Global Energy Perspectives

Charting a new course: Hydrogen's impact on global shipping

September 2023

Key Insights

1. The maritime shipping sector is currently significantly off course for alignment with the Paris Climate Agreement.

2. Hydrogen derivatives provide a credible decarbonisation solution for this hard to abate sector, but challenges remain.

3. The maritime shipping industry is likely to focus on methanol in the short-term, with a progressive switch to ammonia, in the long-term.

4. However, most hydrogen derivatives come with lower energy density compared to current hydrocarbon fuels, leading to a cargo/distance trade-off for shippers.

5. Therefore, a hydrogen fleet is likely to lead to a redrawing of the global trade map, enabling strategically located countries with high hydrogen production potential to become refuelling hubs.

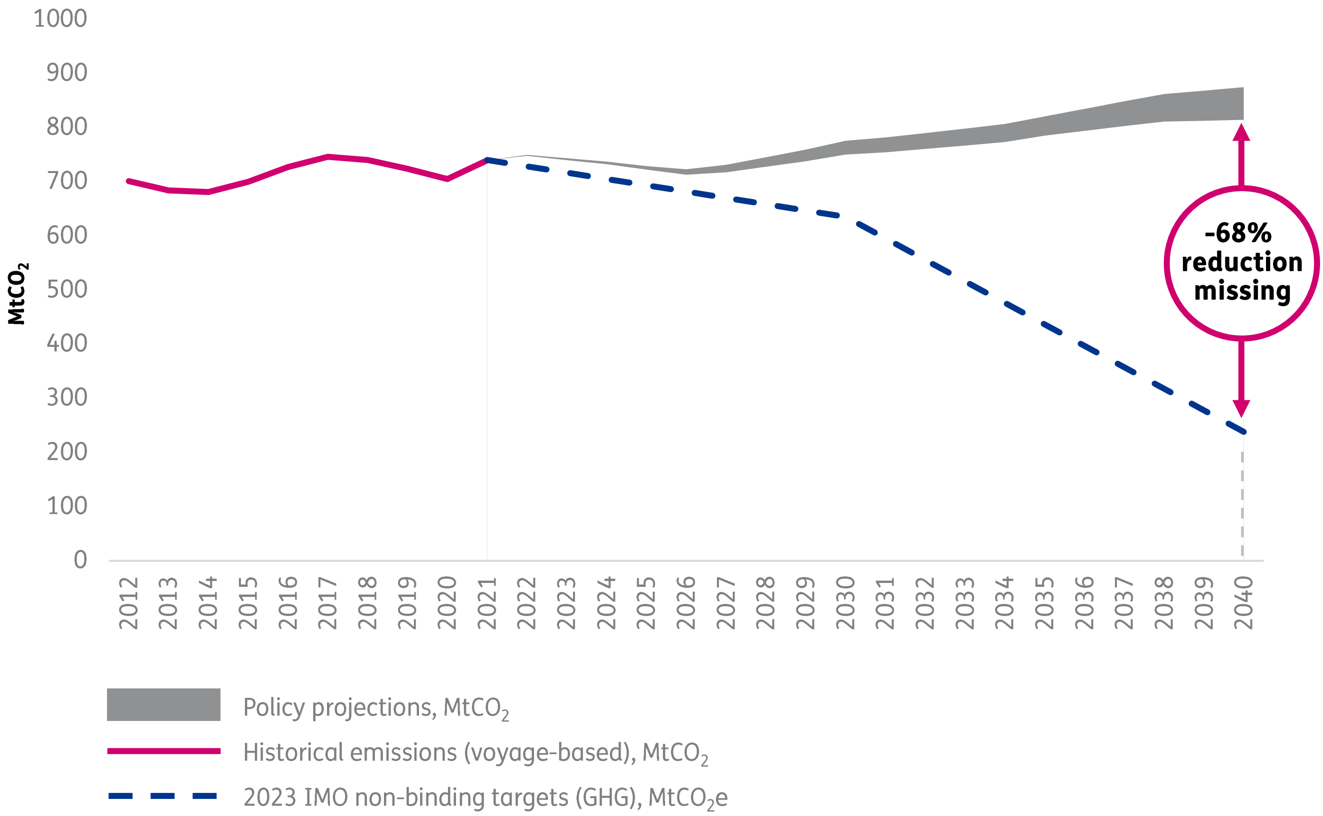
1 The maritime shipping sector is significantly off-course for alignment with the Paris Climate Agreement.

The maritime shipping industry contributes 3% of global greenhouse gas emissions, and nearly 10% of global CO_2 emissions from the transport sector. Decarbonisation of this hard-to-abate sector is complex and, because of the crucial role it plays in the global economy – over 90% of total global trade involves international shipping - it can have far-reaching consequences for countries all over the world.

In July 2023, the International Maritime Organization (IMO) revised emissions reduction targets, ensuring alignment with the goals set out in the Paris Climate Agreement and consistent with reaching net zero around 2050.

These targets require the shipping industry to reduce emissions by nearly 15% by 2030, and by 68% before 2040. At its current rate of progress, the sector is on track to miss its new targets. Legally binding measures are needed to ensure the successful implementation of the IMO's updated strategy.

Global maritime emissions are not on track to meet international targets



Source: IMO, Climate Action Tracker

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2 Hydrogen carriers provide a credible decarbonisation solution for this hard to abate sector, but challenges remain.

Hydrogen carriers as net zero fuels for shipping

Hydrogen-based fuels offer a credible pathway to decarbonise international shipping by 2050. Historically, oil-based fuels such as marine diesel oil (MDO) and heavy fuel oils (HFO) have met over 99% of the total energy demand for international shipping. To be net zero consistent, at least 13% of shipping fuels must be low carbon, such as green ammonia, methanol, hydrogen and biofuels, by 2030.

Hydrogen fuels are not without their challenges

Ammonia is already transported in bulk, with 18Mt traded and exported globally every year, according to the IEA. But it is highly toxic if leaked in a marine environment and still presents technical challenges related to cracking the ammonia back to hydrogen. Methanol production requires a sustainable source of CO_2 and storage availability. Liquid hydrogen must be kept below -253°C to maintain its state. Heat leaks and boil-off increase with distance, increasing pressure on the tank and degrading the quality of the fuel.

		GHG Emissions (1)	Volumetric energy density	Production Cost	Commercial readiness (2)	Scalability	Gaps
Not compatible with net zero	Current maritime fossil fuels (MDO, HFO)					Proven	Incompatible with net zero
	LNG					Proven	Incompatible with net zero*
Compatible but not scalable	Biofuels						Scale deployment
Hydrogen derivatives	E-methanol						Sustainable CO2 source and storage
	E-ammonia						Ammonia cracking
	Liquid hydrogen						Maturity

Unviable — Viable

1: Accounts for well-to-tank and tank-to-wake emissions
2: Accounts for technology readiness and fuel availability
* Unless combined with CCS

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3 The maritime shipping industry is likely to focus on methanol in the short-term, with a progressive switch to ammonia in the long-term.

In 2050, 250 Mt of e-methanol and 135 Mt of bio-methanol are estimated to be produced annually, versus an estimated 566 Mt per year for renewable ammonia, according to IRENA. The latter accounts for more than 80% of the total 2050 global market of ammonia (688 Mt), with most of this supply coming from electrolysis-based production.

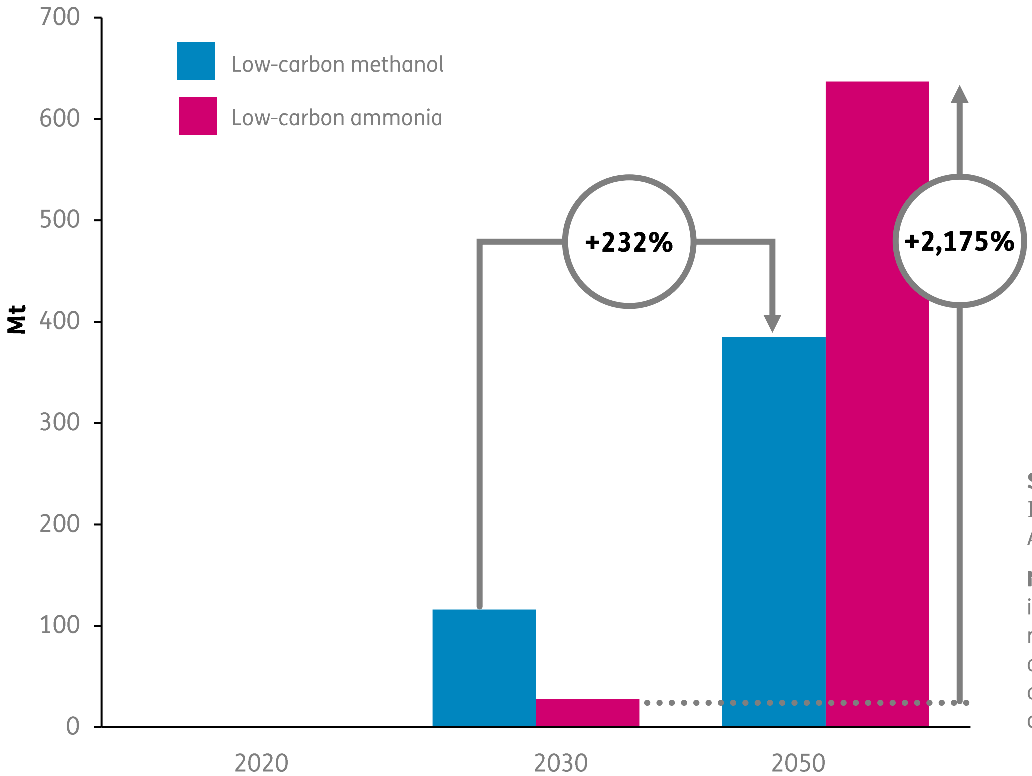
However, in the short to medium-term, renewable ammonia is not able to reach similar volumes to renewable methanol even across optimistic scenarios (e.g. IRENA's 1.5C).

Therefore, in the short-term, the maritime shipping industry is focusing on methanol. This is also due to the current lack of technological readiness of ammonia engines, ship designs and bunkering protocols. Moreover, although methanol is not a zero-emission fuel, it is non-toxic and can be stored at ambient temperatures.

Due to uncertainty around the availability of different low-carbon fuels and their costs projections, there has been a surge in orders of multiple-fuel vessels, and, to a lesser extent, alternative-fuel-ready vessels, such as "ammonia-ready". These vessels currently run on conventional fuels but are designed to need limited technical modifications in the future to be able to run on alternative fuels, such as ammonia or hydrogen.

The market is expecting the first commercialisation of shipping engines capable of running fully on ammonia to happen as early as 2024.

Low-carbon methanol production scales up quicker in the short-term, but ammonia catches up by 2050.



Source: IRENA, Methanol Institute, Ammonia Energy Association, Baringa Analysis

Note: Low carbon methanol includes bio-methanol and e-methanol; low carbon ammonia includes renewable and fossil with carbon capture and storage (CCS).

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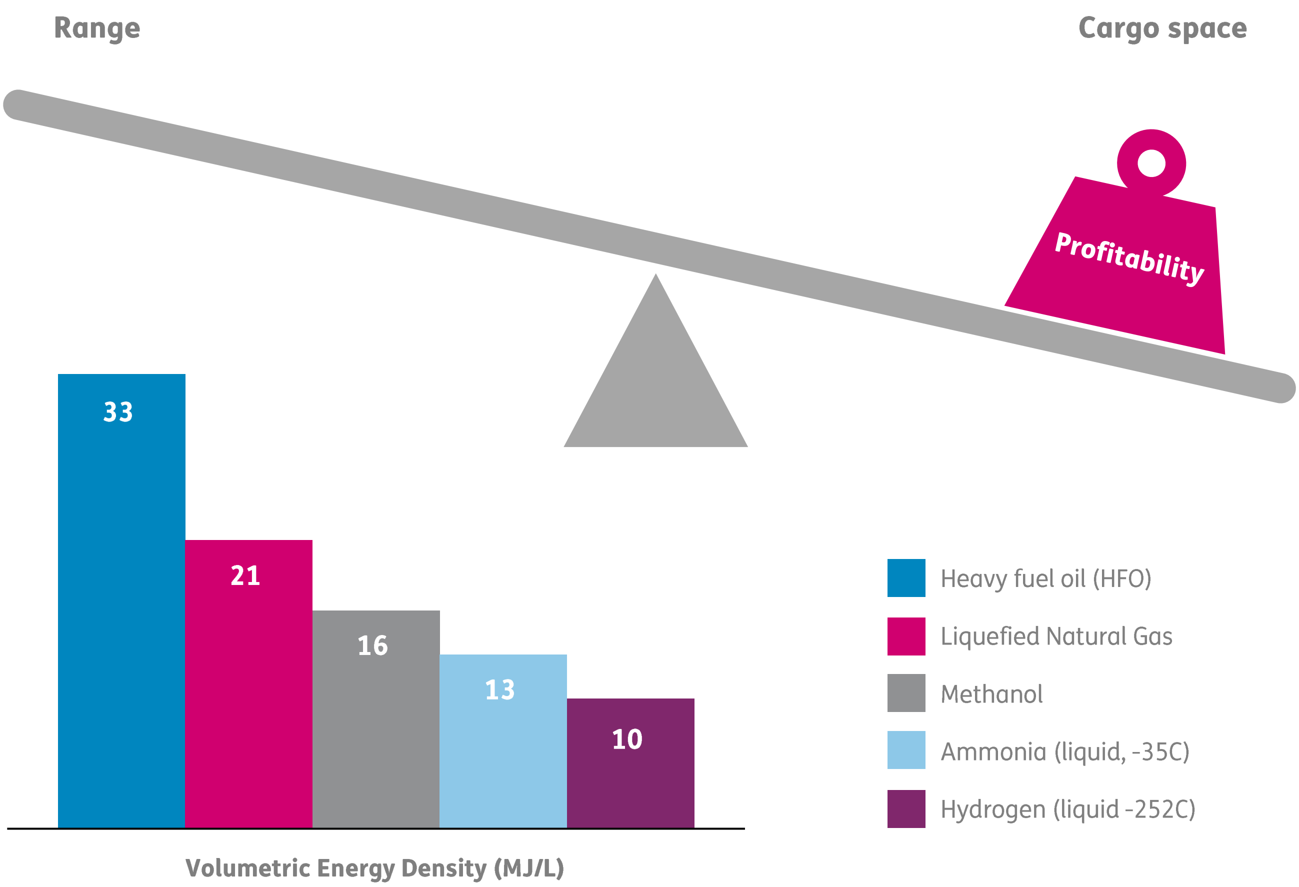
4 However, hydrogen derivatives come with lower energy density, leading to a cargo/distance trade-off for shippers.

The same volume of hydrogen and hydrogen derivatives, such as ammonia and methanol, carries less than half of the energy content of traditional maritime fuels (e.g. MDO, HFO). Lower volumetric energy density means that a higher volume of fuel is needed to carry the same amount of energy, leaving ship manufacturers faced with a complex energy conundrum:

- To maintain the same range, developers will need to sacrifice cargo space to expand onboard fuel tanks; or
- To maintain the same cargo capacity, range will need to be reduced.

Each shipping route will be optimised considering bunkering costs and the profit loss from reducing cargo space. The cost of fuel at the refueling location and the port fees will also be key drivers. However, shipping companies will often seek to prioritize cargo capacity for profitability reasons, as ships size is already maximised for the port of visit. For example, the Kamsarmax bulk carrier by Japanese developer Tsuineishi, one of the most established models in the industry, was designed specifically for the port of Kamsar in Guinea.



Source: International Transport Forum, OECD

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Therefore, a hydrogen fleet is likely to lead to a redrawing of the global trade map, enabling strategically located countries with high hydrogen production potential to become refuelling hubs.

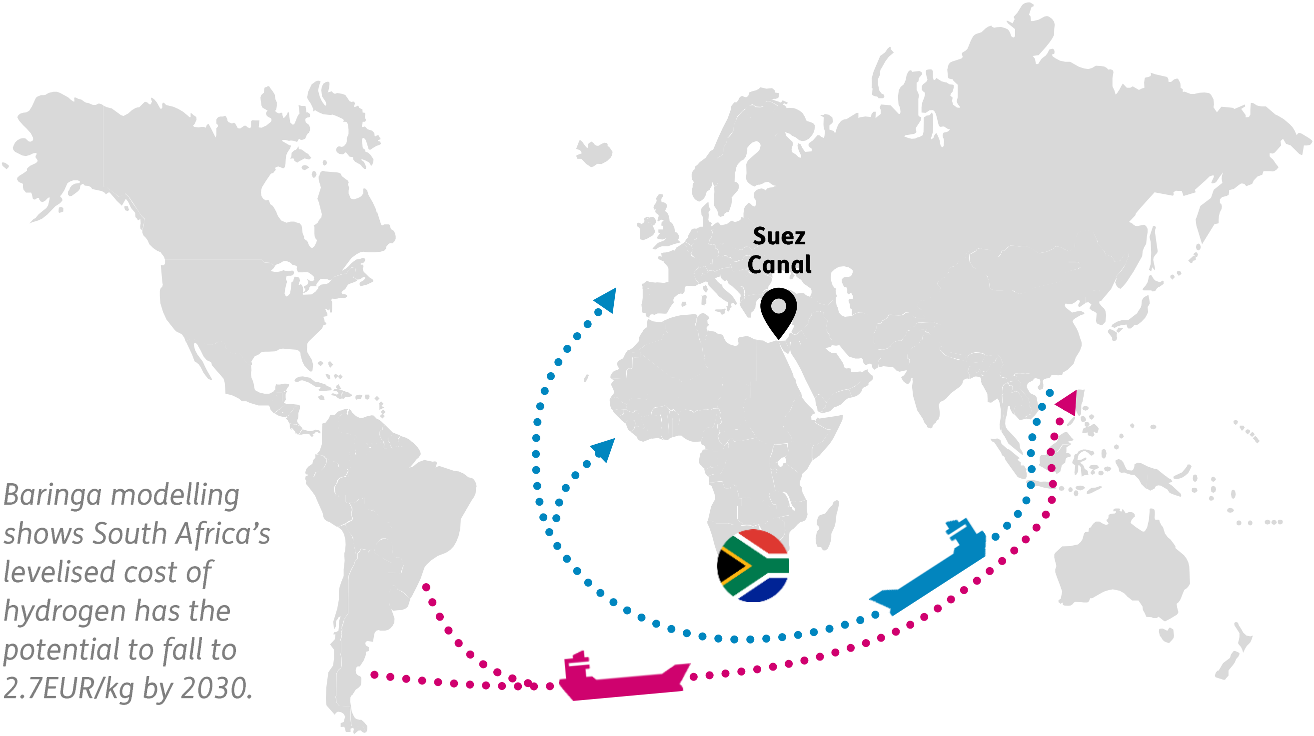
This energy storage trade-off creates opportunities for strategically located nations to benefit from the energy transition. Countries with cheap, abundant renewable energy sources are well placed to produce green hydrogen and hydrogen-derivative shipping fuels, and those located along popular trade routes can leverage their location and act asrefuelling hubs.

South Africa has both abundant renewable energy potential and a strategic location within shipping routes. The country is a mid-point for ships sailing from east to west, not via the Suez Canal. Moreover, it has high potential from renewable energy sources, especially from onshore and offshore wind.

Baringa modelling estimates that South Africa has the potential to reduce hydrogen production costs to 2.7EUR/kg by 2030, undercutting European production by up to 50%, in certain regions. This can allow SA to become a leader in the production, bunkering and export of low-cost green hydrogen and ammonia.

Other well renowned refuelling hubs such as Singapore, Gibraltar, the Amsterdam-Rotterdam-Antwerp region are also strategically located. However, they lack the abundant cheap renewable landscape needed to produce cost-competitive hydrogen and will need to ensure steady import flows.

South Africa offers a mid-point refuelling option for large ships not travelling via the Suez Canal.



Baringa modelling shows South Africa's levelised cost of hydrogen has the potential to fall to 2.7EUR/kg by 2030.

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If you're interested in hearing more, please contact one of our experts to request a meeting:

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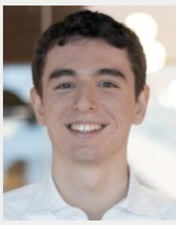

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