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Will alternative fuels be available to meet marine decarbonisation targets?

Introduction

The International Maritime Organisation (IMO) adopted life cycle assessment (LCA) guidelines at the 81st meeting of the Marine Environment Protection Committee (MEPC 81) in March 2024. This followed confirmation of the IMO's net zero targets in June 2023 and the formal adoption of FuelEU Maritime in July 2023. Argus reflects on the current state of marine decarbonisation and analyses the mix of alternative fuels and potential constraints to fuel availability and therefore target realisation.

June 2023: adoption of IMO net zero target at MEPC 80 receives mixed reaction

The IMO's initial strategy on greenhouse gas (GHG) emissions in 2018 set targets for the carbon intensity of shipping to decline by at least 40pc by 2030 and by 70pc by 2050 compared with 2008 levels. Members also agreed to reduce overall GHG emissions by at least 50pc by 2050, pursuing efforts towards phasing them out entirely.

In July 2023, following five years of negotiations, members agreed to reduce emissions from 2008 levels to net zero by or around 2050. In the meantime, they have set a target to cut emissions by at least 20pc, and preferably 30pc, by 2030, and by at least 70pc, and preferably 80pc, by 2040.

During the negotiations, many expressed disappointment in the opposition from states including China, Russia and India to more ambitious targets, deadlines and levies. China reiterated that only 3pc of global GHG emissions come from shipping, while the sector props up 80pc of global trade. The country said that all targets and measures should be "practicable and progressive", and not "impact trade and the economic health of developing countries". India also opposes a levy, with delegates saying that it could impact the country's economy negatively and unfairly punish them. India also said that higher emissions targets were not practical.

The International Bunkering Industry Association (Ibia) described the IMO's revised GHG strategy as a "starting signal" for the maritime sector. Shipping giant Hapag-Lloyd told Argus the IMO strategy would "push decarbonisation efforts all the more forward."

Reactions from the shipping industry were equally mixed. Bimco described the strategy as "groundbreaking", and said that "investment decisions need to be reassessed". But others were less enthusiastic. Stena Bulk chief executive Erik Hanell expressed frustration at the "lower ambition". "We can't afford to wait. It makes neither good sustainability sense nor good business sense to delay," he said. "The outcomes… all but solidify the prospect of the EU and US… pursuing their own strategies." The International Chamber of Shipping (ICS) expressed its disappointment at what it said were inadequate targets. The World Shipping Council said "There is much to do… we are counting on the IMO member nations to press on with the important work of developing and adopting a robust regulatory framework that will make these fuels available and competitive."

Other organisations gave a tepid response to the revision. The International Bunkering Industry Association (IBIA) described the IMO's revised GHG strategy as a "starting signal" for the maritime sector. Shipping giant Hapag-Lloyd told Argus the IMO strategy would "push decarbonisation efforts all the more forward," while Bunker Holding chief executive Keld Demant called it "an important step in

the right direction." Simon Bergulf — head of energy transition and operations at AP Moller–Maersk — described the decision as a call to action, adding that the "time for investment is now."

March 2024: adoption of 2024 LCA guidelines at MEPC 81

Delegates approved base LCA guidelines at MEPC 81, covering emissions from the point of feedstock extraction to combustion of the fuel. The MEPC also invited delegates to prepare a consolidated proposal for a "basket of mid-term measures", which will comprise technical elements, such as fuel standards, and economic elements, such as pricing mechanisms.

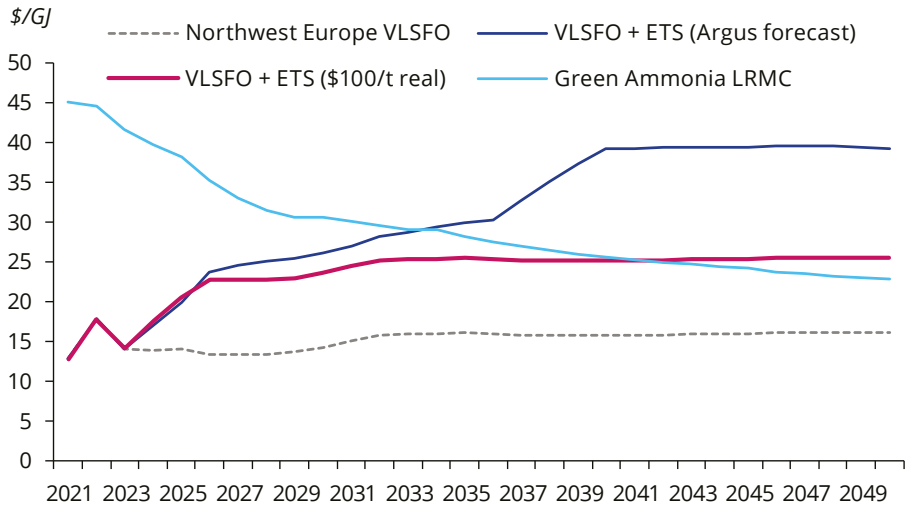
IMO secretary general Arsenio Dominguez emphasised the need for "global regulations for a global sector", and said existing regional regulations such as the EU emissions trading system (ETS) will need to align to a global standard. The timeline to finalise these measures will be by autumn 2025, to become effective from 2027. An "economic pricing mechanism" will be in place by the first quarter of 2025, which may be relabelled in the future as a "levy" or a "rebate".

Market participants had reported concerns around the viability of carbon intensity index (CII) regulations and how consequences for non-compliant fleets will be enforced. Dominguez said that when CII was adopted, it was regarded as a "soft implementation" that will be revised in 2026. A working group will be established at the next MEPC meeting to review the CII system.

Carbon levy yet to be announced but unlikely to achieve price parity in the short- to medium-term

As explained above, the IMO targets will be implemented through a basket of measures to be finalised and agreed by committee by 2025. They will include a goal-based marine fuel standard and a maritime GHG emissions pricing mechanism.

Dry bulk shipowner Diana Shipping said that targets were "unrealistically high [as] we have yet to see an IMO policy in play that actively encourages decarbonisation…The higher end of proposed levies of about $100/t of CO2 [for traditional fuel oils]…would not make e-fuels or biofuels anywhere near profitable against fuel oil." While this is true based on the current cost of e-fuels, we expect declines in



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the cost of renewable energy and electrolyser capital intensity to bring down the cost of green ammonia considerably over the next decade. As a result, a decade from now, a carbon price of $150/t — in real 2023 terms — could be enough for green ammonia to achieve cost parity with VLSFO.

Such a levy has now been introduced in Europe as marine fuels were included in the EU ETS from January 2024 and this will narrow the gap between the price of traditional and alternative fuels, leaving the industry to resolve the residual gap through bi-lateral negotiations. Industry observers have been at pains to point out that the use of alternative fuels will make only a marginal impact on the price of final goods, particularly consumer goods shipped by the container segment, with shipping such a low-cost method of transporting goods around the world. The IEA estimates that the additional costs of green ammonia fuel and infrastructure would add less than $0.01 to the cost of an avocado or an iPhone.

FuelEU Maritime and EU ETS: the only legislation worth the paper it's written on?

Decisions taken at IMO levels are legally-binding for governments accepting the organisation's convention. And the revision of the strategy could have far-reaching consequences. Some market participants pour scorn on the IMO target, questioning the legal power to raise fines on vessel operators. But, similar concerns were raised in anticipation of the IMO 2020 regulation, which mandated a maximum sulphur content of 0.5pc in marine fuels globally. In that instance, between 2019 and 2021 low-sulphur fuel-oil (LSFO) was priced at a $100-200/t premium to high-sulphur fuel-oil (HSFO) but very few instances of non-compliance were recorded. So where fuel availability was not an issue, compliance was high, despite higher prices. This could support the argument made in the chapter above that the willingness to pay is not the most significant barrier to marine decarbonisation, albeit the price of e-fuels will be at a far larger premium to HSFO than LSFO.

By contrast, FuelEU Maritime which covers 100pc of intra-Europe voyages as well as 50pc of voyages in and out of the EU does contain a penalty and - as a regulation - is directly applicable to EU firms and citizens in all member states. The regulation contains a penalty clause and a formula in annex to calculate the penalty, which is set at €2,400 /t very-low sulphur fuel oil (VLSFO) energy equivalent, or about €58.50 /GJ of non-compliant energy use, roughly the current cost of production for green ammonia in Europe. As the fuel reduction factor increases, so does the penalty, creating a burden that could exceed ETS in the late 2030s. Through the pooling mechanism, over-compliant ships running on alternative fuels should be able to monetise their investment, creating a double incentive to switch.

Argus has put together an FAQ document to provide answers to common questions around the EU ETS Inclusion of Marine Shipping. **Click here to read the FAQ.**

The role of LNG under threat

LNG was previously seen as a suitable transition fuel for the marine sector, providing a cheaper source of high energy density fuel, that offered around a 20pc reduction in GHG emissions /MJ, spanning the 10 years or so until ammonia would become widely available, whereupon ships could shift to biomethane and/or e-LNG or run ammonia on dual-fuel vessels. But, this role has been impaired by three considerations:

1. The price of gas has increased following the Russian invasion of Ukraine
2. The IMO net zero target implies that newly commissioned LNG vessels would have to shift the mix from fossil methane to bio- and e-LNG within 5-10 years of commissioning, essentially facing the same cost and availability issues of other pathways
3. From 2027 under revised IMO targets, emissions will be calculated on a well-to-wake basis, which will include methane leaks during production as well as methane slippage on vessels. According to a 2022 ICCT report, methane slippage would need to be reduced by 90-100pc in high-methane-slip engines for LNG to emit roughly the same life-cycle emissions as marine gasoil (MGO). Even putting aside scepticism that the IMO targets can be reached, the optics of new LNG vessels seem to fly in the face of the industry's ambition.

The monthly **Argus European Natural Gas Outlook** provides detailed, forward-looking fundamentals analysis and a price forecast for the region, with a view on the global LNG supply-demand balance

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Long-term challenge for biofuel availability for marine sector

Despite the relative lack of legislative support for decarbonising the maritime sector, there has been a notable increase in consumption of biodiesel in major bunkering hubs such as Amsterdam-Rotterdam-Antwerp and Singapore. Fuels such as used cooking oil methyl ester (UCOME) can reduce emissions by as much as 90pc compared with fossil fuel alternatives, meaning that B30 blends (30pc UCOME, 70pc conventional marine fuels) offer an option to shipowners to reduce emissions with no required investments or operational changes.

Argus Consulting provides a two-year price forecast for these existing alternative fuels in the monthly **Argus Marine Fuels Monthly Outlook**.

Biofuels therefore represent a relatively simple means of emissions reduction, but feedstock availability and competition from other sectors represent significant hurdles that limit long-term growth: only around 10mn t of used cooking oil was collected and utilised in 2023. Although this number is likely to increase, these volumes will be required to service demand in road transport and aviation, both of which have firm mandates in place for the blending of biogenic fuels. That being said, there is potential for new pathways to be explored and new feedstocks to be utilised in biofuels production, potentially unlocking larger volumes for use across different transport sectors in the future.

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Methanol as transition fuel

In the absence of LNG or biofuels as transitional fuels, the most viable short to medium-term alternative is methanol, and the recent increase in orders of methanol-capable ships is often cited as indicative of a major shift in the industry. But inferring a long-term trend from these vessel orders is challenging, because we have limited visibility beyond the next 2-3 years. As an example, the Argus Alternative Fuels Vessels database is tracking around 250 methanol-capable vessels up to 2028, which equates to around 4mn t/yr of methanol demand but this is five times lower than the 2028 methanol demand forecast under the Argus IMO scenario ten times lower lower than the 2030 forecast (see chart below). With more than 1,000 vessels ordered each year, meeting this IMO scenario would require methanol's share of orders to grow from around 10pc to around 90pc by 2028.

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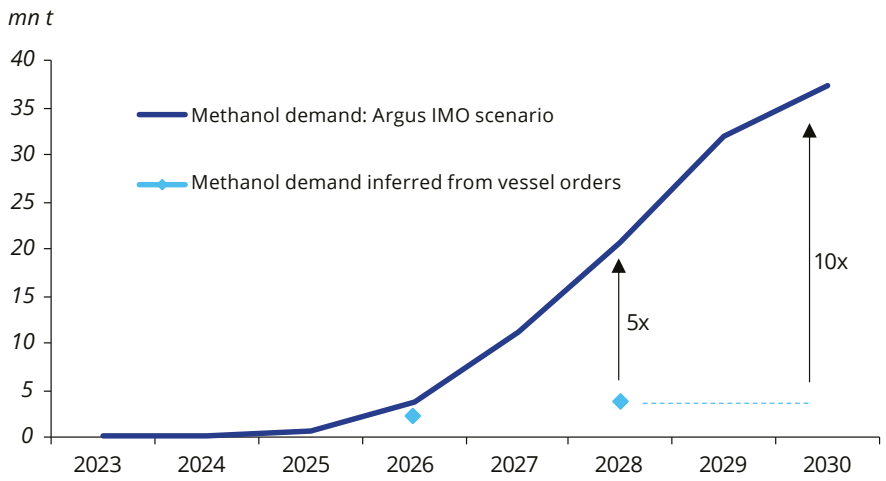
Methanol clearly has much appeal as a synthetic fuel that does not suffer from the challenge of competing uses, which stymies the widespread application of biofuels in the marine sector, nor the safety and bunkering challenges of ammonia. But over the longer-term, e-methanol is likely to be constrained by feedstock availability, specifically biogenic CO2, which leaves ammonia as the only realistic scalable option for the marine sector.

Ammonia is a few years behind e-methanol in its development as a bunkering fuel. Most importantly, ammonia will need to overcome safety concerns - market participants are looking to safety trials in Singapore in 2024 to start the process of establishing rigorous safety measures that can be rolled out worldwide. We expect this process to take 1-2 years and only once completed will we see concrete offtake agreements, the lack of which has been holding back final investment decisions (FIDs) on clean ammonia projects up to this point.



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Long-term challenge of e-fuel availability for marine sector

Ultimately, we cannot think about the marine sector outside of the wider context of the energy transition, as both fuels forecast by Argus to bear the brunt of marine decarbonisation — e-methanol and e-ammonia — depend on ready availability of renewable energy, a consideration that is changing very quickly owing to the rapid increase in renewable capacity. The IEA reported that 2022 saw the largest annual increase in renewable energy capacity at 295GW, only for 2023 to see that record smashed with the addition of 507GW. The UN Cop 28 climate summit in November agreed a target to triple renewable capacity by 2030 from 2022 levels, taking global capacity to 11,000GW, in line with the IEA's Net Zero Emissions by 2050 Scenario. Under the IEA's existing policies and market conditions scenario, global renewable capacity is 7,300GW by 2028, falling short of the tripling goal, while under its accelerated case scenario, global cumulative capacity exceeds 8,130GW by 2028, putting the world nearly on track to meet the global tripling pledge. With IEA forecasts consistently underestimating the growth of renewables over the past decade, it would take a brave soul to bet against this trend continuing.

But there are more bearish voices within the industry. In 2023, the Maersk McKinney Moller Centre released a report outlining constraints on the supply of renewable energy, which will put pressure on achieving marine decarbonisation. The key constraints listed were limits on accessing essential raw materials, constraints on offshore wind penetration owing to a lack of installation vessels and raw materials, the significant investment in transmission systems that increased generation capacity requires, and the skilled labour needed to develop and maintain renewable energy assets. None of these problems is insurmountable in itself, but the fact remains that other sectors will be first in the merit order for renewable energy, namely power generation and heating buildings. The transport sector will electrify all it can, but hard-to-abate sectors such as aviation and marine, dependent on molecules, will be hard-pressed to compete and, within those hard-to-abate sectors, aviation has clear penalties for non-compliance and a provision to make up the shortfall in the following year.

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We can see this prioritisation of easy-to-electrify sectors in the IEA roadmap to net zero by 2050. Emissions from electricity and heat is the largest category in 2020, representing close to 40pc of CO2 emissions while transport is close to half of this. In contrast, by 2040, emissions from electricity and heat are zero and transport represents around 45pc of total emissions. The upshot is that if the world misses its renewable targets even by a small percentage, there may not be sufficient feedstock to supply e-fuels for the marine sector, particularly in the 2030s as the world focuses on decarbonising electricity and heat. The Maersk McKinney Moller Centre

concluded that renewable electricity would be limited in the 2030s and possibly into the 2040s and concluded with the ominous warning: “Shipowners should be wary of relying on e-fuels alone for decarbonisation”.

This is all before we consider the constraints on electrolyser production capacity, the expansion of seaborne ammonia trade and the new storage infrastructure that will be required, all of which must be lined up to ensure consistent supply to the marine sector.

Resource-constrained forecast

The achievement of the IMO target also faces a structural constraint - the speed at which the fleet can be decarbonised. This is contingent on four factors:

Existing fleet

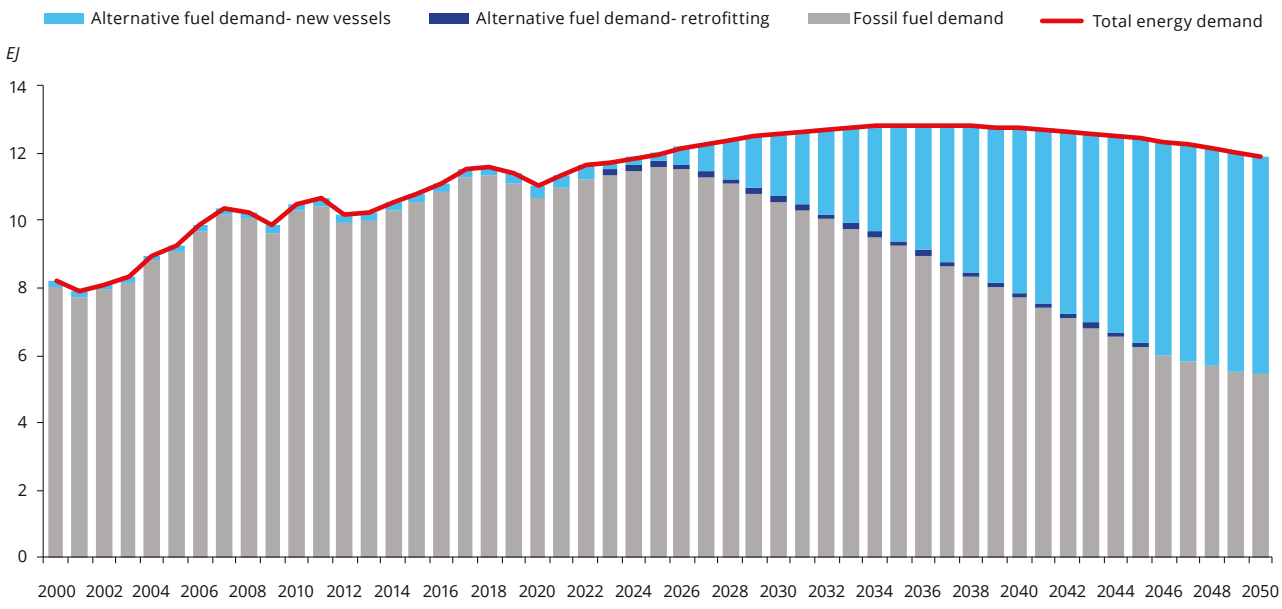
1
How quickly will older ships be scrapped?

2
What role can retrofits play in decarbonising newer existing ships? How will this vary by engine type?

New ships

3
What proportion of newly-commissioned vessels run on alternative fuels?

4
What proportion of the fuel burnt on those vessels is made up of alternative fuels?



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1. In recent years, the average scrappage rate has fallen from 2pc of dwt in 2016 to just 0.6pc in 2022. Achieving the IMO target would require annual scrappage rates closer to 5pc but, given the uncertainty around regulation and fuel availability, Argus understands that shipowners are making the opposite calculation, eking out more years from existing vessels. Roughly 15,000 ships are in line to be dismantled over the next decade but Europe lacks the capacity to recycle end-of-life vessels. This challenge is compounded by length and draught constraints, making it difficult to handle the larger ships expected to require recycling in the future. The European Commission has expanded the list of recycling facilities but also intensified the crackdown on unapproved yards, particularly in southeast Asia. For these reasons, we assume that scrappage rates will remain within historical bounds.

2. Existing vessels can be retrofitted to run on alternative fuels. While there are constraints related to vessel type, age and fuel owing to the higher tank sizes required for less volumetrically-dense alternative fuels, we estimate that around a third of the existing gross tonnage could economically be converted. However, we believe there is only sufficient spare shipyard capacity to retrofit 0.1 pc/year of existing fleet gross tonnage.

3. Despite the net zero commitment from IMO and threat of concrete penalties from the EU ETS and FuelEU Maritime, alternative fuels (including LNG and LPG) represented only around a quarter of new vessel orders in 2023. This means that close to 80% of vessels lack even dual-fuel capability, implying that the uncertainties around fuel availability (and perhaps regulation) outweigh the optionality benefits offered by dual-fuel engines.

4. Dual-fuel vessels operate by injecting a small amount of diesel oil as a pilot fuel. LPG has been shown to work effectively at 70pc substitution. LNG has a high substitution rate for dual-fuel engines ranging from 70-85pc. Methanol's substitution rate can be as high as 90pc using direct dual-fuel stratification. Wärtsilä claims that the new ammonia dual-fuel engine can reduce GHG emissions by more than 70pc, compared with a similar-sized diesel solution.

If we work these numbers through, we believe that the IMO's net zero target in 2050 will be difficult to attain without additional mechanisms to support the uptake of alternative fuels.

Conclusion: how to resolve the chicken and egg dilemma?

The picture for the shipping industry is somewhat contradictory. On the one hand, in theory, shipping should be one of the easiest of the "hard-to-abate" sectors to decarbonise - ships don't run the risk of falling out of the sky and have multiple options for decarbonisation, while the sector benefits from a global regulator in the IMO, and has in FuelEU Maritime the only combination of fixed penalties and concrete mandates to incentivise renewable fuels of non-biological origin (RFNBOs), and decarbonisation imposes only a limited economic impact on the price of shipped goods. From a technological perspective, methanol and ammonia dual-fuel vessels are available.

However, despite all of this, the industry is still riven with uncertainty and the tiresome "chicken and egg" dilemma remains unresolved. Vessel owners must invest in a highly uncertain climate: e-fuel availability for marine sector decarbonisation is uncertain, and ammonia – the most viable scalable option – must still overcome well-justified safety concerns related to burning as a fuel. The industry appears to be voting with its feet - fossil fuel-powered vessels, including LNG and LPG, continue to dominate the orderbook, despite the IMO's net zero pledge, while investments in e-methanol barely scratch the surface of what is required.

Ultimately, the industry is heading in the right direction but can only move so fast. We look forward to the 2025 deadline for the introduction of IMO 2050 implementation mechanisms, which will provide more clarity and more certainty about how trajectories should develop.

About the author

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Biography

Jack Merriott works at Argus Consulting on bespoke projects in low-carbon fuels, spanning clean hydrogen, clean ammonia and e-fuels for clients in the marine, energy, refining and fertilizer sectors

Jack has 15 years' experience in strategy consulting, strategic planning and market intelligence, spanning low-carbon fuels, fertilizers, industrial products and consumer goods.

Example credential

Jack worked on a consulting engagement with a ship charterer considering how to plan its future fuel strategy given the availability of alternative fuels for the marine sector.

The questions this customer sought to answer were:

- What is the effect of marine decarbonisation regulations on marine fuels demand?
- Which fuels are optimally placed to displace traditional fuels, given cost and emissions intensity?
- How will availability of renewable energy affect e-fuels supply and how should the marine sector plan accordingly?
- What role will drop-in biofuels play in the marine sector, given feedstock constraints and competing uses in road and aviation?
- What are the constraints to the availability of other bio-inputs, such as biogenic CO2, biomethane and biomethanol?

Argus Consulting

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