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Harbours review

short stories

economy

sustainability

technology

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do not hesitate to contact us at: editorial@baltic-press.com*

dear readers,

Oh my, it has been a while! "Thanks" to the pandemic, we had to sustain the absence of TOC Europe last year. A real pity, if you ask us, as we were looking forward to meeting you in person after cramming so many corona months under the belt. But, well, there is nothing to forgive. We are all the more mettlesome to come back to Rotterdam in 2022!

We sincerely hope you will like what we prepared for you in this extra-special issue. We gathered a wholesome set of articles that will take you through three main topics of economics, technology, and sustainability (and how these mingle together).

As always, have the most incredible read!

PRZEMYSŁAW MYSZKA



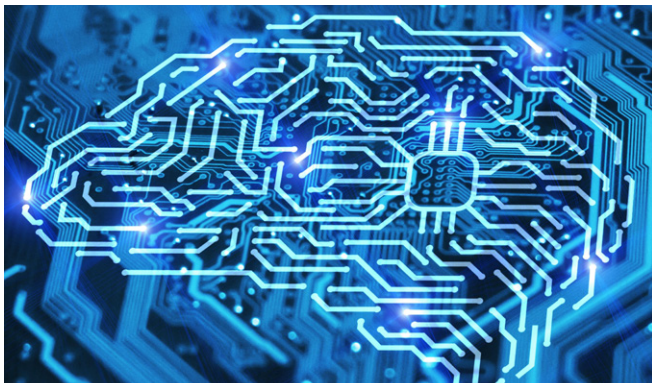
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contents

03. Editorial

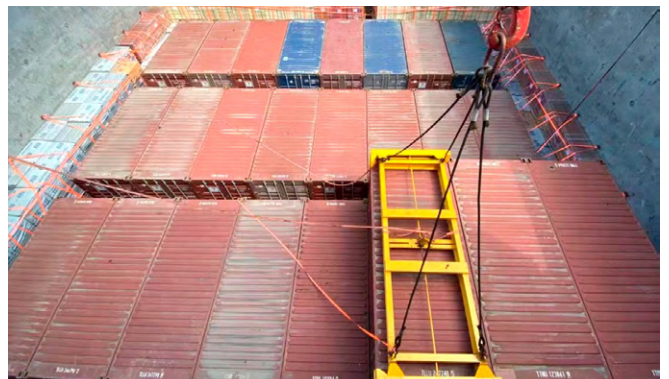
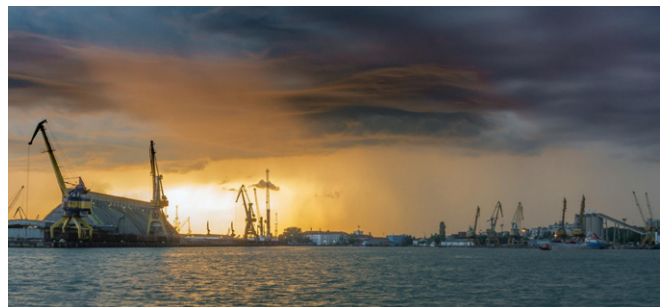
short stories

- 06. Heated discussion over the maritime EU ETS**
Westport orders Kalmar's CCS Electric Reachstacker
- 07. World's first marine fuel trial of carbon-neutral synthetic natural gas**
Hutchison Ports orders 17 Konecranes' ARTGs for Felixstowe
- 08. Langh Ship orders three future-ready multipurpose vessels**
The AI Register
World's first test of carbon capture onboard a ship
Port of Esbjerg-Valmont SM offshore wind energy co-op
- 09. FirstBio2Shipping gets Fit for 55 funding**
Sailing power banks
- 10. PIRIOU to build a sailing cargo ship**
- 11. MOL carries out autonomous ship trials**
Cargotec to use SSAB's fossil-free steel
- 12. IAPH's Cybersecurity Guidelines for Ports and Port Facilities**
The Call to Action for Shipping Decarbonisation
ION to help decarbonise the UK port sector



economy

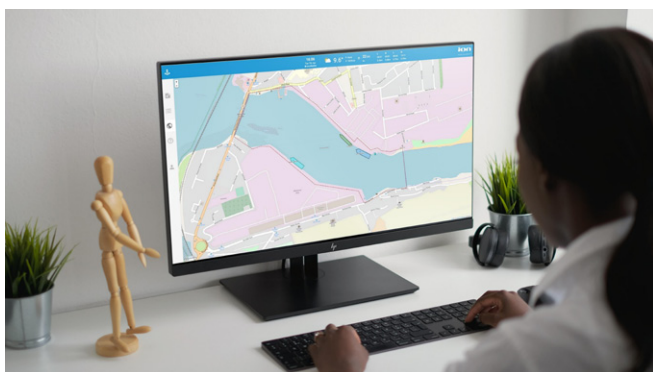
- 14. Filling in the narratives**
– The hows and whys of shipping change in 2022
James Hookham
- 16. How's the weather?**
– Changing climatic risk to the global supply chain
Peregrine Storrs-Fox
- 18. Going around in circles?**
– The why's and do's of circular economy
Ewa Kochańska
- 24. Setting the course for circular economy**
– Ways HaminaKotka mitigates its environmental impact
Jaana Niemi
- 26. Taking hold(s) of boxes**
– Bulk carriers enter the container market
Paillette Palaiologou
- 28. Battle royal**
– The decoupling of China, EU, and US economies
Przemysław Myszka





sustainability

- 36. Bucket of green steam?**
– Decarbonising shipping – successfully and fairly
Przemysław Myszka
- 46. Capturing the carbon in a ship**
– Results of the ferry carbon capture study
Esa Jokioinen
- 48. Making polluters pay**
– Fit for 55's impact on shipping
Gwenaëlle Varin
- 50. Ambition into action**
– Shipping's decarbonisation: how do we get there?
Carlo Raucci
- 52. Too good to be true?**
– The potential of bioLNG in decarbonising transport
Ewa Kochańska



technology

- 56. Volatility and schedule unreliability force terminal operators to digitise and automate**
– Interview with Stephan Piworus, Global VP Sales Marine & Ports, IDENTEC SOLUTIONS AG
Przemysław Opłocki
- 60. First of its kind**
– Visy's Automatic Damage Detection System (ADDS)
John Lund
- 62. Superior digital endowment**
– How a new eco-digital culture shapes the maritime industry
Martin Wallgren
- 64. Ready to drop?**
– Addressing crane cracks and fatigue – before it is too late
Richard Phillips
- 68. Small and attractive**
– The Port of Gdynia tests a floating drone for water research
Hanna Klimek, Beata Szymanowska, and Anna Salomon
- 70. The digital logistics game**
– Encouraging open data cooperation to build the supply chain of tomorrow
Patrik Hellman
- 72. Biofouling tackled head-on**
– The case for better antifouling technology
Markus Hoffmann
- 74. The helping algorithm hand**
– Harnessing Artificial Intelligence to detect ship corrosion
Laurent Hentges
- 76. Ready to compete**
– 3D printing propeller blades – towards remarkable high-quality, instant availability, increased sustainability, and lower costs
Peter Tommy Nielsen

Short stories

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Heated discussion over the maritime EU ETS

Several organisations have recently expressed their concerns with the current shape of the proposal to include sea shipping in the European Union's Emission Trading System (EU ETS). According to the European Commission's plans, shipowners would need to buy permits covering all their emissions from GT 5,000+ ships inside the EU (incl. emissions at berth) and 50% from international voyages starting and ending in the EU (however, specific non-EU ports will also fall under the first category, e.g., ports of call in Norway, except those on Svalbard, and Iceland, while not all "ports of call under the jurisdiction of a Member State" will be included, e.g., Greenlandic and Faroese seaports). The European Sea Ports Organisation (ESPO) fears that the EU ETS will lead to evasive port calls, a practice aimed at lowering the shipowners' costs but potentially leading to higher emissions. ESPO proposes expanding the proposal's scope by considering the evasive call to/from a non-EU neighbouring port as a call to an EU port to count the EU ETS emissions. In addition, ESPO says, the proposed monitoring mechanism should be strengthened to clearly define evasive trends and foresee the following steps if such trends are identified. "Ships can move, ports cannot. The polluter will not pay but move out where possible, without any emission gains. We cannot just wait and monitor the damage that would result from the current proposal," stressed Isabelle Ryckbost, ESPO's Secretary-General. Meanwhile, the Royal Belgian Shipowners' Association (RBSA) agrees with ESPO that the funds generated by the maritime EU ETS should go back to the industry, the so-called Ocean Fund proposed by Peter Liese, Member of the European Parliament and its EU ETS Rapporteur. According to RBSA, the current support scheme, the Innovation Fund, excludes much of the block's shipping, as it requires vessels to be built in a European yard and sail between European ports (in practice excluding the biggest and most polluting ships trading worldwide and put together in a non-EU shipyard). Last year, no money from the Innovation Fund was granted for a large-scale maritime project. At the same time, only two were selected under the small-scale call (one targeting bioLNG and the other hydrogen for inland waterway vessels). RBSA quotes a 2020 UMAS study, which calculated that \$1-1.4tr will be needed to achieve the International Maritime Organization's 2050 target of halving total annual greenhouse gas emissions from international shipping vs the 2008 reference point. Out of this figure, 87% should go to land infrastructure for providing low-to-zero marine fuels, while the remainder should come as green fleet investments (newbuilds and retrofits). RBSA isn't in favour of including ships below GT 5,000 in the maritime EU ETS right now, since it might delay launching the entire initiative (the EU's system for monitoring, reporting and verification of shipping CO₂ emissions, introduced in 2018, includes vessels above GT 5,000 only). This approach stands at odds with Transport & Environment (T&E), according to which the EU ETS should cover GT 400+ vessels, but only those emitting 1,000 tonnes of CO₂ per year. This way, the organisation argues, 12% more emissions would fall under the EU ETS than the current proposal. Citing one of its latest studies, T&E says that 25.8mt of CO₂ won't be included if the GT 5,000 threshold holds. That and keeping in place several exemptions, such as for fishing and military vessels, and offshore gas & oil service ships, the organisation adds. "This means just over half of Europe's ships are exempt from the proposal, despite them accounting for nearly 20% of the EU's shipping emissions – double what the Commission originally claimed the exemption would cover," cautions T&E. Jacob Armstrong, Sustainable Shipping Officer, T&E, commented, "It's good that the EU is finally trying to address shipping's appalling climate impact. But its proposal based on arbitrary loopholes lets too many heavily polluting vessels off the hook. The EU must rethink its shipping laws to ensure that millions of tonnes of CO₂ don't go unregulated."

Westport orders Kalmar's CCS Electric Reachstacker

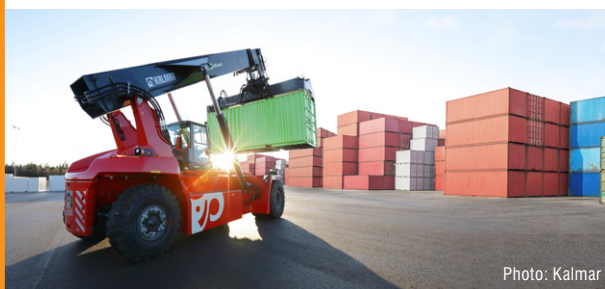


Photo: Kalmar

The 45t of lifting capacity machinery, due for delivery in early Q4 2022, will feature a 326 kWh lithium-ion battery pack covered by a five-year warranty and an expected first life of 10-12 years. According to the manufacturer, the battery capacity is sufficient to cover a complete working shift. The charging will be performed during scheduled breaks using combined charging system (CCS) chargers with a maximum capacity of 350 kW, making it the world's first reachstacker to implement this standard. The purchase comes together with five-year-long Kalmar Complete Care that will provide Westport with preventive and corrective maintenance services.

World's first marine fuel trial of carbon-neutral synthetic natural gas

A two-year partnership between MAN Energy Solutions, Elbdeich Reederei, LIQUIND Marine, Wessels Marine, Kiwi, and Unifeeder has led to bunkering *ElbBlue* with a 50/50 mix of synthetic (SNG) and liquefied natural gas (LNG). The SNG was produced at Kiwi's Power-to-Gas facility in Werlte using 100% renewable energy. According to the parties, the blend (20t of SNG, 20t of LNG) decreased the vessel's carbon footprint by 56t on its coming voyage to St. Petersburg versus sailing on conventional LNG only. "This is a crucial step on the road to decarbonising shipping. In reducing or even eliminating future emissions generated by the global supply chain, synthetic fuels and engine retrofits have a crucial role to play. While a retrofit instantly reduces a ship's emission levels, synthetic fuels like SNG can enable it to run 100% climate-neutrally. Today, we are demonstrating that any LNG-retrofitted ship can also run on fuels generated by power-to-X technology, and even as a mix of fuels depending on availability," Stefan Eefting, Senior VP and Head of MAN PrimeServ, Augsburg, said. Back in 2017, the then-named *Wes Amelie* received a dual-fuel gas-run engine from MAN Energy Solutions.



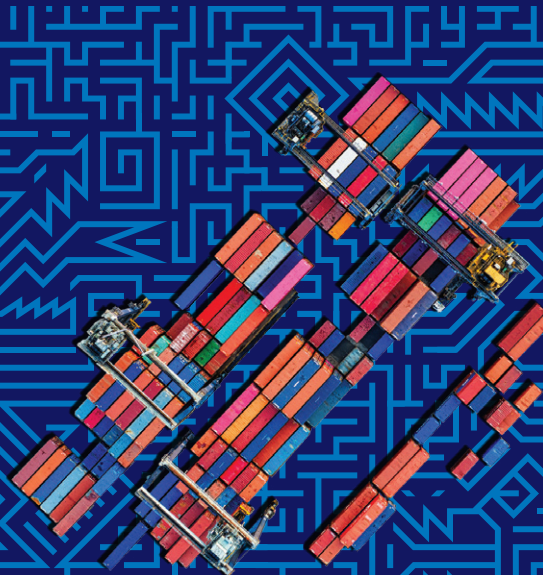
Hutchison Ports orders 17 Konecranes' ARTGs for Felixstowe

The Finnish manufacturer will deliver the all-electric, busbar-powered, automated rubber-tyred gantry cranes (ARTGs) in three phases, with the delivery of the first six machines expected in Q2 2023. By Q4 2025, all 17 ARTGs will be handed over. In addition, Konecranes will integrate the existing ARTG fleet of Felixstowe with its machinery through remote operating stations (ROS) and the company's Crane Task Management System. Konecranes' Crane Adapter Module will adapt the controls to the ROS and give the work orders to the existing cranes. A single operator at the ROS will remotely handle up to five ARTGs simultaneously across the yard. The Konecranes' 'street bogie' solution will enable fully automated, obstacle-free gantry travel. The producer's TRUCONNECT remote monitoring is also included in the buy, providing remote crane diagnostics.

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Langh Ship orders three future-ready multipurpose vessels

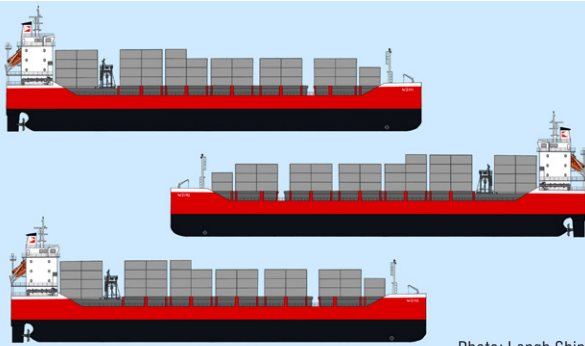


Photo: Langh Ship

The order follows the Finnish shipping company's charter agreement with the also Finnish stainless steel manufacturer Outokumpu. The 7,800 dwt vessels will be delivered by the Chinese Wuhu Shipyard starting from mid-2023. Once operational, the newbuilds will serve Outokumpu's traffic between Tornio and Terneuzen. The vessels will transport semi-finished and finished steel products to customers and for further processing. On the backhaul, the ships will carry steel scrap (the primary raw material of Outokumpu's stainless steel). The new vessels have been designed by Langh Ship in cooperation with Outokumpu and the Shanghai Merchant Ship Design and Research Institute. "The main product, stainless steel coils have a secure ride with Langh Ship's patented pontoon-type coil cradle tween deck. By loading coils both on the bottom of the hold and on the tween deck, the weight is distributed in a way to

make the ship's motions in heavy seas slower. This makes the transport safer and reduces the risk of cargo damage," Langh Ship wrote in a press release. The company also noted, "When loading other goods, the tween decks are stowed in a smaller cargo hold releasing the main cargo hold for bulk cargo or containers. The hold is box-shaped and equipped with adjustable bulkheads to create optimal hold sizes for other cargo as well as the dimensions are optimised for containers. Heavy steel containers especially developed by Langh Cargo Solutions can be carried on the hatch covers." The 1A ice-class vessels will feature dual-fuel engines, initially sailing on liquefied natural gas (LNG) or bioLNG. The fuel tanks are ready to carry methanol or ammonia. The newbuilds are also prepared for installing onshore power supply equipment, with space reserved for adding batteries to enable hybrid operations, too. The ships will have the Ballast Water Management System from Langh Tech.

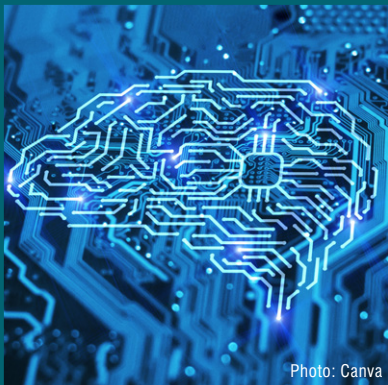


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The AI Register

Lloyd's Register (LR) has launched the Artificial Intelligence (AI) Register, a standardised digital list of AI providers and solutions certified by the London-based class. According to LR, the AI Register will assist maritime stakeholders in minimising the risk and cost of investing in AI technology. AI providers can also use the AI Register to assess existing technology and solutions from the market. The AI Register will also provide details about the specific solution, such as key business benefits, target applications, functions, and performance. "Recent developments in Artificial Intelligence have meant maritime has seen an increase in different AI applications, yet there is a lack of information and guidance around these potential solutions and providers, meaning maritime stakeholders run the risk of investing in untested technology," Luis Benito, LR's Director of Innovation, noted.

World's first test of carbon capture onboard a ship

With the help of the project partners Mitsubishi Shipbuilding and ClassNK, K Line has successfully tested a demonstration plant for carbon dioxide capture installed on the coal carrier *Corona Utility*. The Japanese shipping company says it has been able to catch and store CO₂ with a purity level of more than 99.9%. "[...] the captured CO₂ is expected to be recycled as a new CO₂ source for Enhanced Oil Recovery [...] processes or as raw material in synthetic fuel through methanation," K Line shared in a press release from August 2020 when it revealed the CC-Ocean Project.

Port of Esbjerg-Valmont SM offshore wind energy co-op

The two have signed an agreement according to which the former will erect a wind turbine tower factory in the Danish port. The investment is scheduled for completion in late 2023. Valmont SM will use it to manufacture wind turbine towers for the company's client base, including Siemens and Vestas. The agreement forms part of Esbjerg's larger green master plan. In 2020, the Nordic infrastructure fund Infranode announced a DKK1.0b-big (approx. €130m) investment scheme, following which facilities for manufacturing and warehousing offshore wind components will be set up in the seaport. "These investments will be implemented as producers of wind turbine components, and service providers step up their activities," the port authority says.

FirstBio2Shipping gets Fit for 55 funding

The project initiated by Titan, Attero, and Nordsol has been awarded €4.3m for setting up a bioLNG and bioCO₂ production plant. The facility at Attero's premises in Wilp is set for completion in 2023. It will produce around 2,400t/year of bioLNG, which Titan, the exclusive long-term off-taker, will supply to the maritime industry as a marine fuel. The plant will also deliver some 5,000t/year of bioCO₂. Attero will produce 6.0m Nm³/year of biogas from domestic biowaste for FirstBio2Shipping. Nordsol will use its iLNG technology to upgrade and liquefy the biogas. The solution is said to produce high-quality bioLNG (without contaminants), eliminate methane slip, and have no high-temperature demands in gas treatment technologies. According to the project partners, the produced bioLNG will reduce greenhouse gas (GHG) emissions by 92% compared to conventional marine fuel, representing more than 87,500t CO_{2e} net absolute emissions avoided during the first ten years of operation. Jan-Willem Steyvers, Business Developer, Attero, highlighted, "Producing bioLNG out of biogas is the next step in biowaste digestion, leading to higher-end products. BioLNG from biowaste supports the circular economy and helps dealing with yet another global concern: replacing heavy fuel oil applications. By producing bioLNG locally, traceability and transparency are ensured. Our bioLNG will meet ISCC [International Sustainability and Carbon Certification] certification criteria. The Firstbio2shipping project will create more opportunities for local biogas upgrading plants, produce high-quality, sustainably sourced bioLNG, and help decarbonise the maritime industry. It's a no-brainer."

Sailing power banks

Rederi AB Gotland's subsidiary Gotland Tech Development, Helios Nordic Energy, METS Technology and ABB have received financial support to investigate the electrification of Destination Gotland's ferries. The funds, SEK1.2m (€120k) granted through the Swedish Energy Agency's Energy Pilot Gotland programme, will be used for studying the feasibility of replacing the ships' generators with batteries to provide electricity for onboard use by passengers, including charging e-vehicles. The project aims at reducing the carbon footprint of the ferries that link Gotland with the Swedish mainland by one-tenth. The vessels' power banks will be recharged during port calls from Helios Nordic Energy's solar farms. The company's Project Manager Magnus Rahm commented, "Electrifying large fast ships is a great challenge in itself due to the very large capacity requirements. But in this case, we are also dealing with the heavily constrained grid on Gotland."



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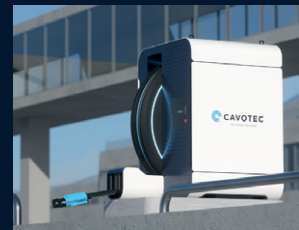
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PIRIOU to build a sailing cargo ship



Photo: Solar Impulse Foundation

The French shipyard has been contracted by the also French TransOceanic Wind Transport (TOWT) to design and deliver a hybrid, two-mast freighter. The 81 by 11.9 m ship will offer a capacity of 1,000-1,100t (in bulk on pallets), plus space for 135 225-litre barrels of wine or spirits. Additionally, the ship will offer six double cabins for up to 12 passengers. According to TOWT, the vessel's maximum speed under sail will be over 16 knots, with an average of 10.5. The two mainsails, two jibs, and one Genoa jib will span over 2,500 m². Two turbocharged 4-stroke diesel engines will supplement them. The launching of the vessel is planned for summer 2023. "The sailing cargo ship [...] will make it possible to reduce CO₂ emissions by more than 90% and to economise 20g of CO₂ per tonne transported per kilometre. It will therefore save 3,000 tonnes of CO₂ per year. In addition to the carbon savings, principally wind-powered propulsion will allow a significant reduction in the air pollution caused by the heavy fuel oil generally used by merchant ships," Guillaume Le Grand, Chairman, TOWT, highlighted. As such, the company notes, the ship " [...] will make it possible to massify its environmental impact by transporting up to 20,000 tonnes of goods per year by sail power." TOWT says it has already secured several orders for transporting cocoa, coffee, wine, champagne, and raw sugar. The company intends to open four routes linking the Port of Le Havre with New York, Brazil, Guadelupe, Colombia, Djibouti, and the Ivory Coast.



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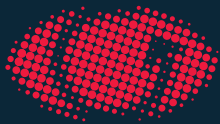


MOL carries out autonomous ship trials

Within the MEGURI2040 project, led by The Nippon Foundation, Mitsui O.S.K. Lines (MOL) and its partners have carried out two port-to-port autonomous sailings with a coastal container ship and a ferry. The sea trials were conducted on 24-25 January 2022 between the Japanese ports of Tsuruga and Sakai. In October 2021, MOL Marine & Engineering did a safety verification test using its 3D simulator. The consortium behind the trials includes Mitsui E&S Shipbuilding (responsible for developing the 'Judgement' and 'Ship Operation' functions – automated collision avoidance routing, automated ship operation in port, and automatic berthing/unberthing); Furuno Electric (the 'Cognitive' function – integration of sensor information during navigation and at berthing); Imoto Lines and MOL Ferry (providing the container carrier and ferry, respectively, and seafarers and developing the ship operation plans); A.L.I. Technologies (mooring support technology); and MOL Marine & Engineering (simulation software for collision avoidance, navigation, berthing, and unberthing). The ships safely navigated the routes formulated by the autonomous collision avoidance routing system based on the integrated information. Autonomous berthing and unberthing were executed using information from the Furuno Electric-developed berthing/unberthing support sensor (equipment that calculates and visually displays accurate relative distances and relative angles between the pier and hull from the data gathered by LiDAR/camera/satellite compass). A robotic flight drone was in charge of the mooring by carrying the heaving line to the pier. During the trials, information on other ships and obstacles/debris on the set route was gathered by the Furuno Electric-developed autonomous surrounding information integration system (which measures and displays positions, speed, types of nearby ships, and position of obstacles/debris by integrating information gained by cognition through radar, AIS, and camera images). The consortium plans further autonomous navigation sea tests using the Sunflower Shiretoko coastal car ferry.

Cargotec to use SSAB's fossil-free steel

To reduce its upstream emissions, which account for over one-third of the company's carbon footprint, Cargotec will start using 'green' steel for producing its cargo handling equipment. "I am proud that we are paving the way in the cargo handling industry through commitment to using fossil-free steel and have this unique opportunity to work with a forerunner in fossil-free steel development. This is an important step towards our vision of becoming a leader in sustainable cargo flow," Mika Vehviläinen, Cargotec's CEO, said.



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IAPH's Cybersecurity Guidelines for Ports and Port Facilities

With the help of the World Bank, the International Association of Ports and Harbors (IAPH) published the Guidelines to serve as a crucial, neutral document for port senior executive decision-makers who are responsible for safeguarding against cybersecurity risks and ensuring the continued business resilience of their organisations. The publication aims to assist ports and port facilities in establishing the true financial, commercial, and operational impact of a cyberattack. It is also intended to make an objective assessment of ports' readiness to prevent, stop, and recover from a cyberattack. At the same time, the Guidelines address the vital question of what port organisations need in terms of resources to manage cybersecurity risks effectively. Pascal Ollivier, Chair of IAPH Data Collaboration Committee and President of Maritime Street, commented, "These guidelines were a logical follow-on from the Port Community Cyber Security White Paper developed by IAPH in 2020 as a guide to those ports gearing up to digitalise processes and data exchanges to deal with the new normal caused by the COVID-19 pandemic. The digitalisation of port communities means ports will need to pay increased attention to cybersecurity risks." IAPH intends the Guidelines to become an active, living document with regular updates and editions.



IAPH Cybersecurity Guidelines for Ports and Port Facilities

Version 1.0



The Call to Action for Shipping Decarbonisation

Over 150 leaders and organisations from across the maritime value chain have signed the call to action in question, urging governments to implement measures for making international shipping emission-free by the middle of the century. The signatories call for three steps. First, committing to decarbonising international shipping by 2050 and delivering a clear and equitable implementation plan to achieve this when adopting the IMO GHG Strategy in 2023. Second, supporting industrial-scale zero-emission shipping projects through national action, among others, by setting clear decarbonisation targets for domestic shipping while providing incentives and support to first movers and broader deployment of zero-emission fuels and vessels. Third, delivering policy measures that would make zero-emission shipping the default choice by 2030, including meaningful market-based measures taking effect by 2025 to support the commercial deployment of zero-emission ships and fuels. The signatories have also produced a report describing actions and initiatives taken by them to decarbonise shipping.

ION to help decarbonise the UK port sector

The Edinburgh-based software group has received a grant to advance port decarbonisation through its Marlin SmartPort climate-smart platform. The Data-Led Emissions Management (D-LEMA) project is part of the Clean Maritime Demonstration Competition, funded by the UK Department for Transport and delivered in partnership with Innovate UK. The half-year-long pilot study will validate whether vessel fuel usage and CO₂ emissions can be reliably estimated in and around ports using the International Maritime Organization global standard. The Clean Maritime Demonstration Competition is a £20m investment from the government alongside a further £10m from industry to reduce emissions from the maritime sector. The programme supports 55 projects across the UK and will be used to support the research, design and development of zero-emission technology, plus infrastructure solutions to accelerate the industry's decarbonisation. The grant received by ION supports the UK's Ten Point Plan to address climate change and help achieve the country's net-zero emissions target by 2050.



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Filling in the narratives

by James Hookham, *Director, Global Shippers Forum*

Although container shipping capacity remains in short supply, there is no shortage of forecasts for what 2022 holds for the sector and those that rely on its services. Having enjoyed huge profits from an unexpected surge in demand for imported goods into North America and Europe over the past 18 months, most shipping lines and logistics service providers are confidently predicting more of the same this year. That is to be expected – **an analysis published last month by the Financial Times** showed the earnings growth of some shipping lines exceeded that of high-profile tech companies, like Netflix and Amazon. Unsurprisingly, most shipping lines would quite like that trend to continue. Yet, hopes that the ‘Great Shipping Crisis of 2021’ turns into ‘Profits as Usual in 2022’ may be premature as carriers overlook the impact of a few factors that look set to dominate this year unless a further variant of COVID-19 engulfs the world.

The working hypothesis of most shipping industry observers is that chronic delays through major ports and congested inland distribution systems, especially in the US, will maintain the upward pressure on shipping rates and transit times globally, much as they did during 2021. There is no new shipping capacity being deployed until 2023 at the earliest and no significant expansion plans being commissioned at the world’s major gateway ports. Indeed, possible labour disputes in US and Canadian ports may worsen the situation before it improves.

The acid test

But this scenario presupposes that the demand for imported containerised goods into Europe and North America will remain at, or above, last year’s levels and maintain the pressure on congested infrastructure. Absent from this narrative

is any recognition of the broader economic developments that are now almost certain to play out over the same period.

For months, central banks and finance ministries have been making clear their intention to increase interest rates with the express purpose of stifling exuberant consumer demand to contain the highest rates of retail price inflation experienced in over three decades (at least in the US and the UK). The OECD has demonstrated that the high cost of shipping goods has contributed directly to these inflationary pressures. The debate is now about how many rate increases will be made in 2022 and their impact on consumer expenditure in importing countries.

There are good reasons why the ‘click-fest’ of online shopping that triggered the ‘Great Shipping Crisis,’ and the over-ordering of stock by importers to beat the subsequent delays, could end as quickly as it started. From March or April this year, household expenditure

will come under additional pressure as winter energy bills at double or triple last year’s rates need to be paid. It will coincide with the first of several predicted rises in interest rates that will start to feed through to higher mortgage interest charges and credit card repayments later in the year. Some governments are also increasing taxes to begin restoring order to their public finances savaged during the coronavirus pandemic. As such, the assumption that the demand for imported containerised goods into Europe and North America will remain at or above last year’s levels and maintain the pressure on limited infrastructure looks shaky. Persistently high shipping rates in 2022 are by no means inevitable.

Higher interest rates won’t just affect consumers. Businesses will also see the cost of borrowing rise. The withdrawal of asset purchases (or quantitative easing) by central banks that have made commercial loans relatively cheap and easy to come by for nearly a decade will

make rolling over debt more difficult. It will put pressure on businesses' free cash flows, which could trigger reviews of the currently high inventory levels. As early as mid-year, supply chain managers could once again be examining the relative merits of just-in-case and just-in-time supply chains.

A sustained drop in demand for imports, hence traffic volumes, should restore shipping rates and service reliability to more recognisable levels, allowing for a lag of a few weeks for the backlog of containers at major gateway ports to clear. This should, in turn, trigger a re-deployment of shipping capacity, plus reinstating calls at ports habitually skipped by vessels seeking to recover lost time (or were too full to make a call worthwhile) and longer service strings (many of which have been blanked in favour of simpler shuttle movements between ports on more lucrative trades). According to the Container Shipping Market Quarterly Review Q4 2021 done by MDS Transmodal and our organisation, some ports lost a third of the scheduled capacity that was expected to call due to blanked sailings or the port being skipped during 2021.

The pace at which rates adjust and service quality improves will be the acid test of the other shipping industry narrative. According to it, the record rates and poor service quality experienced since mid-2020 have been one-off events solely attributable to the impact and consequences of COVID-19, rather than a permanent resetting of shipping capacity and prices. Shippers will be very closely watching the responsiveness of the market as demand changes.

Tainted with digitalisation?

But this is not to forecast a return to the relative calm of pre-corona conditions. While coping with COVID-19 last year, the container shipping industry also advanced the process of digitalisation of its operations and dealings with customers.

The digitalisation of container shipping is not just substituting paper documents with their e-counterparts. Done correctly, it has the potential to make booking a slot on a container ship no different to reserving a seat on a passenger aircraft. Many of the essential protocols and procedures to allow data exchanges between shipping lines are being, or have already been, developed by the Digital Container Shipping Association and have started to be deployed. It could very well be the year that the carriers' booking platforms over which these new digital transactions will be conducted achieve take-off, potentially offering a new level of price transparency. How soon before shippers have access to shipping rate comparison sites? The Global Shippers Forum can foresee 'comparetheconsortia.com' becoming a popular site!

Ominously, though, the first deployment of these platforms has been to provide a mandatory spot booking portal for use by smaller forwarders, whom at least two shipping lines have henceforth denied access to contract shipping rates. This has unsurprisingly provoked the wrath of forwarders and their SME clients. It risks tainting the long overdue benefits of digitalisation in a premature and potentially misjudged step by carriers to rationalise their pricing practices. How the market reacts to

this development will be another crucial indicator of shipper (and forwarder) sentiment during 2022.

Another dramatic year of change

The past 24 months will have been the most challenging time of their careers for most shippers. While hoping the fear, and at times the huge stress, of working under the shadow of COVID subsides rapidly, these developments will make 2022 another dramatic year of change – for the container shipping business in general and those relying on it to conduct international trade in particular. ■



The Global Shippers Forum (GSF) is the worldwide trade body that speaks up, advises and supports shippers and cargo owners in the essential role they perform in national economies and work to make international trade and transport safe, efficient and environmentally sustainable. The organisation participates in meetings of international bodies, offering its opinion and advice on issues that affect the way shippers do their job. GSF also provides its members with exclusive briefings and a platform for businesses professionals organising the transport of goods to work together, learn from each other and find a common voice. Visit globalshippersforum.com to find out more.



How's the weather?

by Peregrine Storrs-Fox, Risk Management Director, TT Club

The climate is changing and increasingly so towards more extreme weather events. It necessitates greater awareness of weather-related risks in the global supply chain. Let us then look at some of the considerations cargo handling facilities should contemplate in anticipating climatic events and mitigating their potential consequences. In addition, using TT Club's past claims data, let's highlight the extent of wet damage exposure.



TT Club specialises in the insurance of intermodal operators, non-vessel owning common carriers, freight forwarders, logistics operators, marine terminals, stevedores, port authorities and ship operators. The company also deals with claims, underwriting, risk management as well as actively works on increasing safety through the transport & logistics field. Please visit www.ttclub.com for more info.

Everyone is well aware of weather conditions in their locality; those responsible for operating cargo facilities are likely to be acutely conscious of changes in local climatic conditions. Many have seen tidal surges and wind microbursts, while unprecedented rainfalls are becoming increasingly common. Such operators need to keep 'fresh' their assessment of the changing risk profile concerning climate experience to protect personnel, operations, equipment, fixed property and infrastructure, and importantly – customers' goods.

Meteorological comprehension is advancing, and related risk management assistance technologies are equally widely available. The capability to monitor, record and predict weather patterns will continue to develop. None of this will physically protect operations, but when utilised as an integral component of ongoing risk assessments, they may inform decision-making, such as where to position equipment, how best to stack empty containers, and strengthen procurement specifications.

Lovely weather for ducks...

Whilst many storm events are considered geographically seasonal – such as those in the Tropics – the entire supply

chain industry must take adequate steps globally to prepare for isolated severe weather events.

Typically wind strength is most ferocious in coastal areas. Yet, the surge and flood risk can often cause greater problems, both on the coastline and further inland. The occurrence of extraordinary volumes of rainfall over short periods in various parts of the globe is increasing, resulting in flash flooding and causing significant damage, including to warehouses and cargo stored within them. However, the fact that more rain fell on a particular day than any other in recorded history does not assure legal defence if a claimant can demonstrate deficiencies in the operator's risk assessment or inadequacies in the steps taken in advance of the weather event.

The associated losses of such incidents can be far-reaching; water can penetrate the tiniest cracks and is unforgiving in damage it causes. Furthermore, flood water is inevitably dirty, increasing damage and in many instances creating health challenging situations. Our claims data from the last three years suggest that inland operations were subject to damage in 32% of cases, illustrating (unsurprisingly) that operations positioned on or near a coast are more susceptible

to weather-related incidents (68% of cases). Some 16% of claims notified through the period involved heavy rainfall that overwhelmed drains and guttering, subsequently flooding buildings and storage facilities. Property damage through strong winds and microbursts was featured in 74% of weather-related claims throughout the period.

Extreme weather events can be challenging to predict – and even accurate forecasting may only provide a matter of hours for the respective operators to react. It is essential to ensure that adequate risk assessments are undertaken across the full breadth of the operations to understand the various risks thoroughly and, where appropriate, develop mitigating actions and controls, together with an effective continuity plan (for further reading, kindly check TT Club's **Windstorm II: Practical risk management guidance for marine & inland terminals**).

Don't make the weather any heavier

While not necessarily related to extreme weather conditions, claims resulting from wet damage to cargo are all too frequent under more ordinary climatic circumstances. Many of these can be avoided entirely with a robust pre-loading condition checking procedure. While humidity and condensation are inevitable challenges through the supply chain, pre-existing damage to a cargo transport unit (CTU) should be an easy check.

As TT Club regularly articulates, around 65% of cargo damage incidents are attributable in part to the way that goods are packed within the CTU. The CTU Code and the more recent **CTU Code – a quick guide** and complementary container packing checklist published by the Cargo Integrity Group provide supply chain actors with invaluable risk mitigation guidance.

Pre-packing unit condition checks are critical in protecting the cargo during its journey. Controlling for signs of **pests**, dust, debris, transferable stains, and odours is vitally important. So too are checks for physical damage, holes,

evidence of repairs and items such as rust or water trails that might indicate water ingress. TT Club's claims data for 2020 suggest that 25% of wet cargo damage notifications were caused by water ingress to the CTU through pre-existing damage that probably should have been identified as part of the cargo packing process.

Once the cargo has entered the intermodal supply chain, our data suggest that a further 17% of wet damage claims stem from impact damage to the unit during transportation. Of course, there are many touchpoints throughout the intermodal transit (at the road, rail and maritime terminals) where damage might occur. Road traffic accidents may also expose the shipment to the elements.

The intelligence we gathered indicates the maritime mode poses the most significant risk, accounting for 65% of reported claims. It can be partly explained by the length of time that the cargo is in transit – extending the period of exposure – in addition to the different climatic zones through which the load moves. Road transit was the next most prominent mode at 14%, where shorter journeys, fewer intermodal changes and operator owned units likely influence the better experience. Wet damage arising under air carriage accounted for only 7% of TT Club's 2020 data reported claims, reflecting shorter transit periods and different handling parameters. Data suggest that the primary exposure, unsurprisingly, rests in-between the airside warehouse and the physical loading to or unloading from the aircraft.

Perhaps less expected, incidents where the cargo was wet-damaged while in storage accounted for 13% of reported claims. Causation varies but includes damage occurring to or within the storage facility itself and, with increasing frequency, the incidence of flooding. Some 31% of these incidents followed sudden heavy rainfall that overcame drain provisions. This latter point highlights the importance of routine maintenance to ensure that drains and drain pipes are clear and undamaged

and indicates the prudence of periodic risk assessments to ensure that original building design parameters remain appropriate.

Poor operational practices also attribute to losses, with incidents of cargo temporarily stored entirely unprotected, the shipment being transported on flatbed trailers/flat rack containers with insufficient coverings, and loads being 'cross-stuffed' during periods of rainfall. In too many instances, cargo had been unstuffed from units for customs inspection – laid out on the facility's ground. Rainfall occurring whilst the goods stand unprotected awaiting examination inevitably causes damage.

Pragmatic yet mindful

While this analysis was limited to 2020 incidents, it was triggered by a deteriorating trend, which indicated a potential increase in risk exposure.

In many instances, fortuitous circumstances resulted in a disproportionate monetary consequence. While the outcomes are necessarily cargo-specific, it is noteworthy that numerous consignments were eventually accepted by the beneficial cargo owner (BCO) with an element of rework, reducing the potential cost of the loss. While such solutions are pragmatic for all concerned, it is clear that all actors in the supply chain need to be mindful of the risks.

While there may be contractual defences to wet damage claims, such as where the bill of lading is noted 'shipper load, stow and count,' there are inevitable consequences when damage is incurred in this way. Having entrusted their cargo into your care, custody and control, the BCO might be expected to be aggrieved when part or all of their valuable cargo has suffered wet damage – regardless of fault. Reputational damage can be extremely challenging to repair. ■

Going around in circles?

by Ewa Kochańska

The DHL white paper ***Delivering on Circularity*** takes an in-depth look at a transition from a linear to a circular economic model in the fashion and consumer electronics sectors in the context of reducing waste and greenhouse gas emissions (GHG-E). The report calls for innovative logistics and cooperation between manufacturers and consumers to drive the transition alongside the 5 Rs: reduce, repair, resell, refurbish, and recycle. The authors list specific steps and tools for redesigning global supply chains to accommodate circularity and its net-zero potential.

The current linear paradigm evolves around the produce-sell-use-waste scheme, where manufacturers focus on producing, brands and companies on selling, and the product is bought, used and disposed of by the consumer, generating unnecessary waste and emissions. The circular economic model helps minimise resource consumption during production, lengthen the product lifecycle, and recycle products and materials.

The circular model works as long as stakeholders work towards a responsible and profitable utilisation of resources; the manufacturers and users strive to recycle products for future use as either materials or second-hand items, while the logistics sector provides necessary data and orchestrates the flow of goods.

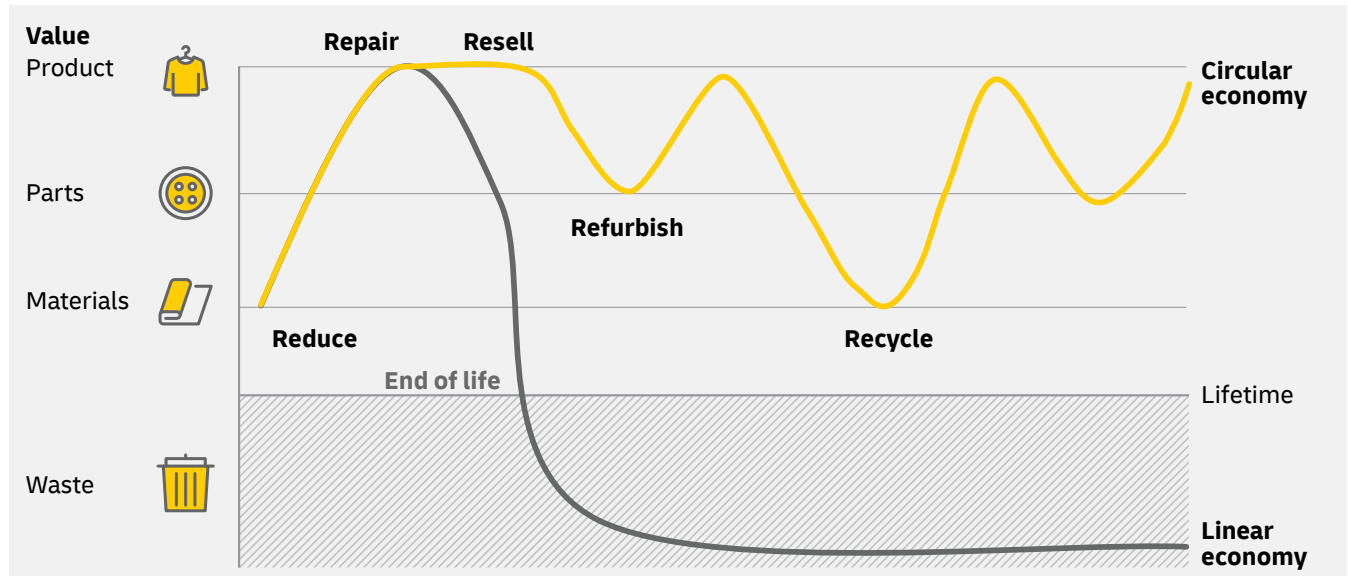
Therefore, to move from a linear supply chain to a closed-loop or circular model, volumes of production and materials, along with the lifecycle of products, must be optimised, and new models for product use and end-of-life recycling must be developed. This type of change, which is much more cost-effective than any other decarbonisation approach, could eliminate up to 40% of emissions.

The damage

Since the fashion industry produces between 4% to 8% of GHG-E and consumer electronics about 2%, combined, they emit twice as much as the aviation industry (3%). “At current consumption levels and under current approaches to managing the lifecycles of these products, emissions from these industries would grow by 60% until 2030 and account for around 20% of the UN GHG emissions target for 2030, which is set at half of today’s emissions,” states the report.

Concerning natural resources, the current linear production and consumption models cause significant damage, particularly when it comes to exploiting non-renewable resources. In the production of consumer electronics, a large number of metals, including rare earths, are required. One of the main culprits in the fashion industry is synthetics, such as polyester, which are often produced using fossil fuels. Land usage and water consumption are also devastating – the fashion industry requires 40 million hectares, mainly for cotton farming, and 150 trillion litres of

Fig. 1. Linear vs circular product lifecycle



Source for all figs.: DHL's Delivering on Circularity

water annually. Production processes in fashion also pollute water when chemicals leak into freshwater. Similarly, improperly disposed electronic products end up in landfills where chemicals and metals used for production contaminate water, air, and soil. This is in addition to the environmental impacts during resource extraction, production, and transportation. Waste at the end of product lifetime is also a major challenge for both industries. Electronic waste is the fastest growing waste globally, with 80% not being recycled. Some 75% of fashion-product-waste ends up either in landfills or is incinerated, causing more emissions.

These high levels of waste, as well as raw material extraction and production, have an adverse effect on workers involved in the manufacturing and waste processes. In consumer electronics, for example, the needed raw materials are often extracted in dangerous conditions – in mines, where contact with toxic material and the threat of mine collapse are ever-present. Improperly discarded electronic waste also poses a risk to workers in the waste processing sector.

The five commandments of circularity

Recycling raw materials in fashion and consumer electronics is especially key because most of their GHG-E are generated during the extraction and production of raw materials. For the fashion industry, the production phase is responsible for 71% of carbon emissions while product use, e.g. garment washing, for 20%. In electronics, the production phase of smartphones is responsible for 80% of emissions, and 15% of emissions are produced during use, e.g., charging. Considering that manufacturing is so damaging in these sectors, extending the usage and inserting the product value back into production are vital to reducing environmental damage. The 5Rs will be key to achieving these goals.

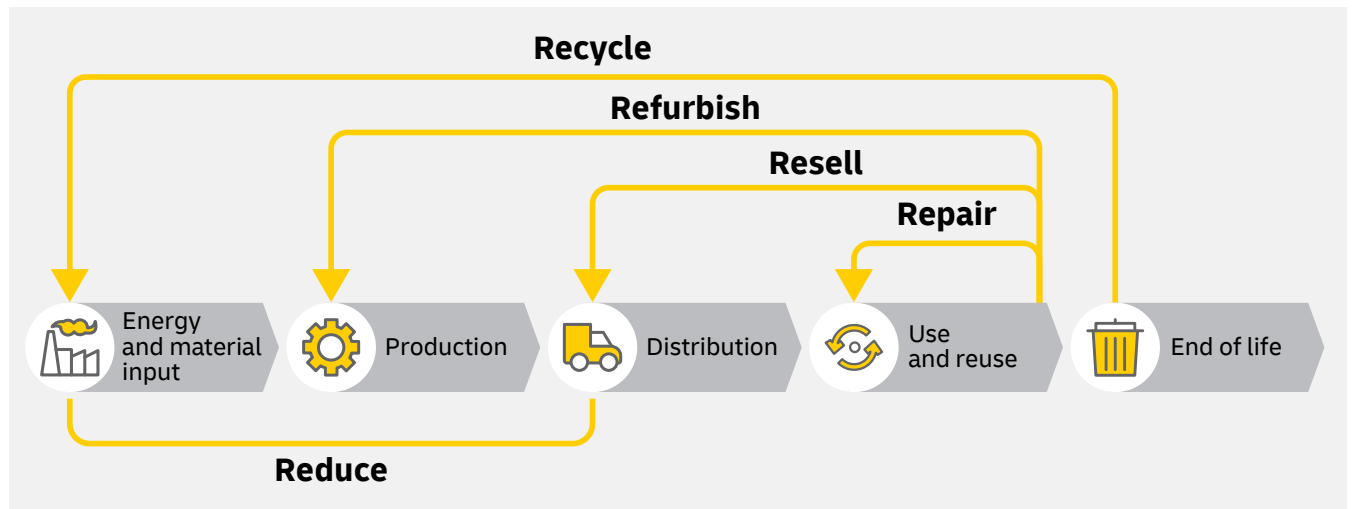
Reduce in circularity refers to the production phase, particularly reduction in volumes. Overproduction is especially present in the fashion industry, keeping at 20% to 30%. Repair calls for fixing instead of disposing of damaged products to extend the lifecycle. Resell pertains to consumers selling their product they no longer want but is still usable.

In the fashion and electronics sector, reselling is still at lower rates than in other industries, such as automotive. Refurbish is about users returning products to the manufacturer, who then checks, enhances, refreshes, and sells them again. Refurbishing in electronics is nothing new but has become more common in recent years. Refurbishment in fashion is rare, except for some rental platforms for high priced luxury items. The last step, recycle, comes only after the product is no longer viable. Such items still have value for the manufacturer, namely their parts and materials that can be used in another production cycle. In fashion, recycling is almost non-existent, with 95% of products being manufactured from virgin materials. Only recently, some retailers started offering take-back programmes often in exchange for coupons or vouchers.

Circular-ready

The consumer goods chain includes many stakeholders such as

Fig. 3. The role of the 5 Rs in the circular product lifecycle



producers, consumers, regulators, and shippers – and they all play a part in implementing circularity. Cooperation will be crucial for the transition to benefit all the groups, likewise the society and the environment. The report identifies three core enablers and ten building blocks that help achieve circularity and its goals.

The first one is circular consumer behaviour, where the customers return products to the manufacturer. This behaviour is critical because that is the only way the producer can reuse the product for parts or resell/refurbish. Additionally, it sends a message to companies and brands that consumers do indeed want and expect the switch from a linear to a circular economic model.

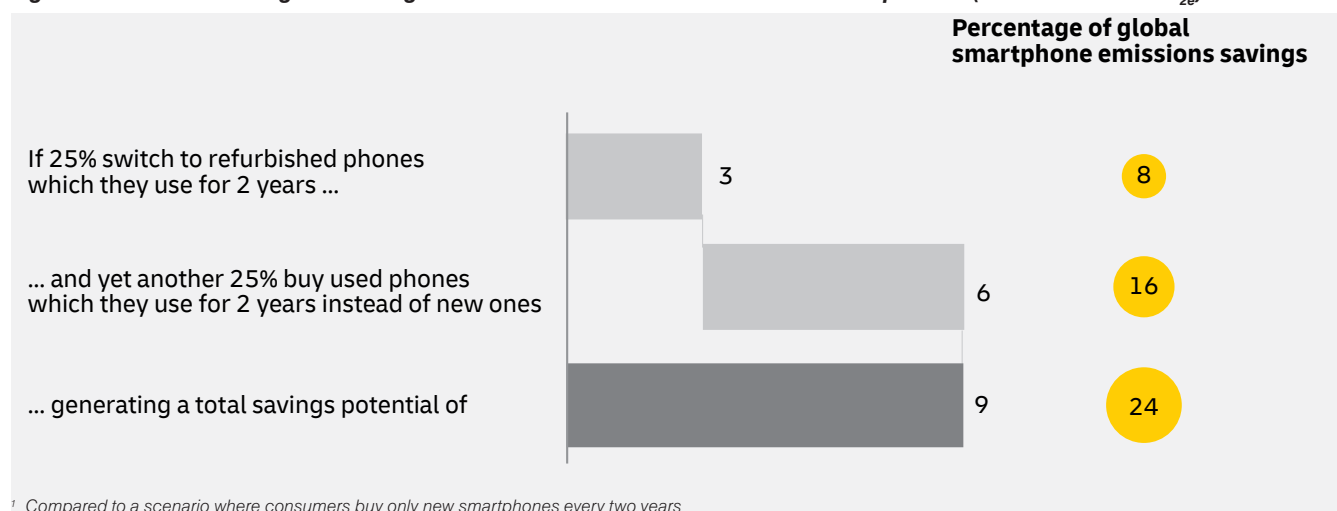
Sustainability has caught on in recent years, especially among the younger generations, but there's a critical difference between social media trends and actual willingness to sacrifice. Certainly, at least at the beginning of the switch, the product price points will be higher. "Bridging the gap between attitudes and actual behaviours is the key [...] and it depends on, among other things, [...] offering attractive consumer incentives, [...] providing a conducive public-sector environment and regulatory guard-rails, and [...] offering smart logistics solutions," points out the report. Some industry leaders have already started product-collection incentives, such as vouchers and discounts on replacement products, and making the return of used items as simple as possible.

The second enabler is the circular supply chain. The current supply chains must be redesigned, and new

supply models need to be introduced. The challenges of economic circularity include accessing the end-of-life or unused products to redeposit them into the supply cycle and a thoughtful design of the supply chain. With the return programmes and incentives mentioned above, the process is starting already, but the returns need to be optimally merged with the existing supply chain. For instance, when it comes to sorting returned items into the type that can be refurbished and the type that has to be recycled – when and where that should be done is significant, e.g., in terms of cost-effectiveness and emissions. This is why the logistics sector is so vital to circularity, as it depends so much on the scrupulous arrangement of the supply loop throughout distinct elements.

The third enabler is visibility and orchestration. As the supply chains become more complex, the report points out that "optimal production planning and inventory management require adaptations to be ready for a circular world." For example, production planning must consider the availability of recycled materials, while inventory management must consider post-sale item flows. That means that advanced technologies and tracking tools will play a significant role in transparency efforts. In the consumer electronics sector, technology allowing for product traceability throughout its entire lifecycle already exists. Further, tech-solutions that combine physical marking with a digital twin allow for improved inventory and stock management. Big data and innovative technologies are at the heart of complex

Fig. 4. Global GHG savings from longer use times and new use models of smartphones (million tonnes CO_{2e})¹



logistics models and are needed in the production planning and inventory management of the circular economy as well.

The blocks to build with

The ten building blocks included in the report encompass the product's entire lifecycle. The first one is design for circularity. Here, one of the key challenges is using many different materials to produce one product and the resulting difficulty of disassembling such an item. Making more mono-material designs in both fashion and consumer electronics could certainly make circularity easier to implement.

Next is the development of innovative (raw) materials. In electronics, e.g., researchers from the University of Sydney are working on replacing the rare metal indium – a component of touch screens in consumer electronics – with a combination of silver and tungsten oxide, which are more widely available.

The third building block, on-demand and circular production, deals with the issues of waste generated during production and overproduction. In the manufacturing phase, waste should be reused as much as possible, e.g., wastewater can be used for industrial cooling or, as long as it is free of pollutants – to water the outside areas. Overproduction, however, is one of the most pressing issues that many industries, particularly fashion, must resolve. Around 20% of manufactured garments in the fashion industry are never used; reducing that number even just by half could free up eight million hectares of land and reduce the sector's waste by

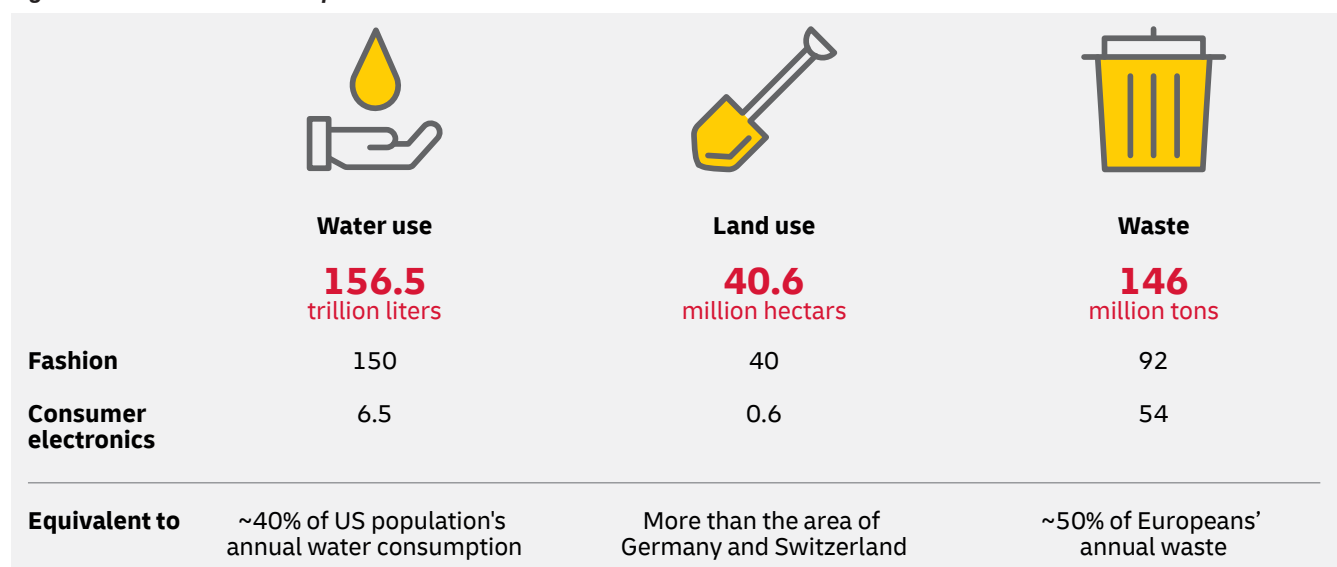
ten million tonnes. Since optimisation is key to circularity, demand-driven manufacturing (e.g., producing a garment once a customer paid for it or producing uncoloured garments) and late-stage differentiation (e.g., only dyeing fabric once a specific order is placed) could be very useful. Here again, logistics service providers will play a vital role, providing demand forecasting and predictive inventory rebalancing.

The fourth building block is reusable and environmentally friendly packaging around the inner product and in external shipping packaging. Government programmes can play a significant role, such as in the UK, where the cabinet offered £200m for research on environmentally friendly packaging, e.g., from plants, wood chippings, and food waste.

The next block is smart product return and recovery solutions which ensure that manufacturers can receive and reuse products and materials. This is followed by the sixth stepping block – new use concepts, such as pay-per-use models, and product rentals and leases. For these two blocks, again, logistics services come into the main focus since the need for innovative digital ecosystems that make secure returns and exchanges feasible for the largest consumer groups possible is necessary.

The seventh block concerns reselling and refurbishing. The GHG-E savings from extended use of a product through reselling and refurbishment are enormous. But, reselling and refurbishing also require smart logistics since deciding early on where a returned product should go next is essential.

Fig. 2. The environmental impact of fashion and consumer electronics



The eighth stepping block is viable repair business models. The logistics of getting the product sent out for repairs and financial feasibility pose serious challenges. As it is today, repairs don't seem to make financial sense for manufacturers and customers alike. However, the report points out that repairs are costly because they are mostly performed manually and automating this process would drive the costs down.

The ninth block is smart asset collection and material recovery to get the maximum value of end-of-life products. Implementing national collection systems for these items is key, as are incentives for consumers – such as vouchers for returns, simplifying the process, and reducing costs to customers for returning products.

The last building block is advanced recycling technologies. Here, once more, logistical solutions are invaluable to accumulate, direct, and sort product flows by, e.g., material type or its condition.

Reaching the critical level

The road to sustainability for global industries is far from simple. For circularity to take root and deliver on its promise to significantly lower GHG-E and become profitable, all stakeholder groups must participate in the process.

The report identified circularity's four key levers, i.e., on the brand side – brand uptake, which is the share of brands offering sustainable products and business models, and assortment

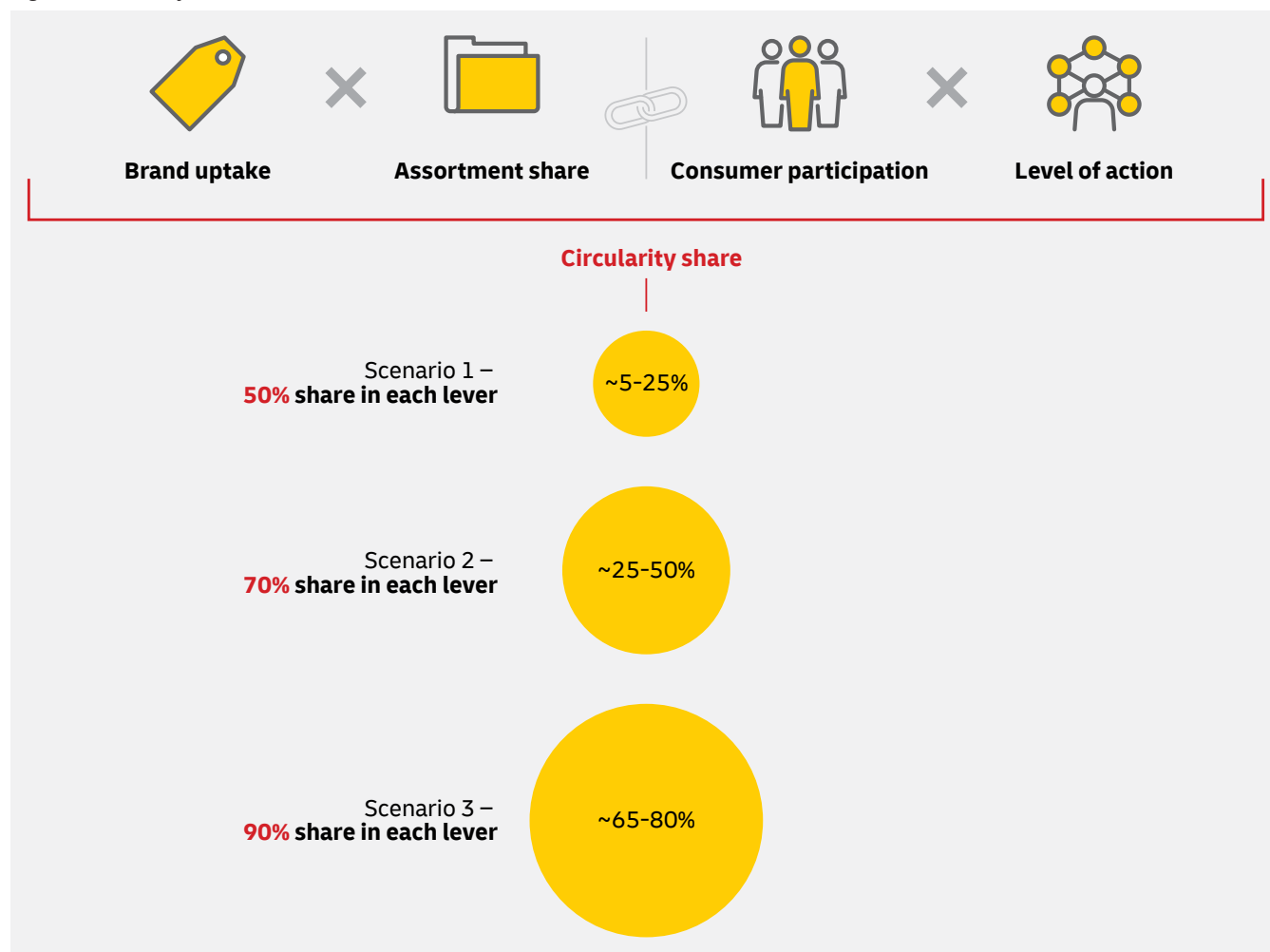
share – brand's portfolio share that is circularity-focused, and on the consumer side – consumer participation and level of circular behaviour. "Uptake in each of these levers must reach a critical level before the combined effect of circularity has a significant impact on the share of circularity," says the report.

In order for the circular model to establish itself, there are some immediate steps stakeholders should take. Brands and manufacturers must establish specific, measurable targets, e.g., for GHG-E reductions; innovate their products and business models; partner with peers and suppliers to incorporate industry standards and data sharing; take a holistic approach to circularity throughout their organisation and raise societal awareness about its benefits.

For consumers, a shift in behaviour is vital to ensure that companies can optimise their 5 Rs. That means a sustainable approach to lifestyle and adapted purchasing behaviour as well as peer education, through word of mouth and via social media, as well as feedback loops – sharing customer opinions with businesses to enable swift adjustments.

Logistics players have always been pivotal in business, but the transition to a circular economic model is impossible without effective supply-chain schemes. Logistics systems will be responsible for supply chain redesign and transparency, best-practices information exchange among various sectors, and striving for transportation decarbonisation.

Fig. 5. Circularity as a function of four levers



Also, governments must play an active and visible role in the transition. Regulatory guardrails can steer the progression of the changes and speed them up by, e.g., banning the destruction of functional products or updating and restricting recycling rules. The state can also stimulate technology and product innovation by offering solutions such as investment opportunities and incentive programmes. Cabinets are also responsible for monitoring and progress management with local and global data collection, and overseeing progress in sustainability-related activities. Additionally, public awareness campaigns encourage sustainable behaviour on an individual level and stimulate societal demand for circularity and its benefits.

Talking logistics

Consumer electronics and fashion sectors were chosen as case studies

for this report because all consumer goods are responsible for 25% of global GHG-E, second only to the mobility sector. With increasing calls for immediate action towards building a more sustainable future, all industrial manufacturing and consumer behaviours must accommodate global environmental targets.

The circular economy model can help integrate the natural ecosystems with business and consumer needs while redefining the concept of growth and focusing on ecological and societal benefits. Achieving these goals is undeniably linked to some game-changing innovations from the logistics service providers. They are the enablers and orchestrators of the transition, which is based on highly-efficient supply chain flows.

And since we're now living with a looming threat of a global war, let us end with a relevant WWII Gen. Omar Bradley quote, "Amateurs talk strategy. Professionals talk logistics." ■



Photo: HaminaKotka

Setting the course for circular economy

by Jaana Niemi

Alongside everyday operations taken with environmental care, the Port of HaminaKotka and its partners have many ongoing projects to make them more climate-friendly. In addition to legislation, such as the environmental permit, both Finland's and international emission targets and climate strategies govern environmental decisions at the ports.

As part of the European Green Deal, the European Union (EU) has, following the European Climate Law, set itself a binding goal of becoming climate-neutral by 2050. This move calls for a considerable reduction in greenhouse gas emissions over the following decades. The EU has also raised the 2030 climate bar, requiring emission reduction of at least 55% by that year vs the 1990 level. The EU is preparing to revise its climate, energy, and transport legislation within the Fit for 55 package to make current legislation conform to the 2030-2050 targets.

The provisions also govern seaport operations. As such, the Port of HaminaKotka will have an opportunity to bunker vessels with liquefied natural gas at both of its ports before this becomes mandatory under regulations. Moreover, the construction of onshore power supply facilities for container and cruise vessels is under consideration.

From waste to resource

The objective of the programme of the Finnish Government headed by Prime Minister Sanna Marin is

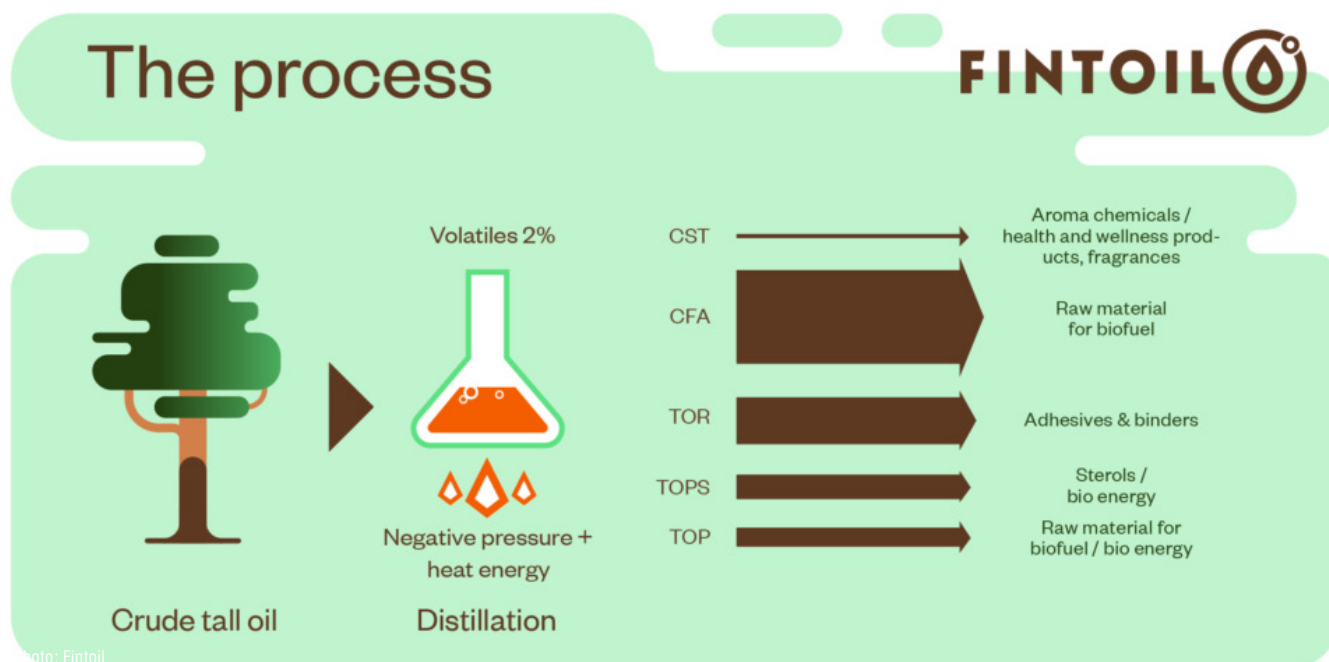
that Finland ticks off carbon-neutrality by 2035, hence becoming the first fossil-free welfare society. One strategic component of the governmental scheme includes securing biodiversity, and another sub-target reinforces Finland's role as a pioneer in the circular economy.

The Port of HaminaKotka has also recognised the importance of making its economy more circular. Among other things, the port company applies the principles of sustainable development and circular economy to construction works. For instance, concrete and asphalt waste from various types of demolition work in the port area is recovered for subsequent use as applicable. When the Hietanen Car Terminal was built, significant amounts of tyres, surplus rubber granules, and other corresponding materials were used to fill the land areas. Similarly, new space at the D-area at the Mussalo Harbour was erected using concrete and brick debris, and materials from old, demolished schools and bridges. At the same time, the earth and rock materials hauled to the area were extracted from the immediate vicinity of the port. All of this contributed to minimising heavy-duty traffic emissions.

The circular economy is also a focal point when treating other refuse, e.g.,

sewage from vessels. HaminaKotka is the first seaport to be involved in the circular economy pilot project of the Baltic Sea Action Group. The wastewater is taken to a local treatment facility, after which the solid waste created in the process is converted into biogas and soil improvement material. Another objective of the project is to encourage ships to leave their sewage ashore instead of discharging them into the Gulf of Finland, thus avoiding aggravating the eutrophication process that negatively affects the Baltic marine life.

In February 2020, Fintoil announced constructing a tall oil distillation plant at the Hamina Harbour. The company distils raw materials for several products from crude tall oil, which is a byproduct of softwood pulp production categorised as waste – until now, that is. Fintoil's new production facility exemplifies how a modern circular economy can feed two birds with one stone, turning waste into a valuable product that, in turn, can help other industries decarbonise. Of Fintoil's products, crude grease acid, for example, enables the production of 100m bio-diesel litres per year, an equivalent to the annual fuel consumption of approximately 110k cars. The processing plant is underway, with commissioning scheduled



for summer 2022 and the first deliveries in autumn. Once operational, the facility will make Fintoil one of the biggest processors of crude tall oil.

Another significant investment project is the biorefinery of the wood processing company UPM, planned to be located at the Port of HaminaKotka in Kotka. The final decision on building the plant is expected in 2022. If realised, the biorefinery will be UPM's second-biggest investment ever, amounting to approximately 1.0b. The plant will produce 500kt of renewable fuels per year for the transport and petrochemical industries. The refinery will use raw materials which currently are of no use, like excess particles from wood processing. The company estimates that the products would significantly decrease the carbon footprint of road and air transports, plus replace fossil raw materials for chemicals and bioplastics with renewable alternatives.

"Both Fintoil's tall oil processing plant, which is under construction, and the biorefinery project planned by UPM in Kotka are excellent examples of how a port environment can create the operating conditions for projects aiming to promote circular economy," Dr. Kimmo Naski, the Port of HaminaKotka's CEO, underlines.

In a good light

The Port of HaminaKotka also strives after lowering its direct carbon footprint. For instance, 80 solar panels have been installed atop the Merituuli office building in Mussalo. The system generates an average of 26,300 kWh of energy, resulting in a yearly reduction of around 4.2t of CO₂ emissions. All the energy produced by the panels can be used irrespective of the year's season, and it is primarily spent on cooling, lighting, and ventilation of Merituuli.

Energy efficiency will be further enhanced by modernising the Port of HaminaKotka's lighting in 2021-2025. It is currently the most significant measure undertaken by the port company to decrease its impact on the environment. A new control system will be implemented, and LED lights will replace the old SpNa lighting fixtures. The projected energy savings will be about 360,000 kWh, and the five-year reduction in CO₂ emissions will sum up to about 58.7t compared to the present level.

Monitoring of water and sea areas also constitutes an integral part of HaminaKotka's eco-efforts. Per the provisions of the environmental permit, the port company participates in the joint monitoring of the sea area in Hamina and Kotka

and conducts regular stormwater monitoring. Cargo or other debris spilt on the ports' paved areas is washed into the stormwater run-off by rainwater. The system contains sand and oil separation sumps intended to prevent the load from entering the sea.

Furthermore, the Port of HaminaKotka, alongside operators that handle fertilisers, is involved in a project led by the John Nurminen Foundation, which conducts intensified monitoring of stormwater fertiliser content at the Mussalo Harbour. Apart from that, means are sought to reduce the content, so cargo handling isn't disturbed.

"The operations of the port have been certified in accordance with the ISO 14001:2015 standard, which means that various environmental aspects have been recognised and considered in all our operations. We aim to continually enhance our operations so that the burden on the environment would be mitigated and that we could contribute to reaching the climate goals set by Finland and the EU," Kimmo Naski concludes.



Taking hold(s) of boxes

by Paillette Palaialogou, Vice President Hellenic, Black Sea and Adriatic, Bureau Veritas Marine & Offshore

The COVID-19 pandemic has disrupted supply chains in many ways. One of the most striking consequences has been the large number of containers sitting on land, waiting to be transported to their final destinations. The industry has been keen to explore new means to resolve this major backlog, including transporting 'boxes' onboard vessels other than container ships. It is creating an attractive opportunity for bulk carrier operators, as the conversion required to allow for the carriage of containers is relatively quick and easy to achieve once safety issues have been addressed. Operators of small- or medium-sized bulk carriers are most likely to consider catching the wave. While it is expected to offer attractive rates for a few years to come, most see it as a sideline to their core business rather than a permanent change. As such, bulk carriers will typically carry containers on ballast runs instead of being dedicated to the new trade.

Bulk carriers are not specifically designed for carrying unitised freight, lacking the cellular structure of container ships. That is why the structural integrity of the vessel and the potential fire risk of the containerised cargo must be considered, not to mention ensuring the safety of crew and stevedores.

From a regulatory standpoint, the International Maritime Organization's Code of Safe Practice for Cargo Stowage and Securing (CSS Code) for ships that are equipped with a Cargo Securing Manual provides a key reference point in its Annex 1 "Safe stowage and securing of containers on deck of ships which are not specially designed and fitted for the purpose of carrying containers," alongside the calculation methods for forces acting on cargo units and the efficiency of securing arrangements.

The safety of crew and stevedores is highly regulated for cargo handling on container ships. Still, the rules are

not necessarily as proscriptive for bulk carriers carrying containers, as this is a new trading pattern. To assist operators with this and other safety, regulatory, and operational requirements, Bureau Veritas (BV) released its [Guidance for Studying and Preparing a Bulk Carrier for the Carriage of Containers](#) in September 2021. The guidance, published in a question-and-answer format, was developed by technical experts based in BV's Piraeus Office in collaboration with the technical directorate in Paris.

Vessel selection and carrying capacity

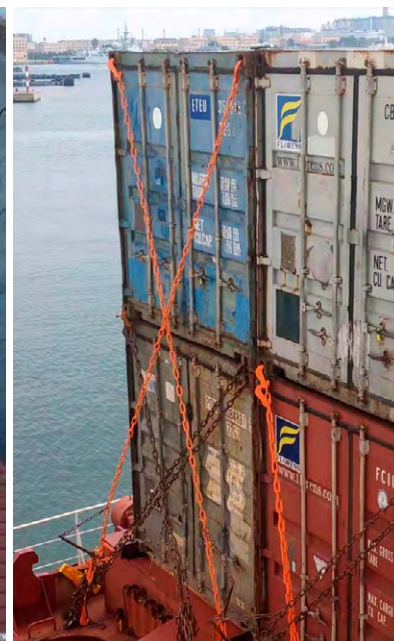
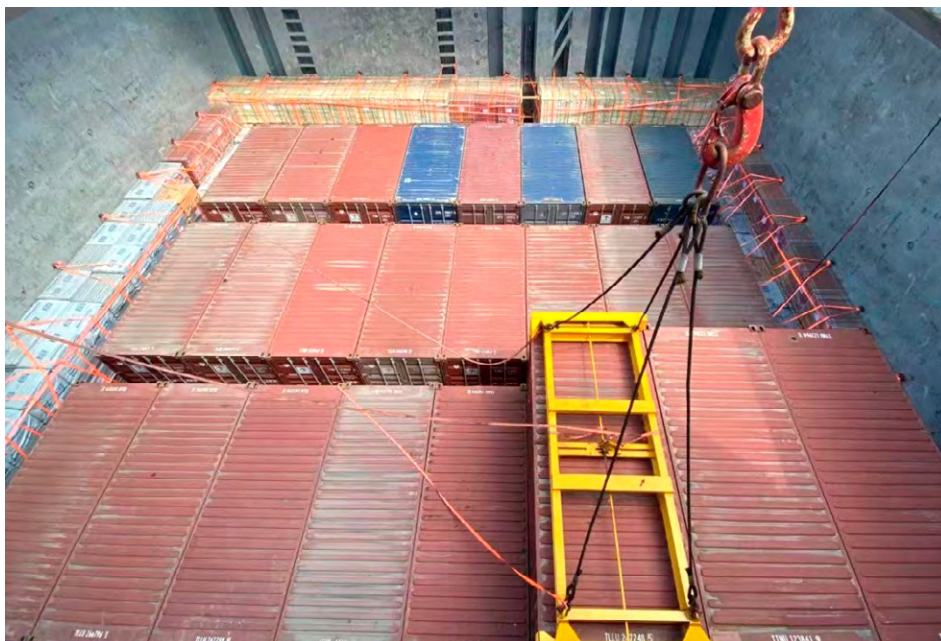
Bulk carriers with a box-like midship cross-section are potentially more suited to carrying containers, although other bulk carrier sizes are not necessarily excluded. However, operators must consider some crucial characteristics to help them make the most efficient choices as they review their fleet and select which bulker(s) will be involved in container transportation.

Capesize bulk carriers that carry coal or ore are usually exempt from the requirement of having a fixed fire-fighting system

in their cargo holds, meaning they are unlikely to receive flag approval for carrying loaded containers in these holds. Moreover, most of them are not equipped with the appropriate stability file for the carriage of cargo on deck & hatch covers, and the side rolling hatch covers represent a less attractive choice for deck loading.

Folding hatch covers typically provide better access to cargo holds than side rolling covers. In some cases, the loading of containers in holds will be limited by the hatchway opening projection; its length will define the number of container bays inside the holds.

In cases when containers are placed all over the length of the cargo hold with the assistance of lifting gear, then the clear length of the flat inner bottom in respect of container length and needed space for stevedores will define the number of bays inside the holds. Ideally, two bays of forty-foot containers is the optimum goal, but this can be challenging to achieve. For twenty-foot containers, three bays is a realistic arrangement.



The number of containers that can be loaded depends on the vessel's cargo hold and hatch geometries, main deck obstacles (hatch railways – for side rolling hatch covers), and on the scantlings of the inner bottom, deck and hatch covers.

Finally, navigation bridge visibility must be included in the deck & hatch cover loading equation. Based on BV experience with around ten operators, stacks of four to six tiers may be possible in cargo holds, stacks of three tiers on deck, and stacks of two tiers on hatch covers.

Ensuring safe container stowage is a complex undertaking due to the many parameters that need to be accounted for and the numerous options available for the final arrangement. Intact and damage stability requirements must be considered, along with local strength, stack weight, stack vertical centre of gravity, loading condition metacentric height (GM), and loading condition hull girder stresses.

Containers are much lighter than typical bulk cargoes, and a loaded vessel will have a draught somewhere between the light and heavy ballast conditions (ballast water will most likely be needed). It is unlikely to pose a significant risk to vessel stability but will result in a GM value and, therefore, a higher potential for roll motion. For vessels carrying containers on deck, windage area due to the deck stowed containers must be factored into intact stability calculations.

Lashing

Containers can be stowed as a 'block' of lashed cargo without retrofitting special

container securing fittings or as more conventional stacks of containers. In the first case, containers must be lashed in a way that ensures they behave as a solid piece of cargo with no relative motion between container stacks. Placing material such as wooden dunnage between containers and the ship's structure can be used to establish uniform load distribution in line with the allowable capacity. This option will result in smaller stack weights due to various limitations, such as the strength of lower containers.

In the second case, container bottom pockets and pad eyes can be installed to increase container weight carrying capacity and, consequently, stack weight. The maximum stack weight depends, firstly, on the containers' strength and lashing and, secondly, the strength of the supporting structure. Our NR625 **Structural Rules for Container Ships** and **VeriSTAR LASHING** software are cut out for assessing the stack weight and associated lashing. BV can assist with these calculations that will be the first input to further design and explore the integration of the stacking arrangement onboard.

BV has simulated various scenarios for different bulkers, showing that a stack of four to six containers is possible inside cargo holds by applying internal lashing to the bottom second and bottom third tiers, with twist locks fitted at every level.

Class review and assistance

BV works closely with operators to facilitate the new trade. Our guidance aims to

ensure that modern analytical tools and techniques support safe and efficient operations. We are involved in the necessary reviews, assisting operators with assessing and preparing their bulkers to transport containers.

We have already performed many feasibility studies, and we are in close contact with shipowners and their technical partners, contributing to preliminary investigations and guiding them to overcome technical issues. Our in-depth experience with bulk carriers and container ships is crucial as we explore this new vista together. ■



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Photos: Canva

Battle royal

by Przemysław Myszkowski

“At its core, decoupling is really a contest being fought over the economy of the future.” That is how the European Union Chamber of Commerce in China’s *Decoupling. Severed Ties and Patchwork Globalisation* report ends. It is a tale of how the world’s three biggest trading blocks, China, the European Union (EU), and the United States (US), are, it seems, increasingly distancing themselves from one another. The divide is most likely the sharpest and widest as far as anything digital is concerned, particularly on the China-US front, with Europe caught between a rock and a hard place. It provokes the question of whether globalisation is a thing anymore. Digital firewalls, export bans, trade tariffs, announcements of self-reliance and market dominance, cleansing of foreign technologies from one’s systems, politicisation and weaponisation of trade, principal cultural values that exclude each other – all those and many more issues brought up by the Chamber are thorns in the flesh of overseas cooperation. If somebody is still up for handshakes and bows, that is. In President Xi Jinping’s words, we may as well be entering the period of “assassin’s mace,” measures developed to pack a hard punch. It does not bode well for issues that require shared effort, like greening the global economy.

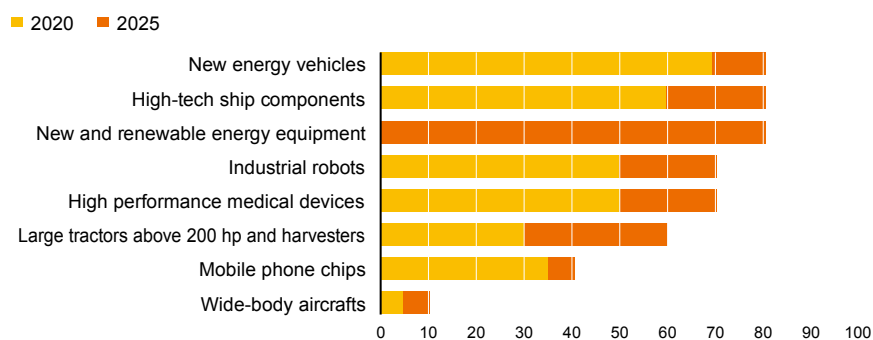
One of today’s most noticeable signs of decoupling is the automotive sector’s pains in sourcing semiconductors necessary for putting together electronic control units (ECUs) – the car’s computers. First, with a 45% share (2018 data), the US dominates the semiconductor production market (China has 5%). Second, the Trump Administration has hit-listed China’s Semiconductor Manufacturing International Corporation, the country’s most advanced manufacturer. Third, the Entities List gives the US the option to cut off supplies to companies on the deny-list as per the de minimis rule, namely if a certain threshold of a product’s value derives from American sources (typically 25%, but the figure can change any time). It puts European

automotive manufacturers sourcing chips from the US for their production in China in a difficult position (Europe’s share in semiconductor output is 9%, so also insufficient to make up for the potential cut-off). It has led to a persisting crunch, with car production lines on hold and the available ECUs used to deliver higher-margin earning vehicles. Other industries, hence consumers, are also feeling the hard way what decoupling means, as evidenced by exorbitantly high prices of graphic cards (with tariffs, supply chain distortions caused by the pandemic, profiteers, and crypto-currency miners adding insult to injury in this concrete case).

Another politically motivated decoupling has taken the form of China’s ban on the import of Australian coal. Although trade has lately been soaring between the two economies (+20% in 2018-2019), so have

tensions; these varied from politicians exchanging insults via banning Huawei from Australia’s 5G network to embargoing beef imports from Australia and hitting its barley exports with an 80.5% tariff. Concerning coal shipments, “As a result, during the first six months of 2021, Capesize and Post Panamax vessels performed 17% less Australia to China journeys, carrying 14% less in cargo volume, compared to the same period in 2020. Despite a reduction in trade between Australia and China, many vessels continued their voyages to China, and this resulted in significant numbers of laden bulkers stranded off Chinese ports, waiting to discharge their cargoes,” reads VesselValue’s *2021 Port Congestion Report*. Among many, there was the Post Panamax *Topas*, which waited near Jingtang for eight months. China, wanting

Fig. 1. The China Manufacturing 2025 initiative (semi-official percentage targets for the domestic market share of Chinese products)



Source for all figs. and tabs.: European Union Chamber of Commerce in China's Decoupling. Severed Ties and Patchwork Globalisation

Tab. 1. Export controls for certain technologies and sectors as proposed by US Department of Commerce

Biotechnology	Data analytics	Robotics
Artificial Intelligence and machine learning	Quantum information and sensing	Brain-computer interfaces
Position, navigation, and timing	Logistics ¹	Hypersonics
Microprocessor	Additive manufacturing	Advanced materials
Advanced computing		

¹ Including mobile electric power, modeling and simulation, total asset visibility, and distribution-based logistics systems

to increase its domestic coal use, ended up troubled by energy outages and the need to take in coal from other, noticeably farther away located exporters such as South Africa. Australia has, in turn, had to find new outlets, chiefly Japan, South Korea and, interestingly, also coal-rich India.

Whole-of-nation system

Since Deng Xiaoping's reform and opening-up, China has been perceived as an enormous market with a potential purchasing power second to none. Meanwhile, owing to its massive labour force, the country has managed to position itself as the 'world factory.' Both still hold, even though some industries that rely on poorly paid employees, little-to-no regulatory oversight, and end-consumers' fixation with low price, have packed their bags and moved elsewhere in south-east Asia (think fast fashion). That said, the Chinese people's desire to consume products and services of increasingly higher quality and quantity has risen, too, alongside the will to produce and sell them, domestically and abroad.

According to the China Manufacturing 2025 initiative, the country will replace global competitors in several strategic technologies (Fig. 1). It stands to reason that China will continue its current practices to that end: selectively coupling with foreign partners in areas it lacks the know-how

to eventually decouple when its national champions are sufficiently trained to first muscle out the competition from the Chinese market and then gain a foothold outside the country. "For example, high-speed rail technology in China developed quickly due to extensive state support combined with mandates for foreign technology transfers as a condition for market access. Once China's high-speed rail companies were confident enough, market access was tightened, though not through direct means such as a change to the legal regime governing foreign investment. Instead, the high-speed rail sector was subjected to one of a plethora of indirect barriers that have long plagued China's business environment. In this case, handpicked, state-owned national champions benefited from an unfair procurement system, which quickly gave them complete market share and the ensuing economies of scale that drove down their costs considerably," authors of *Decoupling* caution.

While the issue at hand might sound like nothing more than the struck record of market rivalry, the involved blocks differ regarding what could be allowed as fair (let alone legal) competition measures. China and the US are poles apart, though also oddly on the same page regarding specific tactics. Even more strangely, the tit-for-tat trade war between the two has only ob-

scured the bigger picture. Though eye-catching, chiefly thanks to President Trump's media ruffling, the hurling of trade tariffs did not cripple China-US trade. Companies, especially multinationals doing business in China, were quick to mitigate the political 'fury' coming from the other side of the Pacific. "One manufacturer had operations in Japan that were mainly for supplying the Japan/South Korea/Taiwan markets, while its China-based factories focussed heavily on exports to the US. The manufacturer simply had its Japan-based production export finished goods to the US and its China operations supply the Japan/South Korea/Taiwan markets," reads one of the examples from the Chamber's report. "The total volume of trade between the two economies did not change significantly and, if anything, increased," the authors add.

While not neglecting the importance of trading soybeans, coal or aluminium, the top tier economy of the future will be about all things digital, with products, services, and processes driven by Artificial Intelligence (AI), big data (BD), and the Internet of Things (IoT). As things stand today – or more precisely: get out of sync – the question is whether it will be American, European, or Chinese AI, BD, and IoT. In other words, we are dealing with an increasing techno-nationalism, "Whether it's the US' Clean Network proposal [purging Chinese technologies from American systems] or measures by Chinese authorities aimed at creating 'autonomous and controllable' technology [made in China solutions], it is all part of the same slippery slope: the technologies that are defining the future, and which are increasingly integrated into every sector of the economy, are being divided between two of the world's three largest economies, each of which has a growing firewall separating itself from the other." From a European perspective, this dichotomy is hard to swallow. On the one side, Facebook/Meta and the National Security Agency of the US spying on its citizens and foreign allies alike, a digital dictatorship on the other.

Drivers and layers of decoupling

While European companies may benefit from the China-US tug of war in the short-term, ousting its American rivals from Chinese deals, they might

find themselves left on the back burner should their Asian counterparts decide it's time to proceed on their own.

The European public eye is also increasingly scrutinising the block's governments and companies' approaches to human rights issues. These include forced labour, with the Australian Strategic Policy Institute releasing in March 2020 the **Uyghurs for sale: 'Re-education', forced labour and surveillance beyond Xinjiang** report, in which the organisation identified 83 foreign and Chinese companies as allegedly directly or indirectly benefiting from the use of Uyghur workers (some 80k) outside the province of Xinjiang through potentially abusive labour transfer programmes. The report is alarming because it shows that abstaining from doing business in Xinjiang or relocating factories from the region is not enough – and that forced labour isn't a matter of geography, as if erecting a production site a stone's throw from the province's borders would fix anything, but supply and demand. And there are the Hong Kong protests; for example, Cathay Pacific, the flag carrier of Hong Kong, was compelled to suspend staff that appeared to have displayed support for the pro-democracy movement.

That is not to mention China's long-standing, and it appears nowadays – hardening, line of treating Taiwan as part of the People's Republic of China, with a harsh backlash against anyone naming or just hinting at the island as an independent country. The actor John Cena has recently become a meme after professing love to China in response to calling Taiwan a country – in all probability to prevent getting the ninth episode of the *Fast & Furious* off mainland China cinemas, Hollywood's biggest overseas market. Meanwhile, Lithuania and Taiwan's intention of establishing representative offices has prompted China to discipline the Baltic country by scratching train stops in Vilnius, thus turning Lithuania into a transit country only for the New Silk Road. Transport companies complain that Lithuanian containers now have to be hauled from the border with the Kaliningrad Oblast.

The authors of *w* also write, "Catalysed by the COVID-19-induced disruption of global supply chains, there is a growing debate about vulnerabilities associated with a perceived 'overdependence' on China with regard to imports of certain critical products (rare earths, personal protective equipment, or the battery, hydrogen and cloud technologies, among others)." Then again, there is this sense of hope that trade and business between China and the EU will, this way or another, continue

to flourish, politics-no politics. One 'coupling' example from the Baltic Sea region would be the set-up of several facilities to cater to the battery market, posed to grow as Europe's electricity generation shifts towards renewables. It all started with Northvolt Ett, a lithium-ion battery production site under construction in Skellefteå in northern Sweden (annual capacity of at least 32 GWh by 2024, with the potential to expand to 40 GWh in the future). The Swedish battery producer will also establish – on the territory of the Pomeranian Investment Centre, near the Port of Gdańsk – what it says will be Europe's largest energy storage factory. The 50k m²-big facility will be set up in two stages, with works on the first to commence in autumn 2021; initially, from 2022, the plant will have an annual output of 5.0 GWh of energy storage modules and packs, up to a total capacity of 12 GWh after the completion of the second phase. Third, Shenzhen Senior Technology Material will erect a production line, its first outside China, at the Svista industrial estate, with supplies going by rail via the Eskilstuna Intermodal Terminal. Once operational, the Senior Eskilstuna factory will provide the Northvolt Ett with separators. The involved seaports, Gdańsk and Gothenburg, will benefit from handling supplies coming from overseas to 'fuel' the production lines. The Swedish Scanlog



Photos: Canva

Tab. 2. Layers of decoupling

Macro decoupling	Political	The politicisation of business and geopolitical tensions is making the Chinese business environment increasingly difficult for foreign companies to navigate and act as catalysts for decoupling in other areas.
		The current impacts on European companies in China include increasing risks due to a souring of public opinion in home markets towards China, a drop in business sentiment, and uncertainty for operations due to the securitisation of business flows.
		The European business community in China is worried about the increased risk associated with 'political reciprocity' dynamics and the potential for more unpredictable tit-for-tat exchanges of economic restrictions resulting from political/diplomatic tensions.
	Financial	To further reform its financial system, China is working to integrate into the global financial system by establishing new investment channels into its capital markets and new opportunities for foreign financial institutions and investors.
		As long as China lacks a fully convertible capital account and an internationalised renminbi, its reliance on the USD remains its 'Achilles heel'. Efforts to internationalise both its currency and financial markets are likely to accelerate, but liberalisation is needed to do so.
Trade decoupling	Supply chains	Any broad restrictions on access to the USD would amount to a 'nuclear' option that would bring considerable economic damage to the US and the rest of the world. A massive escalation of political tensions seems likely to trigger it, as happened with Russia and Iran.
		Supply chains were already changing considerably in China before the COVID-19 pandemic or the trade war, with low-cost production moving elsewhere and most European companies expanding locally and further onshoring their supply chains.
		Although the trade war and the pandemic had been disruptive and expensive, still, European multinationals proved resilient, making shifts in supply chains to outright avoid many tariffs and maintain operations in China during its COVID-19 recovery.
	Critical inputs	Many European companies report a desire to invest further in China and onshore supply chains for the local market to avoid potential disruptions. However, enthusiasm varies by sector based on how welcome they feel in the market.
		Targeted restrictions on the sale and export of critical goods – such as semiconductors, related manufacturing equipment, software, or even rare earths – have become a more pressing concern for companies operating in China and globally.
Innovation decoupling	Research & development	European companies have so far felt a limited direct impact due to export controls, but exposure is considerable for most. Pandemic-related shortages have shown how damaging lost or limited access can be, giving companies a taste of what the future may hold.
		Even companies with little to no risk may still be hit if their suppliers/customers can no longer source components or equipment from abroad. China's new export controls increase risks as well, as locally developed goods and solutions could be blocked from export.
		Although China is an increasingly attractive R&D destination, a number of issues – some long-standing and intensified by decoupling trends, others that have recently emerged as a result – constitute barriers to European companies' R&D activities.
	Standards	In Europe, government stakeholders are re-considering their engagement with China on innovation cooperation, and the EU is working on tools to prevent unfair practices within its internal market.
		Consequently, European businesses will encounter increased difficulties when developing both their global and China R&D strategies.
Digital decoupling	Data governance	While access to standardisation bodies in China has improved considerably in recent years, European companies – particularly in key sectors – still face informal barriers that prevent them from effectively engaging in standards-setting in China.
		These access issues become all the more relevant when considering China's use of standardisation as a tool to advance its industrial and geopolitical agenda both at home and abroad.
		As a result, European companies may see their competitive edge being dulled and their market share reduced. At the same time, these standards-setting trends could also lead to distortion, or even fragmentation, of the global standardisation system.
	Network equipment	Data governance regimes in China and the EU already significantly restrict the transfer of data across the borders of these jurisdictions, creating significant compliance risks for companies.
		European companies anticipate that further restrictions on privacy and national security grounds will come into force soon, partly due to new legislation and judicial decisions in the EU and further measures in China.
		As a result, it will be difficult and risky to exploit the potential of data pools across the EU's and China's jurisdictional boundaries, even as the importance of data as a tool for innovation and efficiency-building grows.
	Telecom-munication services	US efforts to decouple from Chinese telecommunications and network equipment and scrutinise any China-originated links found in network value chains under its Clean Network programme are impacting European companies and their offerings in the US market.
		China's rapidly expanding barriers to foreign telecommunications and network equipment value chains via requirements for 'autonomous and controllable' technology is pushing European players out of the market or into niche roles.
		In combination, these dynamics are inadvertently forcing companies to consider firewalling their China and US network operations from one another, with the former relying more and more on local solutions and the latter being stripped of China-sourced inputs.
		China's long-standing barriers to foreign telecommunications services and digital solutions have surged, especially regarding the digital technology at the centre of the fourth industrial revolution, which includes value-added telecommunication services like cloud and data centres.
		European companies are forced into joint ventures with Chinese counterparts to offer their digital solutions, which increasingly come from traditional industries outside of ICT/ telecommunications.
		As a result, European companies often have to integrate their products with locally sourced digital solutions to serve local customers, resulting in the provision of suboptimal offerings that are not globally interoperable.

has been contracted to take care of the logistics for Northvolt's activities in the country, ramping up its capabilities in Gothenburg to account for the increase in shipments.

However, the overall feeling is that the business environment in China has become more politicised lately, thus prone to abrupt change as per the shifting line of the Chinese Communist Party (CCP). According to the Chamber's *Business Confidence Survey 2020*, some 43% of respondents "[...] stated that China's business environment had become more political over the previous year, with almost half of those saying that external political pressure was being exerted by the Chinese Government and media." The report furthers, "If a country has political tensions with China, the Chinese public and government tend to scrutinise its businesses more. The greater the tensions, the more exposure a company has to negative messaging on Chinese social media [...]."

While experts debate what constitutes the **"Chinese State Capitalism,"** the Chamber notes a profound shift from Deng Xiaoping's times, namely that CCP members are penetrating companies across the board. It is especially problematic for those European enterprises that must form a joint venture with Chinese companies to enter the market. Atop that sits the necessity to pick from two unprepossessing options: to start a JV with your competitor or partner with somebody outside the sector, hence receiving no added value. The Chinese history of industrial espionage and disregard for intellectual property would further take it beyond palatability; if it hadn't been for the princely revenues of China's internal market, that is. Of course, not all sectors of the Chinese economy are subjected to such a dilemma. Yet, those picked to attest of the country's coveted dominance – unavoidably so. As such, it is all the more thought-provoking to see the recent opening up of the lucrative Chinese financial services sector. Albeit done cautiously, it has included events like taking full ownership of its Chinese securities business by Goldman Sachs. On the flip side, "[...] 16 per cent of members reported having felt compelled to transfer technology to maintain market access, in

Tab. 3. The European Union Chamber of Commerce in China's Members' impact assessment of decoupling (% of respondents)

Area of decoupling	All negative (significantly negative)	No impact	All positive
Digital/telecoms	85% (34%)	12%	0%
Data governance	76% (24%)	16%	4%
Financial	70% (23%)	23%	1%
Supply chains	68% (23%)	23%	6%
Standards	68% (15%)	22%	5%
Self-sufficiency	64% (15%)	26%	6%
Political	59% (12%)	34%	0%
Critical inputs	49% (15%)	42%	3%

strategic industries like medical devices, aerospace and aviation, and environment, this number rose to close to a third of respondents." Are we up for the repetition of the high-speed rail scenario then?

The global financial system will most likely be another of the battlegrounds between China and the US. The latter has dominated it through its currency, whereas the Chinese renminbi (RMB) struggles internationally. "Despite the size of China's economy and the RMB being upgraded to an international reserve currency by the International Monetary Fund in 2015, the share of RMB payments in cross-border transactions was just 1.66 per cent in October 2020. [...] Even China's flagship BRI [Belt and Road Initiative] projects are primarily being funded in USD," reads the Chamber's *Decoupling*. Losing control over its currency, including exchange rate and possible outflow, makes the CCP sit on the fence between full liberalisation and tight domestic supervision.

Given its upper hand position, the US has, in theory, the 'nuclear' option of weaponising the dollar by "[...] preventing financial institutions from offering their USD clearing services to Greater China-based clients through increased sanctions." Should political and security matters take precedence over economic considerations, the Chamber cautions, shock waves will hit the global economy. Economically speaking, China isn't Russia or Iran, against whom the US has exercised the currency-cut-off measure, and the fallout would severely affect the attacker, too.

In the meantime, the US has put into effect lesser, although caustic, means. American investments in entities having links with the (rising in power) Chinese military are banned. The US administration has also reasoned with pension funds to stop investing in Chinese stocks. The European Council has taken similar steps, "While not mentioning specific countries or regions, the

regulation [Council Regulation 2020/1998 of 7 December 2020 concerning restrictive measures against serious human rights violations and abuses] gives the Council the possibility to freeze and restrict access to funds and economic resources for 'natural or legal persons, entities or bodies responsible for, providing support to or otherwise involved in serious human rights violations or abuses, as well as those associated with the natural and legal persons, entities and bodies covered'," mentions the Chamber.

Technical-turned-political

Standards of business conduct, research and development, and privacy also differ, including how data are handled. Reciprocity is hardly a thing when European companies have to hand over their data sets but cannot transfer information outside Chinese borders. It put sand in the wheels of multinationals, who miss out on the opportunity of working on combined globally scaled data pools from Europe and China (think pharmaceutical companies or research & development on autonomous vehicles).

On the other hand, European standards provide for a borderless flow of data – something that might very well change soon, as the von der Leyen Commission weighs the pros and cons of Europe's openness in this regard. "Government regulations in this domain [data management], originating from both China and the EU, have already caused disruptions to cross-border data flows, as different jurisdictions impose sweeping data localisation requirements due to a combination of privacy, national security and economic concerns," the Chamber observes.

The Chinese are aware of it and are preparing accordingly by instituting their standards, intentionally defying international standard-setting bodies, or pushing their standards through them. "A discipline traditionally considered highly technical, standardisation has become increasingly



politicised in recent years,” the Chamber notes. In principle, standards developed in China aren’t, for want of a better word, “bad” just because they are Chinese. There are, however, certain red flags to take account of. Among them is that non-Chinese parties are generally excluded from standardisation activities in China; the top three restricting issues are unclear access procedures, unavailability of information, and the inability to obtain full voting rights. The rate of adopting international standards has also gone down in China, the Chamber reports. At the same time, convergence between domestic and international standards remain “extremely low.” Finally, “In areas such as ICT [information and communications technology], cell and gene therapies, smart manufacturing and new energy vehicles [...], an increase in domestic standardisation activities has been observed by European Chamber member companies.”

The BRI is also used as a means for promoting Chinese standards outside the country’s border, “If a project-recipient country accepts the use of Chinese standards, the immediate effect will be a drastic reduction in the chances for foreign companies to participate in such projects.” It could also “[...] result in an increased economic and technological dependence of these third countries on China and, in a worst-case

scenario, contribute to the fragmentation of the global standardisation system.”

The crippling

According to the Chamber, if left unchecked or further rubbing salt into wounds, all of the above will result in European companies deciding to leave the Chinese market or adapt. “[...] the global technology ecosystem has already deteriorated to the point where some companies are seriously looking into which of the unappealing options available to them is the least damaging. Others are beginning to wake up to the fact that the date for exiting China may be approaching,” says the Chamber.

Enterprises will fall into one of three categories, starting with the ‘Business Class,’ which will include companies encouraged by the Chinese to strengthen their foothold in the country, like semiconductor manufacturers or software developers. Then the ‘Economy Class,’ companies whose presence neither poses a threat nor an advantage to CCP’s plans (car producers, among many). Lastly, the ‘Cargo Hold’ type: enterprises at increasingly higher risk of getting the wolf ticket (such as ICT).

Choosing to stay will necessitate going down two exclusive paths: adopting a dual-system model or incorporating a flexible architecture, both disadvantageous

compared to how companies would prefer to operate. The first would involve setting up two separate supply chains and research & development systems – one to serve China (and, future-wise, its “dependencies”), the other for the rest of the world (if the rest won’t fall victim to Balkanisation, that is). The Chamber predicts, “[...] the immaterial costs of the technology war will be extensive. Innovation that drives efficiency gains, as well as new goods and services, will take a significant hit. This is not only due to the cost of running dual R&D systems (every euro spent to localise into one or the other market is one less euro spent developing new technology at the global level) but also due to the growing isolation of data pools, which diminishes the ability of companies to build efficiencies and find new solutions.” The other possibility would be to deliver products and services as neutrally as possible for the global market, customising them to suit the particular landscape of regulations, standards and politics, something which certainly sounds easier said than done.

The Chamber’s *Decoupling. Severed Ties and Patchwork Globalisation* soberly summarises

Fig. 2. Three possible stages of globalisation and what they would mean from a macro, trade, digital, and innovation perspectives

Increased decoupling					
		Globalisation renewed		Patchwork globalisation	
Geo-economic strategies		Liberal integrationist, principled multilateralism		Open strategic autonomy; plurilateral and like-minded clubs	
				Self-sufficient 'dual circulation' and nationalism	
MACRO	Politics	Rules-based alignment; financial stability		Systemic competition; financial uncertainty	
	Finance				
TRADE	Supply chains	Integration and reciprocity		Fairness and leverage in strategic competition; diversification and resilience	
	Critical inputs				
DIGITAL	Data governance	Deep connectivity		Digital distance	
	Network equipment				
	Telecommunications services				
INNOVATION	Standards and IP	Techno-globalism		Industrial policy renewal	
	R&D				
Decoupling status		'Trusted open relationship'		'Marriage of convenience'	
				Winning and prevailing; 'my country first (or alone)'	
				Conflict; financial disruption	
				Weaponising interdependence; reshoring and nationalising	
				Digital dilemmas; data exploitation and bifurcation of technology stacks	
				Technological autarky	

the situation by stating, “There is no returning to a period in which globalisation is renewed to some pre-Trump ideal, because such a time never really existed – China was not coupled with the rest of the world economy in many areas, and its self-reliance drive that is providing a backdrop to the current state of affairs had already been well in place for more than four years.” Suppose governments cannot iron out a risk-managing framework. In that case, the Chamber bodes no good to the global economy as “[...] entire industries will become completely impenetrable due to intensive restrictions imposed in the name of national security or self-reliance. The unthinkable result would be the crippling of global value chains, economies of scale and innovation systems.”

Resources would go for coping with what was an avoidable but now highly irreversible reality, with every dollar or renminbi allocated for ‘cleaning networks of non-autonomous and uncontrollable’ technologies being one less spent on development. But maybe that’s the idea behind the new arms race – bleeding out the opponent to seize the means to advance the agenda further. One’s scheme, precisely. “The conquered mourns, the conqueror is undone.”



A mosaic portrait of Marco Polo, showing his face with a beard and a red turban, set against a golden mosaic background.

"THE BEST MAP OF THE NEW SILK ROAD!"

MARCO POLO*

*** NOT A REAL QUOTE (BUT WOULD BE IF
MARCO POLO WAS HERE WITH US – SCAN THE
QR CODE AND CHECK FOR YOURSELF!)**



Photo: Canva

Bucket of green steam?

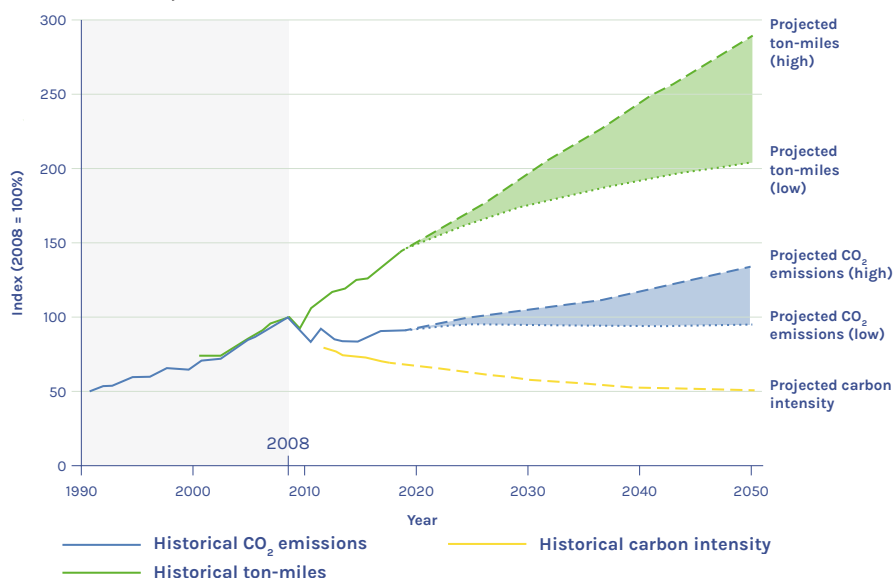
by Przemysław Myszk

“Shipping is an essential global industry which is currently on an emissions trajectory that is dramatically out of line with the Paris Agreement temperature goal,” reads *Closing the Gap. An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping*, a report prepared by UMAS on behalf of the Getting to Zero Coalition. If the transport community, both off- and ashore, truly cares about the environment and wants to participate in keeping the global temperature rise below one and a half centigrade, then there is no other option for it than to become zero-emission – and do so relatively fast. Fortunately, UMAS marks, several measures can get the sector to the Promised Land by mid-century. Implementing some of them will be essential, which isn’t to say others cannot put a match to setting the green revolution alight. The authors also note that decarbonising shipping is something more than what next-gen marine fuel goes into the tank – in that the transition should be fair, reducing inequality instead of hammering the fractures between the well-off and the underprivileged.

In 2018, the entire shipping industry released an estimated 1,076mt of greenhouse gas emissions (GHG-E), which translates to the widely publicised figure of 2.9%, the sector’s share in total anthropogenic carbon footprint. Should the industry do nothing, its emissions will rise by 90-130% by 2050 (counting from a 2008 baseline) following an increase in traffic powered by fossil fuels.

In spring 2018, the International Maritime Organization (IMO) signed off on its Initial GHG Strategy: halving international shipping’s absolute annual GHG-E by 2050 (again, versus the 2008 starting point), plus reducing the sector’s carbon intensity by at least 40% till this decade’s end. All of this is to align international shipping with the 1.5°C-Paris Agreement target. UMAS adds that domestic shipping, which falls under

Fig. 1. Historical and projected international shipping emissions and trade metrics, indexed in 2008, for 1990-2050



Source for all figs. and Tab. 1: UMAS' Closing the Gap. An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping

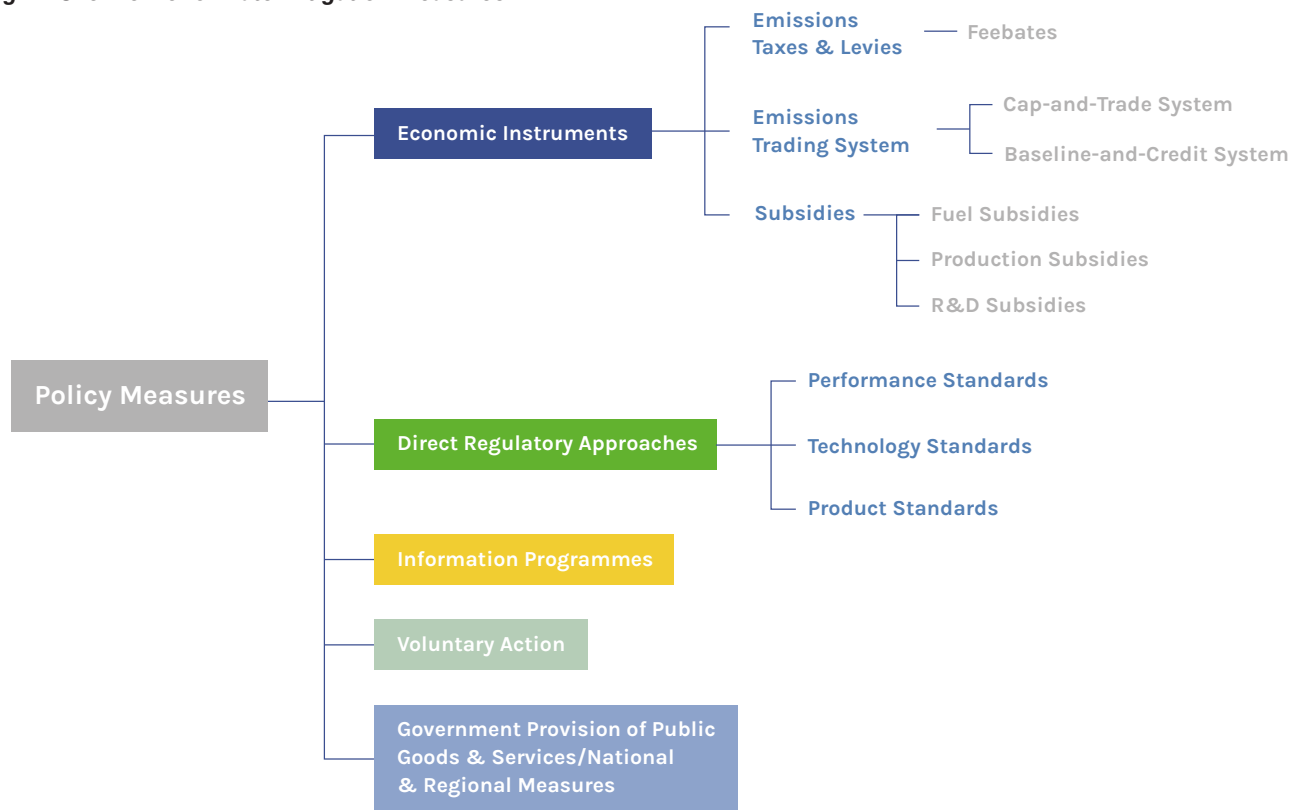
national jurisdiction, should join the effort as quickly as possible since it accounts for 30% of the industry's total GHG-E.

In essence, UMAS sees only one possible way to marry the increase in transport demand with making shipping climate-neutral: transitioning to zero-

emission fuels, which should become the dominant energy source by the 2040s. Because these will be at best double the price of fossil bunkers throughout the 30s and 40s, incentives are needed to close the gap. Preferably, a whole bucket of policies – economic and politi-

cal (global, regional, and national), plus informational and voluntary for good measure. If played out with skill, shipping might, without batting an eyelid, call itself the most environmentally friendly transport mode. Sink or swim.

Fig. 2. Overview of climate mitigation measures



Economic policies

Economic instruments for decarbonising shipping revolve around market-based measures (MBMs) used by regulatory bodies to narrow the price spread between fossil and zero-emission fuels. It can be done by increasing the cost of using the former (by imposing a price on carbon) or lowering the latter's (through subsidies, tax breaks, and funding research & development).

Economic policies can generate mind-boggling revenues, counted in billions of dollars annually, which could be recycled to aid shipping in the transition. They can also incentivise fleet renewal towards tonnage that performs better than a set reference point, thus receiving rebates generated from collected fees (hence their name: fee-bates).

Better late than never, the IMO decided to start working on mid-term GHG-E cutting measures at the 76th meeting of its Marine Environment Protection Committee in June 2021. These include MBMs, not necessarily a novelty topic to the IMO, looming at its agenda-horizon since 2003, but with discussions null and void from 2013.

Carbon price & revenue recycling

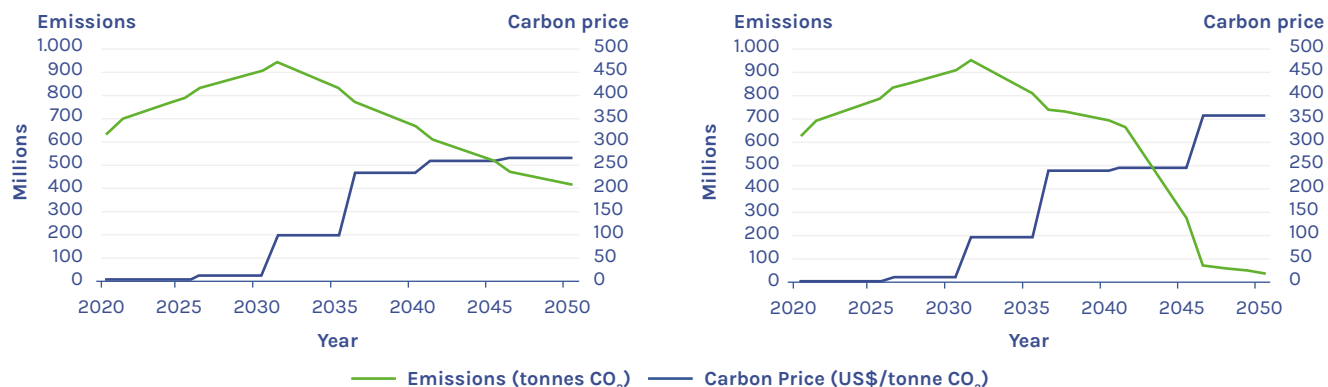
Setting a carbon price – on the amount of fossil fuel consumed or CO₂/GHG emitted – would be the most straightforward solution. Authors of *Closing the Gap* scrutinised two scenarios in this regard: axing by half or entirely beheading absolute emissions by the middle of the current century.

The analysis was conducted on the assumption that carbon pricing is the only measure undertaken to fulfil IMO's obligations.

In both cases, carbon pricing starts in 2025, beginning with a modest 11 US dollars per one tonne of CO₂. GHG-E reach their highest five years later

when the levy goes up to around \$100/tCO₂. For the -50% scenario, the carbon price averages at \$173/tCO₂, peaking at \$264/tCO₂. Interestingly, the levy in the -100% storyline isn't much higher and averages at \$191/tCO₂ (though its peak reaches \$360/tCO₂).

Fig. 3. Carbon price trajectories and their associated emission trajectories



However, the authors note that a more aggressive pricing approach might be sounder, “[...] it could be better to set the initial carbon price at a higher level than the model and

be recycled, i.e., returned to the industry to support decarbonisation. If all funds were to come back, the carbon price could be lowered by half. In the -100% scenario, this would mean an average

As such, these funds would cover the \$1.0-1.4tr of investment need for (partial) decarbonisation of shipping as estimated by UMAS. The figures for the -100% case are \$41-81b/year, \$1.0-2.0tr, and

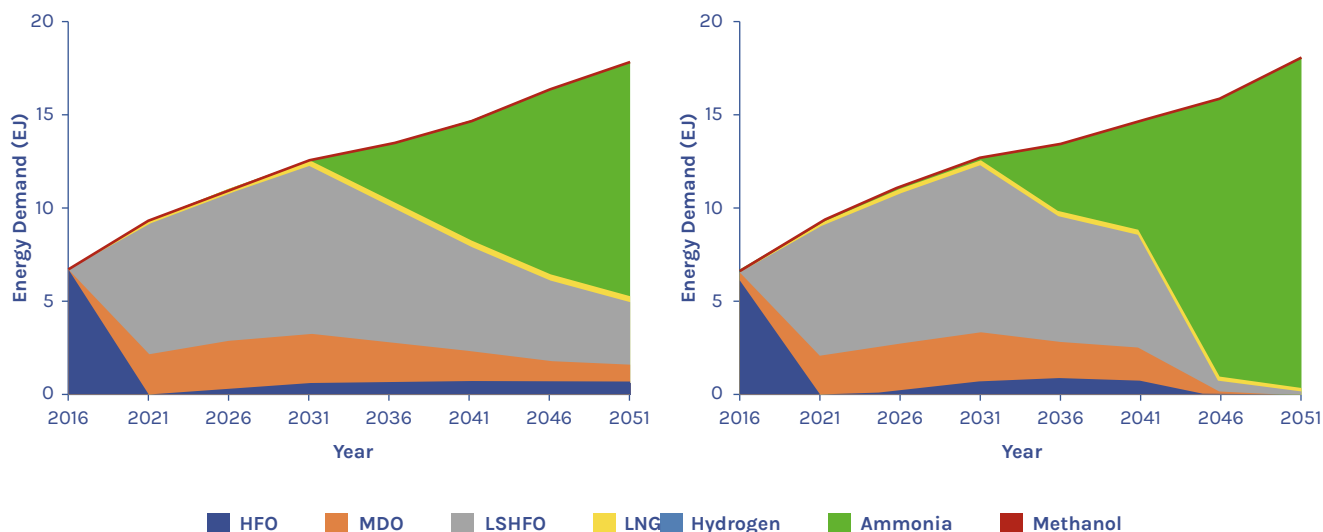
Fig. 4. Projected future marine fuel demand

SCENARIO E

Target of 50% absolute reduction in operational shipping GHG emissions globally by 2050 (compared to 2008); zero operational shipping GHG emissions globally by 2070.

SCENARIO D

Target of zero operational shipping GHG emissions globally by 2050



follow a smoother increase, thereby easing potential economic shocks of sharp price increases. This could also help to ensure there is an emergence phase of the transition during the 2020s (e.g. funding RD&D to reach five percent zero-emission fuel penetration by 2030), which enables shipping-specific cost reductions prior to the more rapid uptake of new fuels scheduled for the 2030s.”

Pricing will also depend on the degree to which the revenues will

of \$96-191/tCO₂ (peaking at \$179-358/tCO₂). UMAS also underlines that “[...] the expectation of what the carbon price will be in the future is key to establishing the business case for zero-emission investments. Price corridors – i.e. setting a band of minimum and maximum carbon prices – could be implemented to offset some of the business uncertainty with future carbon pricing.”

Depending on the level of recycling, yearly revenues gathered under the -50% scenario tot up to \$53-105b, rounding up \$1.3-2.6tr in 2025-2050.

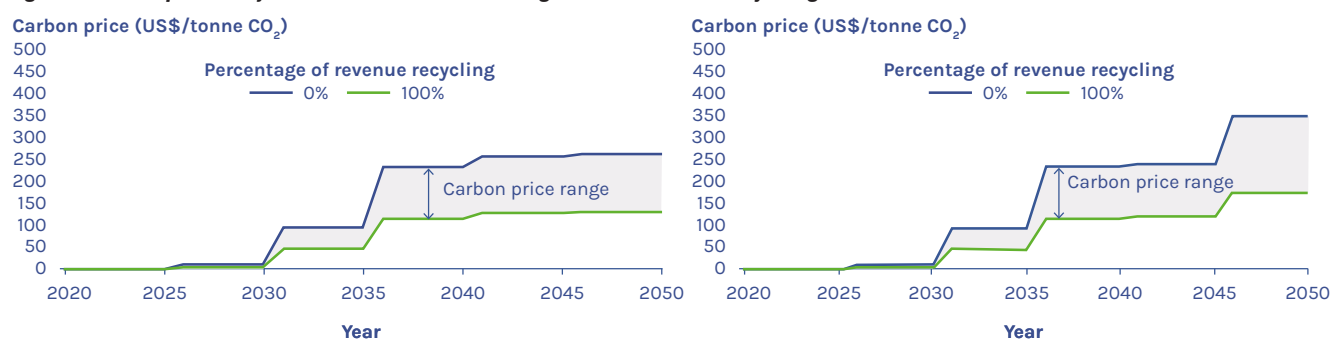
\$1.4-2.0tr, respectively. “A higher carbon price and a faster decarbonisation trajectory in the scenario targeting full decarbonisation by 2050 result in a lower amount of total revenue generated. That is because, in this scenario, emissions reduce rapidly from the early 2040s to achieve zero emissions by 2050 and with that, the potential for generating revenues decreases as well,” explain the authors of *Closing the Gap*.

UMAS notes that recycling all the revenues would leave no money for supporting what the authors call least

Fig. 5. Fuel price projections

		Lower bound				Upper bound			
		\$/GJ				\$/GJ			
Primary energy source	Fuel	2020	2030	2040	2050	2020	2030	2040	2050
Oil	LSHFO	8	11	11	11	8	11	11	11
Biomass	Bio-diesel	22	24	27	29	25	49	74	98
Biomass	Bio-methanol wood	23	25	27	30	24	48	72	96
Biomass	Bio-methanol waste stream	19	21	23	25	20	40	61	81
Substitution price for biofuels		9	19	26	33				
Renewable electricity	E-diesel	130	114	99	83	208	182	156	130
Renewable electricity	E-methanol	84	73	63	52	136	118	101	83
Renewable electricity	E-LNG	69	60	51	42	113	98	84	69
Renewable electricity	E-ammonia	55	47	39	30	96	82	68	55
Renewable electricity	E-hydrogen	52	44	36	28	92	79	65	52
Natural gas	NG-ammonia	28	26	24	23	46	43	40	38
Natural gas	NG-hydrogen	25	23	21	19	44	40	37	34

Fig. 6. Carbon price trajectories based on the degree of revenue recycling



developed countries and small island developing states, two groups worst-hit by climate change. These nations don't have the means to counter what is already happening, let alone bear the brunt of greening their logistics chains.

One solution would be to have a higher than needed decarbonisation carbon price, generating surplus revenue for subsidising other projects. These investments could include crew training for Global South populations to provide them with future hi-end jobs like

handling remotely-operated vessels. The funds could also be used for setting up future fuel production plants. For instance, the International Energy Agency (IEA) reports that currently, almost all capacity for producing zero-emission hydrogen and fuels based on it are in advanced economies and China, meaning that less developed countries might end up throwing themselves at others' mercy. Transferring money and technology would, in turn, help the Global South to become independent

– from extractivism and imports.

"The language in the Initial GHG Strategy [...] was a hard-fought political compromise that does not specify how the principles should be interpreted or operationalised," *Closing the Gap* reads. While it prescribes a socio-economic analysis of climate policy measures ahead of implementation, it doesn't specify how such impacts, especially disproportionate ones, could be addressed.

Fig. 7. Future revenue range from carbon price based on the degree of revenue recycling

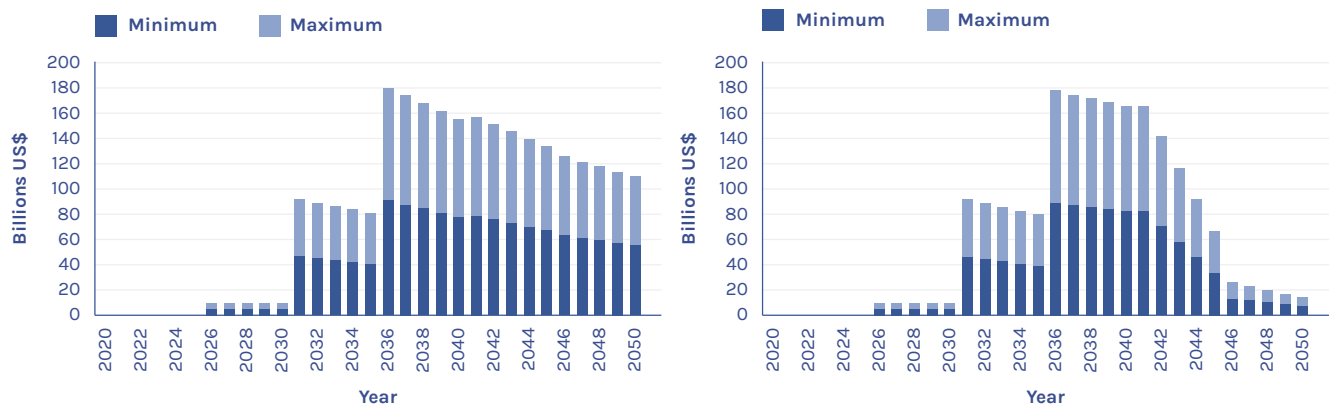


Fig. 8. Total investment needs compared to total revenues that could be generated

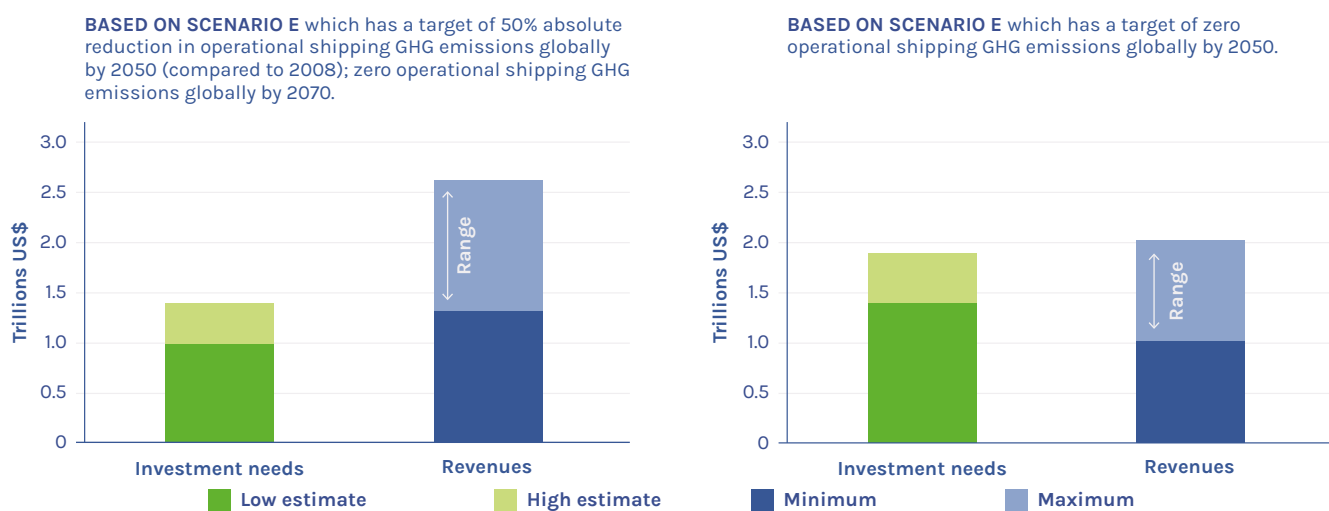
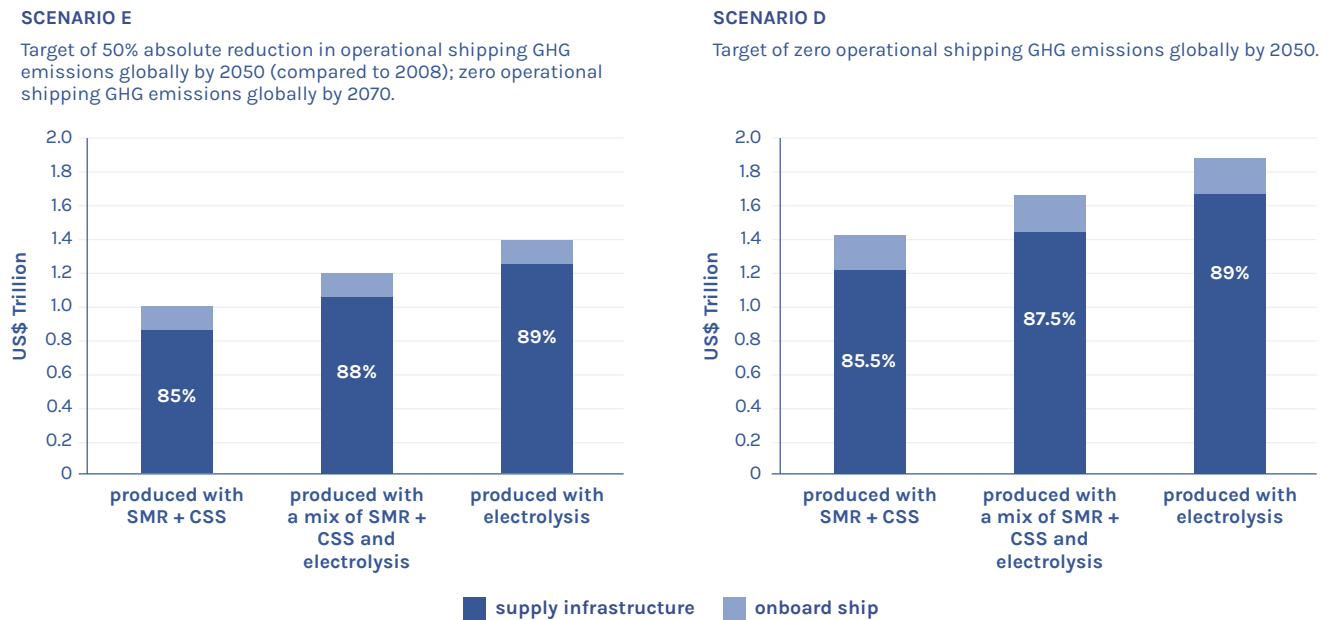


Fig. 9. Total investments needed to decarbonise shipping





Photos: Canva

Feebates

A feebate system is when an emission or carbon intensity benchmark is put in place, adjustable to keep track of the changes. The demarcation line separates those underperforming, who incur a fee, from those going beyond the minimum, hence awarded.

"A feebate mechanism offers added value by providing incentives for continu-

ous improvement in carbon intensity, investment in zero-emission fuels and technologies and more efficient operations, thereby stimulating innovation and reducing emissions," UMAS observes. Still, they caution, a feebate scheme is as good as the accuracy of the set benchmark. It may also make it exceptionally difficult for companies whose fleets are red-flagged,

as they will have to pay the penalties whilst scrambling to renew their tonnage to start receiving feebates.

Then again, a feebate system would be largely passive in management. Revenues would be directly recycled, evading a redistribution system, thus lowering the administrative expenses gnawing at the fund.

Emission trading system(s)

In a sense, an emission trading system (ETS) is the opposite of carbon pricing. The regulator regiments an overall emission target, leaving the topic of sorting out the goal-hitting carbon price to the market.

There are different ETS set-ups, but UMAS argues that the cap-and-trade (CAT) one is more probable in achieving the targeted outcome. Under a CAT ETS, an upper limit on GHG-E is set while allowances are traded (some might be distributed for free, e.g., to ease the initial collision). Those better performing can earn extra money, whereas others continue to operate (and pollute) as

long as they can afford to buy another CO₂ tonne.

However, the authors of *Closing the Gap* note that a CAT ETS has certain drawbacks. First, it doesn't incentivise companies to surpass the system's targets. Second, the price volatility of carbon allowances doesn't add to daily business nor longer-term investment certainty. If the set-up's design fails, market prices can rapidly fall due to global shocks. In this instance, companies are discouraged from making green investments because the market promotes the contrary – burning fossil fuels.

Such a situation was the fate of the European Union's ETS in the wake of

multiple 21st crises, prompting the block to slim down its ETS to ramp up the prices. The current proposal of the European Commission is to increase the EU ETS reduction target for 2030 to -61% (vs 2005). This move would increase the prices to €90-130/tCO₂ in 2030, sharply contrasting with the below €10 prices seen in 2011-2017. Since the EU intends to make shipping part of its ETS, shipowners and operators have at least a more or less informed insight into what it will mean to serve the Fit for 55-EU market cost-wise.

Subsidies

The United Nations' definition of an environmental subsidy is "current or capital transfer that is intended to support activities which protect the environment or reduce the use and extraction of natural resources." Consequently, subsidies decrease the price of zero-emission fuels rather than increase the cost of fossil fuels.

UMAS brings forth three types of subsidies that can help decarbonise shipping. First, fuel subsidies – cash handouts or tax breaks per unit of fuel or GHG-E reduction. Second, production subsidies – allocated to lower fuel production costs, set up the bunkering infrastructure, and construct zero-emission vessels. Third, R&D subsidies – supporting technological breakthroughs that lower the cost of zero-emission fuels (e.g., more efficient and cheaper electrolyzers and storage). These are, authors of *Closing the Gap* say, "[...] examples of policy options which promote and support the production of alternative zero-emission fuels. As such, they

complement demand-side policy, [...] carbon pricing or command-and-control measures. Combining both demand- and supply-side policies is viewed as a more effective mix than stimulating only one side of an energy transition."

Subsidies have their own set of challenges. They may go against state aid rules, which from a combating climate change perspective is an argument against prohibiting state support and an exit point from the profit-over-environment/ethics system. Subsidisation can also turn into winner-picking, which runs the risk of betting on the wrong horse. This uncertainty can be circumvented by basing the decision on the best scientific understanding (or aggravated by letting petty political and corporate interests take precedence over environmental care).

Speaking of discrimination: according to research outlined in *Fossil Fuel Welfare versus the Climate*, annual fossil fuel subsidies amass to \$2.9tr – and over \$5.0tr by adding the externalities. In contrast, IEA calculates that \$1.71tr/year in clean energy and energy efficiency is needed by 2035 to nail the 1.5°C

goal (the UN's Intergovernmental Panel on Climate Change sets the figure at \$2.38tr/year in 2016-2035 – still lower than what fossil fuel companies get; compare that to annual climate finance flows in 2017-2018 averaging at \$574b). Author of the cited report, Alex Lenferna from 350.org (one of the few global eco-NGOs not hijacked by Big Oil & Gas), sounds the alarm, "[...] if we reinvested that fossil fuel welfare into social and ecological welfare, we could create a much more socially and ecologically prosperous future." UMAS adds, "While subsidies alone are unlikely to decarbonise the shipping industry, they could play an important role in closing the competitiveness gap by lowering the prices of zero-emission technologies and fuels and stimulating RD&D and innovation. They could also be designed to support an equitable transition [...]."

In the end, it seems, the discussion shouldn't centre around ideological dead-end chop logic whether subsidies are bad or good per se – but to what end they are used. To decarbonise shipping in particular, and the world in general, green subsidies should go in, while the dirty ones – out the window.

Direct regulatory approaches

Called command-and-control measures, they set standards that directly aim at decreasing ship emissions, therefore indirectly making fossil fuels

more expensive. "They could have a positive effect on RD&D and stimulate the uptake of alternative fuels in a similar way to carbon pricing. By mandating certain outcomes,

they can also bypass some of the market barriers and failures and guide investments in a way that avoids locking in infrastructural choices and stranding of assets," says UMAS.

Performance / emission standards

These lay down mandatory performance targets by capping certain activities' maximum allowable GHG-E or carbon intensity. However, it is done without setting in stone the specific technologies and techniques of achieving the end.

There are some already in place or just around the corner regulations. These include the Energy Efficiency Design Index (EEDI: a CO₂ intensity metric which considers

a ship's total emissions, at the design stage, relative to the transport work done by the vessel resulting in grams of CO₂ per tonne nautical mile); the Energy Efficiency Existing Ship Index (EEXI: which will apply technical efficiency standards to the existing fleet); and Carbon Intensity Indicator (CII: requiring ships to achieve a specified annual operational carbon intensity).

Taken alone, UMAS remarks, "[...] the stringency levels of these standards

are currently too low to lead to significant emissions reductions and, by themselves, will not cause the sector to even meet the IMO's minimum level of ambition." While there is a relatively high certainty that performance standards will achieve their goals, it is outside their scope to decrease absolute GHG-E. More shipping activity by better performing vessels, hence cheaper operation-wise, will nevertheless increase emissions.

Technology standards

These, in contrast, do determine which solutions are applied – without setting the overall outcome. "With regards to decarbonising shipping, technology standards could, for example, mandate the use of wind propulsion technology, set

mandatory speed limits, and phase out or ban the use of fossil fuels altogether," reads *Closing the Gap*.

Implementing technology standards across the board can stumble over a variety of obstacles. While specific solutions are already mature enough, think wind

assistance, it might take significant time before supply meets demand (including shipyards' capacity to install rotors or sails on both newbuilds and retrofits). At the same time, a uniform **speed limit** may be beneficial for this-and-that route or vessel but backfire when applied to others.

Product standards

These define the characteristics of a given product, fuels among others, either banning the use of those that fall out the parameters or labelling them so that clients (shipowners and operators) and their customers (shippers, freight forwarders) can make an informed decision when determining what product or service to buy.

Emission Control Areas (ECA) are probably the most widely known applications of product standards insofar as they mandate the use of compliant fuels for lowering sulphur and nitrogen oxides. Enforcement is another issue, as some may decide to cheat, hoping to slip under the radar given the authorities' lack of capacity to check all traffic within an ECA.

Heading towards shipping decarbonisation, UMAS considers that "[...] product

standards could, for example, specify the maximum (lifecycle) carbon content of marine fuels used and set sustainability standards for marine fuels (e.g. biofuels)." Blending could act as a transitional solution, used already today when the questionable CO₂ lowering benefit of liquefied natural gas (LNG) is patched up by adding bioLNG (whose GHG credentials can also be controversial, especially if manure is the base source, as animal agriculture is one of the leading pollutants; refuse can be used for producing bioLNG, too, though this is the function of rampant consumption and food wastage; the question is whether we turn waste into resource or don't litter in the first place).

Authors of *Closing the Gap* speak in favour of direct regulatory approaches as

they have proven effective and "[...] can be less cost-intensive to develop for the regulatory body because their design is relatively simple compared to MBMs." On the other hand, performance, technology, and product standards don't generate revenue for recycling, which could be used to speed things up and aid a just transition. Regulations are also prone to political pushing and shoving. It means that less affluent countries might get exemptions because they cannot afford to comply at the same pace as advanced economies. However, doing so could aggravate their situation, as older and dirtier non-compliant otherwise fleets would be forced to serve their supply chains.

Information programmes

(governance-by-disclosure / information-based governance)

These are all about transparency – in the case of shipping decarbonisation, of the costs & benefits of different options. UMAS notes, "Indeed, there has been a significant rise in focus on carbon disclosures in annual reports and ethical investing in general. This points to a need for greater information disclosure in any decarbonisation measures."

As things stand today, there are two GHG-E information-gathering systems. First, the IMO Data Collection System (DCS) for ship fuel oil consumption (although its

data sets are confidential). Second, the EU Monitoring, Reporting and Verifying Regulation (EU MRV) collects data on CO₂ emissions from maritime transport, which are then available under the Regulation.

Closing the Gap reads that "[...] despite their important role in alleviating market failures, available evidence – both in- and outside the maritime sector – suggests that the actual impact of information policies in terms of emissions reductions is small. Therefore, information programmes are best suited to

be a complementary instrument to enhance the effectiveness of other policy measures aimed at driving shipping's decarbonisation." In other words, GHG-E data fit best for sharing knowledge and best practices – towards creating well-informed regulations and making sure runner-ups, often less developed players, pick the optimal solutions. Ideally, with equitable transition in mind, best practices should be distributed in an open-source way.



Voluntary measures

These are actions undertaken by any party interested in greening the shipping industry meant to go beyond the regulatory minimum. While alone they likely won't decarbonise the shipping sector, they are an essential driver of R&D (e.g., investments in pioneering low- or zero-emission tonnage) and demand (e.g., when cargo owners decide to use eco-friendly logistics chains only).

Since it is mostly large players with significant PR outreach that embark upon voluntary measures, they can raise awareness throughout the industry (and who knows, maybe catch

the public eye, too) and encourage others to follow suit. Information sharing is crucial as well, since other players might feel compelled to invest in a given solution as it benefits their competitors.

Yet, publicity is one thing; hard data is another. UMAS cautions in this regard, "[...] numerous studies have been critical of the role of voluntary/private initiatives in the past. [...] of 23 voluntary programmes across 18 countries [...] many of the programmes did not meet their target for emissions reductions, and only voluntary programmes which were tied to future regulations were generally successful in meeting their goals."

As Naomi Klein points out in the chapter

No messiahs: the green billionaires won't save us of her book *This Changes Everything: Capitalism vs. the Climate*, fighting climate change cannot be left to those who have made profits on exacerbating the problem and who might feel motivated to drive future earnings out of 'disaster capitalism.' Over-the-top declarations of the Bransons and Gates, coupled with underperformance of the Obamas of this world, should be taken with a pinch of salt. Better sceptical than sorry.

Then again, as reported in the 1/22 issue of the *Baltic Transport Journal* when rounding up the **Baltic transport highlights of 2021**, there is this organic, bottom-up movement that blazes the trail.

Tab. 1. Examples of voluntary initiatives in the maritime sector

Name	Date of establishment	Overview
Cargo Owners Zero Emission Vessel Initiative	2020	Under this initiative, shippers/buyers make commitments to provide a specific volume of freight to zero-emission vessel(s) and have set a target for exclusively buying zero-emission maritime freight by 2040. Shippers/buyers will also track their maritime emissions to check alignment with their goals.
Clean Cargo	2002	Focused on improving environmental performance in marine container transport using standardised tools for measurement, evaluation, and reporting.
Climate Bonds Initiative: Shipping Criteria	2020	An international organisation working to mobilise the \$100tr bond market for climate change solutions by promoting investments in projects and assets necessary for a rapid transition to a low-carbon and climate-resilient economy. The Shipping Criteria provide a definition for evaluating whether a shipping project contributes to climate change mitigation.
Environmental Ship Index	2011	Identifies seagoing ships that perform better in reducing air emissions than required by the current emission standards of the IMO.
Poseidon Principles	2019	This initiative is aimed at financiers and provides a framework for integrating climate considerations into lending decisions to promote international shipping's decarbonisation.
Science Based Targets Initiative	Yet to be launched	Aims to drive ambitious climate action in the private sector by enabling companies to set science-based emission reduction targets. It is a partnership between the Carbon Disclosure Project, the United Nations Global Compact, the World Resources Institute, and the World Wide Fund for Nature.
Sea Cargo Charter	2020	Addressing charterers, this initiative provides a global framework for aligning chartering activities with responsible environmental behaviour to drive international shipping's decarbonisation.
Sustainable Shipping Initiative	2010	A multi-stakeholder collective driving change through cross-sectoral collaboration to create a more sustainable maritime industry.

National & regional policy measures

These are divided into ship- and land-side actions. The former target the decarbonisation of both international and domestic shipping, plus inland navigation and fisheries. The latter focuses on investing in the production and supply of zero-emission marine fuels, following money put into producing renewable energy.

To stimulate lowering domestic shipping's GHG-E, the IMO has urged its Member States to develop and update a voluntary National Action Plan. Yet, this has been met with limited success (*Closing the Gap* mentions that only India, Japan,

the Marshall Islands, Norway, and the UK have submitted their plans).

Notwithstanding, several countries and organisations are at the forefront of implementing their own measures. Norway, for starters, wants to reduce its domestic shipping and fisheries' GHG-E by half by 2030. In four years, the country's fjords will become zero-emission areas (covering not only GHG-E but also other air pollutants). Norway is also known for making strides in hybrid and battery-powered shipping.

The UK has tabled the Clean Maritime Plan, which includes encouraging the uptake of low-carbon fuels and supporting green innovation (including zero-emission propulsion

technologies). The 2021 United Nations Climate Change Conference in Glasgow also saw the emergence of the Clydebank Declaration. In it, governments plan to establish 'green corridors:' maritime routes decarbonised from end to end, sea- and land-wise. Germany has its National Hydrogen Strategy, including works on hydrogen as a marine fuel. There is also the Pacific Blue Shipping Partnership, a multi-country initiative for a large-scale blended finance investment to facilitate Pacific island countries' transition to zero-carbon domestic shipping by mid-century (with a 40% reduction by 2030).

The EU, apart from including shipping in its ETS, is also working on the FuelEU Maritime

Regulation. It aims at stimulating the uptake of sustainable maritime fuels and zero-emission technologies. The FuelEU Maritime Regulation wants to introduce a goal-based fuel GHG-E intensity target, increasing its stringency over time, thus requiring operators to reduce the carbon footprint of the energy used onboard ships calling at EU ports. In addition, the block wants to advance

cold ironing, mandating that vessels berthing at EU quays draw energy from the shore (from 2030). The main bone of contention with FuelEU Maritime is whether LNG fits the sustainable fuel definition while regarding onshore power supply – if the supplied electricity comes from renewable sources.

Authors of *Closing the Gap* summarise this thread by saying, “[...] these national

and regional approaches may assist in the development of the market for zero-emission fuels. In stimulating demand for these fuels on a smaller scale, the development and production of zero-emission fuels can be initially shielded from the market pressures and barriers of the wider industry before supply is scaled up over time.”

Less is more?

This article's main body was ready ahead of the Kremlin's aggression on Ukraine. In a manner of just days, the world took a U-turn, and it seems that there is no turning back to pre-24 February 2022 times.

It remains to be seen what will be the war's impact on combating climate change. Perhaps the EU will catch the wave and transition towards a zero-emission economy faster to sever its ties with Russia's oil & gas. It may, however, lead to importing more shale gas from the US, extraction of which causes higher GHG-E than when using traditional methods and pollutes the areas in the drill shafts' vicinity. It might also lessen the restrictions on fracking in Europe. Taking in crude oil from Canadian tar sands will have an even more catastrophic effect on the environment at large.

One also gets the impression that the analysis laid forth in *Closing the Gap* includes an unspoken assumption, namely that global trade will more or less continue

to function in the foreseeable future as it does today. After all, as the late Mark Fisher wrote in his *Capitalist Realism: Is There No Alternative?*: it is easier to imagine the crack of doom than the end of capitalism.

In his disturbing yet razor-sharp essays, Fisher surfaces the dominating system's capacity to devour initiatives seemingly at odds with it, e.g., consumers can save the environment – they 'just' need to make the right buys. For instance, capitalism is inherently unable to raise the question of the justness of owning a car. Rather, it lures into changing your old vehicle for a new one – this time hybrid or electric. Such “remedies,” however, cannot patch the system's internal failure – that infinite growth is impossible when there are finite resources (in addition, redistributed upwards). It results in “glitches,” capitalism's externalities that remind us that the larger system, Earth, has its arsenal of countermeasures of restoring balance. As capitalism feeds on

societies, there are internal glitches, too, the rising prevalence of mental illnesses, loneliness, and feeling out of place and needless, particularly scrutinised by Fisher. Cynism or hipster irony, he adds, also became part of capitalism's toolbox – attitudes that sabotage the will to act.

Is it possible to imagine, maybe not capitalism's fall, but less trade, although still with increasingly greener fleets? Fewer purchases, sourced locally and of higher durability? Handicraft over factory production? More refurbishment instead of wastage? Essentially, a new strenuous age that builds character and ensures an equitable future for the generations to come, say nothing of the environment, in place of instant gratification-consumerism? There are, it appears, two conflicting meanings to the saying “less is more.” ■





Photo: Deltamarin

Capturing the carbon in a ship

by Esa Jokioinen, *Director Sales & Marketing, Deltamarin*

The shipping industry is under much pressure to cut its greenhouse gas emissions in the coming years. We at Deltamarin are seeing this first-hand. Today, each of our design projects involves us examining and implementing various technologies to enhance performance and reduce the carbon footprint. We are investing heavily in our research & development to gain and maintain industry-leading knowledge of the technologies implemented on ships. One emerging technology that has maybe received less attention in the maritime greening context is post-combustion carbon capture.

In short, such a system can extract CO₂ from a ship's exhaust gases, after which the captured material is liquefied, stored onboard, and eventually discharged to shore for either permanent storage or further use. Deltamarin recently participated in a joint industry project with Total, Minerva and DNV. We studied zero-emission pathways for tankers, with carbon capture technology examined among many other options. One of the conclusions was that it could provide "the 30% step" in carbon footprint before going into more expensive low- or zero-carbon fuels.

The project has been thought-provoking and led us to scrutinise the potential applications of carbon capture further. Specifically, earlier this year, we joined forces with Wärtsilä Exhaust Treatment to study how the system could be implemented in passenger-freight ferries (ro-pax). Our partner has recently announced that it has product development underway, and the company is also installing a pilot plant at its test facility in the Norwegian Moss.

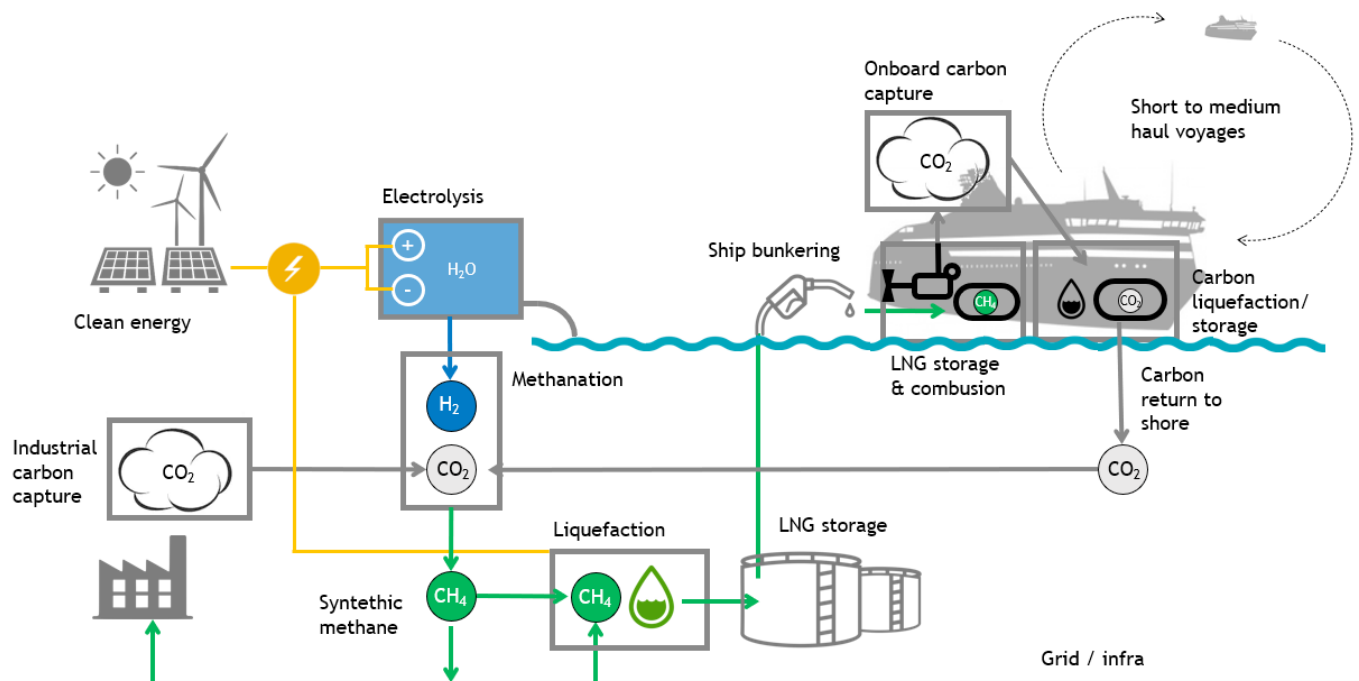
Why ferries?

Our starting point was that ro-paxes could be good candidates for carbon capture as they operate on fixed routes where the captured CO₂ can be frequently

discharged to shore, and less volume is needed for onboard storage. Many of the ferry operators have also selected liquefied natural gas (LNG) as their fuel. LNG has some inherent benefits with an absorption-based carbon capture system as it offers clean exhaust gases, and the engine fuel supply can be used as a heat sink for liquefaction of the captured CO₂.

If green energy is available in the operational area, it would also be possible to use the captured CO₂ to produce synthetic LNG through electrolysis and methanation. It would then make part of the CO₂ circulate back into the fuel supply. Obviously, such infrastructure would also require some adjacent industrial users.

The study compared a medium-sized 155 m-long ferry newbuild with alternative fuel arrangements for marine gas oil (MGO), heavy fuel oil (HFO) and LNG, the last two coupled with a carbon capture system. Dimensioning of the exhaust gas treatment, the carbon capture system, and related auxiliaries were made in close co-operation with Wärtsilä, taking into account the ship's heat balance. The vessel was then compared in the technical aspects of CAPEX, OPEX, and emissions across three different routes. Compliance with the current and upcoming regulations,



like the Energy Efficiency Design Index (EEDI) and the Carbon Intensity Indicator (CII), was also checked.

The study concluded that a carbon capture system is technically feasible within the given arrangement of the case ship without compromising cargo or passenger spaces. The achievable CO₂ capture rates vary depending on the operating profile – from roughly 25% at the lowest for the HFO scenario to nearly 40% for the LNG ship. When comparing the emissions against an MGO ship, the aggregate reduction with LNG and carbon capture could exceed 50%.

The additional CAPEX required for carbon capture and related auxiliaries was calculated in detail using our cost modelling plus information received from Wärtsilä. When put into the scale of the total new-build cost, carbon capture implementation requires about 5-to-7% extra investment.

It looks promising!

Of course, the key question is: can this also make commercial sense, and if so, under what circumstances? Achievable capture rates depend on several factors, e.g., how much waste heat is available for the system. The capture rates can be analysed when the heat balance of the ship,

space restrictions for the systems, and the configuration are known. After that, the payback time for carbon capture systems depends on two main things: how much fuel is burned during the operation (frequency and speed on the route) and the level of tax applied on CO₂ emissions (the CO₂ tax and CO₂ disposal cost difference to be precise).

The HFO ship with carbon capture reached payback times of less than five years at around 110/tonne of a CO₂ tax on the most intensive route. In general, the LNG ship with carbon capture had quicker payback times, as the capture rates are higher than for the other options, while the investment in the system is a bit lower. LNG with carbon capture already reached a five-year payback at 50/tonne on the fastest route. On slower routes, the payback times for both fuels were longer, but each of the examined combinations was under ten years, and half of them were below five years at 150/tonne.

The end conclusion of the study is that carbon capture looks technically feasible for ship integration – a very interesting option in reducing CO₂ emissions from ferries indeed. The technology looks particularly promising for LNG-fuelled vessels due to some inherent benefits of the fuel.

As the technology will be built on existing knowledge of exhaust gas cleaning systems, it can also be expected to become available sooner than some low- and zero-carbon fuels, which might require longer timelines to make the supply and distribution infrastructure available. Naturally, each ship and operation is different. Still, carbon capture onboard a vessel definitively provides an up-and-coming alternative for ferry owners and operators who wish to set their course for decarbonisation. ■



Deltamarin is one of the leading companies in ship design and offshore engineering in the world. Services are offered from concept development and engineering to project management during shipbuilding and commissioning as well as a wide range of services for operating vessels to maintain the fleet in excellent condition or even upgrade it. The company has invested extensively in developing sustainable and cost-efficient designs both for cargo and passenger vessels. Please check www.deltamarin.com for more info.



Making polluters pay

by Gwenaëlle Varin, Shipping Policy Researcher, Transport & Environment

According to the International Maritime Organization's (IMO) *Fourth Greenhouse Gas Study 2020*, maritime transportation accounts for an estimated 2.9% of global greenhouse gas (GHG) emissions. But today, the sector relies entirely on fossil fuels. As per the same paper, the industry's GHG emission level is projected to increase dramatically in the coming years, even by 130% in 2050 compared to 2008.

As Europe is heading to climate neutrality by the middle of the century, it has become clear that shipping must also deliver its fair share of the EU's decarbonisation effort. As a vessel's lifetime is about 25 years, it means that ships commissioned today are likely to be operating well into the 2040s. The deployment of zero-emission vessels is thus imperative in this decade.

To reach these objectives, the European Commission (COM) released its Fit for 55 Package, in which several legislative proposals were made for the decarbonisation of EU shipping. While the shipping Emissions Trading System (ETS) proposal provides a reasonable basis for the upcoming legislative debate, the FuelEU Maritime proposal drastically lacks the ambition to drive green fuels in the sector.

A ship operator overtaking coal plants?

The ETS is Europe's flagship climate policy. It works under a 'cap and trade' principle where a limit is set on the total amount of pollution that the installations covered by the system can emit and is reduced over time so that total emissions fall.

Polluters must buy allowances (EUAs) for each tonne of GHG put in the atmosphere. If the cost of reducing their emissions is lower than the price of an allowance, the company will invest in emissions reductions and sell allowances. Conversely, if the price of reducing emissions is higher than the carbon price, the company will buy allowances, thus incentivising emissions reductions elsewhere in the carbon market. The ETS, therefore, provides flexibility and incentivises the most cost-effective emission reductions.

In July, the COM proposed to include international shipping emissions in the ETS. It is an important move because it means shipping companies will finally pay for their climate pollution. They will be accountable for all emissions between and within the European ports but only half from voyages with non-European ports. According to our latest research, the Mediterranean Shipping Company would rank 6th among the EU's biggest carbon emitters if shipping was part of the bloc's emissions trading system. "For the third year running, the biggest shipping emitter has climbed the top 10 of Europe's largest polluters. It's emblematic of an industry that doesn't pay a cent for its pollution. That a ship operator is overtaking coal plants shows that business as usual isn't working. We need an EU carbon market

that makes shipping pay for all its pollution," Jacob Armstrong, Sustainable Shipping Officer at our organisation, said. He also stressed, "Anything less than a carbon market covering extra-European voyages lets the biggest shipping companies off the hook and leaves smaller operators who sail mainly within Europe to pick up the tab. It would also forfeit ETS revenues that could be reinvested in greening the sector."

Including maritime transport in the ETS presents a significant benefit: it would have a minor effect on overall prices. Firstly, price increases will stay within the normal fluctuation of fuels. Secondly, **it will be the consumer and not the shipping company that will end up paying**. But the impact on the price of consumer goods will remain negligible. For instance, the price of an iPad shipped from China will increase by 0.003, that is to say, almost nothing.

That said, the ETS will generate a significant amount of revenues. Rough calculations show that the shipping ETS could bring in sums of more than 6.0b per year (the impressive economies of scale of the shipping business is laid bare when juxtaposed with the marginal impact on consumers).

One challenge for policymakers will be to ensure the ETS achieves its ultimate

goal: decarbonised shipping. In this sense, revenues from the ETS should be forwarded to a dedicated fund (i.e. The Ocean Fund), as per the **European Parliament's proposal**. This tool would incentivise innovative green shipping projects. The fund would be especially useful if combined with Carbon Contracts for Difference, subsidy schemes for clean fuels that are proven, market-friendly tools to kickstart shipping's transition.

In parallel, concerns about carbon leakage – where ships would reroute to non-EU ports to avoid paying the full carbon cost – have been expressed after the plan's release. On that matter, **another T&E study** found that the risk of evasive port calls in three locations (Rotterdam, Algeciras, Piraeus) close to potentially competitive non-European ports is unlikely to happen. Under the proposed scope, only 6% of voyages to these ports would be tempted to evade at a carbon price of 60/t CO₂ prices. The extra costs associated with the need to carry out economic activity in that port (additional port dues, extra fuel expenses, port congestion, opportunity cost) render the actual risk marginal.

Nonetheless, the maritime ETS is unlikely to be sufficient to bridge the price gap between conventional fossil and sustainable marine fuels, hence the importance of a complementary regulation to make a fuel switch happen finally. This is the purpose of the FuelEU Maritime initiative.

Fail to push?

If energy efficiency can deliver up to one-third of emission cuts, **full decarbonisation by 2050 will require the gradual deployment of zero-emission vessels from 2025**. The stated objective of the FuelEU Maritime initiative is to promote green marine fuels.

The COM proposed to introduce a goal-based fuel GHG intensity target that increases in stringency over time. One outstanding achievement is that the target is expressed in life-cycle GHG emissions (so-called Well-to-Wake) to account not only for CO₂ but also methane (CH₄) and

nitrous oxide (N₂O) emissions of the different fuels used on board ships.

Nevertheless, if adopted in its current shape, the regulation will fail to push the maritime sector to invest in genuinely sustainable fuels such as green e-fuels, including e-hydrogen and e-ammonia. On the contrary, implementing the GHG target would likely result in accelerating fossil gas uptake in the shipping sector. It is because fossil liquefied natural gas (LNG) is allowed until 2040 under the current targets and enjoys a competitive advantage compared to more sustainable fuels due to its considerably low price; that's despite the limited or even negative benefits of fossil LNG use to reduce GHG emissions.

A report from the World Bank released in April 2021 strongly advised policymakers not to encourage the use of LNG in shipping. It found that LNG is unlikely to play a significant role in decarbonisation, including as a transitional fuel, because of the risk of stranded assets it creates. The report also described green ammonia and hydrogen as having **the most promising balance of favourable features relative to other options for zero-emission shipping**. It is also **the opinion** of the biggest shipyards in the world that plan to deliver the first big container ships powered by green ammonia by 2025.

But to make a case for shipping companies to invest in e-fuels ships, FuelEU Maritime needs powerful add-ons. Multipliers have worked well to push electric cars under EU car CO₂ standards. As far as shipping is concerned, they would make it more cost-attractive for ship operators **to invest in an e-fuel-powered ship than blending biodiesel in existing fuel oil ships**. According to T&E estimations, a multiplier of 5 would be a good level to promote e-fuel ships, i.e., counting five times carbon intensity improvements achieved by using green fuels onboard. The incentive would be even stronger if companies could exchange excess compliance points from ships powered by renewable fuels only within the credit exchange system proposed by the COM.

In addition, the proposed “pay to comply” system, exempting ships from GHG intensity reduction efforts, must be removed. Only dissuasive penalties making non-compliance cost-prohibitive should be used; otherwise, one cannot reasonably expect a fuel switch to happen on the market.

This measure will also be complemented with EU targets on infrastructure through the Alternative Fuel Infrastructure Regulation (AFIR), which must encourage ports to deploy hydrogen refuelling points instead of fossil LNG.

Room for improvement?

While the COM's proposal for ETS provides a sound basis for applying the polluter pays principle in shipping, the FuelEU Maritime will need a change of philosophy, from simply promoting alternative fuels to supporting those truly sustainable ones.

As the texts will enter negotiations in the European Parliament and the European Council starting from September, there is still room for improvements before the proposals enter into force in 2023-2024. ■

TRANSPORT & ENVIRONMENT

Created over 30 years ago, the Transport & Environment (T&E) NGO has shaped some of Europe's most important environmental laws: we got the EU to set the world's most ambitious CO₂ standards for cars and trucks; campaigned successfully to end palm oil diesel, secure a global ban on dirty shipping fuels, create the world's biggest carbon market for aviation, and make Uber commit to electrifying much of its European operations; we've also helped uncover the Dieselgate scandal. Head to www.transportenvironment.org to discover our vision of an affordable zero-emission mobility system with a minimal impact on our health, climate, and the environment.



Photo: Canva

Ambition into action

by Carlo Raucci, *Marine Decarbonisation Consultant, Lloyd's Register*

The shipping industry's collective commitment to deliver on zero-emission by 2050 was palpable at the Glasgow UN Climate Change Conference of the Parties (COP26) last November. The sector enjoyed a higher profile than at previous COPs, and commitments were signed that placed intention ahead of regulation. Among these was the **Clydebank Declaration on Green Corridors**. It currently involves 22 countries and allows getting such large-scale demonstrators tested and into service in a controlled, risk-managed-and-mitigated manner.

The initiative put forth by the Clydebank Declaration focuses on major port hubs and specific trade routes, gathering the relevant supply chain actors under one banner. It points to scalable and commercially viable solutions, supports the green transition policy-wise, and encourages targeted public and private investment. The initiative also enables a fuller understanding of where the first land-based new fuel production infrastructure might have the biggest initial impact. The Green Corridors are, without question, essential to encouraging first-mover activity.

Navigating the opportunities and risks

The creation of Green Corridors is tied to another crucial area where pioneers require a helping hand to convert their ambition into action, namely in navigating the opportunities and risks associated with the many transition scenarios out there. That is why we have established the Lloyd's Register (LR) Maritime Decarbonisation Hub.

In December 2021, the Hub launched 'First movers in Shipping's

Decarbonisation – a framework for getting started,' an approach that enables a detailed comparison of different fuel transition pathways regardless of vessel type or trade lane. It, among others, focuses on comparing different fuel options and what the evolution of a specific fleet means for the regional supply chain.

It also entails raising critical questions, ranging from "What are the material costs needed by all stakeholders to meet these changes?" and "Are there any synergies across the supply chain once a path is selected?" to "What do we need to keep monitoring to continue improving our strategy?"

Framing the work

The Maritime Decarbonisation Hub framework evaluates the entire supply chain, from fuel production to onboard use, and can be applied to any fleet, revealing the implications of each transition strategy and offering insights to support future fleet investment decisions.

We can pinpoint a common solution by identifying the breakdown of different costs for the supply and fleet sides for a specific fleet and location. This way, we encourage stakeholders to think about what works for them holistically, helping

kickstart a scalable transition for other fleets and locations.

Until now, research has either focused on a specific ship and fuel or been too high level and generic to have real relevance for shipping companies. LR's new framework can help the industry move from analysing the entire global shipping fleet to focusing on plausible real cases for large demonstration projects worldwide. By doing this, we can help reduce uncertainty and risk by providing an understanding of the transition pathways open to stakeholders in those particular demonstrations. This approach can also inform a strong business case for a potential coalition that will support the chosen route ahead.

Lessons already learned

Our first study analysed three transition pathways – for methanol, ammonia, and hydrogen – and applied each potential fuel to the container ship feeder fleet operating regionally between Singapore, Hong Kong, and other nearby Asian economies. The set comprised 222 ships, totalling around 360k TEU capacity, with an annual fuel consumption estimated at 1.4mt of fuel oil equivalent and 4.7mt of CO₂ emitted per year.

We chose that particular region because it is a regular trading route that generates an aggregate demand to specific ports, so much so that fuel providers are more confident to make investment commitments to serve this market. And we wanted to pick an ecosystem or green corridor that can be scalable to other ships serving this port network/region, so the supply chain could, in theory, start the transition here and scale it out. Below is what we found out.

First, different transitions might be suitable for this specific fleet – based on either methanol, ammonia, or hydrogen, which can, in turn, be produced from natural gas, renewable electricity, or in some instances, also sustainable biomass.

Second, similar emission reduction trajectories have different implications for the fuel supply infrastructure. The fleet transitions based on methanol, ammonia, or hydrogen can all meet similar emission reductions; however, this result is achieved using different infrastructures and at varying implications.

Third, the sector must balance early results with strategic planning. The analysis shows a trade-off between early efforts to decarbonise the fleet, which allows for a smoother transition, versus the long-term planning approach, which attempts to find the solution with the lowest overall cost. This balance must be found while providing a growing fuel supply through different feedstock routes without major price fluctuations.

Fourth, both retrofits and newbuilds will be required to meet net-zero by mid-century. In all transition pathways, approximately 26% (by the number of ships up to 2050) of the transition is

achieved through retrofitting. It means that replacing vessels near the end of their lives with newbuilds powered by zero-carbon fuels is no longer sufficient to meet the net-zero 2050 target. Instead, younger ships in operation today need to be retrofitted to accelerate the uptake of zero-carbon fuels.

Fifth, fleet costs vary per transition pathway. The total fleet costs up to 2050 are lowest for ammonia (\$44.5b), followed by methanol (\$51.5b) and then hydrogen (\$69.4b) – compared to the fossil fuel baseline of \$42.3b (incl. carbon cost).

Sixth, voyage expenses dominate the fleet's total costs, representing between 71% and 82% of the cumulative fleet total costs depending on the transition. Therefore, improving vessel energy efficiency and voyage optimisation becomes increasingly instrumental in reducing the cost of decarbonisation.

Seventh, the fleet fuel transition leads to a specific fuel supply. The production location delivering the cheapest fuel production option typically also benefits from being the location with the lowest feedstock prices, except when the cost of transporting that fuel to the fleet becomes too large (e.g., for the hydrogen transition scenario).

Finally, co-location of fuels produced with natural gas and fuels produced with renewable electricity could deliver further cost reductions. Saudi Arabia and Australia are likely production locations because of the relative lower feedstock prices. There can be key economic advantages in plant co-location, such as de-risking investments and building long-term security of supply capability and associated costs.

Unearth and accelerate

This first step was an exercise to show what the framework can do, i.e., to find a system-based solution that brings the supply and fleet sides together. By focusing on a particular Green Corridor, the framework can highlight issues in advance, helping to identify what we think might work best for a specific fleet and, importantly, reach a common solution that holds good for the majority of stakeholders. The framework can be applied to different fleet types, geographies, and transition strategies outside of the three fuels explored in the report. As we advance, we want to develop the framework further and test it on a real case.

Building on this fuel agnostic framework, the LR Maritime Decarbonisation Hub aims to steer cross-industry alliances that can unearth and accelerate resilient energy transitions, enabling the carry out of Green Corridor projects this decade. ■



Launched in 2020, the Lloyd's Register Maritime Decarbonisation Hub is a joint initiative between Lloyd's Register Group and Foundation. It brings together thought leaders and subject matter experts with the skills, knowledge and capability to help the maritime industry design, develop and commercialise the pathways to future fuels required for decarbonisation. Click www.lr.org/en/marine-shipping/maritime-decarbonisation-hub to learn more.

Too good to be true?

by Ewa Kochańska

Last year's report ***BioLNG in Transport: Making Climate Neutrality a Reality*** argued in favour of liquefied biomethane (bioLNG), claiming it might be the renewable fuel of the future, especially in long-hauls due to its comparably seamless ability to replace high-emission fossils. The paper analysed the entire value chain to showcase, in particular, its tangible benefits when used in heavy-duty vehicles (HDVs) and maritime transport to decrease pollution and meet the increasingly stringent EU climate targets. The co-authors, the European Biogas Association (EBA), Gas Infrastructure Europe (GIE), The Natural & bioGas Vehicle Association (NGVA Europe), and SEA-LNG also made corresponding policy recommendations on how to streamline the transition to bioLNG to start replacing fossil fuels in the fastest and most affordable way.

bioLNG gets portrayed as a renewable, non-fossil variant of liquefied natural gas (LNG), the cleanest fossil fuel currently available in long-distance, heavy-duty transport. Trucking companies, ship operators, and ports & terminals (cargo handling equipment, handling, storage, bunkering) have been using LNG for some time now. While its use isn't as widespread as traditional fuels, the technology is tried-and-tested, rules are in place, and new facilities are being put on the infrastructure map, on- and offshore.

Facing the realities of the EU's carbon-neutrality goal of 2050, the report authors recognised that solutions capable of meeting this target must be affordable and technologically accessible right now. One of the main benefits of bioLNG, compared to other renewable fuels, is that it can use the same facilities, engines, and technologies as LNG, making it

a cost-effective and straightforward transition. Also, it can be produced locally – as it's already the case throughout Finland and Sweden – further cutting costs and transport emissions.

However, fuelling infrastructure and biogas production capacity needs to build up, meaning that significant government incentives will be necessary (also to drive down the price). Consequently, the report emphasised that to make the EU-enforced emission cut a reality, it's imperative that the European Commission (COM) acknowledges the importance of renewable fuels and supports the utilisation of bioLNG with adequate policies.

Production, benefits, infrastructure

BioLNG is a biofuel made by breaking down organic waste, such as manure, municipal and household waste, or sewage sludge treatment, via anaerobic digestion into methane-rich biogas. It is estimated that a minimum of 95b m³ of biomethane can be produced annually by 2050, compared to the current 3.0m

m³ (some reports show even higher output). The bioLNG production capacity is expected to increase as much as tenfold by 2030. "Navigant estimates the bioLNG demand for transport to reach 461 TWh by 2030. This approximately represents 45-50% of the total production capacity of biomethane in Europe." Currently, bioLNG can be mixed with traditional LNG to reduce emissions. For example, the report reads, "using a 40% bioLNG mix with LNG will help reduce the CO₂ emissions from [...] trucks by 55%."

Furthermore, biogas can help prevent methane emissions escaping into the atmosphere from the agriculture and waste sectors. By capturing methane, bioLNG production might as well generate negative carbon emissions. Additionally, the quality and health of the soil in Europe, endangered according to the COM's Joint Research Centre (JRC), could benefit from sustainable cropping, which would later be used for renewable energy. As such, bioLNG can become a driving factor in transport fuels becoming a part of

a circular economy instead of being an environmental hindrance.

The paper's authors underline that when policymakers consider various energy sources, they must look at the entire life-cycle of such fuel – on a well-to-wake basis – before making regulatory or investment decisions, among others. Related policy recommendations include extending “the scope of Annex IX of the Renewable Energy Directive to integrate more feedstocks such as residues that cannot be used for other purposes or secondary crops,” and creating “a single market for biomethane and bioLNG by facilitating trading of volumes and certificates across borders free of technical or political barriers.”

Since LNG on its own has been evolving from a niche fuel to a more mainstream solution to help with improving air quality, Europe already has a sizeable LNG refuelling network in place (though noticeably more in its west- and southern parts). Since bioLNG uses the same infrastructure and technology, this issue becomes pivotal when switching to renewables.

According to NGVA Europe, the number of LNG stations in Europe was above 300 as of 17 November 2020. That sounds like a large number, but considering the already high demand for LNG from regions such as Eastern Europe and the somewhat lacklustre availability of refuelling stations there, much work still must be done in terms of distribution infrastructure.

Regarding maritime transport, 118 ports already have LNG bunkering infrastructure/option, and it's under construction at 90 more. In Europe (incl. the UK) in 2020, there were 53 ports with various

LNG bunkering options and a further 37 where these facilities were being developed. There is a growing interest in private investment in bioLNG as well. One example would be Shell announcing an expansion of its LNG station network in Germany last year by 35-40 sites. This September, it was followed by a decision to build one of the largest biofuels facilities in Europe (turning a decommissioned Rotterdam oil refinery into an 820kt/year plant). The paper's authors recommend the EU should “recognise the role of LNG infrastructure as an enabler for integrating higher shares of bioLNG, in particular by supporting the development of refuelling infrastructure for road and maritime transport along with SSLNG (small-scale LNG), under the revision of the Alternative Fuels Infrastructure Directive.”

BioLNG in road transport

HDVs are one of the main targets for bioLNG transition. Currently, they add up to about 10% of all motor vehicles globally yet contribute about 50% of CO₂ emissions – and even more in particulate pollution (a major global health issue in itself). Electrification of HDVs is one alternative. However, high-capacity batteries are presently needed, such as a 6.4t pack to operate a 40t HDV for more than 1,000 km. For the same distance, 280 kg of LNG would suffice.

The production of gas-powered heavy-duty trucks is also rising, with around 12k LNG trucks already on the European roads in 2020. NGVA Europe predicts that there will be 280k such trucks on the streets by this decade's end. In 2030, they will need approximately 100 TWh in fuel, of which 40% will be bioLNG.

The HDV sector has been slow to reduce greenhouse gas (GHG) emissions due to increased demand for freight transport. With the use of bio and synthetic gas in HDVs, the level of GHG emissions can be brought down; when comparing fossil LNG and diesel, the reduction ranges from -10% to -20% (depending on engine technology), while comparing a blend containing 17% of bioLNG, the emission savings are about 34%. With 100% biomethane, the reduction is -130%.

While the environmental gains become increasingly important from a business point of view, on account of regulatory demands and climate targets, for HDV owners – who are primarily small and medium-sized enterprises, the Total Cost of Ownership (TCO) is a crucial parameter.

Due to economies of scale and high distribution costs, bioLNG is still more expensive to produce than diesel. Building a biogas facility is also a complex task; issues such as access to the correct type of organic waste, maintaining proper temperature and moisture, and producing enough gas to make the infrastructure financially viable are challenging to overcome.

That said, the report states that LNG-powered trucks lower the TCO when compared to diesel vehicles. Currently, the high costs of an LNG truck can be offset by the price difference between LNG and diesel: when averaging the last 20 years, natural gas has been about 35% cheaper than oil. Also, its price point has been more stable.

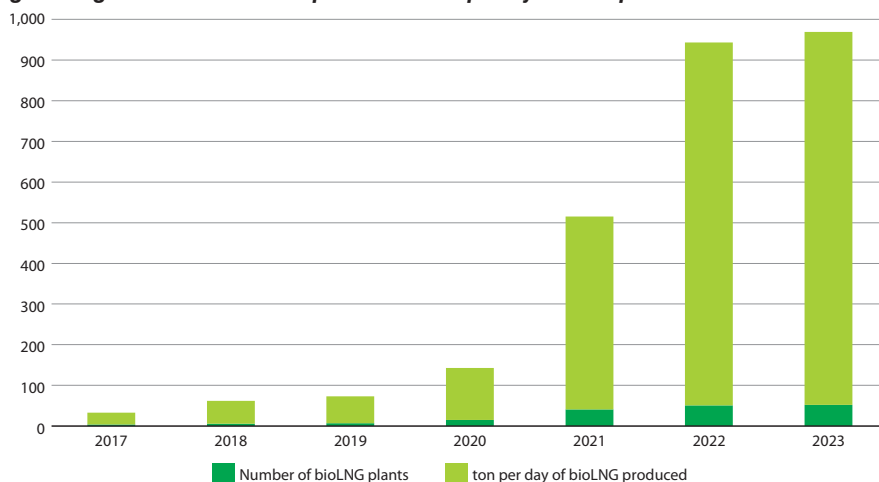
Still, the right type of policies are needed to compensate for the currently high costs of bioLNG production. The authors recommend to “adopt an approach based on technology openness and guarantee a true level playing field between different mobility solutions under a well-to-wheel thinking; integrate the bio dimension of LNG in the revision of the CO₂ emissions standard regulation for HD vehicles to stimulate a quick take-off of the decarbonisation effect; acknowledge the benefits of LNG/bioLNG in road transport to reduce local pollutant emissions.”

BioLNG in maritime transport

Right now, there are around 170 LNG-fuelled vessels of all sizes and shapes, plus another 150 LNG-ready ships in operation, most of them in Europe. Some 230 are on order. The numbers are growing, but it's still a fraction of the 53,973-strong global merchant fleet (ships over GT 1,000 in 2021). Newbuild orders include 13% of LNG-run and 16% LNG-ready vessels, while in the ultra-large container ship segment, more than half of all orders are either for LNG-fuelled or LNG-ready vessels. In November 2020, TotalEnergies and CMA CGM hit a milestone when the latter's CMA CGM JACQUES SAADE got the world's largest LNG fuel batch of 17.3k m³, 13% of which was bioLNG.

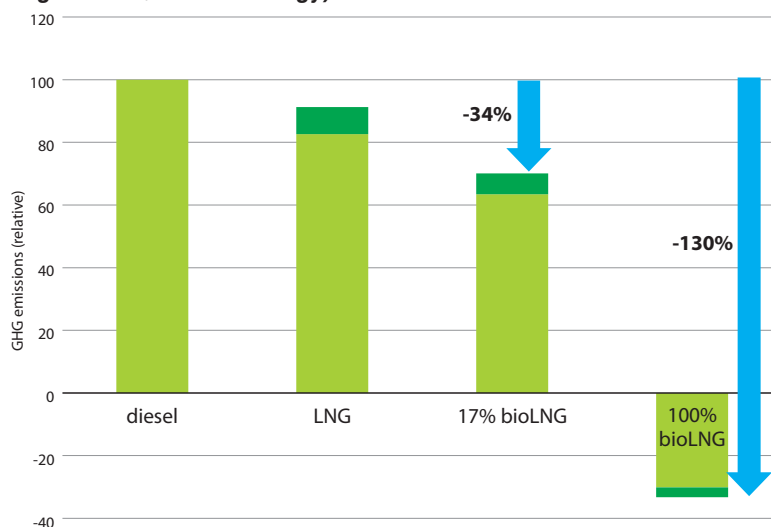
LNG as a marine fuel can reduce GHG emissions by 21% compared to oil-based fuels (over the whole life-cycle from well-to-wake). That, paired with the Energy Efficient Design Index (EEDI) improvements to vessel design, means that gas-run ships will likely be consistent with the IMO 2030 target for newbuilds as well as the current European 2030 target. BioLNG, even if at first used only as a drop-in fuel, can offer reductions of up to 92% compared to fossil LNG in the combustion cycle, “with even further reductions

Fig.1. Progression of bioLNG production capacity in Europe



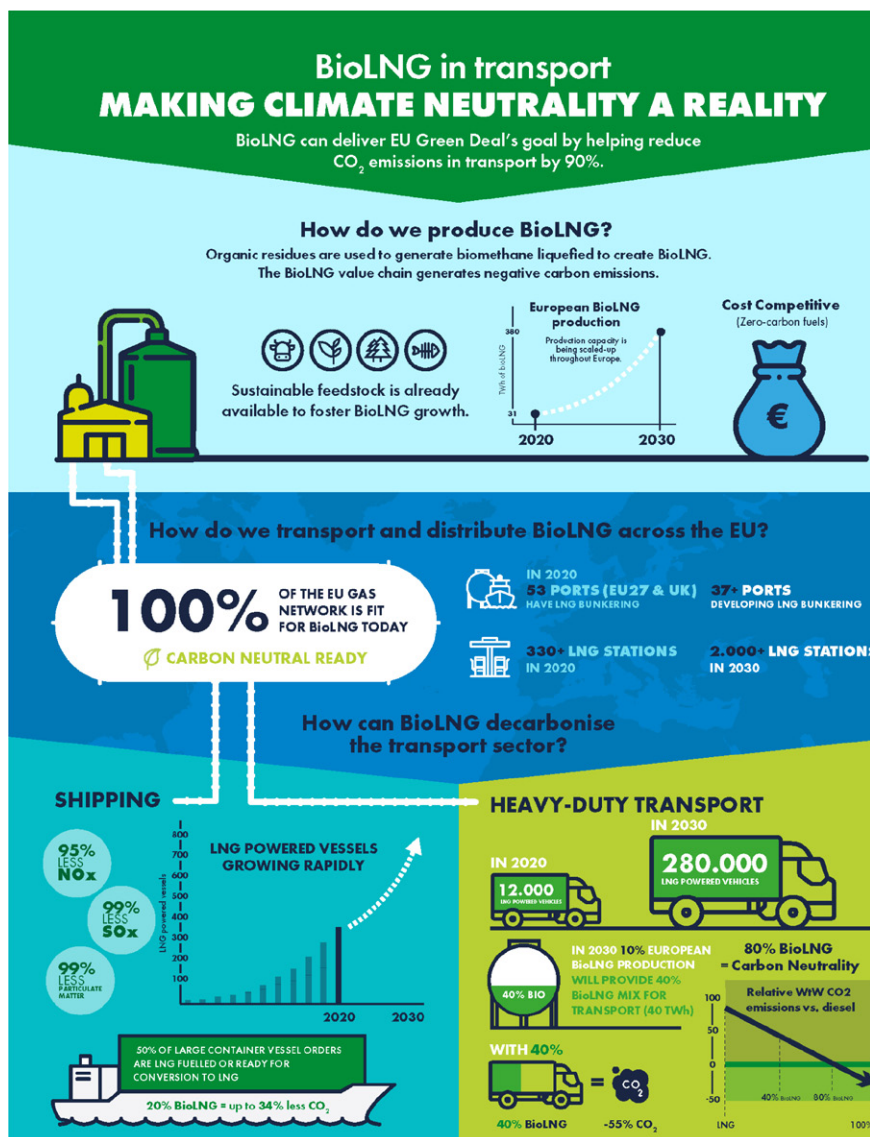
Source for figs. 1-2: BioLNG in Transport: Making Climate Neutrality a Reality

Fig. 2. Greenhouse gas emissions (vehicle + fuel) for a 40t gas-run truck (min-max according to HPDI/S.I. technology)



possible on a well-to-wake basis depending on the origin of the bioLNG.” Furthermore, “It also virtually eliminates particulate matter, including black carbon or soot, which, while not yet regulated, is a growing environmental concern.” Since bioLNG is (renewably sourced) liquefied methane, the only emissions related to it have to do with “the combustion of the very small amounts of pilot fuel used in LNG dual-fuel engine technologies.”

When using the CAPEX data on LNG-fuelled ships of different types and trade routes compared to traditional marine fuels, LNG shows the best return on investment on a net present value basis when compared to low sulphur fuel oil over ten years. Paybacks range from less than one year to five years (and the costs continue to fall). BioLNG's CAPEX is the same as LNG, while price-wise, “bioLNG blend is currently viable in NW



[northwestern] Europe, with a 10% blend of bioLNG with LNG on par with 0.10% marine gasoil [...] in Rotterdam.” Additionally, a recent study from CE Delft shows bioLNG as financially competitive with other green fuels such as green hydrogen or ammonia, with an advantage over other renewables thanks to its compatibility with LNG infrastructure, engine, and bunker technologies.

The main problem related to LNG and bioLNG often discussed in maritime

transport is methane slip. It can occur during bunker transfer when some of the gas leaks or from fuel that is not burned in the combustion process. This issue, which has been a problem particularly with older LNG-engine designs, is being continually addressed by engine and ship engineers and manufacturers. For instance, “[Man Energy Solutions] indicates that engine design changes together with new solutions for post-treatment

and the transfer of technology from high-performance two-stroke [...] to four-stroke engines have the potential to reduce methane slip by a value greater than 90%.” Another ship engine manufacturer, Wärtsilä, reported they have been able to reduce methane slip from its dual-fuel engines by 75% over the last 25 years, while WinGD added technology improvements resulting in a reduction of methane slip in its two-stroke low-pressure internal combustion engine by 50%.

Here, the authors of the report recommend policies that “adopt an approach based on technology openness and guarantee a true level playing field between different mobility solutions under a well-to-wake thinking; integrate the bio dimension of LNG in the revision in GHG reduction targets for shipping to stimulate a quick take-off of the decarbonisation effect; acknowledge the benefits of LNG/bioLNG in maritime transport to reduce local pollutant emissions.”

The final step

The transport industry has been slowly realising the benefits of using LNG and drop-in bioLNG to cut its sizeable carbon footprint. To meet the increasingly demanding emission standards worldwide, the sector must consider and invest in 100% renewable fuels. As such, the report urges the European authorities to acknowledge the potential of bioLNG in achieving the EU and Paris Agreement climate targets. The final step away from fossil fuels in transport cannot be achieved without the help from policymakers who need to consider creative incentives and government stimuli when planning future transport legislation and national strategies to ensure a swift green fuel transition.

Volatility and schedule unreliability force terminal operators to digitise and automate

by Przemysław Opłocki

The perfect storm of disruptions, such as Brexit, the COVID pandemic, and the Russian attack on Ukraine, has shaken the maritime supply chain to its core, increasing volumes and putting enormous pressure on port logistics, especially container terminals. We are talking with Stephan Piworus, of IDENTEC SOLUTIONS AG, about remedies to the resulting challenges like ship delays, lack of accurate data, and balancing profitability with necessary investments and new technologies.

- **We are talking today about challenges for container terminals in general, focusing on the European and Baltic Sea regions. Some of the issues are volatility and ship delays. How does it look in the current situation, especially with the war in Ukraine?**

Yes, volatility and ship delays, or lack of schedule reliability, pose serious problems for container terminals. Volatility is something that we have been facing for many years already with bigger vessels and a lot of mergers, which automatically brings the volatility in the market. But I think when it comes to ship delays or schedule unreliability, these are issues that have become worse now in COVID times. When looking at this situation, I remember the time when I used to work for a terminal operator myself. Back then shipowners were always aiming at a schedule reliability of 90%.

And right now, it went down, I think below 50%. There is a big gap there. And there are many, many reasons for all these issues that the shipowners are facing at the moment. But the end result is that the yard utilization is heavily increasing, and it's hard for the container terminal operators to cope with that situation. It's very unpleasant. Only way out is to digitize and then automate your processes and make sure you got the right data in real time in order to become more flexible and make best decisions. Establishing common standards, like TIC4.0, will be crucial, too. The war in Ukraine has definitely some impact. Already with the annexation of Crimea and the subsequent sanctions, container throughput in most European ports steadily declined. Now it drops even further. But container throughput of goods to and from Russia, compared to bulk cargo, is on a much lower level and the effect is not nice, but not so dramatic for most European container terminal operators.

- **What about the Terminal Industry Committee 4.0 (TIC 4.0), could you tell us something about this initiative?**

With all the challenges we just addressed, the best reaction right now for terminal operators is to digitise processes and invest in process automation. This is what we see at the moment. There is a big demand right now for process automation to face these challenges. And TIC 4.0 plays a major role here in terms of taking away risks and reducing costs. During the necessary digitalisation. A very helpful part of TIC 4.0 is that it's not only the terminal operators or just the equipment manufacturers who sit together, but it is all stakeholders. It's terminal operators, the equipment manufacturers, and the solution providers who try to promote, define, and adapt standards together, to eliminate loose ends, so to speak. If you have a great solution, you need it to be able to talk to other existing solutions in a container terminal



independent from the manufacturer or solution provider, but it needs also to be prepared for any future development as well. For example, due to budget restrictions you only automate part of your terminal, but in the future you want to automate other parts as well, but you might consider doing this project with another vendor. It makes sense that all of these solutions easily communicate with each other so that implementation or replacement is “plug & play”. With the current set-up where all the major stakeholders are involved, the biggest terminal operators and most important equipment manufacturers, this collaborative approach, will be to the benefit of the whole industry. The terminal operator has less risk and implementation time goes down. This will not only bring down the cost, but also encourage terminal operators in their willingness to automate and lead to better quality by becoming much, much better and more efficient. I'm really supportive of this initiative.

■ **And what about the fleet management and asset utilisation?**

I believe it is crucial that all your data is digital and connected in real-time. And you need to make sure that even all your assets, e.g., the container handling equipment which is quite

expensive and a big investment for container terminals, are smart and well connected by speaking the same language so that you can manage the fleet of your container handling equipment, or any equipment you have, and improve your asset utilisation as well. Not only saving a lot of cost, but also enabling much better planning and smart utilisation of equipment, in addition to knowing the status of the equipment, all in real-time. That permits the terminal operators to be on top of things and to make smarter decisions. Terminal Operating Systems for example can only be as good as the data input is, which usually defines the limits of the best systems. Poor data input = poor analysis = poor decisions. Making all your assets smart is very often even the groundwork for successful automation.

■ **And do carriers, when they choose the destination for their services and ships, also expect this kind of automatization from the terminals? That is, if you are not an automated terminal,- we won't be coming to your terminal?**

I don't think so. The customers of a container terminal expect to get the best service for the best price. Nothing more, nothing less. But in order to achieve this there are no real alternatives to digitalization and automation.

I think the good news is that semi-automated terminals can be as productive as fully automated terminals. Full container terminal automation is expensive and scepticism towards the ROI is always there. Therefore it can be an interesting alternative to automate just certain parts (e.g. gate, yard, reefer) and progress over the years with other parts enabling the terminal operator staying financially stable on the one hand and increasing terminal's productivity on the other hand.

■ **Could you elaborate more about planning and scheduling as it pertains to the sometimes-strained relationship between the technical department and operations?**

Yes, coming back again to that concept that everything is connected, the assets are smart, and you have all the information in real-time, helping you to be much better not only with your operations, but also with your planning and scheduling. As a terminal operator, you usually have a technical department, which is taking care of all of the equipment and an operations department and by nature there are some kind of competitive



Photos: IDENTEC SOLUTIONS



goals between them, which leads very often to conflicts between these departments. The operations want to run in the best way, very efficient, with no delays, everything's on time, and with the maximum output. The technical department needs to make sure that all the equipment is working and that you don't have any unforeseen maintenance problems, e.g. one of the container handling equipment is down. But if you take a closer look at it, the competitive goals are sometimes even common goals. Most issues arise from lack of information or from information that was sent too late. Still many terminal operators send Excel sheets back and forth to plan equipment and their shifts for the operations. deciding from a document, which is already outdated when it was sent, how to plan the shift. Very often this is still how it works. But if everything is transparent and you have all the information in real-time and everybody has access to it, that makes this process much, much smoother. Nobody has to provide any information or prepare any data and if something happens, you will see it right away, not with a delay because someone needs to tell you something or prepare the data or in the worst case manipulate data. Tension between the two

departments is taken away and everybody can concentrate on more important tasks. All in all it leads to better utilisation of your equipment and more efficiency. Also, it improves the safety of operations when you really know what is going on, for example, if you have a problem with tire pressure. When you have visibility and transparency, that helps a lot.

- **So, the common goal is the best utilisation, efficiency, and safety in operations. How to ensure safety or even how to increase safety standards when there is significant growth in volume and productivity?**

Yes, safety has always been one of the most important factors and challenges for a container terminal and will always be. And, of course, if you have an increase in volumes and growth, along with what we mentioned in the beginning, volatility and so on, that brings more pressure to operations, and more pressure translates to a higher risk that things will go wrong – definitely an unpleasant situation. If you automate, however, you can take away a lot of these challenges. To put it simply, the fewer people you have in the yard, the safer it is. Usually, not much happens if someone sits in front of a laptop or computer instead of walking around between container handling equipment. But also smarter assets bring more safety to the game. For example, you have shock sensors on your RTG or straddle carrier, and

you realise that you have shocks in a specific area of your yard. When you realise and localize it you can act accordingly by defining this as a no-go area or a slow-down area. You can take action ahead of time before a crash to machine or injury happens. And you can only do a proper investigation if you have data, if you are aware that there's a problem. So, this helps a lot in improving safety and with the investigation process as well. But also predictive maintenance is a good example how you can become safer on the one hand and more productive on the other.

- **Let's talk about the most significant challenges and your solutions at IDENTEC SOLUTIONS. As you already mentioned, the biggest challenge is really complexity – larger vessels, ship delays, less space, safety, and so on. How to stay profitable with all those issues on the table in the management of the terminal and how to handle them.**

Profitability is crucial that applies not only to container terminals, but to any other business area as well. Latest developments, we already discussed earlier, have made it more difficult for container terminal operators, but fortunately they can influence most of these challenges on their own by pushing digitalization and automation. Political conditions and framework are more or less given, but the decision to invest in automation (even partially) enables them to stay profitable. I can



see limitation for example, when due to bigger vessels, a terminal operator needs to invest in bigger ship-to-shore cranes in order to reach all the containers. That would be a major investment in your equipment and not automatically in automation and a challenge in terms of profitability. But what we have seen recently are a lot of automation projects all over the world, not only in Europe. Everybody automates or is in the process of installing automation solutions right now not only being a trend from the typical innovation leader in this industry, but even from terminal operators where you would never have expected that. Starting point is always a clear return on investment (ROI) calculation. And the reason is simple – with automation investments, we are more efficient and more profitable. It is just a simple ROI calculation.

- **In terms of IT Tech solution projects, could you give us an example of how you try to help your clients deal with these challenges, perhaps a success story with your IDENTEC SOLUTIONS?**

One of my favourite examples of a success story is in Algeciras, Spain, TTIA (Total Terminals International Algeciras), where we were from the very beginning.

The challenge there was to handle from scratch, getting the first semi-automated container terminal port in the Mediterranean operational in only 6 months. Biggest challenge in

the beginning was to build trust and change their mindset coming from conventional terminal operators. They developed great and are still very happy, still using it today and in 2020 the Container Port Performance Index listed them amongst the top 10 terminals worldwide and the only one in Europe to achieve this level of performance. Although they have grown over the years, they have kept their flexibility, they have an accurate picture of their equipment in real-time, and whatever is necessary, they have the fleet management module, they have good asset utilisation, and also they have had proper planning and scheduling from the beginning because they have had that needed visibility. So, I think TTIA is definitely a good example of how automation through our solution called Terminal Tracker made TTIA work better.

We also have customers for whom we have installed our solutions like Terminal Tracker afterwards in a 24/7 environment although they managed so far to grow without us; Good example is our current installation at Eurogate Tanger in Morocco. They have had tremendous growth over the last years, incredible really, and they have had issues now that came along with that growth. So, in terms of yard capacity, in terms of having more and more equipment, issues arose of how to better utilise assets and how to find enough qualified personnel; when you do everything manually, of course, you need more staff, and you need to

find people who can do the job. Pressure increased because of their significant growth. And right now, we're installing Terminal Tracker there as well to overcome these challenges. And they are very happy with the first results here, but we're not quite finished yet – we have not gone live with all of the equipment, but hopefully, we will do this summer.

- **Lastly, I'm really curious about artificial intelligence (AI). Do you have these kinds of solutions in your portfolio as well?**

In my opinion artificial intelligence is a very broad term, you might have some kind of more or less simple algorithm, and you can already say this is AI. Now if we keep this broad definition, I would say yes, we already have some AI in our solutions. But I think artificial intelligence has so many possibilities and will become more and more crucial for container terminal operators because of the challenges we already discussed earlier. However the groundwork for AI is always to have good data and preferably in real-time. Without this you don't even have to think about any artificial intelligence. And I believe this is the homework that still needs to be done by many container terminal operators. ■



Photos: Visy Oy

First of its kind

by John Lund, Sales and Marketing Director (Global), Visy Oy

Aspects of science fiction films from the 1980s and 90s are becoming a reality in the modern container terminal. Some 20 years ago, vision technology in terminal operations was limited to optical character recognition (OCR) for container code recognition (CCR) and license plate recognition (LPR; also referred to as automatic number plate recognition, ANPR, depending on your geography). The game-changer in vision technology occurred in 2013 with the advent of dynamic neural networks (DNN). Long story short, using a DNN provides a faster, more efficient, and more accurate way to extract data from images using deep learning techniques. The benefit for the industry is that virtually everything that you photograph can be automatically digitised and therefore used as a basis for process automation. The latest application for container terminals, and those interested in a container's condition, comes in the form of Visy's Automatic Damage Detection System (ADDs), the first system of its kind.



Visy provides process automation ecosystems to manage the flow of traffic, cargo and personnel in transportation hubs and logistics centers. Every asset that goes in or out of a facility, whether by road, rail or quay, can be managed by Visy technology. Using vision technology and other data collection tools, Visy ecosystems manage more than 5,000,000 automation tasks per day in over 25 countries. Visit www.visy.fi to learn more.

It is safe to say that the issues surrounding damaged containers cost the industry billions of dollars per year. Broken boxes lead to spoiled cargo, and containers with severe structural damage present safety problems. Indeed, a container full of waterlogged iPhones, or one with warped corner posts that causes a stack to collapse, will evoke a ripple effect of insurance claims, angry customers, delays, and safety concerns. As a result, many container terminals have created processes to manage damaged cargo. However, until recently, those processes have been manual and therefore labour-intensive, slow, error-prone, and unpredictable despite management's best efforts. Today, damage inspection is automated through ADDs. This process automation improves the terminal's key performance indicators (KPIs), including truck turnaround times, lifts per hour, and profitability.

Container terminals use OCR camera systems to identify assets entering or exiting the facility via road, rail, or quay to im-

prove KPIs. The common industry terms for these solutions are gate operating system (GOS) with OCR for trucks, train GOS for rail operations, and crane OCR for quayside movements. These deployments all utilise vision technology to collect event data (box ID, seal presence, door direction, hazardous goods labels, etc.) and share it with third-party systems such as the terminal operating system (TOS).

The same camera systems can now be upgraded to include the ADDs feature through a simple software add-on. For example, as a truck drives through an OCR pre-gate portal and images are taken to identify the box number, the same camera system now tells the operator if the box is damaged, shows where the impairment is and specifies the damage type. Afterwards, it is up to each operator how they want to use this new, digitised data.

Quayside operations

As boxes enter the terminal via ship-to-shore gantries, images are taken of



all visible sides by the crane OCR system. Cameras are typically located in the spreader and on the crane's frame. As the spreader grabs the box(es), Visy's TopView application (i.e., spreader OCR system) captures images of the roof and uses those images for CCR, twin-20' detection, and ADDS. The operator receives confirmation of the box IDs even before offloading, thus preventing wrong moves. As the containers move into the exchange area, the frame cameras capture images of each box's long and short sides. These images are also used for automatic data processing, not least the box ID, ISO code, door direction, hazardous goods labels, tare weight, seal presence, and damage detection. Before the cargo touches the ground, the operator knows everything about it, including its condition. The information is digitised and shared with the TOS, meaning that exceptions, such as the lack of seal or extreme damage, are promptly managed. Perhaps the operator changes a work order so that a box goes to the maintenance & repair (M&R) centre and then updates the shipping line. With digitised data, previously inconceivable levels of automation become the standard.

The same data are used during loading operations. When a box is picked from the quay, all relevant information is captured, including its state. In this case, the terminal automatically collects and shares the standard OCR features, such as the box ID, but also confirms that the box is fit for sea travel. An equipment interchange receipt (EIR) can be automatically created and shared with the shipping line using the digitised data codes. Additionally, the terminal verifies that the box was in the same condition when it entered the terminal, refuting potential damage claims.

Truck gates

Before trucks and cargo arrive at the main gate, they typically drive through an OCR pre-gate portal. Depending on the operation, the portal is equipped with lights and cameras to capture high-resolution images for the OCR processes. The data extracted from the images will be similar to that utilised in quayside operations, save for apparent differences like truck license plates instead of terminal tractor ID, etc. Again, using a single set of images from the OCR portal, ADDS will find damage on the cargo, digitise the result, and create an exception handling event if required. Because the damage condition is digitalised, the work order can be automatically changed, and the container can be rerouted to the M&R centre if warranted by its state.

Much like the in-gate process, the out-gate process can be automated with ADDS. As the truck drives through the out-gate OCR portal, hi-res images are taken before reaching the main gate area, and all relevant data are acquired. The cargo is matched with the truck and work order, and the damage condition is determined. If the cargo is unfit for road travel, or some other discrepancy exists, the truck will be prohibited from leaving the terminal as an exception handling event. If there are no discrepancies, the truck will go, and the terminal has evidence that the assets were in acceptable condition when exiting the facility.

Rail operations

Like the truck pre-gate portals, rail tracks can be equipped with train GOS OCR portals to collect and share data in a variety of train operations. The train OCR portals work with double-stacked, dual-track, and bi-directional operations as

the site requires. As the train travels through the portal, cameras capture hi-res images of the wagons and cargo to extract and share relevant data such as the box and wagon IDs and the composition.

The data are shared with the TOS and compared to the expected composition. Exception handling events are created in the system for box/wagon discrepancies and damaged cargo alike. If a box is damaged upon arrival, the information can be automatically shared with a third-party system before the terminal even offloads it. Similarly, as the train is departing, the OCR portal will verify that the boxes are in acceptable condition when they leave the facility.

Only the beginning of a new era

Visy ADDS automatically digitises the condition of shipping containers. This tool presents a massive opportunity for operators and the industry alike. The ability to automatically know the condition of a box as it arrives at a terminal would have qualified as sci-fi only two decades ago. Today, operators can utilise deep learning technology to automate processes, provide better customer services, and make prudent business decisions.

Sharing damaged cargo data with third-party systems like the TOS, creating a website for customers, or automatically generating and sending EIR reports are only the beginning of this new era in terminal automation. It will be amazing to see where vision technology takes the industry after another 20 years of development. ■



Photo: Canva

Superior digital endowment

by Martin Wallgren, Chief Information Officer, GAC Group

Business leaders are looking to digitalisation to support a return to pre-COVID profitability. But to reap the benefits, management teams need to grasp the technology they use, be it integration, data governance, cybersecurity, blockchain, or Artificial Intelligence. More than that, they need to understand the workforce shaping the future of their trades.



The GAC Group is a privately-owned company specialising in delivering high-quality shipping, logistics, and marine services to customers worldwide. Emphasising a long-term approach, innovation, ethics, and a strong human touch, GAC offers a flexible and value-adding portfolio to help you achieve your strategic goals. Go to www.gac.com to learn more.

The coronavirus pandemic has triggered a renewed focus on addressing businesses' fundamental problems. The priorities and budgets assigned for digital solutions reflect this. **McKinsey & Company** has recently acknowledged that accelerating digital adoption during the COVID-19 pandemic has widened the gap between the top and bottom companies: "Competitive differentiation, now more than ever, emerges from superior digital capabilities and technology endowment, more agile delivery, and a progressively more tech-savvy C-suite."

All looking for a competitive edge

It has played out in the maritime and transport markets, which have seen a wave of consolidation, with some players exiting the sector entirely. Those service providers still operating post-pandemic are looking to capture contracts previously awarded to firms no longer in business. Customers seek information, facts, data, and reports to give their executives the insights they need to make timely business-critical decisions. And where static reports once sufficed, they now want a clearer and deeper understanding of their supply chains' performance. But with staff numbers down due to **'The Great Resignation'**, such insights can no longer be maintained in-house, and

companies are turning to their suppliers for the data they need.

It places new demands on service providers like GAC – but we are well prepared. We have invested early in creating an accurate data model of the company's business – a significant investment for an incumbent global business. This data model is now paying dividends in many ways, one being the ability to operate as a data transfer business that can pivot in response to market changes (similarly to what Uber did during the pandemic when it shifted from taxi to food delivery services).

Our data model means we can adapt faster and more frequently than competitors operating traditional one-size-fits-all models. Rather than this costing jobs, we have worked hard to retain our global presence and local knowledge. Being physically present is a vital part of our ability to deliver digital solutions – it builds the trust that enables us to roll out services to a wide range of companies, all looking for a competitive edge.

Changing perspectives

This nimble adaptation has resulted in profitability, flexibility, and resilience, making GAC attractive to would-be recruits as we emerge from the pandemic. We don't view 'The Great Resignation' as a threat



even though it has become a global phenomenon involving millions of workers rethinking their place in the workforce. There is a shift in the mindset of those starting their careers, with most new entrants having grown up with the Internet. Recruits are already digitally literate and will prove integral to company success through digitalisation.

They are part of a fundamental shift occurring in workforces around the world. The 2020 global research report from Cushman & Wakefield titled **Demographic Shifts: The World in 2030** notes that for 2020-2030, Millennials will comprise the largest share of the workforce, representing more than 40% of the global working-age population by 2030. At the same time, 693m Baby Boomers are reaching retirement age, and 1.3b members of Gen Z will enter the labour force over the next decade.

New imperatives

This changing workforce brings new business imperatives. Recovery from the pandemic is being coupled with the need to accelerate environmental, social, and corporate governance (ESG) agendas, driven by 'young blood' perhaps more than any earlier generation.

The **Deloitte Global 2021 Millennial and Gen Z Survey** found that after a year

of intense uncertainty due to the pandemic, political instability, racial discord, and severe climate events, Millennials and Gen Zs are determined to hold themselves and others accountable for society's most pressing issues. "Climate change and protecting the environment" remains a top issue: no. 1 for Gen Zs and no. 3 for Millennials. They are channelling their energies toward meaningful action. In turn, they expect institutions like businesses and governments to do more to help bring about their vision of a better future.

Our organisation appreciates the importance of ESG for business success and values its staff's focus on it. The GAC Group has recently unveiled its **Roadmap to Sustainability**, which sets out its commitment to adapt and innovate its activities (also reduce if necessary) while supporting and influencing change in others. We have joined the Eyesea maritime pollution reporting and mapping project and the Ocean Race's CleanSeas initiative as part of our environmental protection and preservation engagement. Both are in line with the Life Below Water UN Sustainable Development Goal – one of the goals GAC's Roadmap states must be measured by all GAC companies.

We have further demonstrated our commitment to climate change by joining

the Call to Action for Shipping Decarbonisation and the Global Maritime Forum's Getting To Zero Coalition. Climate-neutral sea transport should be the default choice by 2030, and GAC supports the decarbonisation of international shipping by mid-century.

A grounded approach

Digitalisation will be critical in supporting decarbonisation. From improving fuel efficiency to integrating and optimising new technologies on board ships and in ports, true digital transformation requires a long-term commitment and a grounded approach. It needs to target achievable and measurable boosts to profit, performance, and safety during the green transition. It requires a solid overarching digital vision, excellence and governance across all knowledge silos, the rollout of digital initiatives that generate business value, and a robust digital culture.

Digitalisation will transform all business areas. We will be in debt to the future generation pioneering the cultural change for taking this step forward. Today's 'young blood' is truly helping address the challenges we all face together. ■



Photos: Canva

Ready to drop?

by Richard Phillips, *Mechanical Engineer, Casper, Phillips & Associates Inc.*

Lately, it seems that ports have been putting off crane purchases and want to use their existing machinery past their design life. Additionally, cranes have been pushed harder than ever as they move record amounts of container traffic. These two factors have led to a rise in fatigue-related maintenance issues on older container cranes.



CPA was founded in 1987 by Bill Casper and Rich Phillips after relocating from a California consulting firm. We started with pre-established worldwide recognition as structural engineers specialising in container cranes. For the container industry, we are unique in that we offer a multi-discipline combination of mechanical, structural, electrical and computer science engineering, plus anti-corrosion coating technology. We have also expanded our crane expertise to include most types of cranes – from RTG, RMG and Goliath cranes to B.O.P handlers on drillships. Ports and crane manufacturers worldwide use our services to design and procure all types of load handling equipment. Head to www.casperphillips.com to learn more.

although steel can have an infinite design life if the stresses are low enough, designing cranes to last forever would increase the cost beyond the competitiveness point. Ports vie for shipping lines, so if one pays more for a container crane, the box move cost will be higher to repay the investment. Carriers will go to a port with lower operational costs unless there is another hourly operational benefit. Even if crane structures were designed to last infinitely, they would still eventually become obsolete due to the increasing size of container ships.

Some 20 years ago, container cranes didn't have to service vessels as large as they do today, so it was unheard of to have a gantry with an outreach of over 200 feet (approx. 61 m) because container carriers weren't that big. Back then, the largest cranes could pick up a single 40-foot or twin 20-foot container, while nowadays, the biggest gantries can lift tandem 40' or four 20'.

In addition, the biggest cranes have a second trolley to help sort the containers when the primary one places them on the dock, which speeds up yard operations. Today, cranes with an outreach that extends beyond 230' (70 m) are standard on big ship-to-shore gantries, made to handle the largest container ships with 202-foot-beams (61.5 m) – with spare room for the future growth of container

ships. All that said, crack and fatigue issues may be present in cranes of all sizes.

Slipping between the cracks

Many people think of fatigue as 'wearing out' of the steel, but this is not quite right. Fatigue failure occurs in components subjected to a high number of fluctuating stresses. Under these conditions, failure can occur at a stress level that is significantly lower than the tensile or yield strength for a static load. Steel has infinite fatigue life if the fluctuating stresses are low enough and operations take place in an ideal environment.

Cracks can initiate from many sources, such as high cycle fatigue, poor manufacturing, corrosion, or overload events like snag, earthquake, or storm winds. The initial flaws may be microscopic or macroscopic. Growth rate increases with crack size, so a defect that has grown from microscopic to a detectable size is well towards reaching critical size. However, if the steel lacks reasonable notch toughness, the critical crack length will be significantly smaller than steel with excellent notch toughness.

It is highly unlikely that someone without training would be able to detect the first signs of cracking or fatigue. It is also not likely that the operator would notice a change in the crane's performance, even if they are very familiar with it.

Addressing crane cracks and fatigue – before it is too late

Further, not all cracks are equal – it's all about risk management. If failure of a structural beam would cause catastrophic failure, it is considered a fracture critical member. If a fracture critical member has a crack, it is not worth the risk of a catastrophic failure to continue operating until the crane can be taken out of service and the damage is repaired.

Fatigue and corrosion failure of container cranes has been rare, but there has been at least one incidence of a total collapse. There were also several close calls where imminent failure was avoided because cracks were discovered just in time. Numerous fatigue failures of individual members and connections have occurred, but a shift to an alternate load path usually prevents a total collapse. Therefore, alternate load paths are a vital fatigue design consideration.

Fatigue issues are not always a by-product of overuse. Sometimes the crane design is not robust enough for its specified duty class; other times, there are manufacturing defects that the quality assurance/quality control programmes missed. Also, accidental overload cases

such as collisions, stalls, snag loads, or high wind events and earthquakes can reduce a crane's fatigue life. From our

perspective, fatigue problems appear to be increasing due to the record amounts of container traffic.

Managing cracks

Just how critical is the problem when cracks appear? The answer depends on how much damage the area can safely withstand and the consequences of such failure. Damage due to a crack is directly related to how fast the crack can grow. The study of crack propagation is called 'fracture mechanics,' which combines analytical methods with experimental research to quantify a crack's growth potential. The consequences of a member or joint's failure also play a part in determining the criticality of a crack. A member or joint with no alternate load paths and whose failure would cause a crane to collapse is called fracture critical.

One methodology to manage cracks and other defects within fracture mechanics is using 'damage tolerance.' Pioneered by the aerospace industry, the idea is that the engineer assumes there is a crack of the smallest size with a given inspection method. The engineer can then calculate the crack growth rate during regular use. This analysis is then used to set the appropriate inspection intervals based on the criticality of the member or joint. By calculating the crack damage tolerance of a crane and implementing the resulting inspection programme, chances are much better for identifying and scheduling repair work to minimise operational downtime.

Like in a car, the oil needs to be changed more often than the timing belts. The same is true about cranes: some areas need more attention than others. It typically depends on both the duty cycle the cranes were designed for and how the equipment is operated. A damage tolerance programme integrates these parameters to provide a rational basis for effective inspection intervals.



Best practice: prevent accidents

Consulting engineers, port authorities, and shipping companies have developed container crane design specifications. These particulars usually require that the design of various elements comply with domestic and international design codes.

A consultant with engineering expertise is often hired to validate if the crane structure and components meet the requirements. Ensuring a crane design meets the design specifications – that appropriate materials and loads are used – reduces the risk of structural failures.

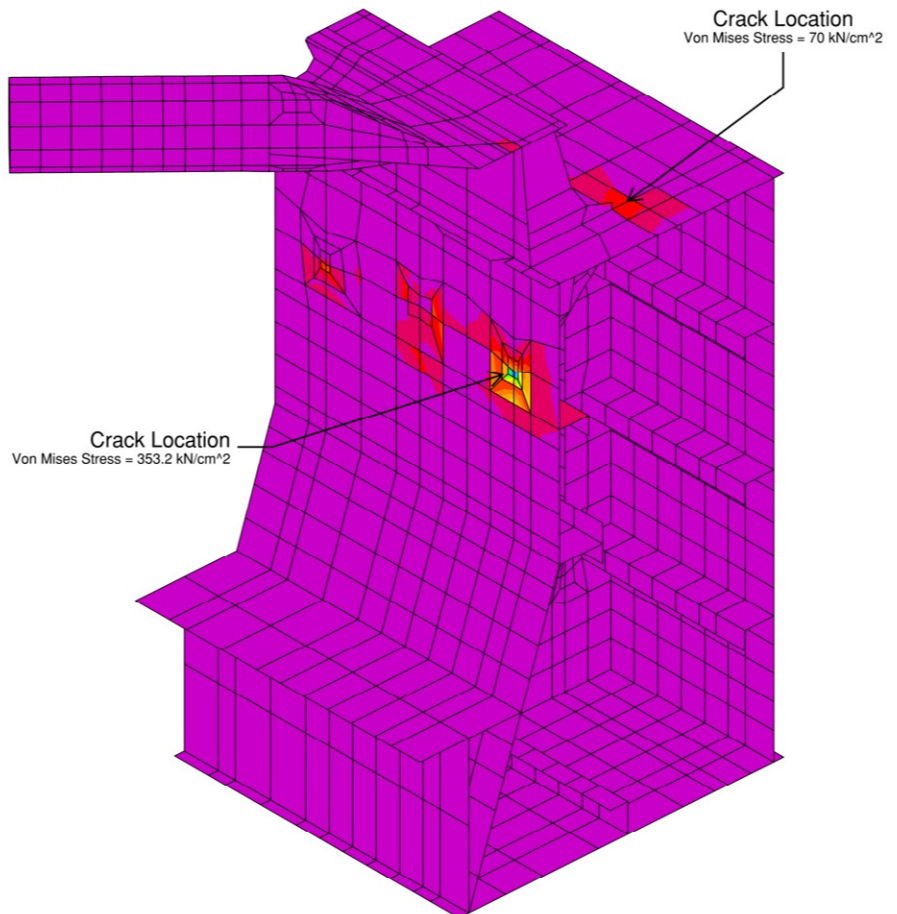
Unlike other industries, the container crane sector has no formal body for investigation, documenting, and reporting structural failures. These are often a source of embarrassment, liability or litigation – and therefore remain confidential. If an accident occurs, disputes are usually settled through private litigation. This is unfortunate because the entire industry would benefit from sharing such information.

The best practice is to prevent accidents, so it is always a good idea to have a qualified engineer reviewing the crane manufacturer's design before construction, along with having a good maintenance programme once the crane is in service.

Calculations have their limitations

Typically, cranes are designed only considering high cycle fatigue. Overload events are checked for strength but usually aren't included in the fatigue analysis. Several moving load locations are considered, and an equivalent lifted load for fatigue is decided based on the crane classification or specified by the purchaser. The more realistically the moving load paths model how the crane is used, the more accurate the analysis results will be.

However, even the most thorough calculations have their limitations. They have many built-in assumptions that may not be accurate. For instance, if a weld has poor fusion or porosity, it may not be detected by a surface inspection such as visual, dye penetrant, or magnetic particle testing. This weld can have subsurface cracks or defects that can grow to the surface much faster than calculations predict. Design to a fatigue criterion is no guar-



antee that fatigue will not occur. That said, on a statistical basis, fatigue design does provide reasonable fatigue protection.

Another vital point to consider is corrosion. Container cranes work in a relatively hostile environment surrounded by saline

and acid laden air. Corrosion is an ever-present enemy that is no mystery to any maintenance department or owner. Techniques and materials for preventing corrosion are well known, and the failure to maintain a corrosion-free crane is tantamount to

accepting a reduced life for the affected crane components.

With advancing age, poor structural maintenance programmes become evident exponentially. For some container cranes, it is too late; hence they should be retired. In other cases, it is possible to increase the life of cranes well beyond the original purchase specifications. If the design of a structural component is controlled by strength and not fatigue, its design life may well exceed the required minimum fatigue life.

The new life of a crane

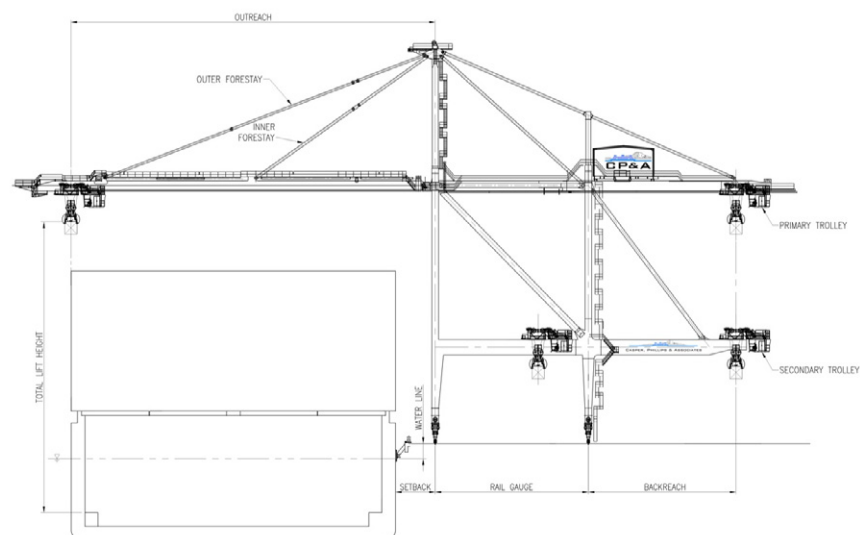
In the current economic environment, there is much uncertainty surrounding steel fabrication. Steel prices, access to components, labour force costs and availability, etc., are all extremely volatile. Owners want to protect themselves by procuring cranes on a firm fixed-fee contract. Such a deal includes all expenses associated with crane procurement, including delivery and commissioning for a single price (you'll forgive me for not publishing any figures). Likewise, crane manufacturers protect themselves by building in a lot of the costs due to the uncertainty surrounding steel fabrication.

This situation has further increased the number of crane owners taking an interest in extending the life of cranes. A gantry may have been designed for two million cycles. Still, its owners want to study the business case for upgrading the crane structurally and mechanically to extend the life up to three or even four million cycles.

As cranes are used beyond their original design lifespan, structural strengthening is a common method to extend the useful life. After the initial investment, strengthening will lower the stresses in critical areas, decreasing both downtime and inspection costs. If a critical area has been properly strengthened, it will be less likely to develop cracks and won't require frequent inspections.

Crane upgrades come in many forms: crane raises, boom extensions, rated load increases and increasing the useful life of the crane. Raising the crane and extending the outreach helps extend the machine's useful life by allowing it to service ever-growing vessels. Even if the cranes are large enough to handle the calling ships, they may need structural strengthening to enable them to be used longer. Strengthening can help prevent cracks, thus minimising downtime and increasing operational profitability.

Yet, some cranes begin having significant structural problems. Like a beater,



they become too expensive to operate because the maintenance costs and downtime are too high.

Repairing the cracks

If a crack is detected in time, it can be repaired. However, due to residual stresses and other limitations from the on-site crack repair, detectable cracks may re-develop after fewer load cycles. If cracks are found, further engineering analysis should be conducted to determine what repairs must be made. Due consideration should be given to increased inspections – and possibly reinforcement. The most common fix for cracks is grinding out and repairing them.

Remember, the best solution is preventing cracks from forming in the first place. Cranes can benefit from designs by experienced engineers who have put in the time to learn and master the subject of fracture mechanics. Fracture mechanics and related research have shown which types of designs and connection details are less likely to have fatigue issues like cracks.

Don't turn a blind eye

The most important defence against structural ageing is targeted inspections performed at specified intervals. Of course, operators and maintenance personnel should be trained to inspect constantly at every opportunity. This is the best form of insurance, and like buckling a seat belt, it is free. However, this should not replace inspection by trained technicians working at known intervals.

Periodically, all cranes should be examined by a technician with broad, generic

experience with structural maintenance problems. Dangerous cracking and deterioration can escape even the most conscientious visual inspection. A sizeable fatigue crack can close so tightly that it may not be visible to the naked eye even if known to exist. The only reliable way to find fatigue cracks is by a qualified expert using non-destructive testing (NDT) methods.

An engineered inspection manual can tell inspectors where and how often to look for cracks. A good inspection manual will show which NDT tests to run on the welds, which are the most likely to develop fatigue cracks. For container cranes, maintenance windows are available in between berthing vessels. The inspection methods most used are visual, magnetic particle, or ultrasonic, and will depend on how critical the member is to the crane's load-carrying capacity.

Inspection by outside technicians is expensive but can save property and lives. Like all other risk-benefit alternatives, there is no universal answer to how much one should spend to reduce the danger. The key to getting the best life out of these cranes is to have a good inspection manual and a responsive maintenance programme. Creating post-design life structural inspection manuals is a widely accepted service many crane owners currently utilise. Early discovery of a crack can limit the scope of the repair and curb unscheduled downtime. ■



Photos: Port of Gdynia

Small and attractive

by Hanna Klimek, Beata Szymanowska, and Anna Salomon, *Port of Gdynia*

Innovation is about qualitative change, the much-needed novelty and originality that pushes organisations, markets, and agendas forward. Concepts and processes (of technical or other nature) replace the status quo, bringing about progress. Some of the 'breaking news' solutions are grand indeed, think the use of green hydrogen. It, however, doesn't mean that small innovations cannot result in huge advancements. The Port of Gdynia has been testing one such inconspicuous novelty: an autonomous floating drone conducting water research, also known as a hydrodrone.

Satellite applications are among the many (technological, social, political, or economic) industrial innovation trends identified by the European Commission. Various sectors, including transport, can use these new solutions developed by the space industry to increase efficiency thanks to, e.g., data-driven process optimisation. Equally important, space-enabled applications can contribute to increasing people's safety or improving the protection of property and the environment. They are already used, among others, in flying and floating drones, road and rail vehicles, and vessels.

The Port of Gdynia is tapping into the global tech innovation trend by trialling a robotic floating platform to conduct water and seabed research in port basins. This device can work fully autonomously, following a planned trajectory, or remotely, which is particularly handy in bodies of water that are impossible or difficult to access by larger vessels and their crews.

On 18 November 2021, in one of the port's basins, the first tests of the robotic unit were held. As part of the trial, the correct functioning of all automated mechanisms used for taking water samples from various depths, bottom sediment probes, and measuring the water pH was verified. Communication systems were tested, too, while safety protocols were checked. The hydrodrone will begin cyclic testing of port waters as of March this year.

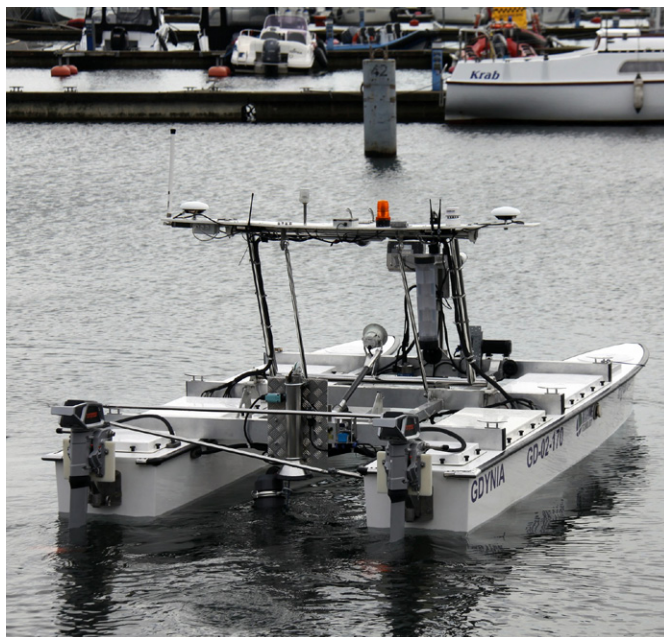
The technicalities

The floating drone tested in Gdynia is a catamaran: 4.0 m-long, 2.0 m-wide, and 1.0 m-tall (1.4 m with the antenna gate raised), having 0.5 m of draft. The hull is constructed of acid-resistant steel, while the floats are made of laminate. The unit weighing 300 kg can develop a maximum speed of 14 knots (about 26 km/h), but the measurement speed is best at 3-4 knots (5.5-7.4 km/h). It can be used for hydrographic surveys in port areas, rivers, lakes, lagoons, or bays. The set of installed batteries (two Torqeedo Cruise 4.0RL 0-4KW motors) allows it to carry out measurement works for up to 12 hrs. The hydrodrone is additionally equipped with two photovoltaic panels. It is environmentally

friendly as it emits no harmful substances. Remote control of the device is possible up to 40 km, while transmission of on-board data is up to 6.0 km.

The hydrographic equipment of the drone consists of an in-water sound velocity profiler (AML SVP Base X2), an in-water sound velocity sensor (AML SV Xchange), an inertial navigation system (SBG Ekinox2-D), an interferometric echo sounder (PING 3DSS-DX-450). All of these provide highly accurate measurements of water depths and 3D side images.

The drone's navigation sensors were installed on an automatically folded mast, ensuring the safety of transport of the vessel and access to the measurement area. These include two LW20 laser rangefinders of the UMRR OC Type 42, a 24 GHz radar (weather insensitive and sunlight independent), a Velodyne Puck VLP-16 LiDAR (used in autonomous vehicles), a Hikvision camera (the water- and dust-proof model DS-2CD2025FWD-I), a Hikvision PTZ camera (model DS-2DE3304W-DE with high quality 3.0 Mpix resolution imaging), an Airma weather station (WX Ultrasonic Weather Station), and two vertical echo sounders (EchoRange 200 kHz).



In addition to typical navigational data, the drone records video (pan and tilt), stores data from the weather station, and measures the battery voltage level and the mast and hydrographic head actuator position. These data sets are transmitted to a shore station, while hydrographic data from the multibeam probe and LiDAR are recorded on in-vehicle industrial computers.

The ashore operator has two control consoles and one hydrographic console with a computer. A dedicated navigation console protects from dust, water and shock, while a small manoeuvring console is used to steer the vessel close to shore, including mooring. Also included is the radio mast required to communicate with the vessel.

Water samples collected by the hydrodrone will be analysed in a laboratory so that the physicochemical profile of the port basin waters can be established during the project. The data obtained during the research, especially the results of observations and analyses, will be included in the final report containing recommendations and indications for the state administration on the use of floating robotic platforms in research work in port waters.

Part of something bigger

The Polish Gdynia-based Marine Technology is the owner and developer of the hydrodrone. Since its inception in 1998, the company has been conducting research & development in the field

of technical sciences. Among others, it employs experts in navigation, hydrography, geoinformatics, geodesy and cartography, oceanography, remote sensing, photogrammetry, automation and robotics, computer science and electronics. Marine Technology has carried out many research projects (on modern technologies, including Artificial Intelligence) and filed several patents. In October last year, it won a tender announced by the Port of Gdynia Authority and is now responsible for executing the necessary measurements using the hydrodrone.

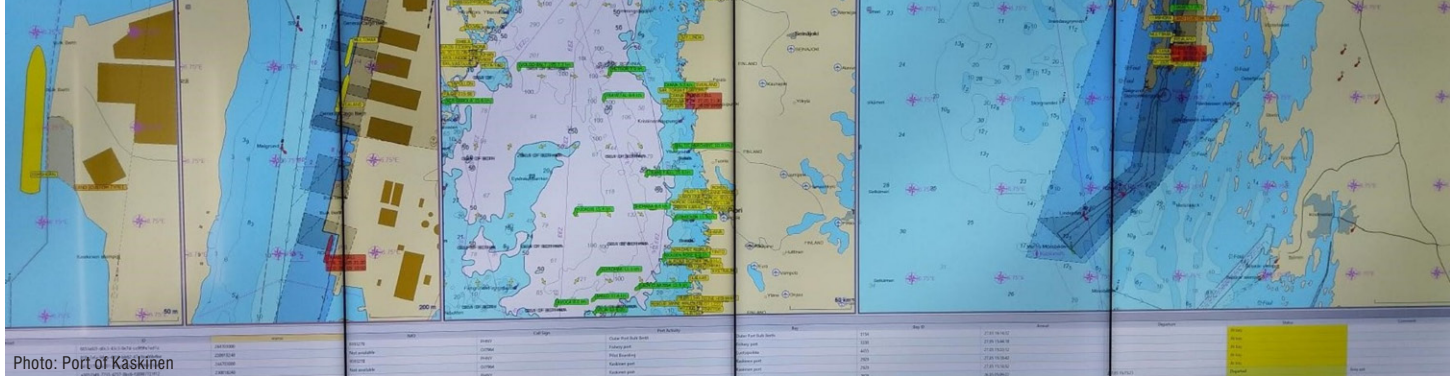
The robotic craft for port water research in Gdynia is part of the Monitoring and Observation System for Port Areas Using Floating Unmanned Mobile Research Platforms international R&D project. Its consortium consists of the Port of Gdynia Authority (the Project Lead), Gdańsk University of Technology, Gdynia Maritime University, the Norwegian Institute of Water Research, and the Asker-headquartered Miro AS (a tech company that specialises in measuring the ocean surface). The 1.6m project is sponsored by the Polish National Centre for Research and Development, with the funding support (1.25m) from the Norwegian Mechanism in its current perspective. The project's main objective is to determine the possibility of obtaining accreditation from state administration units for all research carried out using robotic surface platforms and creating recommendations for technical standardisation in this area.

The deep dive

The essential benefits expected to result from using the hydrodrone include an increase in the effectiveness of research work through the implementation, in cooperation with the Maritime Office and the Harbour Master's Office in Gdynia, of unified rules for the use of robotic platforms in port waters.

With the help of the hydrodrone (hopefully, an entire fleet in the future), we hope to ensure constant surveillance of port waters, including places difficult to access or dangerous for humans. We also want to expand the scope of observations of the marine environment thanks to measurements of water currents and waves together with their modelling, increasing the intensity of performing environmental research (even 24/7). The research will result in reports that will be an important contribution to the emerging legislation on floating robotic crafts.

The hydrodrone innovation fits the EU's policy on climate protection, including the sensitive Baltic waters, through implementing a pro-ecological monitoring system. It will also certainly boost the Port of Gdynia's know-how in ecology and innovation. This small, robotic vessel has truly proven to be an attractive alternative to the solutions used so far, especially concerning water research in difficult and dangerous to access places. ■



The digital logistics game

by Patrik Hellman, CEO, the Port of Kaskinen

“Digital” is the word of the (every)day. If you are not part of cyberspace, you are essentially pulling out the port development plug. Many Argonauts are sprinting for what seems to be the golden fleece of our times, irrespective of the industry involved, namely replacing the old way of management thinking with the future-attuned mindset. That and, of course, the right tools to walk the talk. However, the race is more of a marathon, requiring careful planning rather than rushing headlong into what was glittered by the silver-tongued marketing hotshot.

The goal might sound straightforward: to digitalise the operational and administrative works of a port. Yet, what are the most essential and valuable digital instruments to put into play? Is it all just ‘nice to have stuff,’ or can you better your port business with digitalisation, perhaps also lowering the carbon footprint for good measure?

The digitalised logistics game zone

The elephant-in-the-room-obstacle is the somewhat conservative and protective way of thinking, which still exists within the port sector. There is this fear of giving away too much information, “the family silverware,” instead of trying to understand the benefits of being with others part of an ‘open code,’ that is, putting those ‘knives and forks’ to exemplary work. The goal should be streamlining the A-to-B-to-C data chain, making this source open to everybody in the logistic ecosystem. Or the ecotech system, if you please. Getting that what-when-where-how full awareness, and even more, a way of simulating and predicting future

operations and movements should be something to strive for.

Let us use some imagination. What if the future business in shipping, road haulage, rail, airline, and port operations – the movement of goods – was a digital game run from different global and regional control centres, and the information stream was an open set of players and variables. The business – trading – would not be the business itself but a digitalised game zone. Almost like a casino or a strategy video/board game where you bet on certain events based on what you think will be the outcome. However, the difference would be in skill, not random luck, as true knowledge and experience with processing open logistic data would differentiate players. Ultimately, we would witness digital twins run by Artificial Intelligence (AI) playing with each other to sort out the best outcome of getting goods overseas. That way, perchance, we could avoid “canceling Christmas” because the global supply chain is, at present, ill-fortuned.

Why risk?

Sure thing, but maybe it starts to sound more of science-fiction than your daily glamourless logistics. Or does it? The ‘Big Picture Challenge’ is that there is

not enough accurate data on cargo movement, without distinction for the used transport mode – or ports for that matter.

It is common knowledge that vessels spend some 30% of their life cycle at quays instead of ploughing the seven seas. Naturally, ships have to berth to load or unload the freight; still, more often than not, they idle waiting for the goods to arrive, there is not enough service supply in the port, or because some black swan has decided to turn things on their head. Media coverage is packed to the brim about container ships stuck here and there, but tramp and bulk traffic are also plagued by subpar vessel-cargo alignment. Compare it to the airline business, where the ideal turnaround for aeroplanes is a maximum of two hours on the ground, with low-cost carriers staying for one hour (or even less).

Coordination and supply of land transport can add insult to injury, to mention the hunt for empty containers only. Weather is also a factor that can be rough to incorporate because of its unpredictability (surely, climate change won’t make things easier in this regard). Again, unprecedented events, long-standing as the current pandemic or one-offs such as the Ever Given incident, disrupt the logistics chains, shredding the schedules of ports, cargo



owners, and carriers. The impacts of the Suez Canal jam are still with us today.

Perhaps one should think of the logistic chain as a single entity comprising all chains – not just one item going from place A to B. It is, however, easier said than done, as the human factor comes into play. We cannot simply control all cargo or vessel movements as an agent, broker, or stevedore. We, therefore, end up concentrating on a few operations we can wrap our heads around. And since everybody is doing the same, we finish with relatively inefficient logistic chains. That is not all. Cargo owners and shippers are very reluctant to try to search for different or more competitive logistic routes. “Why risk a seems-to-be working system, when you do not have good enough information about the alternatives?” It shouldn’t be the way of thinking, in any case!

Back in the port, one focuses on the operative and administrative functions and how to digitalise them. The challenge is that the way things operate in a harbour is split up into many single operations or operative entities, each more or less siloed. Without having the whole ongoing picture, there is no complete understanding of the processes, thus integrating and making them digitally workable. Also, not every operation and process are worth digitalising – but you must see the forest through the trees to discern what-why-and-how will be better of by making it digital.

The most critical issues for ports are time and place. One wants to maximise berth, warehouses and storage area usage. You want to plan to be efficient since time is of great essence. The port needs to move the machinery as little as possible to save time and energy and minimise its carbon footprint. One also wants to know the (exact) arrival and departure times of vessels, vehicles, and cargo to effectively coordinate processes, including maximising the input of human resources.

A fairly long way to go

Sensor data, identification, and timestamps are the most valuable information in digitalising the logistic chain. Ideally, you would want to know in advance when the cargo is planned to leave point A heading for the port at point B – and when it leaves in real-time. Cargo owners or shippers would like to know when the vessel arrives, while the receiver at point C wouldn’t mind knowing when the delivery could be expected. Those handling the cargo at different stages within this process are busy wanting to know when it is their turn to do what, when, and where.

It is a complex system that is nowadays administrated via telephone and email or local communication modes. Somebody might still be using a telefax... As things stand today, the described mixture cannot be handled efficiently on a bigger scale. And that is why digitalisation will come in handy.

Unfortunately, there is not yet a fully-ready system that would ‘talk’ with everybody on the same level and share the information equally to anybody connected. There is no coherent approach to dealing with all these challenges. Every player is just learning to transform port management and cargo movements into a digital information stream. And even if there are many providers of digitalised systems, some specifically catering to ports and a few of them very much ahead of others, we still have a fairly long way to go. It goes beyond high-tech, too; there are many other third-party issues (think insurance policies, legislation, business protection rules, cybersecurity) in need of careful consideration.

The field in front of us is still full of unturned stones. AI and automated logistics chains? Reliable timetables? Widespread data sharing? Pure sci-fi? Brace yourself!

The fun begins

Honesty is the best practice, they say. That is why this read poured much cold

water on the transport & logistics status quo. It is because I firmly believe we are – should be! – going towards a digital and automated logistics ecotech system.

Yet, the system won’t set up itself; cooperation is pivotal. It isn’t very sensible if stakeholders are trying to gain a competitive advantage by developing closed systems. The intention behind it seems obscure – is it better service for the customers or tethering them so they will think twice before seeking an alternative? This way, we will achieve nothing, just repeating the past, but in a more refined, digitalised way.

There are steps taken with the Maritime Single Window and the Single Window Environment for Customs on the EU level. Several national and cross-border projects have picked the gauntlet of addressing data exchange for better freight traffic. There are the Finnish-Swedish EfficientFlow, Fintraffic’s Vessel Traffic Services, the recent teaming up of the Finnish next-gen logistics tech-pioneers Awake.AI and Youredi, or the fastest growing Finnish IT company Unikie whose PortActivity App is used in almost every port in Finland, to name but a few. Atop that sit solutions that enable even smaller ports to tap into the digital revolution: automated warehouses, digital twins, and terminal operating, traffic and port management systems.

Interestingly, getting that digital and automated logistics ecotech system online will be just the start. The fun with building specialised digital operative and administrative tools for the needs of a specific stakeholder, such as ports, will begin. Yet, no sooner than all 21st century Argonauts board the e-Argo. Let the game begin! ■



Biofouling tackled head-on

by Markus Hoffmann, *Technical Director, I-Tech*

Biofouling and the ways of tackling it encompass the full range of environmental challenges that shipping faces. Not only does it impact carbon emissions, but it also affects the spread of invasive species. Even the means to combat fouling itself are strictly regulated, given their effects on ecosystems. At the same time, finding the right coating for a vessel's operational profile is complex yet essential for efficient, cost-effective operations. It creates a complex puzzle for owners to solve – made all the harder by an altering regulatory environment and a literally changing climate.

In recent years, the need to take fouling more seriously has escalated. Increased risk from climate change, alongside a greater understanding of the damage fouling can impart, combined with the regulatory, societal and political pressure for shipping to reduce its environmental impact, have pushed the maritime industry to get more serious on the subject and find viable, long-term solutions. What are the main issues then, and where should owners start looking for answers?

'Hotspots' and the negative feedback loop

Biofouling and climate change are inextricably linked. Biofouling, especially what is commonly referred to as 'hard' fouling caused by shell-forming marine life, such as barnacles, causes some of the highest levels of hydrodynamic drag created by their volcano-shaped shells on vessel hulls. According to the research paper ***Economic impact of biofouling on a naval surface ship***, a vessel with just 10% barnacle coverage requires an increase in shaft power of 36% to maintain the same speed through the water compared to a ship free of hard fouling. It leads to higher fuel costs,

increased emissions, and reduced efficiency for many owners and operators.

A recent study from I-Tech and independent marine coating consultants from Safinah found that, out of 249 vessels surveyed, nearly every ship had a degree of underwater hull hard fouling. On 44% of the surveyed vessels, over 10% of the underwater hull surface was significantly covered with hard fouling to a level deemed by experts to cause an 'unacceptable' impact on performance. Approximately 25% of vessels displayed hard fouling coverage of between 10-30%, and the remaining vessels suffered much higher levels. It might mean there is at least an increase of 110mt of carbon emissions and \$6.0b spent on marine fuel per year (basing on the assumptions made by Michael P. Schultz in a 2012 paper that quantified the impact of biofouling on a naval frigate's shaft power requirements).

This high level of fouling is compounded by the fact that fouling hotspots are growing globally due to our environmental footprint causing rising temperatures. Warmer waters around the Mediterranean and Asian regions have long presented an added challenge for shipping's antifouling efforts, as warmer waters provide a better environment for fouling organisms to grow. With the 'hotspots' growing, so are the risks of biofouling.

It is clear that biofouling produces a negative feedback loop if not tackled head-on. Higher levels of hull fouling could equate to higher emissions; higher emissions could equate to increased carbon footprint; increased carbon footprint could equate to rising water temperatures. It is an issue that affects both the longer-term ability of shipping to meet climate goals and its day-to-day performance.

Niche areas and the risks of invasive species

Further data gathered and analysed by Safinah and I-Tech during a 2020 study shows that nearly every vessel poses a biosecurity threat, despite the uptake of advanced coatings that tackle hull biofouling.

A significant proportion of this biosecurity threat comes not from hard fouling on flat underwater surfaces but niche areas spread through a vessel's submerged structure, such as sea chests and gratings. Although the data is difficult to obtain, these areas could account for as much as 10% of the total underwater hull surface of the global shipping fleet.

The consequences of niche area fouling are multi-fold – and significant. For one, this type of biofouling can detrimentally impact the vessel's health and efficacy if it's allowed to accumulate without maintenance.

For example, fouling build-up in a sea chest can impact the functioning of box coolers, a vessel's water-cooling system. When heavy fouling occurs here, the box cooler's ability to control temperature can be compromised or even completely fail.

But perhaps most notably, biofouling in niche areas poses a significant biosecurity threat to marine ecosystems through its role in transporting invasive aquatic species. In some parts of the world, evidence suggests that 70-80% of invasive species introductions have occurred through biofouling. According to the International Maritime Organization (IMO), several studies have determined that vessel biofouling has been a comparable, if not more significant, factor to untreated ballast water for introducing invasive aquatic species.

A whole new standard for antifouling

Recent findings from the tanker *Calypso* clearly demonstrate a way around this and that the power of effective antifouling coatings cannot be underestimated, particularly where these 'hotspots' are becoming increasingly rife.

Calypso was painted on its vertical sides and bottom of the hull with a five-year copper-free antifouling product in November 2015 and embarked on a 63-month-long operation through heavily impacted fouling areas across global routes. In addition, the tanker remained static for over a month while waiting to dry dock, exposing the hull to a very high fouling risk.

The result of this operation is massively significant – for the vessel operator Team Tankers, I-Tech, whose active agent Selektope® was used to power the coating, and for the wider industry. Following over five years at sea, *Calypso* was carefully examined. Whereas the vessel showed a normal amount of wear after the period, it demonstrated zero barnacle growth across its hull, despite the duration of the period and the landscape in which the ship took its route.

Because of this, the vessel exhibited far lower than expected speed loss. Thanks to the use of the Selektope®-powered coating, *Calypso* displayed an average weighted speed loss of only -0.5%, providing a whole new standard for antifouling technology in maritime and combatting this hydrodynamic drag.

Regulations and the battle on biofouling

The increasing effectiveness of these coatings will play an essential role in helping owners to comply with a dizzying number

of new regulations. On climate and CO₂ emissions, as decided on IMO's Marine Environment Protection Committee June gathering this year, the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII) are the latest additions to these regulations. These could push antifouling coatings further into the conversation, as they mandate continuous improvements in terms of greenhouse gas emissions.

Owners and operators looking to meet energy efficiency and carbon emissions regulations may be required to turn to tactics such as slower speeds to help them do so. And indeed, it's likely to be one of the preferred responses to these new regulations for many owners. That, however, comes with complications: the slower a vessel travels, the easier it is for organisms to foul the hull and niche areas.

Aggravating matters, some coating technologies have reduced efficacy at these slower speeds, increasing the risk of fouling. Furthermore, fluid dynamics increase the importance of hull coatings at relatively low speeds. Viscous friction impacts performance at lower speeds more than wave friction, increasing the relative impact of coatings on performance. It's clear then that even though owners will need to think about how they operate, investing in coatings will be crucial in responding to EEXI and CII.

When it comes to the CII, aside from de-rating engines, the only other major way to approach the requirement is to invest in alternative fuels. We know these will be more expensive than conventional fuels, so investing in clean technology such as coatings remains a valid approach with real return on investment.

Similarly, regulations surrounding coatings themselves, and more specifically their compositions, complicate the matter of antifouling technology. Regionally and nationally, the industry is seeing increasing – and stringent – regulations surrounding biocides to protect the ecosystem and public health. These include, e.g., copper oxide, frequently found in antifouling coatings. Korea is clamping down on copper on the grounds of worker health, while the likes of California, Australia and New Zealand are limiting the amount of it in coatings out of environmental concerns.

At the same time, efforts to reduce invasive species and protect ecosystems are emerging at an increasing frequency. For one, port authorities in California have stated that all vessels of GT 300 or more

have been required to complete and submit a "Marine Invasive Species Program Annual Vessel Reporting Form" at least 24 hours before their first arrival of the calendar year at a Californian port. Ships must also present a Biofouling Management Plan and record all management actions in a Biofouling Record Book. In New Zealand, all international vessels arriving into the country must have a fully clean hull.

It is important to note that these regulations are likely to increase alongside the pressure put on shipping to reduce its environmental footprint, making it challenging for many coating manufacturers to ensure their product is viable, effective, and in line with these evolving requirements.

Selektope®, I-Tech's proprietary antifouling technology, is technically classified as a biocide but isn't a typical one due to its ability to repel species and fouling – where other biocides terminate. Because it's highly effective in small concentrations, it reduces the overall biocidal load of any coating to which it is added. One of the product's core advantages from a regulatory standpoint is the small quantities of Selektope® that are effective in the paint. The active agent only needs to be applied to coatings at 0.1% weight-for-weight – or a few grams per litre compared to 500-700g of cuprous oxide.

Tackling the issue effectively

Just like the maritime industry, all aspects of the biofouling landscape are changing continually. That is, besides one: our need to effectively tackle the issue. From the threat of invasive aquatic species on our ecosystems to the impact climate change has on the prevalence of fouling, antifouling technology will be instrumental in our collective efforts to reduce our environmental impact. ■



i-Tech is a Nasdaq First North Growth Market-listed bio-technology company based in Sweden. We develop, market, and sell the performance ingredient Selektope® for use in marine antifouling coatings. Visit i-tech.se to learn more.



The helping algorithm hand

by **Laurent Hentges**, *Vice-President Operational Excellence, Bureau Veritas Marine & Offshore*

Artificial Intelligence (AI) is changing our world in multiple ways, from enabling medical breakthroughs through powering industry robots to facilitating our daily lives through smart applications. Advancements in AI are also transforming the maritime industry, including how we detect and address corrosion on ships.

Corrosion is an insidious enemy for vessels, costing the global industry an estimated \$90bn to \$330bn a year (depending on the scope of calculations) in repairs, maintenance, and off-hire downtime. The cost of inaction is also high: if left untreated, corrosion can cause considerable damage to hulls, structures and tanks, impact the ship's integrity, and even force the owner to scrap the vessel early, thereby losing a major investment. Therefore, the capacity to detect corrosion at the earliest and carry out the necessary works at the right moment is key to ensuring the ship's optimal maintenance and minimising repair costs.

Classification surveyors play a key role in the important decisions about what repairs are required to maintain the hull's structural integrity. They assess the severity of corrosion through periodic surveys, monitoring its evolution during the vessel's entire life cycle to decide if and when steel needs replacing. Given the value of the investments at stake, they must make the right calls to protect their clients' assets in the long term.

Surveyors used to rely on their own eyes and experience to make these delicate decisions. Now a new tool is being added to their arsenal: AI. In the short term, it can support decisions made by surveyors by improving safety and enabling quicker assessments, especially in areas that are difficult to access. In the long run, AI has the potential to magnify our collective knowledge and experience.

Teaching an algorithm to detect corrosion

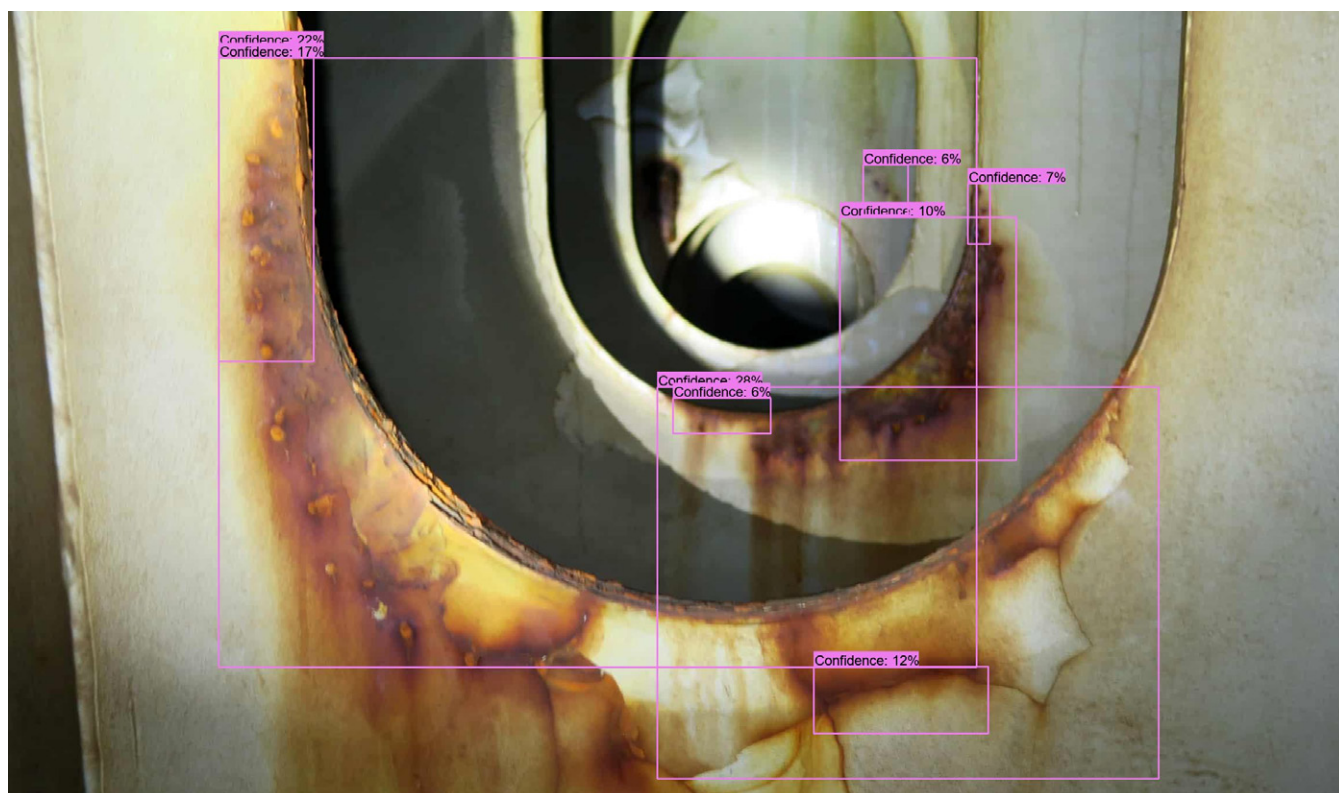
One area of AI is of particular interest for corrosion detection: deep learning. It is a type of machine learning in which artificial neural networks extract and process information from data, such as images, videos, or text. An algorithm learns to recognise patterns and solve complex problems through deep learning, just like a human brain. In our case, we taught it to detect, localise, and pre-assess corrosion in pictures.

We needed lots of data and the experts to curate and label it correctly to achieve that. Fortunately, we have both at Bureau Veritas. We trained the algorithm with tens of thousands of corrosion pictures from our dataset, built over decades of work by our surveyors. Our experts carefully labelled each image to indicate

the exact locations and nature of the corrosion. Over months of development, our algorithm has progressively learnt to identify, localise, and qualify corrosion.

While the algorithm might work perfectly in a lab, the real test was to know whether it could bring value in actual survey conditions. Here, a key factor is the capacity to use the AI solution in real-time and offline. After all, surveyors do not benefit from long hours in their offices to assess corrosion. They must make decisions on the spot during the inspection itself, often finding themselves in confined spaces with limited access to the Internet. It means even the most high-performing software would be of no use unless it can work offline and deliver information instantly in the field.

Another significant benefit of the AI software was the capacity to install it on a drone, which can be used live during the inspection and provide a view of areas that are otherwise difficult to access. Here, the role of the algorithm is to support the visual inspection led by the surveyor and reinforce their assessment, not to replace human judgement and decision-making. If the algorithm could recognise corrosion, bring the surveyor's attention to areas of interest, and provide all this support in real-time, the test could be called a success.



The moment of truth

Earlier this year, we carried out a real-life inspection of a water ballast tank on a bulk carrier in Dunkirk in collaboration with MaDfly Marine Drone Services. During the test, video footage of the tank was captured by an aerial drone and fed in real-time to the algorithm, which performed the calculations live.

The test met the highest expectations: not only did the algorithm correctly identify all the corroded parts, but the system could also run offline, without any connection to the Internet or mobile networks, which confirmed its flexibility for use in a variety of conditions.

Most importantly, our surveyors confirmed that the algorithm is a helpful tool for them. By highlighting problematic areas, it enabled them to make the most of their allocated inspection time. Moreover, the objective assessment provided by the AI will back their decisions and support their recommendations to clients on the necessary repairs and investments to their ships.

Collective intelligence

The potential of AI for corrosion detection does not stop there. Surveyors and shipowners can benefit from it alike. For example, the next step could be a self-assessment corrosion detection

tool that shipowners can use between formal surveys to better anticipate the repairs and optimise their assets' maintenance.

Ultimately, AI may also help optimise rules surrounding corrosion management. Deep learning can be used to connect more dots and find data-based patterns between the ship's design, structure and coating, the way it is operated (including routes, weather conditions, and maintenance efforts), and the resulting corrosion condition after a given amount of time. These insights may support our efforts to ensure that rules on corrosion margins, coatings, ship designs, and inspections reflect corrosion progression, helping shipowners protect their assets in the best possible way.

Beyond that, we hope that the algorithm will become a repository of knowledge that will endure for decades to come. Traditionally, surveyors have learned their profession through mentorship – by accompanying a senior colleague during inspections and learning from their experience. Like us humans, our algorithm will improve as it learns from the data and expertise provided by our surveyors. It will ensure that our team's formidable knowledge and expertise is preserved beyond this person-to-person shared learning, capturing what

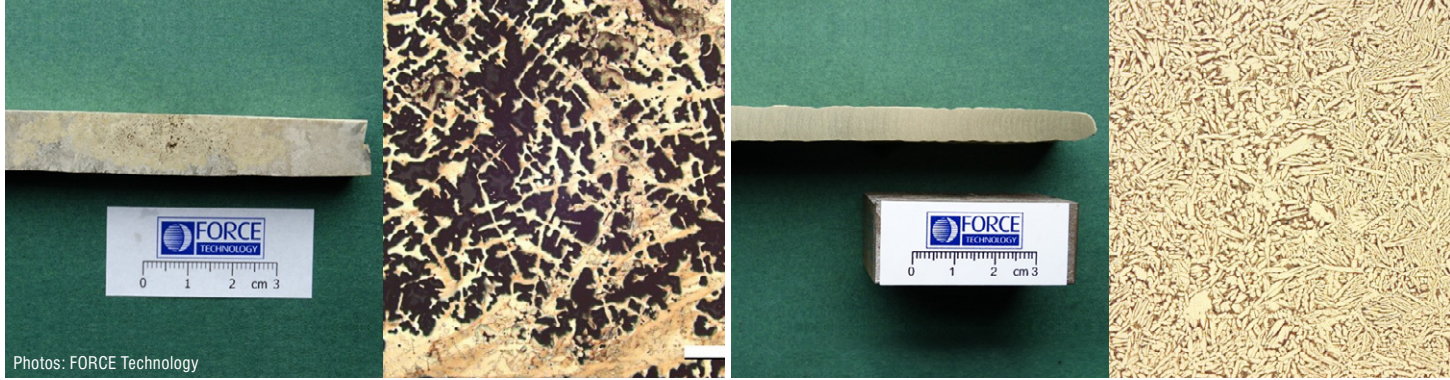
we call our collective intelligence and make it available for the next generations of surveyors.

In such a way, AI will take its place as part of the next generation of digital tools and techniques at the surveyor's disposal, becoming an integral element in our digital strategies that will shape the future of classification. ■



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Photos: FORCE Technology

Ready to compete

by **Peter Tommy Nielsen**, *Head of Department, 3D Print & AM Technology, FORCE Technology*

In the shipping industry, stagnation caused by wear, accidents, or other factors that put a ship out of service is a well-known expense driver. Often a repair service requires specialised and approved operations regulated by classification societies. Though costly, it makes perfect sense, as the best possible service should be applied to reduce the risks of failures outside the service intervals. The question is: can we do better?



FORCE Technology is a tech consultancy and service company that strives to create positive technological change and make the world more sustainable and safer. The company helps others become technological and sustainable frontrunners for the benefit of society. Each year, thousands of customers entrust us with their products, materials, structures, largest potentials or worst challenges since we create security and value based on impartiality, confidentiality, and knowledge. Go to forcetechnology.com to discover more.

We deal with three categories when viewing spare parts. First, the plug & play option, a ready-made spare part component (considered a consumable good to a certain extent). Second, there are high value and 'large' spare part components often manufactured when needed (in some cases, the piece is ready, just in case, due to insurance purposes). Here, refurbishment is possible if the timeline and expected quality allow it or the specified material isn't available. Third, extensive service that includes several parts of the two above.

Imagine

Highly skilled service companies take care of these categories. Although strategically placed worldwide, one still might find the locations 'too distant,' by which we mean service accessibility, material availability, costs, or timeline. Moreover, considering that the typically accepted manufacturing method is based on subtractive technologies, such as turning and milling, it also implies that a larger workpiece should be available. This setup will result in the 'production' of scrap. In other words, these solutions work; yet, there is room for fine-tuning.

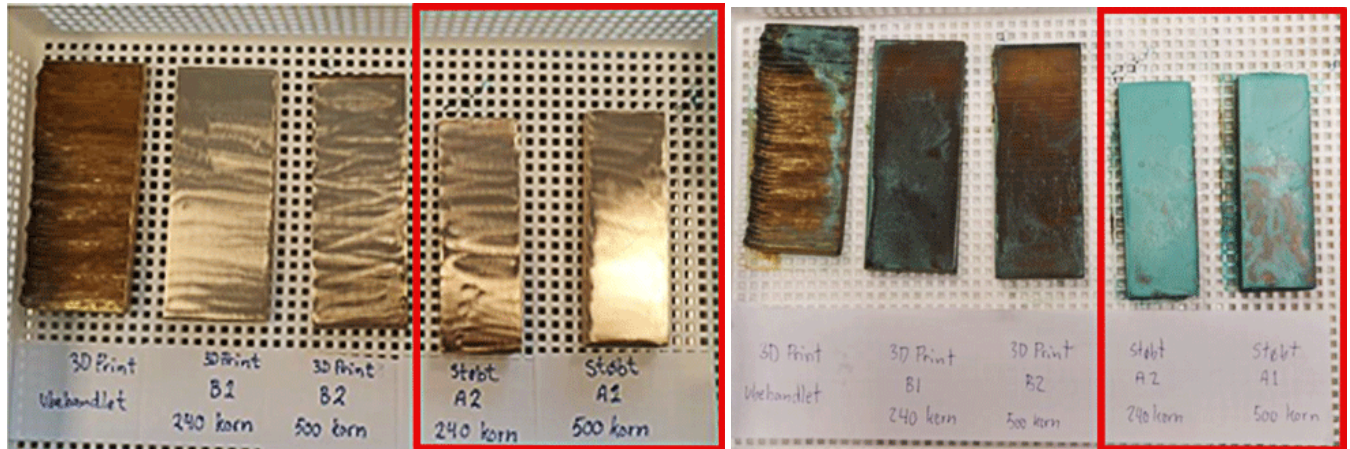
Imagine a manufacturing world where all critical components and wear parts

are stored as 3D files in the cloud. These blueprints can be downloaded by appointed and qualified additive manufacturing shops, printing the pieces on demand and precisely when the replacements are needed. Think of a print machine that only requires a 3D drawing and build material in the form of wire or powder, which you can shape according to your specific needs.

Additive manufacturing is not limited to polymer materials or space industry applications (or just for the fun of it). Thanks to its flexibility and efficiency (read: lower costs and lead times, plus local availability), 3D printing is a growing market. At FORCE Technology, we have scrutinised many different cases over the past couple of years. For example, print production of a 7.0 kg component for an F35 jet fighter showed reduced material consumption and time of production in the 90% parallel with acceptable quality.

3D printing vs traditional casting

Another study by FORCE Technology compared the wire arc additive manufacturing (WAAM) technology directly with traditional casting. As a production method, WAAM has been known since the 1920s. Today, the technique is utilised with CAD files and a robotic arm,



quite a novel combination. WAAM is well-suited for large-scale components, meaning production isn't limited by space but by the robot's reach.

The work focused on propeller blade manufacturing in aluminium bronze (as propeller blades are already a subject of repairs). We included a bronze cast for direct quality comparison purposes. For casting, the requirements for processing propeller blades include raw material, a crucible, a mould, and post-processing. For 3D printing: wire material, a welding machine, a robot, and post-processing. Although casting has been used for thousands of years, while 3D printing is a new technology, the study delivered compelling findings favouring the 'newcomer.'

The images show three printed propeller blade samples (left) and two cast samples (right). The latter received some surface finishing, while the former set was taken right out of the 3D printer. Next, we exposed all samples to the same salt mist procedure. As can be seen in the bottom picture, the printed pieces experienced mild oxidation. The oxidation would have been even less if the samples had been subject to surface finishing. The cast samples experienced strong oxidation, independent of surface finishing.

The mechanical properties of the cast and printed samples also showed remarkable differences. Due to defect formation during the casting process, the cast samples did not meet the mechanical properties stated in the standard for the material. The 3D-printed samples, to the contrary, obtained values that were very close to the standard material. The propeller blade samples' visual appearance and microstructure differed notably (left image – cast, right – 3D-printed).

Best of both worlds?

On top of the significant quality benefits, 3D printing is often a more cost-efficient alternative to casting. Additive manufacturing can yield direct production savings compared to casting since there is no need to create and maintain a mould. Furthermore, it can grant a higher degree of design freedom. Finally, 3D printing optimises resource use, with printing powder often made of recycled material.

Looking ahead, working with welding-based additive technologies, hybrid manufacturing – the combination of traditional and additive manufacturing – isn't something unthinkable. Mastering this method would allow for building special features on a turned shaft, saving heaps of material. ■



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