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INSIDE:

SHIP.ENERGY SURVEY 2025
MEDSECA
GHG PRICING
WIND PROPULSION

Here we go again!

Welcome to the latest edition of the ship.energy survey, in which our many respondents, old and new, take stock of what was achieved in 2024 and make their predictions for this year

Many of us had a strong sense of déjà vu going into 2025. Conflict in Ukraine and the Middle East continues, the climate crisis still looms – and Donald Trump is back in the White House. You may love him or loathe him, but there's no denying he knows how to command attention and he has the air of a man with unfinished business on his mind.

Will political uncertainties stymie shipping's energy transition – or is the movement towards new fuels now so firmly on track that even an allegedly climate sceptic US President cannot derail or impede its progress?

Are we looking at a new era of trade wars that could have a major impact on global commerce and shipping – or will the threats of tariffs and counter-tariffs give way to the art of negotiation and realpolitik?

Shipping has always proved impressively resilient in the face of adversity, and we have seen this again recently as vessels have re-routed round the Cape of Good Hope to avoid the Middle East danger zones. Will shipping now show the same tenacity in side-stepping the obstacles on its path to long-term profitability and sustainability? Let's find out if our survey respondents have the answers.

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contributors

Our pool of contributors for the ship.energy annual survey represents a broad cross section of the industry. Some participants answered the survey questions but chose not to make their comments public and we have, of course, respected their wishes.

We thank everyone for their contributions – and we are especially grateful to the following:

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Carrot and stick

We begin our annual ship.energy survey by asking our respondents to consider the effectiveness of the international regulations which have been introduced to curb shipping's emissions and support its transition to using alternative fuels and energy-saving technologies

The European Union (EU) has been making much of the running on regulations for maritime decarbonisation through its Emissions Trading System (ETS) and FuelEU Maritime (FEUM) – so these two initiatives are the starting point for this year's survey.

DO YOU BELIEVE THAT SHIPPING'S INCLUSION IN THE EU ETS IN 2024 HAS BEEN A SUCCESS SO FAR, AND DO YOU EXPECT THAT IT WILL HELP TO SUPPORT THE MARITIME INDUSTRY'S DECARBONISATION EFFORTS?

We'll hear first from respondents who answered this question with a No. In most cases, however, this was not so much a show of negativity as an acknowledgement that a great deal of work still lies ahead.

Erik Hoffmann told us: 'EU ETS has not been phased in fully yet and the carbon price is projected to rise, but so far we can't really say that the ETS has done much to bridge the infamous price gap between low- and high-emission fuels to curb emissions. It's been a carbon tax rather than a fuel switching regulation. When GHG emissions become part of the ETS from 2026 that will help to price methane and nitrous oxide – the other major global warming contributors. But the ETS will still lack a well-to-wake approach to account for the true emissions of a fuel pathway.'

Peninsula's **Nacho de Miguel** gave a global bunker supplier's perspective: 'I don't think it has been a success, at least in terms of the goal of decarbonising the maritime industry. The EU ETS operates on acceptable principles: the polluter pays. However, it has a significant bias: depending on where you pollute, you pay more, pay less, or don't pay at all. This regulation has introduced asymmetries that are causing shifts in traffic, mainly in container shipping, thereby reducing workloads and consequently wealth in European ports while redirecting it to non-European ports.'

He also flagged a concern that was shared by many: 'A regulation like the EU ETS can only be effective and avoid creating asymmetries if it is applied worldwide simultaneously, as is the case with the IMO's international regulations.'

Michael Schaap would like to see more

action, and on a global scale: 'The impact has not been felt that much, and in order to make a more significant impact, the rate needs to go up as soon as possible. Other countries and continents should consider a similar structure as well to make a real impact.'

Dimitrios Marantis also flagged up the problems that can be caused by one region going alone: 'The EU ETS is not sufficient because it is not applied globally; it rather creates an additional administrative and financial burden to shipping companies that operate in Europe, rather than incentivising decarbonisation.'

Among the respondents who took a neutral position on this question, **Nuala Doyle** gave a delicately balanced answer, pushing for regulations which are not only global in reach but cover a broader spectrum of the shipping fleet.

'The very fact that shipping has been included in the EU ETS is a success and brings about an additional means to drive maritime decarbonisation in the EU. However,' she continued, 'this success is tempered by the narrow scope of the ETS for the maritime sector. Not covering all international emissions, and being limited to vessels over 5,000 gross tonnage (GT) has led to key sectors of the industry not paying for the true cost of their emissions.

'Therefore, to be considered a true success, the EU ETS must be extended to cover all international emissions – until such a time as there is a robust global mechanism in place – and include emissions from vessels between 400 and 5,000 GT. Pricing these emissions will lead to a greater incentive to develop alternatives to fossil fuels for all voyages, with particular importance to the smallest vessels that can act as crucial offtakers for radical, new zero emission technologies such as battery electric and hydrogen propulsion.'

Alexander Prokopakis began by noting that 'shipping's inclusion in the EU ETS has raised awareness of the financial implications of emissions and encouraged investment in cleaner technologies' – although he judged that it is 'too early to fully assess its success after just one year'. Then, as befits the Executive Director of IBIA – the International Bunker Industry Association, he emphasised 'the importance of global regulations over regional schemes to ensure fairness, avoid market distortions, and promote a level playing field. Future developments should prioritise harmonisation with global frameworks, such as IMO measures, to support coordinated decarbonisation efforts across the industry.'

2050 Marine Energy owner and the current IBIA Vice Chair **Adrian Tolson** felt that 'the results so far have been underwhelming', as 'putting a price on CO_2 emissions seems such a small step to take and a long way from changing the decarbonisation story in shipping'. However, he said that EU ETS was 'better than nothing' and at least 'it's a start which does put some pressure on IMO'.

> 'The EU ETS operates on acceptable principles: the polluter pays. However, it has a significant bias: depending on where you pollute, you pay more, pay less, or don't pay at all'
>
> *Nacho de Miguel*

Alan Jones said that he was ticking the 'Don't Know' box on EU ETS for the following reasons: 'The data reported by EU Member States as of 2 April 2024 show a 15.5% decrease in emissions in 2023, compared to 2022 levels. With this development, ETS emissions are now around 47% below 2005 levels and well on track to achieve the 2030 target of -62%. European shipping and ships calling at EU ports became subject to the EU ETS in January 2024. Whilst much about the administration and operation of the scheme has become clearer in recent months, some elements of the EU ETS and its application to chartering, management arrangements and vessel operations have been more difficult to navigate due to limited guidance from the EU and Member States and the many variations of ship ownership structures, management and operation that are seen in the industry.

'There still remain difficulties which need to be fully considered by shipping industry participants to avoid pitfalls in the future,' Jones continued. 'Careful drafting of chartering clauses and ship management agreements must take into account these complex issues and parties must understand that, as the percentage of emissions allowances that are required to be surrendered rises year on year, reaching 100% in 2026, these liabilities will become increasingly significant.'

Kim Rosello hailed shipping's inclusion in the EU ETS as a 'milestone' in 'holding the maritime sector responsible for its carbon footprint', but she was another who emphasised the need for a level playing field. 'The EU ETS values carbon emissions, thus providing a financial incentive for shipowners and operators to invest in clean technologies and alternative fuels,' she said. 'This policy will therefore be fully in line with the general decarbonisation policies of the EU and reflective of a sound regulatory will for the solution of climate change.

'Early indications are that this initiative has so far raised awareness in the industry of long-term sustainable practices. Businesses have started weighing investment options in technologies related to energy efficiency, retrofitted vessels, and alternative fuels like LNG, biofuels, or even green hydrogen. Secondly, the framework has started catalysing dialogue about integrating the target of reduced emissions into corporate strategies so that decarbonisation becomes quite normal as a priority concern for every shipping business.'

Rosello then outlined some of the less positive aspects. 'Inclusion of shipping into the EU ETS was a bold step; however, the success is well debated,' she told us. 'Critics think that the present implementation does not have a global approach and creates a risk of market distortion, with EU-regulated shipping being at a disadvantage in competitive terms relative to other non-EU operators. This may be discouraging significant investment in meaningful technologies of decarbonisation, particularly those by companies operating globally.

'The financial burden of compliance may also weigh more heavily on smaller operators, reducing their ability to invest in cleaner technologies. There are also concerns about the sufficiency of available alternate low-carbon fuel options and infrastructure to meet the demand generated by the ETS. Unless these systemic challenges are resolved, the ETS is unlikely to stimulate the level of transformative change required for effective decarbonisation of the industry – it will merely have shipping fund other EU decarbonisation efforts.'

Now, let's hear from those who ticked the Yes box. They include **Eirik Nyhus**, although he had reservations: 'We have just wrapped up the first year of the transition towards the fully-fledged application of the ETS, and it is too early to conclude on its impact,' he said. 'The success of the ETS will be judged on how it is able to drive decarbonisation, but we cannot yet say whether this has already started to happen in 2024.

'It is still early days, but we expect that the

commercial logic of dealing with increasing emission costs will eventually contribute towards this goal, by making energy efficiency projects more commercially attractive and increasing demand for lower-emission fuels. And if as expected the cost of emission permits (EUAs) ramps up over the coming years, this will make both even more attractive.

'That said, it appears that global availability of alternative fuels is not yet increasing fast enough to meet the demand that the ETS and FuelEU Maritime creates. And while the increase in alt-fuel capable newbuilds is encouraging, it remains to be seen to what extent the availability and price of the fuel will make switching possible and commercially attractive.

'We hope that the IMO mechanisms currently under development and scheduled for entry into force in 2027 will supplant regional schemes such as the ETS and FuelEU eventually. However, while the EU legislation does have clauses mandating review in the light of IMO developments, we expect a fragmented regulatory landscape to remain the status quo through this decade.'

Allyson Browne said that: 'The EU ETS has injected much-needed urgency into the industry's decarbonisation efforts by putting a price on emissions, but there's plenty of room for improvement. We're seeing shipowners starting to explore cleaner technologies and experimenting with cleaner fuels, and we're learning where we need to focus our efforts for adoption at scale. It will be critical for Europe's policies including the ETS and FuelEU Maritime to support fuels development and uptake, and to consider alignment with global policy like the IMO GHG Reduction Strategy.'

Dionysis Diamantopoulos judged that: 'EU ETS' inclusion in shipping has been a success in that the maritime industry has started to adapt to this new reality, either by setting up the required accounts from the side of owners/managers or the side of charterers (i.e. trading accounts). The quick reflexes of our industry have shown that shipping can be agile and swift in adopting new protocols and processes to follow compliance pathways.

'In 2024,' Diamantopoulos continued, 'EU ETS required that 40% of the total reported emissions of the fleet calling at European/EEA ports were covered by emissions allowances, which is now ramping up to 70% in 2025. This increase, together with the implementation of the FuelEU regulatory framework, is creating a further push for the industry to explore the use of alternative fuels. This can be deemed a success, as the goal of the EU regulators is to incentivise efficiency (EU ETS) and further drive the uptake of alternative fuels (EU ETS + FEUM) to achieve the intermediary and future targets that have been set.'

Julien Boulland emphasised that EU ETS will continue to evolve – and hopefully allay some of the concerns that some of our survey respondents have raised: 'The introduction of shipping into the EU ETS regulation has resulted in a largely positive initial change within the industry, prompting shipowners and operators to engage with clean technologies and energy efficiency measures that will help to support regulatory compliance.

'Of course, the regulation is being introduced in iterations and currently only covers vessels over 5,000 GT which are obligated to achieve a 40% reduction in carbon emissions, with this percentage set to increase to 70% for the same vessel size in 2025. So, it is still too soon to definitively assess the longer-term impacts that the regulation will have on the industry.

'However, when considering the impact that EU ETS has had in other sectors, having been found to have reduced emissions from European power and industry plants by 47% from 2005 baselines for instance, the EU ETS framework should continue to support the maritime industry in its decarbonisation efforts.'

Goran Dominioni hoped that the EU ETS could be a spur, rather than an impediment, to action at IMO: 'The inclusion of shipping in the EU ETS is, in my view, a significant step forward for shipping decarbonisation. It has been in the making for over 10 years, and it finally happened. The positive impact of the extension of the EU ETS to shipping is due to the instrument itself (for the GHG price and revenue use), but also for the political signal it sends to the IMO and other jurisdictions. If multilateralism does not work, unilateralism will be the answer, but this can come at a cost for many.'

> 'The EU ETS values carbon emissions, thus providing a financial incentive for shipowners and operators to invest in clean technologies and alternative fuels'
>
> *Kim Rosello*

Pekka Pakkanen felt that the spur is already working, as he believed that: 'A sign of the EU ETS' success and ongoing potential is that the IMO has taken note and looks set to introduce a global carbon levy – as discussed at MEPC 82 in October 2024. Carbon levies such as the EU ETS are widely recognised as a low cost and relatively simple economic measure for incentivising greenhouse gas emissions reductions.

'We have not seen the full impact of the EU ETS either,' Pakkanen continued, 'as it continues to be phased in, the share of emissions that needs to be covered by emissions allowances (EUAs) will rise to 100% in 2026 within the EU, and 50% for voyages between an EU and a non-EU port. According to analysis from Clarksons Research based on 2022 trading patterns and an EUA price of $90 per tonne, the total cost of EUAs for shipping could rise to $8 billion by 2026 from an estimated $3.3 billion in 2024.

'Those figures demonstrate the importance of making the most of existing and proven technology to reduce GHG emissions in the short term. Every percentage of fuel saved will help reduce the EU ETS bill for shipping, helping companies remain competitive. The most obvious place to start is voyage optimisation, which has the twin benefit of minimising fuel consumption and emissions, and offering more predictability for companies. This should be a no-brainer, as those systems can already be deployed with little to no CAPEX and cut emissions on all trips, from shorter intra-European journeys to long international deep-sea voyages.'

Dana Rodriguez agreed that the inclusion of shipping in the EU ETS would help encourage ship owners to 'look at investing in decarbonisation solutions like energy efficiency technologies and retrofits, near-to zero emission vessels, and alternative fuels'. However, she joined the chorus of voices calling for a 'globally encompassing approach to decarbonisation' from the IMO.

Ingrid Irigoyen was also hoping for 'mid-term measures from the IMO that send clear signals to the emerging clean energy-powered fuels markets' – and warned that: 'Falling short could result in unpredictable pathways and a fractured regulatory environment that impacts the ability of freight buyers to successfully operate their global businesses.'

Ruben Tins gave a bold perspective on how the EU's initiative could be dove-tailed with future IMO developments. 'EU ETS is a

'The success of the ETS will be judged on how it is able to drive decarbonisation, but we cannot yet say whether this has already started to happen in 2024'

Eirik Nyhus

"Polluter Pays" mechanism and is the only mechanism that gives a direct financial incentive to reduce emissions,' Tins said. 'It both incentivises the reduction of fuel consumption and the use of renewable fuels. Even though EU ETS alone is not enough to cover the premium of renewable fuels, it does help in closing the price gap.'

Looking ahead, Tins speculated that: 'There could be a possibility of extending the authority of the ETS to international waters, meaning that the regulation would not only apply within the EU but would be extended to cover all voyages globally. Another potential scenario is that the ETS could be integrated into the IMO's carbon levy approach, should the uptake of the system prove successful.'

Jesper Sørensen is hoping the EU ETS could encourage more shipping companies to follow the example being set by the forward-looking first movers.

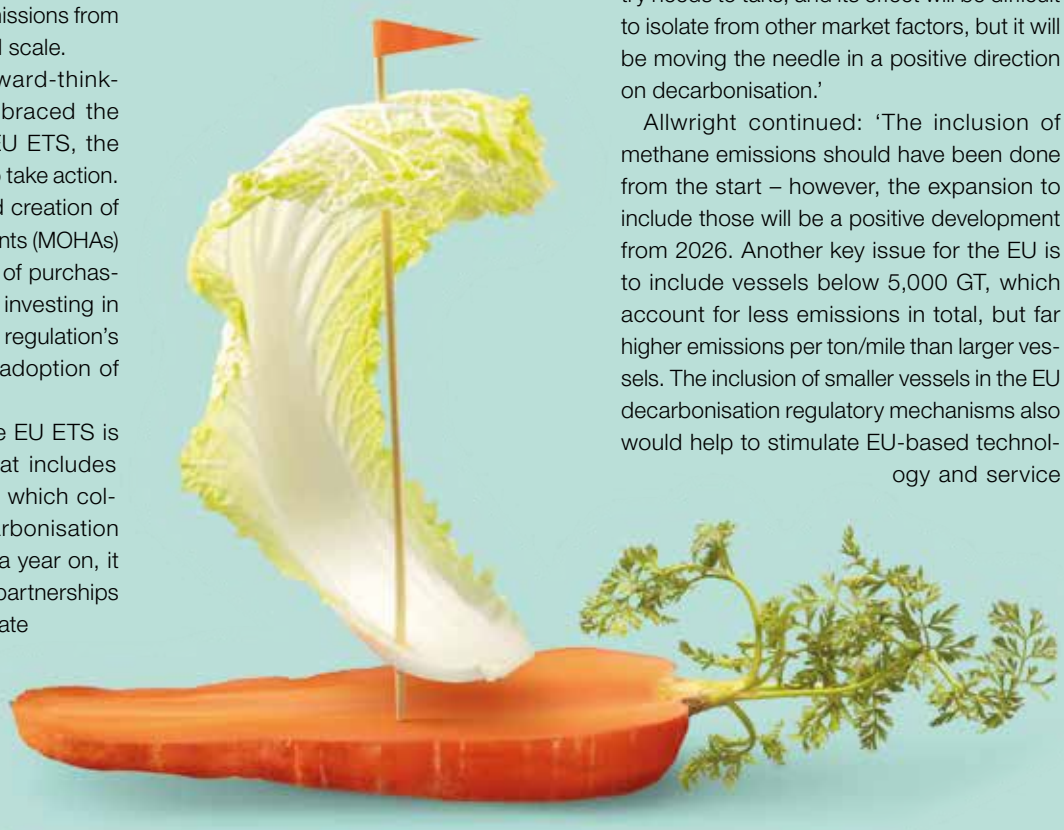
'Shipping's inclusion in the EU ETS has been a success in laying the groundwork for linking emissions directly to financial consequences,' he judged. 'It also helps mark one of the first steps in addressing emissions from the maritime industry on a global scale.

'However, while some forward-thinking vessel operators have embraced the decarbonisation spirit of the EU ETS, the industry at large has been slow to take action. Challenges such as the delayed creation of Maritime Operator Holding Accounts (MOHAs) and the current cost advantage of purchasing EU Allowances (EUAs) over investing in alternative fuels have limited the regulation's ability to catalyse widespread adoption of cleaner energy solutions.

'Despite these obstacles, the EU ETS is part of a broader package, that includes initiatives like FuelEU Maritime, which collectively aims to enforce decarbonisation across the industry. More than a year on, it has paved the way for essential partnerships and strategic planning to accelerate the energy transition.

'As the EU ETS matures and integrates with other regulations, it has the potential to spark long-term, industry-wide change. The lessons learned from its implementation will undoubtedly inform future frameworks, helping to ensure that regulatory measures encourage faster adoption of alternative fuels and technologies.'

Leon Arets also emphasised the importance of galvanising the industry into action. 'The (gradual) inclusion of shipping in the EU ETS is a first step of creating more awareness in the shipping industry that efforts with regards to decarbonisation need to be made,' he said. 'However, more needs to be done in order to really push the maritime industry to step up its game as currently the price difference between fossil+EU ETS compared to the cost of sailing on low carbon fuels such as biofuels is still too big and shipping is simply passing down the cost of EU ETS to its customers. Only once the cost of fossil+EU ETS (+CII and FuelEU Maritime) is getting close the cost of low carbon fuels, we should see a much needed balance shift. Shipping companies should be properly incentivised to invest in the solution: reducing their emissions with widely available solutions like biofuels, rather than closing their eyes to the problem by paying a fine and not having to deal with the actual consequences.'



Gavin Allwright pointed out that the success of any policy – including the EU ETS – can be 'judged in multiple ways'. These could include looking at it 'from a structural or procedural perspective through the passage and process of constructing the policy, the achievement of the negotiation and passing of the given policy'. Alternatively, Allwright continued: 'It can be assessed from a strategic perspective, i.e. is the message that the policy sends to those being regulated being heard, whether the intent of the policy is manifest and is the desired behavioural change underway and delivers on the stated aims and objectives. Or it can simply be judged on the more practical merits of whether the policy has been implemented well and all those subject to it are well-informed and understanding of the structure and how that impacts their business.'

Overall, Allwright considered: 'Including shipping into the EU ETS has been relatively successful in the first case – although from a strategic perspective it is still too early to tell. Nevertheless, the message has been delivered into the market and is deemed to be a building towards a significant cost that will need to be mitigated, especially between EU countries. In this, it is one lever among others signalling the direction of travel that the industry needs to take, and its effect will be difficult to isolate from other market factors, but it will be moving the needle in a positive direction on decarbonisation.'

Allwright continued: 'The inclusion of methane emissions should have been done from the start – however, the expansion to include those will be a positive development from 2026. Another key issue for the EU is to include vessels below 5,000 GT, which account for less emissions in total, but far higher emissions per ton/mile than larger vessels. The inclusion of smaller vessels in the EU decarbonisation regulatory mechanisms also would help to stimulate EU-based technology and service

providers and the retrofitting and building of those smaller vessels is often undertaken in EU yards, whereas larger vessels are often serviced outside of the EU zone.'

Matthew Smith told us that 'from Tankers International's perspective' – which is a useful viewpoint to have, as it operates the world's largest pool of very large crude carriers (VLCCs) – the inclusion of shipping in the EU ETS 'represents a significant step in aligning the maritime sector with wider climate goals'.

Smith continued: 'With the incorporation of a reduction factor, EUAs are structured to encourage price appreciation, creating a strong financial incentive for investment in emissions reduction initiatives and clean technologies.

'Compared to FuelEU Maritime, compliance costs under the EU ETS are relatively straightforward to pass on to charterers. This helps minimise the immediate financial burden on shipowners, making it an easier transition to begin with. However, many shipowners may prioritise short-term cost management strategies, such as shifting costs to charterers, instead of committing to substantial investments in decarbonisation.

'To help develop EU ETS in the future, it would be beneficial to include additional vessel types and smaller emitters to ensure a level playing field. The reduced emission caps can create stronger incentives for investment in clean technologies.

'However, the ultimate effectiveness of this system will rely on the ability to adapt and the successful implementation of supporting policies. Over time, key refinements such as strengthened global coordination, increased reinvestment in green technologies, and a broader system scope will play a crucial role in establishing the EU ETS as a long-term driver of decarbonisation within the sector.

'A key challenge during the first year of implementation has been the difficulties faced by many participants in establishing MOHA's and trading accounts. This issue has the potential to expose participants to heightened price risks and non-compliance penalties. Addressing these barriers will be essential to ensuring the system operates efficiently and achieves its full potential.'

DO YOU BELIEVE THAT THE SHIPPING INDUSTRY IS SUFFICIENTLY PREPARED FOR FEUM – AND HOW DO YOU ENVISAGE COMPANIES WILL BALANCE THE REQUIREMENTS OF EU ETS AND FEUM COMPLIANCE?

We'll begin by letting **Alan Jones** set the scene and flag up some of the concerns shared by many of our respondents: 'The Regulation promotes the use of renewable, low-carbon fuels and clean energy technologies for ships, thereby supporting the decarbonisation of the maritime sector. Many within the relevant shipping domains have not had a real chance to digest the regulations requirements and understand what is expected of them.

'The FEUM is significantly percentage driven with an initial 2% running up to 80% reduction in pollution by 2050. This will require either massive costly refits to adopt the inclusion of new net zero alternative fuels and/ or the same application to next gen vessels. However, these have additional issues relating to the availability of such fuels and the current lack of value chain infrastructure to support this implementation.

'The application of compliance balance could be a secondary measure,' Jones noted. 'If you are in a negative balance mode, this can be overcome by pooling with over-compliant ships to attain an overall pool compliance – or if this is not a viable option then the payment of a penalty is the alternative measure. Such compliance rules need to be made less complex if they are to be adopted and, in some cases, defeat the objective of integrating net zero fuels. For example: who is the legal party, for example the ISM company has been initial assigned this role. This misaligns the interactions between the MRV, ETS and FEM and will cause information challenges with owners and ISM companies. Real time data will be required to satisfy both commercial requirements and contractual obligations.'

Steve Esau said: 'Those fleet operators who operate and who have ordered LNG dual-fuel vessels will be better positioned to comply with FuelEU Maritime and will also face lower costs under EU ETS because of the lower greenhouse gas emissions associated with the use of LNG as a marine fuel. Today, LNG is able to comply with FuelEU Maritime up until 2039 in its fossil form, depending on the dual fuel engine technology. The regulation's pooling mechanism allows fleet operators to take advantage of fossil LNG's initial overcompliance. This generates credits, which can be used to ensure operators meet GHG intensity limits for their fleets as a whole. Alternatively, credits can be traded with other fleet operators. The FuelEU Maritime pooling mechanism also stimulates demand for liquefied biomethane and e-methane because of the additional credits these fuels are able to generate.'

Dimitrios Marantis gave a compact summary of his concerns: 'FuelEU creates a further administrative & financial burden to shipping companies that operate in Europe. It over-promotes the biofuel usage despite its limited availability; also, it doesn't include any provisions for the future nuclear-powered vessels. Last but not least, there is no guarantee the funds collected through EU ETS & FuelEU schemes will be directed towards decarbonisation projects.'

Erik Hoffmann felt many in the industry will be feeling the shock of the new: 'GHG intensity is a very alien concept to large swathes of the shipping and bunkering industries. It's a new way of thinking about fuels, not just as vanilla-traded commodities, but as sustainable across their lifecycle. Some companies have obviously entered 2025 well prepared, having done their homework months or years in advance, while for day-to-day spot traders FuelEU has presented a steep and challenging learning curve.'

Julien Boulland is well-placed to field this question because, as he pointed out: 'As a leading classification society, it is the role of Bureau Veritas (BV) to support the industry as it adapts to newly introduced regulations.' He explained what BV has been doing in this role: 'The industry has been aware of the introduction of FEUM since the announcement of the EU's Fit for 55 package, in 2021. In that time, BV has developed information and advice as well as dedicated seminars to help owners and operators understand the details of the provisions and what is required from them in order to remain compliant.

'BV has also partnered with leading organisations, such as OrbitMI, to develop intuitive and easily integrated platforms that will support shipowners in managing their compliance processes. VeriSTAR Green is BV's cloud-based application which is designed to help shipowners comply with various IMO and EU regulations, including EEDI, CII, EU ETS, and FuelEU Maritime.'

Boulland then tackled the issues of balancing FEUM and EU ETS: 'The introduction of FuelEU Maritime complements the objectives of EU ETS by directly addressing the GHG intensity of the fuels used within the shipping sector, which in turn will promote the uptake of alternative low-carbon fuels. The regulation's technology-agnostic approach is also designed to prompt innovation and development within new fuel technologies.

'FEUM includes mechanisms to support compliance – namely borrowing, banking, and

pooling – which provides an element of flexibility in terms of how compliance is achieved, whilst the pooling system also allows operators to balance surpluses and deficits across their fleets. However, as the EU has acknowledged, compliance will be easier for more modern vessels than older ships where emissions are harder to abate.'

Most of our respondents felt that shipping companies were not ready for FEUM – and not so much because of inactivity on their part, but because of the scale and complexity of the regulations, and perhaps a lack of clarity in how they have been presented.

Goran Dominioni believed that: 'The aims of the two measures, and how they complement each other, could be communicated more clearly.'

Dionysis Diamantopoulos also emphasised that there is a great deal of complexity to master. 'Some are well prepared to face FuelEU regulation, but many do not understand the legislation and the compliance issue which come with it,' he warned.

Diamantopoulos then speculated that the advent of FEUM and the like could mean that 'traditional bunker trading and purchasing will soon be obsolete.' To prepare for this future, he said: 'The bunker trader needs to assume the role of an expert consultant who can guide the customers and their relevant departments, teams, purchasers, and bunker desks through the complexity of regulations and pathways to compliance.

'Companies must find the right counterparties able to assist them in properly understanding the regulations, implementing processes to accurately calculate the effect of the regulations, and provide thorough market knowledge relating to available pathways of compliance – including cost-benefit analysis. For example, the availability of specific biofuels or blends, and discussion around future alternative fuel options such as sustainable types of methanol or ammonia.'

Technology will play a key role, he continued, as: 'Platforms such as [Baseblue's] Fuelink allow users to monitor vessels, have control of bunker operations, and explore different scenarios and pathways of compliance, with different alternative fuels, comparing costs and impact Vs typical conventional fuels.

'Companies that have a solid global reach and access to different physical suppliers in a wide array of ports globally will provide competitive advantage, and it is also essential that counterparties have the appropriate certifications that allow the trader to provide sustainability documentation accepted by the verifiers.

'Companies that manage to create an ecosystem with close, trusted collaborators and take a proactive approach to understanding the regulations and compliance options will have no trouble in swiftly creating a mechanism that allows them to save time and effort, seamlessly transitioning in this new era.'

Leon Arets agreed that meeting the FEUM challenge is a daunting task – and urged fuel suppliers to work with the shipowners to achieve compliance: 'It is the first time ever that the shipping industry is confronted with a regulation to lower the GHG intensity of energy used on board. It requires a thorough understanding of what is exactly required in order to be compliant and a (more strategic) view on the years to come (as with the banking and borrowing mechanisms, parties can take decisions now or postpone them based on their view of future cost of decarbonisation).'

He continued: 'It also means that parties who are postponing their decision-taking until the last minute may be confronted with the most expensive compliance option (this being the penalty). This will unlock new market dynamics and probably also lead to new ways of pricing energy (whereby the actual GHG intensity of the (bio)fuel is also taken into account).

'Due to this complexity, there are many shipping companies considering to simply pay the penalty and pass on those costs together with EU ETS to their customers, which may eventually prove to be a competitive disadvantage.'

But Arets argued that: 'This behaviour is not needed as there are cost-competitive solutions available by using low carbon (bio)fuels and monetising the forthcoming over-compliance by means of pooling.'

This is where FincoEnergies and GoodFuels can help out. 'Even though we started out as solely an end-to-end fuels provider,' Arets explained, 'we now offer both routes to compliance; shipping companies can either take delivery of GoodFuels biofuels or sign up their vessel(s) with FincoEnergies PoolEU. We strongly feel that it is our responsibility as a sustainable fuels supplier to allow more shipping companies to benefit from the direct decarbonisation impact of biofuels, even when they don't have direct access to lower carbon fuels because of technical or geographical boundaries.

'As a fuels provider by nature, we are stepping out of our comfort zone this year also, by providing an innovative new service and taking over the administrative burden from the shipowners. But we realise that we all have a part to play to make decarbonisation of global shipping work. In the end, it's all about moving the CO_2e-reduction needle and as an industry, we are still best equipped to make an impact this year and lead by example, aided by the regulatory package.'

Helge Hermundsgård gave us a Yes and No answer to this question, because: 'There are some differences in the levels of preparedness, with about one third of companies still coming to grips with the requirements of the regulations, while the remaining two-thirds are already looking more deeply at the practical or enabling mechanisms, like vessel pooling, adjusting charter contracts, and making sure they have high quality verified data.

'To dig a little deeper, with the introduction of the FEUM from the EU ETS,' Hermundsgård continued, 'we go from historic CO_2 emissions (EU ETS) to a well to wake GHG footprint which enables relocation of the emissions created (or not). And I think this is something the industry is still grappling with, because it means we need to look at how the commercial contracts reflect these new responsibilities – right across the value chain. There will be additional costs, and being on top of the different mechanisms for coverage is essential. BIMCO released their time charter terms for FEUM just before Christmas, and this is a good start, but I think we will see many versions of terms covering FEUM.

'Quantifying compliance and commercial terms will rely on high quality data. And once again there are different levels of preparedness between the players who have taken steps to ensure they have "one universe" of data. This means having a data set that is consistent across all parties, from the ISM company, regulators, operators, to charterers. At DNV we think it's best to have con-

'The introduction of FuelEU Maritime complements the objectives of EU ETS by directly addressing the GHG intensity of the fuels used within the shipping sector'

Julien Boulland

tinuous verification of this to ensure efficient management and control, which will also help resolve any issues.

'Finally, on FEUM, having a compliance strategy in place – most notably securing low-cost compliant fuels like biofuels – is marking out the early movers from the rest of the pack. Because in today's market, paying the fine is not going to be the most cost-efficient path to compliance. But here we really need to see how the market for alternative fuels continues to develop as demand grows.'

Alexander Prokopakis believed that: 'While there is growing awareness of the FuelEU Maritime, the industry's preparedness varies widely.' He also felt that: 'Companies face challenges in understanding how FEUM and the EU ETS align, as their objectives and mechanisms differ.'

Michael Schaap said that FEUM is 'a great opportunity for those that have invested time to understand this', but felt that 'interpretations are different between stakeholders, advisors, class and governments on how to implement going forward'.

Pekka Pakkanen pointed out that the shipping industry is 'so vast and diverse' that it is hard to say how prepared the sector is, as a whole, for FuelEU Maritime and EU ETS. However, he emphasised that: 'What is clear, is that it is essential for companies to have a strategy in place for reducing emissions in line with the tightening requirements of EU ETS and new demands of FuelEU Maritime. This relies on being able to track and manage performance at a vessel and fleet level, which will require comprehensive data, and the right tools to enable everyone from captains to board rooms to make sense of it. In the longer term, this comprehensive understanding of one's operations will also be an essential foundation for the transition to the zero-carbon fuels that will be required to comply with FuelEU.'

Kim Rosello also saw varying levels of preparedness, with company size being a factor. 'Large shipping companies,' she judged, 'are well-positioned to navigate compliance challenges, leveraging resources and advanced technologies to achieve economies of scale, access alternative fuels at lower costs, and form strategic alliances. Independent traders, however, may struggle without significant collaboration or external support.

'While FEUM and EU ETS create overlapping compliance pressures, they also offer opportunities to streamline strategies. Large operators will likely integrate compliance into broader sustainability initiatives, investing in technologies like fuel-efficient engines and digital fleet management to align with regulations and maintain competitiveness.

'Smaller players face greater financial burdens and may rely on partnerships, shared resources, and collective bargaining for low-carbon fuels. Collaboration with governments, financial institutions, and technology providers will be essential to levelling the playing field.

'Workforce training and operational transparency will also be crucial. A well-trained workforce can manage compliance complexities, and transparent reporting will build trust with regulators and stakeholders. Success will require proactive planning, strategic investments, and fostering sector-wide collaboration.'

'Larger companies are reasonably well prepared for FEUM whereas smaller operators have been struggling to get to grips with the new regulation and the ramifications of non-compliance'

Gavin Allwright

Albert Leyson was another who detected a disparity between large and small operators' awareness because of the different levels of resources they can commit to gathering information. He also pointed out that ship operators based in Europe may also have an advantage, as they are better placed to send representatives to in-person seminars on the subject.

Gavin Allwright agreed that 'larger companies are reasonably well prepared for FEUM whereas smaller operators have been struggling to get to grips with the new regulation and the ramifications of non-compliance'. In addition, from his vantage point at the International Windship Association (IWSA), he has spied 'a growing appreciation among all stakeholders of how wind propulsion system installations are a good option for compliance and lowering costs for both the FEUM and EU ETS'.

'With the FEUM,' Allwright informed us, 'there is the wind propulsion 1-5% 'reward factor' and this is encouraging shipowners to consider this technology basket as a way to be fully compliant with the initial FEUM 2% reduction step from 2025-2030 and also deliver pooling benefits for the rest of the fleet if substantial wind propulsion systems are installed. At the same time these retrofit systems are also delivering 5-20% reductions in fuel consumption, thus reducing the exposure to EU ETS costs too.'

Diane Gilpin also assured us that Smart Green Shipping (SGS) has seen a 'significant uplift' in market interest for wingsail technology as 'a simple close-to-market compliance solution'. But she added: 'I would also say that the "FuelEU" mechanism is very beneficial for the wind-assisted propulsion system (WAPS) providers but the FuelEU nomenclature underlines the inability for the industry and policy makers to think about whole energy systems – it is not just 'fuel' that can provide energy to ships. We should rethink our use of the F-word.'

Adrian Tolson declined to say if the industry was ready for FEUM but said he was 'sure' that 'the pooling concept will benefit some again in the short and medium term'. **Ruben Tins** shared this view, saying: 'There is an increasing consideration within the industry for pooling as a flexible and potentially cost-saving mechanism, particularly in comparison to using alternative fuels or biofuels. Pooling may provide a more adaptable solution to meeting the FEUM requirements. Therefore, while the industry is not yet fully prepared, pooling could be the key to compliance and companies will need to be ready to adopt this approach in the near future.'

Dana Rodriguez included some thoughts on pooling in her answer: 'I am not quite sure if the shipping industry is fully prepared for FEUM, and frankly I am not sure average citizens, and the economy are prepared for it. There is of course much enthusiasm from many decarbonisation first movers, but in reality, the recipe for a successful FEUM is not fully there – as in the infrastructure for the e-fuels needed to meet FEUM. However, the good thing about FEUM is the opportunity to "pool" emissions, as in one ZEV can fully benefit a pool of ships. Is this good? Yes for industry, but in the long term probably not for the upscale of e-fuels and unsure if it is good for the long term need to sustainably decarbonise.'

Having flagged up the opportunities for pooling, let's hear from Tankers International's **Matthew Smith**: 'The shipping industry's preparedness for FuelEU Maritime varies

'There is an increasing consideration within the industry for pooling as a flexible and potentially cost-saving mechanism, particularly in comparison to using alternative fuels or biofuel'

Ruben Tins

significantly. FuelEU Maritime is far more complex than the EU ETS. While EU ETS costs can easily be passed on to charterers, FuelEU requires far more complex contractual wording to ensure compliance and associated costs are handled correctly. The mechanism to transfer the cost is much more difficult, something particularly notable as long-term non-compliance costs for FuelEU are also much higher than EU ETS. All of this creates a stronger need for action.

'While some FuelEU costs can also be passed to charterers, time charterers or pools – like TI – will also bear the cost of this. However, the mechanism for doing so will be different to that of EU ETS. FuelEU also requires far more complex contractual wording to ensure compliance and associated costs are handled correctly.

'A key consideration for the industry is evaluating whether investing in compliant fuels, such as biofuels or other green alternatives, offers better long-term value than simply absorbing penalties or other solutions such as buying compliance from compliance pools. This decision requires careful analysis of cost implications, fuel availability, and potential technological advancements. Tankers International will help pool members explore the different fuel types to achieve compliance and weigh up the cost benefit of that.

'Over-compliance can create surplus emissions credits, which may be pooled or banked for future use, offering operational flexibility and long-term cost savings. Pooling has the potential to create a significant advantage and using our industry insight, we can advise on the approach that makes the most commercial sense'.

Smith highlighted another benefit to be had from pooling: 'Having the right relationships in place and a real idea of the quantities you're going to be buying over time too will be important. Tankers International's scale, relationships and buying power will be a benefit – as a pool, we buy large quantities of marine fuels from various sources around the globe, enabling us to have a strong understanding of data transparency. By leveraging these established relationships, we can alleviate concerns relating to availability and cost.'

Turning back to the industry's preparedness, the TI COO noted that: 'While some companies have proactively invested in alternative fuels, energy efficiency, and robust monitoring systems, many are still navigating the practical challenges these frameworks introduce.' He went on to advise that: 'A proactive approach to compliance, including over-compliance, offers significant advantages:

- Cost Savings: Early adoption of clean technologies and low-carbon fuels can mitigate rising allowance prices and tighter regulations;
- Market Positioning: Leadership in sustainability enhances reputation and attracts eco-conscious customers or partners.
- Financial Gains: Exceeding FEUM requirements may create compliance surpluses, potentially valuable in emissions markets or pools.

'While larger companies are generally better prepared, smaller operators may face more challenges. Success will ultimately depend on regulatory clarity, industry collaboration, and forward-thinking investment in sustainable practices and technologies. Integrating compliance strategies for FEUM and the EU ETS presents an opportunity for companies to achieve both cost and competitive advantages.'

Smith also picked up on our supplementary question regarding FEUM and EU ETS compatibility, telling us: 'FEUM and the EU ETS, though complementary, differ significantly in their approaches. EU ETS imposes a direct financial cost on emissions through the purchase of allowances, incentivising carbon reduction. FEUM sets strict caps on the carbon intensity of energy use, driving the adoption of cleaner fuels and operational efficiencies.

'To comply effectively, companies must adopt integrated strategies that align fuel procurement, operations, and emissions monitoring. For instance, transitioning to low-carbon fuels can help meet FEUM targets while reducing costs under the EU ETS. Accurate data and analysis will also be critical to optimising compliance.

'Some operators may struggle with the distinct objectives of FEUM and the EU ETS, given the former's performance-based focus and the latter's market driven structure. Misunderstandings could lead to inefficiencies or non-compliance. Clear guidance from regulators and industry groups will be vital to addressing this and ensuring smooth integration of the two systems.

'Despite these challenges,' Smith concluded, 'the frameworks do complement each other: FEUM's carbon intensity limits naturally reduce emissions subject to EU ETS allowances, while the ETS incentivises investments needed to meet FEUM requirements.'

Nacho de Miguel didn't think that players in the maritime industry – or most marine fuel producers – were fully prepared for FEUM and pointed out that: 'The requirements for using fuels with a lower GHG emission factor (a demand imposed by regulation) go beyond the actual production capacity of these low-GHG fuels.' However, he judged that: 'Thanks to

the pooling mechanism, operators who have invested in more modern tonnage or cleaner propulsion technologies will be able to ensure the rest of their fleet complies with FEUM.' Unfortunately, he added: 'Many other operators will have no choice but to pay penalties.'

He also gave a view on EU ETS and FEUM compatibility, which he judged to be 'complementary', as: 'The former imposes an additional cost in $ per ton of CO_2 emitted, that is, based on what you emit, that depends on your bunker utilised and the way your vessel is operated. The latter obliges the consumption of specific fuels, cleaner ones that are still not widely available, at a much higher cost than conventional bunker fuel, with penalties if this obligation is not met.'

Allyson Browne's response allows us to close this debate on a positive note: 'Compliance is not a new concept for the industry (think of all the safety features built into vessel design and operation), so I have no doubt that the industry is up to the task here. The challenge with EU ETS and FEUM lies in harmonising strategies to navigate overlapping requirements while preparing for global regulations on the horizon.'

DO YOU ANTICIPATE THAT WE COULD SEE FURTHER REGIONAL MARITIME EMISSIONS TRADING SYSTEMS – OR A GLOBAL SYSTEM – EMERGING SOON?

'If we are solely talking about direct GHG emissions regulatory frameworks,' replied **Gavin Allwright**, 'then the answer is a qualified yes. If we are talking about the wider "climate impacting" emissions framework, inclusive of non-GHG emissions such as Black Carbon, Underwater Radiated Noise, Fugitive Hydrogen emissions etc., then that is a definitive no. Regarding specifically maritime carbon emissions trading systems, then we have substantial measures under consideration in the IMO which are likely to keep in check the proliferation of regional schemes until the outcome of the negotiations is evident in the Autumn. Whether a trading scheme or some other framework will be decided upon is subject to much speculation, a lot of politicking and some uncertainty of whether a robust, fit-for-purpose resolution will be delivered. There is certainly a lot of good intent, however if the IMO fails to deliver on this, then I can see a movement towards regionalism picking up pace in some areas, while others may well back track and take this lack of binding global regulation as a licence to operate as "business as usual".'

Given that this question called on our respondents to take an international perspective on regulations and ETS, we were particularly interested to hear from the International Chamber of Shipping's (ICS) Secretary General **Guy Platten**, who judged that: 'We are currently experiencing a rise in new unilateral regulations and emissions trading systems that will act as barriers to free trade and have negative impacts in both the short and long term.

'Unfortunately,' Platten continued, 'unilateral regulation such as an ETS, however well-intentioned, will have little effect in disincentivising the acts, policies and practices of other countries, but could also damage national import and export market competitiveness, and increase costs for consumers.

'Frankly, the world economy is already facing a considerable number of issues, including conflicts, tariffs, and labour availability, all during a time when we are pushing towards decarbonisation. Increased protectionism will simply make this journey to net-zero harder, and impede global trade and economic growth.'

> 'A global industry requires global regulations. The ICS-proposed greenhouse gas emissions pricing mechanism for international shipping is an ideal example of a global solution that will work for the entire industry'
>
> *Guy Platten*

Platten then focused on the Chamber's much-discussed proposals to IMO: 'A global industry requires global regulations. The ICS-proposed greenhouse gas emissions pricing mechanism for international shipping is an ideal example of a global solution that will work for the entire industry. Just recently, the International Chamber of Shipping joined 47 governments in the joint submission of this mechanism to the final round of negotiations at the United Nations' International Maritime Organization (IMO). This will require shipping companies operating ships on international voyages to make GHG contributions per tonne of CO_2e emitted to a new 'IMO GHG Strategy Implementation Fund'.

'The key purpose of this mandatory GHG charge will be to reduce the cost gap between zero/near-zero GHG emission (ZNZ) fuels (such as green methanol, ammonia and hydrogen) and conventional marine fuels, to incentivise the accelerated uptake of green energy sources. Revenue generated will be used to reward the production and uptake of ZNZ fuels, whilst also providing billions of US dollars annually to support the maritime GHG reduction efforts of developing countries.'

Opportunity Green's **Blánaid Sheeran** gave us a climate NGO's perspective on the developments going on that the IMO: 'At the international level, we hope to see agreement on a specific set of global measures, including technical and economic elements, that will drive emissions reductions in shipping and ensure justice and equity in their design and implementation. Without global action, there is a risk that local and regional regulation will lead to a piecemeal adoption of measures. This could create a fragmented regulatory landscape, which does not facilitate a global transition and could intensify socioeconomic and climate-related inequities between countries.

'In 2025, the IMO is set to adopt a global GHG pricing mechanism, the design of which is essential for ensuring a just and equitable transition. A high price on all of international shipping's GHG emissions could help to drive decarbonisation at global scale and its revenues can be used in a way that prioritises climate vulnerable developing countries, including small island developing states (SIDS) and least developed countries (LDCs).

'Forms of credit trading systems have been proposed to facilitate flexibility with the forthcoming IMO measures,' Sheeran noted, but she maintained that: 'It is important to consider how these kinds of measures could exacerbate pre-existing global inequities, entrenching financial flows to certain ships and regions, while leaving others, including those who have contributed the least to climate change, to bear the brunt of the transition.'

Erik Hoffmann believed that the IMO will 'most likely agree on some form of GHG pricing this year', but added that: 'Whether that will be an ETS-style cap-and-trade system, a GHG levy or some other form of incentive like a feebate is not set yet.'

However, he emphasised that: 'The key here is to close the price gaps to sustainable fuels and make sure that costs and responsibilities are shouldered equitably between nations with different capacities and resources at their disposal.'

Ruben Tins will also be keeping a close eye on the IMO's London HQ, as: '2025 is going to be an exciting year as MEPC 83 will be held in April. This will finally provide more clarity in the mid-term measures. This will likely determine if there will be more regional systems or if a global system will emerge.

'Nations such as the UK and the US have already introduced their own emissions trading schemes that involve maritime emissions. Additionally, globally, the IMO's carbon levy is set to impact emissions from Tank-to-Wake (TTW), while global fuel standards will influence Well-to-Wake (WTW) emissions. Given these developments, it is clear that a global system for reducing carbon emissions from shipping is emerging.'

Surveying the possible outcomes of such a global system, like a global carbon credit trading system, **James Forsdyke** recognised that the concept may be divisive: 'While proponents see it as a market-driven tool to accelerate emissions reductions and drive investment into sustainable projects, others within the industry argue that it risks becoming a distraction – allowing companies to delay direct action on their own emissions by relying on offsets instead.

'It is true that carbon trading can enable countries and businesses to fund critical initiatives such as reforestation and renewable energy while balancing their carbon footprint. It also creates pathways for cross-border collaboration, fostering investment in emissions reductions where they are most cost-effective. However, for this system to be credible, it must be viewed as a short-term mechanism – a bridge rather than a destination.

'Ultimately, the goal must be to transition beyond reliance on traded credits to direct, tangible decarbonisation efforts within organisations themselves. Carbon markets should serve as a tool to accelerate action, not as a substitute for it.'

Leon Arets passed on some interesting news about further developments within Europe: 'In the Netherlands, the current system of renewable fuel units (HBEs) – which is based on mandated biofuel blending for the road, but voluntary for marine – is changing to emission reduction units (ERE's) in 2026. With this change to emission reduction units, a blending mandate will also be introduced for suppliers of marine fuels in the Netherlands. Moreover, the governments of Belgium and the Netherlands signed a MoU, based on which we would expect a similar obligation for suppliers of marine fuels in Belgium. The full details are not clear yet and are expected to become available over the course of 2025.'

'As we work towards a global system, we can leverage the EU's policy as a blueprint, but we must ensure that we're prioritising equity and efficiency in the system's design'

Allyson Browne

Matthew Smith said that Tankers International anticipates that: 'Other jurisdictions may follow the EU's lead, by introducing regional emissions trading schemes. For example, China has an established ETS and could potentially seek to include shipping. These could create additional regulatory challenges but may encourage further decarbonisation.

'Although a global system under the IMO is the ideal long-term goal, geopolitical and economic barriers may impact immediate progress. A step-by-step approach, with regional systems serving as a foundation, may eventually lead to a more aligned global framework.

'Shipowners face the challenge of balancing their environmental responsibilities while also safeguarding the sustainability of their businesses. At Tankers International, we support the move towards greater regulatory clarity and alignment, as this would streamline compliance for shipowners operating in global markets.'

'For shipping's decarbonisation to pick up pace and scale, we need a clear, global, uniform system of regulations'

Jesper Sørensen

Allyson Browne was another who felt other countries and regions could follow the EU lead. 'The EU ETS has set a strong precedent by integrating shipping emissions into its broader carbon pricing framework,' she said. 'This approach not only internalises the cost of pollution but also encourages investment in low- and zero-carbon solutions, which is critical for jump-starting the transition.

'As we work towards a global system, we can leverage the EU's policy as a blueprint, but we must ensure that we're prioritising equity and efficiency in the system's design. It's paramount that we level the playing field, incentivise and support development, and streamline compliance while maximising emissions reductions.'

Eirik Nyhus began by flagging up developments in a European country which is not in EU (yes, that one!) before broadening the scope. 'Right now,' said Nyhus, 'it seems unlikely that there will be any new regional ETSs introduced in the next few years that cover shipping. The exception is in the UK, which is considering adding domestic shipping (which includes port calls for international shipping) to its ETS from 2026.

'The prime candidate the industry has been watching in recent years is China, in part because China has a domestic carbon trading scheme that in principle could be extended to shipping. However, China seems to have been mainly focussed on international measures, i.e. the IMO, when negotiating the next generation of greenhouse gas regulations. Additionally, China has not been enthusiastic when regional trading systems have been introduced elsewhere. Policies and political priorities may of course change, but expanding the existing or introducing a maritime focussed scheme looks to be very low probability.'

Nyhus continued: 'Historically there has

also been some interest in emissions trading systems in the US, and there have been proposals for MRV-like systems. These could be potential precursors to a Federal ETS, but none of the proposals have garnered meaningful political support. And this seems unlikely to change under the incoming administration.

'Globally, the IMO has committed to rolling out an economic measure as part of the next tranche of GHG regulations, entering into force in 2027. And while the details are not 100% clear, it will not be an emissions trading system as this has been explicitly rejected by MEPC. But MEPC 83 will provide further clarity. Interestingly, proposals on the table do contain trading elements, but nothing like a fully-fledged emissions trading system.'

Eng Kiong Koh also identified China as an area of interest, where 'a pilot ETS scheme like that in Shanghai for local shipping may be expanded to national level'.

In the main, our respondents emphasised the need for a global solution, rather than a proliferation of regional initiatives.

Alexander Prokopakis articulated the bunker industry's position: 'A global system is preferable to ensure consistency and avoid market distortions. At IBIA, we advocate for global frameworks under the IMO's leadership, as they provide the necessary clarity and fairness for the shipping industry.'

Jesper Sørensen – the Head of Alternative Fuels for one of the main players in that industry (KPI OceanConnect) was of like mind. 'For shipping's decarbonisation to pick up pace and scale,' said Sørensen, 'we need a clear, global, uniform system of regulations. This leadership should come from the IMO, and the outcomes from this year's MEPC meetings will be eagerly anticipated. Creating this level playing field, where greenhouse gases are priced the same everywhere, is essential to avoid fragmentation across global markets and a slowing down of the energy transition'.

Sticking with the major-league players in the bunker industry, Peninsula's **Nacho de Miguel** said: 'I'm not sure if it will happen soon, but the only way to manage a gradual decarbonisation in a sector that knows no borders is through international and universal regulation. Otherwise, there will always be loopholes and ways to evade the rules, impacting certain ports to the benefit of others.'

Some of our respondents were clearly enthused by the goings-on at the Albert Embankment HQ. **Namrata Nadkarni** told us that: 'The IMO Secretary General is confident that measures will be adopted at MEPC towards the end of the year - and indicated that Member States were currently supporting a proposed carbon levy. This is fantastic news as the market has been hankering for certainty and this will allow vessel operators to begin pricing their operations in a manner that fast tracks adoption of lower carbon fuels and technologies.'

Image © Shutterstock

Kim Rosello was anticipating that: 'The IMO may move toward implementing a global emissions trading scheme to regulate emissions across the high seas.' And she also thought that: 'Simultaneously, nations committed to decarbonisation are highly likely to establish or expand their local or regional schemes, creating a multi-layered approach to managing maritime emissions.'

> 'IMO will come up with something – but probably, at least for now, less than is really needed to tip the balance'
>
> *Adrian Tolson*

Diane Gilpin agreed that we 'need a global system as soon as possible' and she was 'cautiously optimistic' about the likely outcomes from MEPC 83 this spring as she sensed that the IMO Secretary General is 'pretty determined to find a way to facilitate the net-zero strategy'. However, she added: 'I remain vexed by the over-use of the F-word ['fuel'] and the implications this has on how we think about powering ships. The Global Fuel Standard seeks to examine well-to-wake emissions which is, of course, essential. Deploying primary renewable energy like wind needs different lifecycle assessments. If a fifth to a quarter of the power needed to move your ship can come from the 100% zero emission power – wind – why aren't we enthusiastically stimulating investment into this cleaner, closer-to-market technology? Through a Global Energy Standard maybe?'

While Gilpin was 'cautiously optimistic', **Adrian Tolson** admitted to being 'a bit of a pessimist' on this issue. He felt that there is currently 'less excitement about decarbonisation than we have had in recent years', adding: 'I would be surprised in the shorter term to see any coherent regional efforts. We do hear a lot about China – but they are hardly likely to rush in now, at such a fractious and volatile time in global politics.' So it will be down to IMO to make the running, and Tolson felt that: 'IMO will come up with something – but probably, at least for now, less than is really needed to tip the balance.'

Where do you get your energy from?

The shipping industry's transition to alternative fuels and energy sources is the topic of debate in this section of our annual survey

As shipping's energy transition continues, the global LNG-powered fleet has been growing steadily and we are now seeing methanol and ammonia-fuelled vessels hitting the water. LNG bunkering has become an established feature in ports such as Singapore and Rotterdam; deliveries are being made to methanol-fuelled vessels; and procedures and safety protocols are being developed for ammonia bunkering.

WHICH LIQUID FUEL DO YOU THINK 'RAISED ITS GAME' THE MOST AS AN ALTERNATIVE TO TRADITIONAL BUNKER FUEL IN 2024, AND WHICH DO YOU THINK LOST GROUND?

We asked our respondents to pick out their winners and losers from among biofuels, ammonia, methanol, hydrogen and LNG (with a bioLNG as a subset). While all of these fuels had their proponents, LNG and biofuels garnered the most support as leading contenders for the short term at least, although – as we shall see – LNG also came in for the most criticism.

Leon Arets gave biofuels the thumbs up because they 'are currently the easiest drop-in fuel, the most widely available and can be burned by a very large part of the fleet, whereas for other low carbon fuel types this is still very limited and depending on the fleet conversion.

'For 2025, also due to the introduction of FEUM,' he continued, 'we expect the most from biofuels in terms of uptake. In the long term, along with the conversion of the fleet, it will probably become more of a "mixed bag" of low carbon fuel types. Uptake of fuels like ammonia and methanol will still take time (we expect ~5 to 10 years), either because of a lack of vessels being able to burn those fuels due to safety concerns, or due to high prices. Given the total amounts required by shipping, there will not be one single solution.'

Eng Kiong Koh felt that biofuels and LNG had both upped their game in 2024 based on 'the actual volume bunkered' and, in the case of LNG, the number of newbuilds. Looking further ahead, he felt that ammonia was promising because 'it is not constrained by the lack of biogenic and recycled carbon necessary for bio- and e-fuel'. However, he added: 'Given ammonia's toxicity, a well-defined emergency response plan needs to be developed, and crew safety must be addressed before we can expect to see adoption at scale.'

Nacho de Miguel agreed that biofuels and LNG had 'undoubtedly' made the most progress last year, and he believed that 'it will remain that way for a few more years'.

Looking at the other fuel contenders, he said: 'Despite the media buzz caused by operators' fears of high LNG prices seen in 2022, I believe methanol lost considerable momentum in 2024. On its "e-methanol" version, green methanol is a very challenging fuel to be produced on a large scale. On its bio version, it competes for the same feedstock with BioLNG, which already has a healthy demand from LNG users. There is the need for availability of a steady green hydrogen production, but also enough supply of biogenic CO_2 to make the synthesis. Green ammonia still has years to go before there is real demand and large-scale production, and hydrogen, due to its low energy density, will never become a primary fuel for ships engaged in open-sea navigation.'

Jesper Sørensen was circumspect, reasoning that: 'It would be premature to write off any of the mentioned fuels at this stage. Rather than focus on what has lost ground, the range of fuels available today and mooted for the future are a reflection of the ongoing diversity of operational needs that drive fuel choice.

'Based on what we've seen in the market,' he judged, 'biofuels and fossil LNG are likely to be the most attractive fuels for the short term, as they offer greater availability and therefore affordability. Increasingly, LNG, via its future pathways of bio-LNG and e-LNG, is also positioning itself as a decarbonisation solution in the longer term.

'Looking further ahead, hydrogen-based fuels will see greater demand due to their zero-emission potential. But to get there, the

shipping industry will need to work in partnership to develop and deliver the infrastructure needed to support the supply chains for these fuels.'

Albert Leyson pointed out that 'there are many ships in operation with conventional engines that will need to rely on a drop-in fuel like biofuel' – but also flagged up that: 'Some newbuild announcements on the other hand appear to be leaning toward methanol which will continue in 2025.' Scanning the horizon, he felt: 'It's too early to predict a winner for 2050. In the end, the winner will be a compliant energy source that is widely available and gives the most bang for the buck.'

Alexander Prokopakis told us that 'LNG significantly strengthened its position in 2024' and believed that in 2025: 'LNG is likely to maintain its strong trajectory, particularly with increasing interest in bio-LNG'. He added that: 'Methanol on the other hand, appears to have lost momentum. The unexpected pivot by Maersk from methanol to LNG was a key development that underscored this trend.'

Michael Schapp also saw LNG gaining, and methanol losing, ground in 2024. 'LNG and the pathway that it provides has been regarded viable finally by the broader industry since bio-LNG (liquefied biomethane) is being delivered and looks to be more scalable and economically viable than methanol,' he said. 'This realisation has turned the attention away from methanol, which was also hampered with some supply chain issues, hindering its ability to go larger scale. Ammonia also gained some traction, but not enough to spur widespread investments in bunkering vessels and terminal infrastructure yet.'

Julien Boulland, who marked his scorecard in accordance with Schapp and Prokopakis, commented: 'It's widely considered that LNG has grown in popularity over the last year and is viewed as the leading transition fuel that will help support the industry's efforts to decarbonise. BV has played a significant role in developing and integrating LNG into maritime operations, having certified 35% of the world's LNG bunker ships in service, and holding around 50% of the world's orderbook. Recently, our fleet has grown with several newbuilds, including two 18,000 m^3 LNG bunkering vessels for Hercules Shipping, the shipping arm of Peninsula, at Hyundai Mipo Dockyard, and one 18,600 m^3 vessel for Ibaizabal at Hudong-Zhonghua, which will be ready for delivery from 2026.'

And here's why he felt methanol had lost some traction: 'The challenges surrounding the development of methanol as a viable alternative fuel continue, with ongoing concerns regarding safety and the design challenges of integration. From an operational perspective, integrating methanol would require cargo tanks that are two and half times larger than those required for traditional HFO. Furthermore, methanol is a toxic and highly flammable substance, which will require dedicated training for crew members to support safe handling and implementation of the fuel. Finally, there is a distinct lack of availability of green methanol at scale to keep pace with the demand of not simply shipping, but the wider transportation sector'

He concluded by informing us that: 'In order to support the industry as it navigates these challenges, BV has developed Rule Note NR670 Methanol and Ethanol Fuelled Ships, which provides requirements for the arrangement, installation, control and monitoring of machinery, equipment and systems using methyl/ethyl alcohol as a fuel.'

> 'In the end, the winner will be a compliant energy source that is widely available and gives the most bang for the buck'
>
> *Albert Leyson*

Steve Esau, the COO of SEA-LNG, said: '2024 saw a surge in orders of LNG dual fuel vessels. LNG-fuelled vessels now account for more than 2% of the global shipping fleet. Once the order book is considered, this number increases to 4% by vessel numbers or 6% by deadweight tonnage. The LNG pathway, starting with fossil methane and continuing through liquefied biomethane and e-methane, is maturing as decarbonisation regulations come into force. Liquefied biomethane is already commercially available, and production is growing strongly. The long-term decarbonisation trajectory for the industry established by the IMO and EU is incentivising investment in an ever-growing number of e-methane projects. A significant milestone for the bio and e-LNG pathway was achieved in 2024 when Hapag-Lloyd won the first tender issued by the Zero Emission Maritime Buyers Alliance (ZEMBA) for biomethane powered ocean shipping.'

Alan Jones was another who felt that LNG did well in 2024, with methanol dropping back down. 'While vessel orders related to new fuels progressed in 2024, LNG also strengthened its position as shipping's most widely adopted alternative fuel,' he said. 'More than 350 vessels (including LNG carriers) were ordered. The industry's efforts to reduce the impact of methane slip on greenhouse gas emissions also evolved. The Methane Abatement in Maritime Innovation Initiative (MAMII), led by Safetytech Accelerator and established by LR, continued its work with more than 20 prominent shipping stakeholders, most recently bringing together shipowners with three methane detection and measurement technology providers for feasibility studies.

'The scale of work going into ammonia was evident. They included approvals in principle and joint development projects for offshore production and storage technologies, fuel supply systems, novel power concepts and vessel designs.

'Hydrogen fuel also consolidated its appeal within relevant vessel segments, with orders for 12 more vessels in 2024. Two hydrogen-powered passenger ferries ordered by Norwegian transport company Torghatten Nord are set for LR class, while a memorandum of understanding with H2Terminals, HiDROGEN and D3IM was signed to assess the feasibility of a green hydrogen infrastructure project in the UK. LR also granted AiPs for several new hydrogen vessels, including ferries and tugboats.

'However,' he pointed out, 'amid strong development across the industry, there remains deep uncertainty about when zero- or near-zero emission fuels will be available, and at what cost. The LR Maritime Decarbonisation Hub's (MDH) latest Zero Carbon Monitor in October 2024 listed supply and infrastructure as a priority action to improve readiness for future fuels.'

Ruben Tins felt that the increase in the number of LNG-fuelled vessels ordered in 2024 – more than doubling 2023's orders – indicated 'a significant shift in the industry', and he also reported that there has been 'a surge of bio-LNG bunkering'. This was an area of particular interest for Tins, as he reminded us that: 'In 2024, STX Group collaborated with Titan Fuels and Hapag-Lloyd with a ship-to-ship bunkering of 2,200 metric tonnes of liquefied biomethane (LBM), the largest ship-to-ship bunkering operation known till date. This sizable transaction is just one example of such deals within the industry but is a proof of

how LBM can be a powerful tool on the path to decarbonise the maritime sector.'

Ammonia was the fuel that Tins felt might have lost some momentum in 2024, 'because uptake has been slowed down due to politics compared to its interest with the previous year'.

Adrian Tolson felt that 'LNG (or the bio-LNG pathway)' probably gained in 2025, while the rest of the alternative fuels 'didn't move or lost ground'. While he acknowledged that biofuels are 'currently quite popular', he didn't think they were a longer term solution. Rather depressingly, he felt that – for the moment, at least – 'anything based on the Green Hydrogen molecule has suffered significantly', due to the 'poor performance of global economies, geopolitics crisis, climate scepticism fuelling nationalist politics, and the sheer enormity of the challenge'.

'The challenges surrounding the development of methanol as a viable alternative fuel continue, with ongoing concerns regarding safety and the design challenges of integration'

Julien Boulland

Erik Hoffmann was another respondent who pointed out that: 'LNG was the most popular alt fuel in the global ship orderbook last year.' But he also flagged up the uptick in LNG bunkering activities, as: 'Singapore's LNG bunker sales quadrupled on the year and several new LNG bunker locations were launched.' He predicted that: 'LNG will see continued growth in 2025, that we will see more liquefied biomethane (LBM) blended in because of FuelEU in particular, and that an ammonia-capable ocean-going ship will enter operation for the first time. Longer-term I think ammonia's future looks bright. It will come more to the fore as questions around safety protocols and real-life engine testing get answered.'

Dimitrios Marantis joined the chorus of voices on LNG's progress, and added that: 'On the other hand, except for some projects for regionally operated hydrogen-powered vessels, hydrogen seems to be less attractive on a global scale.'

Namrata Nadkarni also judged that LNG had a good 2024, and hydrogen has some catching-up to do. But she expected things to change in the longer term. 'LNG has really come out fighting in 2024 and presented itself as a known quantity (which is very attractive when there is this level of uncertainty in the market). Not only is there guidance for LNG as a marine fuel, but pricing has been transparent, sourcing is clear and crew are familiar with it.' However, she then added: 'We must remember that it is NOT a long term solution given the associated carbon emissions. It is a bridging fuel and – if we are all being honest – one that is not good for the environment at all.'

Surveying the fuels that she felt could be long term solutions, she judged: 'The timeline for hydrogen feels like it is moving further away, but this is less to do with technology (from what I can tell) and more to do with pricing (both of the fuel but also the infrastructure). I think that as the ammonia discussion accelerates, the hydrogen conversation will see a reflected boost in confidence.'

Nadkarni's concerns regarding LNG's environmental credentials were echoed, and amplified, by some of our other respondents – and particularly from among environmental NGOs.

Andrew Dumbrille told us that: 'The methane industry, mainly LNG, hasn't raised its game but rather is playing a dangerous game. Significant studies came out in 2024 which continued to prove that LNG doesn't progress shipping's decarbonisation goals, and in some cases reverses the trend on the environment and human rights. In the EU, LNG's well to tank GHG emissions came out 30% higher than anticipated by regulators; in the US the LNG GHG footprint as a fuel source is 33% greater than that for coal when analysed using GWP20; and in Canada, Coastal GasLink and Canadian authorities are building a gas pipeline without the free prior and informed consent from the chiefs of the Indigenous Wet'suwet'en Nation and without addressing their concerns.'

Dumbrille's Equal Routes colleague **Elissama Menezes** added: 'Despite the industry buzz, the data is clear: LNG is linked to climate, health, and social impacts. At least two-thirds of annual methane emissions now come from human activities, with LNG shipping as a contributor. Methane's potency as a greenhouse gas and its life-cycle emissions – now shown in new analyses to exceed coal – have intensified scrutiny of LNG's role in shipping decarbonisation. In addition, the market oversupply of LNG shipping capacity has created inefficiencies and stranded investments, while legal challenges against LNG infrastructure projects highlight growing opposition from communities and environmental groups. The momentum behind these challenges, coupled with increased awareness of the fuel's detrimental effects, positions LNG not as the "transition fuel" it was once marketed to be but as a relic of outdated fossil energy systems. Its inability to deliver tangible benefits for people, nature, and climate reinforces its incompatibility with the industry's future.'

While some of our respondents saw Maersk's decision to order LNG-fuelled vessels as a win for LNG and a loss for methanol, Menezes decried it as a 'massive setback' for the environment.

The NGO Opportunity Green has been playing a leading role in campaigns aimed at what it sees as LNG 'greenwashing', and its Legal Manager **Kirsty Mitchell** told us: 'Despite the steady growth of the global LNG-powered fleet, the credibility of LNG as an alternative clean fuel continued to be challenged in 2024. A growing body of scientific evidence strongly suggests that there are no lifecycle benefits in terms of greenhouse gas emissions savings when using LNG in shipping. In 2024, environmental organisations and campaign groups have heightened attention to LNG's lifecycle impacts, and particularly the issue of methane slip. This has led to increased legal scrutiny of environmental claims about fossil-LNG in the cruise sector. In the UK, following a complaint by Opportunity Green and a nine-month investigation by the Advertising Standards Authority, MSC Cruises withdrew adverts claiming fossil LNG to be a "cleaner" fuel. Similarly, the Dutch Advertising Code Authority publicly ruled against MSC Cruises following a greenwashing complaint concerning statements on LNG. Further, the climate-friendliness of LNG vessels has been called into question through a court challenge against the EU Commission in relation to the shipping (and aviation) criteria in the EU Taxonomy Delegated Act, which currently promote investments in LNG vessels. In 2025, we can expect that scrutiny on fossil LNG investment – and the associated risks (whether climate, legal, reputational or financial) – will increase, further delegitimising LNG as an alternative or transitional fuel.'

Allyson Browne was also adamant that: 'LNG is not a sustainable choice for industry decarbonisation, [because] methane slip throughout the fuel's lifecycle – from extraction to combustion – negates its touted "benefits".' Furthermore, she believed that: 'While

bio-LNG offers some improvement, scalability and availability remain major barriers.'

Consequently, she urged that: 'It's past time for the sector to invest in genuinely net zero and absolute zero-carbon solutions like green methanol and other green hydrogen derivatives, which align with long-term decarbonisation goals, and leave LNG where it belongs – in the ground.'

Clearly, the debate on LNG as a marine fuel will continue – and opinions are firmly entrenched on both sides. So we will move on to hear from our survey respondents who felt progress was made in 2024 by the fuels often perceived as the longer-term options: methanol, ammonia and hydrogen.

Having hit the pause button on LNG, we will restart with Browne, who told us that: 'Methanol gained momentum as a pragmatic choice – it's scalable, less carbon-intensive than traditional bunker fuel and infrastructure-ready. But we need to prioritise green/e-methanol–with captured carbon and hydrogen produced with renewable electricity–to minimise the fuel's lifecycle emissions.'

While **Kim Rosello** acknowledged that 'methanol has gained traction through several large-scale commitments', she maintained: 'Ammonia remains the only single fuel that is remotely scalable as a replacement for traditional fuels.' This was in contrast to biofuels, which she felt will 'face significant availability challenges' and 'scaling their production could also impact agriculture, particularly in terms of food generation'.

Dana Rodriguez pointed to Maersk's demonstration bunkering as a definite plus for methanol, but she saw progress for the other fuels too, as: 'Biofuels applications for book & claims discussions were moving closer. LNG vessel orderbook expansion is a fleet side demonstration of progress. [While for] ammonia, ZEMBA report findings show several projects reaching FID, with potential to supply shipping, but lacking on vessel orders.' The one fuel she felt had lost ground in 2024 was hydrogen, as she judged that: 'The application of hydrogen in deep sea shipping has not moved into the mainstream. Other alternative fuels are viewed more credibly as fuel options for deep sea shipping.'

Sunil Krishnakumar was another who felt methanol had raised its game in 2024. 'During the last year the industry saw a substantial increase in the orders for methanol-capable ships,' he noted. 'We also saw an increasing number of long-term methanol supply agreements being signed and supply infrastructure being developed, [although] it is important to note that there are concerns around the lack of FID and actual breaking of ground.

'With the latest and upcoming environmental regulations, there has been an increased focus on reduced GHG emissions including methane from ships. Along with concerns related to methane slip of LNG engines, the focus on carbon free fuels such as ammonia and hydrogen has reduced the attractivity of LNG as an option for long-term decarbonisation projects.

'That being said, in the ICS Maritime Barometer Survey in 2023-24 we saw that despite its reputation as a transition fuel, LNG remains the most well-perceived option among the c-suite level survey participants, but its standing would likely drop in a longer term forecast. LNG is seemingly a lower risk option for shipping over a 10-year timescale, but is potentially on a downward trend.'

While **Jason Stefanatos** felt that LNG and biofuels are both currently doing well, he felt that ammonia might have raised its profile most because: '2024 was the year that we saw the first ammonia-fuelled vessel sailing the seas (*Green Pioneer*, FFI, MPI flagged, DNV classed) and there were a large number of orders for non-ammonia carriers that will be fuelled by ammonia. By the end of 2024, 20 ammonia-fuelled vessels (excluding the ammonia carriers) were on the orderbook, dominated by large bulk carriers.'

He added: 'LNG continued strong (stronger than ever) in 2024 with the largest number of LNG-fuelled ships ever ordered. LNG provides compliance today with FuelEU and can act as a transition fuel or even help with net zero targets by using RNG.

'Biofuels have picked up their game as well, as they are a technically-easy solution for compliance with FuelEU, avoiding the penalty. It is the most popular current drop-in solution for ship owners.

'Overall,' he continued, 'it's really interesting to see that all the alternative fuel solutions make sense, depending on the specific business and market conditions. And it will be even more interesting to see these vessels being delivered, how the industry processes these new experiences, and the impact this has on decision making in the future.'

On a less positive note, Stefanatos added that: 'While methanol started quite strong, after the summer we saw some scepticism around ordering methanol-fuelled vessels and a decline in the number of orders. The perception seems to have been sparked by cancellations of some methanol production facilities and some large owners changing their decisions. Still, with methanol-fuelled vessels making up almost a third of alt-fuel orders, it's a solution that will have a role to play in shipping's future energy mix.'

Alan Jones emphasised that there is currently 'a concerted effort to understand the specific practicalities concerning the use of ammonia – including the development of training and competency frameworks; and JIPs looking at the environmental impact of ammonia releases'.

While many of our respondents were dubious of hydrogen's prospects, **Nuala Doyle** sees it as one of the marine fuels of the future. She was another who flagged up the Lloyd's Register findings that orders for alternative-fuelled ships grew by 50% in 2024, and maintained that: 'This shift away from fossil fuels will be critical to the sector achieving its emission reduction obligations. While methanol has demonstrably made strides in the last year – with vessels capable of using this fuel making up the bulk of new orders for alternative-fuelled ships – we should also acknowledge the steps that have been taken to forward hydrogen propulsion in the last year.

'When produced using renewable electricity made via electrolysis, green hydrogen propulsion has huge potential to lower emissions. In 2024, significant steps were made towards the use of green hydrogen as a maritime fuel, with innovator Future Proof Shipping (FPS) launching its second hydrogen-powered vessel in February, and Torghatten Nord placing an order for the construction of the largest hydrogen-fuel cell ship yet attempted in May. This may seem like modest progress in comparison to the order of 119 methanol-fuelled vessels, however progress in driving the development of hydrogen propulsion is key if we are to see significant use of the technology in the coming decades.'

> 'The LNG pathway, starting with fossil methane and continuing through liquefied biomethane and e-methane, is maturing as decarbonisation regulations come into force'
>
> *Steve Esau*

We'll close this debate on future fuels with

Gavin Allwright, whose response leads us in neatly to our next section, on alternative 'energy sources'. Allwright said that, 'rather than commenting on which of the fuels has gained/lost ground in relation to one another', he wanted instead to flag up on the 'growing realisation that the timeframe for delivering affordable and widely available alternative fuels is very challenging and that delivering on the lower 5% target for zero-emissions fuels, let along striving for the 10% target, is almost impossible by 2030'.

'Thus,' he continued, 'there is a growing focus on the other two elements that were included in that target, i.e. zero-emissions energy sources and technologies which most significantly include wind propulsion. In the list of fuels, then only fossil LNG and biofuel are being used by vessels (rather than fuel-ready) at any scale and the question being raised more frequently is that fossil-derived versions of the other fuels that will likely be required to enable the building out of the infrastructure required to deliver the 'green' versions of those fuels in the later 2030s and 2040s will actually increase emissions in that transition period.

'The discussion around longer term winners is somewhat dependent upon what regulatory framework those fuels will be delivered under. For example, if that framework adopts a holistic approach to emissions in the future, then non-GHG climate impacting emissions will have to be included as will other pollutants. Black carbon is a climate change accelerant, as are fugitive hydrogen releases. Other pollutants such as nitrogen, particulate matter, VOCs [volatile organic compounds] and the impact of URN [underwater radiation noise] are all very important considerations for the industry to tackle early and thus avoid stranded assets and dead-end development cycles at a time when we have no more time for wrong moves in the energy transition.'

DO YOU THINK WE SAW SIGNIFICANT PROGRESS ON WIND PROPULSION / WIND ASSISTANCE TECHNOLOGIES IN 2024?

Given his role as the Secretary General of the International Windship Association (IWSA), we'll stick with **Gavin Allwright** here, who said: 'Naturally, this is a question I will answer with a Yes. However, I think it is becoming apparent that this not just a "potential" energy source but one that is already delivering a growing contribution, with 54 large vessels installed and another seven wind ready vessels, or approximately 4 million DWT. The order book is already 80+ ships for delivery in 2025-6 and another 50+ announced but not yet ordered. This marks a doubling of the total number of ships installed with wind propulsion systems over the last 12 months – however this was also a nearly three-fold increase in installations compared to the previous 12-month period.

'We have also seen significant investments going into production facilities and the lead time for retrofits is coming down, with annual delivery capacity now in the hundreds and growing. Perhaps most importantly, we have started to see fleet orders for vessels, moving away from single ship installations into dozens of units being ordered, along with that we have seen four primary wind ships delivered this year ranging from 40-85 metres in length with a number of larger newbuilds underway for delivery over the next 12 months or so.

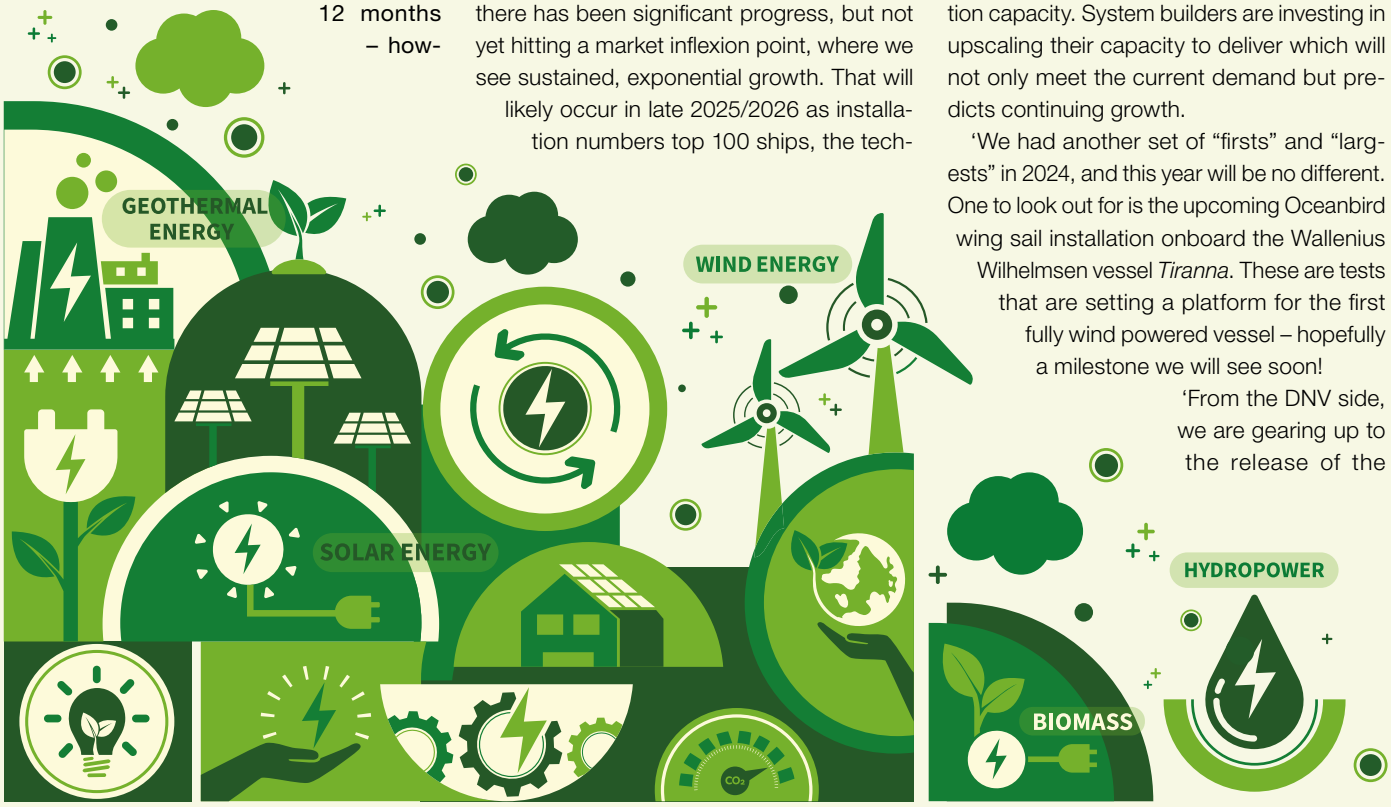
'Therefore,' Allwright concluded, 'yes, there has been significant progress, but not yet hitting a market inflexion point, where we see sustained, exponential growth. That will likely occur in late 2025/2026 as installation numbers top 100 ships, the technology is disseminated into most industry sub-segments, costs and lead times start to come down significantly and the full weight of EU regulation kicks in and the direction of travel from the IMO is clearly signaled.'

Hasso Hoffmeister was also encouraged by the numbers. 'Last year we had another big step up in the number of installations, both in terms of retrofits and newbuilds,' he noted. 'Looking at the orderbook at the end of 2024, if those vessels are delivered on time, we could hit 100 WAPS [wind-assisted propulsion systems] by the end 2027 – if not even sooner.

'One of the things that makes me optimistic for WAPS overall, is the increase in production capacity. System builders are investing in upscaling their capacity to deliver which will not only meet the current demand but predicts continuing growth.

'We had another set of "firsts" and "largests" in 2024, and this year will be no different. One to look out for is the upcoming Oceanbird wing sail installation onboard the Wallenius Wilhelmsen vessel *Tiranna*. These are tests that are setting a platform for the first fully wind powered vessel – hopefully a milestone we will see soon!

'From the DNV side, we are gearing up to the release of the



'We have also seen significant investments going into production facilities and the lead time for retrofits is coming down, with annual delivery capacity now in the hundreds and growing'

Gavin Allwright

first WAPS ready notation, a new white paper, and a new recommended practice to assess the performance of WAPS. We'll be working with industry to make sure this reflects their needs – and we hope it will be a big step forward in building confidence in the systems, by providing a new, transparent methodology, backed up by verifiable data.'

As the founder and CEO of Smart Green Shipping (SGS), **Diane Gilpin** is obviously heavily involved in this sector, and she was happy to report that: 'We certainly felt a seismic change in interest and acceptance of our FastRig. We had hundreds of guests visit our land-based test site to "have a go" at flying the FastRig and then join us at events in Southampton and Greenock in Scotland where we and the crew of the UK flagged vessel MV *Pacific Grebe* demonstrated the FastRig's capability to lift, lower, turn to capture winds at all angles. The *Pacific Grebe* crew berthed during the sea trials programme which was the first in the world to be conducted using ITTC test criteria – a science based method designed to encourage a level playing field for performance results from all wind-tech providers.

'It seems that wind-assist is now widely accepted across the industry as a viable tech but the uptake of WAPS remains hindered by uncertainty about where the fuel/emission-save benefits accrue commercially – owner or charterer. We're working with BIMCO and Reed Smith on finding a way through this via standardised charterparty agreement clauses. Apportioning the savings depend on having trustworthy and reliable fuel/emissions-savings data and that's where our now validated FastRoute savings analysis tool comes in.'

Summing up, Gilpin said: 'Our sea trials test validate our digital-twin analyses in the real-world, giving SGS much greater confidence in our ability to predict savings. In turn this helps underpin financing arrangements for all project partners.'

The environmental arguments for harnessing wind power have always been strong, but wind propulsion proponents have also been emphasising the business case too. **Sunil Krishnakumar** judged that: 'The shipping industry has significantly increased its adoption of wind propulsion and assistance technologies over the past year, driven by the need to reduce fuel consumption and comply with the various environmental regulations.'

Pekka Pakkanen went into more detail, as he explained: 'The development of FuelEU Maritime has given wind-assisted propulsion systems, such as rotor sails, a boost by enhancing the commercial rationale for adopting such technologies going forwards. Under FuelEU Maritime, a ship with wind-assisted propulsion technologies installed can benefit from a reward factor which effectively improves the annual average greenhouse gas intensity of the energy used onboard. This improvement can go up to 5%, depending on the ratio between the effective wind power and the installed propulsion power of the ship. This overlap between wind-assisted propulsion and FuelEU Maritime reinforces the importance of leveraging data and digitalisation alongside the adoption of pioneering clean technology.

'Harnessing wind power and gathering performance data is also as much about digital technology as it is about the physical sails, wings or kites on board,' Pakkanen continued. 'A simulation study led by NAPA with Sumitomo and Norsepower found that combining rotor sails and voyage optimisation can reduce emissions by up to 28% on average, with 12% attributable to weather routing. Combined with the wind reward factor, this can be a powerful competitive advantage within the era of FuelEU Maritime and shows how the shipping industry's digitalisation and decarbonisation transitions go hand-in-hand.'

Julien Boulland felt wind was now on a firm footing and ready for further development. 'As of mid-2024,' he reported, 'over 105 wind propulsion systems have been installed on more than 45 ships globally, and projections indicate that up to 30% of the world fleet could incorporate WAPS technology by 2050.

'There are already a wide variety of systems, but further innovations are expected. BV published a technical report on wind propulsion in 2024, detailing the various technologies that have been developed, the challenges and barriers they face regarding their integration on ships, as well as their role in supporting compliance within an evolving regulatory landscape.

'One area of potential innovation is the development of hybrid systems that integrate wind propulsion with other sustainable technologies, such as solar panels. By combining wind power with complementary clean energy sources, these hybrid systems have the potential to create more efficient and reliable propulsion and energy generation solutions for ships.

'Additionally, the role of wind propulsion could expand beyond just ship propulsion, exploring ways to leverage wind energy to generate onboard electricity or even produce hydrogen, further diversifying the applications and benefits of wind power in maritime transportation.

'Wind propulsion systems are well-positioned to capitalise on this trend, as they can contribute to improving a ship's Energy Efficiency Design Index (EEDI), Energy Efficiency Existing Ship Index (EEXI), and Carbon Intensity Indicator (CII) ratings. This makes them an attractive option for shipowners looking to stay ahead of the curve.'

Alan Jones was another who referenced Lloyd's Register's analysis of the WAPS market, which he said has indicated that 'uptake is on the verge of a tipping point, and is expected to pass the 100-installation

'From the DNV side, we are gearing up to the release of the first WAPS ready notation, a new white paper, and a new recommended practice to assess the performance of WAPS'

Hasso Hoffmeister

milestone in the next 2-3 years'. For Jones: 'Rapidly maturing technology, successful pilot projects and growing regulatory recognition – including a dedicated reward factor under FuelEU Maritime – are key drivers, while challenges such as standardising fuel savings verification and scaling up technology production are already being actively addressed.' However, he pointed out that: 'There is a need for early planning of compliance and integration elements to streamline retrofit such projects.'

Ruben Tins also believed FuelEU Maritime will help to incentivise wind and added that: 'Some companies on the market have made significant strides, indicating clear industry interest in adopting wind-assisted technologies.'

Michael Schaap said that wind-assisted propulsion gained some traction in 2024 – 'as an addition to other decarbonisation efforts'. He emphasised that: 'These appear to be complementary efforts as the investments are relatively modest, and, of course, wind propulsion will require other technologies to also mature as this is not a stand-alone solution.'

Kim Rosello reminded us that: 'Wind propulsion and assistance technologies have existed for years but lacked significant commercial adoption due to minimal incentives.' But now, she believed: 'The introduction of FuelEU has changed this by creating financial and regulatory frameworks that encourage investment in wind-based solutions. In 2024, there was notable progress with technologies like rotor sails and kite systems, which help reduce fuel consumption and emissions. While adoption remains in its early stages, the interest sparked by FuelEU highlights the potential of wind propulsion as a key part of the maritime industry's decarbonisation strategy.'

Although no one had a bad word to say about wind, some of our respondents felt that there was still work to be done.

'While WAPS is a viable technology to reduce fuel consumption, the cost of the system is still quite high,' considered **Eng Kiong Koh**. 'A proper financing mechanism and scheme to share early adoption risk and for return of investment to all stakeholders will be required.'

> 'While the technology is not new, the regulatory landscape may not be ready as it requires political will for international cooperation between countries of port of calls'
>
> *Eng Kiong Koh*

Nacho de Miguel said: 'I don't think these have been technologies with a significant level of implementation yet, except for some pilot tests.'

For **Alexander Prokopakis**: '2024 saw advancements in wind propulsion and wind assistance technologies, with increased adoption of systems such as rotor sails and rigid sails on larger vessels. These innovations demonstrated tangible fuel savings and emission reductions, driving greater industry interest. However, scalability and integration into broader shipping operations remain challenges.'

Allyson Browne also underlined the need for joined-up thinking on WAPS. 'It is great to see new advancements in wind propulsion moving beyond trials with adoption on commercial vessels,' she said. 'These technologies address both operational efficiency and emissions reductions, providing a modular solution that can complement other propulsion methods.

'However, as with any new technology,' she emphasised, 'we need to ensure we're building the port infrastructure to support these wind-equipped vessels. As with battery technologies, standardisation across ship design will enable streamlined maintenance operations, which will help to accelerate widespread adoption.'

We'll give the last word on wind to **Namrata Nadkarni**, whose enthusiastic support builds a bridge to our next topic: 'Kudos to the IWSA and CORE POWER for keeping the wind and nuclear conversations progressing over the course of 2024. There has been a lot of buy-in from the market for these power generation solutions that were almost absent in 2022 and very nascent in 2023 – and this has been reflected in the ICS Maritime Barometer report.'

DO YOU EXPECT TO SEE FURTHER PROGRESS BEING MADE ON THE DEVELOPMENT OF NUCLEAR POWER FOR SHIPS OVER THE NEXT DECADE?

Having announced her support for this technology in her answer on wind propulsion, **Namrata Nadkarni** was emphatic that: 'Nuclear power is a truly green solution and a lot of information fuelling fear is about outdated technologies. We simply cannot meet carbon reduction targets (note: not net zero, but actual reduction) without wind and nuclear power in the mix. We must be open to investing in these tracks and accepting the rigorous data collection work done by OEMs including Smart Green Shipping as well as class societies.'

Gavin Allwright felt that there is a place for both wind and nuclear in shipping's future energy mix. 'It is clear,' he said, 'that nuclear power for very large vessels is being viewed as an attractive proposition in some quarters of the industry and that will attract more proponents and investment. Many commentators indicate there are still significant obstacles to widespread uptake, however I would expect to see prototypes and demonstrator vessels in operation in the 2030s once the new Small Modular Reactor (SMR) nuclear power systems are proved on the technical, safety, security and economic basis on land and then these are effectively marinised. Will this be in time to be a major contributor to the decarbonisation pathway required for the 2030's is an open question.'

The technology also appears to be winning support from the 'traditional' bunker industry, as Peninsula's **Nacho de Miguel** proclaimed: 'I am a seasoned energy professional, and I believe in nuclear energy as a decarbonisation solution. And I think that, when well-managed, it produces more benefits than problems. Just as SMR are being explored for onshore electricity needs, why not use the same concept for large commercial vessels?'

Julien Boulland said that BV expects 'the development of nuclear power to progress steadily over the next decade'. He explained why: 'The technology exists to support nuclear powered vessels, especially with the development of viable advanced modular reactors (AMR) and SMR that can be mass produced, whilst using ambient cooling systems, rather than pressurised water.'

However, he added that: 'Underdeveloped

regulatory frameworks as well as a lack of a ratified liabilities convention, that would set a cap for total damage insurance providers would be liable for, continue to hamper the development of nuclear propulsion systems. Without joint consensus from insurance providers, as well as coordinated regulation between the IMO and the Atomic Energy Agency, progress regarding nuclear propulsion will continue to develop slowly.'

Eirik Ovrum reported that: 'There are several initiatives in the industry now working towards nuclear powered ships at the present. Several of these are working to map out the regulatory hurdles, the safety and risk aspects, as well as the commercial aspects. At the same time, there have been contracts awarded for new SMR on land for use with data centres and AI.'

Dimitrios Marantis believed it is 'only a matter of time before SMR are fitted on seagoing vessels – and then: 'After the environmental/safety aspects are addressed through the relevant regulations & effective crew training, the nuclear technology will be a gamechanger towards zero carbon emissions.'

Kim Rosello was another who identified the importance of SMRs, telling us that, 'with their compact design, high energy output, and extended operation without refuelling', they are 'well-suited for shipping and align with decarbonisation goals'. However, she warned that: 'Adoption will require addressing challenges like public perception, regulatory hurdles, nuclear waste management, and crew training.' Nevertheless, she judged that: 'As SMR technology becomes more cost-effective and safer, nuclear-powered ships could become viable for long-haul, energy-intensive routes within the decade, provided industry and regulatory collaboration.'

Sunil Krishnakumar took a similar view, telling us: 'There is a growing interest in this technology as an option for zero-emission shipping. There are various developments in smaller, modular nuclear reactor and micro-reactor technologies that could address the safety and scalability concerns. Efforts are also ongoing at the IMO to review the Code of Safety for Nuclear Merchant Ships to facilitate the use of these modern technologies. However, issues such as public perception and acceptance of the technology, high initial costs, waste disposal and crew training and safety need to be resolved.'

> '2024 was another ''steady as she goes'' year for battery and hybrid vessels, with the milestone of reaching 1,000 vessels in operation'
>
> *Henrik Helgesen*

Alan Jones gave an update on the work LR is doing in this area. 'Nuclear propulsion for commercial vessels gained momentum in 2024, driven by increasing shipowner interest in the advance of SMR technology,' he reported. 'The LR Fuel for Thought report on nuclear propulsion highlighted the dramatic impact the technology could have on shipping, including longer ship lives and new ownership models. As an example of early activity in the nuclear field, LR is working with mobile nuclear company CORE POWER on a study to determine the safety and regulatory considerations for a potential next-generation nuclear-propelled feeder container ship.'

While some other respondents saw a compellent case for nuclear technology, others were looking for more progress.

Alexander Prokopakis judged: 'There is interest but we haven't seen any groundbreaking developments.'

Leon Arets said: 'We do not expect nuclear power to become available for commercial shipping over the next decade, due to complexity, safety concerns and disposal issues of nuclear waste.'

Eng Kiong Koh considered that: 'While the technology is not new, the regulatory landscape may not be ready as it requires political will for international cooperation between countries of port of calls.'

Some of our respondents questioned whether nuclear power would be successful onboard commercial ships (rather than military) ships.

'I still remain a sceptic,' said **Adrian Tolson**, 'not of nuclear power as a route to planetary decarbonisation – but on a ship-by-ship basis I am doubtful.'

One of our respondents, **Allyson Browne**, felt the nuclear option was neither practical nor desirable. 'While nuclear propulsion remains a theoretically attractive zero-emission option, its practical implementation faces substantial barriers,' she maintained. 'The infrastructure for supporting nuclear vessels, including port-side handling and disposing of nuclear waste, is prohibitively complex and expensive. Regulatory hurdles and public perception pose additional challenges, particularly in regions with strong anti-nuclear sentiment.

'And then there's the core challenge of nuclear development – mining uranium, reactor construction, decommissioning and waste storage – all of which carry significant environmental, safety and security risks.

'Over the next decade,' Browne continued, 'it's highly unlikely that these obstacles will be resolved at the scale needed to integrate nuclear power meaningfully into commercial shipping.

'The industry – and the planet – would be better served by focusing on scalable, renewable options like e-methanol and other green hydrogen derivatives.'

DO YOU THINK WE SAW SIGNIFICANT PROGRESS ON MARITIME ELECTRIFICATION (IN TERMS OF BOTH BATTERY-POWERED PROPULSION AND SHORE POWER TECHNOLOGY) IN 2024?

This was a question that **Allyson Browne** was happy to answer with a Yes, as she told us that: 'In 2024, we saw significant strides in maritime electrification, with California leading the charge through its At Berth Regulation. The regulation, which requires vessels to plug into shore power at berth, aims to achieve up to 90% emissions reductions from at-berth operations. This isn't just policy – it's proof that bold action works. And while shore power adoption is scaling up globally, ports need to think bigger.'

But, she emphasised: 'Electrification can't stop at the dock. To fully decarbonise, ports must electrify their entire systems – yard equipment, cargo handling equipment, trucks, operations facilities and more – and power them with renewable electricity. This means battery storage and grid upgrades are no longer optional; they're mission-critical. Globally, innovations like offshore wind integration in Europe and hydrogen energy projects in Asia show what's possible when ports embrace their role as energy hubs.

'Ports are at the nexus of global trade and clean energy. The question isn't if ports will electrify, but how fast they can scale – and that speed will define the trajectory of maritime decarbonisation.'

As Senior Technical Manager with the International Chamber of Shipping, **Sunil Krishnakumar** is well-placed to give a global perspective. 'The number of ships equipped with energy storage systems has risen particularly in ships that are on shorter voyage duties like tugs and ferries,' he reported. 'Environmental regulations are driving the demand for shore power capabilities. Several ports are investing in shore power infrastructure and many incentives are being offered to ships that making use of these installations. Standardisation of shore installations and compatibility with ship-side equipment remains a concern. The industry is working towards resolving these issues.'

Julien Boulland said that last year marked progress in both battery-powered propulsion and shore power technology. 'A clear example of this progress,' he said, 'was BV's classification of the largest inland waterway LNG bunker barge built in Europe – the *Energy Stockholm* – a Tanker Type G, double hull, electric hybrid, dual fuel, which utilises battery technology and shore power.

'Battery systems, particularly for ferries, short-sea shipping and inland shipping, benefited from improved energy density, safety, and cost-efficiency, with solid-state batteries gaining interest.

'Several electric vessel projects showcased the viability of full-electric operations. Shore power infrastructure expanded globally, enabling ships to reduce emissions by shutting off engines in port. Efforts to standardise connections and increase capacity supported larger vessels like container ships and cruise liners. While challenges such as cost and infrastructure gaps persist.'

> 'Electrification still has a long way to go in the future, especially for short and regular-distance coastal navigation'
>
> *Nacho de Miguel*

For **Henrik Helgesen**: '2024 was another "steady as she goes" year for battery and hybrid vessels, with the milestone of reaching 1,000 vessels in operation. And with another 375 expected to be delivered in 2025, according to our AFI portal, uptake continues to increase. Most vessels are currently operating in Norway (33%) or Europe (34%), so we still have a lot of room to grow globally.

'One possible booster for battery/hybrids ships are the incoming regulations on providing shore power in FuelEU Maritime, the EU's Alternative Fuels Infrastructure Regulation, and the California ARB requirements. We can already see European TEN-T ports planning for the infrastructure required to provide power supply facilities by 2030.

'One of the most exciting news items from 2024 was that Berge Rederi plans to build an all-electric bulk vessel for operation along the Norwegian coast. Designed to operate with batteries and rotor sails, the 230 nautical mile operational route would be the longest commercial voyage for a battery electric vessel.'

Looking ahead to future innovations, **Eng Kiong Koh** said that: 'The advancement of electric vehicles (EVs) will result in the diffusion of learnings and supply chain developments to other sectors, including shipping.'

Nacho de Miguel questioned whether significant progress was made in 2024 – but added that: 'Electrification still has a long way to go in the future, especially for short and regular-distance coastal navigation. Undoubtedly, it will be further encouraged by emissions regulation, as well as shore power technology, that will become compulsory at some ports and for certain traffics.'

Alexander Prokopakis saw a future for maritime electrification, but felt it will probably be confined to short sea shipping and shore power at ports.

Michael Schaaps considered that 'not enough progress has been made', while **Kim Rosello** also felt that: 'Progress in maritime electrification during 2024 has been modest.' Diving into the detail, she believed that: 'Battery-powered propulsion saw incremental advancements in energy density, safety, and cost, but these remain insufficient for large, oceangoing vessels. Adoption is mainly limited to smaller ships and short-sea routes.

'Shore power technology made some strides, with a few ports installing infrastructure and regulations promoting its use in certain regions,' Rosello said, but she added that: 'Implementation remains uneven, hindered by financial and logistical challenges like retrofitting older facilities and upgrading power grids.

'Overall,' she concluded, 'while some progress has been made, widespread adoption of maritime electrification technologies will require greater investment, stronger regulations, and increased collaboration among stakeholders.'

DO YOU EXPECT TO SEE FURTHER PROGRESS BEING MADE ON THE DEVELOPMENT OF FUEL CELL TECHNOLOGY FOR SHIPS IN 2025?

According to PowerCell's Sustainability Officer **Victor Åkerlund**: 'In the last years, we have primarily seen pilots and proof of concepts, but 2025 could be the year we go into true commercial operations with fuel cells among some ship operators. With increasing fuel cell systems on the waters, it is also natural to imagine that standards and safety procedures continue to mature and consolidate.'

Antonio Santos believed that: 'There will be further progress in the development and deployment of fuel cell technology for ships in 2025, especially for harbour craft.' And he then gave us an update on progress in the United States, where he said: 'Federal funding programmes currently support the purchase of zero-emission harbour craft, such as ferries, tugboats, and offshore supply boats. Harbour craft are well suited for fuel-cell technology and electrification given their short and predictable routes. Of note, the world's first hydrogen-powered commercial passenger ferry was launched in San Francisco in July 2024.

'Further, the Biden administration in its Action Plan for Maritime Energy and Emissions Innovation released in December 2024 set a target that, by 2030, at least 25% of all new-build harbour craft are hybrid electric, battery-electric, or hydrogen fuel cell, reaching 50% by 2040 and 75% by 2050.

'For ocean-going vessels, as the IMO, European Union, and other countries move forward with adopting/implementing regulations to reduce GHG emissions from ships, they will push the shipping industry to explore cleaner technologies, which in turn could contribute to the further commercialisation of fuel cells.'

Santos concluded: 'The development of hydrogen infrastructure is critical for the widespread adoption of fuel cell technology. At the beginning of this year, the U.S. Department of the Treasury released its final rule for the Clean Hydrogen Production Tax Credit under the Inflation Reduction Act that will provide investment certainty and drive deployment of clean hydrogen in the United States.'

Allyson Browne was also an enthusiast, convinced that: 'Fuel cell technology offers a promising pathway for maritime decarbonisation, particularly for longer voyages where batteries may not yet be viable.

'In 2025, I expect we'll see continued research into this technology, backed by increasing global investment in green hydrogen production.

'But for fuel cells to scale,' Browne maintained, 'the industry must address key challenges like hydrogen storage, onboard infrastructure and the safety protocols required for handling hydrogen in port and at sea. Additionally, developing port-side hydrogen bunkering infrastructure will be critical to supporting early adopters. Collaboration among stakeholders–including policymakers, technology providers, energy suppliers, port authorities and shipping companies–will be key to advancing these efforts.

'As the technology matures, fuel cells could become a cornerstone of shipping's energy transition, particularly if supported by smart policy and investment.'

Eirik Ovrum reported that: 'There are several ongoing projects for solid oxide fuel cells that aim to test them onboard in real operating conditions, and that can provide us with insight into the real operational performance over the operational profile of a ship. When these projects are finished and their results analysed and published, this will provide the industry with important data that can potentially drive an effort into investing in fuel cells for use on ships, if they show positive enough results.

In **Julien Boulland's** estimation: 'Fuel cell technology for ships is set to advance as the maritime industry pushes toward decarbonisation significantly. Hydrogen fuel cells, likely combined with batteries in hybrid systems, have the potential to power more commercial vessels, particularly for short-to-medium distance routes like ferries and port service ships. Efficiency gains and cost reductions in fuel cells will make them more viable, while green hydrogen production and improved storage technologies will enhance the fuel supply chain.

'BV has also been involved in certifying fuel cell-powered vessel projects, including its role in supporting the design and construction of fuel cell systems. In 2023, BV awarded an AiP to Nedstack Fuel Cell Technology, a leading provider of hydrogen fuel cell solutions for its containerised fuel cell systems. More recently, French hydrogen power solutions developer, Genevos, has been awarded an AiP for its new marine fuel cell, a 250kW Hydrogen Power Module, created to meet the growing demands for zero emission coastal vessels.

'Additionally, BV has been working on standardising guidelines and safety protocols for hydrogen and fuel cell technology in maritime use. Government incentives and private sector investment will also drive progress, helping to lower operational costs and support the transition to zero-emission shipping.'

Alexander Prokopakis said: 'As fuel cell technology for ships is a viable alternative research and improvements will continue to be made'. Meanwhile, **Nacho de Miguel** suggested that: 'Perhaps this is where green hydrogen could play a role in the decarbonisation of certain segments at shipping, such as in cruise ships, to cover the energy needs for hotel services (onboard life).'

Erik Hoffmann judged that: 'Hydrogen fuel cells took a hit in 2024, with TECO 2030 and others not being able to realise their plans. Norwegian authorities announced that larger ships don't have to be zero-emission in their heritage fjords until 2032, pushed back from 2026. For ocean-going ships fuel cells probably need a technological breakthrough and solid oxide fuel cells (SOFCs) seem to be the answer, so look out for progress on those.'

We will close this section with some thoughts from **Kim Rosello**, who believed that: 'Fuel cell technology holds great promise for maritime applications, particularly in achieving decarbonisation goals. However,' she continued, 'its development and adoption face significant challenges, primarily related to fuel quality. Fuel cells are highly sensitive to impurities, and ensuring the consistent quality of fuels such as hydrogen or ammonia remains a longstanding issue, even for conventional fuels in the maritime sector.

'In 2025, progress is expected to focus on addressing these quality issues through advancements in fuel purification technologies and the development of more resilient fuel cell systems. Research efforts may also explore alternative fuel sources that are less sensitive to impurities while maintaining efficiency and environmental benefits. The maritime industry is likely to collaborate closely with fuel producers and technology developers to establish standardised fuel quality benchmarks, which are essential for scaling fuel cell adoption.

'Infrastructure development will also play a critical role. The lack of robust bunkering facilities for hydrogen and other alternative fuels continues to be a bottleneck for fuel cell deployment in shipping. Addressing this will require significant investment and coordination among ports, shipping companies, and governments.'

Optimal solutions?

This section of the ship.energy survey focuses on IMO regulations and technologies designed to help boost ships' energy efficiency and reduce their emissions

The International Maritime Organization's (IMO) Carbon Intensity Indicator (CII) and Energy Efficiency Existing Ship Index (EEXI) regulations have now been in effect for two years, and opinion is still divided on their efficacy. So we invited our respondents to consider:

Do you believe CII and EEXI regulations are having a positive effect – and how do you think that they could be improved?

This question certainly elicited some strong opinions – particularly from those in the No camp. But while no one felt that CCI and EEXI were perfect, some of our respondents felt that they have played an important role.

Tore Longva, for example, said that: 'Looking at the impact of the Ship Energy Efficiency Management Plan (SEEMP) and in particular the CII, the big effect is the new awareness and focus they have brought to operational efficiency in the industry. And even though there has been some criticism, for the first time we now have a common metric and rating which combined with management plans have lowered the hurdle to making and demonstrating improvements, and which we expect have led to overall efficiency gains.

'We still don't have a full picture of the impact the EEXI has had, but the engine power/shaft limitation has most likely prevented some vessels from speeding up with consequent reductions in fuel consumption.

'The big question on the CII, is how to adapt this so it is more universally applicable across vessel segments. There are no one efficiency improvement solution or metric that can apply to all vessel types, or even within many subsegments, and the CII and SEEMP need to better cater to this in the future.

'Work is ongoing to review the metric and process and this should mitigate the main issues. While looking ahead, the CII and SEEMP will be further refined and strengthened and also adapted to work together with a fuel GHG intensity requirement. We do not expect any further phases that strengthen the EEXI.'

Dana Rodriguez was positive but recognised why there has been some pushback. 'Regulations in general have a positive effect because they focus attention on the need to improve energy efficiency and therefore decarbonisation; creating lasting improvements to the maritime industry,' she said. But she acknowledged that: 'The CII specifically has not been welcomed by many ship owners and the formula to calculate it might need improvement to create sensible results, where it does not penalise ships that are idling over ships that are increasing their transport work.'

> 'The big question on the CII, is how to adapt this so it is more universally applicable across vessel segments'
> *Tore Longva*

Allyson Browne was pleased to see that: 'The CII and EEXI regulations are starting to drive meaningful action, prompting shipowners to consider retrofitting older vessels and investing in more efficient designs.' However, she also believed that: 'These frameworks require stronger enforcement and clearer pathways for incremental improvements. Incentivising best practices and introducing mechanisms to track and penalise non-compliance could enhance their impact.'

Leon Arets saw a split in the market on CII. 'We have seen a CII-driven uptick in biofuels adoption, but this is counterpointed by a two-sided approach in the market,' he explained. 'One part of the market is taking CII into account, and thus also really looking to achieve and maintain a C-rating or improving its rating, and the other part of the market is not looking at CII at all due to a lack of clarity on the consequences of non-compliance. Hence, improvement can come from making the consequences clearer (compare with the penalty under Fuel EU, which can be a clear driver to work towards reduction of GHG intensity of energy used onboard).'

Many of our respondents shared their view on how the regulations could be improved. **Ruben Tins** said: 'The IMO has been advocating for both the CII and EEXI for many years and since their implementation, companies have been motivated to invest in energy efficiency technologies to improve their CII ratings and overall energy performance. This has

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led to a positive impact, with emissions being reduced, particularly through the use of retrofits. Further improvements could be made by installing Energy Efficiency Technologies (EETs) onboard, supported by alternative financing options and simplified solutions for easier implementation. This would encourage broader adoption and accelerate progress in energy efficiency across the industry.'

Namrata Nadkarni maintained that: 'If we want shipping to become greener, we need incentives such as market-based mechanisms (MBMs) and also penalties such as unfavourable freight rates (if a vessel has a bad rating). The regulations certainly need to be polished more and in an ideal world, the CII would be linked directly to cargo carried and not just capacity - but I know that this is already being considered.'

'From an environmental advocate perspective,' urged **Jamie Yates**, 'it is imperative that shipowners and carriers look at operational avenues to reduce emissions and increase efficiency. Especially for the IMO's 2030 emissions reduction targets, CII and efficiency measures are the primary mechanisms that will enable reaching those targets as the zero and near-zero fuel supply ramps up.

'One necessary change, that we've also heard from cargo owners and major retailers with strong emissions reductions goals,' Yates continued, 'is increased transparency around individual vessel efficiency scores. As sights are increasingly set on reducing Scope 3 emissions, the ability to preferentially ship cargo on efficient vessels would create the needed market pressure for ship owners and operators to invest in needed efficiency improvements or shift to better operational practices. It would also be possible to evaluate which carriers and shipowners are taking needed action in fleet improvements and changing outdated industry practices.'

Pekka Pakkanen gave a detailed view of what lies ahead in the continuing evolution of these regulations. 'On the one hand,' he began, 'CII has been positive in raising awareness of the importance of vessel and operational efficiency and highlighting any laggards in shipping's decarbonisation transition. CII also provides a promising framework for tracking and monitoring the efficiency of individual ships and different vessel segments. However, it does appear there are some iterations and improvements required to the regulations.

'Iterating upon CII and EEXI regulations will remain on the IMO's agenda for 2025. There was only very minor progress at MEPC 82 in 2024, as delegates "commenced the review" of CII, as well as the SEEMP and EEXI. No gaps were identified regarding EEXI, while the remaining gaps in CII and SEEMP may be addressed in the first phase before 1 January 2026.

'A widely recognised challenge that remains with CII,' Pakkanen continued, 'is split incentives and barriers to collaboration between shipowners and charterers. This is because responsibilities and incentives are shared: owners will be on the receiving end of a good or bad CII rating, yet it is largely outside of their control as they often only have indirect means to impact the ship's operational efficiency. Meanwhile, the regulations arguably over-rely on charterers demanding a positive CII rating and on highly rated ships commanding higher charter rates. As a result, CII is not incentivising shipowners to invest in efficiency as well as it is intended to.

'Overcoming these barriers requires collaboration and trust between owners and charterers – and the foundation for this trust is digital! In essence, both parties need a neutral, objective platform where they can develop a shared understanding of how a vessel's CII evolves throughout the year, and what can be done to improve or maintain it. This is one area where the use of simulation and data analysis tools can be so valuable, and is increasingly being deployed by sustainability frontrunners.'

Andrew Dumbrille called for a new perspective to looking at ships' energies and energy efficiencies: 'Scalable zero emissions fuels are still out of reach for the shipping sector in the short term. To meet ambitious Paris aligned 2030 GHG targets, efficiency and a revamped CII are going to be key tools to get there. A more efficient vessel can cover the same distance while consuming less fuel, leading to reduced GHGs and air pollutants. Efficiency saves fuel costs, and if considered appropriately, can minimise underwater noise, decrease the risk of ship strikes on marine animals, and reduce ship pollution discharges. For the CII to support this vision it needs to be based on overall energy used, ie. megajoules. This approach would incentivise speed reductions and investment in retrofits. The per year efficiency ratings, or Z factors, also need to be dialled up from 2% to near 8% per year, this would align the CII with Paris level commitments. Lastly, the CII needs to be more transparent and have robust enforcement. Right now there are no penalties for non-compliance and the public cannot hold operators to account because the reporting of efficiency levels isn't public.'

Gavin Allwright also called for a new approach, as he – like many others – felt that CII in its current form can sometimes produce 'perverse incentives'. He explained: 'The intent of these regulations has had a positive impact from the perspective of raising the awareness of decarbonisation requirements within the industry. However, how effective these have been from a practical, implementation sense is more complex. The EEXI has delivered a minimum efficiency requirement, which is often met by EPL installations and thus not delivering a heavy burden on the industry, but equally arguably not delivering significant positive behaviour change. The CII approach has been far more controversial and the general consensus is that while it can lead to reductions in carbon emissions, there are multiple cases where it delivers perverse incentives.

He continued: 'Both measures could be significantly improved upon, with the EEXI requirement strengthened and thus incentivising more impactful adjustments and retrofitting of energy efficiency measures and systems. CII could be re-organised to incentivise alternative fuels and technologies much more directly, with reward factors or multipliers introduced for these low and zero-emissions options and by adopting a more sectoral approach, taking into consideration the unique circumstances of each shipping segment operational profiles. It also needs to have teeth and the review

'EEXI is a design index that doesn't take into account the operational profile of the vessel; in most cases, the result is a limitation on vessel's available propulsion power and speed. The associated limitation on the capacity of the global fleet is not taken into account'

Dimitrios Marantis

process will likely embrace this issue, going beyond the low bar of imposing an enhanced SEEMP requirement alone.'

Turning to those who answered our question with a No, **Erik Hoffmann** said that: 'CII is seen as a bad joke as it incentivises steaming around to improve ratings. An empirical approach is needed when the CII is up for a revision, so that regulators can look at whether it has created more or less emissions in various settings, and close those loopholes.'

Michael Schaap was concerned that: 'There are too many ways, which are still available, to reduce the effectiveness and to trade your way out of material impact at the moment.'

Dimitrios Marantis flagged up the anomalies: 'EEXI is a design index that doesn't take into account the operational profile of the vessel; in most cases, the result is a limitation on vessel's available propulsion power and speed. The associated limitation on the capacity of the global fleet is not taken into account.

'CII focuses on fuel consumption; however, it does not take into account the cargo carried in each voyage, as the formula includes the DWT. So, a vessel that is only half-loaded would appear to be more efficient as the fuel consumption would be less for a given speed, compared to a fully loaded vessel.'

Adrian Tolson said: 'No, on balance' and questioned whether there is 'really any enforcement or should I say commercial consequences for a poor rating'. He continued: 'CII regulation in particular has been heavily criticised and rightly so. In the bunkering industry there is a clear problem with short voyages if bunker barges [are] greater than 5000 GRT with those vessels usually at an E rating.' But he added that: 'Revisions will come – and hopefully these types of issues will be fixed.' **Goran Dominioni** took a similar view, saying that: 'There are significant improvements for both CII and EEXI. Hopefully we will see some of these improvements being implemented soon at the IMO.'

We'll close this section with **Kim Rosello**, who acknowledged both the regulation's achievements and shortcomings, and looked for a way forward. 'The IMO's CII and EEXI regulations have highlighted the importance of reducing emissions but fail to address operational inefficiencies caused by poor management or commercial priorities,' she said. 'While the CII focuses on carbon intensity and the EEXI on design efficiency, they do little to incentivise optimal operational practices like voyage planning or fuel management.

'To improve their impact, these regulations could incorporate measures encouraging real-time monitoring and optimisation, as well as fostering collaboration between stakeholders to address systemic inefficiencies. Expanding their scope to include lifecycle environmental impacts would also promote long-term investment in cleaner technologies.

'Greater transparency and stronger enforcement are essential to ensure accountability and drive innovation. While these regulations are a positive step, addressing operational and systemic gaps is key to achieving meaningful decarbonisation in the maritime industry.'

Has onboard carbon capture (OCC) gained more credibility as a viable option for reducing ships' emissions?

On balance, our respondents felt OCC has been making progress. **Eng Kiong Koh** reported: 'We are beginning to see OCC installations on commercial vessels'. He pointed out that the technology is not new, but he believed that 'what is lacking is the value chain for post-captured CO_2.'

Namrata Nadkarni said: 'The greater number of conversations about technologies to facilitate onboard carbon capture indicate that this is gathering force. There are some solutions that are already market ready (I remember them being debuted at NorShipping in 2023), but I know that pricing is an issue that must be addressed (which a carbon levy will do).'

> 'In 2024, interest from the industry in OCC continued to ramp up, as we saw a lot of progress both on the technology and its implementation.
>
> *Chara Georgopoulou*

Alexander Prokopakis said that OCC was in the early stages of its development but predicted that: 'We will see great developments around carbon capture over the next decade.'

Chara Georgopoulou judged that: 'In 2024, interest from the industry in OCC continued to ramp up, as we saw a lot of progress both on the technology and its implementation. What also became clear was how its success will depend on collaboration between regulators, policy makers, industry stakeholders, class and suppliers.

'Several on-board pilots came online, including the ongoing conversion of a Ro-Ro vessel of Neptune Lines with Erma First's amine-based system going through class approval. Different technology types, including absorption and mineralisation, demonstrated onboard capture and port disposal. In addition, several feasibility and risk assessment studies showed how OCC can be safely onboarded and used to minimise emissions.

'At DNV,' Georgopoulou reported, 'we issued new class rules and notations for OCC, that provide a framework and requirements for new systems, including exhaust pre-treatment, absorption, after-treatment systems, liquefaction, CO_2 storage, and transfer ashore.

'One of the ongoing questions is the terms under which new regulations will credit the removal of carbon emissions, and how smoothly OCC can be integrated into the growing CCUS value chain, as this will have a big impact on the commercial attractiveness of the technology.'

Ruben Tins reminded us that: 'Carbon Capture and Storage (CCS), including OCC, has been a concept in the shipping industry for some time, but its real implementation began only a few years ago. In 2024, there were clear indications of progress, particularly with its inclusion as a potential technology under the FuelEU Maritime (FEUM) regulation. Using CCS enables ships to continue using conventional fuels until they are ready to transition to renewable alternatives.

'However,' Tins noted, 'while CCS is a promising solution, it does have some drawbacks. One of the key challenges is the lack of support from governments to incentivise early adoption. A notable example is TECO 2030, which went bankrupt after attempting to implement CCS technology for ships without sufficient backing from the Norwegian government.'

Julien Boulland gave an update on some of the work that Bureau Veritas (BV) has been doing in this area. 'Although alternative fuels are generally considered to be the preeminent means by which shipping will achieve its decarbonisation objectives,' he said, 'carbon capture and storage is becoming an increasingly viable onboard technology to reduce CO_2 emissions.

'BV published a technical report on carbon capture & storage technology within the

marine market in 2024. The shipping industry will play a vital role in facilitating the development of the global carbon capture, utilisation, and storage value chain as a major mode of CO_2 transportation, particularly when considered alongside the growing interest in offshore CO_2 storage sites. Globally, approximately 230 million metric tonnes of CO_2 are already used in industrial applications every year, including the production of fertiliser, steel, as well as food and beverages. This suggests that greater investment in CCUS infrastructure could unlock significant revenue potential for owners and operators that have integrated CCS technology onboard.

'Significant challenges still inhibit the adoption of CCS technology on ships at scale, such as significant upfront CAPEX investment, limited space for CCS systems on board, as well as a current lack of regulation. Nevertheless, the impact of CCS technology can be substantial when it achieves market viability. This is why BV is committed to supporting the industry in the development and deployment of innovative carbon capture technologies. An example of these efforts is our recent partnership with Samsung Heavy Industries Co., Ltd (SHI) to develop Floating CO_2 Storage Units (FCSU) and CCS projects in the Republic of Korea, with the aim to significantly reduce GHG emissions.'

Gavin Allwright believed that OCC had 'gained ground in 2024', but he was another who flagged concerns on the costs of installation and 'the need for a global regulation framework that doesn't repeat some of the pitfalls that we had with ballast water systems and scrubbers'.

Kim Rosello was in the neutral corner on this question, as she believed: 'Onboard carbon capture holds promise for reducing ship emissions, but its viability is uncertain due to challenges like energy consumption and space requirements. Installing OCC systems often necessitates larger, more fuel-consuming vessels, which could offset its benefits. The full chain of CO_2 management – from capture onboard to transportation, storage, or reuse – must also be evaluated for feasibility and environmental impact.

'Economic and operational challenges, including high installation and running costs, further complicate OCC adoption. To gain credibility, advances in energy-efficient systems and the development of a global CCS infrastructure are needed. While OCC shows potential, it remains unproven compared to other decarbonisation technologies.'

Those in the No camp included **Allyson Browne**, who reasoned: 'While onboard carbon capture is an intriguing concept, it remains at a nascent stage with significant technical and economic hurdles. Deployment at scale requires addressing storage challenges, high costs, and energy penalties. Rather than chasing these false solutions, the industry should focus on scalable, mature solutions like electrification and green fuels, which offer more immediate and direct impact.'

> 'Significant challenges still inhibit the adoption of CCS technology on ships at scale, such as significant upfront CAPEX investment, limited space for CCS systems on board, as well as a current lack of regulation'
>
> *Julien Boulland*

Michael Schaap pointed out that: 'Investments are required to take it from the ship and form an accredited value chain that processes the carbon properly.' And **Erik Hoffmann** put his case succinctly: 'I have not yet heard of any carbon capture systems that can effectively cap emissions at a high average percentage and with an acceptable impact on the fuel economy, cargo space and weight of a ship.'

Adrian Tolson judged that OCC has made some 'marginal' gains in credibility – but he maintained that the challenges of 'how to process carbon, what to do with it at ports, and how to transport and dispose/store it around around the world' will be hard and 'very costly' to overcome. 'I think OCC will have a role,' he concluded, 'but like many solutions it will be only part of the puzzle, not the whole puzzle.'

Do you believe that voyage optimisation, weather-routing technologies and Just-in-Time (JIT) scheduling could have a significant role to play in helping ships to improve their energy efficiency and reduce fuel consumption?

Given NAPA's heavy involvement in this area, we'll hear first from the company's **Pekka Pakkanen**, who told us: 'Looking at the big picture, environmental regulations and economic measures are proliferating and becoming more impactful. In this regulatory landscape, voyage optimisation platforms – which use real-time data on weather and sea conditions to evaluate and adapt a vessel's course – do not only slash fuel expenses and emissions but also reduce the costs of regulatory compliance. In today's market, these solutions are no longer "nice to have" but rather a commercial necessity, and this effect will only compound as regulations become more stringent.

'The "Sail Fast, Then Wait" or "Rush to Wait" phenomenon is more challenging. The trend goes back to the early 20th century, a time when communications between vessel and shore were limited, and information about ships and cargoes was not known to third parties. This is no longer the case. The Blue Visby consortium, underpinned by NAPA's technology and expertise, provides an innovative contractual framework and platform that enables vessels to arrive perfectly just in time (JIT). This can reduce fuel consumption and GHG emissions by 15% on average. If applied globally, the solution has the potential to reduce the carbon footprint of the global shipping fleet by more than 60 million tonnes of CO_2 per year – which is larger than the total emissions of an entire country like Norway.'

Namrata Nadkarni was no less enthusiastic. 'Honestly,' she said, 'this is a no brainer and it baffles me that the industry has not accepted this as standard practice. There are so many cases where the benefits have been proven and in fact for JIT, a study by the IMO's GreenVoyage2050 team even showed that this type of scheduling helped in virtually every scenario. Adapting your ship operations to match available berths and timings feels like a win-win that is only being held back by traditional contracts that insist on specific ship speeds. This really does need to change.'

Alexander Prokopakis saw multiple benefits: 'These options are increasingly recognised as effective tools for improving energy efficiency and reducing fuel consumption. By leveraging real-time data, these technologies can help vessels avoid inefficiencies, minimise fuel use, and reduce emissions.'

Elissama Menezes emphasised the environmental upside: 'Voyage optimisation, weather-routing technologies, and JIT scheduling play a crucial role not only in enhancing energy efficiency and reducing fuel consumption but also in addressing the interconnected

challenges of climate change, pollution, and biodiversity loss. These efficiency measures provide an opportunity to mitigate the triple planetary crisis – a global threat with profound implications for ecosystems, societies, and economies that transcends borders. By adopting these practices, shipping can avoid routes of cultural, ecological, and biodiversity significance, while simultaneously reducing fuel use and the associated air pollution. The shipping sector, positioned at the crossroads of these crises, has a unique opportunity to contribute meaningfully to their resolution. Prioritising solutions with co-benefits such as these places shipping at the nexus of tackling the triple planetary crisis.'

Jamie Yates noted that the technologies have already been proving their worth. 'We have been hearing from industry during the IMO's review of CII that time at anchorage and berth can have significant impacts on a vessel's efficiency score,' she noted. 'There has been leadership from the Republic of Korea in developing and highlighting the benefits of a Just-in-Time programme in reducing wait time and improving ship CII scores. When using a Just-in-Time or berth queuing system with a specific arrival time and date, ships can reduce speeds to match the assigned slot and increase fuel efficiency by slow steaming, instead of continuing current industry practice of "Sail Fast Then Wait."

'In addition, wind-assisted propulsion systems – while not available for every ship type – are another tool increasingly adopted across the industry that can significantly reduce fuel consumption along a vessel's voyage. When paired with weather-routing software, the benefits can be even more dramatic.'

Hans Anton Tvete looked ahead to a future of digitalisation and data sharing. 'Increasing operational efficiencies can significantly reduce fuel consumption, its associated costs, and emissions,' he said. 'One of the most effective methods for achieving this is reducing a vessel's speed, where small reductions in speed can result in considerable savings. Therefore, the combined effect of 1) sailing the most optimal route based on factors such as weather conditions and distance, which allows for lower speeds and minimises added resistance, and 2) ensuring Just-in-Time arrival at available berths to avoid unnecessary waiting times (hurry up and wait), will be key to maintaining minimum speed while still meeting operational schedules.

'Additionally, data sharing across the supply chain will be crucial in enabling these improvements. When ship operators, port authorities, terminal operators, and even fuel suppliers share real-time data, it can create a unified, transparent system that allows for smarter decisions. For instance, sharing berth schedules, cargo handling times, and real-time weather updates can help fine-tune the timing of arrivals and optimise routing. This level of coordination ensures that operational decisions are based on the most accurate, up-to-date information, significantly improving fuel efficiency and reducing idle times.

'Moreover, independent third-party verification can play a vital role in ensuring that the data shared and used for these optimisations is accurate and reliable. By having an unbiased entity verify the data, it can increase trust among all stakeholders and ensure that the decisions made based on this data are delivering efficiencies as promised.'

> 'When ship operators, port authorities, terminal operators, and even fuel suppliers share real-time data, it can create a unified, transparent system that allows for smarter decisions'
>
> *Hans Anton Tvete*

Kim Rosello looked at how market forces and industry collaboration will dictate the pace of the technologies' adoption: 'Voyage optimisation, weather-routing technologies, and JIT scheduling can significantly enhance energy efficiency and reduce fuel consumption in shipping. However, adoption depends on economic realities and freight market dynamics. When freight markets are strong, companies prioritise revenue over efficiency, but during downturns, cost-saving measures like voyage optimisation gain focus.

'Charterparty agreements often limit flexibility for energy-efficient practices by mandating specific speeds or delivery windows. Revising contracts to incentivise efficiency and embracing digitalisation are key to unlocking the potential of these technologies. Collaboration between shipping companies, charterers, and ports is essential to implement JIT scheduling and reduce idle time.

'While these tools are promising, their success depends on industry-wide changes in operations, training, and contract structures to prioritise efficiency alongside profitability.'

Julien Boulland was again able to support his answer with new BV research, as he reported: 'In our recently released decarbonisation trajectories position paper, BV outlined the significant role that more immediate operational measures will play in supporting the industry's decarbonisation efforts. Our modelling confirmed that leveraging measures such as voyage optimisation, weather routing, as well as just-in-time arrival scheduling has the potential to provide a significant cumulative impact on operational and technical efficiency measures.

'BV's simulations show that without action to reduce speed or waiting time while ocean transportation volumes grow moderately to reach a 50% increase by 2050, GHG emissions would be 92% higher in 2050, with 44% more emissions over the period from a GHG budget perspective, without these optimisation levers'.

Both **Allyson Browne** and **Dana Rodriguez** saw weather routing and optimisation technologies as 'low-hanging, affordable fruit' to support decarbonisation. Browne added that: 'Just-in-Time scheduling, in particular, minimises idling time at ports, reducing fuel use and emissions. Industry-wide adoption of digital solutions could deliver transformative gains if paired with regulatory support and collaborative data-sharing.'

As one would expect, the International Windship Association's (IWSA) **Gavin Allwright** was among the respondents who said that voyage optimisation and weather routing can be even more potent with a bit of wind beneath their sails. 'These operational approaches along with energy efficiency measures and wind propulsion will be the three key pillars for delivering on IMO 2030 and 2040,' he asserted. 'These are all off-the-shelf solutions that pay for themselves over a relatively short period of time. In isolation, these could easily deliver 20% of the energy savings required if rolled out across the fleet. However if these are combined with wind propulsion installations then these have the potential to act as a significant multiplier there too. We are seeing increasing sophistication in these systems including incorporating machine learning, and that will likely only continue to grow.'

Fuel quality, availability and pricing trends come under the microscope

While the shipping world may be gearing up to use alternative fuels, for now the vast majority of the global fleet is still running on conventional fuel – and shipowners still have to focus on obtaining sufficient quantities of fuel that is fit for purpose.

Have you noticed any quality trends with any of the main marine fossil fuel grades in 2024?

Chris Turner reported that: 'Very low sulphur fuel oil (VLSFO) has faced challenges meeting ISO 8217:2024's updated viscosity requirements, with over 45% of global supplies falling below the new minimum standard of 120 cSt. Adjustments to blend recipes are needed, which could lead to stability issues. Additionally, sulphur off-specification incidents remain a concern, particularly in ports like Rotterdam and Barcelona (for VLSFO). Flash point issues are noted in LSMGO where road fuels are used in the marine pool, particularly in the Mediterranean.'

Adrian Tolson told us that: 'In the broadest terms, VLSFO is less popular and less in demand! The quality is variable and problematic. HSFO is continuing (along with the uptake in scrubbers) to increase in volume – even with a Hi-Low spread that had been quite limited for much of 2024 – and it has been the dominant fuel type in New York and Rotterdam. Who said HSFO was dead in 2019! MGO has held its ground and will get a big boost in 2025 with the MedSECA [Mediterranean Sulphur Emission Control Area].'

Kim Rosello said: 'We are unsure of any specific quality trends in marine fossil fuel grades in 2024, though fuel variability remains a concern. The use of VLSFO continues to raise issues such as sediment formation, instability, and inconsistent energy content, likely linked to increased blending to meet sulphur regulations.

'Improved testing and digital monitoring tools are helping operators manage fuel quality better, but widespread adoption is still evolving. While fuel quality is critical, clear trends in 2024 are difficult to identify without further data. Staying informed through suppliers and industry updates remains key.'

Allyson Browne felt that 'quality issues remain consistent with past trends, including variability in fuel stability and compatibility' and she therefore urged that: 'Ports should prioritise greater transparency and enhanced testing capabilities to mitigate risks.'

Have you noticed any quality trends with marine biofuels in 2024?

We'll stay with **Allyson Browne** a bit longer, who warned that: 'The growing demand for biofuels has revealed critical challenges in supply chains, particularly regarding consistency and transparency in fuel quality. One concern is the lack of standardised grading

processes, which creates uncertainty for shipowners and operators relying on biofuels as a consistent alternative to traditional fuels.

'Additionally, the production of biofuels can sometimes exacerbate supply chain issues for other fuel types. For example, the diversion of feedstocks from food or other industrial uses to biofuel production can strain existing resources, driving up costs and creating shortages in unrelated sectors. Transparency in sourcing and grading is essential to ensure that biofuels can be adopted reliably without creating unintended bottlenecks or negative social and environmental impacts.

'Ports and regulatory bodies must work toward harmonising standards globally to address these concerns and ensure biofuels can play a meaningful role in the energy transition.'

For **Albert Leyson**: 'The most surprising biofuel quality was net heat of combustion. DF-grades had 12.6% less energy content vs ULSFO-DM [ultra low sulphur fuel oil] grades, whereas RF-grades had 4.2% less energy content vs VLSFO-RM [very low sulphur fuel oil] grades. The DF-grades were essentially B100 and the RF-grades were closer to a B30. Therefore, the percentage of FAME [fatty acid methyl ester] feedstock used in blending plays an important role in biofuel quality. The higher the percentage of FAME used in blending, the greater the impact in biofuel quality.'

Erik Hoffmann flagged up 'high pour points for certain biofuel grade and problematic cashew nut shell liquid (CSNL)', while **Chris Turner** offered these insights: 'Biofuel blends, particularly those with higher FAME content, can face cold flow issues in colder climates as well as increased acidity, which can affect performance. The variability in biofuel quality depends on regional feedstocks. Biodiesels produced from a variety of feedstocks are on offer in different regions. First-generation – and unsustainable – feedstocks like palm oil are blended into low sulphur marine gasoil (LSMGO) by mandate in Indonesia. US suppliers have been seen to offer biodiesel produced from a mixture of tallow, soy and used cooking oil (UCO). While in the EU, second generation UCO and palm oil mill effluent (POME) are key feedstocks.'

Turner added that: 'Sulphur and viscosity compliance issues have been most notable in ports like Singapore, Rotterdam, and Balboa, while the Mediterranean has seen increased flash point risks due to blending automotive fuels into marine grades.'

Adrian Tolson did not comment on any specific quality issues, but added that he has 'generally noted an increase in attention paid to HVO or Renewable Diesel (RD)' and also detected 'some wariness about biodiesel because of the dubious certification of some FAME'.

> 'Specific quality trends in marine biofuel grades in 2024 are still emerging, but variability remains a key concern'
>
> *Kim Rosello*

Kim Rosello reported that: 'Specific quality trends in marine biofuel grades in 2024 are still emerging, but variability remains a key concern. Differences in feedstock quality, production processes, and blending practices have led to inconsistent performance, with some regions reporting more off-spec fuels due to less stringent quality controls. Pre-bunkering checks and supplier reputation are critical to mitigating these issues.

'FAME-based biofuels are more prone to contamination and oxidation, especially in warm climates or during long storage periods, while HVO offers better stability but is less widely available and more expensive. Enhanced transparency, testing protocols, and collaboration between stakeholders are essential to address these challenges and build confidence in biofuels as a reliable decarbonisation solution.'

As the Trading & Operations Director of the biofuels specialist FincoEnergies, **Leon Arets** has a keen eye for the trends in this market, and he reported that: 'In general, we see that the quality and stability of biofuels is very good and is leading to less problems onboard, as opposed to fossil fuels, where de-bunkering regularly takes place. As long as the crew onboard the vessels perform proper housekeeping and carefully follow the biofuel supplier's instructions with regards to storage and usage of the biofuels, no problems are to be expected. Selecting a trustworthy and experienced biofuel supplier is key to not only ensuring the right quality is delivered and proper guidance to the vessel crew is provided, but also that the sustainability documentation provided along with such biofuels are complete and can be relied upon.'

Rounding off our look at quality trends for both conventional and bio marine fuels, **Sunil Krishnakumar** considered that: 'The overall state of fuel quality in 2024 remains much like that of the past few years, particularly since the transition to predominantly VLSFO in 2020. Persistent issues such as cat-fines, stability, sulphur content, and flash point continue to be challenging, and isolated incidents of chemical contamination are still occurring. We noted continuing issues on ship engines caused due to unusual chemical compounds in fuels bunkered at ports in the US Gulf Coast including Houston and New Orleans.

'The publication of the latest ISO standard for marine fuels (ISO 8217:2024) has been a positive step towards increasing the industry's confidence in taking up FAME and HVO blends for use on ships. An increasing number of ship operators are starting to use biofuels onboard on a regular basis or at least trialling to gain necessary experience. As of now there are no indications of widespread quality issues with these fuels. However, we do expect this to change once the use of these fuel blends become more common.'

Do you believe that there is sufficient availability of HSFO, VLSFO, MGO and biofuels in the main bunkering ports to meet the industry's needs for the different grades?

'In general,' **Alexander Prokopakis** reported, 'there is sufficient availability of HSFO, VLSFO, MGO, and biofuels in major bunkering ports. However, regional disparities exist, especially in smaller or more remote ports where fuel supply can be less consistent, and biofuels are still less widely available.'

From his vantage point at global supplier KPI OceanConnect, **Jesper Sørensen** found that: 'Despite steady demand, we continue to see availability challenges when it comes to HSFO, VLSFO and MGO as a result of seasonal utility demands. However, demand for biofuel is on the rise and in 2024, we saw demand in Singapore increase by 51% compared to 2023 to reach 779,900 tonnes, topping ARA. With the recently implemented FuelEU Maritime regulation this positive trend is expected to continue.

'As a result our group has focused on expanding our biofuel supply network to reach a milestone of more than 120 supply locations around the world. Adopting a partnership approach to building our infrastructure has helped the business increase the availability of alternative fuels for our clients.

'In shipping's multi-fuel future, fuel availability goes hand-in-hand with confidence in its offtake potential. By aggregating volume and demand for any fuel type or grade, intermediaries like KPI OceanConnect will play a critical

role in helping ship owners and operators to decarbonise the fuel strategies.

'KPI OceanConnect was involved in a number of first deliveries for clients and customers this year. We recently worked with partners across the value chain on the first successful delivery of renewable diesel in the cruise sector in Singapore. The landmark delivery of HVO100 marked a significant milestone for the Asia-Pacific marine sector and showed the importance of collaboration for meeting the energy needs of a range of sectors.

> 'In 2025, demand for biofuels and their blends will rise significantly'
>
> *Dionysis Diamantopoulos*

'Through all these bunkering operations, we were able to collaborate with our customers to ensure they could access fuel that met their specifications, wherever they needed it. We helped to shift the industry conversation from biofuel availability to understanding the operational profiles of our clients and delivering a fuel strategy that meets these needs.'

And from his position on the supply side of the biofuels market, FincoEnergies' **Leon Arets** noted that: 'We generally see good availability of fossil fuels and biofuels in the main bunkering ports (i.e., Singapore and Rotterdam). With regards to biofuel (blends), the restriction of availability is usually caused by insufficient notice time, as biofuel (blends) usually require a slightly longer lead time and higher order volumes, which complicate loading and/or blending operations.'

Over at the ICS, **Sunil Krishnakumar** said: 'We haven't seen any particular concerns regarding availability of HSFO, VLSFO and MGO grades. The availability landscape for biofuels is unclear and in our understanding these are mostly focused around Singapore and the ARA regions.'

Chris Turner pointed out the question of availability 'depends on the fuel', as he explained: 'HSFO is the only product that is not readily available globally with just 237 ports listed as of October 2024. Availability continues to be centred around bunkering hubs and geographically key areas likely to receive passing trade from very large crude carriers (VLCCs) and/or the ever-growing scrubber-fitted fleet. VLSFO remains available in almost twice as many ports (483) as HSFO. The challenge with VLSFO is that 98% of fuels traded are ISO 8217:2010 or 2017 specifications – 2024 fuels are rarely marketed or requested at this time. Biofuels remain less widely available, with demand and supply uneven across regions. However, momentum is building in the biofuel market as more suppliers enter the scene and expand blending capabilities.'

He also noted that: 'The rerouting of ships around the Cape of Good Hope has increased demand for HSFO in African and European ports, adding pressure on supply chains in these regions.'

Adrian Tolson felt that fuel availability was 'generally' sufficient – but he detected 'some concerns from the buy side of our industry regarding the availability of good quality VLSFO in many ports'. He felt that 'this fuel grade remains a challenging one', with stability being an issue, adding that: 'The challenge in many ports for VLSFO to meet the RMG380 2024 specs raises concerns, especially on the buy side, about quality VLSFO being available.'

On the positive side, Tolson said that: 'HSFO seems to be where it needs to be, and everyone has MGO.' However, he judged that: 'Generally bio availability in most ports is not great. The obvious operational challenges (segregation, barging etc.) are still there and this discourages supply in many locations. We see plenty of one-off trials, etc. but limited repeat availability.

'As a regional comment,' he continued, 'the US is worse off than most locations. Bio is not available, mainly because it's been very expensive – but even as the credits have lost value and the prices have dropped it still fails because of the operational challenges and lack of demand. Panama (a 5 million tonne PA+ bunker location) just announced its first supply option for bio – but I don't get the feeling that anyone is that confident regarding finding demand for even a small volume of bio.'

We had mixed reports on the availability of biofuel for the marine sector. **Dimitrios Marantis** considered that: 'There is not sufficient biofuel supply on a global scale.' But Erik Hoffmann said: 'Biofuel bunker supply comfortably outweighs demand in most ports. It's still a nascent market and bunker buyers willing to pay for biofuel blends tend to be able to get them with short lead times.'

Elissama Menezes focused her comments on biomethane (also known as bioLNG), saying: 'Biomethane is a limited resource, constrained by the availability of truly sustainable feedstock, yet it remains under consideration as a fuel option for shipping. From production to combustion, the biomethane supply chain poses significant challenges, including inefficiencies, unintended knock-on effects, and potential lock-in to unsustainable practices. Without robust demand reduction measures and improved efficiency strategies, its use risks exacerbating rather than solving climate, environmental, and social issues.

'The shipping industry's expectations for biomethane availability as a decarbonisation solution are overly optimistic. A comprehensive evaluation is urgently needed – one that incorporates a food systems perspective, a life-cycle assessment of methane leakage, and a systematic review of its broader impacts. Only through an interdisciplinary approach can we fully understand the implications of biomethane use. Until then, it cannot be deemed a viable or sustainable solution for shipping's energy transition.'

We'll close this section with **Alan Jones**, who switched the focus away from the availability of conventional bunkers to that of the 'alternatives'. 'Amid strong development across the industry,' he said, 'there remains deep uncertainty about when zero- or near-zero emission fuels will be available, and at what cost. The LR Maritime Decarbonisation Hub's latest Zero Carbon Monitor in October 2024 listed supply and infrastructure as a priority action to improve readiness for future fuels.'

Have you noticed any significant changes in the price differentials between VLSFO, HSFO, MGO/MDO & biofuels in 2024, and you expect this trend to continue in 2025?

For Baseblue's **Dionysis Diamantopoulos**: '2024 marked a turning point for biofuels with the introduction of EU ETS in shipping and the enforcement of FuelEU regulations. These changes prompted physical suppliers to add biofuels into their product portfolios to meet demand for trials and improve vessel CII ratings. This shift fostered the growth of biofuel ecosystems in major ports like Singapore, Rotterdam, and Gibraltar, where suppliers began offering these options. As the FuelEU deadline approached, global efforts intensified to develop biofuel supply solutions, with both new and established players expanding supply chains via barges and trucks.

'Biofuel pricing now hinges on various factors, including the port location, government subsidies (e.g., the Netherlands' HBE system), feedstock availability and cost, local demand, import versus local production, and bunker market conditions for blends. Consequently, global pricing rules are hard to establish.

However, in major hub ports, premiums for specific blends, like B24/30 VLSFO, have become predictable.'

Looking ahead, Diamantopoulos predicted that: 'In 2025, demand for biofuels and their blends will rise significantly. This growth could strain supply if new market entrants or production capacity expansions fail to materialise, or if feedstock availability declines due to competition from the aviation industry – an aggressive and high-paying buyer – or tariffs affecting feedstock exports globally.'

Leon Arets focused on the differential between conventional and bio fuels, telling us that: 'In 2024, prices of fossil fuels went down causing also the product spreads to narrow. Simultaneously, this had an adverse effect on the biofuel premiums (over fossil) which increased. Moreover, the HBE multiplier in the Netherlands changed from 0.8 (2023) to 0.4 (2024), having an adverse affect on the HBE value to be applied. In general, this meant that the biofuel premium for B100 marine bunkers went from flattish over gasoil in 2023 to premiums of 300 to 400 $/m over gasoil in 2024. For 2025, whilst the HBE multiplier remains 0.4, we expect that due to increase in bio demand, combined with a tightening availability of advanced feedstocks, the premium for biofuels to continue to move up throughout 2025'

As ENGINE's Managing Editor, **Erik Hoffmann** always keeps a close watch on the fuel differentials, and he concluded that: 'The Emissions Trading System (ETS) did little to close bio-fossil price gaps in 2024. The Carbon Intensity Indicator (CII) is hard to quantify and add onto prices. 2025 will be different. FuelEU pooling in combination with a more phased-in ETS can translate to a bio price advantage in some cases. We track this in our weekly fuel switch snapshots on ENGINE.

'More restrictive US sanctions on Russian oil transport lent some support to Brent initially, until Trump countered some of that with a call to OPEC to turn on the taps to cool prices. If we consider Russian fuel going into the bunker market, Singapore and Fujairah are perhaps the biggest ports that stand to lose, with a potential short-term knock-on effect on supply.'

Adrian Tolson said that it was 'no shocker' that HSFO is now more expensive (or less cheap) relative to VLSFO than in the past, but he added that 'in essence this is partially because the VLSFO and distillate cracks have dropped against crude as well'. He felt that there were 'lots of reasons' for HSFO becoming more expensive – 'but apparently not so expensive as to discourage scrubber installation' – including increased demand for HSFO as a feedstock and for power generation. His predictions for 2025 included: 'MGO demand picks up in the Med with the SECA – global demand jumps by 1/3rd or so. VLSFO takes a MedSECA hit – and everyone still wants HSFO (from non-sanctioned sources).'

We'll wrap up this section, with some observations from **Kim Rosello**, who noted that 'significant changes in the price differentials between VLSFO, HSFO (IFO380), and MGO were evident in 2024'. She said that VLSFO maintained a premium over HSFO of around $110, but the gap 'narrowed slightly over the year, likely due to increased adoption of scrubbers allowing more vessels to utilise HSFO'.

MGO maintained a premium of around $185 over VLSFO, she added, with 'the spread between these fuels underscoring the cost considerations influencing operators' fuel choices, with MGO generally used for specific operational needs or regulatory requirements'.

'The difference in price between VLSFO and HSFO,' Rosello reminded us, 'is a key factor for shipowners using scrubbers, as it determines whether their investment in Exhaust Gas Cleaning Systems (EGCS) delivers the expected cost savings.

'Looking ahead to 2025,' she continued, 'this price gap is likely to remain under pressure due to increasing regulatory changes, including the recent expansion of Emission Control Areas (ECAs) into the Mediterranean. These regulations, alongside the global push for decarbonisation and the adoption of biofuels, add further complexity to fuel cost management. For scrubber-equipped vessels, a narrowing VLSFO/HSFO price differential could significantly impact their ability to maintain cost efficiency.'

Rosello took the opportunity to inform us that Paratus offers a bespoke policy that helps shipowners protect their return on investment in EGCS.

Do you believe that we may see a shift in bunker demand – in terms of both individual ports and geographical regions – over the next few years?

Most of our respondents felt that we will see a shift. Some put this down to changes in global trade patterns, fuel price differentials and maritime security concerns (such as the current Red Sea crisis which has led many shipping companies to re-route round the Cape of Good Hope). And looking more long term, the new world bunkering map will have to take into account the key supply and production points of the 'new fuels'.

Focusing on FincoEnergies' area of expertise, **Leon Arets** said: 'To a certain extent, and especially for global shipping companies, we expect (and already see) a shift of biofuel demand towards the ports of Singapore and China, driven by lower biofuel premiums (over higher fossil prices), although in 2025 biofuel bunkers in the Netherlands remain very competitive, if not the most competitive, due to the HBE discount on advanced biofuel bunkers.'

Michael Schaap judged: 'Local supply will become more important for low carbon fuels as the origin of production is a key factor for pricing. Ships will take less bunkers in what are currently considered main ports, as we have seen over the last years already, except for Singapore.'

> 'The energy transition is reshaping global demand patterns'
>
> *Allyson Browne*

Alexander Prokopakis told us: 'Regional and port shifts in bunker demand are possible, driven by factors such as port dynamics, price differentials, and changing trade patterns. While we may see some shifts towards more competitive or convenient bunkering hubs, these changes are likely to be incremental rather than major upsets. The re-routing of vessels around the Cape has likely boosted bunker sales in key African ports, as ships seek alternative refueling options away from the Middle East.'

Erik Hoffmann said that ships rerouting round the Cape 'have increased their tonne-miles and fuel consumption, to the detriment of the environment'. He said that this has been 'a boon to bunker suppliers operating in certain African locations', with demand 'surging off Namibia's Walvis Bay'. However, he added that: 'Many South African ports have been unable to capitalise on the extra traffic, either because of inefficient ports or because of banned bunkering off Algoa Bay.'

Allyson Browne said that: 'The energy transition is reshaping global demand patterns'. She added: 'African ports, benefitting from rerouted trade due to Middle Eastern instability, could emerge as new players in the bunkering landscape. This presents an opportunity to support development in this region and help these economies be part of the transition and future of zero-emission shipping.'

As one would expect of the President and CEO of ZEMBA, **Ingrid Irigoyen** was also

hopeful that shipping's energy transition will create new opportunities – not just in Africa but globally. 'The evolving clean fuel market will fundamentally shift how, where, and what kind of fuel is bunkered around the world,' she said. 'Investments from governments supporting the development of new clean fuels could help shape this transformation, stimulating the creation of new bunkering hubs in geographies like the United States, the Middle East, and Southeast Asia and triggering modernisation of existing bunkering hubs seeking to maintain their position.'

All our respondents would probably agree with **Alan Jones'** assertion that: 'A key factor in vessel investment decisions is confidence in future supply of fuel. To reduce uncertainties and accelerate investment decisions at the "ship" stage, stakeholders across the entire value chain must work together to create supply chains for future zero (or near zero) carbon fuel uptake.'

However, some felt that this may not necessarily bring about a big change in where ships are lifting their fuel because, as **Sunil Krishnakumar** reasoned: 'Most, if not all, of the supply ventures for alternative fuels are happening at already well-established bunkering ports around the world (Singapore, ARA etc.). Singapore remains the industry leader in this respect, especially considering first mover initiatives such as the ammonia bunkering project. At least over the next few years, we do not see a shift in bunker demand.'

Adrian Tolson was another who flagged the Cape re-routing and also pointed to the likely impacts of the upcoming MedSECA. However, he added: 'Once we drop the immediate regulation and the geopolitical challenges, I am not sure we will see any major shifts in demand – large cargo ports will still attract the larger bunker volumes. There will be shifts on the margin for different regional demands for sure – but it will take some time.'

Looking at the impact of the energy transition, Tolson said that: 'Europe and North America reducing fossil refining capacity and shifting to alternatives for energy production will have very different impacts in each, I am sure. Europe I see as remaining at the forefront of alternative fuel supply and demand – including LNG. One year ago, I felt the US post-IRA [Inflation Reduction Act] might lead as a supplier of the green versions of methanol and ammonia, but now I am more concerned about key elements of this legislation being altered and economic nationalism keeping these new fuels for American consumption only.'

Chris Turner agreed that the Mediterranean ports would likely see increased demand for low-sulphur fuels with the implementation of the MedSECA. He added that: 'Northern European and East Asian ports will remain dominant but face growing competition from emerging hubs offering biofuels and LNG, [while] shifts in trade patterns and geopolitical instability are reshaping demand dynamics, with African and Mediterranean ports becoming increasingly attractive as bunkering hubs.'

Kim Rosello agreed that the MedSECA was important – and she thought that this, coupled with FuelEU Maritime regulations and the EU Emissions Trading System (EU ETS), will 'drive demand for low-sulphur fuels like VLSFO and MGO in Mediterranean ports and encourage the adoption of alternative fuels such as LNG and biofuels in regions with advanced infrastructure.'

She added: 'The EU ETS will also influence trade routes, pushing operators to minimise emissions costs, potentially reducing bunker demand at traditional ports in favour of those outside regulated zones. Geopolitical changes, such as trade realignments or shifts in energy supply chains, may further impact regional bunker demand, particularly in ports well-positioned for alternative fuel bunkering.

> 'Local supply will become more important for low carbon fuels as the origin of production is a key factor for pricing'
>
> *Michael Schaap*

'In summary, ports investing in alternative fuel infrastructure and aligning with new trade and regulatory dynamics will likely see increased demand, while others may face declines.'

Let's hear now from the bunker supplier community. KPI OceanConnect's **Jesper Sørensen** said: 'We are likely to see a shift in bunker demand across individual ports and geographical regions over the next few years, driven by evolving trade patterns and geopolitical developments.

'Geopolitical disruptions, reshoring and shifts in global trade flows are already influencing where and how vessels operate. For instance, the ongoing situation in the Red Sea has altered shipping routes, leading to increased bunker fuel demand in wayports around Southern Africa while reducing demand in regions where passage has declined. Additionally, as vessels re-route, some have increased speeds to mitigate longer transit times, resulting in higher fuel consumption overall.

'These changes have also spurred increased activity in non-major ports, which are emerging as critical points for refuelling and logistics. Economic growth in developing regions and regional political strategies are further reshaping trade lanes and influencing bunker demand distribution.

'At KPI OceanConnect, our agility and established partnerships in these emerging areas have allowed us to adapt quickly and maintain supply continuity for our clients. As these dynamics evolve, the industry must remain responsive and proactive, leveraging innovative solutions and strategic partnerships to address shifting demands and ensure a smooth transition in global trade flows.'

Dionysis Diamantopoulos brought together many of the threads that have run through this discussion, and also pointed to some of the political concerns that we will cover more fully in the final section of this year's survey. 'A shift in bunker demand could be something that we will see in the upcoming years, depending on geopolitical events,' he said. 'We have already seen the majority of maritime companies avoiding the Red Sea as a high-risk area. This led to a surge in volumes bunkered for larger vessels in Singapore, China or Hong Kong, but also a surge in bunkering in Mauritius or the Canaries for ships that didn't have the tank capacity to fill up in the Far East.

'In turn, bunker volumes in Mediterranean ports, like Port Said, Piraeus, and Malta, have dropped. Another example is the Black Sea area. The ongoing Russia/Ukraine conflict and the sanctions that the United States, United Kingdom and the European Union have placed on a wide array of Russian exported products have had a ripple effect, with fewer vessels calling at Black Sea ports and damaging the bunker volumes in Istanbul, Piraeus and Malta. It is uncertain how the event will settle or unfold in the coming years, and it is therefore difficult to say with certainty that bunker demand will shift to specific ports from the traditional big hub ports of the world. A new map could be drawn, as – much like the shipping companies in our industry – those ports which do not adapt to the new reality and incorporate alternative fuel options into their offering, will be left behind.'

Measuring success?

We now look at efforts underway to use technology to improve transparency, accountability and efficiency in the bunker industry

The Ports of Rotterdam and Antwerp-Bruges are set to make the use of mass flow meters (MFMs) compulsory for bunker deliveries in 2026 – and Singapore and, more recently, the Port of Sohar and the Port of Ceuta, have already done so. Singapore and Rotterdam have also been leading the way on licensing schemes for bunker suppliers and electronic bunker delivery notes (e-BDNs).

Following on from Singapore, Rotterdam and Antwerp-Bruges, do you believe that the momentum is now building for MFM to become mandatory, or standard practice in other bunkering hubs too?

There was completely unanimity here, as all our respondent who chose to answer this question did so with a Yes.

Allyson Browne said that: 'The momentum for MFMs is undeniable, with Singapore and European ports like Rotterdam leading the charge. MFMs improve accuracy and transparency in bunker operations, providing a strong case for global adoption.'

IBIA's **Alexander Prokopakis** was well-placed to observe the global trend, and he concluded: 'More and more ports and stakeholders are discussing it. As carbon pricing will have an increasing role, accurate measurement of supplied fuels will be even more important.'

Sunil Krishnakumar was emphatic: 'Frequent bunker fuel quality and quantity issues remain a thorn in the flesh of the shipping industry. This situation needs to change especially considering the advent of alternative fuels into the mix. Strict control over the quality, safety and sustainability of marine fuels will be critical in the industry's voyage towards net-zero emissions. The use of MFMs is an important first step in this regard.'

Erik Hoffmann expects to see more take-up of MFMs in other ports 'because of global commodity trading firms, which have been growing their shares of the global bunker supply pie'. He continued: 'Suppliers like TFG Marine have pushed MFMs off Malta and other locations. Singapore continues to offer success stories. Less serious actors opposing MFMs are also up against an adapt-or-die energy transition, and I believe it will shake things up with more accuracy and technical rigorousness as a result.'

Adrian Tolson was also keen, but said that he would prefer to 'go with standard practice rather than mandatory'. He also felt that 'some supply locations and ports really don't see this as a priority', and judged that

'in most countries mandating something like this might be near impossible' He summed up by saying: 'There is significant momentum in MFMs favour – and I personally support that momentum – but this is a conservative industry used to operating in often backward ways. This will take time before we reach a real tipping point.'

We'll close with this observation from **Leon Arets**: 'Whilst we very much encourage the implementation of MFM to become mandatory, it does not stop with just implementing MFM alone. Strict regulations and enforcement are equally important to ensure a real industry shift takes place.'

Do you believe that other ports will also look to follow the lead from Singapore and Rotterdam on implementing bunker licensing schemes over the next few years?

Alexand Prokopakis explained why he said Yes: 'Tighter control over supplies will be more relevant than ever and Port Authorities will need to act to remain competitive.'

Allyson Browne was forthright: 'Licensing schemes like those in Singapore ensure quality control and accountability, setting a standard for others to follow. Implementation in additional ports could enhance global fuel transparency and trust.'

Adrian Tolson would like to see more ports follow suit – but he felt it will take time: 'Bunkering has traditionally been an afterthought for most port authorities – I am pleasantly surprised that we are now on their radar – small faint blip! In Singapore or Rotterdam that radar blip is much stronger and other ports are trying to get engaged with the bunkering industry as they address the challenges of developing alternative fuel infrastructure for their clients.'

But, he continued, 'Bunker licensing is a massive leap – and it's too premature to talk about this in most locations. Most ports don't even know their fuel suppliers or have a list of them. At a recent event I attended focusing on alternative fuel development, a senior manager from one of the world's largest bunkering ports tried to demonstrate their knowledge of the local bunker market by naming four suppliers – three of which no longer supplied in the port having dropped out between 10-15 years ago. This needs to change and happily it is changing – even in the US where ports like such a Long Beach and New York are becoming more engaged – but there is a long way to go. Licensing may have to wait.'

Leon Arets urged that: 'Similar to the implementation of MFM, it is equally important that there is strict regulation and enforcement in place, otherwise such licences are just paper tigers.'

> 'As carbon pricing will have an increasing role, accurate measurement of supplied fuels will be even more important'
>
> *Alexander Prokopakis*

Sunil Krishnakumar was of like mind, as he emphasised that: 'Strict control over the quality, safety and sustainability of marine fuels will be critical in the industry's voyage towards net-zero emissions. Singapore is a perfect example of how a strictly enforced robust bunker licensing system has ensured minimal bunker issues and, where issues have been identified, the ability to trace these issues to their root causes along with proportional enforcement action over bunker suppliers who have been found to have not met the required standards. It is therefore important that other bunkering ports around the world establish and enforce mandatory licensing schemes for bunker suppliers.'

Do you see mandatory eBDNs as a positive development for the bunker industry?

'It's about time!' said **Michael Schaap**. 'This will allow for more digital processing on the authority's side and we would hope to get a better overview of throughput.'

Alexander Prokopakis was certain that eBDNs are 'a major step for digitalising the bunker industry'.

Kim Rosello agreed, as she believed they will 'enhance transparency, accuracy, and compliance'. She continued: 'By digitising BDNs, fuel deliveries and consumption can be tracked more effectively, reducing errors and ensuring data reliability. eBDNs allow integration with Artificial Intelligence (AI) tools and AIS data to detect discrepancies, highlight regulatory breaches, and ensure adherence to emissions laws.

'eBDNs also streamline operations, reducing administrative burdens and providing verifiable records of fuel quality and quantity. They align with digitalisation trends, improving efficiency and sustainability while offering deeper insights into fuel consumption and operational performance. While challenges such as standardisation and global adoption remain, eBDNs will enhance accountability and efficiency across the bunker industry.'

Leon Arets believed that eBDNs will make for 'more efficient communications and data sharing', in addition to more transparency.

Erik Hoffmann was succinct, saying eBDNs 'limit human error, save time and are more traceable. What's not to like?'

For **Dana Rodriguez**: 'In a fast-paced, interconnected world, increases in efficiency and digitalisation are crucial. The development of mandatory eBDNs can be seen as positive for the industry, so long it is accompanied with efficient data management processes.'

Adrian Tolson was another enthusiast and felt that the technology will be taken up because: 'Happily, this will not depend on port authorities – buyers will demand it from suppliers.'

Alan Jones was supportive, but also sounded a note of caution: 'Although the application of such notes could be more efficient there could be data security concerns. Digital systems like eBDNs can be at risk of cyber threats – because bunkering data is sensitive, cybersecurity is a top priority. To keep eBDNs secure, strong encryption, authentication, and constant monitoring are essential. Such threats can be enhanced if human error is applied or the application of direct violations.'

Do you see the use of AI in shipping and bunkering as a positive development, and what sort of applications do you think it will be used for?

For **Allyson Browne**: 'AI offers game-changing potential, from optimising fuel consumption to predictive maintenance. Its transformative power lies in its ability to analyse vast data sets for real-time decision-making, enhancing operational efficiency.'

Adrian Tolson kept it short: 'A fundamental shift in the human existence – it would be pretty sad if bunkering decided to opt out! Applications – too early to opine.' **Michael Schaap** felt ready to offer a few suggestions, as he judged: 'AI will help enormously to optimise routing and weather forecasting, also stowage will become more optimal.' **Erik Hoffmann** had a few more: 'The potential future applications of AI in shipping and energy are almost endless. What first comes to mind is modelling and simulations of fuel pathways, voyage optimisation, energy efficiency and autonomous sailing.'

Leon Arets was also thinking creatively: 'The use of AI in shipping can automate certain procedures, regulate and drive certain standard checks avoiding errors and mistakes and make document generation and filing more efficient.'

As was **Alexander Prokopakis**, who said: 'In the bunkering sector, AI could be applied to optimise fuel purchasing strategies, predict fuel consumption, and improve inventory management. It could also help in detecting fuel quality issues early on through predictive maintenance and real-time monitoring.'

Sunil Krishnakumar also had some suggestions: 'For shipping operations we anticipate the use of AI in areas such as voyage optimisation, fuel consumption monitoring and emissions monitoring. In terms of bunkering operations AI may be used in improving the fuel quality assessment process and traceability of fuel streams and blend components through the supply process back to their points of origin.'

Hans Anton Tvete saw lots of possibilities: 'AI can enhance the efficiency of applications like predictive maintenance, route optimisation, bunkering optimisation, and ultimately opens up the possibility for autonomous vessels.'

However, he cautioned that: 'The success of AI relies on high-quality, accurate data. AI systems need reliable, real-time data from ships, ports, and suppliers to make informed decisions, such as fuel-efficient routing or timely maintenance. To ensure AI-driven decisions are trustworthy, independent assurance is critical for verifying data accuracy and compliance with regulations.'

Kim Rosello also called for a balanced approach, as: 'The use of AI in shipping and bunkering has potential benefits but must be implemented carefully. AI can improve efficiency and compliance by analysing data, optimising routes, predicting fuel demand, and identifying regulatory breaches, such as through cross-referencing eBDNs with AIS data. It can also enhance predictive maintenance and monitor fuel quality trends, supporting better decision-making.

'However,' she continued, 'shipping and bunkering are relationship-driven industries that rely on trust, local knowledge, and real-world understanding. Overreliance on AI risks overlooking complexities like trade dynamics, market behaviour, or geopolitical impacts that require human expertise. While AI is a valuable tool for efficiency and analysis, it should complement human judgment rather than replace it.

'Balancing AI with human oversight and maintaining industry relationships will be essential for its successful integration in shipping and bunkering.'

> 'AI systems need reliable, real-time data from ships, ports, and suppliers to make informed decisions, such as fuel-efficient routing or timely maintenance'
>
> *Hans Anton Tvete*

Alan Jones answered this question with a 'Don't Know', which he said 'purely reflects that there is a lack of representative evidence on this subject'. He explained his reservations: 'The application of AI in similar activities can take actions away from the operator, taking the human out of the loop and decreasing situational awareness and the ability of an operator to diagnose faults, failures and/or incorrect or misleading information, which can have a significant knock-on effect.'

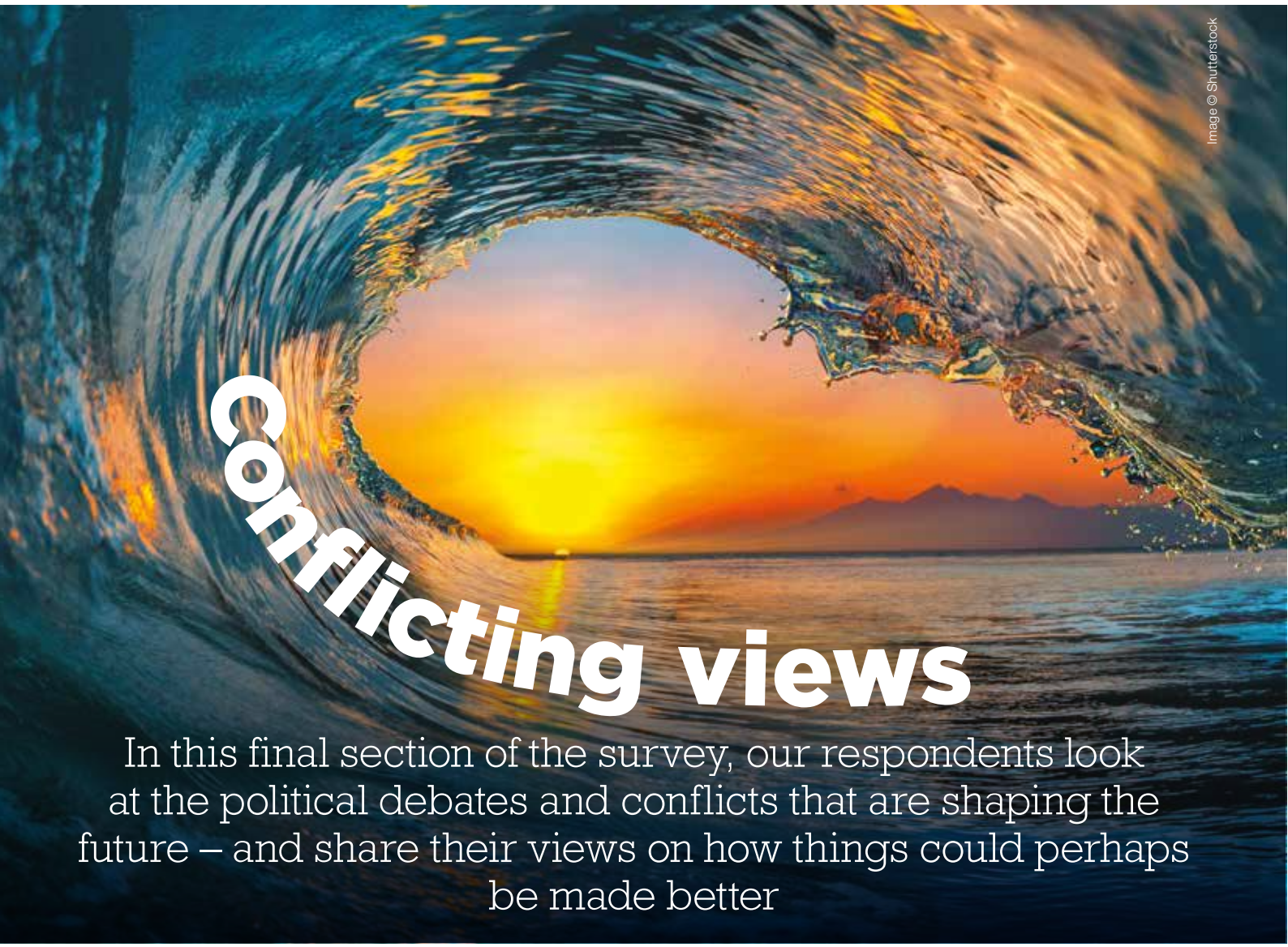
Consequently, he said: 'Adequate and representative evaluations need to be carried out to ensure such systems are fit for purpose and to not encourage human error activities.'

Gavin Allwright answered 'Yes and No', and pointed out why he believed we will need to proceed with care. 'AI or machine learning will continue to be incorporated into almost all aspects of shipping design, operations, technology optimisation and routing programmes,' he began. 'While this is only likely to grow and have a positive impact on efficiency and efficacy, there are a number of issues that need to remain of central concern. Firstly, is that the effective use of these computer systems is only as good as the data, the direction and strategic considerations that are fed into them. Thus, if we are feeding bad data, misinformation or mis-guided strategic visions into these systems then we can't expect good outcomes from them. If we are expecting a paradigm shift, then we need to ensure that all options and a holistic approach is enshrined in shaping that new paradigm and not simply relying on "business as usual" approaches. Wind propulsion is a very good example of this, whereas 5-10 years ago many in the industry dismissed this as an unviable option, and AI systems would have been fed that bias, whereas we now know that it is not just a viable toolbox of zero-emission solutions but likely to be a major component required for the energy transition. We must ensure that we are not programming these systems to take us down a development dead-end.

> 'The US's increasing focus on energy independence, national security, and future-proofing the economy could represent a major opportunity for American fuel and technology innovation and the ramping up of clean fuel production and bunkering in US ports'
>
> *Ingrid Irigoyen*

'Secondly, we have to keep in mind that these systems are there to enhance and not replace our valuable industry personnel, especially our overworked and often stressed seafarers. If these systems continually add complexity and add distance between the operators and the operational processes that they are responsible for and ultimately the safety of our fleet, then this is of great concern.

'Finally, as with all technology advances, we can see a technology gap opening up between those who can deploy these systems effectively and at scale and thus reap huge benefits and competitive advantage, and those that have access to inferior versions of these systems and lack the capacity to deploy them effectively. In this relatively early period of deployment, we need to be seriously mindful of these issues, guard against the negatives and mitigate those as far as possible where they can't be tempered or controlled.'



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Conflicting views

In this final section of the survey, our respondents look at the political debates and conflicts that are shaping the future – and share their views on how things could perhaps be made better

The war in Ukraine – which some thought might be over in days – is now coming up for its third anniversary. The Israeli-Palestinian conflict re-ignited by the October 2023 attacks on Israel continues, and the Middle East situation has been further complicated by the fall of the Assad regime in Syria.

Elections have been changing the balance of power in Europe, and in the United States Donald Trump has embarked on his second (and the country's 47th) presidency. As we were preparing to send out our questionnaire to our Survey Correspondents, a bi-partisan group of US Senators and Congressmen introduced a new bill which aims to: expand the US-flagged fleet; require that by 2040 10% of all cargo imported into the US from China be imported on US-flagged vessels; and establish that a US-flagged vessel shall be given priority at any port of the US ahead of a waiting vessel of a foreign country. A host of maritime associations backed the proposed legislation, but some in industry felt that it was 'protectionist' in tone and wondered if we might see counter-measures from China. Meanwhile, the new US President has been talking about imposing tariffs on goods from not only China but also Mexico and Canada. He also caused quite a stir in the maritime world by suggesting that the US might retake control of the Panama Canal because the Panamanian authorities are charging US ships excessive fees and becoming too close to Chinese interests. Furthermore, President Trump has a reputation as a climate-sceptic who is not averse to prolonging the use of fossil fuels, so his inauguration has not been welcomed by many in the environmental community.

Do you believe Donald Trump's victory in the US Presidential election will have a major impact on the global shipping industry, and its energy transition?

We'll kick off with the short and snappy answers. **Ruben Tins** said: 'Yes, there will be an impact as his policies are likely to favour the use of fossil fuel and delay the switch to renewable fuels.' While **Michael Schapp** said 'Yes' because: 'It will clearly hamper the energy transition and may cause disruptions due to trade conflicts.'

Sticking with Yeses, **Ingrid Irigoyen** told us: 'While the United States has always had influence in the maritime sector, the return of President Trump to the White House has major implications for the sector's future. The US's increasing focus on energy independence, national security, and future-proofing the economy could represent a major opportunity for American fuel and technology innovation and the ramping up of clean fuel production and bunkering in US ports. These investments have the potential to elevate the US's role in the evolving maritime fuel and bunkering landscape. Bipartisan interest in stimulating shipbuilding capacity in the US could also affect the sector. A key outstanding question will be whether the US chooses to prepare to compete in the global economy of the future, which will be characterised by innovative clean technologies for all sectors, including maritime.'

Kim Rosello felt that Donald Trump's victory could have a major impact because: 'A shift toward pro-fossil fuel policies may reduce financial incentives for decarbonisation, delaying the adoption of cleaner technologies and alternative fuels. This could also hinder investment in clean energy infrastructure at US ports, limiting the availability of greener bunkering options.

'Potential tariffs or changes in trade agreements could alter global shipping routes, reducing demand on some routes while increasing domestic production's reliance on local shipping. Additionally, reduced support for international climate initiatives, such as the Paris Agreement, might weaken global cooperation on maritime decarbonisation.

'While these policies could slow the energy transition, strong regulatory and market pressures from other regions like Europe and Asia may continue driving progress, mitigating the broader impact of US policy changes.'

Elissama Menezes was particularly concerned about the likelihood of 'policies promoting fossil fuel expansion, including LNG exports' – because she believes that LNG projects 'sideline the urgent need to transition to truly renewable energy sources, further delaying the shipping industry's decarbonisation goals' and 'locking the industry into a path that is incompatible with the future of sustainable shipping'.

Goran Dominioni echoed Menezes' concerns, fearing that a Trump presidency 'is likely to slow down climate action overall and, as a result, the pressure on shipping to decarbonise may lower. In addition, it may help the uptake of LNG as a bunker fuel, and this is not a real solution due to its GHG profile.'

Allyson Browne drew upon her knowledge of the US political systems to tell us: 'Trump's presidency may cast a shadow over US federal climate ambitions, but it's a prime opportunity for subnational leadership to shine. Ports like Long Beach and Oakland have demonstrated how local action can drive global impact and progress, and there's so much opportunity for US ports to champion climate action. By building global alliances, sharing innovation and piloting transformative solutions, US ports can become the proof of concept for sustainable shipping–even in the face of federal inertia. The energy transition doesn't need permission from Washington; all it needs is a climate champion at the helm.'

Erik Hoffmann predicted that: 'Trump will test the global order by undermining international law and sovereign countries' borders and natural resources. Whether he will bite as hard as he barks has yet to be seen, but he and his MAGA [Make America Great Again] followers seem a lot better organised this time, which was evident in the flurry of executive orders he signed within hours of his inauguration. For Trump not to pursue his stated imperialist aims in Mexico, Canada, Greenland and Panama will lead observers to cry wolf. That would negate his overarching, more transactional aim of making America not just "great" but respected again.'

For some of our respondents, the global momentum on the energy transition is already too strong.

'On the international level,' said **Antonio Santos**, 'I don't think the incoming Trump administration will derail the maritime decarbonisation efforts already being undertaken by countries and the shipping industry, but the administration could slow things down. Given the progress that has already been made by member states at the IMO following the adoption of the 2023 IMO GHG Strategy, Pacific Environment and our allies are hopeful that they will move ahead and adopt ambitious GHG reduction measures (a GHG fuel standard and a GHG emissions pricing mechanism) later this year as planned.'

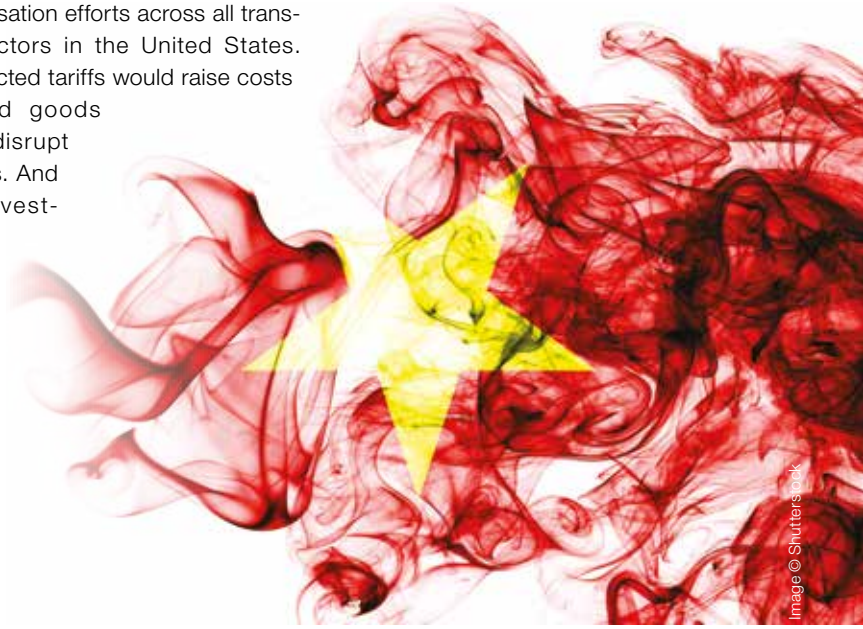
> 'Trump's presidency may cast a shadow over US federal climate ambitions, but it's a prime opportunity for subnational leadership to shine'
>
> *Allyson Browne*

However, Santos added that: 'Domestically, the Trump administration is expected to prioritise deregulation and could roll back climate-focused policies, hindering the push for decarbonisation efforts across all transportation sectors in the United States. Further, expected tariffs would raise costs for imported goods and could disrupt supply chains. And renewed investments in fossil fuel production and exports (e.g., LNG) could reduce funding/incentives for zero-emission technologies, including maritime. Having said that, many US states and private companies remain committed to their climate goals, which could help sustain the clean energy transition during Trump's tenure.'

Adrian Tolson said: 'It would be nice but not essential to have the US behind such IMO issues as carbon taxes, levies etc. – but this might not have been truly forthcoming even with another winner of the 2024 election. From a US bunkering point of view this might be quite sad – reduced sales of bunkers at US ports except for LNG?

'Now, if you tell me that the MAGA agenda is a worldwide trend then perhaps I would be more worried about IMOs efforts being de-railed – but happily most global governments seem to have a reasonable grasp on climate science.'

Gavin Allwright judged that: 'The biggest impact that the incoming US administration will have is likely to be an increase of uncertainty in an increasingly uncertain global situation.' He continued: 'Comments already floated even prior to inauguration concerning the Panama Canal, Greenland and the potential renaming of the Gulf of Mexico speak to



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this. Whether the flurry of pronouncements and pro-fossil fuel stance will seriously impact international shipping or turn out to be more of a negotiating tactic is an open question. Some will argue, fairly or unfairly, that the US hasn't been in the driving seat of climate action or acted as a fully aged positive international actor under a procession of administrations coming from both sides of the aisle over the last few decades. Nonetheless, there will likely be a chilling effect on the "climate" or "environmental" driver which has been evident from other actors and stakeholders on the global stage too.

'However,' Allwright continued, 'is the decarbonisation driver only fuelled by those concerns? I would argue that the solutions such as energy efficiency technologies, voyage optimisation solutions and wind propulsion deliver tens of billions in lower costs for shipowners, offer significant business opportunities as do renewable energy developments and new fuels while delivering millions of quality jobs to those countries that embrace these changes. So, if the US is not interested to age in this 4th Industrial Revolution and the Energy Transition in Shipping, then I am sure others are and will continue to reap the benefits, whatever their commitments to environmental considerations.

'We should also note that the first Trump Administration, 2017-2020, coincided with the enactment of the groundbreaking 2018 IMO Initial GHG Reduction strategy. One could argue that this could have delivered a stronger target than 50% reduction of emissions, however this landmark strategy did light the touch paper for the industry to work towards the 2023 Net-Zero target. Thus, while political calls may trump environmental and economic logic in the short term, when the latter align then that logic becomes irresistible over the longer haul.'

Do you expect that the situation in Ukraine could be a key factor for energy security and prices in 2025?

Dimitrios Marantis said: 'The war in Ukraine is affecting, as a minimum, the electricity supply and prices in Europe. An indirect effect is also the higher LNG price in Europe as a result of the imposed sanctions on Russia.'

Erik Hoffmann made his views clear: 'Russia's atrocious invasion of Ukraine will continue to influence oil and gas prices. It already has this year, with Dutch TTF gas futures rising as Ukraine's gas transit deal with Russia and some eastern European nations expired. Unfortunately, I think Trump will try to cut a deal with Putin that will involve some form of illegal land grab by the Russians. Trump and Putin are both klepto-authoritarians with a disdain for the EU.'

Adrian Tolson hypothesised on how a resolution of the conflict in the Ukraine could be the first in a chain of global events. 'I am sceptical on an easy peace here,' he began, 'but let's assume that it happens and so the US (and others) start weakening the sanctions a little, allowing Russian oil and gas to flow more freely. I am thinking that the West is not rushing back to this supply source but for sure the price of oil drops a little. Then let's assume that we have a weakened Iran that agrees to alter its plans for nuclear weapons and in return gets a weakened sanctions and so Iranian crude and products flow a little more freely and the price of oil drops a little. Then let's assume the Venezuelans finally get rid of Maduro and this opens up crude exports and the price of oil drops a little.

'A perfect storm and MAGA diplomacy triumphs – but meanwhile the price of crude drops to $40/bbl and LNG export values also tumble – MAGA has failed. So, will we actually get an end to these geopolitical challenges, or will political pragmatism take over? Only one man knows! But at least he is a "very stable genius".'

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Gavin Allwright said the ongoing impact of the Ukraine war 'in part depends upon whether this conflict remains in the roughly stalemate situation that it has been in for the past 12 months, either as an "active" or "frozen" conflict that any temporary peace initiative created.

'However,' he continued, 'the majority of Europe and regions further afield have steadily weaned themselves off the Russian supply of energy, especially gas, from the region and while sanctions are leaky, the supply of oil from the region is not at large enough quantities to be at a significant level to threaten energy security or prices in 2025. Prior to the Russian invasion of Ukraine, Europe received about a third of its imported gas from Russia, but that is now below 10%. The recent ending of the five-year transit agreement for Russian gas though Ukraine is a clear case-in point, and while it is having a serious impact on a number of European countries, such as Austria, Slovakia and in particular Moldova, this is limited and the closure has had little impact further afield. It should be noted that Hungary and some other regions have been affected but are still receiving Russian gas through the pipeline through Türkiye.'

> 'Russia's atrocious invasion of Ukraine will continue to influence oil and gas prices'
>
> *Erik Hoffmann*

Allwright concluded: 'I don't think that the energy dynamic will change significantly in 2025, even if some form of truce or even a peace deal is reached as the EU will unlikely resume anything like the same level of energy dependency as before, the US is self sufficient in fossil resources and while markets would open up for energy exports from the region, these would take quite some time to reach significant levels again.'

Kim Rosello said that: 'Diversification of energy supplies is already well underway to ensure security of supply. However, the situation in Ukraine continues to contribute to price volatility in global energy markets.

'While diversification efforts, such as expanding LNG capacity and sourcing from alternative suppliers, have reduced dependence on Russian energy, these strategies take time to fully mitigate risks. As a result, markets remain sensitive to disruptions caused by the conflict.

'Price volatility continues as sanctions on Russian exports and shifts in global trade flows impact energy markets and shipping costs. The conflict has also disrupted supplies of key materials like grain and metals, indirectly driving up energy demand and transportation costs.

'Looking to 2025, unresolved conflict in Ukraine could prolong these changes, influencing energy security and pricing. Nations will accelerate renewable energy investments, but geopolitical and economic factors linked to the crisis will continue to shape global energy dynamics.'

Do you expect that the situation in the Middle East could be a key factor for energy security and prices – and the shipping industry – in 2025?

It's that man again! The 47th US President cropped up in a lot of our survey answers.

Erik Hoffmann expected that: 'Israel's conflicts with Hamas, Hezbollah and the Houthis will continue to move the price of Brent crude and determine whether Suez Canal transits will become safe again. The Israel-Hamas ceasefire is regretfully fragile, with vested interest in reigniting tensions on both sides. What OPEC+ does will carry more weight, though.

For **Alexander Prokopakis**: 'The situation in the Middle East is a significant factor for energy security and pricing in 2025, given the region's central role in global oil production and transportation. Any instability or geopolitical tensions could disrupt energy flows and affect shipping operations, particularly in terms of route diversions and fuel price fluctuations.'

Gavin Allwright warned that: 'The instability in the region is far more concerning for energy security and wider security in general and any prediction about how things will play out is always going to be wide of the mark, a point underscored by the startling speed that the Assad regime in Syria crumbled in a matter of weeks, reminiscent of the collapse seen in Afghanistan in 2021.'

Looking ahead, Allwright added: 'There seems to have been a serious shift in the major power dynamic in the region that has been relatively stable (though fraying) over the last two decades since the end of the second Iraq War. The result of that shift and the radicalisation brought on by the conflicts in Israel, Gaza, Lebanon, Syria and Yemen could have a continued profound impact on transit through the Suez and on fossil fuel supply and thus prices. Uncertainty and instability in this region have always led to energy security concerns and this vital shipping artery will continue to impact the industry. What a return to peace looks like is difficult to imagine in 2025, so I would expect that these macro geopolitical issues to rumble on with little dramatic change – but then I do hope I am wrong.'

Michael Schaap felt that the Middle East situation would be a key factor for energy security and prices 'only if things escalate further'.

We'll close with **Kim Rosello**, who emphasised that: 'The region plays a critical role in global energy markets, being a major supplier of crude oil, natural gas, and petroleum products. Any disruptions in the Middle East, whether due to geopolitical tensions, conflicts, or policy changes, could have significant ripple effects on energy prices and the shipping routes essential for global trade.

'Tensions in key areas like the Strait of Hormuz, a vital chokepoint for global oil and LNG shipments, could lead to supply disruptions, increased shipping risks, and higher insurance premiums. Such developments would directly affect bunker fuel prices and overall operational costs for the shipping industry.

'In addition, efforts by major Middle Eastern energy producers to transition toward renewable energy and diversify their economies might influence long-term shipping patterns. For example, increased production of LNG and hydrogen in the region could lead to shifts in energy trade flows and the demand for specialised shipping infrastructure and vessels.

'It is highly likely that Red Sea attacks on merchant shipping could resurge if the Middle East conflict fails to de-escalate. Such incidents would reduce the availability of open tonnage, subsequently impacting freight rates and the broader shipping market.

'Finally,' said Rosello, 'the region's geopolitical landscape, including the outcomes of diplomatic negotiations or new alliances, will shape global energy supply dynamics and trade routes. The shipping industry must remain adaptable to these changes, ensuring flexibility in operations and routes to manage risks associated with the Middle East's ongoing influence on energy security and pricing.'

> 'Tensions in key areas like the Strait of Hormuz, a vital chokepoint for global oil and LNG shipments, could lead to supply disruptions, increased shipping risks, and higher insurance premiums'
>
> *Kim Rosello*

And now, we come to the final question of our 2025 Annual Survey.

If you could have one wish granted for 2025, what would it be?

We will round up the short answers first:

Michael Schaap: 'Less polarisation on the decarbonisation pathway, but rather applause for those who are really making an effort or a difference, and rewarding them accordingly.'

Dimitrios Marantis: 'I wish that the EU as a whole would focus on reducing the taxes in order to be more competitive and easily retain its skilled workforce.'

Alexander Prokopakis: 'A clear pathway to reach 2030-2040 and 2050 IMO decarbonisation goals. The establishment of a clear and achievable framework for decarbonisation would provide certainty and enable the bunker/marine energy industry to align with global maritime goals.'

Steve Esau: 'Regulatory certainty: in particular, clarity from the IMO on mid-term measures for reduction of greenhouse gas emissions from shipping in line with its stated ambitions set out in 2023. All measures should be goal-based and technology-neutral, incentivising the industry to identify and develop the most efficient solutions to meet regulatory goals and targets.'

Kim Rosello: 'Our wish is to continue to support as many businesses as possible, providing solutions that transform how firms mitigate against fuel price volatility and accelerating the transition to renewable energy sources and sustainable fuels as a result.'

Ingrid Irigoyen: 'For 2025, our wish is to receive many competitive bids for e-fuel powered shipping in response to ZEMBA's second tender so that we can provide our now almost 50 freight buyer members with a great deal that enhances their supply chain resilience,

credible emissions reductions, and help kick-start the market for scalable maritime e-fuels.'

Now the wishes start to get a little longer – and sometimes more contentious too.

Elissama Menezes: 'My wish for 2025 is a shipping industry that centres people and equity and is free from LNG and other false solutions – moving to one that fully commits to genuinely sustainable and equitable alternatives. This would ensure a healthier ocean and a thriving planet for present and future generations.'

Victor Åkerlund: 'Politicians and decision-makers should optimise for the long term rather than the short term. Making the marine industry compatible with a net-zero and no-emission future is not an easy or quick fix, so it requires long-term certainty on critical milestones. When mid-long-term goals are technology-neutral, the industry can usually adapt through investments and innovation, but if there is uncertainty regarding the goals because of shortsighted lobbying or other factors, the transition will slow down.'

Erik Hoffmann: 'I hope that Europe and countries in other regions continue unabated to regulate emissions, stimulate investments into green fuel infrastructure and finally walk the walk after years of climate denial and inaction. A nascent momentum is there and even if some nations regress back to "drill baby, drill", the real economic and environmental values will be unlocked in the green transition.'

Blánaid Sheeran: 'I'd like to see a substantial increase in donations to the International Maritime Organization's (IMO) Voluntary Multi Donor Trust Fund (VMDTF) to facilitate fair and representative decision-making at the IMO's GHG-related meetings. Strengthening this fund is a move towards ensuring that all countries have the ability to participate meaningfully in discussions and decisions that shape the future of our world. This inclusivity is vital for fostering justice and equity in the design and implementation of climate-related measures, ensuring that no voices are left unheard in the transition. The VMDTF is open to voluntary contributions from all States, non-governmental organisations, intergovernmental organisations, other interested entities, and individuals.'

> 'The need for decisive, collective action has never been greater, and we must remain steadfast in our commitment and actions to ensure a sustainable future for generations to come'
>
> *Eng Kiong Koh*

Eng Kiong Koh: 'Balancing commercial realities and operational demands with long-term decarbonisation goals has long been a challenge. Today, this challenge is compounded by economic uncertainties, geopolitical tensions, and evolving regulations. Collectively, these headwinds are testing the industry's resilience and resolve.

'If I could have one wish granted for 2025, it would be for the industry to not slow down or lose focus. The need for decisive, collective action has never been greater, and we must remain steadfast in our commitment and actions to ensure a sustainable future for generations to come.'

Adrian Tolson: 'World Peace! Well, that's unlikely. In the US, perhaps a pleasant surprise that the Ships Act creates a greater maritime focus and that ports and port infrastructure get supported – along with clearly extending to maritime the support for renewables in the Renewable Fuels Act and the Inflation Recovery Act.

> 'I'd like to see a substantial increase in donations to the International Maritime Organization's Voluntary Multi Donor Trust Fund to facilitate fair and representative decision-making at the IMO's GHG-related meetings'
>
> *Blánaid Sheeran*

'But above all – and I am surprised I have really only briefly touched on this before – we need a clear price on carbon from the IMO, and one that is as high as possible. Everyone on both the supply and demand side of the shipping industry seems to want it. My concern is that IMO consensus politics – the art of the possible – will drive us to a much lower level that may not work. If the carbon price is really high I am sure MAGA will complain until they realise it's actually a tariff on foreign goods coming into the US!'

Gavin Allwright: 'The passing of a robust, ambitious and impactful carbon pricing mechanism for global shipping, one which delivers on the striving targets set by the IMO in 2023, thus leading to a 30% reduction in emissions by 2030 and 80% by 2040.

'Robust, means that it will need to cover all vessels, hopefully including smaller vessels that have higher ton/mile emissions and one that is easily implemented with the burden of compliance reduced, especially for smaller operators. Ambitious, means that the pricing level will need to be substantial enough to effect behaviour change across the industry and make the adoption of energy efficiency measures, voyage optimisation and alternative zero-emissions or low emissions energy sources such as wind propulsion and new fuels become the de facto position, not a "Green" option or add-on. It also needs to be sign-posted early and indeed we could be incentivising this movement with advance credits for early action from this year rather than waiting another 2-3 years until this framework comes into force.

'Impactful, would mean that proceeds from this carbon pricing mechanism would come back into the industry to fund these lower energy consumption and alternative energy pathways, thus reducing the upfront costs. However, there will also be the need to also ensure a Just and Equitable transition, where Least Developed Countries (LDCs) and Small Island Developing States (SIDS) are supported to ensure their transport costs don't increase, but also they are assisted in building out the infrastructure and vessels that they will require to meet the transition requirements and also in part to fund other adaptation projects for these areas so heavily impacted by climate change and shipping pollution.

'The industry, the technology providers and energy suppliers stand ready to deliver on this, as long as there are clear regulatory signposts and a positive policy direction. These require a bit of backbone and vision from our policy makers, but I am confident that this isn't wishful thinking, but the start of the "new normal".'

Jesper Sørensen: 'The vision for 2025

would be to see the industry take a proactive approach to partnerships to not only build out alternative fuel infrastructure but to also be equipped with the right expertise and resources to successfully navigate any challenge or market volatility. No one business will be able to navigate the energy transition on their own.

> 'The vision for 2025 would be to see the industry take a proactive approach to partnerships to not only build out alternative fuel infrastructure but to also be equipped with the right expertise and resources to successfully navigate any challenge or market volatility'
>
> *Jesper Sørensen*

'This collaboration-first approach has stood the test of time to demonstrate that partnerships, up and down the marine fuels supply chain, are critical to future proofing businesses. They foster a better-informed approach towards complying with evolving regulations and meeting sustainability targets, as well as a culture of continuous learning and innovation.'

Alan Jones: 'As part of the next generation vessel V-cycle, apply best practice Human Factor Integration at the concept stage and manage that throughout the process – design initiative technology that considers the operators needs and takes the onus away from the seafarer and the requirement to be creative in developing safe work arounds. This has a knock-on effect with the following:

- Enhance the STCW training and competency levels for seafarers, through immersive SIM's and representative scenarios to meet the demands of new tech and adoptive net zero fuels.
- Enhance from a human centric perspective the digitalisation and automation of vessel systems, which are increasingly revolutionising the shipping industry by introducing new technologies that enhance safety, security and efficiency, optimise performance, reduce environmental impact and ensure sustainability.'

James Forsdyke: 'In 2025, my greatest hope is for the global maritime community to stand resolute against the rising tides of protectionism and geopolitical division, ensuring that collective action prevails over isolation. We must protect the momentum of innovation, investment, international accords, and decisive climate action. By fostering collaboration, upholding ambitious regulatory frameworks, and inspiring confidence in our shared capacity to decarbonise shipping, we can reject acceptance, abandonment or apathy and chart a course toward a sustainable, zero-emission future for our oceans and our planet.'

Making his 2025 survey debut, **Gregory Dolan**: 'As we look ahead to 2025, there is much to be hopeful about, especially with the MEPC meeting in April, where key decisions on carbon pricing and measures to guide shipping's decarbonisation will take place. The Methanol Institute, with its observer status at the IMO, will actively contribute to shaping this crucial process.

'A major step forward would be increasing industry awareness that the maritime energy transition is a gradual process involving multiple fuels gaining traction over time.

'It's not a simple choice between traditional diesel and a single synthetic fuel. Blended fuels, such as conventional and low-carbon methanol, will play an essential role. These blends can gradually incorporate more bio-methanol and e-methanol as supply expands to meet carbon intensity goals.

'Different applications will require different solutions, and there is no single right answer. This is not a competition with clear winners or losers. Instead, it's a collaborative effort. At the Methanol Institute, we've seen that advancing safety, technology, and capacity building takes dedication and a commitment to sharing knowledge and expertise.

'The achievements of our members - whether shipowners, producers, or technology companies – over the past year highlight the significant role methanol plays in the energy transition. As we look to 2025, we are ready to tackle new challes and continue driving progress toward a more sustainable future in shipping.'

Allyson Browne: 'My wish for 2025 is to see a global wave of climate champions driving transformative change at ports.

'At HACC, we're doubling down on our commitment to foster collaboration, facilitate knowledge exchange, and provide actionable roadmaps for decarbonisation. We invite port policymakers, industry partners, and community leaders to join us in this movement.

'Ports are more than trade hubs – they are pivotal energy nexus points with the power to lead the global energy transition. By focusing on system-wide electrification, advancing renewable energy procurement, and investing in sustainable fuels, we can convert this energy of climate urgency into climate action.

'2025 must be the year ports rise to their full potential as leaders of the energy transition. Let's work together to make ports the beating heart of a sustainable future – because the stakes have never been higher, and the opportunity has never been greater.'

We will wrap up our wish list and this year's survey as a whole with this plea from **Guy Platten**, which we are sure will resonate with all our respondents and readers: 'If I had one wish for shipping it would be that seafarers are placed at the forefront of any and all decisions made by leaders in maritime and across our industry. It is crucial to consider the human factor in international shipping. Seafarers are the backbone of the global maritime industry, yet their well-being is often overlooked. By focusing on our seafarers, we have the opportunity to safeguard the future of global shipping and ensure the continued prosperity of the maritime industry.'

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