



Charting a path to more sustainable shipping

This paper reviews the role of fuels and lubricants in helping meet the International Maritime Organization's sustainability ambitions for the global shipping industry and discusses the different fuel and propulsion technology options available to support these goals.



Yannis Chatzakis

Global Marine Technology Program Manager
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Foreword

ExxonMobil hosted a virtual round table in collaboration with The Motorship to discuss the role of fuels and lubricants in helping meet future marine industry sustainability ambitions, specifically in light of the International Maritime Organization's (IMO) ambitions to significantly reduce the carbon intensity of international shipping.

The panel discussion, which was moderated by **Unni Einemo**, Director, International Bunker Industry Association (IBIA), included contributions from **Yannis Chatzakis**, Global Marine Technology Program Manager at ExxonMobil, **Evi Politi**, R&D Manager at Danaos Shipping, **Christophe Pouts**, Global Regulatory Affairs Advisor at ExxonMobil, **Charlotte Røjgaard**, Global Head of Marine Fuel Services VeriFuel at Bureau Veritas, **James Sagar**, Global Marine Sustainability Manager at SeaRiver Maritime, and **Andreas Schmid**, General Manager Technology Development at WinGD.



Setting the scene

The marine industry entered a period of far-reaching change in 2018 when the International Maritime Organization (IMO) started down the path of more stringent emission regulations. The first, a global reduction in fuel sulphur content, down from a maximum of 3.50% to 0.50%, was the initial step on the journey. Since then, the IMO has developed ambitions to reduce the carbon intensity of international shipping by at least 40% by 2030, and 70% by 2050, compared with a 2008 baseline. These targets could be revisited in 2023.

ExxonMobil, in partnership with The Motorship, hosted a round table discussion that brought together industry leaders representing ship owners, charterers, engine builders and fuel and lubricant suppliers. The aim was to discuss the challenges created by decarbonisation and regulatory change and to identify potential solutions. The discussion was moderated by **Unni Einemo**, Director of IBIA, who used her extensive knowledge of the maritime sector to drive the debate and sharpen its focus.



Unni Einemo
Director of IBIA

"The IMO is not only working on cutting the carbon intensity of international shipping, it also aims to reduce its overall greenhouse gas emissions by at least 50% by 2050," said **Einemo**. "These levels of ambitions, which were agreed in 2018, may get even more ambitious when the initial strategy is revised in 2023. So it could get a lot stricter."



Charlotte Røjgaard
Global Head of Marine
Fuel Services VeriFuel
Bureau Veritas

Charlotte Røjgaard, Global Head of Marine Fuel Services VeriFuel at Bureau Veritas, said that the sheer variety of different stakeholders requires the greatest possible levels of cooperation and openness. "Only then can we look ahead; and it's a very diverse future with lots of different fuel options." Ship owners will make fuel choices based on their individual circumstances, such as their routes, vessel sizes and geographical location, but greater openness will help ensure that the best possible decisions are made.



Creating a menu of opportunities

“I think those are very good points and I’ll add a little observation of my own,” said **Einemo**.

“There’s a menu but we don’t yet know which picks to make from it. Cooperation between all stakeholders in the industry is therefore very, very important as it will not only help us to all create the right menu, I think it will help ensure we choose the right things from it, depending on your operational appetites.”

Evi Politi, R&D Manager at Danaos Shipping, said that regulators have an essential part to play in enforcing the IMO rules. “Another important role flag states have during this critical phase is to ensure an open dialogue with classification society partners and all relevant stakeholders in order to overcome regulatory uncertainties and grey areas,” she added.

“From our perspective, as a ship owner, in order to proceed toward zero carbon vessels there are a number issues. For the investment to be viable the technology should be there, the regulatory framework should be in place and the port bunkering infrastructure, as well.”

Consistent regulatory frameworks

Participants emphasised that regulators needed to play a part in establishing a level playing field to enable OEMs and industry stakeholders to develop and commercialise solutions.

Christophe Pouts, Global Regulatory Affairs Advisor at ExxonMobil, underlined “the industry would expect that the member states’ regulatory bodies would provide a stable, predictable technology-neutral regulatory framework, supporting the important societal goal of reducing greenhouse gas emissions”.

Yannis Chatzakis, Global Marine Technology Program Manager at ExxonMobil, emphasised that potential solutions would likely rely on a multi-faceted approach. “The world needs to come together from a legislative standpoint, from a technological standpoint and from a fuel specification standpoint, to make the transition happen safely and efficiently.”

“The establishment of a low-carbon market is essential to enable the effective transition towards the use of alternative fuels,”

Pouts continued, adding that: “ExxonMobil supports the creation of such a market.”

A performance-based, technology-neutral approach, such as a Low Carbon Fuel Standard (LCFS), aimed at a gradual reduction in the life cycle carbon intensity of the fuels consumed by ships, would offer an approach to achieving society’s goals.



New fuel formulations

“New fuels, and potentially new engine designs, will be needed to reach the IMO’s upcoming emission targets,” said **Einemo**. “So, let’s consider some of the candidates being discussed within the industry, and there’s quite a few. Let’s look first at biofuels and ethanol, which are interesting to many because they could be drop-in or virtually drop-in fuel solutions. If crop-based formulations impact on land use and natural habitats, do we see an issue with that?”



Andreas Schmid

General Manager Technology
Development WinGD

Andreas Schmid, General Manager Technology Development, WinGD, pointed out that the issues with land use are relevant beyond the marine industry. Despite this, interest remains high. “Resources are limited and there are a lot of industries looking at biofuel, so I don’t think we’ll have to deal with that problem because that fuel is not going to be available for the marine industry at this point.”



Christophe Pouts

Global Regulatory Affairs
Advisor ExxonMobil

For **Pouts** there are other issues with biofuels and ethanol.

“To me the answer is life cycle assessment methodology. We should not only account for the GHG emissions that are directly attributable to biofuel production and use, but also to emissions that may be associated with the land use change. That will provide metrics that will be beneficial when making decisions about what are the best biofuels to use in the future.”

Turning to ammonia, **Schmid** began by stating that while ammonia may offer potential benefits as an alternative fuel, there are safety and training considerations that should be addressed. An initial focus on crew training to raise awareness of the safety requirements for using ammonia as a fuel would likely need to be supplemented by ongoing refresher training if ammonia was widely introduced. With appropriate training and understanding, he proposed that the potential risks of ammonia could be appropriately mitigated and managed. As **Schmid** noted, these risks are already handled in the ammonia industry; he therefore suggested that with the proper training and safety installations on board and at the port side, “we can handle this”.

Politi pointed out that the first ammonia engine is scheduled for launch in 2024 with a design based on the fuel supply system for LPG engines, albeit with careful modifications. “Ammonia is corrosive so will attack cast iron, copper, brass, copper alloys and plastics, hence careful material selection is required. It’s flammable, too, and the pressure vessels used for the storage of ammonia can explode when exposed to high heat. Given the toxicity of ammonia, it’s essential to be able to control all scenarios in order to design and operate a safe ship.”

Are there grey areas for hydrogen?

Einemo turned the conversation towards hydrogen, a fuel selection that arrives with a number of benefits and issues. "Hydrogen, as you know, can be produced from many sources, including natural gas and via renewable energy, to be burned in internal combustion engines or oxidised in fuel cells," said **Pouts**. "As far as blue or green hydrogen are concerned, they both produce significantly reduced well-to-tank carbon emissions versus traditional pathways."



James Sagar

Global Marine Sustainability
Manager SeaRiver Maritime

In the case of hydrogen, the industry will need to look at it from a lifecycle basis and check its production sources and their scalability. "For green hydrogen, we're really going to need to test the scalability," said **James Sagar**, Global Marine Sustainability Manager at SeaRiver Maritime.

Both **Sagar** and **Politi** saw LNG as a "bridge fuel" in the transition towards zero carbon emissions, although **Sagar** added that the fuel could offer a longer-term solution "if combined with bio-LNG or synthetic LNG from renewables. This could open a potential future pathway for LNG to stay viable as a lower GHG emission fuel."

Røjgaard pointed out that that most of the fuels currently being discussed are already viable aside from ammonia. Most have moved from cargo to fuel as a result of vessel operators realising their potential use as fuels, she explained.

"Everything has to start somewhere and what we really need now are some front runners."



Evi Politi

R&D Manager,
Danaos Shipping



A new fleet of vessels

In order to switch to a low-carbon future the shipping industry will need to invest in new vessels and new engine technologies, as well as focus on operational efficiencies, said **Sagar**. "Retrofitting existing vessels - that gets to be a real challenge. I think future engines will be dual fuel but I'm fascinated to see how a large, slow-speed diesel engine will work with multiple fuel injectors and different fuel sources."

"I think the whole engine industry is working full steam ahead to develop this technology," said **Schmid**. "In the meantime, the supply chain has to be grown, as well, so that in 2025 when the ships are there, the fuels are there, too."

And with new fuels and engine designs comes the need for new cylinder oil formulations. "If we build on the experience we have with IMO 2020 in regards to fuel adoption, I would say that chances are that we will likely have a proliferation of cylinder oils," said **Chatzakis**. "The engine designs are evolving quite rapidly and are becoming more demanding in terms of pressures and temperatures. So, if I were to take a guess today, I would say that probably more specialised lubricant technologies will have to be developed, too."

Schmid said that when it comes to new fuel types, such as ammonia, the lubrication challenge could become quite complex. "When it comes to oils, we are working with companies to see where this leads with new fuels. It's going to be a difficult task for them, especially when different fuels are mixed or intermittently changed and applied." He therefore doesn't believe that one oil can cover the entire fuel spectrum because it's just too wide and there are many diverse requirements.

Learning from the past

The continued safe operation of engines was raised next. "Taking into account what we've done during the IMO 2020 transition, monitoring the engines via visual inspections or using onboard scrape down oil analysis to gain an insight of what's happening in your cylinders will be essential when switching to different fuels," said **Chatzakis**. "OEM guidance is crucial here, too."

Another aspect of safe running will be training as the new fuels are likely to have quite different operational characteristics. "I think that you need to put a little of your own interest on the shelf for the benefit of the industry and look at the bigger picture," explained **Røjgaard**. "These new fuels are all quite different creatures from what the industry has been familiar with, so it's really important that we share knowledge and learn from each other."

Schmid underlined the need for crew training for safety purposes and the absolute need to ensure safe and efficient engine operations. "But who should give the training? And when it comes to ammonia, new training will need to be developed. This must involve the whole supply chain."



Tying it all together

Einemo ended the round table by asking each of the participants one final question:

“What are your prevailing views about the short- and long-term measures needed to ensure that our industry successfully meets the upcoming challenges?”

According to **Pouts**, it will be essential to create a low-carbon market if the transition is to be effective. “We believe that a performance-based, technology-neutral approach, such as a low-carbon standard that gradually reduces the lifecycle carbon intensity of the fuels consumed by the ships, is an appropriate way.”

“It’s not a game from one player; I think the whole industry needs to come together, from a legislation standpoint, from a technology standpoint and for fuel specifications, to actually make this happen and do it safely and efficiently,” said **Chatzakis**.

Politi thought there were short-term operational enhancements, such as speed reductions, cargo optimisation, route optimisation strategies and the application of energy efficient measures, that could have an immediate effect. “These are easy to adopt and do not require major modification,” she explained. “Also, new on board technologies such as carbon capture, will become increasingly relevant as cost-effective first steps to improving the efficiencies of the current global fleet.”

“There is no silver bullet for solving greenhouse gas emissions so we’re going to have to continue to collaborate with all stakeholders to ensure compliance,” said **Sagar**. “When we take joint action and develop technologies, we’ll find solutions for our customers. Everyone has a part to play to achieve the required outcomes.”

“**Unni**, you started off calling it a menu of options,” said **Røjgaard**. “I think that is a very accurate illustration of what we have. To make the best choices we need incentives, we need investments, we need support and we need collaborations across the industry.”



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