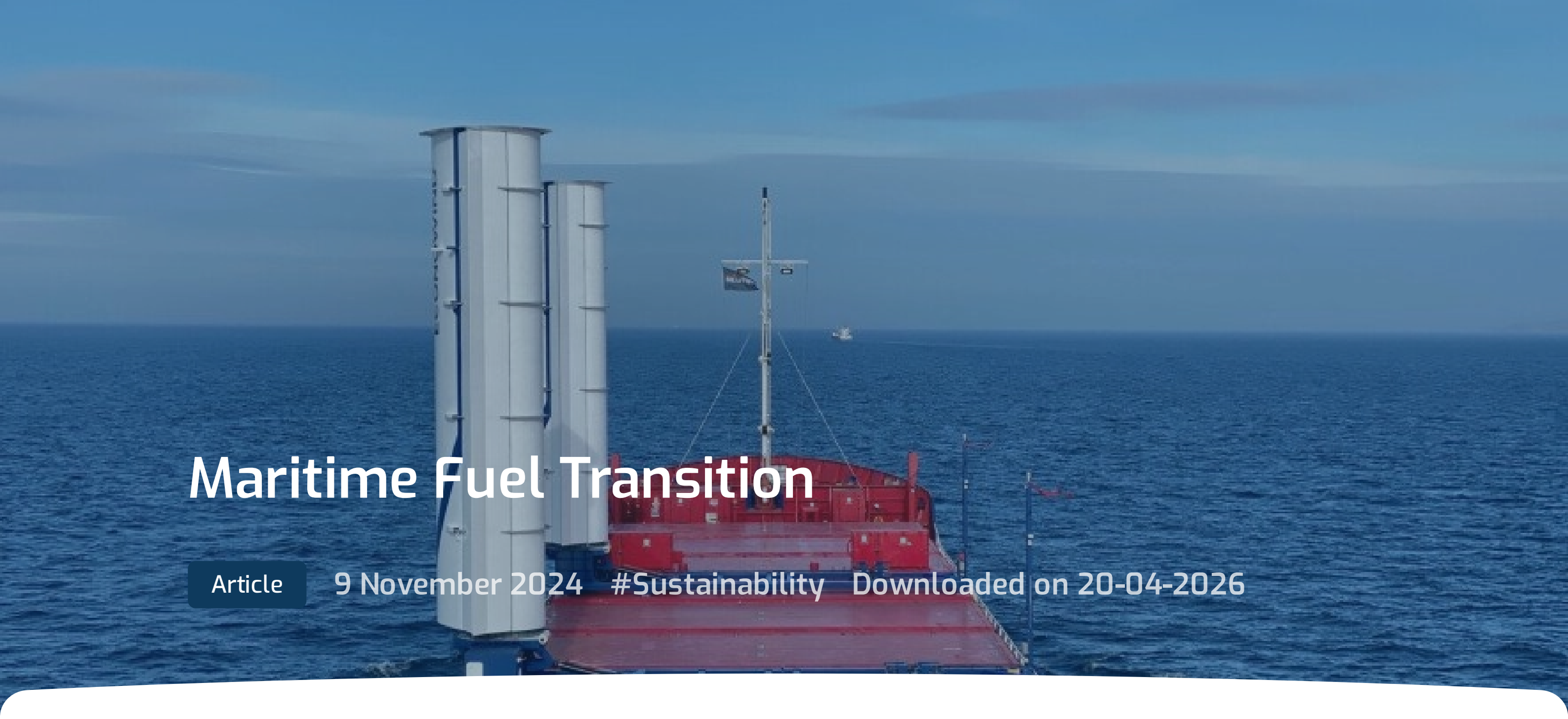

Maritime Fuel Transition

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Emission-free ships, how on earth are we going to get that done?

How do we make the more than hundred thousand ships sailing the world's oceans more sustainable in the comming 25 years? This complex task requires innovations on multiple fronts, from technology and energy efficiency to regulation and economic viability. In this article, we highlight the main challenges and the opportunities facing the maritime sector. We will also outline the steps that are already being taken, such as stricter environmental regulations and pioneering projects in the Netherlands. Find out how the future of sustainable shipping is taking shape, with the end goal of net-zero emissions by 2050.

The maritime energy transition is not easy. Because it is not just about the necessary technology and fuel density, the much needed infrastructure also has to be put in place worldwide and new energy carriers must be available in sufficient quantities. Fortunately, the Netherlands already has several ocean-going vessels that can operate without greenhouse gas emissions.

The 5 factors

To move seagoing vessels from the current stage to having net zero emissions on a large scale by 2050, we need to distinguish five factors that play a key part in realising this challenge:

- Technology
- Energy demand
- Economy
- Regulation
- The international context

What each of these factors means is being explained below.

1. Technology

Marine vessels currently run mainly on diesel and, in some cases, biodiesel. For full sustainability, we need new engines and technologies that run on renewable fuels. Think of hydrogen fuel cells, or internal combustion engines that can run on methanol and ammonia. There are strict requirements for such new technologies. First of all it has to be safe and be able to withstand rough handling so it survives the conditions at sea. Since you can't just call 999 whilst sailing the ocean.

New types of fuels take up more space, at the expense of spaces needed for cargo. These alternative fuels are also still much more expensive than fossil fuels. For shipowners this makes it important to do proper research into the most efficient use and fuel before they invest in an alternative fuel. This risk of investing is also a reason why there is an increasing focus on the energy efficiency of ships. For in stance, old technologies such as sails are making their return but in a newer and more innovative way. The Dutch company eConomwind's vent-i/o-foils are, for example, more comparable to vertical aircraft wings than traditional sailcloth.

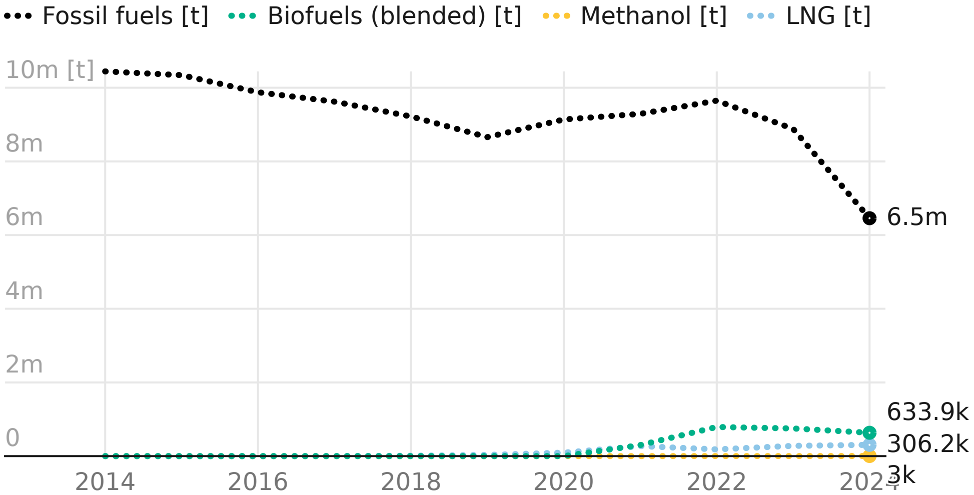
Energy carriers

2. Energy demand

Although maritime shipping is the most efficient mode of transport, ocean-going ships still have a significant energy requirement. Currently, they consume about 300 million tonnes of fuel oil annually, transporting about 90% of the goods traded worldwide.

To become more sustainable, these fossil fuels must be replaced by alternative, renewable fuels such as hydrogen, methanol or ammonia. These fuels must not only be produced sustainably, but also need to be available in large quantities at the ports where ships bunker. This requires a substantial expansion of both production capacity and the necessary infrastructure. Not just in the Netherlands or Europe, but worldwide.

Bunker volumes Port of Rotterdam over the past 10 years



NB: Data bunker volumes untill Q3-2024

Chart: KVNR • Source: Data Port of Rotterdam • Download image • Created with Datawrapper

3. Investments

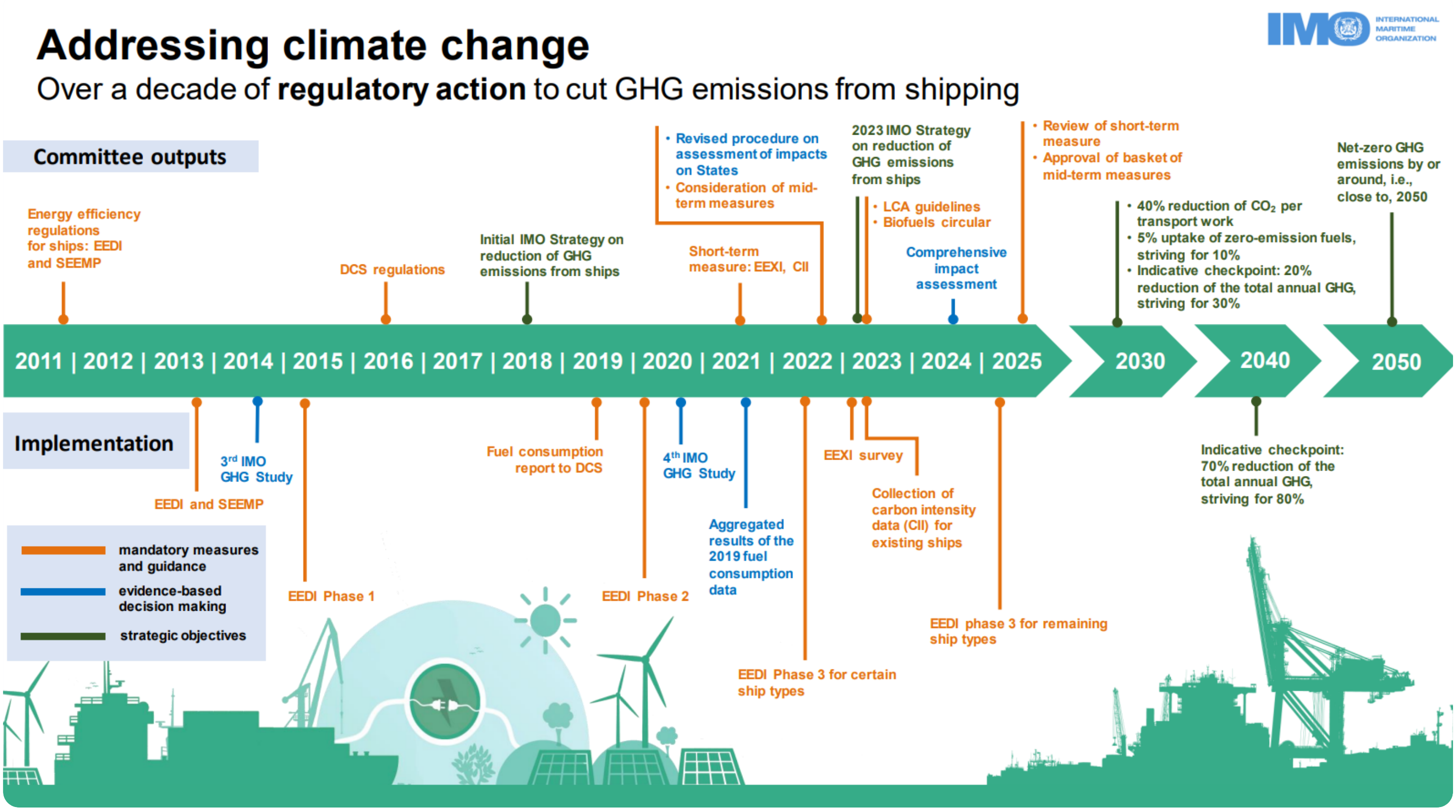
Renewable ships are significantly more expensive than conventional ships. This is due to the higher cost of technology and especially the price of renewable fuels compared to conventional

marine diesel. Shipping companies will need higher loans for these investments and have to pass the extra costs on to their customers, but this isn't always that easy.

In addition, the risk of the investment can also be an issue, especially when the technology is new, legislation is still developing, fuels are still scarce and when it is uncertain whether customers are willing to pay the higher costs. The higher the risk, the harder it is to invest.

4. Regulation

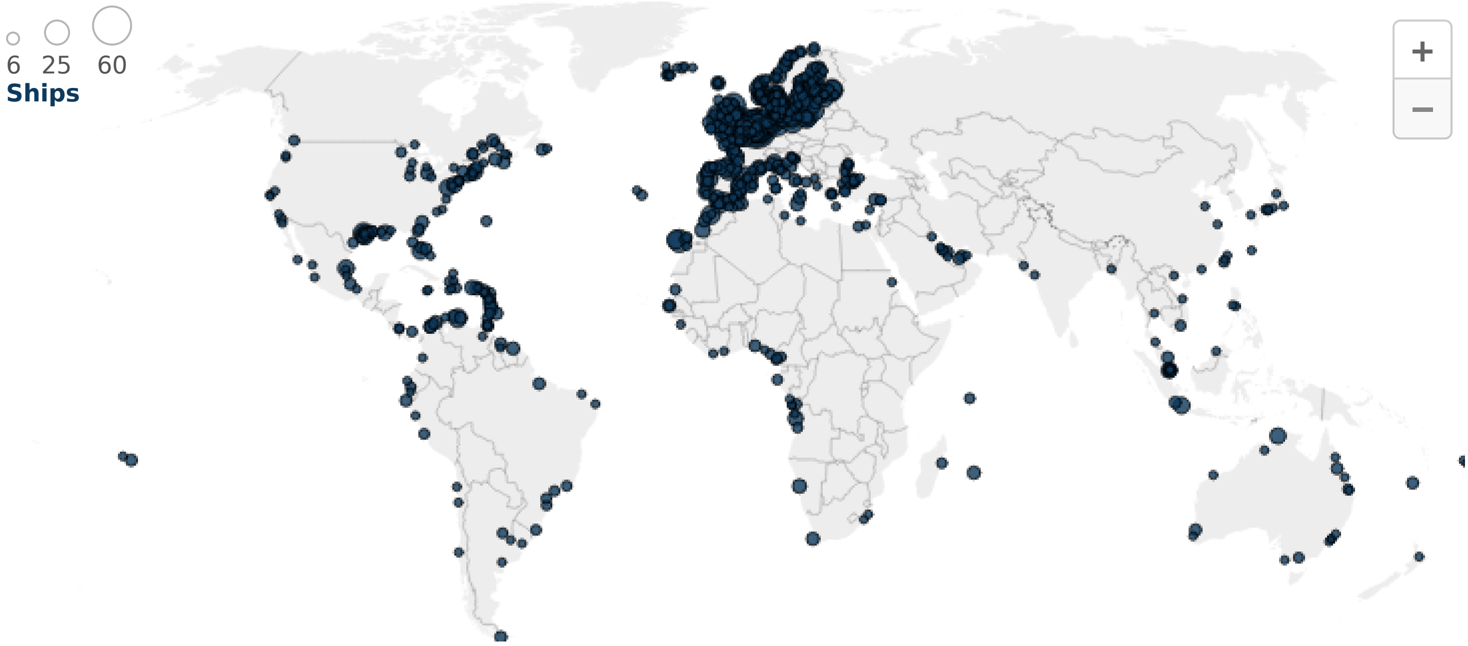
Legislation plays a key role in making shipping more sustainable. New fuels also require new safety regulations for both ship design and operations. In addition, regulation can alleviate the economic challenge, for example by a carbon tax that makes fossil fuels more expensive or by imposing obligations to use renewable fuels. Both the International Maritime Organisation (IMO) + and the European Union (EU) play a crucial role in drafting these regulations.



5. International context

The international nature of shipping brings additional challenges. For example, shipowners will need to be able to bunker sustainable fuels in different countries, and it is better if the same safety standards apply everywhere. Moreover, companies can easily evade regulations if they are not international, so local pricing and standard-setting measures have little to no effect. International cooperation between governments and companies is therefore essential to make sustainability effective.

Worldwide port calls members of the KVNR



NB: Total number of port calls by KVNR members from the previous month.

Map: KVNR • Source: Data KVNR • Download image • Created with Datawrapper

To give a good overview of the big challenge, the opportunities and challenges for each new energy carrier are listed below.

Batteries

Opportunities: For ships operating short fixed routes, such as ferries, batteries can be a viable and completely emission-free sustainable solution. The technology can be rolled out quickly, especially when there is sufficient green power in the port. For other ships, batteries can contribute to energy efficiency by absorbing peak loads, and they can act as support for hybrid systems.

Challenges: The energy density of batteries is currently far too low for most ocean-going vessels, making large-scale battery deployment unrealistic for most. There are also concerns about the sustainable production of batteries and their environmentally friendly dismantling after use.

Hydrogen

Opportunities: Hydrogen offers huge potential as a sustainable fuel, especially for ships with lower energy requirements and thus for shorter distances. Storing hydrogen liquid on board can also significantly increase energy density. When hydrogen is produced from renewable energy sources, the only emission in the whole process is water. Innovations in storage technologies and fuel cells can improve long-term feasibility.

Challenges: Hydrogen still has a low energy density compared to diesel, which means that ships need significantly larger storage capacities. In addition, it is a more difficult substance to control, especially in its liquid state at -253°C. Other challenges include the current limited production, the timeline for large-scale scale-up, safety and the high cost of production and infrastructure.

Methanol

Opportunities: Methanol technically offers a relatively easy transition to sustainable shipping, as it requires only minor on-board modifications compared to other options. For instance, it can be stored in tanks on board without refrigeration or pressure. Moreover, methanol has a relatively high energy density which makes it more attractive for longer distances, although still only half that of diesel.

Challenges: The sustainable production of methanol requires a sustainable CO2 source, e.g. from biomass or captured from the air. This is necessary because when methanol is burned, it is also released back into the air. So there is still carbon in the system, and this can be challenging. Moreover, sustainable methanol production is still limited, currently expensive and the timeline of scale-up is uncertain.

Ammonia

Opportunities: Ammonia has the potential to become a major player in marine shipping because it has a higher energy density than hydrogen and does not involve carbon. It can be used in fuel cells and probably also in internal combustion engines. The inputs for production are green energy, water and nitrogen. In principle, these can be obtained sustainably to a large extent.

Challenges: Ammonia is highly toxic and poses significant safety risks, both to the crew and the environment. There are also concerns about ammonia slip, NOx emissions when burned. Moreover, the required technology is not yet far advanced and cost is also a challenge.

Nuclear power

Opportunities: Nuclear power can provide an almost unlimited source of energy with virtually zero emissions. For large ships travelling long distances and large offshore vessels, nuclear propulsion offers a solution for high energy needs without CO2 emissions. The development of SMRs (Small Modular Reactors) can make the technology safer and more accessible to shipping.

Challenges: Nuclear technology still needs considerable development before it can be used on board ships, and then it will only be suitable for large ships. This will also require legislative and regulatory adaptation and social acceptance.

Carbon Capture and Storage (CCS)

Opportunities: CCS offers an interim solution for ships that cannot yet fully switch to zero-emission fuels. It can significantly reduce CO_2 emissions without requiring large volumes of renewable fuels. With large-scale implementation, it can play a crucial role in meeting climate targets for 2030 and 2040, for example, while industry continues to scale up sustainable alternatives in the meantime.

Challenges: Scaling up CO_2 capture requires a lot of onshore infrastructure and further technology and regulatory development. Capturing 100% of emissions is technologically challenging, partly because it takes up a lot of space and weight on board. Lower percentages, such as 30%, do seem realistic.

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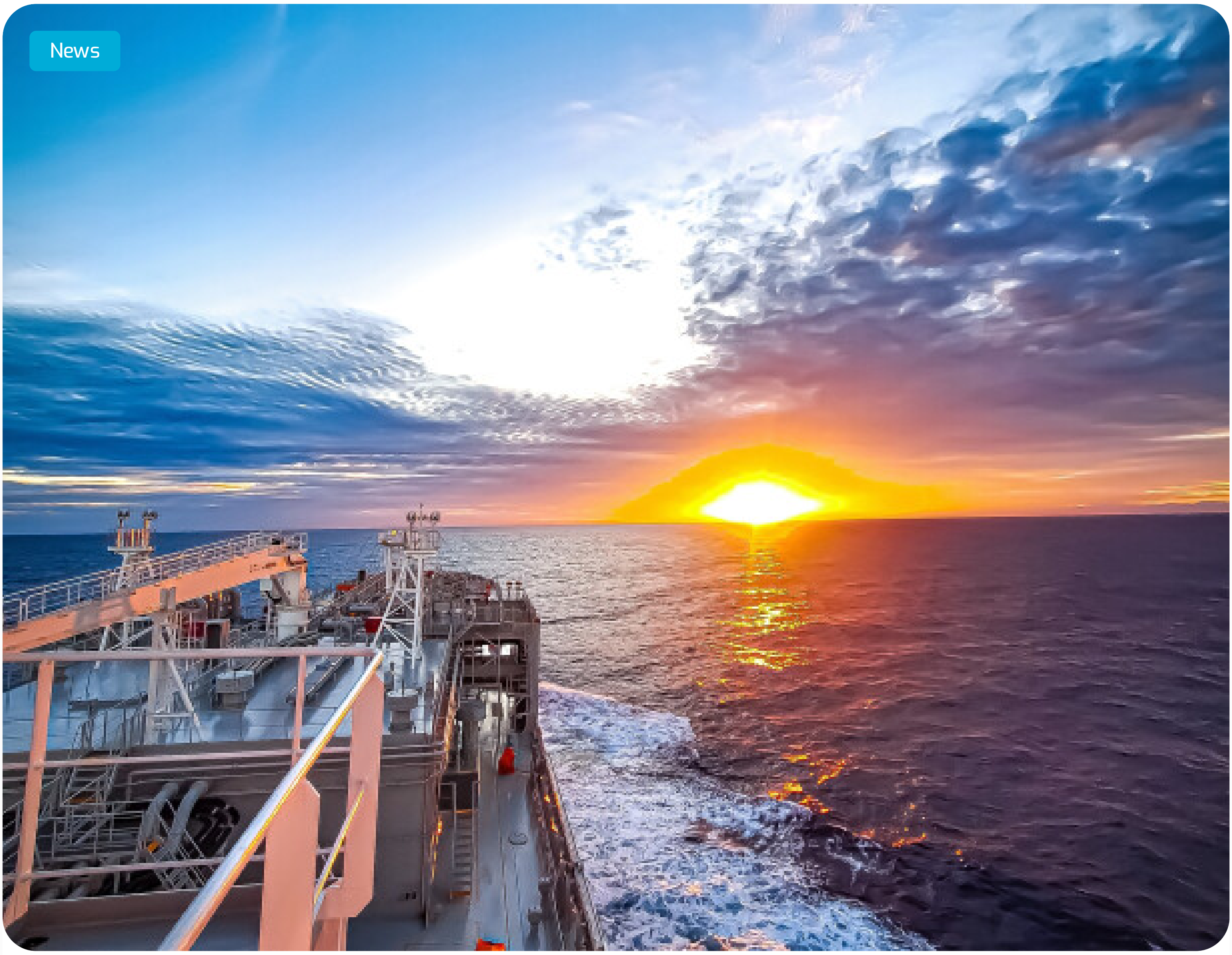

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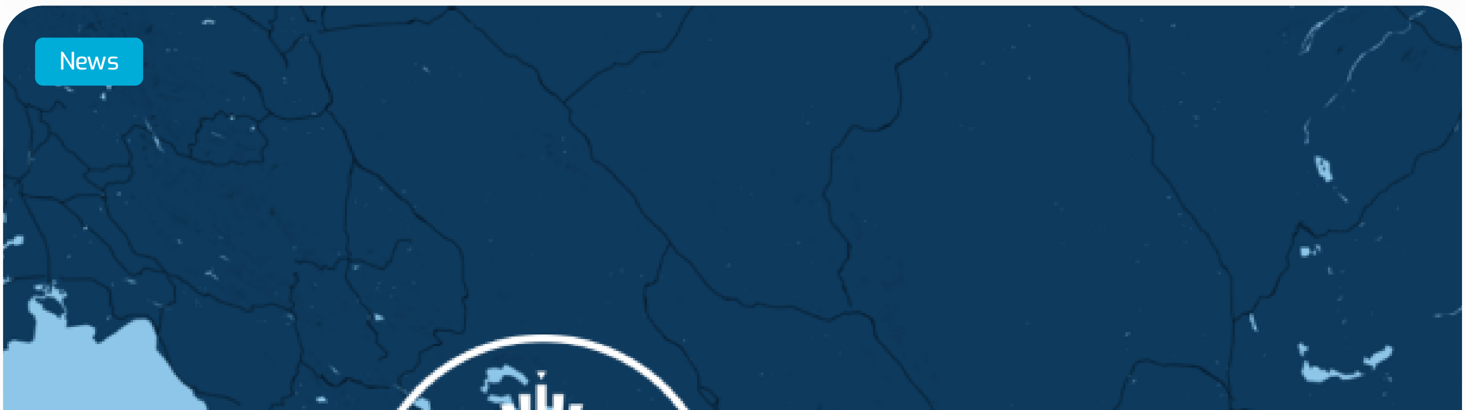

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