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Decarbonisation

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Decarbonisation

Fuel options are slim and future regulations uncertain as shipping maps its course to decarbonisation, leaving companies with few good choices. Collaboration, efficiency and flexibility will be vital, but shipping has its work cut out to become carbon-free come 2050.

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Published by Informa UK Ltd.

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Making sense of decarbonisation

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The ships that carry around 90% of everything must find something to run on without emitting carbon dioxide and its equivalent GHGs.

The gulf between action needed to decarbonise shipping and regulations to drive transition is vast — but with the right mix, it can be achieved, **Declan Bush** reports

Shipping has about eight years to set its course for success or failure on the path to decarbonisation.

The defining challenge of the next half-century will force innovation and uproot business practices, some of which have not changed in centuries.

Grand ambition must match precise detail if the job is to be done properly — and decisions taken now will matter.

It is, at once, simple and fiendishly complex. The ships that carry around 90% of everything must find something to run on without emitting carbon dioxide and its equivalent greenhouse gases.

Charles Haskell, programme manager at Lloyd's Register's Maritime Decarbonisation Hub, says the industry has resolved to act, with companies now asking: "How much do I have to pay? How easy will it be to convert?"

"There's more intent on a number of projects to actually be truly ready," he says, adding the pressure will only get stronger as customers demand greener products.

Regulation is the first step. The International Maritime Organization must regulate to push up the price of fossil fuels above that of zero-carbon fuels without bankrupting the industry.

Anyone familiar with the IMO will know how slow and bureaucratic the process is. Yet there are signs it is increasingly agreed on at least the need for a market-based measure, if not how it will work.

"The thing that I find so encouraging is how the nature of the transition for which these policies need to be designed is pretty universally accepted," says Tristan Smith, director of green consultancy University Maritime Advisory Services.

"I think the remarkable convergence of that in a relatively short period of time is very impressive."

While high-level talks focus on carbon levies and fairness to poor countries, shipping companies will wrestle with incoming short-term efficiency regulations — which, because of their design, will create compliance headaches while doing little for the planet.

Reed Smith partner Nick Austin says this is "an immense compliance task", while scientists predict "business as usual", with no cuts to emissions.

The IMO will probably produce a mid-term regulation between 2025 and 2030, sources predict.

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It is likely to be influenced by the shape of the EU's Fit for 55 climate package, which will soon include shipping in the emissions trading scheme and limit the carbon content of marine fuels.

Like any product of global compromise, the IMO's mid-term measure will not be perfect. Yet it does not need to be if it works and is fair to poorer states.

Chinese plan

A critical voice is that of China, a huge industrial and financial force in shipping that has so far taken a back seat to — and often voted against — green initiatives.

However, the country has proposed a market-based emissions plan, and its companies are also signaling greater engagement.

The IMO has five such plans in front of it, and must choose one in the next two or three years for further development.

It is likely to be either a carbon levy or a cap-and-trade scheme combined with a low-greenhouse gas fuel standard.

Countries and the industry disagree over which is best. Companies will back anything that works.

The biggest questions are what greenhouse gases should cost and how much revenue should be spent helping poor countries cope with the costs of global warming.

The piles of money raised by such a regulation must then be used to find out which fuels work and where.

Shipping must go from cheap, plentiful and universally available fuel to something costlier and scarcer.

Green ammonia and methanol look like the top candidates if shipping can get enough of them — which is far from certain.

The IMO will probably produce a mid-term regulation between 2025 and 2030.

Drop-in synthetic hydrocarbons like e-methanol and e-LNG will be more expensive to make than hydrogen and ammonia, because the carbon molecule will have to come from somewhere.

However, the industry may decide to pay for costlier fuel in exchange for peace of mind while fundamental concerns about hydrogen and ammonia's safety and sustainability are answered.

As more ships run on fossil LNG, the fuel will continue to dominate the debate. Producers must overcome technical challenges, such as its planet-warming methane emissions in the long term, and high prices in the short term.

Underpinning everything is the need for a seismic increase in renewable electricity production. Shipping will need about as much renewable power as is produced worldwide at present, according to a recent study for the International Chamber of Shipping. That is no mean feat.

States, companies and classification societies are already looking at the most feasible early routes and future fuels.

To this end, green corridors offer much promise. Yet, like any voluntary scheme, they will suffer from a lack of funding and enforceability. Expect fights at a national and international level over what is and is not green.

Groups like the Global Maritime Forum have mapped how to make 5% of fuels zero-emission by 2030. They argue that whatever shipping can demonstrate, it can later replicate.

Efficient and flexible

In the meantime, shipping companies should make their fleets as efficient and flexible as possible. Those that can order ships with the option to convert to methanol or ammonia should do so.

The once-niche field of efficiency technologies such as antifouling coatings, wind power and route optimisation is gaining more interest as shipowners seek small efficiency gains. These technologies are promising but remain a tough sell.

As with digitalisation and sanctions compliance, more transparency and co-operation within the industry would be a plus.

"Where we are seeing the uptake of some of these technologies, is where we're seeing a lot more collaboration between the charterers and the shipowners," Mr Haskell says.

> *"Where we are seeing the uptake of some of these technologies, is where we're seeing a lot more collaboration between the charters and the shipowners"*

Charles Haskell
Programme manager
Lloyd's Register's Maritime Decarbonisation Hub

Shipping must also choose between a steeper curve, which starts lax and get stricter over time, or more pain now for less pain later.

An industry in need of up to $2trn for full decarbonisation will struggle to find it. Private finance to the industry has dried up in recent years and it is hard to see where this funding will come from.

However, governments — many of which are used to helping prop up their respective maritime industries as a symbol of national pride — can help by guaranteeing green investments.

Rare advantage

All heavy industries must decarbonise to keep global warming below 1.5C. Shipping, though, has one rare advantage: a legal mechanism to do the job.

"We have a binding treaty. Whatever we agree to by amending Marpol is legally binding on the parties and signatories, and that is a hugely powerful tool," says Bryan Comer, shipping lead at the International Council on Clean Transportation.

Such a tool is scarce in international policy, he adds.

Whichever fuel shipping adopts will depend in part on what is available, driven by factors on land. Yet Dr Comer says it can also help drive demand for different fuels.

"Some 40% of the stuff we move by ship is fossil fuel itself, so there's plenty of interaction between what's going on the water, what's happening on land, and the global transition to zero," he says.

No one technology, regulation, person or company can make this happen alone. The fragmented shipping industry must establish a means of working in sync and in the most efficient way.

Untried technologies

Big shipowners will take risks on untried technologies. They must be more transparent so smaller companies and poorer countries can make the transition together.

Governments, big cargo interests and financiers used to ignoring shipping will have to bring it back into thinking if they are to cover all their supply-chain emissions.

Dr Comer says shipping will use more than its share of the global carbon budget — and its decarbonisation curve will be bumpy.

"I think zero by 2050 is achievable. I think we could actually get there," he says, but adds: "We have our work cut out for us."

Helen Tolokonova /Alamy Stock Photo

Underpinning everything is the need for a seismic increase in renewable electricity production. Shipping will need as much renewable power as is produced worldwide.

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> International Council on Clean Transportation

CMA CGM

Container carrier CMA CGM is betting on liquefied natural gas, hoping to use synthetic methane in the same engines in the future.

The hidden cost of 'drop-in' future fuels

Synthetic LNG or methanol will cost more than hydrogen and ammonia, but will be easier to live with; which path will prevail is still an open question, **Declan Bush** reports

Nothing combines power, cost and convenience quite like fossil fuels. Their low-carbon alternatives — which shipping desperately needs — will be weaker, and often more dangerous.

Biofuels will help some companies in the medium term. However, these will become increasingly scarce and costly to scale up as competition from other industries, such as aviation, rises.

That leaves e-fuels, made by using renewable electricity to split hydrogen from water in an electrolyser.

Hydrogen can either be used by itself or to make ammonia, which is easier to store — albeit highly toxic. Alternatively, carbon can be added to make synthetic methane or methanol.

These synthetic hydrocarbons are attractive because ships can already run on them.

Maersk has gone for methanol, with 13 ships on order.

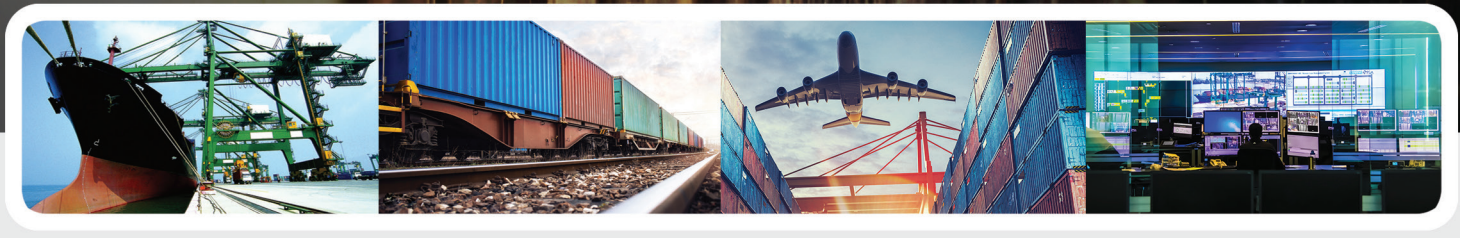
Rival European container carrier CMA CGM, meanwhile, is betting on liquefied natural gas, hoping to use synthetic methane in the same engines in the future.

Yet while the world struggles with too much CO_2, synthetic fuel producers may have the opposite problem.

"We could face a future where carbon will actually be a scarce commodity," says Brian Sørensen, head of two-stroke research and development at engine manufacturer MAN Energy Solutions.

"Ammonia has the potential to actually be the cheapest fuel to produce."

Katharine Palmer, the UN Framework Convention on Climate Change shipping lead, says if the fuel still contains a carbon molecule, "it's going to be naturally more expensive because you need to get that carbon from somewhere".



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This is because carbon capture — especially direct-air capture, where you suck CO2 from the sky — is experimental and has a dismal record. More than 80% of commercial carbon-capture projects have failed, a 2020 study found.

"The technology needed to capture the carbon is not as mature as, say, the technology needed to produce green hydrogen," Ms Palmer adds.

University Maritime Advisory Services director Tristan Smith says while the costs of ammonia and hydrogen will be huge, these are easier to predict than carbon-based fuels.

He says those opting for synthetic hydrocarbons are placing "a massive bet" on a technology in which the Intergovernmental Panel on Climate Change has little confidence.

"I don't think anyone has pulled this into the fuels discussion," Dr Smith says.

Conversion costs

Alexandra Ebbinghaus, general manager for decarbonisation at Shell Marine, says each time you convert one molecule into another — from electricity to hydrogen, then to methanol or e-LNG — it adds cost.

"All the technology steps are known, but none are scaled up and the energy efficiency of that process is probably less than 20%," she says.

Ms Ebbinghaus adds that the falling cost of renewable power could make synthetic carbon fuels with direct-air capture more competitive.

"But it's still always going to be more expensive than just using hydrogen or ammonia."

So, why not just do that?

The drawbacks of hydrogen and ammonia are well documented. They are less energy-dense, so take up much more space on board the vessel. Hydrogen is explosive and must be cooled to -253degC.

> *We could face a future where carbon will actually be a scarce commodity. Ammonia has the potential to actually be the cheapest fuel to produce*

Brian Sørensen
Head of two-stroke R&D
MAN Energy Solutions

While ammonia is zero-carbon and does not need to be kept so cold, it weighs twice as much as fuel oil, taking up three times as much space. It is also highly toxic, so requires more safeguards in its use and bunkering.

What's more, ammonia is a poor fuel to burn.

Inefficient combustion of the stuff results in nitrogen oxides (NOx), while more efficient combustion (through hotter burning) produces nitrous oxide (N2O), a greenhouse gas 300 times stronger than CO2.

"When you have a fuel that has a low energy density, and then an inefficient combustion, and then additional costs and inefficiencies associated with the exhaust gas after-treatment, the whole thing may require even more fuel than synthetic methanol or methane," Ms Ebbinghaus says.

> *The technology needed to capture the carbon is not as mature as, say, the technology needed to produce green hydrogen*

Katharine Palmer
Shipping lead
UNFCC high-level climate champions

With e-LNG, there is another problem: methane slip, the fugitive emissions of unburned methane, a greenhouse gas 30 times stronger than CO2. Environmentalists argue this renders LNG ships worse for the climate than heavy fuel oil.

Better engines and after-treatments are hoped to reduce the problem, but it is not solved yet. And it does not go away if the LNG in the engine is the green sort.

For Maersk, the choice came down to ammonia or methanol, which takes twice the space of fuel oil on board but is much easier to handle.

"It's hard for us to see why we would make hydrogen to e-LNG instead of e-methanol, because you will still need the carbon molecule and end up with a gas that has methane emissions," says head of decarbonisation innovation Jacob Sterling.

Mr Sterling says ammonia will work out cheaper than methanol in the long term, barring dramatic improvements in direct air capture of CO2.

Operating costs

Yet the price difference will depend on the various inputs — and the operating costs of methanol will be cheaper, since it is easier to handle and does not have to be kept cold.

Maersk wants to halve its emissions per container shipped by 2030, but the first ammonia engines will not be ready until 2024-25.

"If you want to have an impact in this decade, then it has to be methanol," Mr Sterling says.

"Even in the long run — into the 2030s and 2040s — methanol and ammonia will co-exist because they have different pros and cons."

Observers continue to predict a mix of future fuels, with batteries or hydrogen on shortsea ships — and methanol, ammonia or e-LNG for oceangoing ships.

Lobby group Sea-LNG says interest and investment in direct air capture is exploding. It says 75%-80% of the cost of synthetic hydrocarbons will come from the hydrogen, and factors like safety, availability and operational experience matter too.

"The operational cost will be high, taking into consideration two bunkering fuels, onboard storage space, system safety and the loss in cargo volume," it says.

The group adds that ammonia also needs liquid fuel to ignite it — as much as 30% — which will have to come from biofuels.

Mr Sørensen of MAN ES expects greater uptake of methanol in the coming years, and more ships being retrofitted to run on alternative fuels.

"That needs to go hand in hand with newbuildings, otherwise we will not make it," he says.

Dual-fuelled ships

While 58% of ships ordered today are dual-fuelled, 42% are not, and they will still be sailing in 10 or even 20 years from now.

Swiss enginemaker Winterthur Gas & Diesel says the lessons learned from developing LNG will help its progress with other alternative fuels.

"We are already seeing catalyst reduction technologies to reduce methane slip that could be applicable to marine engines," the company says.

"This was something we didn't think could happen for two-stroke engines a matter of months ago."

"While costs of ammonia and hydrogen will be huge, these are easier to predict than carbon-based fuels"

Tristan Smith
Director
University Maritime Advisory Services

"All the technology steps are known, but none are scaled up and the energy efficiency of that process is probably less than 20%"

Alexandra Ebbinghaus
General manager for decarbonisation
Shell Marine

More companies are promising 'ammonia-ready' ships with features like extra tank space — though there is no agreed definition for this yet.

"Even in the long run — into the 2030s and 2040s — methanol and ammonia will co-exist because they have different pros and cons"

Jacob Sterling
Head of decarbonisation innovation
Maersk

"How can you be ammonia-ready when you don't have any safety guidance yet?" asks Ms Ebbinghaus.

At any rate, no e-fuels will be available without a massive increase in renewable power supply.

A recent study, commissioned by the International Chamber of Shipping, found shipping will need about as much as the total produced worldwide today.

Marginal technologies

Most sources say shipowners should opt for the most efficient ships possible and explore marginal technologies such as wind propulsion, hull coatings and shaft power generation before 'new fuels' become viable.

Almost anything is technically possible; cost and efficiency are usually the bigger barriers.

Shipping just needs a way to persuade customers to help absorb the immense transitional cost.

BHP Billiton

Mining giants BHP and Rio Tinto have said they will look at using green ammonia for iron ore trades between Australia and East Asia.

Where will green corridors lead?

In the absence of global regulations to force the industry to clean up, governments and companies hope voluntary green corridors can help test zero-carbon technologies. Yet there are limits to what can be done without a carbon levy or worldwide rules, **Declan Bush** reports

The Clydebank Declaration was one of the bigger pledges to come out of the COP26 climate summit — and it was aimed squarely at shipping.

Countries agreed to form six 'green corridors' by 2025, while aiming for "more and larger" lanes by 2030.

Since then, 24 nations have signed up to the proposal and several plans have been announced for shipping lanes where zero-emissions fuels and technology can be tested.

In January, the ports of Los Angeles and Shanghai announced one such plan, with partners including AP Moller-Maersk, CMA CGM, Cosco Shipping, Shanghai International Ports Group, and the Amazon-backed Cargo Owners for Zero Emission Vessels group.

A tie-up between five Northern European and Baltic Sea ports followed in March.

Mining giants BHP and Rio Tinto and bulker operators Oldendorff and Star Bulk have said they will look at using green ammonia for iron ore trades between Australia and East Asia. Chile is also looking for greener ways to ship its exports.

Green corridors have been billed as a way for the industry to create markets and supply chains for zero-emissions fuels without being tied to the plodding International Maritime Organization.

Yet there are concerns about how they will move from idea to reality.

"The main thing is, who's paying for it?" says Alexandra Ebbinghaus, general manager for decarbonisation at Shell Marine.

"On the one hand, you have the technology and visibility and finding [the right] people — but I think much more important for the green corridors is to assess the commercial viability."

Ms Ebbinghaus cites a hydrogen truck project Shell once looked at. It failed because it accounted for capital costs, but not running costs, she said.

Transport & Environment shipping programme director Faig Abbasov says green corridors are voluntary and unenforceable.

"If the situation changes, there is no obligation on anyone to live up to it," he says.

Deciding what is 'green' is another problem, such as whether to allow LNG-fuelled ships, whose environmental benefits are contested.

Ports can argue that acting without regulation is the whole point, Mr Abbasov says, "but then how much hope can you put in something that cannot be guaranteed?

"You cannot create expectation that is based on the goodwill of the actors involved. One thing we know: if the economic situation changes, ambition takes a back seat," he says.

UN Framework Convention on Climate Change shipping lead Katharine Palmer says since governments cannot pay all the costs, shipping must work out how to attract some of the billions pledged by businesses to reach net zero.

However, financiers consider the industry too high-risk and have mostly abandoned it for safer bets elsewhere.

Ms Palmer says another problem is the role of less-developed countries, and how the costs will be split.

"There's absolutely no way they can finance a green corridor. And then the question is: do they partner with a port in a developed country, and then expect the developed country to fund it all?"

International Council on Clean Transportation shipping lead Bryan Comer says governments will make green corridors happen, and will probably get up to six by 2025, "but they're going to be super short".

The Shanghai-LA project could work, "but I think we're several years away from that".

Containerships and ferries are the obvious candidates, since they trade on set routes, Dr Comer adds.

Ms Ebbinghaus says EU emissions trading scheme revenues could be one source of funds for green corridors.

> *It's a bit uncertain, to put it mildly, what the incremental cost will be... [The companies are] doing it because they see there's a business in it*

Johan Svendsen
Program manager
Maersk Mc-Kinney Moller Center for Zero-Carbon Shipping

> *The Shanghai-LA project could work, but I think we're several years away from that*

Bryan Comer
Shipping lead
International Council on Clean Transportation

Ms Palmer says green corridors do not need to be around forever; a global IMO regulation will do the job of driving decarbonisation when one is enacted.

The not-for-profit Maersk Mc-Kinney Moller Center for Zero-Carbon Shipping is working on the US, Europe and Chile

> *You cannot create expectation that is based on the goodwill of the actors involved. One thing we know: if the economic situation changes, ambition takes a back seat*

Faig Abbasov
Shipping programme director
Transport & Environment

green corridors, and hopes to grow their number and scale.

Program manager Johan Svendsen says money and enforcement are challenges, and there is a "huge risk" of green standards being undercut.

Mr Svendsen says subsidies will be needed in the short term, as well as ultimately a "substantial" carbon tax (about $200 per tonne of CO_2), since green fuels will always cost more than fossil fuels.

Customers will likely pay some of the green premium in response to pressure from their own customers. Amazon, IKEA and other big retailers have pledged to use zero-carbon shipping by 2040.

Yet while costs will be passed down the supply chain, "it's a bit uncertain, to put it mildly, what the incremental cost will be", says Mr Svendsen.

He says the success of green corridors will not depend only on the goodwill of the companies involved.

"They're doing it because they see there's a business in it."

What to expect from the IMO — and what not to

Short-term measures are expected to cause compliance headaches while doing little to cut ship emissions; there is progress on mid-term carbon price plans, but the big fights are yet to come, **Declan Bush** reports

John Rendle NZ/Alamy Stock Photo

One problem is whether to measure well-to-wake emissions, from production to burning, or just the tank-to-wake emissions from the ship itself.

Carbon pricing will continue to dominate the regulation debate while operators grapple with short-term measures effective from 2023.

The International Maritime Organization has five plans for market-based measures on the table, submitted by the Marshall Islands, Norway, China, Japan and the International Chamber of Shipping.

The proposals include carbon levies, emissions trading schemes and a low-greenhouse gas fuel standard, while China and Japan have proposed 'feebate' schemes, where ships are taxed or rewarded based on their average emissions performance.

The Marine Environment Protection Committee's greenhouse gas working group started looking at these items in detail in May.

University Maritime Advisory Services, a consultancy, called that intersessional meeting a "major development", with the IMO agreeing consensus on the need for market-based measures after a decade of talks.

Countries agreed there should be a basket of measures — more than one policy — but have not yet decided what should actually be in that 'basket'.

Umas noted support for a fuel standard, including backing from industry. Members seemed to prefer a levy, but some were open to an ETS, Umas said.

Industry sources suspect the EU27 countries would support Norway's ETS plan, but are unable to say so formally because the bloc's own ETS is not yet in place.

Industry, meanwhile, backs a carbon levy because of the price certainty, and because an ETS could limit demand for shipping if technology is not available when the emissions cap starts to bite.

While China's MBM was welcomed as a sign that the country is getting serious about carbon pricing, the plan itself has been criticised for its complexity, and for lacking ambition.

Meanwhile, the ICS continues to insist its International Maritime Research Fund — a plan for a $2-a-tonne fuel tax — is not an MBM, but countries tend to treat it like one.

The plan has won more support in recent months, but opponents say they should use scarce negotiating time to agree something with teeth.

Carbon prices are the most divisive topic with which the IMO has ever dealt. Past attempts to agree on them — or even to agree to discuss them — have collapsed. No other global industry has agreed one.

However, Umas director Tristan Smith is bullish this time.

"I think the IMO will move much faster than people think, given [the] level of convergence we now see," he says.

Yet while there is more support that a measure should be implemented, countries are far from united on how it should work.

The big problems are how much a tax should cost, and how much of the money should be spent helping poorer countries and island states cope with the costs of adapting to climate change.

Another is whether to measure well-to-wake emissions, from production to burning, or just the tank-to-wake emissions from the ship itself (the latter would be much easier for operators to calculate).

The split is broadly between more ambitious countries (such as the EU27, UK and island states at risk from rising sea levels), and developing countries and petrostates, such as China, Russia, Saudi Arabia, Argentina, South Africa and Brazil.

These argue that developing countries bear less responsibility for climate change and are less able to pay the costs. They have pushed for weaker measures, and for a bigger chunk of any funds raised.

Technical University of Denmark professor Harilaos Psaraftis was disappointed that the US under President Joe Biden has not been more proactive at the IMO.

He is doubtful how much can get done without the support of the world's top two biggest economies, and adds the talks are also "much less structured" than in 2010-13.

Some proposals include impact assessments and some do not; some deal with the issue of how the revenues will be used and some do not; some are technical and others economic.

"Terms like 'equitable transition' are not defined, and when they say that a basket of measures will be adopted, it is not clear what the basket will be," Prof Psaraftis says.

"In a sense, we do not yet know what the proposed measures are — and more may be coming."

Sources disagree on how long a global measure will take, but most say between five and 10 years.

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Professor Psaraftis was disappointed that the US under President Joe Biden has not been more proactive at the IMO.

What next

In the near future, operators will be more worried about the IMO's two short-term emissions measures, which kick in from 2023: the Energy Efficiency Existing Ships Index and the Carbon Intensity Indicator.

The EEXI measures emissions per cargo tonne-mile and the CII rates ships on operational carbon intensity, from A to E.

> *"Terms like 'equitable transition' are not defined, and when they say that a basket of measures will be adopted, it is not clear what the basket will be"*
>
> **Harilaos Psaraftis**
> Professor
> Technical University of Denmark

Reed Smith partner Nick Austin says this and the challenge of decarbonisation present "an immense compliance task and an urgent need to understand the impact on the charterparty and other contractual arrangements under which each ship is operating".

Questions will include how the cost is split between the owner and charterer, what to do to maintain energy efficiency, and what happens if they fail to comply.

For green groups, the answers to the latter two are 'slow down' and 'nothing'.

"It's really no different than business as usual because the existing ships are already sailing so slowly that even if they fail to comply with their required EEXI, and limit their engine power, actual ship speeds are still low enough to not come close to that cap," says Bryan Comer, shipping lead at the International Council on Clean Transportation.

He says the EEXI is enforceable, and so more likely to have an impact — but that impact will be small.

However, the CII has no enforcement mechanism and there are no consequences for failing to comply, except perhaps looking bad.

"If you get a D [rating] for three years, or an E in any year, then you have to write how sorry you are, make a plan and get it approved by your administration and implement that plan," Dr Comer says.

"There's no guidelines for what the format of that plan needs to be. There's no consequences if you fail to implement the plan... and there's never a case where a failing ship is going to be required to stop sailing."

Regulatory timeline
2022 - 2024

Some states could limit access to ships rated C or better, but D-rated ships will probably find a market, he adds.

Prof Psaraftis adds that while the EEXI and CII are approved, the IMO is still deciding between two ways of measuring carbon intensity.

And its weaknesses could have bigger consequences, since China's MBM plan — supported by many conservative states — uses its rating system.

However, the EEXI and CII could create conflicts between owners and charterers over whether ships should slow down (to get better ratings) or speed up (to deliver their cargo faster).

Dr Smith says the CII could disrupt centuries-old business practice, by making operators responsible for an owner's carbon intensity.

This will go further than the owners-versus-charterers debate over the EU ETS, which is a matter of simply passing on costs through a clause in the charterparty.

"If you charter a vessel for six months to Shell [for example], and Shell insists on running at 15 knots and you're trying to hit your CII objective of an A or a B, they've just destroyed your commercial opportunity in the subsequent six months, because you'll now have to run it at 13 knots or spend several million fitting some [efficiency] technology," he says.

"The way that one charterers' decision-making imposes commercial risk on your business is really different."

Mr Austin says time charterparties are particularly vulnerable to EEXI and CII. Charterers' traditional rights to employ the vessel for its own commercial ends are likely to be affected.

Ships may have to reduce cargo intake, deviate or slow-steam to ensure compliance. Extending voyage duration to comply with EEXI and CII could reduce an owner's earnings under contracts of affreightment or put them in breach of "due" or "utmost" despatch obligations if protective clauses are not agreed.

Cultura Creative RF/Alamy Stock Photo

Ships may have to reduce cargo intake, deviate or slow-steam to ensure compliance.

Dr Smith says shipping needs a new business model to recognise how different parties' responsibilities for emissions are interconnected, not siloed like today.

However, the design of the MBMs matters more than their initial stringency. Get the plumbing right at first and you can raise the price to have greater effect later; but get the design wrong now, and problems will be magnified later.

> *"[Decarbonisation presents] an immense compliance task and an urgent need to understand the impact on the charterparty and other contractual arrangements under which each ship is operating"*

Nick Austin
Partner
Reed Smith

Many at the IMO are closely watching the development of the EU ETS and FuelEU carbon standard, as both push the IMO to regulate faster, and provide a model to do so.

The IMO will probably come up with something, and different national regulations may start to point one way in the next few years that influences the final scheme.

Dr Smith says reading the runes at the IMO is 30% of the decarbonisation puzzle. He argues self-regulation factors like the Poseidon Principles, for greener lending and insurance, and the Sea Cargo Charter will matter too.

In March, the US Government proposed sweeping changes to rules on disclosing Scope-3 emissions. These are the indirect emissions outside of their control. Since shipping is a big source of Scope-3 emissions for most big corporations, this could add further pressure.

A senior IMO negotiator says the fact the IMO has a strategy that guides its work on GHGs is important progress.

Green non-governmental organisations and industry groups do not always understand the decisions that member governments have to account for.

He says it is not yet certain that the IMO will adopt an MBM but is encouraged that no options are off the table.

"When you're building a house, at the start you can't see any progress. It looks the same from day to day," he says.

"And suddenly you come to the end, and there's a house. [But] if you skip the groundwork, you will not get the final result."

Shipping decarbonisation at a Chinese pace

Progress made by Chinese shipping companies in decarbonisation cannot mask their lack of ambition on the global stage; however, they have the potential to accelerate the pace and signs are promising, **Cichen Shen** reports

China News Service/Yang Bo

The maiden voyage of a 3,000 dwt fully electric cargoship on the Yangtze River earlier this year was one of the more impressive achievements in domestic trade.

Chinese shipping companies are making strides along their green path, but there is still little appetite for them to lead global efforts.

The maiden voyage of a 3,000 dwt fully electric cargoship on the Yangtze River earlier this year was one of the more impressive achievements in domestic trade.

The green methanol-fuelled very large crude carrier design, co-developed by Cosco Shipping Energy Transportation and domestic yard Dalian Shipbuilding Industry, which won approval in principle from class societies, was equally encouraging.

Yet few examples of adopting alternative fuels — a key solution to shipping's decarbonisation — on existing fleets or newbuildings on a large scale can still be found among leading Chinese owners, unlike their foreign peers such as Maersk and Eastern Pacific Shipping.

CEST's sister company, Cosco Shipping Holdings, for instance, is the only company among the world's top five container lines that has not ordered dual-fuelled vessels.

Its management team told investors of its reservations about liquefied natural gas, due to its lack of green credentials. Instead, CEST declared an interest in methanol, but without any concrete adoption plans.

In its recent sustainability report, the Shanghai and Hong Kong-listed company unveiled a target to reach carbon neutrality by 2060.

While the move marks the first time the Chinese giant publicly revealed its emissions-cutting commitment, it is still 10 years behind what has already been set by some of its major foreign competitors.

Meanwhile, CSH's Hong Kong-based container shipping subsidiary, Orient Overseas (International), appears a step ahead.

"We urge regulatory bodies to lay out decarbonisation roadmaps and support the maritime shipping industry in the journey to net-zero carbon emissions by 2050," it said.

However, the rhetoric cannot mask the fact that this is not the goal the company has set for itself.

Meanwhile, Chinese leasing companies — a main force in today's ship finance arena — are starting to grasp the decarbonisation imperative, according to Abhishek Pandey, head of shipping finance at Standard Chartered Bank.

The Poseidon Principles are now a regular feature of refinancing deals with Chinese lessors, who have become less resistant to the framework, Mr Pandey told Lloyd's List.

The initative was launched in 2019 to align lending activity to shipping's climate goals. It gained signatories from some 27 banks, covering about half of the global ship finance portfolio.

However, the Chinese lessors remain absent on this roster of signatories, who are required to report their portfolio alignment score annually.

For Chinese lenders to join, it would require consent from the banking regulators in China, said a senior Chinese leasing executive — "and they haven't yet given the nod to the move.

"Most large leasing houses are subsidiaries of state-owned banks or enterprises, so we're very cautious about participating in this type of initiative overseas, or even the less formal ones, such as 'Call to Action', which may cause regulatory concerns or constrain our ability to do business," said the leasing executive.

"We certainly like to finance cleaner ships, but we also need to engage in the less-clean ones."

Another reason Chinese shipping firms are dragging their heels could be that China, on a national level, is aiming for a slower pace of 'green transition' compared to Western, developed countries.

CSH's 2060 carbon-neutral deadline is in keeping with the country's national decarbonisation agenda, whereas countries like the UK and Japan are targeting net zero by 2050.

Steve Saxon, a maritime expert at McKinsey, argued that an acceleration is still possible, though.

Customers — at least in certain segments, such as container shipping — are increasingly demanding low- or zero-carbon supply chains and are often willing to share the costs, he said.

"It makes economic sense for Chinese shipping companies that serve not only domestic but also global shippers to decarbonise their services, because if you are unable to provide that, you'll be missing out on that high-value cargo that would be going to other carriers who are able to meet those zero-carbon shipping goals."

> *Once the policymakers set out the direction, [the Chinese companies] will know that's what their competitiveness will rely on in future*

Zhuang Wei
Asia head
BIMCO

> *China has the potential to really be a leader in defining what is the path to decarbonisation and build a consortium on this*

Steve Saxon
Maritime expert
McKinsey

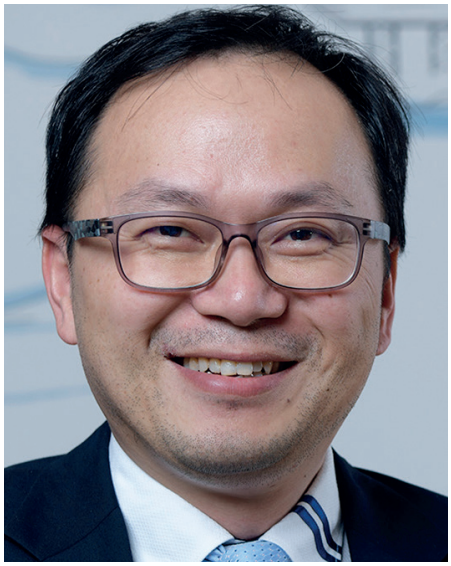
Moreover, the country is blessed by an extensive shipping ecosystem and is even in a position to be a pacesetter in the industry's fight against climate change.

"China has the potential to really be a leader in defining what is the path to decarbonisation and build a consortium on this," he said.

"Everything is here: power companies, energy companies, shipyards, ship designers, shipowners, financers and charterers."

Some have seen the market-based measures proposed by China, alongside an influential group of developing countries, at the International Maritime Organization to reduce shipping emissions as a portent of heading in that direction.

The proposition would set upper and lower carbon dioxide emissions limits for ships based on the Carbon Intensity Indicator's C-rating range. Emitting more than average would entail tax levies; emitting less would lead to rewards.



The so-called International Maritime Sustainability Funding & Reward scheme is low in detail and even lower in ambition compared to similar plans by some developed nations, but could garner extensive support.

China had been reluctant to consider MBMs at the IMO level, and the change of attitude will have an impact on the approach of domestic shipping firms to cutting emissions, according to BIMCO Asia head Zhuang Wei.

"Those Chinese companies — especially the leading state-owned ones — have been keeping a close eye on the market, technological and regulatory developments," he said.

"Once the policymakers set out the direction, they will know that's what their competitiveness will rely on in future."

There have already been talks domestically about Cosco Shipping mulling a joint venture with Sinopec to invest in plants producing green methanol, although the plan has not been confirmed by the companies and details are few.

Meanwhile, China Merchants Energy Shipping, the shipping arm of state conglomerate China Merchants Group, is looking to deliver the first river-going ro-ro vessel powered by hydrogen, made using green methanol, next year, according to an internal company presentation seen by Lloyd's List.

"The company is also planning to publish its first ESG report in the coming months, in which it will lay out its decarbonisation schemes by 2025, 2030 and 2050." said a person close to the company.

"They want to be more vocal on the subject going forward."

Forest/Alamy Stock Photo

The LNG bunkering market is rapidly evolving to replicate the conventional marine fuels market.

High LNG marine fuel prices block transition pathway

When choosing between saving money or the environment, shipowners are opting for the fuel that provides the lowest operating cost, **Michelle Wiese Bockmann** reports

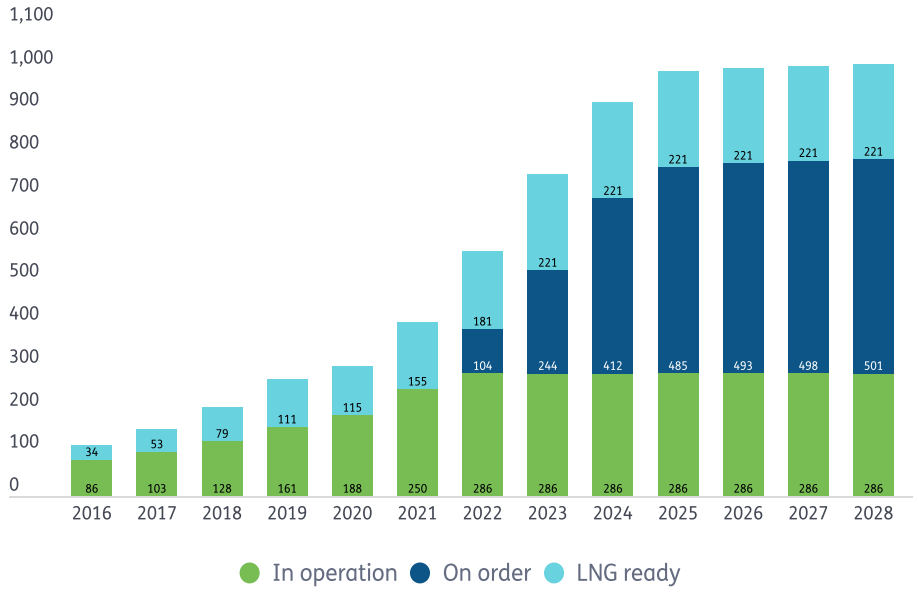
High natural gas prices are deterring the greater uptake of LNG bunkers as owners of dual-fuelled vessels opt for conventional marine fuel at nearly half the cost.

LNG fuel was assessed $424 per tonne above very-low-sulphur fuel oil and $631 per tonne higher than high-sulphur fuel oil during April, according to price reporting agency Argus Media.

Elevated costs over the past nine months have deterred shipowners with the option of using either fuel from choosing LNG as rising natural gas prices across Asia and Europe outpace gains in conventional bunkers.

"The spread has been in the favour of conventional fuel throughout the winter, but now we are seeing that the spread is closing somewhat, and we do expect that within a reasonable time it will equal out," says Finland-based energy company Gasum's vice-president of marine Jacob Granqvist.

Yearly development of LNG-fuelled fleet



Source: DNV

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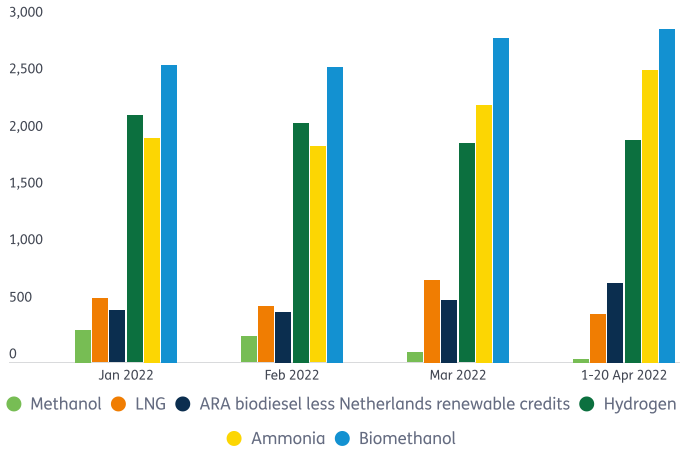
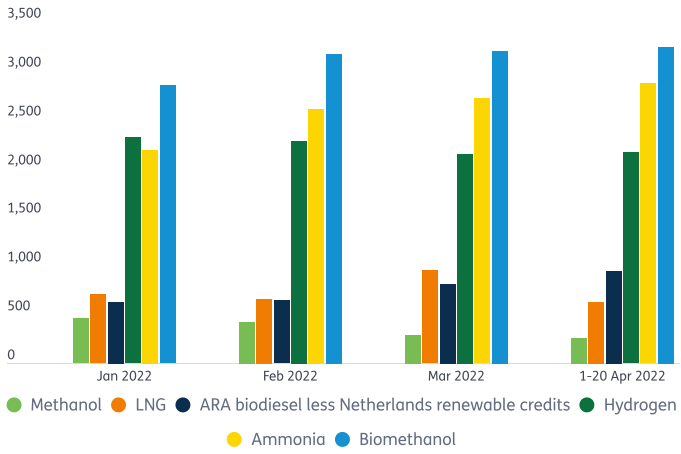


Northwest Europe marine fuels less HSFO ($/t)



Source: Argus Media

"It seems that this is also what the shipping community is thinking as we are seeing every month now that orders of LNG-fuelled vessels are being booked at the shipyards."

Fewer vessels opting for LNG marine fuels saw Gasum operate its LNG bunkering tanker outside the Amsterdam-Rotterdam-Antwerp hub to utilise it better.

"We had to get the utilisation up. We could not afford to have one vessel just hanging around," he says.

Like most in the LNG market, Mr Granqvist sees delivery of hundreds of larger, dual-fuelled LNG vessels over the next five years as a game-changer, providing the traction needed for commercial scale alongside regulatory decarbonisation goals.

The fleet of ships with the option to use LNG is at 370 but is expected to swell to 530 by the end of 2023 and 760 two years after that, according to DNV.

There are also some 220 newbuildings on order classified as "LNG-ready" for retrofitting to use LNG later if required, data from the Danish classification society shows.

Nevertheless, current turmoil in the energy industry shows that shipowners can and will use dual-fuelled engines as a pricing hedge, and that operating profits can trump decarbonisation targets.

Still, rising LNG prices will not deter newbuilding orders.

Some of the biggest shipping names dominate the orderbook for LNG-fuelled ships, which now comprise some 30% of all tonnage on order at shipyards worldwide by deadweight.

This shift to larger vessels, such as very large crude carriers — as opposed to early-adopters, such as smaller passenger and ferry ships — in northwest Europe helped LNG become a transition decarbonisation fuel for the global fleet in the absence of any zero-carbon alternatives.

Even though LNG is a fossil fuel, studies show it can lower ships' carbon dioxide emissions by as much as 20% compared with conventional marine fuel oil.

Detractors highlight that decarbonisation and environmental benefits can be much smaller, depending on engine type, and levels of methane emissions are also damaging.

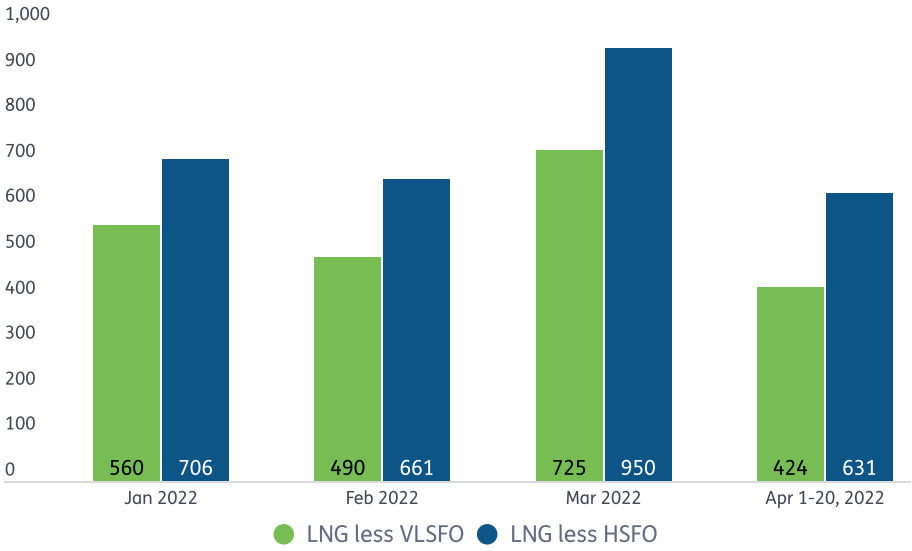
However, most newbuildings are using two-stroke engines that show minimal methane slip, according to a TotalEnergies paper on marine fuels published in January.

The French energy giant also forecast the global LNG bunker market will reach 10m tonnes by 2025 and 10% of total consumption by 2030.

That represents a huge leap in the current fuel mix. LNG uptake is estimated at some 0.19% of the current marine fuel mix, in a market that consumes some 185m tonnes of bunkers annually.

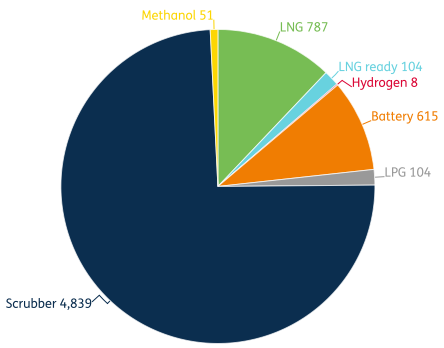
Mr Granqvist says the LNG bunkering market is rapidly evolving to replicate the conventional marine fuels market as shipowners seek a balance of longer-term supply contracts as well as spot market purchases.

Northwest Europe LNG less conventional bunkers ($/t)



Source: Argus Media

Total number of ships (in operation and on order)



Source: DNV

"The vessels that are being ordered now are heavy-consuming [fuel] vessels. Heavy consumers switching to LNG means that LNG demand in northwest Europe is going to jump dramatically in the next five years," he says.

The largest containerships now on order to use LNG would consume 24,000 tonnes annually, according to Mr Granqvist. These vessels would bunker the full capacity of a 15,000 cu m bunkering tanker, he said.

While LNG remains high-cost, some of the sector's pioneers, such as Sweden's Furetank, are now being supplied with bio-LNG.

Bio-LNG and liquefied biogas produced from biodegradable materials is interchangeable with LNG and a key selling point for LNG's environmental credentials post-2030.

"The beauty of bio-LNG is that it is blendable to any amount and ratio with LNG, which means that when you are making an investment in LNG assets, then you are already on a path towards decarbonisation," says Mr Granqvist.

"You already gained 20% over conventional fuels with LNG, but then you can start to blend in bio-LNG, and you have other options as well, and 20% by making ships more efficient.

"Furetank are able to reduce about 50% of CO_2 emissions compared with the older generation of tankers that they have of the same size."

However, shipowners need to commit to buying bio-LNG volumes, he says.

> *"To just sit on the fence and wait might not be a good idea if your strategy is to decarbonise. But the question within the shipping community has always been about price"*
>
> **Jacob Granqvist**
> Vice-president of marine
> Gasum

"To just sit on the fence and wait might not be a good idea if your strategy is to decarbonise. But the question within the shipping community has always been about price.

"Even though we could decarbonise some vessels fully — even today — by using biogas, the willingness to pay for such a service has not been there."

Sipa US/Alamy Stock Photo

Governments are expected to use state intervention to change the culture of shipbuilding.

Shipowners will be 'forced' to build greener ships

According to the head of Maritime London, 'the big container lines understand they have got no choice; the major problem will be for the smaller, private owners', **David Osler** reports

Most shipowners will not voluntarily build greener ships and will have to be forced to do so, with state export credit agency backing acting as an important incentive, according to the head of Maritime London.

The expanded role of ECAs is necessitated by the departure of traditional bankers, who are reluctant to lend against unproven vessel types even if they are more ecologically friendly, said Harry Theochari.

"Shipowners are going to have to be forced to build green ships, but a lot of them are coming round to the idea anyway," he told Lloyd's List.

"The big container lines, for example, understand they have got no choice and Maersk is leading the way. MSC and CMA CGM are making all the right noises as well.

"The major problem will be for the smaller, private owners. It is more difficult for them to finance the changes they will need to make."

Mr Theochari, one of the world's leading ship finance lawyers during his career at Norton Rose Fulbright, said estimates are that the cost of meeting the current International Maritime Organization target of a 50% reduction in greenhouse gas emissions from shipping by 2030, compared with 2008, is a range of somewhere between $1trn and $1.4trn.

Yet the IMO goal is widely seen as too soft, and public pressure is mounting for shipping emissions to hit net zero by 2050, in line with every other major industrial sector in the world. That would be likely to cost between $1.4trn and $1.9trn.

However, there has been a precipitous fall in the volume of lending to shipowners since the global financial crisis, when mainstream banks alone made up to $120bn of new money per annum available to shipping and offshore sectors.

The shipping downturn that followed saw banks with decades of shipping exposure — including such big names as Royal Bank of Scotland, HSH Nordbank, NordLB and Commerzbank — rush for the exits.

Lending plummeted

By 2017, bank lending to the industry had plummeted by two-thirds and came in at just $40bn. It may well have fallen further since then.

A big part of the explanation is that it has become harder for European banks to get hold of dollars, and that the applicable capital adequacy rules under the Basel convention make lending to shipping more expensive than to other sectors.

"There's no point pretending shipping isn't a dangerous business; it's hugely volatile," said Mr Theochari.

"If you look at the ups and downs of shipping, they're pretty regular. You just have to make sure you don't get caught."

Until now, lenders could work on the assumption that ships had 25-year lifespans, would use standard bunker fuel, and had quantifiable trading prospects. Many of those considerations no longer apply.

"Would you finance a ship in the same way as you do now, when you don't know whether the drive train is going to have a future or what fuel it's going to be using?" said Mr Theochari.

"I don't see financial institutions, private equity or equity investors being prepared to finance or invest long term in new, untried and untested technology."

Private equity

Private equity did take up some of the slack, lending $12bn in 2017. That sounds like a lot of money, but it does not come anywhere near to filling the gap left by the banks. Moreover, PE firms are, by definition, short-term players.

US capital markets raised $8.2bn for shipping in 2014, but only $4bn in 2018 and a minimal $600m in 2019.

Despite being famed for their supposed limitless depths, US markets are at present on the cusp of being overtaken by Oslo, which has more understanding of shipping projects.

Bonds raised about $5.8bn in 2009, and offerings in 2012 topped $20bn. Yet by 2015, they had fallen below $10bn, plateauing at just $1bn the year after that, with partial recovery since.

> *"There's no point pretending shipping isn't a dangerous business; it's hugely volatile. If you look at the ups and downs of shipping, they're pretty regular. You just have to make sure you don't get caught"*

Harry Theochari
Chair
Maritime London

Chinese institutions

Chinese financial institutions — especially the leasing arms of the big banks — are also now an important part of the mix. However, here the limitations are political, said Mr Theochari.

"We know the Chinese have got lots of money, their banks and leasing institutions are pretty powerful and influential. But do we in the West want to have China financing our shipping? There are geopolitical issues we are going to have to think about."

Extensive sanctions have been imposed on Russia following that country's incursion into Ukraine in February, and something similar would appear likely were China to enter Taiwan.

Given the lending trends of the past two decades, governments that are desirous of seeing their country's owners invest in green shipping are probably going to have to make it happen themselves, and resort to judicious state intervention as well as moral suasion.

"Governments are going to have to stand behind the building of new ships, and it's going to be the export credit agencies that are going to have to come good. That's what I see happening," said Mr Theochari.

ECAs are willing to guarantee up to 80% of borrowing against ships, thus enabling banks to provide financing at cheaper rates, in certain knowledge of recourse.

From the point of view of politicians mindful of the public purse, the beauty here is that taxpayer money is not needed up front. The guaranteed fees ECAs charge for their services should even mean they can operate profitably.

Market leader

Britain's UKEF is already a market leader in aviation, with an $80bn portfolio, and there is no reason it could not do the same for shipping, as it did in the 1980s and 1990s. That would provide a fillip for the government's existing UK shipbuilding strategy.

While Mr Theochari admitted that British yards cannot realistically compete with China, Japan or South Korea on standard designs, they do have a future in the construction of high-quality advanced ships, many of which would be fuelled by hydrogen or methanol.

Additional reporting by Declan Bush

Clean-tech breakthrough needs new thinking on investments

Norsepower

Rotor sails provider Norsepower claims all the pilot projects it has initiated have led to the continuous usage of rotor sails.

No single clean-tech solution has yet to prove a gamechanger, but IMO emissions targets and the introduction of the Carbon Intensity Indicator have the potential to be just that and energise a raft of new technologies, **Richard Clayton** reports

Shipping's 'clean-tech' solutions have struggled to get much uptake from shipowners, but there are indications from tech providers that interest is growing as the cost of fuel increases and pressure to comply with sustainability goals heightens.

The number of operational efficiency products on the market has ballooned since 2020, but this has brought confusion rather than clarity for shipowners.

In addition to the upfront cost of these products, it is still unclear whether the promised cost and emissions reductions will continue over time.

Part of the reluctance to invest in new technology can be attributed to shipping's dislike of change, its conservative attitude to risk, a fear of making investment mistakes, and an understandable — but stifling — need to see a good business case.

> *To make clean technologies, such as wind, more mainstream, we need to challenge the conventional thinking about energy-efficiency, clean-technology investment*

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Shipowners have held back on investment, whether for voyage optimisation software, for premium hull coatings, or wind propulsion. Tech firms have struggled to provide certainty without risk-takers willing to test them over an extended period.

According to one provider, there is a deeper concern. Tuomas Riski, chief executive of rotor sails provider Norsepower, believes this reluctance to invest reveals a weakness in shipping's business model.

"To make clean technologies, such as wind, more mainstream, we need to challenge the conventional thinking about energy-efficiency, clean-technology investment," he says.

Shipowners think they have to invest in a single technology to enable them to comply with sustainability goals.

"Investment decisions are often decided by outdated payback algorithms," he comments, adding that charterers should help by guaranteeing longer charter party agreements at attractive rates for owners who invest in these technologies.

Sarah Barrett from the product insights team at Wärtsilä Voyage sees a trend for shipmanagers to invest in optimisation software in order to offer it as part of their service and gain competitive advantage.

However, she recognises that while some Voyage customers like the idea of the software, "they don't feel they have the data skills, manpower, or resources to successfully engage in digitalisation products, and can't justify the investment".

Further, Ms Barrett says, investing in different software from several companies has left customers overwhelmed by what she describes as a "fragmented ecosystem". They need integrated solutions.

Mike Konstantinidis, founder and chief executive of METIS Cyberspace Technology, believes shipping's resistance to change lies behind a reluctance by most shipowners to invest in clean-tech solutions.

> *Our customers are first-movers. They realise that if they don't embrace digital transformation, they will get left behind*

Mike Konstantinidis
Founder and chief executive
METIS Cyberspace Technology

"Our customers are first-movers. They realise that if they don't embrace digital transformation, they will get left behind."

He believes a new cadre of forward-thinking managers will steer a new course.

"The trend is led by an awareness that the only way to be competitive, compliant and profitable is to be technologically advanced."

Mr Konstantinidis says clean-technology products should cater to individual ships because no two vessels are exactly alike.

Each vessel performs in a unique way, he says, "because it has different hull and propeller fouling, encounters different weather conditions, has different damage [characteristics], enjoys different maintenance and repairs, burns different quality and types of fuel oil and, above all, is being operated by different crews, with similar but different skills, training, and reactions".

That's why no clean-tech solution should be applied across a fleet of ships, he believes. Each ship must be treated individually, which is not the way the industry is used to working.

> *The time taken by paint-makers to develop new products — and to show those products' effectiveness — has been challenging*

Philip Chaabane
Chief executive
I-Tech

For other providers, it has taken a long time for their products to prove their value.

Philip Chaabane, chief executive of I-Tech, which makes a barnacle-repelling antifouling agent for hull coatings, says the time taken by paint-makers to develop new products — and to show those products' effectiveness — has been challenging.

However, I-Tech has now started to show the agent's effectiveness over a five-year timespan. It is an easier sell for newbuilds than for ships in drydock, where regulatory approvals may not be in place.

To be successful, clean-tech providers must do more than promise an emissions reduction of 8% or 10%. Pilot projects monitoring both fuel consumption and emissions over time stand a much better chance of being expanded across a series of ships or an entire fleet.

Mr Riski claims that all the pilot projects Norsepower has initiated have led to the continuous usage of rotor sails. The company now offers a 'pay-as-you-save' system to tempt customers.

"The idea is to minimise upfront investment and have a service agreement and monthly payments based on the fuel savings that can be achieved with the sails," he says.

Technology providers believe the industry's reluctance to invest in new tech is starting to turn, although there remain challenges. Among these are upfront costs, proving the promises, reducing the number of stand-alone technologies, and upskilling seafarers to use them effectively.

All are agreed that first-movers will be critical for future development of clean-tech solutions.

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