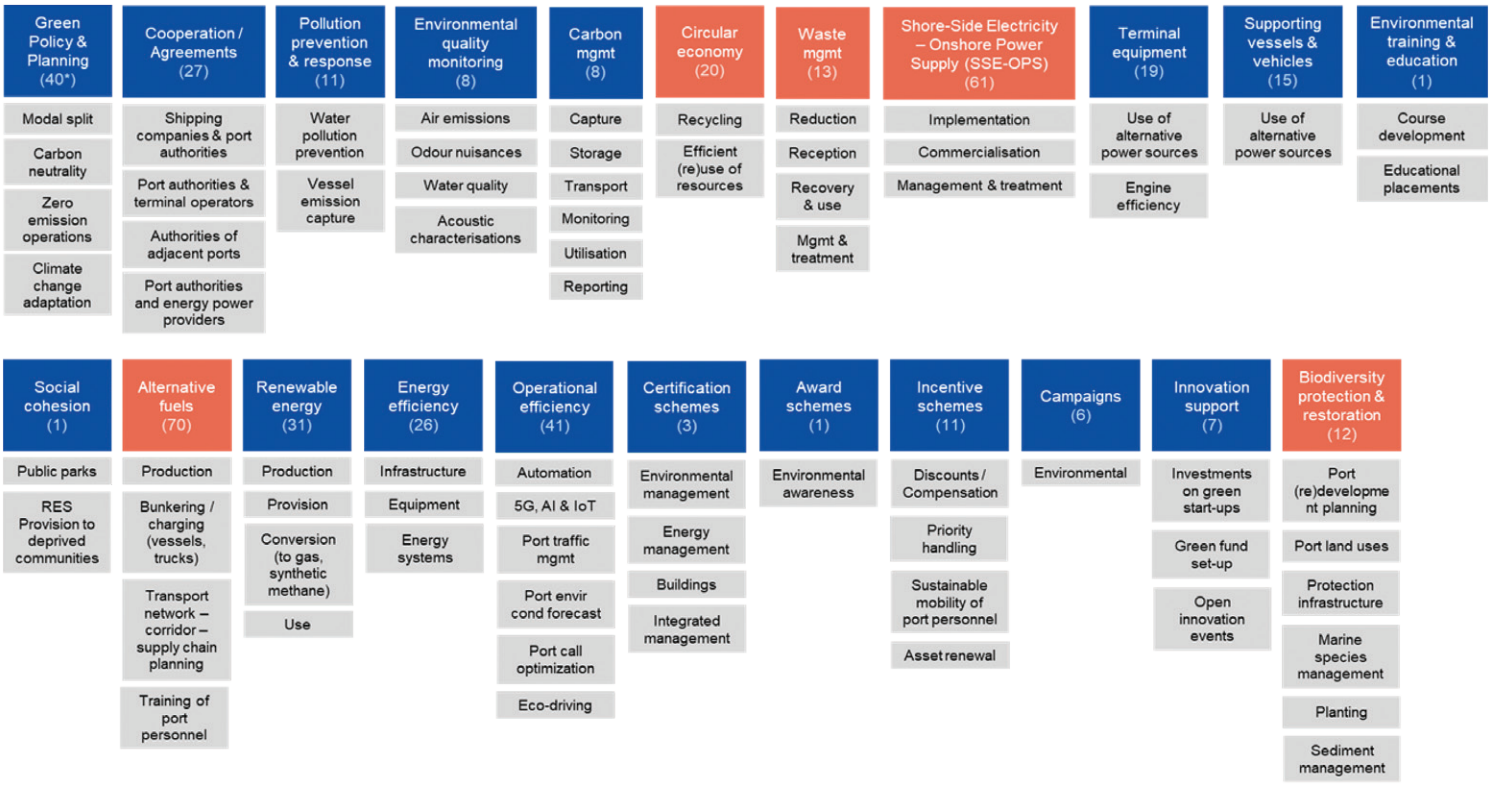
However, best practices can be adopted as long as their transferability (i.e., ability to modify initiatives developed in larger, well-resourced ports to smaller ones) potential is first carefully examined. Key aspects of transferability include addressing the complexity and scale of green initiatives, which may require simplified implementation strategies, custom-made formulas, and capacity-building efforts for smaller seaports to align with their resources and capabilities.

Technology transfer is another significant component, emphasising the need to adapt environmentally friendly technologies to suit the operational and technical frameworks of smaller harbours. Ensuring compatibility and relevance of these technologies enhances their applicability and success in less complex settings.

Capacity-building programmes further support the transferability process by equipping personnel with the knowledge and skills necessary to implement and sustain green practices effectively. These efforts can involve training, knowledge-sharing collaborations, and partnerships with industry experts to bridge the expertise gap that smaller ports often face.

Finally, financial resources are fundamental to enabling ports to adopt and maintain sustainable practices, and for smaller organisations, financial constraints can present insurmountable roadblocks. Addressing these challenges

Fig. 2. Good green practices taxonomy



involves exploring diverse funding options, such as government grants, green bonds, public-private partnerships, and technical assistance programmes.

Assessing these components of transferability ensures that smaller ports can effectively incorporate green initiatives, considering the challenges they face due to limited resources, capacities, and lower risk-resilience. Drawing lessons from the experiences of larger entities allows fellow professionals managing smaller seaports to navigate challenges more effectively and focus on practical, actionable strategies. This holistic approach facilitates the equal distribution of sustainable practices across the port sector, promoting environmental responsibility on a broader scale.

Follow the green brick road

The roadmap put forward by the report is a strategic guide designed to help ports adopt eco-friendly practices, ensuring their operations remain sustainable while meeting regulations and supporting broader environmental goals. The roadmap's main areas of intervention include policy and target setting, measure assessment and prioritisation, and monitoring and reporting.

Policy and target setting for ports involve two key steps: understanding the legislative context and fostering motivation among stakeholders. Compliance with legal frameworks, including EU directives, national laws, and local regulations, is essential for ensuring adherence to existing rules and preparing for future ones. Ports must analyse relevant legislation, sometimes with legal experts, to mitigate risks. The complexity of regulatory compliance is exemplified in dredging projects, where ports must assess environmental impacts, secure permits, and manage waste disposal according to legal requirements; addressing legal considerations early is crucial to the success of sustainability-focused initiatives.

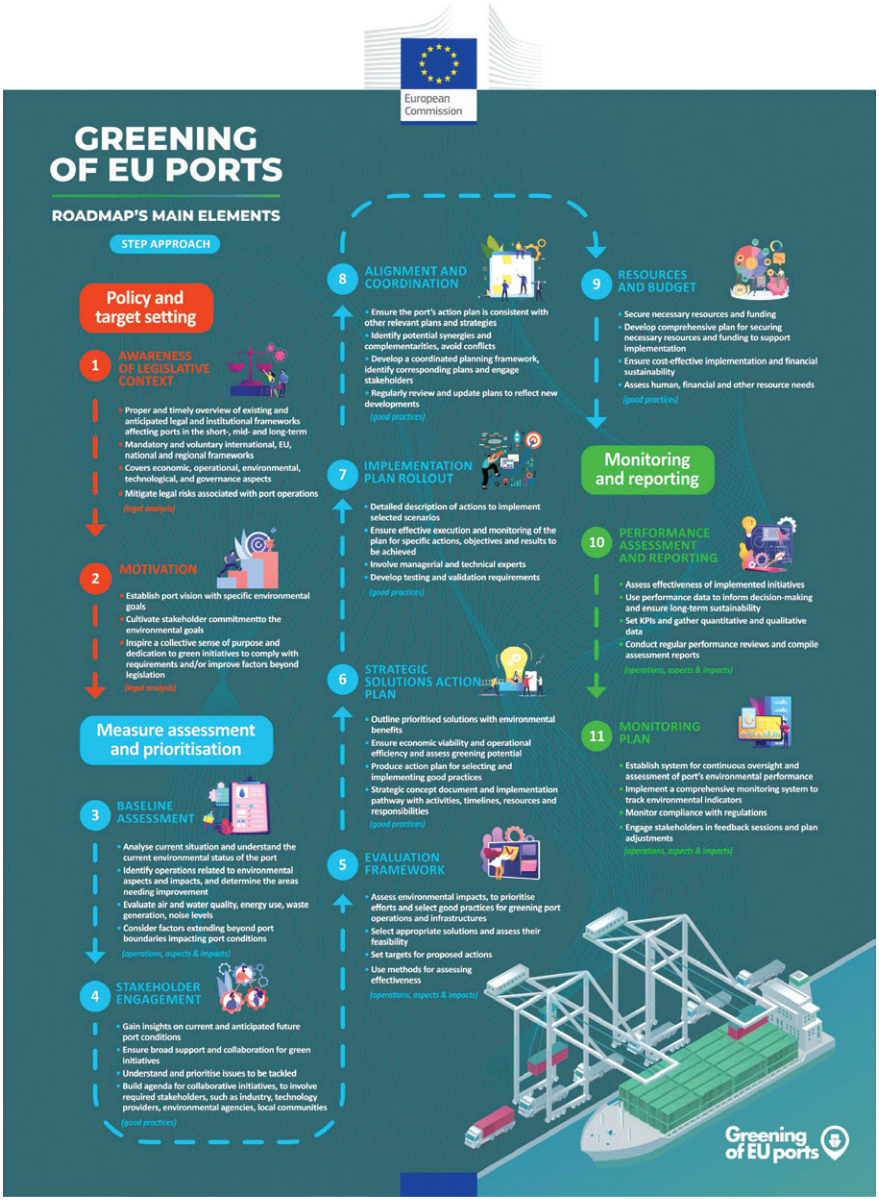
Motivating stakeholders is equally important in making green steps, requiring a clear vision, defined goals, and active engagement. Communicating the benefits of sustainable practices through preliminary assessments and structured discussions helps align stakeholders, from employees to regulatory bodies. Engagement strategies range from formal committees for large projects to informal meetings for smaller ones. For instance, in a solar panel installation, assessing energy use, setting reduction targets, and maintaining stakeholder involvement through updates and feedback ensure commitment and long-term success.

Measuring assessment and prioritisation involve seven key steps: baseline assessment, stakeholder engagement, alignment and coordination, implementation plan rollout, strategic solutions action plan, evaluation framework, and resource and budget. A baseline assessment establishes a port's current environmental status by analysing factors such as air quality, energy consumption, and waste generation. The findings help identify areas for improvement, forming the basis for future sustainability efforts.

Engaging stakeholders ensures that diverse perspectives are considered and fosters collective stewardship of green initiatives. This process involves consulting industry representatives, environmental groups, and local communities through workshops or surveys, leading to the development of an engagement plan that outlines goals, participants, and methods of interaction.

Alignment and coordination ensure the port's action plan complements other relevant strategies while optimising resources and avoiding conflicts. This involves identifying related plans, engaging stakeholders to ensure consistency,

Fig. 3. The roadmap for greening the EU seaports



and regularly updating the framework to incorporate new developments. The primary outcome is a harmonised planning framework with coordinated actions (particularly at local and regional levels).

The strategic solutions action plan aims to implement prioritised green initiatives that balance environmental sustainability, economic viability, and operational effectiveness. Depending on project size, plans may be detailed or simplified, outlining chosen practices, execution steps, timelines, resource needs, and expected impacts. The report encourages seaports to explore innovative solutions beyond conventional methods and seek alternative funding models, such as partnerships with tech start-ups or public-private collaborations.

The implementation plan rollout focuses on translating the action plan into concrete steps for effective execution. It involves engaging managerial and technical experts to oversee the process, with detailed implementation steps and progress monitoring for large projects, while smaller initiatives can adopt a simpler approach emphasising key actions and quick results.

The evaluation framework assesses potential environmental solutions by analysing feasibility, cost-effectiveness, and overall impact. It builds on the baseline assessment and stakeholder input, using pre-feasibility studies and cost-benefit analyses to guide decision-making. Preliminary feasibility studies, including cost-benefit evaluations and consultations with relevant parties, are essential in identifying the most promising approaches.

The last step, resource and budget, requires evaluating material, financial, and human resource needs while establishing viable funding mechanisms. A well-structured financial strategy should explore multiple funding avenues, leverage specific provisions in port concession agreements, or engage third-party service providers who help secure the necessary funds.

Assessing performance and reporting are essential for measuring the success of sustainability initiatives. This process involves establishing KPIs and collecting both quantitative and qualitative data to evaluate outcomes. Metrics such as energy consumption, waste reduction, levels of different emissions, and cost savings provide concrete evidence of impact, while stakeholder input – gathered through surveys, workshops, and consultations – adds valuable insights. Evaluations should consider economic, social, environmental, and technological factors to ensure a holistic approach to port greening. Regular reviews and detailed assessment reports help track progress, outlining the effectiveness of initiatives and refining strategies where needed. Further, a well-structured monitoring system ensures ongoing evaluation and adaptability of sustainability efforts. Continuous tracking through performance dashboards, periodic assessments, and stakeholder consultations allows ports to refine their strategies in response to evolving needs and circumstances. Establishing a dedicated monitoring framework supports data-driven decision-making, ensuring transparency and accountability in environmental initiatives.

The greening climate

The maritime sector is facing challenges pertaining to achieving environmental neutrality and thriving within its ecological ecosystem. The *Greening of European Sea Ports* report points out that the ambitious sustainability goals put forward by global communities can only be achieved in a climate of cooperation and resource sharing. This way, seaports, big and small, can diminish their negative impact on the environment while continuing to serve as vital economic drivers. ■

A FRESH REVOLUTION AT SEA

by Oren Saar, *CEO, Agwa*

As the maritime industry undergoes a profound transformation – driven by digitalisation, automation, and decarbonisation – the health and well-being of the 1.9 million mariners powering global trade often remain an overlooked priority. The reality is that poor diet and nutrition at sea present a growing challenge, affecting not only individual health but also vessel safety and operational efficiency.

Despite their indispensable role, seafarers continue to face alarming health challenges, largely driven by poor diet and nutrition. According to the 2024 edition of the Re:fresh Global Seafarer Wellbeing Report, 70% of the people working at sea are classified as overweight or obese, a direct consequence of diets high in processed and preserved foods. Studies also indicate that long-term consumption of low-quality food at sea is linked to an increased risk of cardiovascular disease and metabolic syndrome.

Beyond the physical toll, inadequate nutrition can cause impaired cognitive function while exacerbating mental health struggles. In an industry already facing a projected shortage of over 60 thousand officers by 2028, the question is no longer whether crew nutrition needs to change but how quickly the industry is willing to embrace solutions that directly enhance crew health, morale, and operational resilience.

As younger generations bring new expectations to the workforce, the industry must rethink its approach to crew welfare. This is where artificial intelligence (AI)-powered onboard agriculture is poised to be a game-changer.

The Virtual Agronomist

Traditionally, ship provisioning has been limited by infrequent port resupplies, long voyages, supply chain disruptions, and storage limitations, leading to a reliance on frozen, dehydrated, and canned products. Even when fresh produce is stocked, it often perishes within days.

Advancements in controlled-environment agriculture now make it possible for vessels to autonomously grow fresh produce on board. AI-powered hydroponic systems, such as those developed by Agwa, deploy a Virtual Agronomist, continuously monitoring plant growth through three key data streams: image analysis, sensory data, and consumer behaviour insights.

These intelligent systems analyse environmental conditions in real-time, adjusting variables, such as light, humidity, and nutrients, to optimise growth and ensure the highest-quality yield, regardless of a vessel's location or climate.

This 'plug & play' technology requires only water, electricity, and Wi-Fi to function, and the integrated app provides real-time updates on vegetable growth, alerts for optimal harvesting times, and the ability to customise plant selections. This means that crew members with no agricultural experience can easily operate the system.

Owners-operators using Agwa's technology – including Maersk, Synergy Marine, Eastern Pacific Shipping, Capital Shipping, Anglo Eastern, and others – are already cultivating leafy greens, herbs, nutrient-rich greens, and bulbs year-round. Additional crops, such as tomatoes, peppers, strawberries, and sprouts, are under development. This variety ensures a more balanced diet for seafarers, catering to different culinary preferences and dietary needs while providing essential vitamins and minerals.

This shift to self-sustaining onboard food production means that vessels can harvest fresh vegetables on demand, reducing spoilage, food waste, and logistical complexities. More importantly, it provides seafarers with consistent access to high-quality, nutrient-rich vegetable supply, improving both health and morale.

A sound mind in a sound body

The link between nutrition, cognitive function, and safety is well-documented.


PHOTOS: AGWA

Poor diets contribute to fatigue, cognitive decline, and reduced alertness, increasing the risk of human error, which is one of the primary causes of maritime accidents. Mental health challenges among seafarers are also rising, with stress, anxiety, and depression reducing job satisfaction and exacerbating retention issues. At the same time, higher incidences of chronic disease related to inadequate nutrition are also likely to result in more medical emergencies at sea.

Conversely, research into seafarers' dietary habits found that 98.8% of crew members believe a healthy diet is essential for well-being, highlighting the widespread demand for fresh, nutrient-rich foods. Evidence shows that access to balanced meals enhances concentration, reaction times, and overall performance, making vessels safer and more efficient.

Beyond its nutritional value, onboard agriculture introduces a vital connection to nature in an otherwise industrial ship environment, providing significant psychological and social benefits. Engaging with plants through gardening, harvesting, and preparing fresh meals fosters teamwork, strengthens community bonds, and enhances morale.

Meanwhile, the 'biophilic' effect of having greenery aboard reduces stress, improves mental well-being, and instils a sense of accomplishment. The autonomy gained from growing and consuming fresh produce counteracts feelings of isolation, offering crew members greater control over their diet and health. These benefits contribute to a more rewarding onboard experience, helping to attract and retain talent.

Closed-loop & hyper-local

Currently, ship operators' budgets are spent inefficiently on port-supplied vegetables, much of which is wasted due to spoilage. Onboard food production allows ships to spend the same while receiving more – ensuring a reliable, high-quality vegetable supply year-round. By addressing limitations in the maritime food supply chain, AI-powered farming presents a practical, scalable, and financially viable solution.

Onboard vegetable production also supports industry-wide decarbonisation efforts. By growing food at the point of consumption, onboard farming reduces emissions from food transportation, storage, and packaging disposal, eliminates packaging waste associated with traditional provisions, minimises food waste as vegetables are harvested fresh when needed, and strengthens food security, reducing the impact of global supply chain disruptions.

For an industry increasingly under the ESG microscope, adopting a closed-loop, hyper-local food production model aligns with global sustainability commitments while supporting better long-term planning for ship operators.

The standard

The maritime sector can no longer afford to overlook the fundamental needs of its workforce. AI-powered onboard farming is not a futuristic concept – it is a real, scalable solution that is already transforming crew welfare and sustainability.

While the industry has invested billions in automation, digitalisation, and fuel efficiency, the people who keep ships running must remain on the front burner. By ensuring access to fresh, healthy food at sea, shipping can foster healthier, happier, and more resilient crews while addressing retention challenges and supporting maritime decarbonisation.

Food security and crew well-being must become strategic priorities as the industry navigates economic pressures and ESG commitments. Onboard growing systems like Agwa's offer a practical, cost-effective solution that bridges the gap between life at sea and life on land. Fresh food should not be a luxury – it should be the standard. The future of shipping isn't just about efficiency; it's about people.

It is time to set a new benchmark for crew nutrition, resilience, and well-being – and AI agronomists are the answer. ■

agwa

Agwa is spearheading a fresh revolution at sea with an advanced, fully autonomous system that empowers vessel crews to grow fresh, chemical-free vegetables year-round. Using state-of-the-art AI technology, Agwa ensures a reliable supply of nutritious produce, no matter the route, port restrictions, or weather conditions. Visit agwafarm.com to harvest more.

RESILIENT, EFFICIENT – AND CARING

by Fitzwilliam Scott

The maritime industry, long known for its demanding work environment and physical isolation, is undergoing a significant cultural shift. Traditionally, the focus within this sector has been on ensuring physical health and safety to meet the arduous demands of life at sea. However, in recent years, a growing recognition of the psychological pressures faced by seafarers has sparked a change in priorities, driven by an evolving understanding of the critical role mental health plays in the overall well-being and performance of maritime professionals.

As the industry embraces this new perspective and begins to actively address the unique mental health challenges posed by prolonged isolation, high-stress conditions, and the demanding nature of life at sea, VIKAND, a global leader in maritime healthcare and well-being solutions, has unveiled a novel wellness data-collection tool, enabling seafarers to share their mental health concerns anonymously. This innovation, developed in partnership with the Danish tech company Scoutbase, is transforming how ship operators address seafarers' well-being, fostering openness and proactive care in an industry that relies heavily on its people.

Ronald Spithout, Managing Director of OneHealth by VIKAND, recently spoke about the new tool at the International Maritime Human Factors Symposium (IMFHS) in London, stating that it underlined the concept of 'Crew Asset Management' – treating crew members as a ship's most valuable resource. He explained how real-time data gathering can revolutionise the maritime industry's approach to mental health, ensuring that seafarers receive the care and support they deserve. "The shift to digitalisation in maritime has massively impacted how we can support our seafarers. By capturing and monitoring wellness and health information in real-time, we can provide seafarers with medical advice and support unlike ever before. This is a huge step forward!" Spithout underscored.

How it works

Scoutbase's tool enables seafarers to provide anonymous feedback via a chatbot interface. Every 48 hours, it asks crew members a simple question from a rotating bank, such as "How are you sleeping lately?" or "What's the most stressful part of your job?" Responses are collected anonymously and analysed using artificial intelligence (AI), which assigns each response a sentiment score – positive, neutral, negative, or critical; the last of these triggers alerts, allowing for immediate action, including voluntary calls with mental health professionals.

The solution's simplicity has been key to its success, and with engagement rates surpassing 80%, Scoutbase has proven to be an effective method for encouraging seafarers to open up about their mental health. The system can engage with seafarers in 200 languages, and this has also been helping them to talk about what is really going on in their life on board. The user-friendly design not only provides a platform for self-expression but also generates actionable insights for ship operators.

From feedback to action

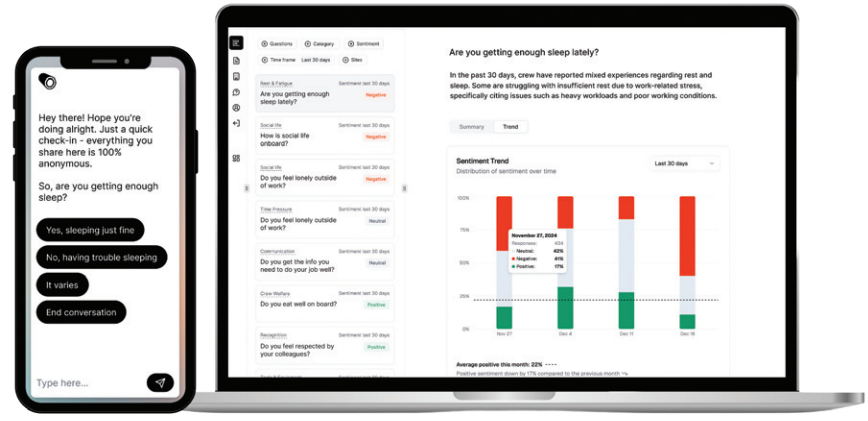
Scoutbase's data collection extends far beyond simply identifying issues – it transforms feedback into opportunities for improvement. For instance, on one ship, the collected input revealed that crew mattresses hadn't been updated in a decade. This insight led to a fleet-wide bedding upgrade, directly improving crew wellness and job satisfaction.

The tool's primary aim isn't to act as a digital complaint box but to empower ship operators with the data needed to make informed, proactive decisions. The insights generated can uncover systemic issues (such as workplace bullying, fatigue, or outdated safety protocols), and by addressing these challenges head-on, ship operators can enhance safety, productivity, and crew morale, ultimately supporting better business outcomes.

Shining a light

One of the biggest challenges facing the maritime industry is crew retention. Attracting new talent and retaining experienced seafarers requires creating a safe, satisfying, and supportive work environment so that tools like this can make seafarers feel valued and listened to. "Understanding how a crew is doing and what they need to succeed is the first step to creating a culture of proactive change," explained Yassin Askar, Co-founder of Scoutbase. "One client told us it's like shining a light on challenges that lurk in the shadows. To take those insights away now would be like going back to the dark ages."

By offering a platform for seafarers to express their concerns anonymously, Scoutbase acts as a pressure valve, allowing long-standing issues to surface in a constructive manner. For many ship operators,



PHOTOS: SCOUTBASE

this represents a significant cultural shift towards prioritising the human element of their operations.

Someone is listening

VIKAND has integrated Scoutbase's safety and well-being platform into its healthcare solutions, creating a seamless system for collecting, analysing, and acting on crew feedback. This integration allows ship operators to address health, safety, and operational concerns more effectively than ever before.

One of the main features is the possibility for crew members to provide feedback anonymously without fear of retribution, fostering genuine openness. Data is analysed instantly, enabling proactive decision-making by shipping operators, who can then tailor feedback and advice to the needs of the individual seafarer. For instance, a crew member may be struggling with a mental health issue, flagged by their responses, and so they can be 'nudged' to contact a VIKAND psychologist by clicking a button. Sentiment analysis and predictive modelling also identify trends and critical issues. "Our experience is that more people are opening up to AI rather than a human," observed Ronald Spithout. "The whole idea of this tool is that it makes seafarers feel like someone is listening."

Number one priority

Traditionally, decision-making in the maritime industry has been reactive. Issues were often addressed only after they had escalated, leading to reduced crew morale, safety risks, and financial losses. The integration of Scoutbase's technology into VIKAND's healthcare solutions marks a shift towards proactive care. Operators can now identify and address challenges before they become major problems, creating a safer and more supportive work environment.

This shift is particularly important as the industry adapts to evolving workforce expectations. Younger generations entering the maritime field prioritise mental health and work-life balance, making technology such as that from Scoutbase essential for attracting and retaining talent.

The well-being of seafarers is more than just a moral obligation – it is vital for business. Fatigue, dissatisfaction, and mental health struggles can lead to accidents, injuries, and high turnover rates, all of which carry significant costs for ship operators. By addressing these issues proactively, VIKAND and Scoutbase are not only improving the lives of seafarers but also ensuring the long-term sustainability of the maritime industry. Yassin underlined, "Looking after seafarers must be our number one priority. With tools such as ours, we can give them a stronger voice, help operators make informed decisions, and create a brighter future for commercial shipping."

Seafarers – empowered

As the maritime industry continues to embrace digitalisation, tools like VIKAND's wellness data-collection platform will play an increasingly vital role in shaping its future. By empowering seafarers to share their concerns and enabling operators to act on real-time insights, this innovative solution is setting a new standard for mental health and well-being in the maritime sector.

Ultimately, the success of any ship depends on its crew, so by prioritising their mental health and addressing their needs proactively, VIKAND and Scoutbase are ensuring that the maritime industry remains resilient, efficient – and caring. ■

VIKAND provides proactive total healthcare solutions for the shipping, cruise, yachting, and offshore industries. Crew members and guests alike trust VIKAND to provide expert medical care, telemedicine, risk mitigation, and other valuable health services, and the world's leading maritime companies rely on us to protect their most important asset at sea – people. Visit vikand.com to learn more.

Scoutbase We support organisations in creating better and safer workplaces by helping to identify what makes work difficult for people. Scoutbase collects feedback, automatically and continuously, directly from seafarers about their work and life at sea and displays this in real time. Our interdisciplinary team combines safety science, design thinking, and technology to help improve work and life at sea. Discover more at scoutbase.com.

A new maritime platform redefines connectivity

ALL GOOD IN THE HOOD

by Alexa Ivy

The Hood Platform, a novel digital hub for people in the maritime and energy sectors, made its debut at Crew Connect in Manila in November 2024, winning acclaim. More than just a typical social platform, it's a dynamic space for online interaction that caters to the unique needs of people within the maritime industry. Creating social network communities and redefining professional advancement, The Hood combines career development with learning and well-being features. The app's launch marks a significant step in providing a secure space for seafarer connectivity, professional evolution, and, equally important – their mental health.

The Hood's Limassol-based Founder and Managing Director, Josephine Le, envisioned the app after years of working closely alongside maritime professionals. Her goal was simple: to bridge the social gap she noticed amongst professionals within the industry and to make it much easier for them to access the necessary information that once seemed impossible. By using The Hood, individuals can communicate more effectively, wherever they are, from one user-friendly interface.

"When I first started in the industry, it was evident that people wanted to connect but weren't sure where to begin," says Le. "I wanted to create a platform that not only brings people together but makes it much easier for them to find relevant information while also feeling seen and heard, creating meaningful relationships for both work and more personal life."

She went on to explain that the idea stemmed from observing how many people struggled with finding the right balance between professional networking and genuine connection. "It is not just about building a network; it's about creating a community where people feel supported, valued, and empowered to grow, not just in their careers, but as individuals too."

The creative focus to deliver something impactful came from Le's commitment to understanding the unique challenges faced by the maritime community. Through her deep understanding of the needs of seafarers, recruiters, and other industry professionals, she was able to ensure that The Hood would meet every one of its users' requirements.

To support & connect

The Hood alleviates some challenges that are commonly seen within the maritime industry. Crews often face long periods of isolation, limited access to resources, and a lack of opportunities to engage with others who understand their experiences. By providing tailored features – such as an easy-to-navigate introduction tool, time-zone adaptability, and job application tools – The Hood helps to bridge these gaps in ways that typical platforms don't.

Users can build profiles that display their expertise and professional experience, apply for new jobs easily, and connect with old colleagues, family and friends. They can build personal and professional profiles, enabling them to keep different interactions separate. Beyond networking, The Hood also includes other features, like the We Care Centre, providing access to mental health support. Its range of resources and e-learning tools means users can enhance their professional skills. In February 2025, a new Career Hub was added to the platform, marking another important milestone. This feature helps to navigate professional growth and stay up to date with the latest career opportunities. From seasoned marine engineers and ship managers to cadets first starting their seafaring journeys, The Hood is there to support and connect them, no matter their role or level of experience.

What sets The Hood apart from mainstream platforms is its commitment to creating an online environment specifically dedicated to the maritime sector. Features have been carefully curated to meet the needs of a global and culturally diverse workforce that operates across multiple time zones, often under challenging and varying circumstances. With ongoing safety concerns, connectivity issues, and a general lack of mental health support for crews in particular, the need to feel connected is more crucial now than ever before.

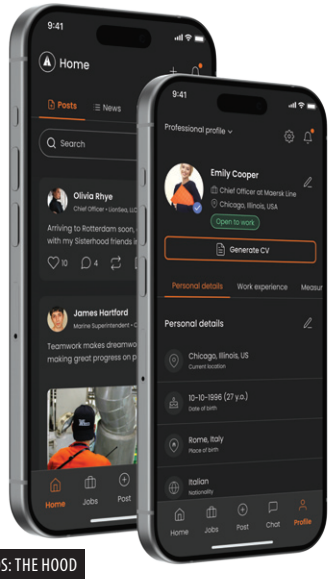
Users can create groups dedicated to niche topics and professions, including maritime regulations, sustainability, or advice on a particular field, encouraging conversations and creating a plethora of sub-communities. "This is more than just a tool to help individuals find a job or post something new to their status," Le underscores. "It is a space where people can truly connect with one another on their own terms, wherever they are in the world, no matter their role, experience, or connection to the industry."

Whilst the launch of The Hood is already generating excitement across the board, it's only an inkling of what is to come. The platform is designed with evolution in mind, ensuring that it will meet the progressing needs of its global users. These include enhanced connectivity, seamless integration, and a collective sense of resilience against possible industry disruptions.

What is more, it's already making waves in attracting young talent into the maritime sector. By making the industry more appealing and inclusive, the platform resonates with the values and aspirations of the next generation. With its innovative approach, it's addressing the need to modernise and revitalise the sector through positive change. The Hood is creating communities and transforming how people engage in maritime.

One large family

As the industry braces for old & new challenges in 2025 and beyond, The Hood is set to play an essential role in shaping its future. Through innovation, the platform creates a space where maritime professionals can access the support, resources, and connections needed to thrive in a digital world. The long hours at sea, often spent away from loved ones, have highlighted the need for stronger personal connections and



PHOTOS: THE HOOD

a growing awareness of the importance of creating environments that support and nurture mental health and overall well-being.

The Hood has introduced monthly giveaways to reward its members, which highlights the platform's focus on building community and offering value to users. This initiative kicked off with the Christmas Giveaway in December last year, where members could enter to win a one-night stay for two, bed-and-breakfast included, at the renowned Seda Hotel in Manila. Prizes are earned through engagement with the platform, encouraging participation and connection. Regular giveaways are just one way that The Hood fosters a sense of excitement and community, with more stimulating rewards set to follow.

Drawing from endearing familial terms such as 'brotherhood' and 'motherhood,' the platform creates a sense of unity and belonging that goes beyond typical networking. "This is more than just a platform," Le explains, "it's a community that is designed to connect people in an environment where they feel supported and understood. Much like being part of one large family." ■

THE HOOD

The Hood Platform, masterminded by Josephine Le, is an innovative digital hub for the maritime and energy sectors, providing a community-driven social network tailored to the unique needs of industry professionals. Designed to foster connection, career growth, and support, The Hood combines professional networking features with sector-specific tools. You can download it from the App Store or Google Play.

Developing and testing a robotic application for handling container railway wagon pins

PIN UP & DOWN

by Johann Bergmann, *Team Leader Port Technologies, Fraunhofer CML,*
Dr. Holger Müller, *Systems Engineer, HHLA Sky,*
and Britta Sommer, *Project Manager, HHLA Container Terminal Tollerort*

Modern container terminals are complex logistics facilities connecting the flow of goods by water, road, and rail. Although the automation of cargo handling and transport processes is progressing, numerous supporting activities are still operated manually. One of these activities is the pin adjustment on container railway wagons. Even in container terminals with a high level of automation, the handling of railway pins is performed by terminal employees. This article addresses an innovative automation approach for handling rail wagon pins by mobile robots.

The manually conducted process of pin handling has the potential for automation. Pin handling is a repeating activity with an unambiguous output. Due to container handling activities, the working environment is of high risk for terminal staff, whose skills could be better allocated to other operations. In addition, manual pin handling makes the automation of railway cranes more difficult because an automated crane mustn't operate in a manned area. Finally, depending on the terminal size and modal split, the terminal operator must keep a certain number of employees for manual pin handling, taking into consideration their (planned and unplanned) absence.

HHLA has recognized that the automation of pin handling can bring about an increase in safety plus save operational costs. The potential in automation would also lead to the expansion of rail handling, an increase in competitiveness and, in the long term, securing jobs.

No solution? No problem!

Since the market does not offer commercial products for automated pin handling, HHLA has decided to invest in the corresponding development work. In cooperation with the organization for applied research in the maritime sector Fraunhofer Center for Maritime Logistics and Services CML, the Pin-Handling-mR research project has been launched in October 2022. The German Federal Ministry for Digital and Transport supports the initiative through the IHATEC (Innovative Port Technologies) programme. Besides Fraunhofer CML, the project stakeholders include HHLA Sky, Metrans, and Hamburg Port Consulting.

The project's objective is the conception, development, and testing of a robotic-based solution for pin handling. In this constellation, Fraunhofer CML is contributing with expertise in automation and mobile robotics. HHLA Sky, which operates an integrated control center (ICC) for drones, is responsible for its adaptation to the control of the ground-based pin-handling robots. HHLA, with its extensive expertise in terminal operations, provides the field test environment at its Container Terminal Tollerort (CTT) in the Port of Hamburg.

The software…

The technical approach is composed of two core elements: the ICC and the mobile robots. The former, originally used for commercial drone operations, has been extended to control ground-based vehicles. This extension required thorough consideration of the significant differences between flying drones and vehicles driving down on the ground. For example, the distinct skill sets, expertise, and certifications needed for operators, as well as the adherence to stringent procedures and regulations, had to be considered.

In the process of extending the ICC, an interface to the terminal operating system (TOS) was defined specifically for pin handling. The backend software pulls relevant data over this interface, such as container train schedules and loading schemes. Based on this data, the ICC generates a set of waypoints for the location of each pin, which must be adjusted. These are compiled into a mission, also including the target positions of all the pins. A terminal employee selects such a pin-handling mission by choosing a container train and the robot. They approve the start of the mission and monitor the progress remotely. In the case of unexpected events – and after the adjustment of all pins on the respective train – the ICC notifies the terminal employee for further actions. During the mission, the ICC displays relevant information, such as robot and mission status.

… and hardware

The concept of the mobile robot is based on the composition of 'off-the-shelf' hardware components enabling the realization of functions defined at the project's beginning. The key requirements for the robot were autonomous driving and safe collision avoidance, detection of specified pin types & their manipulation, and low-latency communication with the ICC.

For that, a wheeled platform has been equipped with a set of sensors for safe autonomous driving. A 32-beam LiDAR reliably detects obstacles so the robot can stop if necessary. In combination with a stereo camera, it supports navigation on

PHOTO: HHLA/THIES RÄTZKE

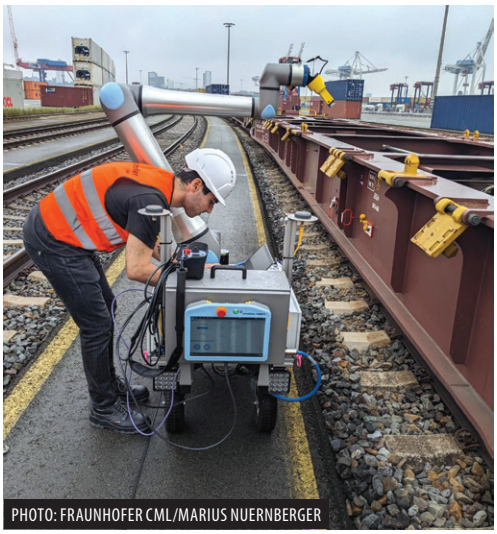


PHOTO: FRAUNHOFER CML/MARIUS NUERNBERGER

a narrow path between the train tracks. For pin adjustment, a robot arm with a payload of up to 20 kilograms and an outreach of 1.75 metres has been selected.

To fulfill HHLA's safety expectations, the robot arm is a so-called 'cobot:' if a defined resistance is encountered when operating the arm, the movement stops. This safety feature is crucial since the robot potentially shares its working area with terminal staff.

The actual pin manipulation is carried out magnetically by connecting a magnet gripper to the robot's arm. A second camera is mounted on the arm, which not only detects the pin, identifying its type and status (flipped up/down) but, in addition, determines the exact distance to the pin. This is crucial for calculating the final manipulation trajectory, such that the magnetic gripper lands precisely on the pin. For pin detection, a deep learning model has been trained to take into consideration different weather and light conditions.

From lab to ground

Once the ICC and robot concepts were designed, the individual functions were developed by HHLA Sky and Fraunhofer CML. Function tests were conducted parallel with the development activities, and correction measures could be implemented accordingly.

For testing the individual robot functions, a mock-up of a container-carrying wagon with real pins was built in the laboratory at Fraunhofer CML. The pin detection and pin manipulation have been extensively tested and tuned. This approach enabled commencing field tests with a functionally mature robot system. The interruptions to daily operations remained insignificant.

After all foreseen ICC and robot functions have been developed and individually tested, they have been integrated. In the ongoing project phase, the partners are testing the mobile robot at CTT, focusing on the realization of integrated missions and observing the robot's behavior under demanding weather conditions. Occasionally, minor faults occur, but they are being resolved during operation.

As the project is in its final stage, the partners can summarize some findings. The existing ICC for drones was successfully adapted without re-inventing the wheel and designing a completely new robot control center. The transition of container train loading schemes from TOS to pin-related waypoints, with significant accuracy, has been realized successfully. The hypothesis that standard hardware components available on the market, in combination with the development of robotics functions according to given requirements, can be successfully composed into a well-functioning robotic system has been confirmed.

More robust

HHLA Sky, HHLA CTT, and Fraunhofer CML have contributed significantly to the automation of pin handling within the joint project. Upcoming activities will concentrate on making the application more robust: the perception approach can be extended to rarely occurring pin types, the robot platform design will be further optimized, and more attention is to be paid to the interaction between the ICC and the TOS. ■

Johann Bergmann holds a university degree in Industrial Engineering and Management. He has been with Fraunhofer CML since 2021 and is in charge of the Port Technologies research group. The project activities cover the safe, economical, and low-emission design of processes in ports. The major focus refers to the automation of cargo handling and inspection activities. Prior to joining CML, he worked as a project manager in the Port Equipment Sales Department of Liebherr Rostock, being responsible for international projects related to harbour mobile cranes, reachstackers, and other port handling equipment.

Dr. Holger Matthias Müller has joined HHLA Sky in 2022. As a Systems Engineer, he is responsible for the development of new software and hardware solutions. Amongst others, Dr. Müller is engaged in the field of artificial intelligence and computer vision. He also coordinates and manages research projects. Before joining HHLA Sky, he accomplished his doctorate at the University of Hamburg's Institute of Astronomy and Astrophysics, and worked there as Research Associate and Postdoctoral Researcher.

Britta Sommer has worked at HHLA for over 25 years. She has been involved in project management in various terminal development projects at Container Terminal Tollerort since 2012, particularly in rail projects to increase handling capacity through automation.

THE FUTURE OF – PROVEN – MARITIME GHG REPORTING

by Hannah Pache, *Research Associate in Team Maritime Informatics, Fraunhofer CML,*
and Hinrich Brumm, *Head of Industry Group Mobility & Outdoor Automation, SICK AG*

Decarbonization and digitalization have been the most used words in the maritime industry since 2008. The whole sector faces major challenges in mastering digitalization and big data to improve efficiency, green ship operations, and emissions reporting. The DIVMALDA project by Fraunhofer and SICK AG aims to develop real-time, automated solutions for catching accurate emissions data to support CO_2 certificate trading and climate change compliance.

Ship operators are under increasing pressure: it's not just government agencies or port authorities that expect them to provide reliable reports on their ships' CO_2 and/or greenhouse gas (GHG) emissions; more and more customers are doing the same. These groups need data on the scope 3 emissions generated by their supply chains for reporting purposes and to help ensure they meet their own climate change targets.

However, accurate calculation of ship emission footprint is not yet fully feasible. For example, most vessels have multiple tanks of fuel with different specifications, leading to manual calculations and potential reporting errors. Automated reporting with verified data could significantly reduce this manual effort, minimizing the potential for error and supporting reliable statements on ship GHG emissions.

Assumptions & outdated data

The vast majority of regulations do not use current and actual emissions as a basis for calculation. Instead, they make assumptions or use outdated data from test bed protocols (e.g., the EIAPP certification under MARPOL Annex VI Reg. 13).

For those regulations where data collection is mandatory (e.g., CO_2 under EU Monitoring, Reporting and Verification, MRV, or under the International Maritime Organization's Data Collection System, DCS), data is mostly collected and reported manually on board the ship. For those regulations where continuous monitoring is required (e.g., IMO MEPC.259 scrubbers), data remains locally on the ship and is only checked when necessary. Even voluntary incentive programs rely on manually generated and individually verified reports (e.g., the Clean Shipping Index and the Environmental Port Index).

Emissions trading is becoming increasingly important in the maritime sector. From January 2024, the EU Emissions Trading System (EU ETS) covers the carbon footprint of a ship 5,000 gross tonnage and above calling EU ports, regardless of its flag. The scheme covers 50% of emissions from voyages that either start or end outside the EU, allowing the third country to address the remaining emissions, and 100% between two EU ports and within the block's ports. While the EU ETS currently covers CO_2 emissions only, it will also include emissions of CH_4 (methane) and N_2O (nitrous oxide) from 2026.

Cyber-secure, real-time, easy to install & maintain, emission-monitoring black box

The DIVMALDA – Digitisation and Verification of Marine Live Emission Data research project is addressing the challenge of harvesting accurate data. The aim of it is to exploit the multiple potentials of digitization for a verified and digitized emissions reporting system for an ecologically and economically optimized ship operation.

The major challenges for DIVMALDA lie in the combination of measuring ship emissions (including exhaust mass flow rate using appropriate sensors), validating and verifying the measured data, and making this set available on a suitable data and analysis platform.

The aim is to provide a basis for increased transparency and efficiency through automated emissions reporting, including communication with various systems (e.g., MRV, DCS, the Carbon Intensity Indicator, voluntary incentive programs, etc.) as an integrated system aboard ships. The system will combine sensor technology, data validation and verification, and an appropriate platform for data exchange.

DIVMALDA will test newly developed sensor systems and a real-time digital reporting system for emissions data in two real-life demonstrators on board a container ship and a harbor ferry. The results are expected to be industrially scalable and usable within two to three years of the project's completion. The validation of the data and the secure processing in a possible data space will ensure the authenticity

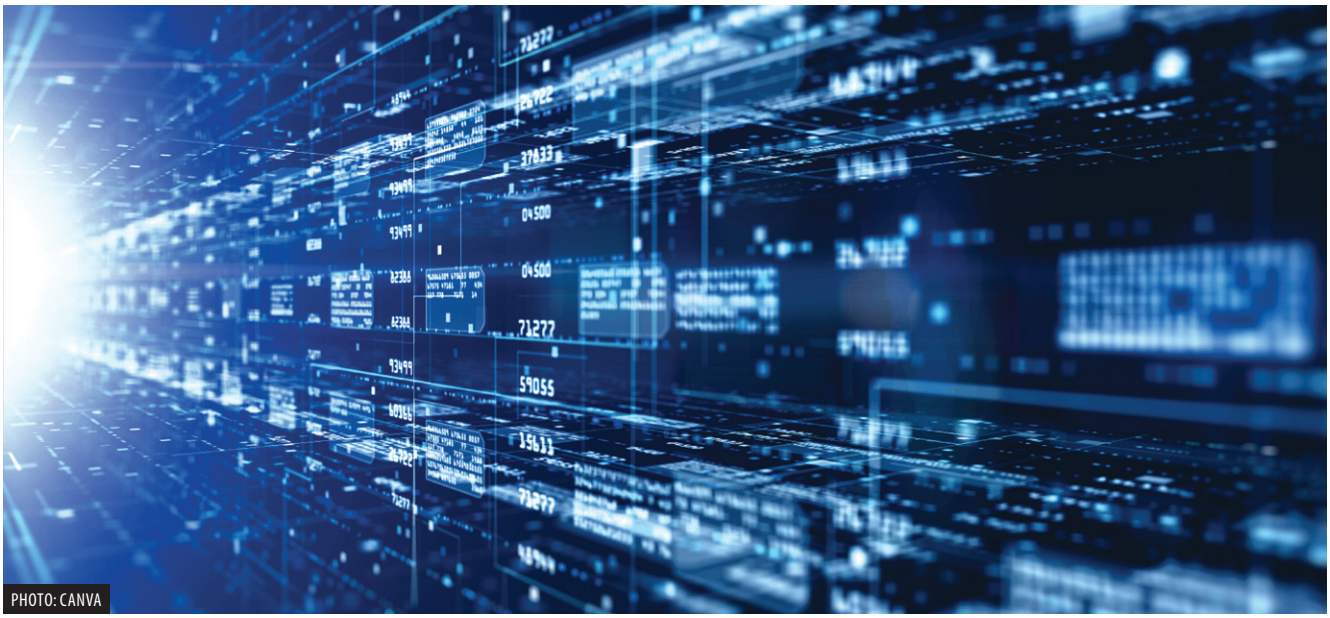


PHOTO: CANVA

and security of the data as well as its transmission and processing in such a way that the credibility of the results obtained can be accepted by classification societies and authorities. Establishing a technological solution for real-time emissions monitoring that is also accepted by class will simplify processes and provide opportunities for use by both shipping companies and port authorities. The new system will save time and reduce potential data errors, providing a clear economic benefit for owners-operators, increasing the potential for their market success.

The overarching aim of DIVMALDA is to lay the foundations for a cost-effective system design, ensuring affordability and applicability to a wide range of vessels. Another key goal is for the system to require minimal maintenance, reducing long-term operating costs and simplifying the user experience. Installation and retrofitting will be straightforward, as the system will be designed as a 'black box' that can be easily integrated into any exhaust stream on board larger vessels. In addition, robust cyber security measures will be incorporated to protect against unauthorized access and ensure the security and integrity of data.

Team effort

SICK AG and Fraunhofer Gesellschaft (within the Fraunhofer Institute for Software and Systems Engineering ISST and Fraunhofer Center for Maritime Logistics and Services CML) have joined forces to create the future of maritime GHG reporting.

SICK AG is responsible for project coordination and the provision of existing sensor technologies, as well as the development and testing of a novel CO_2 measurement system for direct exhaust gas measurement.

Fraunhofer CML develops and optimizes processes and systems along the maritime supply chain, having relevant expertise, experience, and references in the fields of maritime technologies, emissions, and shipping. Accordingly, the collection and evaluation of emissions data are carried out by CML.

The experts at Fraunhofer ISST explore the value and sovereign handling of data. Through contributions to initiatives such as the International Data Spaces (IDS), Gaia-X AISBL, and industry-specific developments, they contribute to the creation and establishment of safe data spaces, as well as to the integration of data and systems. Sovereignty over one's own data is a crucial success factor for automated emissions trading, as the acceptance of market participants is significantly influenced by their willingness to share data. The IDS reference architecture serves as a technical trust anchor.

The research is supported by DNV, CPO Containerschiffreederei, Flotte Hamburg, and the Hamburg Port Authority, who are associated partners and actively involved in testing and demonstrating the newly developed technologies. DIVMALDA is funded as part of the Maritime Research Strategy 2025 by the German Federal Ministry of Economic Affairs and Climate Action (BMWK) from July 2024 to June 2027. ■

Hannah Pache completed her M.Sc. in naval architecture and ocean engineering at the Hamburg University of Technology (TUHH). During her master's degree, she specialized in data-driven insights and solutions for the maritime industry and continued her research as a Research Associate at TUHH's Institute of Maritime Logistics. Since August 2021, she has been a Research Associate at Fraunhofer Center for Maritime Logistics and Services CML, specializing in maritime informatics.

Hinrich Brumm graduated with his master's in environmental protection technology in Hamburg and started his career at Germanischer Lloyd in 1997. During the next 15 years, he was responsible for the type approval certification and the on-board plan-approval of continuous emissions monitoring systems (CEMS), any kind of class- and statutory exhaust emissions approval, like EIAPP and IAPP. Followed by three years as a senior consultant at MARENCON, since 2014, he has been in different positions at SICK AG, where today he heads the Industry Group Mobility & Outdoor Automation.

How to develop a high-efficiency onboard carbon capture system (with a saleable, eco-friendly, circular economy end product)

CAPTURING A GREENER FUTURE

by Laura Langh-Lagerlöf, *Commercial Director, Langh Tech*

Innovation is at the core of Langh Tech. Since our founding a decade ago, we have seen several new rules and regulations enter force to make the maritime industry more sustainable, which have all played their part in shaping Langh Tech into what it is today. Originally, the company was founded as a solution to the 2015 designation of much of Northern Europe as a sulphur emission control area, aiming to provide a more efficient scrubber system to sister company Langh Ship's fleet than the other options on the market at that time. Since then, we have kept challenging ourselves to help the industry become greener, expanding our portfolio with several other tech products, with onboard carbon capture (OCC) being the latest project.

With OCC, it has been important for us to get ahead of the regulations and take action preemptively. Carbon capture is emerging as a key technology in the transition of shipping towards net zero as it provides a cost-effective addition to other decarbonisation options. There are no established solutions on the market yet, which is why we wanted to take on this ambitious project of paving the way and getting the innovation race started.

After the decision was made to start the R&D process, it didn't take long to go from an idea brainstormed at a meeting to a finished, commercialised product. From pilot trials in 2024 to the first commercial project being scheduled for installation this year, the project glided with great success.

Unique design

Langh Tech's OCC system utilises a unique circular approach. Unlike many other carbon capture technologies, ours does not apply an absorption-desorption cycle, which results in a significantly lower increase in energy requirements than most amine-based systems. Instead, our system utilises a post-combustion technique, only including the first part of the conventional two-step process where the ship's exhaust gases containing CO_2 are directed into a capture unit.

The CO_2 in the exhaust gas dissolves into the liquid containing sodium hydroxide (NaOH), commonly known as caustic soda. Thanks to a counter-currently flowing solution and maximised reaction surface area within the unit, the highest possible carbon capture rates can be achieved. Following several consecutive reactions, the CO_2 is eventually chemically bound into the thermodynamically stable product of sodium carbonate.

After the capture step, the sodium carbonate that is dissolved in a liquid phase is transported into a storage unit for offloading at the port. This enables avoiding the typically applied second step of regeneration, where the CO_2 is released from the solution and further compressed and liquefied. This significantly reduces the additional energy requirements for the system and, thus, a higher increase in fuel consumption. Once the vessel arrives at the seaport, the liquid containing sodium carbonate can be offloaded by pumping and further utilised in land-based industries, contributing to the circular economy.

Langh Tech's OCC systems are designed with flexibility in mind, both considering the ease of use and the design. The size can be adapted and scaled according to the specific needs of each vessel. This approach ensures a seamless integration of the technology into the existing ship infrastructure, offering a practical solution for a wide range of ship types.

Sustainability from beginning to end

Throughout the product development, it was important to make every step of the process sustainable, from the reagents required to the end product generated.

The capture reagent, sodium hydroxide, was selected due to several of its qualities. On top of its advantages in chemical properties, sodium hydroxide can be produced via the electrolysis of sodium chloride (NaCl), i.e. table salt, using renewable energy sources. This ensures a substantial reduction in emissions and maximises the overall environmental benefits throughout the product's life cycle.

As for the end product, the sodium carbonate can be further utilised by a variety of other industries, including the manufacturing of glass and detergents. Currently, the sodium carbonate sector predominantly relies on extracting ores from the Earth's crust. The low-carbon alternative that the OCC process provides thereby contributes to the decarbonisation of these related industries as well.

Langh Tech's OCC system allows simple operation processes which do not require new specialised equipment. The used chemical has already been applied and is well-established in the maritime industry.

From functional to optimised

With a ship-owning company within our group, we have always had the shipping point of view as a driving force,

PHOTOS: LANGH TECH

and with that in mind, we have seen the changes affecting the industry as a challenge to improve our own fleet. This has also provided us with a good test platform for our products before taking them to a wider market, which is also where our OCC trials were conducted.

In the spring of 2024, after several months of land-based testing, the first pilot system was installed on board *Laura*, one of Langh Ship's freighters. The initial testing phase was a valuable learning experience, which led to an even deeper understanding of the system and its chemistry. Several improvements were made before finalising a product that could be put on the market.

The testing period last year was highly successful, proving that the pilot system's performance corresponded with the theoretical estimates. But while it's good to have a functional system, it's even better to have an optimised one! That is why we fully utilised the pilot installation to push the system to even better performance. The system's performance is a compromise between several factors, including capture efficiency, energy requirements, and product quality aspects. During testing, we gained the confidence to bring maximum momentary capture rates up to 90% from the exhaust gas coming into the system while ensuring the capture product fulfils purity requirements.

Since the pilot, the design of the OCC system itself has also been iterated. Several end-product storage solutions have also been considered throughout the process, landing at choosing each solution individually for the client's needs. We are also continuously working on improving the performance even further by, for example, conducting research on increasing the reaction area within the system to improve capture efficiency.

What's next?

Besides the first commercial installation later this year, Langh Tech will also be installing the OCC systems on three of its sister company Langh Ship's newbuildings that will be delivered starting spring 2025.

We are also looking forward to engaging in different kinds of projects, which will generate new ideas on how to even further improve the system and fit the diverse needs of various vessels. We are excited to see what kind of opportunities 2025 will bring along to push our innovative skills even further! ■

Langh Tech The Finnish, Piikkiö-headquartered Langh Tech designs and produces scrubbers for SO_x removal from exhaust gases, water treatment units for closed-loop scrubbers, as well as ballast water management systems. In addition to component delivery, the company takes care of commissioning and offers installation supervision, crew training, and after-sales services. In 2024, Langh Tech added an innovative onboard carbon capture system to its portfolio to aid shipping in the industry's decarbonisation efforts. Sail to langhtech.com to discover more.

How to create a net-zero port decarbonisation framework

DETECT > DECIDE > DEPLOY

by Ewa Kochańska

Decarbonising ports is a critical step in achieving worldwide sustainability goals and addressing climate change. Therefore, as pivotal hubs in the global supply chain, ports face mounting pressures and challenges in balancing efficiency with sustainability. The report Getting Ports to Net Zero, summarising a research project by Thetius and Ericsson, clears a concrete pathway leading to carbon-free operations. It describes a systemic approach, beginning with the detection of emission sources, followed by informed decision-making on technologies and funding needs, and effective, thoughtful deployment of solutions. Highlighting advanced monitoring systems and smart technologies, electrification and renewable energy integration, the publication examines implementation factors as well as real-life case studies, allowing ports to identify a proper strategy that best suits their operational framework.

Subpar port performance disrupts logistics and inflates end costs, while significant greenhouse gas emissions damage ecosystems and degrade the quality of life for surrounding communities. With that in mind, the complexity of port ecosystems makes reducing emissions a daunting and, at times, ambiguous task.

Getting Ports to Net Zero explores decarbonisation strategies that include smart technologies, electrification, and renewable energy, also highlighting the critical role that advanced networks play in achieving net-zero goals. Additionally, robust infrastructure, stakeholder collaboration, phased implementation, and continuous evaluation are also pointed out as critical to successful emissions reduction. To encompass all this intricacy in a user-friendly guide, the report narrows down the port decarbonisation framework to three main pillars: detect, decide, and deploy.

Detect

Detection is an obvious first step on the road to reducing and, later, eliminating emissions. Ports must pinpoint their most significant sources thereof to address the problem effectively, and there could be many: quay cranes and other cargo handling equipment, harbour vehicles, port facilities (like warehouses and workshops), as well as visiting vessels, trucks, and trains. Being able to deduce who the main offenders are allows ports to identify what is done well and what areas need improvements. This also involves determining whether the existing infrastructure is sufficient for implementing reduction measures or if upgrades are necessary. Sharing these findings with other ports and stakeholders promotes transparency and offers valuable insights into effective strategies, fostering collective progress in reducing environmental impacts. While ports differ, requiring individual approaches, they also share many touch points to make decarbonisation a group effort.

Getting Ports to Net Zero advises that creating a baseline for emissions and port performance is critical to setting realistic reduction targets. Importantly, having current data on emissions (and related achievements as well as failures) and sharing that information not only builds public trust but also ensures compliance with regulations. Currently, despite increasing awareness of the need for decarbonisation, few ports publicly disclose their emission data sets. A richer statistics base could better inform environmental policies and help in regulatory compliance across the entire maritime & logistics supply chains.

Measuring emissions is also tied to financial incentives and penalties, such as carbon taxes imposed based on CO_2 outputs. Port players can mitigate these fees by adopting greener practices like using low-emission fuels, installing shore power systems, and promoting efficient vessel call scheduling and truck arrival times. These measures not only reduce emissions but also support compliance with goals like the European Green Deal (which aims for a 90% reduction in emissions by 2050). Compliance with these regulations is essential for securing funding and avoiding reputational damage.

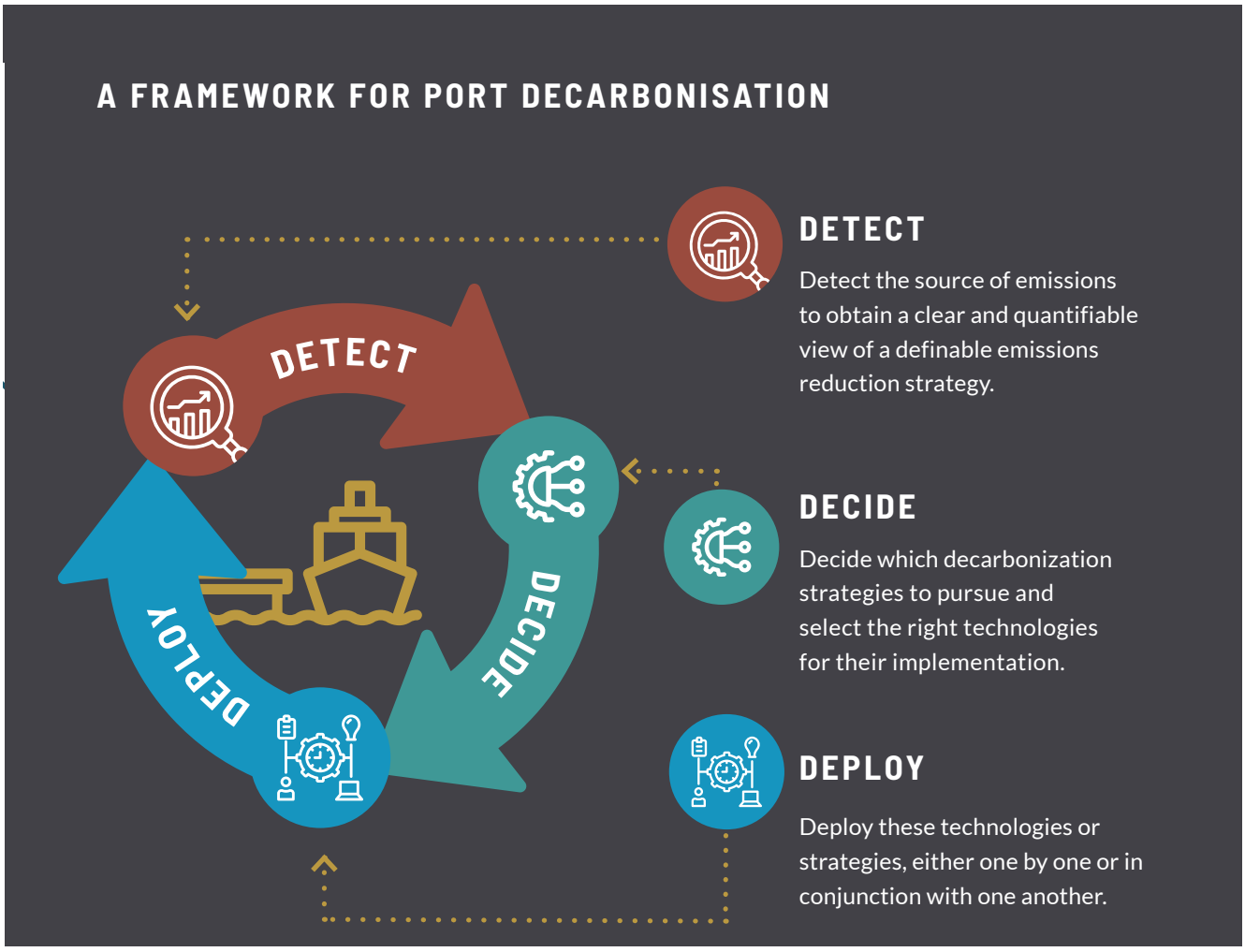
Advanced technologies enable precise emissions monitoring and improved operational efficiency. Digital tools like sensors, drones, and air quality monitors provide real-time data on pollutant levels, while remote sensing and satellite technologies offer broader monitoring capabilities. Digital twins integrate real-time data to optimise port operations, such as berth planning and reducing inefficiencies and emissions.

These innovations require reliable connectivity to function adequately, ensuring seamless data collection and analysis. Consequently, robust connectivity and digitalisation are essential for decarbonising ports and, thus, sustainable maritime operations. Modern technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and high-speed wireless networks, enable real-time decision-making and predictive analysis. High-quality connectivity is also vital for operating autonomous equipment and mobile assets within ports, driving greater efficiency while reducing emissions.

Decide

It is now time to pick out what solutions must be deployed to reach the net-zero emissions objective. *Getting Ports to Net Zero* underscores three 'key routes to choose from:' implementation of smart technologies, equipment electrification and shore power provision, and introduction/escalation of renewable energy.

The publication emphasises that prioritisation is essential when approaching the adoption of smart technologies. Instead of implementing every solution simultaneously, ports are encouraged to integrate one strategy at a time to evaluate its effectiveness. By measuring key performance



indicators, they can determine whether the desired results are being met or if adjustments are required. This methodical process also underscores the importance of ongoing evaluation to ensure optimal performance of implemented technologies.

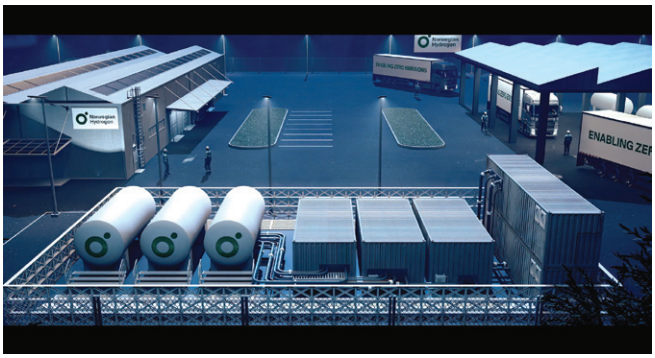
Smart technologies comprise a broad range of innovations, apart from the above AI and IoT also robotics, blockchain, and augmented & virtual realities (AR, VR). As these technologies become increasingly instrumental in society, the market for these tools is also expanding. As such, the port technology market projections, according to Thetius IQ, indicate an increase from $4.1 billion in 2022 to $11.5 billion by 2029. This growth reflects the increasing demand for efficient and sustainable port operations as well as the key role that smart technologies have been and will be playing in optimising port operations and minimising emissions.

Next-gen technologies have many uses in ports, and the possibilities are constantly evolving. Tools like digital twins allow ports to simulate and refine operations before implementing changes (including infrastructure investments), reducing energy consumption and emissions. Predictive maintenance enabled by tech like AR and VR allows engineers to use these tools to address upkeep with greater accuracy and speed, sometimes remotely. Such efficiencies not only save time but also decrease the environmental impact of emergency repairs. In addition, optimising the flow of cargo and vessels in ports can drastically reduce idle times and energy waste. Studies show that better communication between ship and shore, supported by automation and advanced planning systems, can eliminate inefficiencies. Digital twins and port management information systems further aid in aligning schedules and improving turnaround times. Clearly, by improving vessel call & handling times, streamlining traffic management, and enhancing equipment performance, ports become safer and more energy efficient.

The integration of 5G networks is, as such, critical in port hubs. High-speed and low-latency connections are essential for real-time data sharing, whether for remote crane operations or AR/VR applications. Ports equipped with robust networks can manage large quantities of data generated by sensors and IoT devices, ensuring seamless communication and efficient operations. Preparing the infrastructure to support these innovations is a vital step, as ports must invest in durable foundational elements to ensure safe and efficient operations.

Another route when creating a strategy for emissions reduction in ports could be electrification and shore power provision. The former is seen as a rapid path to decarbonisation, as it significantly and relatively quickly cuts pollution; many ports worldwide, especially in Europe, the US, and China, are embracing electrification to cut

PHOTOS: PORT OF HIRTSHALS



emissions. Here, too, technologies like 5G are essential, enabling real-time communication and efficient energy management through smart grids. These systems help balance energy demands, monitor usage, and optimise renewable integration. However, despite progress, challenges to electrification, like infrastructure limitations and ship compatibility, persist, necessitating upgrades and collaboration with third parties.

The third route when deciding on decarbonisation solutions is the utilisation of renewable energy sources such as wind and solar. Hydrogen, while expected to play a smaller role in the global energy mix, is also gaining traction in emission-cutting efforts. DNV predicts it will account for 0.5% of energy use by 2030 and 5% by mid-century, with significant investments projected in hydrogen production and pipelines. Offshore wind farms also allow ports to produce green hydrogen via seawater electrolysis. With appropriate piping systems, ports can use this clean hydrogen for industrial purposes and ship fuelling, offering a sustainable energy source for various logistics operations.

Hydropower (tidal turbines, wave energy converters) is another option. *Getting Ports to Net Zero* gives the example of the Port of Antwerp, which installed a water turbine in a lock, integrating the generated energy with solar and wind power into a smart grid. Notably, Antwerp was aided by VR in the initial planning and understanding of environmental conditions.

Nuclear power in maritime is another option that has recently been increasingly considered, according to DNV's *Maritime Forecast to 2050*. Currently responsible for about 10% of global electricity, this option still faces safety and societal concerns. However, new small modular reactors offer safer and more adaptable designs, potentially providing energy to ports with lower initial costs. Ports near such facilities could use this energy with visiting ships after adapting infrastructure and connecting to the nuclear plant.

Additionally, ports are exploring advanced technologies like carbon capture

PHOTO: EUROPEAN ENERGY

PHOTO: PORTS OF STOCKHOLM

PHOTO: PORT OF RIGA

and storage (CCS) to reduce emissions. This involves capturing industrial carbon output for storage, reuse, or export. Antwerp's CCS project, launched in 2019, estimates it will be able to capture half of the port's CO_2 emissions by 2030. Digital tools, including machine learning and virtual models, are used to enhance the efficiency and feasibility of CCS.

Deploy

With well-defined decarbonisation and implementation goals, ports can finally begin shifting their operations, choosing from the options mentioned above. Successful implementation of new technologies means focusing on infrastructure needs, investments, stakeholder engagement, phased implementation, and ongoing monitoring of success metrics. Assessing infrastructure must factor in future upgrades and scalability to alleviate long-term costs. Building an investment case is pivotal, as securing funds always requires clear justification.

It can be helpful to highlight how private 5G networks improve operations in terms of security and efficiency. In this process, reaching out to various stakeholders, addressing specific benefits and outlining manageable, phased upgrades could produce good results. Also crucial at every step of the funding process is transparency on costs, network security challenges, and legacy system integration.

Further, adopting a phased approach to implementation is recommended as it minimises risks and costs while pilot projects demonstrate value, allowing for refinement and workforce training. This ensures smooth adoption and adaptation to new tools.

Engagement with stakeholders is also essential at every step; awareness of new technologies – and the benefits/drawbacks they offer – creates an atmosphere of open communication and trust. *Getting Ports to Net Zero* recommends involving all parties early on to address concerns, e.g., about automation's impact on jobs. In this type of communication, it is important to emphasise how technology enhances operations and creates upskilling opportunities, fostering collective buy-in. Moreover, identifying and underscoring how new technologies or infrastructure changes can benefit all stakeholders is another critical piece of the puzzle. Forming partnerships with vendors who understand the port's specific operational requirements is essential, too. Tailored solutions and partners with a proven track record can help overcome resource limitations and create a network that fosters data sharing and informed decision-making.

And lastly, measuring successes and failures to understand technological progress and assess and refine smart technologies must also become a part of the process. Well-made projects serve as benchmarks, while shortcomings provide learning opportunities for future improvements.

Getting the basics right

As centres of economic activity and gateways to international trade, ports have become key players in the global shift to sustainability. Thetius and Ericsson's report underscores that ports aiming to decarbonise can make significant progress by adopting smart technologies, electrification, and renewable energy.

But the publication also cautions that ports must focus on getting the basics right before embracing advanced technologies. Robust infrastructure is a necessary foundation; skipping this step can lead to disappointing outcomes. By taking a gradual approach – first establishing infrastructure, then rolling out technologies, and scaling up efforts as benefits become clear – ports can ensure that their decarbonisation transition is efficient and effective. ■

How EU regulations will boost the economic value of renewable methanol in shipping

SUSTAINABILITY IN NUMBERS

by Dr Jeroen Dierickx, *Founder, iDefossilise*

The maritime industry is under increasing pressure to reduce its environmental impact, particularly concerning greenhouse gas (GHG) emissions. In response, both international and regional regulatory frameworks have been developed to encourage emission reductions and promote sustainable shipping practices. Notably, the maritime industry now faces a transitional challenge in complying with the latest EU rules, as the changes brought by them are posed to make green methanol competitive.

Under the EU's Fit for 55 regulatory package, vessel owners and operators are incentivised to transition to sustainable fuels through significant penalties levied on continued fossil bunker use. For fuel producers, the regulations offer a stable, long-term framework from 2024 to 2050, paving the way for secure investment opportunities in the maritime sector.

A new white paper prepared for the Methanol Institute concludes that the FuelEU Maritime Regulation and the EU Emissions Trading System (EU ETS) will create a level playing field for bio- and e-methanol, making them economically competitive compared to fossil marine fuels.

Regulations

FuelEU Maritime is a cornerstone initiative of the EU aimed at reducing GHG emissions from the maritime sector. This legislative framework sets specific targets and measures to decarbonise shipping and promote cleaner fuels. Its key elements include yearly average (well-to-wake) GHG intensity reduction targets and a 2% sub-target for renewable fuels of non-biological origin (RFNBO) starting in 2034 (with incentives for RFNBO use until then). It also mandates the use of onshore power supply in major European ports.

The EU ETS is a cap-and-trade system that limits the total CO_2 emissions from certain sectors, with shipping included as of this year. The scope of maritime emissions covered by the EU ETS increases from 40% in 2024 to 70% in 2025 and 100% in 2026. Shipping companies must buy emission allowances, each covering one tonne of CO_2 or the equivalent of other potent GHGes, such as methane (CH_4) or nitrous oxide (N_2O). Allowances are auctioned, and companies can trade them in secondary markets.

Penalties

The 'stick' for not meeting the FuelEU Maritime GHG intensity reduction targets increases every five years, starting at €39/tonne of very-low sulphur fuel oil (VLSFO) in 2025, rising to €1,997/t/VLSFO after 2050. This increase corresponds with the stricter GHG intensity reduction targets over time. When the cost of an EU emission allowance is €100, the FuelEU Maritime GHG intensity penalty surpasses the EU ETS cost by 2035 – and more than doubles it after 2040.

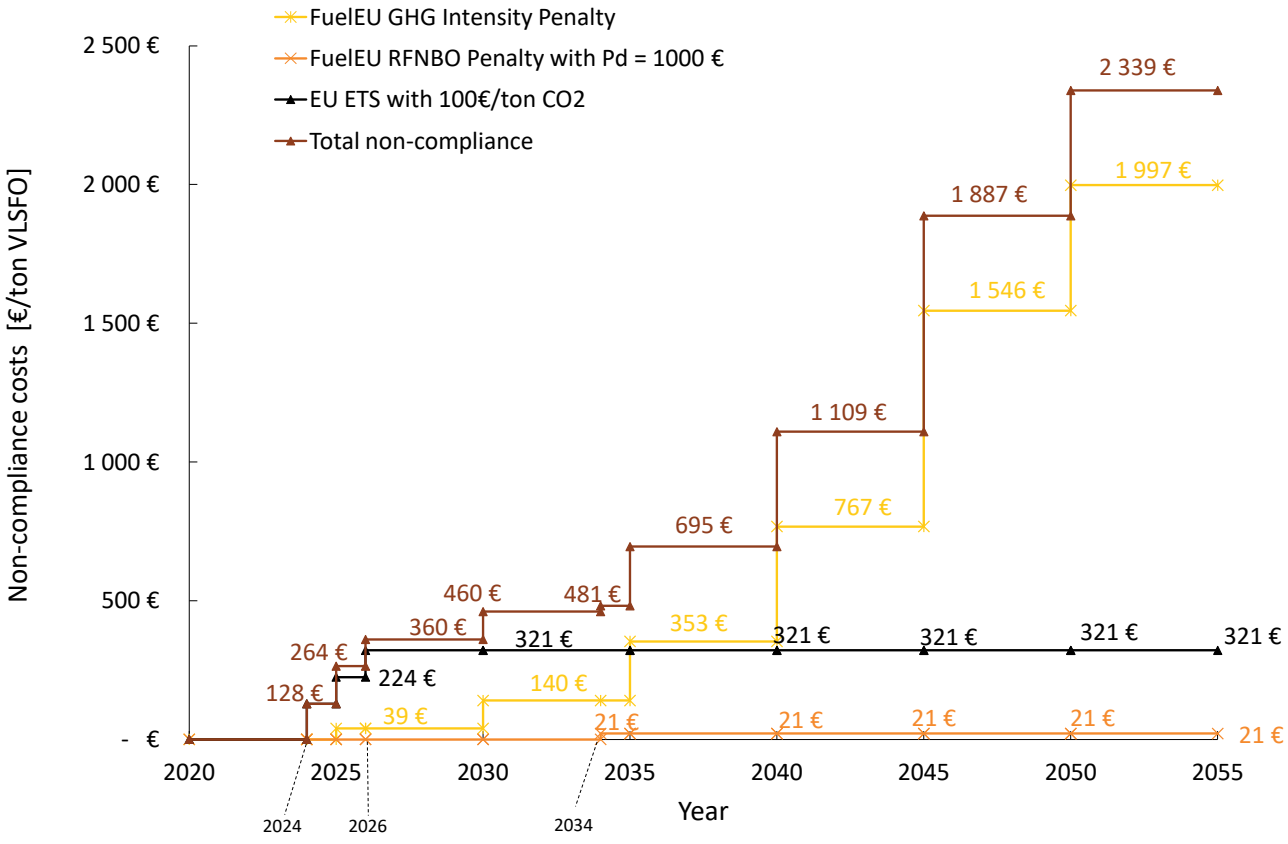
The penalty for not meeting the RFNBO sub-target was calculated using an assumed price difference of €1,000 between RFNBO and VLSFO, resulting in a penalty of €21/t/VLSFO used. For context, if the price difference between RFNBO and VLSFO were €500 or €2,000, the penalties would be €10 and €42/t/VLSFO, respectively.

The EU ETS is gradually introduced to the maritime sector, covering 40% of emissions this and 70% next year, resulting in costs of €128 and €264/t/VLSFO, accordingly. By 2026, all emissions will be in scope, thus costing €321/t/VLSFO. This cost does not include CH_4 and N_2O emissions, which come into effect in 2026 and add about €5.50/t/VLSFO. For fossil liquefied natural gas (LNG), because of the methane slip, this additional cost can reach €74/t of LNG used.

Compliance using methanol

Given the significant non-compliance costs for the continued use of VLSFO for propulsion, shipping companies are looking at regulatory compliance strategies. While several pathways exist – including

Fig. 1. Non-compliance costs for using VLSFO under FuelEU Maritime and EU ETS



the use of bio-fuels, e-fuels, wind propulsion, or pooling of vessels – this section focuses on mitigating non-compliance costs using methanol.

This can be done for individual ships or a pool of vessels, where one sustainable ship offsets the GHG emissions of another group of vessels. In determining the compliance pathway, it is important to note that shipowners are currently favouring dual-fuel internal combustion engine technology with methanol.

PHOTO: MPC CONTAINER SHIPS

Fig. 2. Energy shares of VLSFO and bio- or e-methanol in dual-fuel vessel operation to comply with the FuelEU Maritime GHG intensity reduction targets (Pathway 1) – based on the assumptions made in this analysis

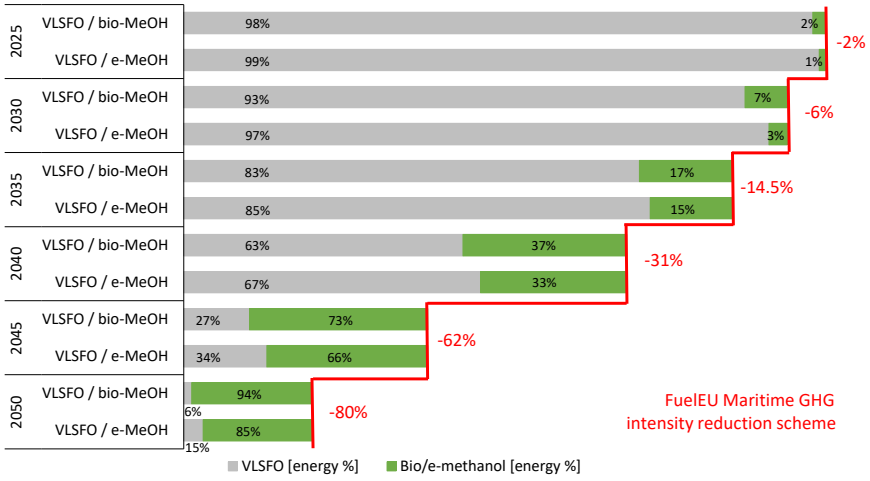


PHOTO: STENA PROMAN

While there are several pathways possible to be compliant with FuelEU Maritime, this analysis explores two options for using methanol. Pathway 1 uses, on an annual basis, the average required (and minimum) amount of methanol to be compliant. The results of this pathway can be used for individual vessels or a pool (or, hypothetically, at the EU level, i.e., assuming that sustainable methanol would be the only solution to achieve compliance).

PHOTO: HUTCHISON PORTS UK

Pathway 2 uses methanol blends, i.e., a mixture of fossil-based and sustainable methanol. Again, the results of this pathway can be used for individual vessels or a pool. This option is interesting to investigate as it allows the existing methanol supply to be used and fossil-based methanol to be gradually replaced by its sustainable version.

The two pathways are analysed as if they were two independent solutions to become compliant with FuelEU Maritime. In reality, they will co-exist and interact with each other, as well as with other compliance solutions.

This analysis focuses on the stringent European regulatory framework for GHG emissions, particularly FuelEU Maritime and the EU ETS. These regulations impose significant penalties for non-compliance, driving the need for alternative fuels. The non-compliance costs for using VLSFO will rise sharply due to regulatory penalties, from €264/t in 2025 to €2,339/t by 2050. This increasing cost supports the shift to alternative fuels like bio-methanol and e-methanol.

Economic value of bio-methanol and e-methanol

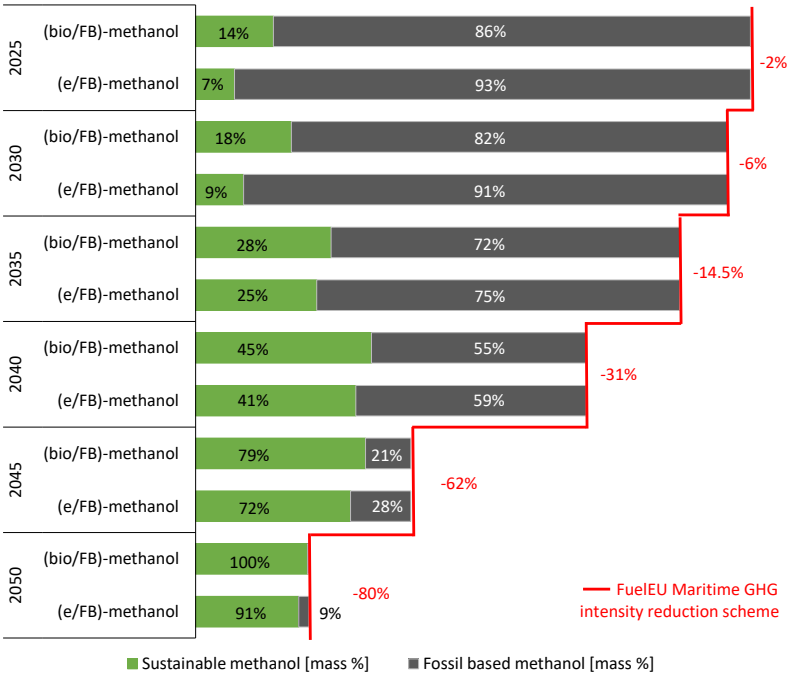
The economic value of methanol is expressed in this analysis as the maximum price of methanol for which the total fuel cost of VLSFO, including non-compliance costs, is equal to the total fuel cost with Pathway 1. For instance, the maximum price for bio-methanol considering only FuelEU Maritime is €936/t in 2030 and €965/t in 2040. By adding the EU ETS to the picture, both maximum prices increase by €120/t.

The reward factor for e-methanol from 2025 to 2034 also significantly impacts its price, making it, for example, €2,405/t in 2030 but dropping to €1,330/t five years later when the reward factor ends. Including the EU ETS results for e-methanol in a maximum price increase of €150/t. It is also concluded that the economic value of sustainable methanol depends on its potential to reduce GHGes: the higher the well-to-wake emission reduction, the greater the economic value under FuelEU Maritime.

Market incentive for sustainable fuels

FuelEU Maritime and the EU ETS provide strong incentives for the adoption of sustainable fuels in the maritime sector. The non-compliance costs for

Fig. 3. The composition of methanol blends to comply with FuelEU Maritime (Pathway 2) – based on the assumptions made in this analysis

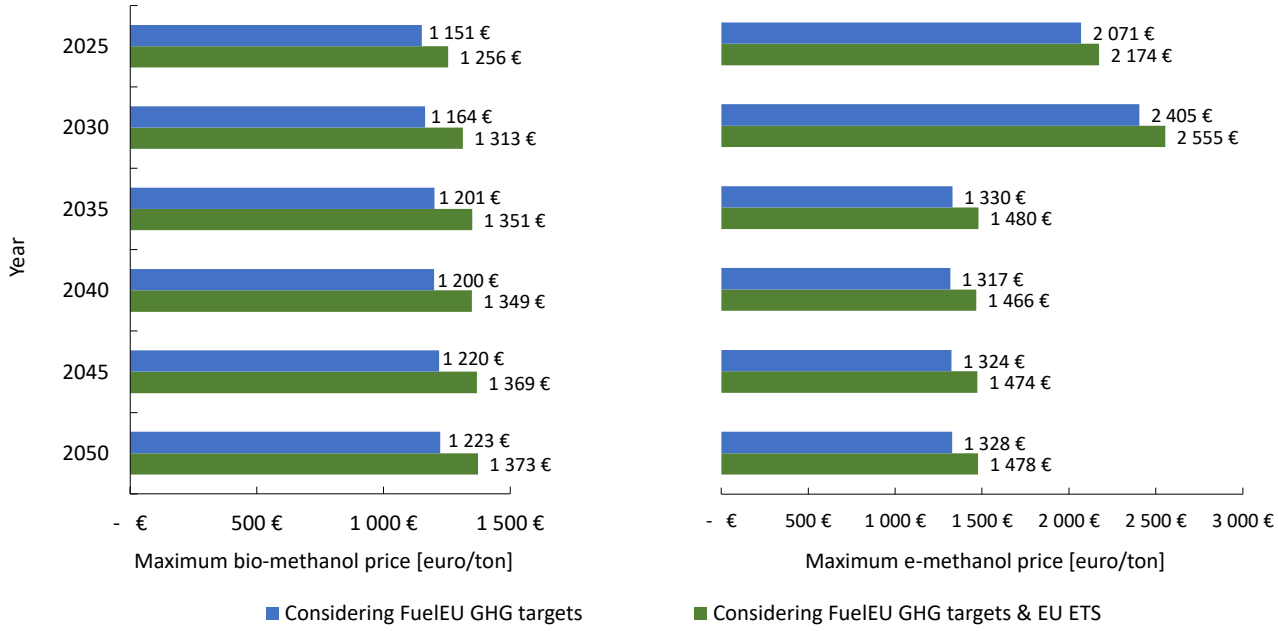


VLSFO are substantial, making bio- and e-methanol attractive and economically viable alternatives.

With average maximum prices of €959/t for bio-methanol (excl. the EU ETS, from 2025 to 2050) and up to €2,238/t for e-methanol (excl. the EU ETS, from 2025 to 2034), and given that production costs for bio-methanol and e-methanol are typically lower, it is concluded that the regulations enable bio- and e-methanol fuel producers to charge a premium, making investment cases profitable. This suggests that the regulatory frameworks effectively support the transition to sustainable fuels in maritime shipping.

FuelEU Maritime and the EU ETS are creating a level playing field for sustainable fuels like bio- and e-methanol. With significant penalties for using fossil bunkers, owners-operators are incentivised to switch to sustainable methanol. For fuel producers, these regulations provide a stable, long-term framework until mid-century, facilitating secure investment opportunities. ■

Fig. 4. Maximum bio-methanol and e-methanol price using Pathway 1 to match with the total price for VLSFO under FuelEU Maritime and EU ETS – based on the assumptions made in this analysis



Dr Ir. Jeroen Dierickx is an energy and fuel expert with a degree in electromechanical engineering (2010) and a master's in business administration. He gained extensive experience at Engie, focusing on energy management, offshore wind development, and industrial solutions. Jeroen completed his PhD at Ghent University in 2023, researching sustainable fuels like hydrogen, methanol, ammonia, and biofuels for energy conversion technologies. He has conducted numerous feasibility studies on fuel transitions, some leading to demonstration projects, and has authored and co-authored 13 journal and conference papers. In 2024, he founded iDefossilise, helping companies transition from fossil fuels to sustainable technologies and energy carriers, tackling technical, economic, and regulatory aspects.

BEYOND IMAGINATION

by Chad Van Derrick, *VP of Software Product Management, Tideworks Technology*

In early December 2024, Jack Ma, the Co-founder of the Alibaba Group, made a rare public appearance discussing how, over the next two decades, "AI will change everything." According to The South China Morning Post, Ma stated that "from today's perspective, the changes brought by artificial intelligence in the next 20 years will go beyond everyone's imagination, as AI will bring a greater era."

Such visions of artificial intelligence (AI) are becoming more commonplace from today's executive suite, and certainly, many claim that the ongoing stock market bubble is, in fact, not a bubble but indicative of the potential value that AI will produce for companies across many industries.

What, then, is the impact on marine terminals, and how can operators prepare now to reap this value and establish themselves as leaders in an AI future? Let's start by dissecting these acronyms and how they apply to our industry.

AI, ML, and GenAI

Artificial intelligence is the broadest term, referring to any system or algorithm designed to mimic human intelligence. It encompasses tasks such as learning, reasoning, and problem-solving. AI includes rule-based systems, robotics, and more advanced techniques, like machine learning (ML) and generative AI (GenAI).

Machine learning is a subset of AI focused on developing algorithms that can identify patterns in data. ML is typically used for predictions, classifications, and decision-making tasks, relying on techniques like supervised or reinforcement learning for improvement. ML examples include spam filters, recommendation engines, and fraud detection (and yes, your last Netflix watch was probably recommended or influenced by ML). And those CAPTCHA systems that verify that you're a human – like identifying buses, crosswalks, or traffic lights – often contribute to supervised learning, helping to train ML models for image recognition tasks.

Generative AI is a specialized subset of ML that focuses on creating new content that mimics existing data, such as text, images, music, or code. ChatGPT, Microsoft Copilot, and Google Gemini are all examples of the so-called large language models. GenAI excels in creative tasks, among others, generating images, writing text and code, and producing synthetic data for training other models.

This is where GenAI can help

As you may have guessed, our industry has already begun adopting AI, from optical character recognition at the gate to automated rubber-tired gantries and terminal tractors, all of which leverage technologies such as AI, ML, and robotics to achieve their tasks.

So, does this AI-driven future result in fully automated terminals? Not necessarily. The goal should be to achieve greater efficiency and improve the ability to effectively manage uncertainty driven by factors, including climate change and geopolitical challenges.

This is where GenAI can help. Many think of it in terms of chatbots, and while terminal operating systems (TOS) will certainly incorporate these for support, other use cases could have a more meaningful impact. For instance, terminal management could use GenAI to draft detailed operational or compliance reports by analyzing real-time data and summarizing terminal activities.

Taken a step further, GenAI could help complete or even create entire simulated datasets to train and test TOS algorithms, particularly when real-world data, like inventory, is incomplete or contains

biases. To upskill staff in better managing uncertainty, GenAI could create training scenarios simulating various operational challenges, such as equipment breakdowns or weather disruptions.

Layering tomorrow's TOS

But we're just scratching the surface here. Let's go up a level to ML and how it can analyze data patterns to improve operations. ML models could detect unusual container movements or patterns in gate transactions to flag potential security or operational issues. By analyzing historical data, ML could predict peak traffic times for gates or specific cargo types, allowing better resource planning. ML could even learn from past container movement patterns to improve routing for cranes and yard equipment, minimizing travel distances.

Leveraging these technologies and others, AI could automate and optimize decision-making processes across the terminal. AI algorithms could allocate container storage locations based on current yard utilization and vessel schedules, ensuring efficient stacking and retrieval. AI could evaluate scenarios, such as berth allocation, to suggest optimal strategies considering multiple constraints (e.g., vessel size, arrival time, and required machinery). AI-powered systems could predict when equipment might fail, enabling proactive repairs and minimizing downtime.

Tomorrow's TOS could integrate all three technologies. AI could improve resource allocation and suggest real-time operational adjustments, ML could identify trends in container flow and optimize equipment usage, and GenAI could generate realistic simulation environments for training and testing 'what-if' scenarios. This layered approach ensures operational efficiency, predictive insights, and creative problem-solving.

The unsung heroes of TOS innovation

So, where do we start? AI, including ML and GenAI, requires data – and a lot of it! Data platform solutions, like Tideworks' Data Platform, collect and standardize data across the TOS suite in near real-time, ensuring data is accurate, timely, normalized, and ready for AI applications. Our solution also includes the Data Governance application, providing data-quality monitoring and stewardship tools that ensure data completeness and accuracy. For terminals, such platforms function as an enabler, preparing data to be fed into ML and GenAI systems that can produce insights that enhance the use of TOS tools, strengthening decision-making and operational outcomes.

When choosing a data platform for integration into TOS, terminals should consider several key factors to ensure the system accurately represents data for use across functions like GenAI. First, near real-time data movement: merge widely used open-source tools and industry-standard architecture for near real-time data movement. Second, visibility and transparency: allow terminals to present easy-to-understand findings to business stakeholders through a robust data catalog. Third, security: isolate each customer's data – and the type of it (e.g., isolate financial data, ensuring data and intellectual property protection). Fourth, efficient yet flexible data management: provide available, trustworthy data and fast development.

Implementing the right building blocks

Before selecting any sort of AI solution, it's important to define the issue you want to solve. If it's a matter of automating and improving operational precision, your TOS provider should help direct AI efforts toward high-impact applications with clear return-on-investment potential. An AI vendor should be able to take your terminal's historical data and provide a simulation of the amount of savings they could affect. Visibility to savings helps determine if proceeding is financially viable and worth the investment.

Starting with small pilot projects is a pragmatic approach to test AI's potential for TOS while minimizing risk. Such trials also help to gain buy-in and adoption of your staff, a critical necessity for any optimization project to succeed. TOS providers will likely focus on limited-scope proofs of concept, which can help terminals validate the technical solution and its impact on key performance indicators, such as productivity and safety. These pilot projects help build confidence in future ML and GenAI usage, allowing for gradual, evidence-based scaling within TOS.

Adopting ML and GenAI into TOS doesn't require a complete overhaul; it's about implementing the right building blocks. Leading tech companies have adopted a similar approach, creating foundational GenAI tools that allow businesses to build their own custom applications rather than relying on off-the-shelf solutions.

At Tideworks, we take a core-and-extend approach by utilizing a core TOS and extending it with enhancements like ML and GenAI. Adopting a modular AI foundation empowers terminals to work with solutions that address their specific needs. This modular approach also provides future flexibility as the terminal operator's needs change. Lastly, modular approaches also help with adoption among terminal personnel.

Where all thrive

Integrating AI, ML, and GenAI into terminal operations presents significant opportunities, but success depends on a strong foundation of timely data and robust data tools. Implementing a platform that collects, standardizes, and governs data creates an environment where ML, GenAI, and TOS all thrive, enhancing decision-making, efficiency, and operational excellence.

With careful planning, clear objectives, integration of data tools, and workforce engagement, terminals can leverage GenAI's transformative potential in a smart and fiscally responsible manner. ■

Chad joined Tideworks Technology with over 20 years of experience delivering innovative large-scale products and services to markets across a range of industries. Heading Tideworks' Product Management organization, Chad is responsible for injecting innovation, continuous improvement, and increased stability across the company's product suite. Chad was named Most Innovative Technology Consultant in the United States by Wealth and Finance International. As an executive, entrepreneur, author, and speaker, Chad has had a cross-industry impact on businesses through cutting-edge tech and critical foresight. Prior to joining Tideworks, Chad was Vice President at SAP, where he led their Universal ID offering as part of the company's Customer Data Cloud product and directed data management products and services supporting the migration to SAP S/4HANA ERP.

Exploring lessons from nature to develop sustainable products

SMOOTH SAILING

by Kazuaki Masuda, *Corporate Officer, Technical Division Director, Nippon Paint Marine*

Since the earliest days of ocean transport, microorganisms, plants, algae, and animals attached to vessel hulls have been a (literal) drag on the maritime industry. Biofouling has a significant effect on operational performance, not only slowing ships down but impacting manoeuvrability and significantly reducing energy efficiency. Biofouling has been found to reduce vessel speed by up to 10%. Without dealing with it, maintaining speed can require as much as a 40% rise in fuel consumption, increasing operational costs and hindering efforts at regulatory compliance.

Historically, the response of the shipping industry to this challenge was to coat vessel hulls with compounds which were toxic to sea life but reduced the build-up of plants, algae, and other organisms. Lead, mercury, and arsenic were eluted into the ocean to prevent the build-up of organic matter on vessel bottoms. Due to the negative impact that the use of such coatings had on non-target organisms, they have, with the support of coatings manufacturers, been banned.

While preventing the destruction of marine life in our oceans is a positive outcome of the declining use of highly toxic compounds, if shipping cannot solve the challenges of decarbonisation linked to emissions from high energy consumption, the life in our seas and oceans will nonetheless remain under threat. Coatings that restrict biofouling and reduce friction between the hull and the seawater are a proven means of significantly reducing fuel consumption by preventing speed loss. Such hull coatings offer an immediately accessible and sustainable solution for managing energy efficiency and cutting carbon emissions.

The 'secrets'

At Nippon Paint Marine, we have turned to the natural world for inspiration. For more than 140 years, we have pursued ongoing product innovation to help our customers in the maritime industry meet the evolving needs and challenges they face. Today, the R&D programme at our company helps shipowners push forward their decarbonisation efforts while protecting the marine environment and ocean ecology.

Since 2001, Nippon Paint Marine has followed the principles of biomimicry in its innovation efforts. It is a research methodology that attempts to develop innovative and sustainable technologies by copying strategies and solutions found in nature. What works 'naturally' has been tested by time, and by understanding the 'secrets' of these solutions, we can work to replicate them and develop new technologies to solve human challenges.

Hydrogels are a key example of technology developed through the study of biomimicry. Nippon Paint Marine has incorporated hydrogel technology into our hull coatings in an attempt to smooth water flow around the hull and reduce hull-to-water friction. The hydrogel developed by our R&D experts – HydroSmoothXT™ – is a polymer network that holds water. By reducing frictional resistance and lowering drag, this hydrogel improves energy efficiency, reduces fuel consumption, and helps to cut emissions significantly.

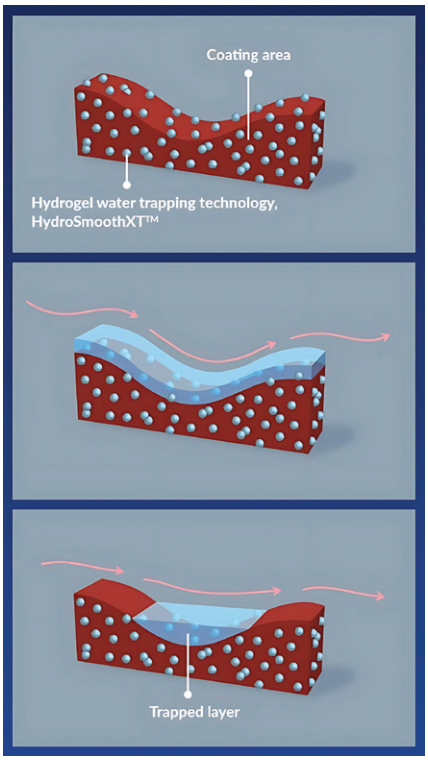
Hydrogels are known to exist on the body surfaces of many marine organisms and have been credited with contributing to the high swimming speeds that certain marine animals can achieve. By studying such natural phenomena and taking a scientific approach to reproducing their natural characteristics in our products, the R&D team aimed to create technologies that could provide innovative solutions to the issues our customers faced.

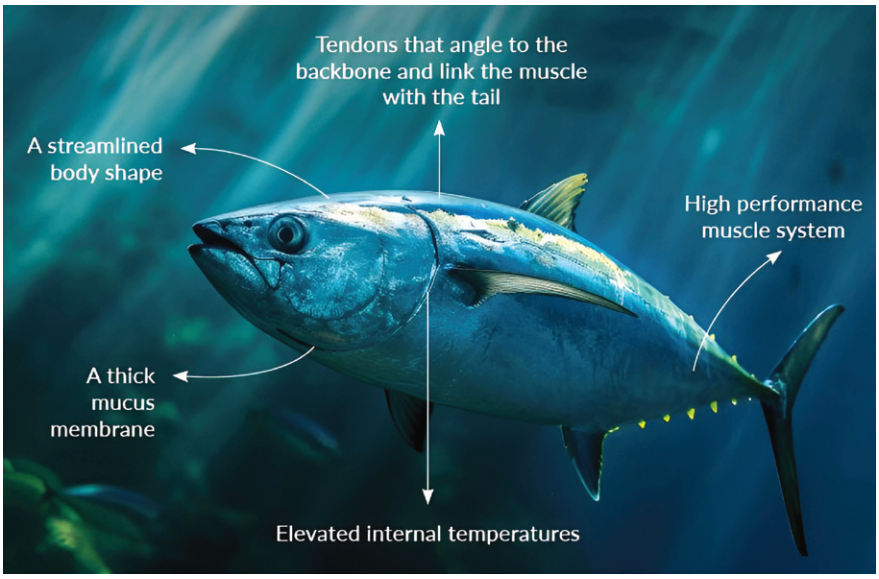
Tuna-efficient

Across its biomimetics programme, Nippon Paint Marine researchers have sought out partnerships with experts to inform their research efforts to better understand these natural phenomena. The programme looked at the best ways to develop subsequent technology, commercialise it, and identify which industrial patents would be required. In developing a hydrogel to reduce friction, the research team looked at two supremely fast marine animals: tuna fish and dolphins.

The former can swim at speeds reaching 100 kilometres per hour. They have physiological adaptations to support such high speeds, including body shape, elevated internal temperatures, and a high-performance muscle system. But they also have hydrodynamic systems, special substances on the surface of their bodies, that reduce friction & drag and aid faster swimming speeds.

Nippon's R&D team focused on the thick mucous membrane that tuna have,





PHOTOS: NIPPON PAINT MARINE

which secretes viscous substances with a high affinity for water, a process often argued to support lower resistance. We persisted with research to imitate this natural phenomenon and design a hydrogel that could be included in our paints. The theory was that this would create a hull coating that 'trapped' a layer of seawater in a surface boundary membrane, which would deliver more controlled turbulence generation on a vessel's hull and reduce friction.

Over a five-year programme, Nippon Paint Marine scientists worked with colleagues at Osaka University to develop the hydrogel as a practical application. Investigating the relationships between surface roughness and fluid dynamics, understanding the chemical properties of hydrogel materials, and designing them into hull coating formulations. Having delivered a product that would reproduce the effects observed in nature, the team developed an industrial process for Nippon Paint Marine's unique water trapping technology, HydroSmoothXT™, which has featured in our LF-SEA, A-LF-SEA, and FASTAR coating lines for over 15 years and applied to more than 5,000 vessels. Crucially, in trials, we have been able to identify fuel and emission savings of up to 14% for ships using these coatings compared with conventional technology.

Breaking new ground

Nippon Paint Marine's commitment to constantly innovating our product line to meet clients' evolving needs is a core pillar of our business. To adapt to the increasingly challenging operational environment, the maritime industry needs to embrace new and innovative solutions that support continued commercial competitiveness.

Biomimetics represents one such means by which Nippon Paint Marine has broken new ground in hull coating performance, enabling our customers to operate more sustainably and reduce their impact on the marine environment. ■

NIPPON PAINT MARINE Nippon Paint Marine offers innovative marine coating solutions that are biocide-free, self-polishing, and nanotechnology-based. The company's antifouling and other systems have been applied to over 40,000 vessels, from tankers and container ships to cruise liners and yachts. Nippon Paint Marine also supports customers throughout the lifetime of their asset, providing technical, training, and ongoing monitoring services to ensure its continued integrity and performance. Visit nipponpaint-marine.com to learn more.

YESTERDAY'S FOSSIL FUEL INFRASTRUCTURE – TOMORROW'S CLIMATE SOLUTIONS

by Alexa Ivy

The Dutch climate tech start-up SeaO2 has announced a bold vision to turn the ocean into a climate solution, harnessing innovative technology to remove carbon dioxide at a gigatonne scale. The company has recently secured over €2.0 million in funding to accelerate the development of its Direct Ocean Capture (DOC) technology. Their approach targets extracting CO_2 directly from seawater, hence addressing the dual challenge of climate change and ocean acidification. The recent investment will enable SeaO2 to transition from prototype development to a fully operational pilot plant, set to launch by mid-2025 and scale its tech towards the ambitious goal of removing one gigatonne of CO_2 annually by 2045.

At the core of $SeaO_2$'s approach lies its innovative technology. Unlike land-based carbon capture solutions that face limitations in scalability and cost, DOC leverages the vastness of the oceans. As the world's largest natural carbon sink, oceans absorb around 25% of global CO_2 emissions per year. However, this process has contributed to rising ocean acidification, threatening marine ecosystems and biodiversity.

The company's technology directly tackles these challenges by extracting CO_2 from seawater and returning carbon-free water to the ocean. This process effectively resets the equilibrium, enabling the ocean to absorb more atmospheric CO_2 while mitigating acidification. "Our goal is to create a sustainable, scalable solution that delivers measurable climate benefits while protecting the oceans," underscores Ruben Brands, CEO and Co-founder of $SeaO_2$. The captured CO_2 can be permanently sequestered in geological formations or utilised in industrial processes, supporting the transition to a growing circular carbon economy.

A multifaceted platform for combating climate change

$SeaO_2$'s long-term vision involves establishing offshore DOC hubs, a transformative concept designed to repurpose decommissioned oil & gas platforms. This is a significant opportunity, given S&P Global's forecast that worldwide offshore decommissioning expenditures could reach nearly $100 billion between 2021 and 2030. These hubs will serve as integrated sites for carbon removal, powered by renewable energy from offshore wind farms, something that will not only support the relatively energy-intensive DOC process but also assist with grid balancing. "We see an incredible opportunity to turn yesterday's fossil fuel infrastructure into tomorrow's climate solutions," says Brands.

$SeaO_2$ envisions creating offshore hubs co-located with geological CO_2 storage facilities, enabling the permanent sequestration of captured carbon. These hubs will serve as scalable solutions for DOC, addressing the gigatonne-scale carbon removal challenge. To speed up global deployment, $SeaO_2$ plans to implement a licensing model that empowers partners globally to establish their own hubs, creating a robust, interconnected network of carbon removal and storage facilities.

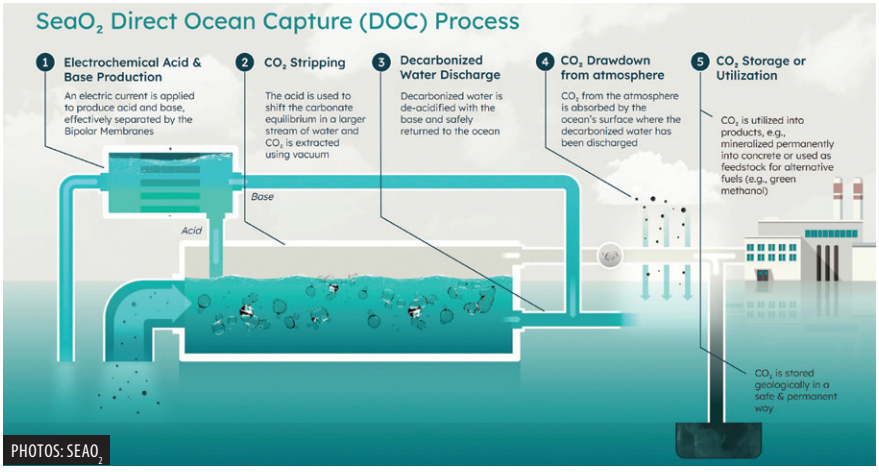
These hubs will additionally unlock broader decarbonisation opportunities by supporting hydrogen production through third-party collaborations. The captured CO_2 and produced hydrogen can be combined to generate green methanol, providing offshore access to net-neutral fuels. This vision aligns with efforts to decarbonise hard-to-abate sectors, such as maritime transportation, enabling ships to bunker sustainable fuels directly at these offshore hubs.

By integrating carbon removal, storage, and renewable fuel production, $SeaO_2$ aims to transform offshore infrastructure into a multifaceted platform for combating climate change and advancing the energy transition.

From lab- to giga-scale

The €2.0+ million funding round – led by investors such as DOEN Participaties, NOM NEW-TTT fund, Future Tech Ventures, CarbonFix, and Transavia Ventures – marks a significant milestone in $SeaO_2$'s journey. This investment will enable the company to build its first pilot plant with an annual capacity of 250 tonnes of CO_2 removal. The facility, scheduled for launch in the summer of 2025, represents a key step towards demonstrating the commercial viability of $SeaO_2$'s technology.

"This funding is a recognition of the hard work and dedication of our team," underlines Brands. "It allows us to transition from lab-scale prototypes to real-world implementation, bringing us closer to our goal of removing one megatonne of CO_2 by 2030 and scaling to a gigatonne by 2045." To this DOEN Participaties added, "We are investing in $SeaO_2$ because current carbon removal methods are not yet effective at the required scale. Therefore, innovations like $SeaO_2$ are urgently needed, and funding is essential to drive the sector forward and unlock its potential for global impact." CarbonFix, another key supporter, highlighted, "CarbonFix is proud to have helped build this coalition. Our role in the ecosystem is to catalyse networks, funding, and talent to unlock innovative pathways in the fight against



PHOTOS: SEAO2

climate change. SeaO$_2$ is a prime example of this impact."

Apart from building the pilot plant, SeaO$_2$ will use the funding to enhance its team and develop a robust monitoring, reporting, and verification system. This ensures that the company's carbon removal efforts are transparent, verifiable, and aligned with industry standards.

In the meantime, SeaO$_2$ has established strategic partnerships with leading organisations, including XPRIZE Carbon Removal, the Delft University of Technology, Wetsus, and Redstack. These collaborations have been instrumental in advancing the company's technological innovation and market reach. Notably, SeaO$_2$ participated in a successful carbon removal project with Paebbl in the Wadden Sea as well as achieved recognition among the top 100 teams in the prestigious XPRIZE competition. The company also delivered award-winning pitches at high-profile events, including The Next Web, Tech Tour Oceans, and Tech Tour Water. "Our journey has been accelerated by these partnerships and the insights we've gained through programmes like XPRIZE, PortXL, and Ocean Vision," Brands shares. "Each step brings us closer to scaling our impact globally."

Pump and process

While the long-term vision focuses on offshore hubs, SeaO$_2$ is taking immediate steps to integrate its technology with industries that already use seawater in their operations. These include thermal power plants that utilise water for cooling, desalination plants, wastewater treatment facilities, and aquaculture operations.

By collaborating with these sectors, SeaO$_2$ can leverage existing infrastructure to reduce costs and step up deployment. This tactical approach allows the company to demonstrate the feasibility of its technology and establish early success stories, building momentum for larger-scale adoption. "Working with industries that already pump and process seawater is a pragmatic way to achieve short-term impact while paving the way for our larger vision," Brands explains.

A powerful ally

SeaO$_2$ aims to remove one gigatonne of CO$_2$ annually by 2045, a target that aligns with global efforts to achieve net-zero emissions. By combining innovative technology with strategic partnerships, visionary funding, and a clear roadmap, the company is well-positioned to meet this ambitious target. "Our vision is to transform the ocean into a powerful ally in the fight against climate change," Brands shares. "With the right support and collaboration, we can scale our impact to the level required to make a real difference."

By integrating its technology into existing industries and establishing offshore hubs powered by renewable energy, SeaO$_2$ is creating a scalable and sustainable framework for global carbon removal. As the company moves towards large-scale implementation, it stands as a beacon of hope in the battle against climate change. ■

SeaO$_2$ The mission of SeaO$_2$ is to protect our planet from getting warmer and warmer – by reducing the CO$_2$ concentration in the ocean and indirectly in the air. To keep us all cool. To de-acidify our oceans so pH is restored. To benefit biodiversity. Founded in 2021 and born from tech developed in the Delft University of Technology and Wetsus' laboratories, SeaO$_2$ provides cost-efficient atmospheric carbon removal by leveraging our biggest ally in battling climate change – the ocean. Check seao2.com to learn more.

MORE!

by Ewa Kochańska

The report Wind Energy in Europe: 2024 Statistics and the Outlook for 2025-2030, *published in February this year by WindEurope, provides a comprehensive analysis of the wind energy sector's performance in 2024 and projections for the upcoming years. Europe added 16.4 gigawatts of wind energy capacity last year, with the EU accounting for 12.9GW. By the end of 2024, Europe's total wind power capacity reached 285GW, comprising 248GW on- and 37GW offshore. The report emphasises the need for accelerated wind farm deployment and supportive government policies to ensure that wind energy can assist Europe in its transition to a sustainable future.*

In 2024, wind power supplied 19% of the EU's electricity. Looking ahead, the report forecasts the addition of 187GW of new wind power capacity in Europe between 2025 and 2030, averaging over 31GW annually. The EU-27 is expected to contribute 140GW to this growth, aiming for a total installed capacity of 351GW by 2030.

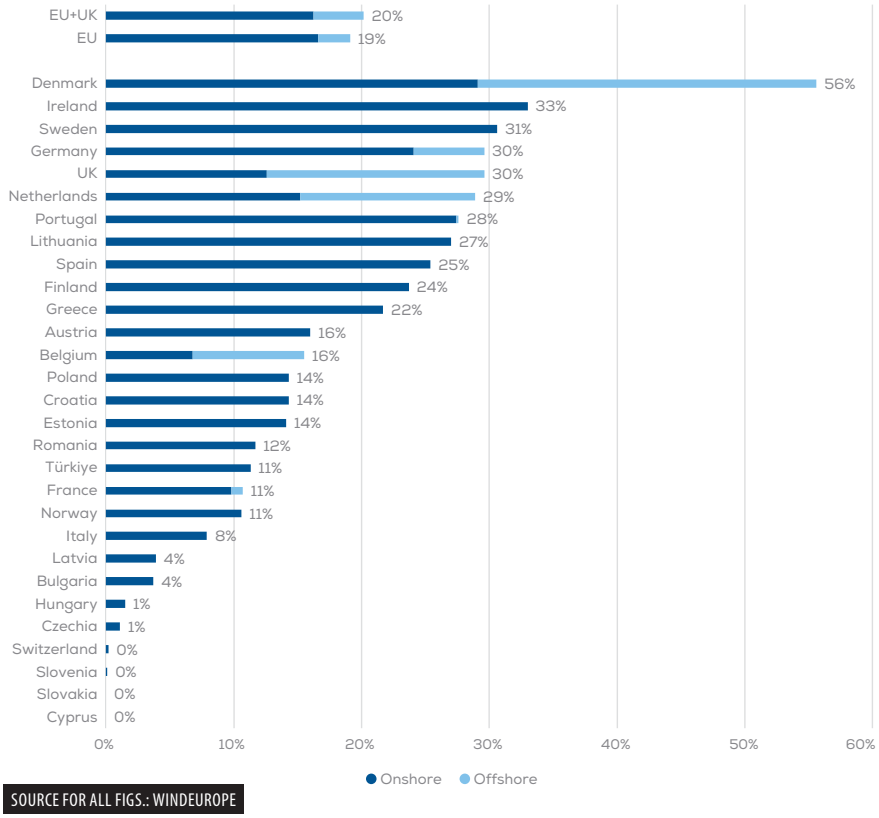
However, to meet the EU's renewable energy target of 42.5% by 2030, installations would need to reach 425GW. Recognising the great potential of wind energy, particularly in decarbonisation and climate goals, as well as economic and energy security, scaling up the development of new wind farms is critical.

Onshore installations take the cake

At this point, land installations are more common than offshore due to much lower construction and maintenance costs; onshore wind farms accounted for 84% of the total new wind capacity added in Europe in 2024.

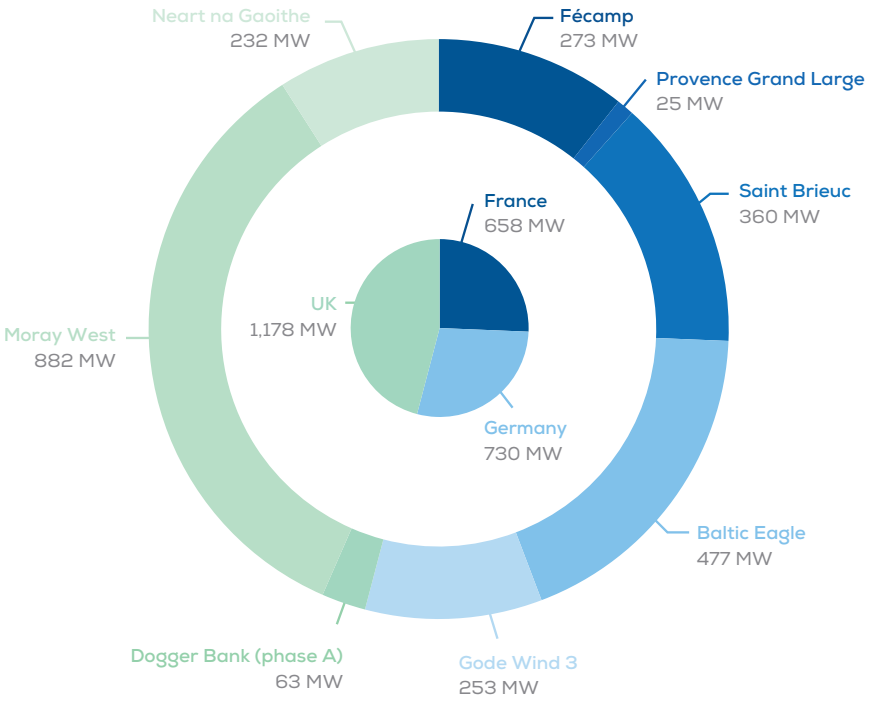
Germany was the leader in onshore wind development, adding 3.3GW from 644 turbines with an average power rating of 5.1 megawatts. Net additions amounted to 2.6GW after 712MW of decommissioned capacity. Finland ranked second with 1.4GW

Fig. 1. Percentage of electricity demand covered by wind in 2024



SOURCE FOR ALL FIGS.: WINDEUROPE

Fig. 2. New offshore wind capacity connected in Europe in 2024



from 235 turbines, maintaining an average rating of 6.0MW. Türkiye doubled its previous year's capacity with 1.3GW (average power rating 4.8MW), driven by ongoing capacity extensions and the 1,000MW YEKA-2 projects. Spain also nearly doubled its volume from 2023 by adding added 1.2GW (power rating of 5.2MW), while France's 1.1GW addition marked a decrease from 2023 (average power rating 2.8MW – one of the lowest in Europe in 2024). Sweden, with 1,015MW from 165 turbines, had an average power rating of 6.2MW.

Poland, the UK, Italy, and Lithuania completed the Top 10 for new onshore wind capacity in 2024. Poland's 805MW was hindered by height restrictions from the 10H rule (requiring that new installations must be located at least the distance of 10 times the turbine's height – including the blade in its upper-most position – from the nearest buildings), resulting in a lower average power rating of 3.3MW. Italy added 685MW with a 4.1MW average power, while the UK installed 739MW at a 3.7MW average power rating. Lithuania saw a record 522MW of new capacity, achieving Europe's highest average power rating (alongside Romania) at 6.3MW. Overall, the European onshore wind sector faced regulatory and supply chain challenges yet saw significant contributions from multiple nations.

Onshore wind energy is projected to dominate Europe's renewable installations, with 140GW of new capacity expected between 2025 and 2030, accounting for three-quarters of the continent's 187GW total. After accounting for decommissioning, the total onshore capacity in Europe is estimated to reach 366GW by 2030, with the EU contributing 113GW of the new capacity. The capacity labelled in the report as 'already awarded in auctions' is expected to add around 26GW by 2027 for the whole continent. Meanwhile, the capacity of 'scheduled to be auctioned' and 'expected to be auctioned' could contribute an extra 35GW and 13GW, respectively, by 2030.

There are also 'non-auction projects' that concern wind power capacity completed without central auctioning systems on power purchase agreements or exclusively on a merchant basis. This last category is prevalent in countries with no government support, such as Sweden and Finland, and the capacity from such systems is expected to amount to 39GW in 2025-30.

Overall, the onshore wind sector in Europe is poised for significant growth, but much of the capacity depends on successful auctions and the effective implementation of non-auction projects.

Offshore – sailing against the wind

Installations out there in the sea lag behind those ashore, posing significant cost, construction, infrastructure, maintenance, and environmental challenges. However, it is important to note that they also offer benefits that surpass those of onshore wind farms, such as greater wind energy efficiency because of higher wind speeds and consistency.

In its calculations, WindEurope only reports new offshore energy capacity that's actually grid-connected and generating energy. Since offshore wind farms are much bigger than onshore, they take much longer to build and connect to the grid. Therefore, some turbines might have already been built but are not counted in this report because they are not yet operational.

All that considered, last year, Europe added 2.6GW of offshore wind power across eight wind farms in three countries. The UK led with 1,178MW from three sites, including the full connection of 60 turbines at Moray West (882MW) and contributions from Neart na Gaoithe (296MW) and Dogger Bank Phase A (1.2GW), averaging a power rating of 12.7MW per turbine (so over three times stronger than the country's land ones). Germany connected 730MW from Baltic Eagle (477MW) and Gode Wind 3 (253MW) with 73 turbines and a power rating of 10MW. In France, 658MW was added from Saint Brieuc (496MW), Fécamp (497MW), and the pilot Provence Grand Large floating project (25MW), with 87 turbines averaging a power rating of 7.6MW. Additional construction took place at six wind farms in the UK, France, and Germany, but their turbines have not yet been connected to the grid.

Europe has set far-reaching goals for its offshore wind sector, recognising its potential for enhancing the continent's energy security, helping to achieve climate goals, lowering noise pollution and visual impact, and creating job opportunities with stable prospects. The initial target set for Europe was 114GW of offshore wind power by 2030, later raised to 158GW. That said, many countries have scaled back these goals due to challenges in setting regulatory frameworks, upgrading grids, and developing supply chains. Despite slower-than-expected progress, new offshore wind projects are expected to come online shortly after 2030; nevertheless, the report states that achieving the original goals on time now seems unlikely.

A significant obstacle to offshore wind expansion in Europe is the slow implementation of offshore auctions (often due to rule drafting or the absence of related regulations). This leads to uncertainty in project timelines and complicates supply chain

Fig. 3. Distribution of new wind installations by country in 2015-24

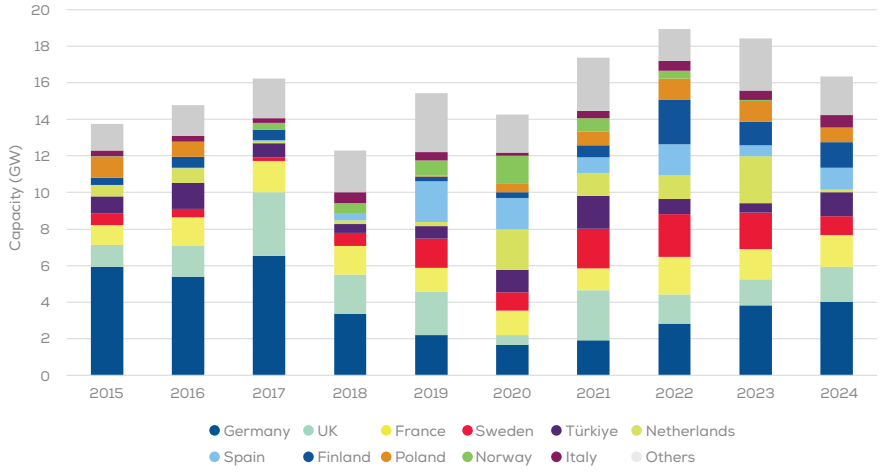
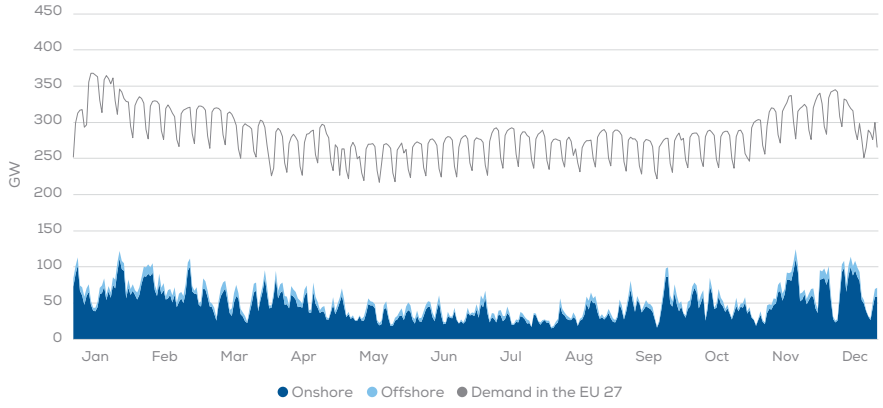


Fig. 4. Power demand and wind energy generation in the EU-27 in 2024 (GW)



development. Although parts of the supply chain are expanding along with the projects, certain elements require longer planning.

Yet, the most critical constraint for offshore development is port capacity. While current seaport facilities can support offshore wind projects until 2028, planned installations are expected to exceed capacity the following year, even when accounting for expansions. "We, therefore, expect offshore project delays to become a major bottleneck across Europe from 2029," says WindEurope in its latest summary. With port development taking 6-10 years, urgent expansion investments are needed to prevent offshore project delays. Additional problems are posed by lagging electrical grid development, inadequate management of connection requests, and outdated grid permitting methods, which hinder project prioritisation.

Vessel availability also creates a conflict. Of around 80 ships supporting offshore wind construction in Europe, only five can handle the largest 14-15MW turbines, which will be the norm by 2030. Demand from global markets and seasonal deployment of ships in the Southern Hemisphere further strain availability. Building new vessels takes 2-3 years, underscoring the importance of timely investments.

Although challenges have delayed offshore wind ambitions in Europe, the sector's outlook remains positive, according to WindEurope. Governments are still committed, and while installations may lag by 1-2 years, a decline in deployment is not anticipated. The EU is projected to reach 48GW of offshore wind capacity by 2030, with 29GW of new installations planned between 2025 and 2030. The majority of this capacity, 24GW, comes from projects already awarded in auctions and considered reliable. An additional 3.0GW is expected from projects scheduled for future auctions, though their timelines remain uncertain until rights are secured. A smaller portion, around 1.0GW, consists of non-auction projects, primarily in Sweden and Finland, which face greater uncertainty regarding their development schedules (especially in the former, whose military is, for this or another reason, against offshore wind energy, a stance sharply contrasting their EU-Baltic counterparts' approach).

By 2030, Europe's total offshore wind capacity is anticipated to reach 84GW, with 39GW from awarded auctions, 8.0GW from upcoming auctions, and less than 1.0GW from non-auction projects. Despite some uncertainties, the outlook for offshore wind expansion remains strong, supported by a mix of auction-backed projects and open development systems.

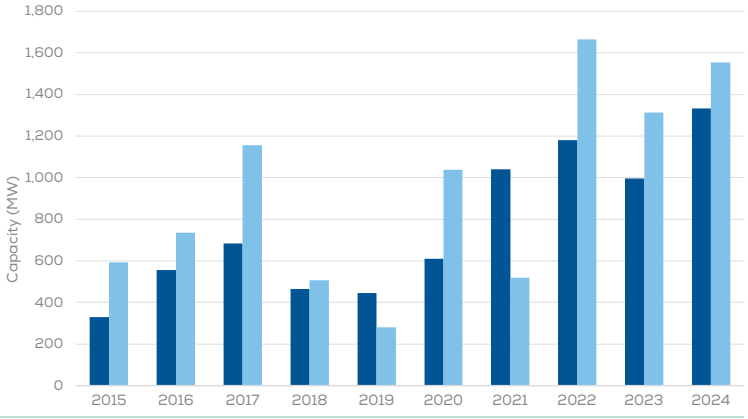
Let there be light (but first, wait to be connected)

Electrification is a key strategy for enhancing resilience and decarbonising Europe, as the European Commission's (COM) *Competitiveness compass* from January 2025 underscored. The EU report highlights Europe's heavy dependence on imported fossil fuels, a vulnerability particularly exposed by Russia's use of energy as a geopolitical (power)tool. The WindEurope report warns that to reduce this reliance, the EU must rapidly expand clean energy and promote electrification.

The COM's Clean Industrial Deal aims to drive electrification by supporting operating and capital expenditures for renewables-based processes. According to the COM's impact assessment, electricity's share of final energy consumption is set to double to 50% by 2040, with generation increasing from 3,360TWh in 2030 to 4,560TWh in 2040. Wind energy will be critical in meeting this demand, potentially quadrupling output by providing 1,830TWh if annual deployment reaches 30GW throughout the 2030s. Streamlined permitting (e.g., Germany increased permitting sevenfold over the last four years), digitalisation, and binding EU permitting rules are essential for accelerating wind deployment.

However, Europe's electricity grid remains a significant bottleneck, hindering renewable energy deployment and competitiveness. Continual underinvestment has resulted in lengthy grid connection queues, curtailment issues, and weakened investment incentives. Over 500GW of wind capacity across multiple European countries awaits grid connection assessments. To address this challenge, the report calls for national authorities, TSOs, and DSOs to adopt dynamic and strategic management of grid connections, moving away from the 'first come, first served' model and implementing prioritisation and filtering criteria. The EU's Action Plan for Grids calls for

Fig. 5. Decommissioned and repowered capacity in Europe in 2015-24



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Decommissioned capacity	329	555	684	466	444	610	1,041	1,180	997	1,332
Repowered capacity	593	735	1,155	508	281	1,037	519	1,666	1,314	1,555

more than €584 billion in investments this decade, primarily for national grid expansion. This requires long-term planning from system operators, risk mitigation tools for investment recovery, and enabling private investment while adhering to unbundling regulations. Strengthening Europe's electricity grids is essential to unlocking renewable energy potential, phasing out fossil fuels, and creating a sustainable investment environment for clean energy.

With great power comes the need for repowering

In 2024, wind energy provided 19% of the EU's electricity demand – the same as in 2023, despite increased output, as electricity consumption rose 1.4%; onshore installations generated 16.6% and offshore 2.5%.

Denmark led Europe, with wind covering 56% of its demand, while Ireland came in second at 33%. Sweden's share grew significantly from 26% in 2023 to 31% in 2024, following a 6.0% increase in installed capacity and improved fleet efficiency, surpassing Spain, the Netherlands, the UK, and Germany. Estonia, Finland, and Lithuania also saw significant gains, with Lithuania's share rising from 21% to 27%, Finland's from 18% to 24%, and Estonia's from 10% to 14%. The UK ranked fifth in Europe with wind energy meeting 30% of its needs, while the Netherlands used wind energy for 29% and Portugal for 28% of their energy demand. Combined, the EU and UK produced 557TWh of wind power, meeting 20% of their joint electricity demand. The UK's offshore capacity alone generated 47TWh (which would cover Hungary's entire demand of 43TWh).

The power capacity of wind turbines has seen a significant rise over the past decade. Onshore turbines installed in 2024 had an average power rating of 4.6MW, a slight increase from 4.5MW in 2023 but an impressive 84% growth from 2.5MW in 2015. Recent innovations include turbines with larger rotor diameters and lower power ratings, designed for low-wind sites, expanding viable project locations. Orders placed in 2024 averaged a record 5.7MW, suggesting continued growth in onshore turbine capacity. Offshore turbines in Europe also experienced notable advancements, with average power ratings increasing 2.4 times over the last decade and more than 25% since 2022. Offshore orders in 2024 averaged 14.8MW, slightly above 14.7MW in 2023, and introducing even more powerful turbines promises further capacity growth in the coming years.

Despite these positive trends in turbine technologies, fluctuations in hard-to-control circumstances, such as changing demand and weather conditions, have impacted generation last year. Inconsistency is a natural aspect of wind power; winter months see greater fluctuations, while summer's stable, high-pressure systems reduce output and variability. Poor wind conditions in 2024 reduced output in Ireland and the UK; on the flip side, favourable weather boosted production in Sweden, Norway, Finland, and the three Baltic States. Estonia and Finland saw a 39% increase in generation, while Lithuania's output surged by 37% compared to 2023. The EU-wide capacity factor averaged 24%, with onshore wind at 23% and offshore at 35%. Here, the age of the installations also plays a role; new wind farms boast higher generation capacity than older ones, with onshore capacity from 30-35% and offshore from 42-55%.

Wind farms do have a finite lifespan, typically ranging from 15 to 25 years for older installations (modern turbines are designed for longer use). When a wind farm reaches the end of its operational life, decommissioning involves dismantling and removing turbines unless their life is extended through upgrades. Repowering can still be a better option, replacing outdated components with advanced technology to enhance efficiency and output.

In 2024, 1.3GW of wind capacity was decommissioned across eight European countries. Repowering contributed 1.6GW out of 16.4GW of new wind installations in Europe (mainly from Germany). Repowered projects are strategic as they leverage existing infrastructure and permits, making them less challenging than new developments. The decision to repower wind farms is influenced by electricity prices, incentives, and environmental regulations, varying by region and project age. Repowering is more common with younger wind farms due to clear economic benefits, while older ones are often maintained until decommissioned. The EU supports repowering by mandating shorter permitting timelines under the 2023 Renewable Energy Directive. However, national challenges persist, such as Italy's auction rules that require discounted bids in repowering, which do not account for decommissioning costs.

By 2030, annual installations from repowering are expected to increase from 1.4GW to over 5.0GW, totalling 21GW, while around 22GW of older wind farms will be decommissioned. Despite this growth, repowered wind farms will only represent 8.0% of Europe's installed capacity by 2030. Though repowering is essential to Europe's energy and climate strategy, persistent challenges like regulatory obstacles and policy discrepancies must be addressed to fully capitalise on repowering potential and strengthen Europe's renewable energy framework.

To speed up wind energy deployment in Europe, cabinets (central and local alike) must modernise and expand electricity grids, enhance port infrastructure, and fully implement the EU's new permitting rules. Streamlining approvals should be a governmental priority across the continent. Additionally, increased investments in grid capacity, ports, and vessels are needed to support offshore wind growth.

Consistently deploying onshore and offshore wind farms at scale is essential to meet the EU's 2030 target of 425GW and drive economic resilience while reducing reliance on fossil fuels. ■

WHEN SOFT MEANS STRONG

by Steven Gosling, *MSc AFNI, Head of Information and Publications, The Nautical Institute*

Over decades, if not centuries, the maritime industry has developed technical expertise, rigorous safety protocols, and the ability to navigate complex global supply chains. As the sector continues to evolve, it's becoming increasingly clear that technical proficiency alone is not enough. So-called 'soft' or non-technical skills – such as communication, leadership, problem-solving, and teamwork – are now understood to be key to ensuring smooth operations, enhanced safety, and a positive working environment on board and ashore.

Interpersonal and emotional competencies enhance the ability to act appropriately during critical situations, adapt to diverse teams, and maintain clear communications. These skills can be the difference between success and failure; hence, they must not be neglected in a demanding industry in which the safety of crew and vessel is paramount.

The human element

At the heart of maritime operations lies the human element: the interactions, behaviours, and decisions of individuals and teams. While automation has streamlined many processes, it has not eliminated the need for decision-making, leadership, and interpersonal communication. Mariners must now work symbiotically with advanced systems, bridging the gap between technology and human intelligence.

Effective team management, critical thinking during emergencies, and the ability to foster a culture of inclusion are irreplaceable components of successful maritime operations. Safety is, in particular, closely linked to soft skills, making them essential. Clear communication, mutual respect, and shared decision-making can prevent accidents, reduce human error, and enhance overall efficiency.

Not something to take for granted

When people are operating in isolated and high-risk environments at sea, clear and effective communication underpinned by emotional intelligence is vital. Any friction within the team is also exacerbated by the need to work and live together for months at a time.

Poor communication has been identified as a significant factor in maritime accidents and operational inefficiencies. Many reports by the UK's Marine Accident Investigation Branch reveal that miscommunication has contributed to numerous collisions and near-misses at sea. Clearly, effective communication is not something to take for granted but is a skill we need to develop. This can be done through training as well as experiences, such as respectful relationships, kind leadership, and mentoring.

An important element of soft skills training is embedding the concept of respectful relationships. Respectful behaviour should be set as a ground rule for all communications and professional relationships. Soft skills training provides participants with practical tools on how to engage with each other with respect – even when they disagree. These tools can include asking questions to understand the perspective of others instead of rushing to judgment in reaction to something said.

Leadership and teamwork are, too, essential for maintaining morale and operational efficiency. Crew members must be able to work collaboratively, resolve conflicts, and adapt to challenging situations. In emergencies, strong leadership and excellent team cohesion can make the difference between a controlled response and chaos. Being a strong leader does not necessarily mean being autocratic. Kind leadership embeds respect and empathy and fosters collaboration, effective communication, and performance improvements. Adopting such an approach can be considered a formal mentoring process since it builds everyone's skills, both technical and soft.

Two-way knowledge transfer

One of the most effective examples of respectfully applying soft skills in the maritime industry is in the use of mentoring. The ocean has always been a challenging working environment, but today's fast-changing technology and the introduction of novel fuels demand new skills from cadets and experienced seafarers alike. The key to handling these changes lies in one of the most time-honoured maritime traditions: mentoring.

Mentoring is crucial for cadets learning to navigate life at sea. Experienced crew members sharing real-world insights and practical knowledge through mentoring help bridge the gap between formal training and real-life operations. It is not only the less-experienced seafarers who can benefit from mentoring; senior officers adapting to new technology can also learn from the new generation, so a mutually respectful relationship develops.

Creating an environment where mentoring occurs naturally is essential. As

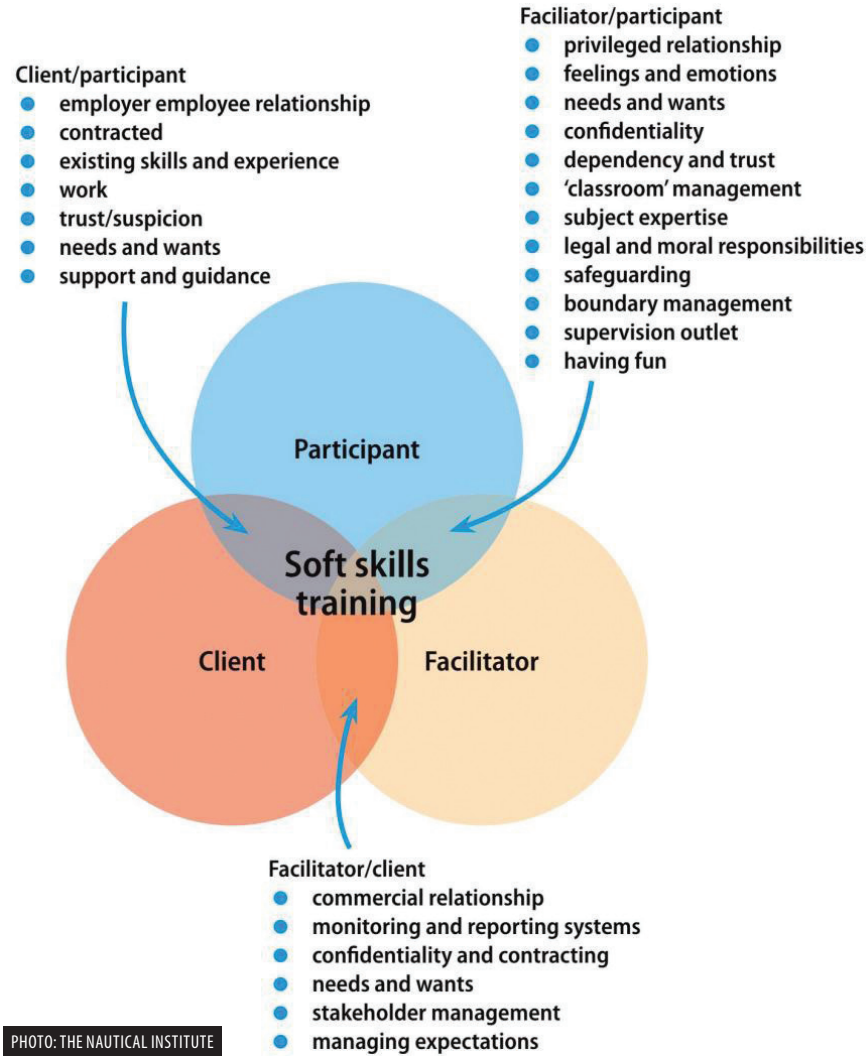


PHOTO: THE NAUTICAL INSTITUTE

such, The Nautical Institute has set seafarers a challenge to spend just 10 minutes a day calmly reflecting and sharing experiential knowledge and support with a colleague, and this knowledge can be paid forward to their juniors or seniors. This challenge is not only an invitation to be available to mentor someone else but also to be mentored and seek the wisdom of someone else, no matter their age, rank, or experience. The Nautical Institute published the second edition of *Mentoring at Sea* last year (and here you can find an introductory extract).

Overcoming cultural barriers

Ships today are more multicultural than ever, and working with colleagues from diverse backgrounds presents both challenges and opportunities. While language and cultural differences can sometimes hinder effective communication, they also enrich and broaden the experience and skills on board. By fostering an environment of mutual respect and understanding, kind leaders and mentors can bridge cultural gaps, tap into a wide range of know-how, and create stronger, more cohesive teams.

A simple yet effective way to encourage inclusivity is by ensuring a common language is spoken aboard. Experience has shown that when crew members consciously make efforts to include all nationalities in discussions, mentoring and leading become more effective, overall teamwork improves, and people are simply happier. This can improve the overall mental well-being of the entire crew.

How to develop soft skills

Unlike technical competencies, soft skills are not easily measured or taught through traditional classroom methods. These competencies require interactive, experiential learning that encourages self-reflection and adaptation. For facilitators of soft skills training, the goal is to create an engaging and psychologically safe environment where mariners can explore these skills and apply them in real-world scenarios. Participants must feel free to question what they do not understand and believe that their desire to fill gaps in their knowledge is actively encouraged.

Senior officers and team leaders play a crucial role in this process. As role models leading by example, they have the power to instil essential soft skills in their crew. By recognising appropriate moments to mentor and guide their teams, such leaders can ensure that every member is equipped to handle challenges effectively.

Structured role play also has an important part to play in developing soft skills because it allows teams to practise resolving conflicts and explore how they will navigate disagreements in a simulated environment. There is also great value to be extracted from more formal teaching of soft skills. The graphic shown illustrates how different stakeholders can interact with each other during such sessions.

The bedrock

The maritime industry is at a crossroads. As technology advances, it's imperative to remember that people remain at the core of every operation. Investing in the development of soft skills is not merely a nod to modernity but a strategic necessity that enhances safety, supports well-being, and drives organisational success.

By prioritising these often-overlooked competencies, maritime organisations can build a future in which every seafarer – whether on the bridge, in the engine room, or ashore – is empowered to lead, collaborate, and thrive. Soft skills are not just a complement to technical expertise; they are the bedrock of a resilient and progressive maritime culture. Let's ensure soft skills receive the attention they deserve. ■

The Nautical Institute is an international membership organisation for maritime professionals, working at sea and ashore, and one of the sector's leading authorities. We are an educational charity dedicated to promoting the highest standards of professionalism, best practice, competence, and safety in the maritime industry by providing professional development opportunities, training, publications, and accreditation. Visit nautinst.org to learn more.

CAN'T SEE THE SEA FOR ALL THE DIGITALIZATION?

by Hari Sundar Mahadevan, *Research Scientist, Fraunhofer Center for Maritime Logistics and Services CML*

Digitalization and automation are revolutionizing the maritime industry. Technologies used in the industry are constantly improving and evolving to optimize efficiency, safety, and sustainability. Shipping operators and navigators worldwide are increasingly embracing and relying on sophisticated digital systems like the Electronic Chart Display and Information System (ECDIS). While these technologies offer various advantages – such as real-time data integration, improved data management, and automated updates of navigational charts – adopting new tech solutions brings forth a myriad of challenges, which can paradoxically compromise safety if not managed properly.

With approximately 90% of global trade being conducted via sea routes, the maritime industry's technological evolution directly impacts international shipping efficiency and safety, reports OECD. Advanced navigation systems significantly enhance operational capabilities. However, their complexity, huge amounts of data, and non-intuitive user interfaces can overwhelm operators in stressful scenarios. This creates a disconnect between available information and effective decision-making, increasing the risk of out-of-loop syndrome.

In the domain of maritime safety, recent studies indicate an inverse relationship between system complexity and situational awareness, a concerning trend for an industry where navigational errors can have severe environmental and economic consequences. This has inspired the study and development of innovative training and assessment approaches that specifically address the unique challenges faced by navigators in the digital age. By helping them become better familiarized with the system, situational awareness improves.

Fragmented attention & impeded understanding

Situational awareness – the ability to perceive environmental elements, comprehend their meaning, and project their status into the near future – forms the foundation of safe maritime operations.

This cognitive process occurs across three critical levels. First, perception: gathering sensory data to form a mental image of surroundings, particularly challenging in frequently poor visibility conditions. Second, comprehension: integrating this data with theoretical knowledge to assess the situation's significance, essential when navigating complex waterways. Third, projection: anticipating future developments based on current understanding, crucial when operating in high-traffic shipping lanes.

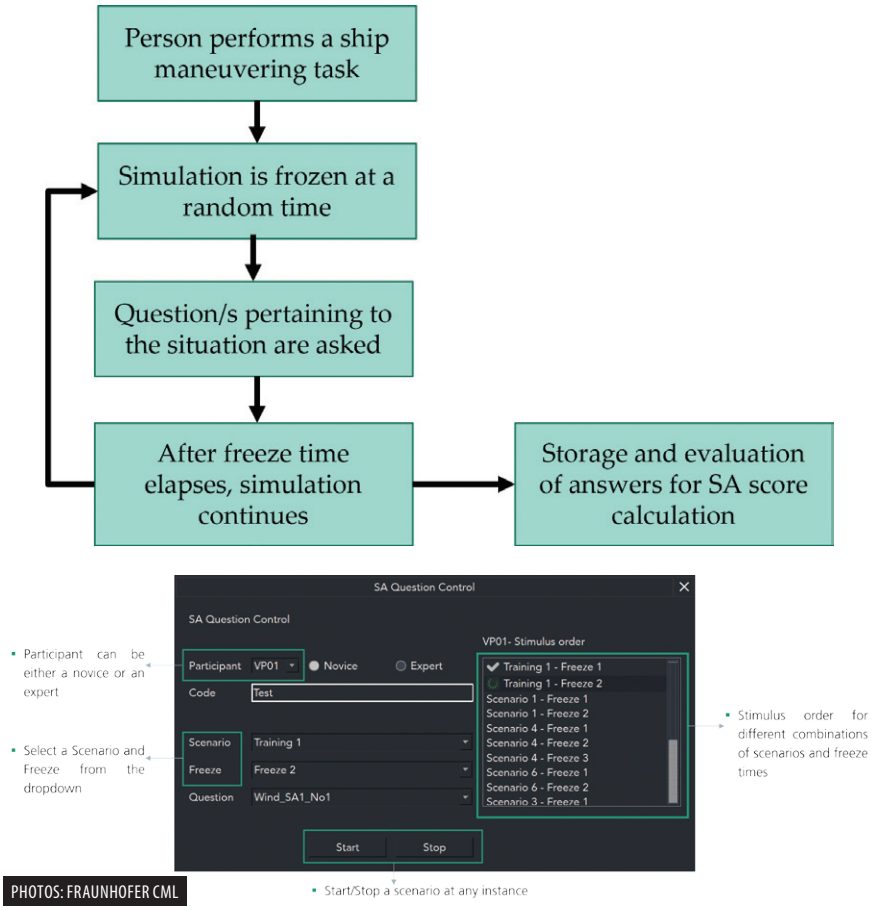
While driving around on a cycle, we must be aware of our environment, like traffic signals, nearby vehicles, pedestrians, and road conditions, to navigate safely. We process all the visual and auditory cues from the environment, like the color of the traffic signal or the sound of a moving vehicle to evaluate our next move, which could be going straight ahead, changing speed, braking, or manoeuvring around an obstacle to move safely and efficiently. Similarly, navigators must also be continuously aware of their surroundings – just that the scale, speed, environmental variables, navigation systems, decision making and communication are far more intricate and complex.

For navigators working with ECDIS, maintaining situational awareness presents unique challenges. The system's layered information, customizable settings, and manufacturer-specific interfaces can fragment attention and impede comprehensive understanding. This fragmentation is particularly problematic in situations where a rapid response is required.

The SA Tool

To address these challenges, a specialized Situational Awareness Assessment Tool (SA Tool) has been developed, with applications for enhancing maritime safety globally. The tool employs the Situational Awareness Global Assessment Technique (SAGAT), specifically adapting it to maritime navigation scenarios. SAGAT uses the freeze frame probe technique to compute the situational awareness (SA) rating.

Here, the manoeuvring task being performed by the participant on the ship simulator is frozen at random intervals, and questions pertaining to the situation are presented to the assessee. The assessee must respond within a fixed duration. The responses are recorded for evaluation and SA score calculation. This technique is applied multiple times for each assessee across different scenarios and questions. The random freeze frame timing makes SAGAT one of the SA assessment techniques with the highest correlation to real performance due to its higher validity and statistical stability.



PHOTOS: FRAUNHOFER CML

This approach allows for objective measurement of situational awareness across various ECDIS interfaces and operational scenarios that mirror real-world navigational challenges.

The SA Tool comprises several integrated components. The Tracker Application facilitates communication between the simulator and assessment tools, ensuring accurate tracking of the vessel's position and performance metrics. The User Map Interface visualizes situational awareness questions directly on the electronic nautical charts, providing a geographical context that is especially valuable when training for navigation in complex waterways. The Simulation Control Tool streamlines the management of simulation scenarios by automating processes such as starting, stopping, and freezing the simulation based on participant selections; it assigns predefined scenarios, determines the timing of freeze intervals, and loads scenarios into the ship handling simulator for evaluation. The Question Control Tool manages the dynamic presentation of questionnaires based on scenarios and individual participant experiences. It presents questions after each freeze, requiring participants to rely on their recollection. A unique challenge for this tool is accurately calculating the answer options for each participant based on their individual navigation experiences. The tool evaluates answers for adherence to COLREGs and collects data for further processing, including participants' confidence levels for each question.

How design affects decision-making

Experimental validation of the SA Tool involved 60 participants working across three different ECDIS systems, with 20 participants assigned to each. All navigators completed predetermined scenarios while responding to situational awareness questions during freeze intervals.

The results revealed significant differences in situational awareness scores between the three ECDIS systems, highlighting how interface design directly impacts navigational decision-making. This finding has relevance for shipping companies and training institutions as they select and implement navigation systems.

Participant feedback indicated a strong acceptance of the assessment methodology, suggesting potential for wider implementation across maritime training programs. Comparative analysis across different ECDIS systems provides valuable guidance for shipping operators making technology investment decisions.

Enhance versus compromise

The integration of digital tools in maritime operations is increasing, creating both opportunities and challenges for maintaining situational awareness. The SA Tool represents an important step toward ensuring that technological advancement enhances rather than diminishes safety margins.

Future developments may include incorporating machine learning techniques to refine assessment methodologies and create more personalized training experiences. This approach would be particularly valuable in international shipping, where navigational conditions vary dramatically by region, season, and vessel type.

Ongoing collaboration between technology developers, maritime educators, and operational personnel will be essential to evolving both the assessment tools and the navigation systems themselves. By prioritizing situational awareness in system design and training protocols, the maritime community can leverage digital transformation to enhance rather than compromise safety.

For the international shipping industry, with its environmental responsibilities and economic significance, these developments represent a crucial investment in sustainable shipping practices and global prosperity. ■

I completed my M.Sc. in Information and Communication Systems from the Technical University of Hamburg, specializing in communication networks, digital communication, and IT-security. As a Research Associate at Fraunhofer CML in the Sea Traffic and Nautical Solutions department, I focus on developing situational awareness assessment tools to enhance safer maritime operations. I oversee large-scale simulation networks and enable real-time data transmission between ships and shore-based systems. Additionally, I design back-end architecture for shore-based systems to improve functionality and efficiency.

The ins & outs of Europe's very first XR Full Mission Bridge Simulator

NEW LEVELS OF REALISM

by Stelios Koukouvios, *Maritime Strategy & Growth, Simulation, Ports & Human Factors, FORCE Technology*

The next generation of maritime training has arrived in Europe, setting a new benchmark for realism, safety, and even sustainability. Capital Ship Management Corp., in collaboration with FORCE Technology, has launched Europe's first Extended Reality Full Mission Bridge Simulator. Planning to be installed at Capital Group's advanced new training centre on the Greek Chios Island, the simulator, based on the SimFlex4 platform, represents a significant leap forward in the use of immersive technologies for ship handling and navigation training.

Extended Reality (XR) is an umbrella term that encompasses Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). In the context of maritime simulation, XR enables the creation of fully immersive training environments where real-world physical elements, such as bridge controls, are seamlessly integrated with high-fidelity virtual scenes. Trainees wear headsets that place them inside this digital world, interacting with actual equipment while responding to virtual scenarios. The result is a highly realistic and engaging training experience that closely mirrors live ship operations.

This shift of maritime simulators – from screen-based visualisation to full-immersive environments – could reshape how training is delivered and how effective it can be. It is enabled by a combination of mature simulation expertise, advances in hardware and graphics capabilities, and a growing need to train crews more efficiently, sustainably, and collaboratively.

Tech's pedagogical value

The roots of FORCE Technology's XR innovation can be traced back to Australia, where a cutting-edge SimFlex4 AR simulator is now operational at Smartship Australia in Brisbane. This facility, renowned for pilotage training and advanced ship-handling simulation, is home to the most advanced maritime AR simulator in the Southern Hemisphere.

Developed in partnership with FORCE Technology, the Smartship upgrade enables a significant leap in training fidelity. It supports port development, risk analysis, and pilot training for clients across Australia and Asia-Pacific. The simulator is also compatible with FORCE Technology's new DEN-Mark2 mathematical model, offering improved hydrodynamic performance and line force accuracy, which is key when training for tug operations or advanced mooring scenarios.

Smartship's AR platform demonstrates the technology's pedagogical value. It shows how immersive, sensor-rich environments can strengthen trainee confidence, promote operational awareness, and deliver better learning outcomes. Smartship Australia broke new ground in AR, and Capital's simulator is doing the same, this time with the first use of XR in a full green screen environment and embedded real-world bridge equipment. The result is that to the trainee wearing a headset, the visual scene is seamless.

Complete rethinking

Scheduled to open this year, Capital's training centre on Chios Island will act as a hub for maritime safety, sustainability, and operational excellence. The XR simulator installed there is provided by FORCE Technology and integrates advanced XR headsets, real bridge equipment, and a cohesive virtual environment enabled by green screen technology used in everything from big-budget summer blockbusters to YouTube shorts and podcasts.

The facility is a complete rethinking of how bridge operations are taught and practised. Designed to give seafarers a heightened sense of realism, the simulator allows users to move naturally within a 360-degree green screen room while interacting with real hardware. It is equipped with FURUNO's latest navigation systems, delivering a tactile experience that mirrors real bridge environments.

At the heart of the installation is FORCE Technology's SimFlex4 simulation engine, known for its precision ship and environment modelling. By embedding physical controls directly into the virtual scene, the system achieves a level of immersion and responsiveness that traditional screen-based setups cannot match. Whether training for confined waters navigation, complex pilotage operations, or port approaches, bridge teams can experience scenarios that are as close to reality as current technology allows.

Importantly, this realism extends beyond the visuals. The system also facilitates collaborative training, with multiple users able to join shared simulation scenarios, even from remote locations, allowing for distributed team coordination and joint response exercises.

PHOTOS: FORCE TECHNOLOGY

The real-virtual blend

The key to this new level of immersion lies in the green screen approach. Instead of relying on multiple high-resolution monitors to create a panoramic simulation, the entire room is painted in subtly varied shades of green. This enables XR headsets to track movement and blend real-world equipment fluidly with the virtual seascape without the jarring visual artefacts typical of digital backgrounds.

With this setup, trainees see the virtual world all around them through the headset: the ship's bridge structure, waves, weather, and port infrastructure, but when they look down, they are interacting with real, tangible navigation controls. This eliminates the sense of detachment that can occur in conventional VR or mixed environments where the floor and walls behind or close to hardware can sometimes become part of the visual scene (think of when you see through your colleague's blurred background on a video call). With the green screen, however, the real hardware becomes a natural part of what the trainee sees.

Traditional but high-fidelity modelling also plays a critical role in realism. As FORCE Technology's flagship simulation platform, SimFlex4 supports a wide range of mathematical and environmental models, including accurate representations of local port conditions and vessel hydrodynamics. The platform is continually refined with input from decades of research and operational data, making it a trusted tool for maritime authorities and ship operators worldwide.

Additional perks

From an operational perspective, the XR solution offers multiple advantages. Conventional simulator setups can require up to 20 monitors and an equal number of high-performance computers to run them. By comparison, the XR solution delivers a superior experience using fewer PCs and no external cameras. It significantly reduces the hardware footprint, lowers energy consumption, and simplifies IT support requirements. Over the lifecycle of the system, this translates into cost savings and a reduced environmental impact – factors that are increasingly important in modern maritime operations.

Another benefit is the potential for remote participation. While the current generation of systems allows external users to join as additional vessels in the scenario, future iterations aim to introduce full avatar presence, enabling remote bridge team members to appear virtually in the same room. It is an exciting development for global fleet operations and collaborative training.

Better-prepared

The deployment of the SimFlex4 XR Full Mission Bridge Simulator on Chios marks a new chapter in European maritime training. It builds on FORCE Technology's long-standing expertise in simulation design and pushes it into new territory. By combining XR immersion with tactile interaction with real equipment that blends perfectly into the visual scene, collaborative capabilities, and strong sustainability credentials, this new simulator provides a glimpse into the future of maritime training. It promises to produce better-prepared seafarers, more efficient training workflows, and ultimately, safer and more resilient operations at sea.

Through its work with Capital and Smartship, FORCE Technology is showing how innovation in simulation can have a real-world impact, supporting not only the professional development of crews but also the broader goals of operational safety and environmental responsibility. As new challenges continue to emerge across the global maritime sector, solutions like SimFlex4 and XR-based training environments – especially with green screen rooms – will play a central role in helping the industry adapt. ■

FORCE TECHNOLOGY

FORCE Technology, a tech consultancy and service company, helps others become technological and sustainable frontrunners for the benefit of society. Since 1940, we have helped organisations through major tech transformations: from rivets to welding; from the oil adventure to wind turbines; from analogue to digital. Learn more at forcetechnology.com how we can together contribute to defining the technological future!

TRANSFORMING MARITIME HYGIENE

by Fitzwilliam Scott

Ensuring high standards of hygiene aboard is critical to protect the health of crew members and passengers on commercial and cruise & ferry ships while maintaining smooth operations. With confined living and working conditions, the risk of infectious disease outbreaks and mold infestations is ever-present. These threats can lead to serious health complications, disrupt operations, and increase medical costs. Advanced technologies are becoming essential tools in reducing these risks, safeguarding crew and passenger well-being, and ensuring compliance with stringent maritime health regulations.

Outbreaks of gastrointestinal illnesses and airborne pathogens can severely impact operations – be they offshore, commercial shipping, or passenger. With high-density living and working environments, the maritime industry requires robust, science-backed hygiene solutions that minimise risk and ensure compliance with stringent health regulations.

VIKAND, a global leader in maritime healthcare and sanitation, is offering one such solution in collaboration with Pyure Dynamic Protection® – an innovative air and surface purification system that proactively combats both norovirus and black mold, safeguarding on-board environments and improving overall vessel hygiene.

The diagnosis

"The Pyure system is an intelligent, proactive solution designed to mitigate the financial and operational risks associated with norovirus outbreaks," explains Mattias Hallberg, Director, Technical Solutions, VIKAND. "By implementing continuous air and surface sanitation, commercial and offshore operators can significantly reduce the likelihood of illness, protect their crews, and safeguard business continuity. What differentiates Pyure is the evidence behind its effectiveness – our international certifications, research studies, and real-world applications prove this technology works."

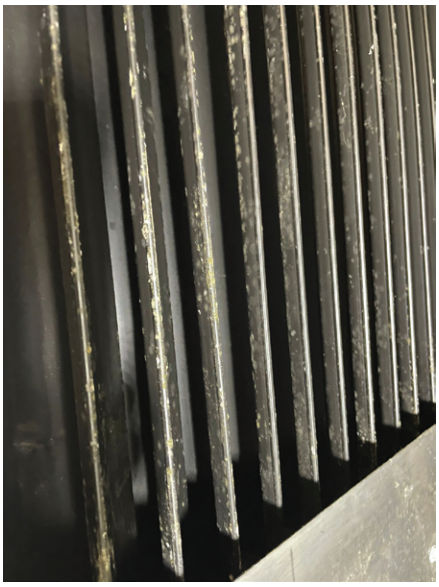
Stachybotrys chartarum, commonly known as black mold, presents another significant challenge for the maritime industry. It thrives in the damp, humid environments found on ships, causing respiratory issues, allergic reactions, and long-term health complications. Left unchecked, mold infestations can compromise not only crew health but also vessel safety. Dr John Howe, Medical Director, OneHealth by VIKAND, emphasises the health risks associated with mold exposure, "Mold produces allergens, irritants, and toxic substances known as mycotoxins, which can trigger allergic reactions and exacerbate respiratory issues. People with weakened immune systems or chronic lung diseases are at a higher risk of developing infections from mold exposure. Additionally, some studies suggest that early exposure to mold may increase the risk of developing asthma in children, particularly those with a genetic predisposition."

The treatment

Pyure's hydroxyl-generating technology provides an active and continuous approach to sanitation by replicating nature's air-cleaning process. Hydroxyls are highly reactive molecules naturally present in Earth's atmosphere that neutralise viruses, bacteria, mold spores, and odours. Unlike conventional air purifiers that merely trap airborne contaminants, Pyure's system actively destroys pathogens, making it a superior solution for maintaining clean and healthy environments on board vessels.

Scientific testing has demonstrated the effectiveness of Pyure's technology: it achieves a 4-log (99.99%) reduction in murine norovirus on surfaces within 360 minutes and a 5-log (99.999%) reduction of airborne RNA viruses within 90 minutes. The system also significantly reduces airborne mold spores, with 99.9% elimination within 30 minutes and undetectable levels within an hour and a half. On surfaces, mold contamination is 99.9% eliminated within 48 hours. Recognised for its efficacy, Pyure is an FDA-registered Class II medical device and has also received the European Centre for Disease Prevention and Control (ECDC) Class I medical device certification.

"Independent laboratory studies confirm that Pyure's air and surface purification technology significantly reduces norovirus and other pathogens in the air and on surfaces," says Dr Connie Araps, Scientific Officer at Pyure. "It reacts so quickly with airborne pathogens that



PHOTOS: VIKAND

transmission from person to person is minimised, *as reported by Pyure in the ASHRAE Journal* (March 2024). By continuously improving air quality, Pyure supports a proactive approach to hygiene management, reducing the risks associated with viral outbreaks in high-traffic environments like ships."

The purification system has already demonstrated great success in real-world applications and is currently installed aboard over 100 vessels in the cruise, yacht, and offshore sectors. One notable case involved a 140+ metre-long yacht struggling with severe mold infestations. After installing Pyure devices directly into the vessel's air handlers, airborne mold spores were eradicated within weeks, ensuring a cleaner and healthier environment for crew and passengers.

"By proactively addressing mold with our Pyure Dynamic Protection® system, VIKAND is setting a new standard in maritime health and safety," states Hallberg. "This technology not only removes existing mold but prevents future growth, offering peace of mind to vessel operators and healthier environments for those on board."

Side effects (positive only!)

Pyure's air purification solution also offers significant operational advantages. It minimises the risk of disease outbreaks, ensuring business continuity, and reduces crew sick days, thus improving workforce efficiency. The system supports compliance with health and safety regulations while lowering operational costs by enhancing air recirculation and reducing resistance. Additionally, it decreases carbon emissions through improved air quality management and requires minimal upkeep, with quarterly cleanings and annual optic replacements.

"As norovirus and other infectious threats remain a challenge for the maritime industry, investing in proactive solutions such as Pyure Dynamic Protection® is not just a health measure – it's a strategic decision that safeguards operational integrity and financial stability," underscores Ronald Spithout, Managing Director, OneHealth by VIKAND. He furthers, "By prioritising advanced air and surface purification, ship operators can significantly reduce the risk of outbreaks, ensuring that crews remain healthy and operations continue uninterrupted. The financial impact of disease outbreaks and mold-related maintenance can be substantial, so having a proven, science-backed solution such as Pyure in place is an investment that pays off in both safety and efficiency." Spithout sums up, "This technology represents a fundamental shift in how the maritime industry approaches hygiene, moving from reactive containment to proactive prevention." ■

VIKAND provides proactive total healthcare solutions for the shipping, cruise, yachting, and offshore industries. Crew members and guests alike trust VIKAND to provide expert medical care, telemedicine, risk mitigation, and other valuable health services, and the world's leading maritime companies rely on us to protect their most important asset at sea – people. Visit vikand.com for more information about VIKAND's Pyure Dynamic Protection® system.

Pyure DYNAMIC PROTECTION® Inspired by nature and trusted to clean, The Pyure Company are world-leading air purifying technology innovators. Pyure's commercial air purifiers are trusted worldwide to safely purify indoor air and surfaces, creating healthier environments for everyone while saving energy by bringing the power of the sun indoors. Check pyure.com to learn more (incl. the science behind Pyure Dynamic Protection®).

Tackling the hidden risks of lithium-ion batteries through supply chain collaboration

CONTINUOUS THREAT

by Petar Modev, *Head of Ship Inspection, The UK P&I Club*

The environment in which seafarers operate has always been fraught with risk, but for the modern crew member, they are now having to contend with an increasingly more complex operational environment. The continued integration of more sophisticated systems on board, the pressures to adhere to strict regulatory provisions to reduce carbon emissions, not to mention the very real threat of physical attack stemming from macro-geopolitical issues, all combine to create an increasingly more complex operational landscape. However, as a result of the energy transition, there are also emerging risks from new cargoes, particularly the health and safety implications of the rising carriage of electric vehicles (EV) on ships.

The EV and hybrid automotive market is developing at an exponential rate, with current projections suggesting that it is set to grow by nearly 10% each year, accounting for over 17 million vehicles in 2028. Although these are encouraging signals in the development of sustainable transportation, the implications for supply chain participants, especially carriers, are significant. This particularly relates to the inherent fire risks posed by lithium-ion (li-ion) batteries within EVs.

The defining characteristic that makes li-ion fires such a significant risk is the creation of an extremely hot thermal runaway; this is a primary risk where the battery's internal temperature rapidly increases, leading to a fire or explosion. Physical damage, manufacturing defects, or exposure to extreme temperatures can trigger this. Even worse, a li-ion battery fire will sustain itself, meaning that rather than lasting minutes or hours, a fire can continue for days. As a result, early identification of such incidents is vital, which means that vessels need systems that use intuitive technologies to identify the fire quickly, as well as suppression systems with additional foam and CO_2 capabilities to control the outbreaks.

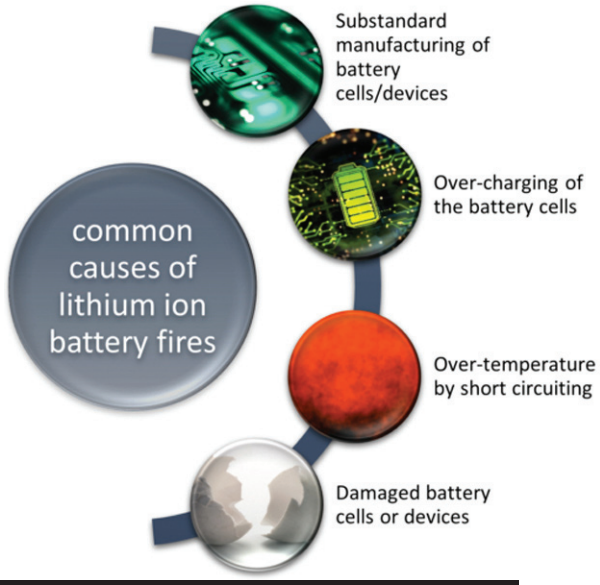
Common guidance

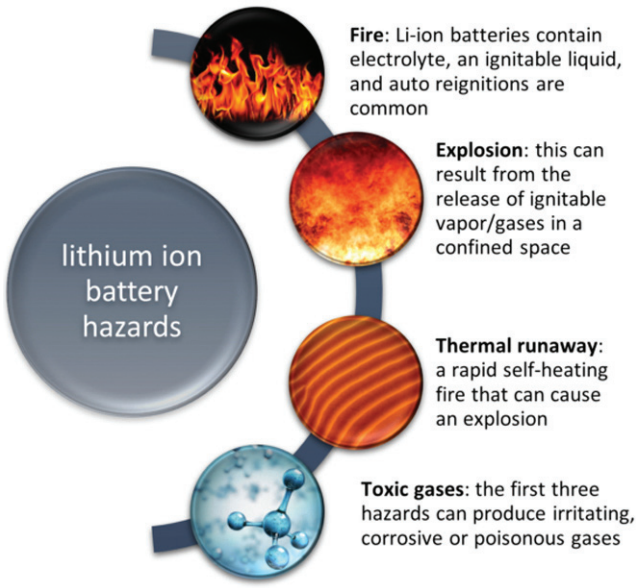
Several regulatory instruments are being discussed at the International Maritime Organization (IMO) level. In March 2024, the IMO's Sub-Committee on Ship Systems and Equipment considered specific proposals related to container ship fires and discussed detailed evaluations of the adequacy of fire protection detection and extinction arrangements with regard to vehicle carriers.

However, due to the pace of the green automotive market's growth, proactive stakeholders across the shipping industry have recognised that they can't afford to wait until international regulation catches up. This has led to the launch of collaborative initiatives across shipping, such as the **CARGOSAFE** study by the Danish Institute of Fire and Security Technology to identify cost-effective risk control options for cargo fires, as well as the kick-off of the **Cargo Fire & Loss Innovation Initiative** by Lloyd's Register's Safetytech Accelerator.

Although these collaborative efforts establish a blueprint for further partnerships, it is not the role of the maritime industry alone to manage this risk. This is a complex, interconnected issue that requires the collaboration of multiple stakeholders throughout the supply chain.

To address the risk implications of li-ion batteries on board, the Vehicle Carrier Safety Forum has recently published its first good practices guidelines regarding the ***Common guidance on the loading and presentation of vehicles.*** Based on shared practices and supported by the International Group of P&I Clubs,





PHOTOS: ICHCA – THE INTERNATIONAL CARGO HANDLING COORDINATION ASSOCIATION

the International Chamber of Shipping, and TT Club, this guidance advises vessel operators and supply chain partners on the safety aspects of booking, planning, and presenting electric and large-battery hybrid vehicles at port terminals, as well as loading, stowage and monitoring vessels during a voyage, with a specific focus on car carriers, ro-ro vessels and ferries.

The value of training

As one of the world's leading providers of P&I insurance for the maritime sector, The UK P&I Club is actively supporting its Members as they navigate new and emerging risks. Equipping vessel operators and crew with suitable guidance to better understand the challenges they face is part of building the foundation for change. As a result, The UK P&I Club has developed, in collaboration with TT Club and BrookesBell, material such as our white paper on the ***Continuous Threat of Transporting Li-ion Batteries***.

In order to ensure that our service offering continues to align with the modern challenges our Members face, we recently launched the new Safety & Risk Management division, which re-positions our in-house loss prevention capability in order to encourage Members to deepen their understanding of the evolving risk environment in which they operate and adopt tighter monitoring and reporting of safety performance.

Our Safety & Risk Management team is helping Members to mitigate the risk of li-ion fires on board. One of our priority focuses is to promote the value of advanced and effective crew training. This is an essential tool for building crews' confidence and effectiveness in managing this growing and opaque challenge. For example, in June 2024, The UK P&I Club – in association with React and Simwave – conducted the Modern Fire Risk training workshop. Delivered at Simwave's Maritime Training Centre of Excellence in Rotterdam, the programme combined classroom and simulation-based learning for superintendents, HSEQ professionals, and technical managers in shipping companies that operate car carriers or container ships. Although physical training is the gold standard, leveraging advanced technologies, such as simulations and online training platforms, can act as a valuable tool for providing the most effective scenario-based training packages.

The enhanced threat of li-ion fires

Unfortunately, despite the documented risk that li-ion batteries pose to the safety of crews, reports have suggested that onboard vessel fire safety standards are in decline. A recent study from the Paris Memorandum of Understanding on Port State Control – which was further corroborated by RightShip – revealed a 14% non-compliance rate for basic fire safety standards aboard inspected ships, with at least 30% of issues identified relating to a basic lack of implementation of the International Safety Management Code. When considered within the context of the enhanced threat of li-ion fires, this lack of preparedness to effectively manage the outbreak of fires on a ship is troubling, to say the least.

Rising EV volumes are reshaping the risk profile of how we manage hazardous cargoes, and this is only going to increase as the market continues to grow. However, if the industry is to ensure it's well-positioned to manage this risk, attitudes and approaches to preparing against such events must also evolve. From a safety and risk management perspective, P&I clubs play an important role in working with carriers and the wider supply chain partners to understand and manage these risks.

Although this issue is complex and multifaceted, the development and implementation of strengthened and standardised training will make a marked difference in giving crew members a greater level of competence in managing the immediate risk that the presence of li-ion batteries pose on board vessels that either carry EVs, make use of powerful battery packs themselves, or both. ■

UKP&I The UK P&I Club is one of the oldest such organisations in the world and one of the world's leading mutual insurers of third-party liabilities for ocean-going merchant ships. The Club insures over 250 million tonnes of owned and chartered ships from 50 countries against potential claims for damage or compensation. Visit ukpandi.com to learn more.

UNLIKELY TO EASE OFF ANY TIME SOON

by Svante Einarsson, *Head of Cyber Security Advisory EMEA, APAC & Maritime, DNV*

As shipping continues to embrace digitalization, the threat of cyber attacks has never been higher. Stakeholders across the maritime industry are making moves to protect their assets, but DNV experts warn that many are underestimating the scale of the threat and should take extra steps to protect their assets.

The digitalization of the maritime industry is in full flow. Shipowners, ports, cargo owners, and many other stakeholders throughout the value chain are increasingly utilizing connected digital technologies to make shipping greener, safer, and more efficient. However, DNV's new report, *Maritime Cyber Priority 2024/25: Managing cyber risk to enable innovation*, highlights that this also introduces new cyber security risks, which need to be managed to enable decarbonization, improve the efficiency of operation, and protect human life and the environment.

Building on insights from the first edition of this publication in 2023, DNV's latest release explores changing attitudes and approaches to cyber security in the maritime sector. The research is largely based on a survey of almost 500 maritime professionals, with even deeper insights harvested through in-depth interviews with experts from Wärtsilä, Seatrium, and DNV. The survey included a wide range of cyber security expertise, from professionals in the field to shipbuilders, offshore operators, and transport specialists. Survey respondents came from Europe, Asia, the Middle East, Africa, and the Americas.

The greatest risk

The survey highlighted several key issues in maritime cyber security. Notably, cyber attacks are rising rapidly. About 31% of maritime professionals reported at least one such incident in the 12 months leading up to October 2024, up from 17% over the previous five years.

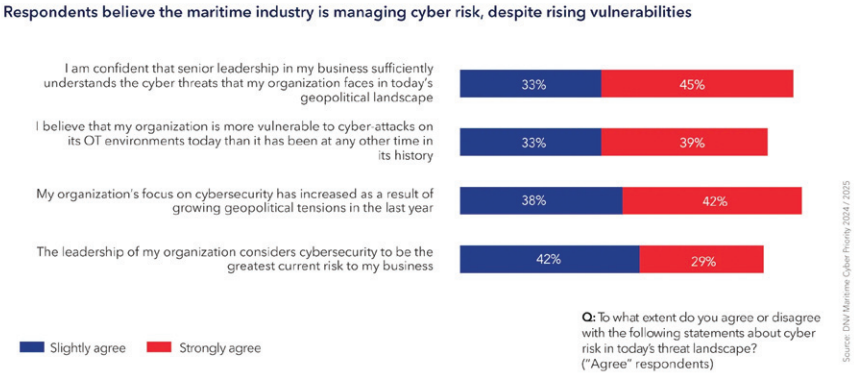
This increasing cyber threat is causing concern at the highest levels of the maritime industry. Seven in 10 (71%) of those surveyed believe their organizations' industrial assets are more vulnerable to cyber attacks than ever before, while the same proportion (71%) say the leaders of their organizations consider cyber security to be the greatest risk their business faces.

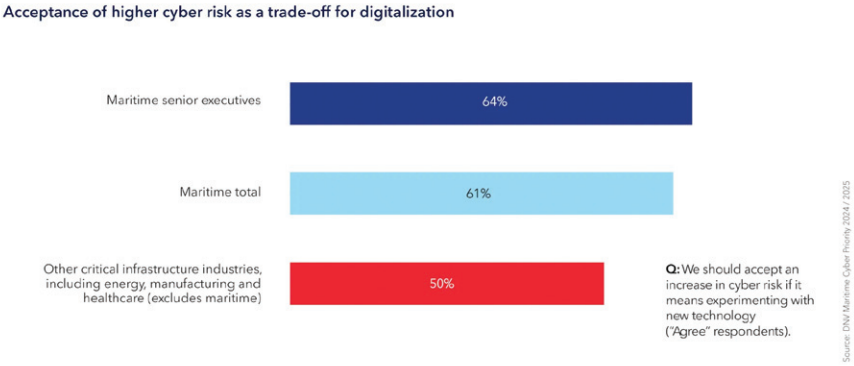
This heightened awareness has led to increased levels of preparedness, and investment in cyber security has grown significantly over the past year. Almost three-quarters of maritime professionals (73%) report that their organization is increasing cyber security spending compared to last year.

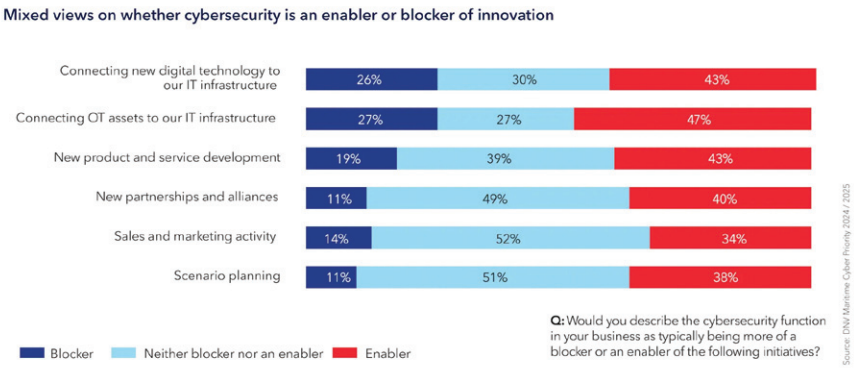
Accept the risk

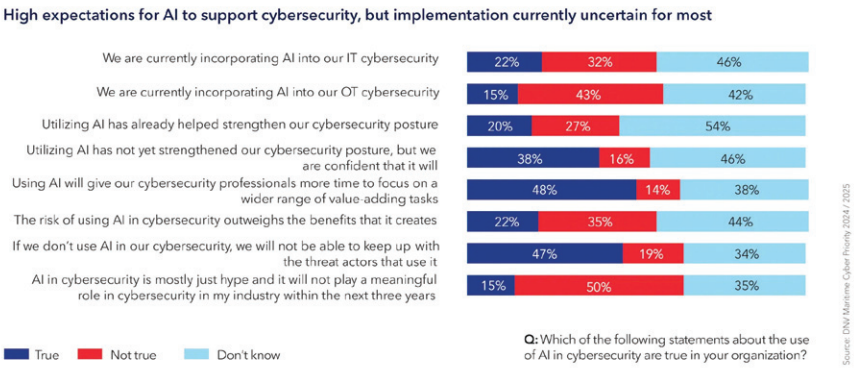
The increasing digitalization of the maritime industry is unlocking a range of new opportunities, helping to drive decarbonization efforts. Survey respondents point to advanced data analytics, the Internet of Things, artificial intelligence (AI), machine learning, high-bandwidth satellite communications, and autonomous operations as presenting the greatest opportunities for their businesses in the coming years. However, this is also creating more opportunities for cyber criminals.

While increased digitalization and connectivity make shipping companies more vulnerable to cyber attacks, this is unlikely to be a reason for them to slow down. In fact, the majority (61%) of maritime professionals believe the industry should accept increased cyber risk from digitalization if









it enables innovation and new technologies, a figure that is notably higher than other critical infrastructure industries, like energy and healthcare. This number was even higher (64%) for maritime executives.

Security by design

As digital innovation continues, the need for strong cyber security grows. Experts recommend involving cyber security professionals early in newbuild projects to integrate new technology safely. However, this practice is not yet widespread, causing issues at a later stage. Failing to incorporate cyber security into the early stage of new projects and initiatives leaves the industry scrambling to address the problem later on. Retrofitting security measures is also more time-consuming and costly than embracing security by design.

One of the key recommendations of the *Maritime Cyber Priority 2024/25* report is for maritime companies to see cyber security as an enabler of innovation instead of an obstruction, providing a framework of security when stepping into the digital future.

The overconfidence and under-preparedness trap

There are clear signs that awareness around cyber security is on the rise, and this is largely being matched by increased investment. That said, success is not guaranteed. The widespread failure to integrate cyber security into processes shows that the industry's confidence in managing risk might be overestimated. While many organizations might feel like an increased allocation of resources makes them more prepared, the complexity of the risk and the sophistication of adversaries complicate the picture significantly.

Many organizations may not even be at the initial 'detection' stage of readiness when it comes to recovering from a cyber incident. Our experience is that maritime organizations are not as ready to detect or handle one within the operational technology domain as they might think. This is backed up by some worrying findings from the survey: while more than eight in 10 (85%) say their organization has a good cyber security posture, 76% say that the cyber security training that their organization provides is not advanced enough to protect against sophisticated threats.

Notwithstanding the above, all maritime companies can attain a greater cyber security posture by building cyber security resilience into their company culture. Many in the industry see cyber incidents as a problem for their cyber security team to resolve, but this underestimates the seriousness of the threat, particularly considering the safety implications of infrastructure that is disabled or malfunctioning. This also excludes professionals who could make a significant contribution to overall resilience. Critical

PHOTO: CANVA

professionals such as ships' masters and chief engineers, as well as the broader crew, are invaluable to cyber defence. However, they need training and support to fully utilize their skills and experience.

Creating a more vigilant cyber security posture requires training that is sophisticated and in line with the latest threat levels. Even if this is achieved, this is not a challenge that remains 'fixed.' Cyber security is turning into an arms race as adversaries improve their capabilities when they encounter an obstruction. This means that the sophistication of their methods might outstrip their targets' ability to respond.

Aside from ensuring that training stays ahead of the curve, this also means that companies need to ensure that their cyber technology outpaces adversaries. Bad actors are already using tools like AI to their benefit, so maritime companies should also be investigating how they can utilize this to create stronger cyber security defences.

Go above and beyond

In addition to advocating enhanced training and culture, an acceleration of technological capability, and the importance of reimagining cyber security as an enabler of innovation, DNV's *Cyber Priority 2024/25* report lists some other key recommendations to the shipping industry for a stronger cyber security posture.

Top of the list is boosting collaboration and transparency across the supply chain. Only 53% of those surveyed are confident their organization can demonstrate full visibility of their supply chain. We strongly recommend all stakeholders demand more insights and visibility from suppliers. This will be supported by IACS UR E27 for safety-critical systems on board newbuilds. However, for other systems and vessels in operation, this needs to come as a demand from shipowners and vessel managers as part of their cyber risk management.

The report also highlights the need to exchange information and best practices throughout the industry, including sharing details of critical incidents, attacks, and near misses. Sharing knowledge and skills will help to address the knowledge gaps that so many organizations say obstruct compliance and their overall readiness.

Finally, while maritime companies are encouraged to keep up with regulations, they should not equate this with protection from cyber attacks. Stakeholders should be seeking to go even further than compliance. In doing so, they will strengthen the resilience of their businesses and build trust among their partners.

The cyber threat is unlikely to ease off any time soon. According to the report, 37% of maritime professionals expect to face more cyber attacks in the next 12 months compared to the last 12. Understanding this risk and embracing the means of containing it will help shipping companies maintain their course of digital innovation, providing the framework for the future success of the maritime industry. ■

DNV

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BALTIC TRANSPORT 2024 HIGHLIGHTS
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How carbon units can help to decarbonize supply chains

INSETTING DOESN'T HAVE TO BE UPSETTING

by Bertil Duinhower, *CEO and Co-founder, CarbonLeap*

There is no quick and easy solution that all companies can implement to decarbonize their supply chains. Not every owner-operator can afford to invest directly in proven technology to reduce emissions from their vessels. Zero-carbon alternatives to hydrocarbons are not widely available across transport networks, making it difficult to switch to using technology that supports them. For manufacturers, retailers, and their shippers, using alternative clean energy sources for heavy road and marine transport in their supply chains could help them cut emissions. Yet, today, these are too frequently difficult to access, in the wrong place, or too expensive for a single operator to develop on their own.

Faced with this challenge, efforts by forward-looking operators to find ways to reduce the carbon footprint of their supply chain operations have run into two problems. First, there is a credibility gap, where stakeholders simply do not believe the claims made of effective decarbonization. Second, there is a barrier to wider action on decarbonization by the whole industry at a scale that could be effective.

Sharing the costs & benefits

Decarbonizing supply chains needs to move forward more quickly, but the limited availability of clean energy for transport has hampered progress so far. Carbon insetting offers a way for the sector to work together and share the costs and benefits of action on decarbonization. Carbon credits that are secured in their own (or an adjacent) supply chain offer cargo owners and shippers an effective and low-cost way to lower their net carbon emissions and progress their energy transition. However, trust and transparency are essential to the success of this system.

Carbon insetting creates a mechanism to share the responsibility and cost of decarbonization across the market so that investments in technology and fuel can be made where they are the cheapest. Businesses that have invested in technology can monetize the carbon reductions they have achieved over and above their statutory obligations and corporate objectives by selling them as carbon credits. This reduces the cost of their investments, allowing the customer to claim emission reductions in their supply chain.

As part of a market in voluntary carbon credits, insetting can be a highly efficient route to decarbonization that allows organizations to support the reduction of their scope 3 emissions. But, it is essential that businesses buying monetized carbon reductions can trust that the carbon units they purchase are verified, well-sourced, and do not double-count reductions. The carbon units need to be credible, offering value for money. Without these assurances, customers will reject carbon insetting as an approach, reducing investment available to first movers and hampering progress towards decarbonization.

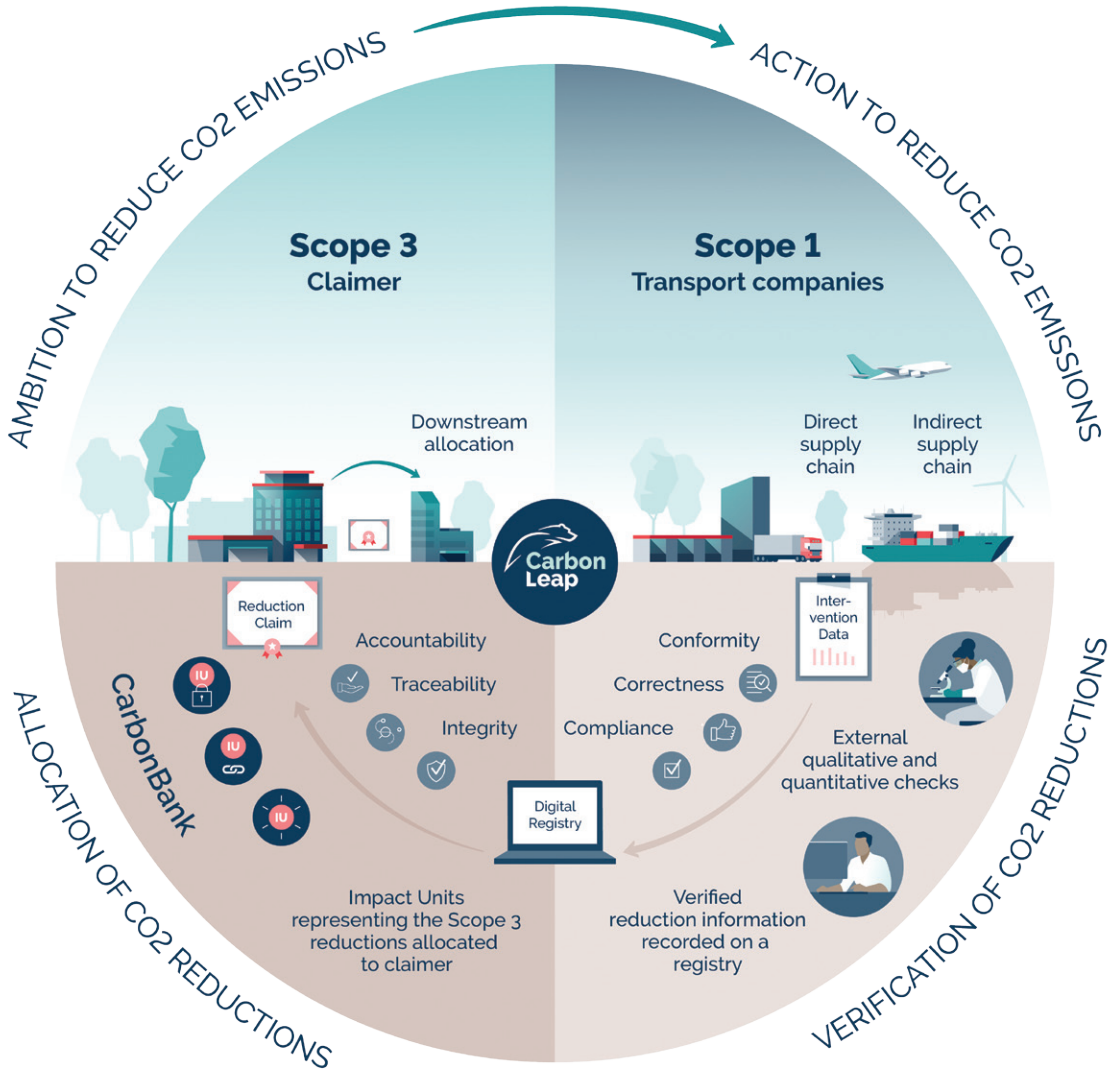
Choosing in confidence

Carbon units must be independently and transparently verified, assured and witnessed by a third party. In addition, such a verification process should be standardized to transparent and universal rules to ensure carbon units are assessed to the same standard in the same way. For many carbon units, however, this isn't the case.

Simply creating the carbon unit for someone to invest in is a hugely complex process. For buyers who want to be able to compare carbon units from different suppliers and be confident that they are getting what they pay for, sourcing and buying carbon reductions can be daunting. At CarbonLeap, we recognize this challenge for buyers; by making carbon units more transparent, we aim to simplify a complex process and help businesses drive forward their decarbonization ambitions.

A standardized set of rules for verifying carbon units would bring greater transparency to the market. It would reduce the information asymmetry between the suppliers of carbon units, low-carbon energy suppliers and users of clean technologies, and the buyers of carbon units who want to reduce their environmental impact. While suppliers of carbon units will have invested in technology to cut their emissions, accurate verification of the carbon reductions achieved, measured against a standardized counter factual baseline, is essential for building trust and transparency in carbon units.

Carbon units need to be packaged and securitized to allow customers to trust that they are getting value for money. At CarbonLeap, we connect the supply and demand sides of the market, helping to build trust across the parties. Our team of experts act as intermediaries, supporting the supply of carbon units by applying their knowledge, specialization and skill to identify and build a deep and wide network of carbon unit suppliers from among the global transport industry. We have built a network of carbon unit suppliers that includes clean energy suppliers and clean technology OEMs, as well as shipowners, freight forwarders, cargo owners and vessel charterers. Working with independent experts to provide verification and assurance of the carbon saved by each of these suppliers, we have created a pool of carbon units that the buyers we work with can choose from in confidence. Our independence in this process is an important part of our ability to work with all parties to bring affordable carbon units to market that help facilitate the energy transition.



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Tech-secured

Our knowledge of high-quality carbon units available in the market means we can securitize carbon units and provide reassurance to buyers, who may have limited time and resources to research for themselves, that they are not paying exaggerated prices for their carbon units.

It is important that carbon unit buyers make sure that the price they pay and the volume of carbon units they purchase are accurate and verifiable. This can be a complex process. At CarbonLeap, we have recruited blockchain to make this simpler and more reliable by providing a secure digital record of your transaction from end to end.

All carbon unit transactions we complete for our clients are recorded using blockchain-enabled technology in an unalterable and transparent ledger, which means the emission reductions that a carbon unit represents cannot be duplicated. The units are delivered to the buyer in a secure digital transaction, and a certificate for proof of reduction is issued, helping to build trust and confidence in voluntary carbon markets and the use of carbon units from insetting.

Faster and at a lower cost

Carbon insetting allows companies operating in related supply chains to collaborate to realize a faster and lower-cost route to decarbonization. Globally, transport relies on fossil fuels for over 90% of its energy. For the sake of the planet, we must act now to reduce transport's carbon footprint.

CarbonLeap is working with suppliers, buyers, and independent verifiers to bring essential accountability and transparency to the market. By creating confidence that carbon units are fairly priced, we can carry forward the fight against climate change more quickly. ■

CarbonLeap

Seeking to reduce your scope 3 emissions? Look no further, as CarbonLeap is committed to guiding you through this journey. We will work closely with you to understand your specific needs and align them with appropriate sustainability solutions. Our strategy involves collaborating with a network of partners who facilitate CO_2 reductions in parallel to your supply chain. The beauty of this approach? You benefit from these carbon savings without needing to alter your operational processes. Go to carbonleap.nl to learn more.

The secret ingredient in low-carbon ship design

CHEK IT OUT!

by Mia Elg, *R&D Manager, Deltamarin*

My previous article was about understanding the big picture and the future of heat processes in shipping. This time, we move from pure heat systems to ship machinery and energy system analysis, with some examples from our newly concluded EU-funded project CHEK (which will always have a special place in my heart, largely because of the people in our great 'CHEK family' and that it was also the first EU-project for me personally). I oversaw Deltamarin's part of the project from planning to execution, so I think that it deserves a moment of detailed reflection.

I may have sometimes mentioned in my writings that our sailing boat is the primary residence of our family during the summer, and we've just got back from this year's adventures. As I happen to have the strongest 'sea legs' in the crew, I usually spend a considerable amount of time inside the boat cooking for everyone, no matter the weather. This also inspired me to serve you this read as it is fresh from the development oven!

Can there be too many cooks in the galley?

The CHEK project was about decarbonising long-distance shipping. Together with 15 consortium partners, we had three years to develop and study two conceptual designs: a cruise ship and a bulk carrier. The goal was to reduce greenhouse gas emissions by 99%, plus achieve at least 50% energy savings compared to Energy Efficiency Design Index (EEDI) phase 2 requirements.

One of the most visible outcomes of the project to the public was probably the installation of two sails on board an existing bulker. In addition to this and many other milestones, the CHEK family managed to fulfil the key goals, and the project itself was listed by the European Commission as a Research and Innovation Project success story. Therefore, even if not every day of working on it could have been called pure pleasure, I have to say that the project was indeed a winner.

I think that the CHEK set-up resembled a typical ship design project: we had a wild mixture of various technical alternatives to be considered. In general, it seems like both the scientific community and the industry agree that there is no single best fuel or technology that would serve as a silver bullet for decarbonisation. Therefore, the new normal for any ship design project is that we have numerous fundamentally ship-changing alternatives on the table early during the conceptual design that should be analysed.

To be more concrete, on top of the 'traditional design task,' each new ship design project is facing a new set of requirements. Three main questions arise at the very beginning. First, what is the fuel for the ship that will be considered at the start of its operation, and which fuels should the ship be ready to bunker in the future? Second, which major energy-saving or emission reduction-related technologies should be included in the ship? Third, what powertrain and machinery incorporate the previous two items, bringing the best performance out of the entire system?

One of the leading ideas in CHEK was to explore these three fundamentals as a synthesis, considering a typical operational pattern for the case ships. Without a doubt, multiple variations and complex modelling meant that our 'decarbonisation kitchen' started to get very crowded. Our role in the project was thus very central since it included orchestrating the various solutions in the conceptual designs.

The taste of synergy

Our bulk carrier concept reached almost 50% digital energy saving vs a state-of-the-art sailing vessel of a similar size. The result was reached as a true symbiosis of technologies and design. The illustration on the next page details one of the comparisons of the propulsion and main engine power in two cases. The figures on the left side are related to a 'baseline' ship simulation with heavy fuel oil (HFO) as bunker, while those on the right side illustrate the results of a vessel with a combination of a new hull and energy-saving technologies (the results are illustrated on all global routes that were analysed in the project).

The figures show how the ship propulsion power requirements are reduced from around 6.0 megawatts (MW) to 3.0MW with the combination of various drag reduction technologies and wind power. Consequently, various hypothetical engine configurations were studied, including a considerably reduced main engine size and a hybrid powertrain. The machinery parameter optimisation contributed to further energy savings.

When modelling the cruise ship energy system, we made interesting findings especially in hydrogen-fuelled machinery. The cruiser was 'put' on a Mediterranean route, and the first of the results included simulating the ship with HFO as the main fuel. Setting aside the EEDI-derived energy consumption scaling, the results were approximately 21% fuel saving with a combination of various technologies. When modelling machinery operated with pure hydrogen but otherwise a similar technology set available for the ship, the results showed 27.5% less fuel energy consumption than a baseline vessel. Several factors in the energy system contributed to this: improvements in the ship power plant efficiency alongside lower heating requirements for a hydrogen-fuelled vessel (leading to lower boiler utilisation and the release of more waste heat for heat-to-electricity conversion).

One generic discovery in CHEK (and in many other projects we have carried out) is that a ship's true power requirements en route are often considerably below its installed capacity. With the CHEK bulker, for instance, the reference main engine size was 9.5MW. The results illustrate how increased energy efficiency will push down the power requirements even further compared to a standard ship. Moreover, the example simulations did not even consider the impact of weather routing or other voyage optimisation possibilities, which can further contribute to fuel savings.

Let's have the cake!

In the CHEK project, our special focus was on ship energy systems and their modelling. Introducing single equipment or design changes – especially a fuel switch – has

The decarbonisation recipe à la CHEK[1]

Basic ingredients:

- Operational data from an existing Kamsarmax-sized bulk carrier and Meraviglia class cruise ship
- A future-proof ship design platform
- Ultrasound antifouling
- Air lubrication
- Waste heat recovery
- Shore power enabled at all ports

Bulker specialities:

- Fuel flexible hybrid machinery
- WindWing sails
- Gate rudder
- Solar panels on wings
- Liquid biogas as fuel

Cruise ship spices:

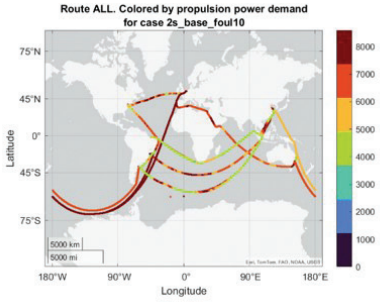
- Waste to power
- 10MWh battery pack
- Hydrogen engine

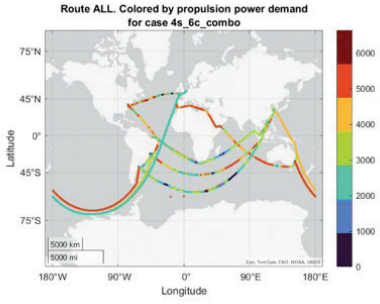
Instructions:

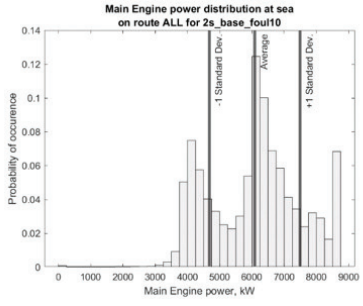
1. Create the necessary design basis and a new efficient hull for the ships
2. Develop a digital operational profile for the ships by combining historical weather data for a typical route of the ships
3. Test and collect performance data about energy-saving technologies, either from a laboratory environment or from real-life demonstrations
4. Integrate the technologies at system level in a ship energy model in order to understand the combined effects and to find synergies between processes

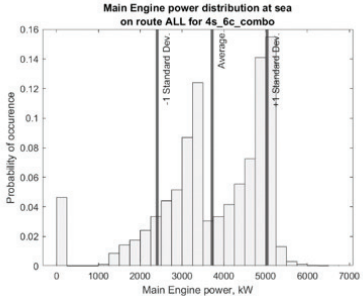
Pro tip: To ensure meeting the goals, the modelling should be performed in several generations, adding more data and improved models each time

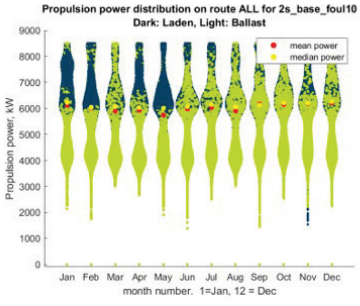
[1] *A longer version of the recipe with insightful pictures can be found in the notes from the 2023 & 2024 HIPER conferences (training videos are also available)*

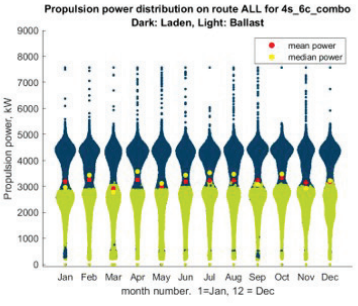












a holistic impact on a ship's energy system. When integrating several onboard energy-saving technologies, there is an impact not only on the entire energy system but also between the new pieces of equipment. Since regulations are pushing for reduced emissions from ships, we will eventually have new clean fuels on board. These bunkers are more expensive – or alternatively, the ship operator or owner will pay for polluting. Either way, energy-saving is 'the' way to commercially survive and beat the competition.

When I entered this business, the energy system modelling was merely seen as the 'icing on the cake' rather than a game changer. Nevertheless, now amidst various decarbonisation solutions and developing legislation, ship energy system modelling and its related analysis should be seen as a new but important ship design discipline. The simulations can enable correct dimensioning of the equipment, such as ship machinery and fuel storage.

In my view, studying design variations on the energy system level, as we did in CHEK, is a highly useful screening step in any project. It is done to identify the solutions that we want to proceed with in a more holistic naval architectural analysis and ship design integration on all levels. The energy simulation also enables later comparison of expected performance with the measured data from the ships, providing a platform for design validation.

Finally, we simply cannot afford to skip the analysis of the combined effect of our design choices. Sticking to the traditional way of dimensioning vessel fuel storage and propulsion machinery with extensive design margins leads to continuously increasing costs for the ships. I believe that the winners of the future will be those who dare to take the next step in pushing for optimised operation and dimensioning the machinery to perform best under the most typical conditions. ■

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