Unique opportunity for design innovation

DECARBONISATION International shipping faces an unprecedented challenge as it prepares for rapid decarbonisation and the adoption of entirely new marine fuels within one or two ship generations. With most ship construction capacity now centred in Asia, the continent's shipbuilders have a unique opportunity to design and develop ships incorporating the latest propulsion technologies, new digital operating networks, and future-proofed systems that offer instant appeal to owners, writes freelance journalist Paul Bartlett.

The environmentally friendly E-Flexer *Stena Embla* was built in China

Source: Stena RoRo

According to statistics from Clarkson Research, the world order book in January consisted of 2,735 ships representing almost 70 million compensated gross tons (cgt), a measure that accounts for the construction complexity of different ship types. The numbers reveal a rapid decline from contracts held by shipbuilders one year earlier. At the beginning of 2020, Clarkson recorded 3,376 ships on order, totalling 81.5 million cgt.

Covid-19 has had a dramatic impact both on new contracting and, at many shipyards, productivity and output. The London analysts estimate that the world order book is now equivalent to a little more than 8% of the world fleet and would have been significantly below this figure without an upturn in LNG and container ship contracting in the last quarter of 2020.

Although there is nothing new about the concentration of newbuilding activity in Asia, global ship construction is becoming even more Asia-centric. European yards will continue to attract contracts for small, specialised vessels in the offshore and renewable energy sectors, for example, and other types of service vessels. And European equipment providers will continue to provide essential maritime components and digital systems. But the workhorses of sea transport – bulkers, tankers and container ships – will continue to be built mostly in Asia for the foreseeable future. ›

› ASIA IN NUMBERS

In January, Clarkson figures reveal that Chinese yards held pole position, with 1,245 ships of 24.6 million cgt on order there. South Korean builders came second – with 452 ships representing 21.9 million cgt. And Japanese yards held third place – with 433 ships of 8.4 million cgt. Between them, shipbuilders in these three countries held almost 79% of the total world order book, compared with Europe's 16%, comprising mostly cruise ships.

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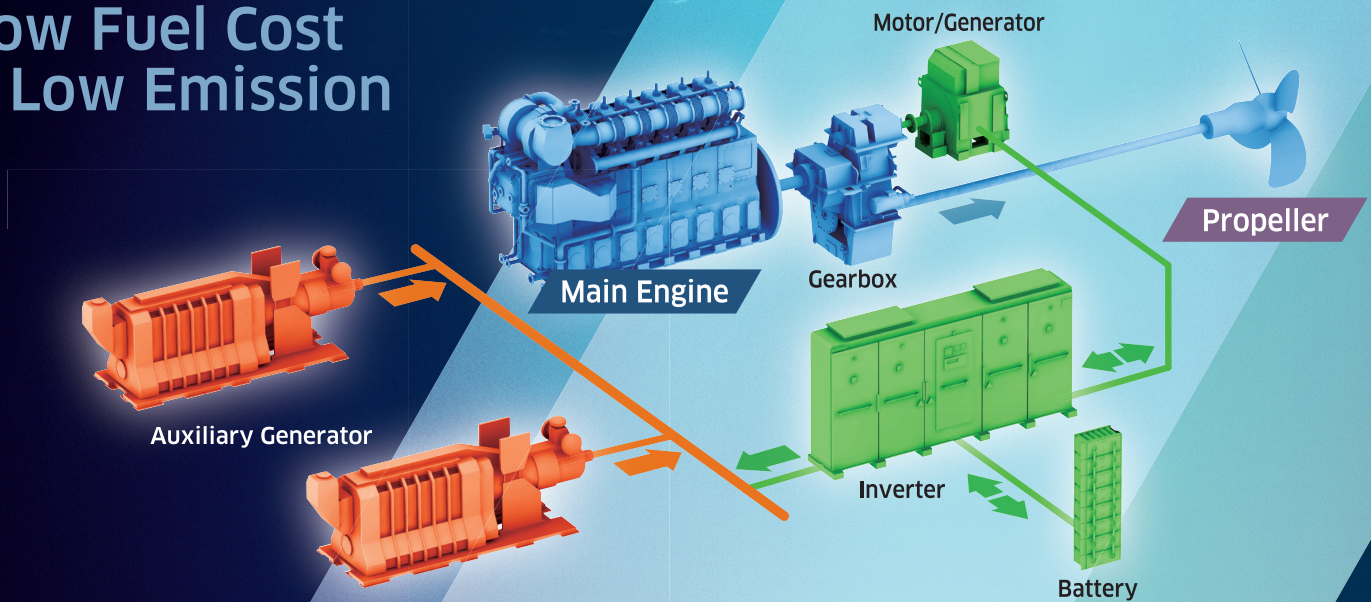

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Mega-carriers to be built in South Korea

One good example is Hapag-Lloyd's order of six ultra-large container vessels of 23,500 TEU from South Korean yard Daewoo Shipbuilding & Marine Engineering (DSME) at a cost of about USD 1 billion. The LNG/dual-fuel vessels are due for delivery between April and December 2023. MAN Energy Solutions is to supply dual-fuel MAN B&W 11G95ME-GI Mk 10.5 main engines for the ships.

LNG paves the way

It is the shipbuilders in these countries that hold the key to innovative ship design as

Meanwhile LNG is gaining ground as a transition fuel, helping to advance cryogenic technology and pave the way for new low or zero-carbon add-in fuels including biogas and synthetic LNG.

Measuring economic benefits

Writing in these pages a few months ago, economist Dr Martin Stopford remarked on the fact that, as yet, it is almost impossible to assess the true economic benefit of an energy-saving investment. "In the case of zero carbon, the problem is that, anomalously, carbon does not have a price," he wrote. "Scientists tell us carbon emissions will have an enormous cost, due to climate change. But that cost is not reflected in a price that can be used by shipping companies and equipment manufacturers to evaluate investment."

Stopford was assessing the challenge of what to do with 60,000 existing cargo ships and another 40,000-odd service vessels that need to become more carbon-efficient between now and 2030. Even before MEPC 75, at which new regulations for existing ships were agreed in principle, he described the existing fleet as a "floating laboratory" to test a range of new energy-saving technologies here and now.

However, his argument applies equally well to the new ships that will be built in the next few years and will operate for at least another two decades. While the existing fleet provides a means by which the IMO's 2030 waypoint can be reached, it does not provide a basis for arriving at the ultimate destination in 2050. For that, one or perhaps two generations of entirely new ships, incorporating new design and operating concepts, will be required.

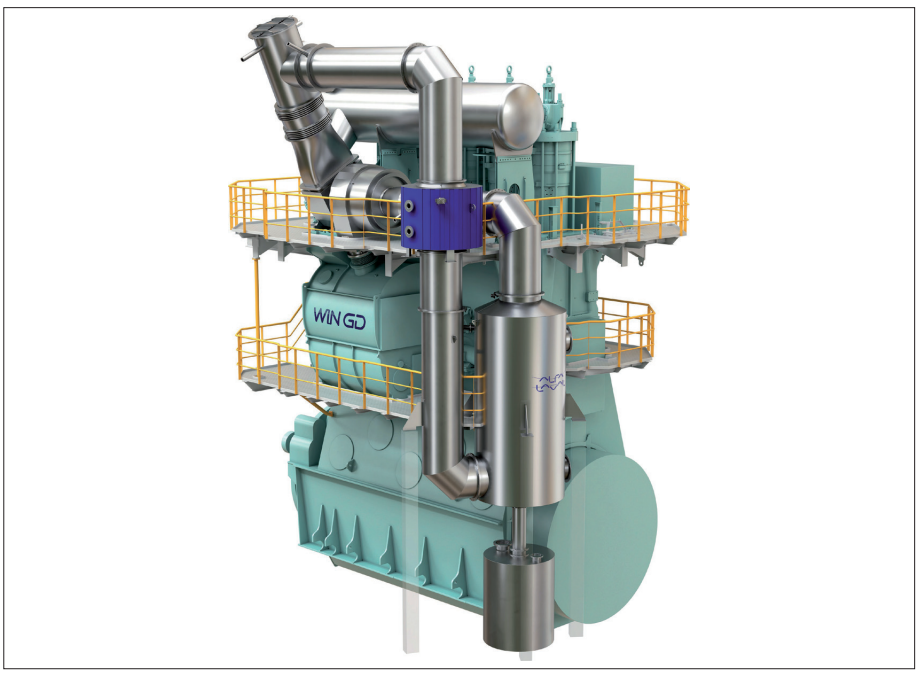
Dr Stopford has also commented on this, and the opportunities that lie ahead for ship designers and builders. He has proclaimed that fundamental ship design has barely changed in decades, noting the marked contrast with progress in vehicle design which has fully embraced the benefits of digital technology and integrated control systems.

Ships, of course, are far more complex than vehicles and must operate with complete reliability in remote seas and conditions which, for most of us, are sometimes unimaginable. However, the point remains that apart from some specialised high-end vessels in the subsea, heavy-lift, wind support and survey sectors, for example, standard cargo ships including bulk carriers and tankers have not changed much in decades. Experts believe there is significant scope to raise both fuel efficiency and the productivity of ships themselves.

The Stena E-Flexers

A good example of this is Stena RoRo's E-Flexer RoPax vessels, up to eleven of which have been ordered at China Merchants Jinling Shipyard (Weihai) Co Ltd (CMJS),

With a capacity of 19,900 TEU, the *Barzan* is already a container giant. But Hapag Lloyd's new ultra-large vessels will reduce slot costs further and improve competitiveness on the Europe – Far East trade Source: Hapag-Lloyd



Last summer, WinGD unveiled a new technology designed to slash methane emissions and cut fuel consumption in its X-DF dual-fuel engines Source: WinGD

formerly AVIC Weihai Shipyard Co. The name E-Flexer was chosen to reflect two principal design objectives – efficiency and flexibility.

The ships that have already entered service for three separate RoRo operators demonstrate these qualities, with optimised hulls designed by Deltamarin, thruster openings shaped to reduce drag and stern lines drawn to minimise wave-making. Two engines provide power to two propellers and at speeds of less than 18 knots, only one is required, with the other left feathering, to minimise resistance.

Deployed on both short crossings and longer routes taking almost a day, the ships are said to be about 50% more efficient than other RoPax vessels of similar size. The most recent delivery, *Stena Embla*, completed its delivery voyage in January and is now deployed on the Irish Sea for Stena RoRo, operating between Liverpool and Belfast.

Meanwhile Stena Line has announced plans to have two zero-carbon ferries in operation between Gothenburg and Frederikshavn by 2030. The project is being undertaken jointly with the Volvo Group, Scania, and the Port of Gothenburg as part of the Tranzero Initiative that aims to cut 2030 port emissions there by 70%. A Stena spokesman said it was too early to discuss possible shipyards but confirmed that Stena RoRo had been "very positive" about the Chinese shipyard's efficiency on the E-Flexer project.

Regulations open up opportunities

Despite the 2020 downturn in orders, Asian shipyards are in a fortunate position. Both the short- and long-term decarbonisation journeys will fuel demand for more sustainable new designs. In the short run, the IMO's energy efficiency existing ship index (EEXI) and carbon intensity indicator (CII) are likely to lead to the phase-out of a significant number of older ships. DNV has estimated that around 80% of existing vessels will require steps to comply with these regulations and, for older ships, the economics may become dubious.

In the longer term, new ships built with hybrid energy systems, possibly incorporating batteries and fuel cells, will have to be introduced. There are already a range of pilot projects under way, both among high-tech European companies such as ABB, MAN Energy Solutions, Wärtsilä and WinGD, but also among some shipbuilders and design outfits in Asia.

Illustration of the zero-emissions electric e5 tanker currently under construction at KHI

Illustration of the LPG dual-fuel VLGC

Source: NYK

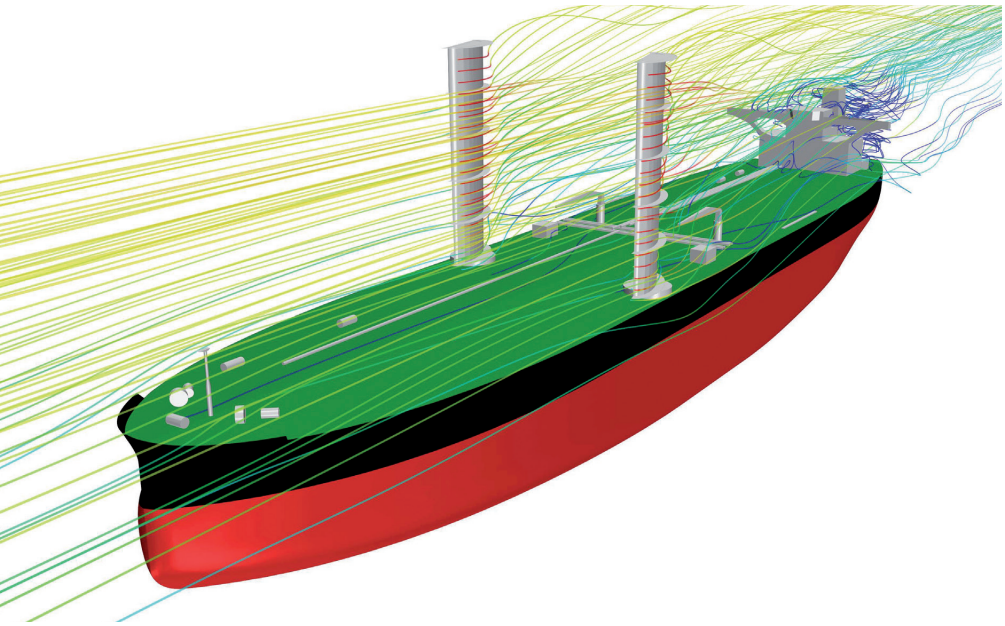
Pilot projects in Asia

Mitsubishi Shipbuilding Co. Ltd, "K" Line, and ClassNK, are currently developing the world's first small-scale CO_2 capture demonstration plant for possible marine applications. Supported by Japan's Ministry of Land, Infrastructure, Transport and Tourism, the project participants aim to have the plant built by the middle of this year.

Following tests ashore, the system will then be installed on board a coal carrier, operated by "K" Line for Tohoku Electric Power Co. The partners are hoping that the captured CO_2 will be recycled and used either for enhanced oil recovery or as a raw material in synthetic fuel, providing a boost to reducing GHG emissions.

Meanwhile, Kawasaki Heavy Industries (KHI) has chosen an energy storage system from Corvus Energy for the first zero-emissions electric tanker currently being built for Asahi Tanker Co Ltd of Tokyo, which operates a fleet of 137 ships. KHI was awarded the contract for the tanker's propulsion system last September and plans to integrate a 3,480-kWh battery pack into the tanker's propulsion system.

The bunker tanker, one of two vessels, is likely to be commissioned in Tokyo Bay next year. The ships have been designed by e5 Lab Inc, a consortium of Japanese maritime companies established to build infrastructure services based on ›



Rendering of a VLCC with the wings sails in place Source: KSOE

electric vessels, and are being built at Koa industry Co and Imura Shipyard Co.

As reported in a statement from Asahi Tanker, the e5 tanker will achieve zero emissions of CO_2, NOx, SOx, and particulates, dramatically reducing environmental impact. In addition, reduced noise and vibration will create a more comfortable work environment for crew members and limit noise pollution in Tokyo Bay and its surroundings. Furthermore, the vessel will make its battery power available to emergency services in the case of a natural disaster in Tokyo. This idea was originally proposed by e5 Lab and Asahi Tanker.

Kawasaki has other emissions reduction projects under way and is incorporating efficiency features into its latest designs. In January, the company delivered the 81,000dwt panamax bulk carrier, *Izumi*, to Wealth Line Inc. Built at its joint venture shipyard with Cosco in China – Nantong Cosco KHI Ship Engineering Co. Ltd. (NACKS) – the bulk carrier delivery comes four months after a similar vessel, *Energy Cosmos*, was delivered to Misuga S.A.

Both ships incorporate a range of energy-saving features including an electronically controlled MAN B&W 6S60ME-C8.5 engine, high efficiency propellers, and the Kawasaki rudder bulb system with fins and semi-duct system with contra-fins, all of which aid propulsive efficiency. The ships have a service speed of about 14 knots and are classed by Lloyd's Register.

Furthermore, the shipyard has received an order from Japanese shipping group NYK for two liquefied petroleum gas (LPG) dual-fuelled very large gas carriers (VLGCs). The newbuildings will be 230m long and 37.2m wide. Tank capacity will be about 86,500m^3 including an on-deck fuel tank capacity of 2,500m^3. By equipping the ships with LPG tanks on deck, it will be possible to load LPG for fuel separately from the LPG cargo. Having the LPG tanks on deck also extends the cruising range of the vessel when LPG fuel is used even though the size of the vessel remains the same.

China's Shanghai Merchant Ship Design and Research Institute (SDARI) has various initiatives in progress. These include a joint development project (JDP) with Italian classification society, RINA, to develop a ship capable of operating on either ammonia or methanol. MAN Energy Solutions is supporting the project, which will initially focus on a tanker design. However, the partners said that the initiative will increase understanding of the application of both fuels in shipping, with opportunities to apply them to other ship types in future.

In another JDP with German dry bulk owner Oldendorff Carriers, Lloyd's Register, Anemoi Marine Technologies and SDARI will assist in the development of wind-assisted propulsion systems for installation on bulk carriers. Rotor sails are likely to be fitted to an existing Oldendorff carrier but SDARI will assess ways in which power from the wind may be incorporated into new ship designs of the future.

Commenting on the project, Oldendorff's director of Innovation, Torsten Barenthin, noted that this is one of several projects assessing the development and application of green technologies across the company's fleet. "By partnering with the ship designer (SDARI), manufacturer (Anemoi) and classification society, Oldendorff Carriers seeks to achieve a comprehensive functional application of wind technology that returns environmental and commercial benefits throughout our vessels' entire lifecycle," he said.

Approval in principle of wing sail design

Another example of wind-assisted propulsion system is the auxiliary propulsion wing-sail system developed by Korea Shipbuilding and Offshore Engineering (KSOE) and Seoul-headquartered SK Shipping that has been awarded Approval in Principle (AiP) by classification society DNV.

The 20m-wide wing sails, with a height of 50m, are installed vertically on both sides of a ship's deck. Suitable for many vessel types, the wings are rotated by wind intensity and direction to generate additional propulsive thrust. They can be lowered to just 10m in height in bad weather, for example, or when subject to air draught constraints.

Head of Future Ship Research at KSOE, Hyunjoon Shin, said: "We are speeding up efforts to bring eco-friendly technologies to the market. The wing sail system will reduce fuel consumption by more than 6%. We will take the lead in the next-generation ship market and continue to strengthen our technological competitiveness."

SK Shipping vice president, Haeyong Son added that this promising technology would provide shipowners with new opportunities to tackle carbon emissions and meet IMO standards.

Not only has DNV recently developed a standard for certification of wind-assisted propulsion systems, but it has also adopted a new class notation – WAPS (Wind Assisted Propulsion System). The AiP could well prove to be a significant step towards the award of this notation for the first time.

While these and other initiatives to raise energy efficiency and reduce GHG emissions are to be commended, many are still largely at a pilot stage. Experts say that there is no time to lose on the large-scale development and introduction of innovative new ship designs by designers and builders across all of the main ship sectors.