International Chamber of Shipping

Shaping the Future of Shipping

# Fuelling the Fourth Propulsion Revolution

## An Opportunity for All


**SUMMARY REPORT**

May 2022

*“Shipping will be a key enabler of the global energy transition, providing cost effective and flexible solutions to transport at least half of the (net) zero carbon fuels traded around the world.”*

*“Decarbonisation and the creation of (net) zero carbon fuels presents a massive economic opportunity for shipowners, companies and countries, as fuel producers, importers and exporters.”*

*“An opportunity for all”*

# Introduction

Decarbonisation and the creation of (net) zero carbon fuels presents a significant economic opportunity for shipowners, companies and countries, as fuel producers, importers and exporters.

This summary report outlines how shipping will play a fundamental role in delivering these fuels globally and act as an enabler for governments and industries to achieve their climate targets.

It showcases why the maritime industry must be included in international decarbonisation plans and have access to the same (net) zero carbon fuels they will be transporting to decarbonise; the world's renewable energy generation would need to increase up to 100% just to supply enough (net) zero carbon fuel to power the shipping industry.

The enormous scale of the opportunity and transformation of the fourth propulsion revolution for governments, ports, developing economies, and key maritime stakeholders is laid out in this summary report.

This research was created in collaboration with author Professor Dr Stefan Ulreich, University of Applied Sciences, Biberach, Germany and Chair of the Task-force Renewables of the European Federation of Energy Traders. ICS is also grateful to the following people and organisations for their input and peer review of this report:

- Roland Roesch, Deputy Director at the Innovation and Technology Center and Gabriel Castellanos, International Renewable Energy Agency (IRENA).
- Araceli Fernandes, Jose Miguel Bermudez and Elizabeth Connelly, International Energy Agency (IEA).

Read the full report:
www.ics-shipping.org/publication/fuelling-the-fourth-propulsion-revolution-full-report

This is a follow up to the Catalysing the Fourth Propulsion Revolution report published by ICS in 2020.

ICS signed a Partnership Agreement with the International Renewable Energy Agency (IRENA) in January 2022.

# Executive Summary

The UNFCCC Paris agreement of 2015 aims for global climate-neutrality by the middle of this century. The global shipping industry has pledged to achieve net-zero $CO_2$ emissions by 2050, meaning that the fourth propulsion revolution will be green. The transition to new fuels presents enormous opportunities as well as critical transformational challenges for all segments of the global economy.

Current geopolitical tensions are creating fuel supply uncertainty and heightening energy security concerns. This increases the pressure to accelerate the transition to green fuels, as well as establish alternative fuel hubs and routes to increase resilience. Governments, ports, developing economies, and key stakeholders that create renewable energy supply centres and production hubs will benefit greatly from early mover advantage.

The International Energy Agency's (IEA) Net Zero Emissions by 2050 scenario says to decarbonise the world, global electricity demand will increase to 60,000 TWh, up from 23,230 TWh in 2020. Shipping will not only be a consumer of (net) zero emission carbon fuels to meet decarbonisation targets, but is critical for transportation of green fuels as it is the most economical option over long distances (above 10,000km). At least half of (net) zero fuels are expected to be moved by ships, according to the International Renewable Energy Agency (IRENA), making maritime a key enabler of the decarbonisation of land-based industrial sectors.

However, maritime decarbonisation is highly dependent on the transition speed of energy producers, in terms of building renewable energy production facilities ashore at scale, catalysts such as global levies needed to accelerate production of fuels at scale, as well as with updated infrastructure at ports.

Governments and industry must act now to ensure that their energy transition plans account for and support the vital role that shipping will play in delivering renewable energy and hydrogen plans. Policy, funding and actions must combine to create an easy path towards the green propulsion transition. This is where development finance can play a significant role in de-risking the much needed investment required to move to a (net) zero carbon fuel future.

This research has looked to identify the amount of electricity needed to produce (net) zero carbon fuels for maritime use as part of the wider global energy transition. For shipping's (net) zero carbon fuel needs, electricity from renewable sources used to supply shipping would need to increase by up to 3,000 TWh. This would require the equivalent of all of the world's current renewable energy production just to provide shipping's fuel needs.

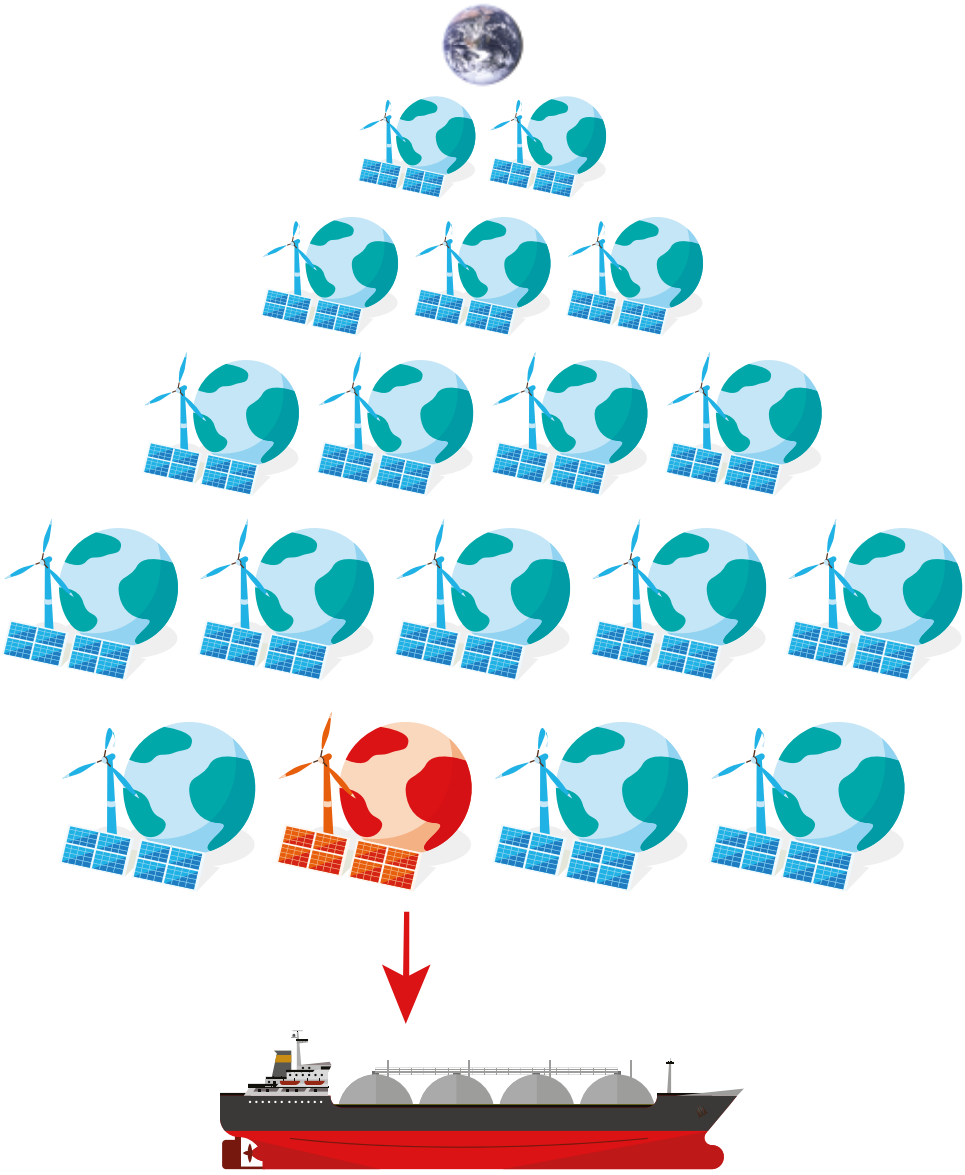
# Key takeaways

| | |
|---|---|
| 1 | **Producing (net) zero carbon marine fuels, especially close to ports, will create a significant opportunity for renewable energy producers**<br>It could require the equivalent of all the world's current renewable energy production just to supply shipping's (net) zero carbon fuel needs. |
| 2 | **Shipping will have a multi-fuel future**<br>No one fuel can replace current fossil fuels for maritime and decarbonising will require a mix of bio-fuels, e-fuels, natural gas and hydrogen derivatives such as ammonia and methanol. |
| 3 | **High demand for (net) zero carbon fuels presents opportunities for the global south**<br>Developing economies are well-placed to become fuel suppliers and exporters of (net) zero carbon fuels but must move quickly to gain early mover advantage and will need support from the international community for capacity building and access to finance. |
| 4 | **Renewable energy production of (net) zero carbon fuels provides economic opportunities for all**<br>Investors should be confident in opportunities for (net) zero carbon fuel production as the demand for hydrogen-based solutions is expected to increase strongly in many industrialised countries with strong green policies, that do not have the potential to produce enough renewable hydrogen for their own needs. |
| 5 | **Invest in infrastructure and research, development and demonstration now or economic gains will be minimised**<br>Early mover advantage is vital and all stakeholders, including governments, ports, fuel suppliers and industry must invest now to ensure a stable supply of (net) zero carbon fuels. |

## 1 Replacing conventional marine fuels with (net) zero carbon fuels, especially close to ports, will create a significant opportunity for renewable energy producers and stakeholders

(Net) zero carbon fuels such as hydrogen-based fuels are expected to become an essential part of the climate-neutral maritime fuel mix in coming decades. Renewable electricity production must be rapidly increased to capitalise upon this opportunity and ensure fuel security for maritime, which will underpin the decarbonisation of other land-based industries. It is crucial for shipping that production facilities for new fuels are within easy access of ports and new bunkering hubs are established to ensure shipping can access and deliver (net) zero fuels globally.

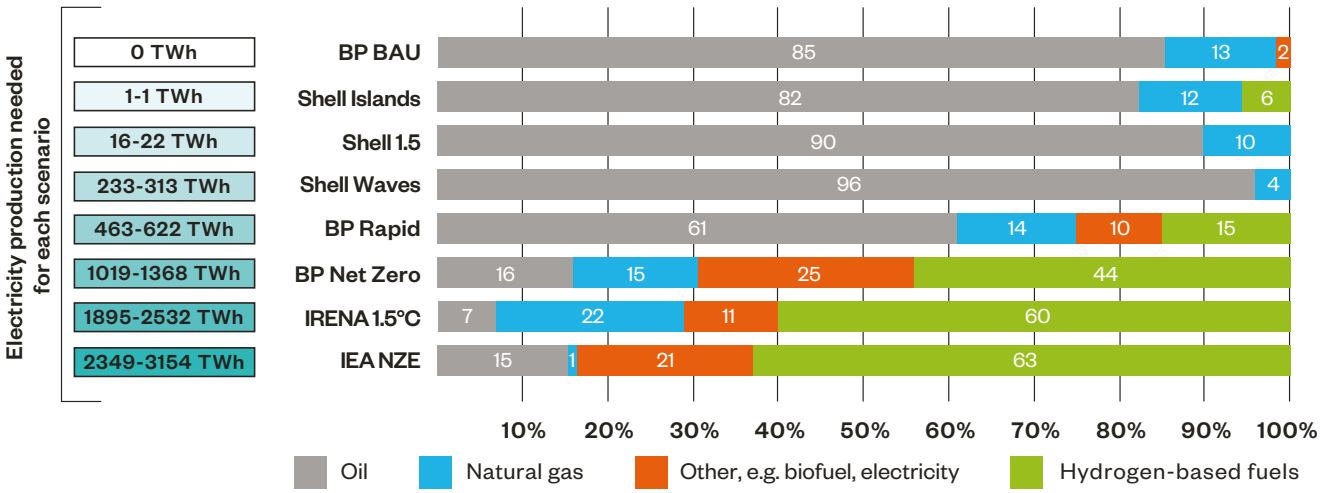
The scale and challenge to supply alternative fuels to decarbonise the shipping sector is often underestimated. To supply shipping's (net) zero carbon fuel needs (as outlined in International Energy Agency and IRENA scenarios), electricity from renewable sources used to supply shipping would need to increase by up to 3,000 TWh considering expected technology efficiencies by 2050. This could require the equivalent of all of the world's current renewable energy production just to provide shipping's fuel needs.



***To achieve the IEA's Net Zero Emissions by 2050 scenario we would need an 18-fold increase in the world's existing renewable production capacity. Shipping would require the equivalent of one of these worlds to meet its own renewable energy needs.***

## 2 The decarbonisation of shipping will have a multi-fuel future

The maritime industry's green transition will take time and consist of a multi-fuel future as there is no single replacement for affordable and readily available current fossil fuels. Biofuels, e-fuels, natural gas and hydrogen derivatives are all likely to play a role in the future fuel mix for shipping. New production ecosystems must be built rapidly across the globe to meet decarbonisation goals. A global carbon levy would be an effective tool to reduce the enormous costs of a large-scale transition away from fossil fuels.




***Various scenarios of fuel mixes for maritime shipping in 2050***

*Note: Each scenario is explored in detail in the full version of this report*

*Sources: International Energy Agency (IEA), Shell, BP and International Renewable Energy Agency (IRENA).*

Using and transporting these new fuels comes with significant operational and safety challenges which will need to be addressed. Defined and agreed global safety and sustainability standards for hydrogen-based fuels and strong safety standards for the transport and use of (net) zero fuels must be developed quickly, to keep pace with the transformation. Seafarers and those in the supply chain will need to be trained and new standards developed to maintain safety and minimise risk.

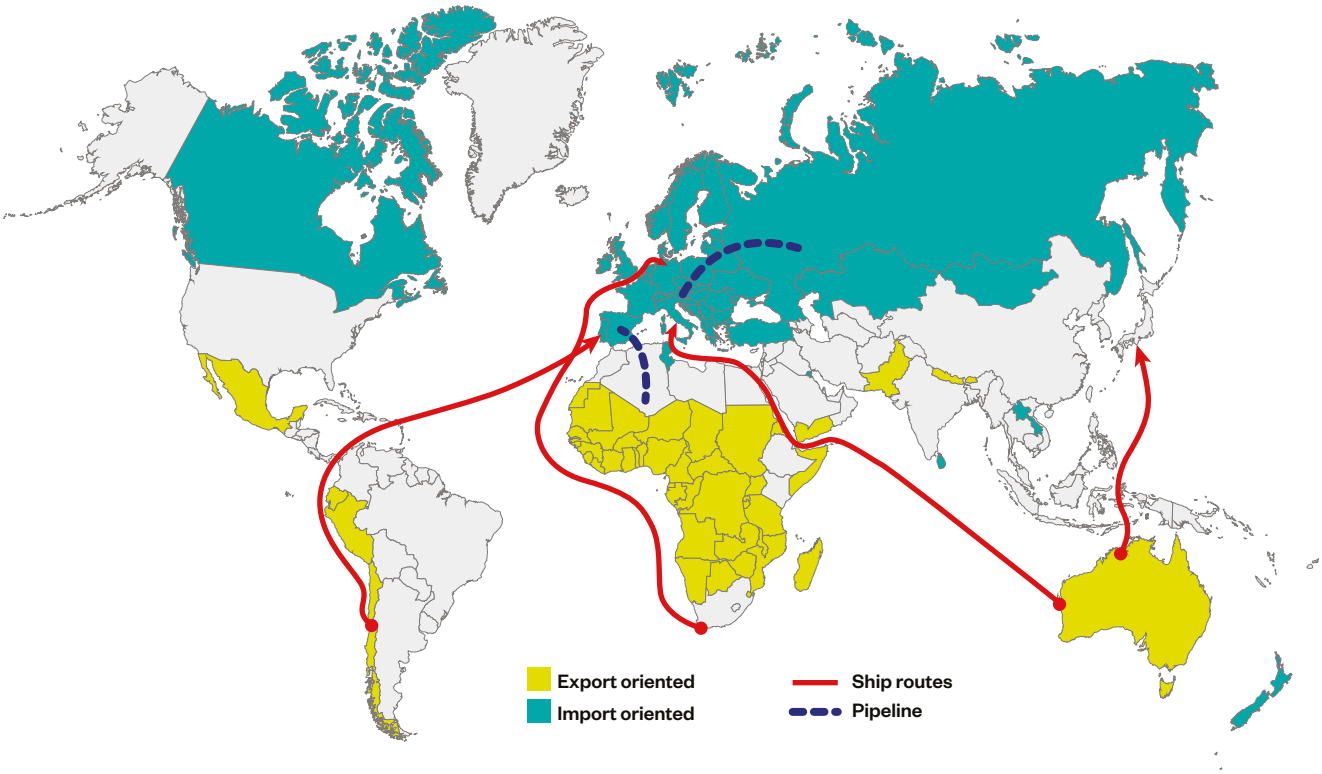
## 3 Supply side dynamics: High demand for (net) zero carbon fuels presents enormous economic opportunities for the global south

Developing economies are well placed to benefit economically by becoming fuel supply producers and exporters of (net) zero carbon fuels to meet high demand from Europe, North America and Asia. Shipping presents the most cost effective means to trade (net) zero carbon fuels from these supply hubs to different parts of the world over long distances.

Regions such as Latin America and Africa are expected to benefit from a 20%+ lower cost of production and transport of fuels due to the abundance of solar and wind in these regions. Existing energy hubs in the MENA region are primed to transform themselves from fossil fuel sellers to (net) zero carbon fuel supply hubs due to their excellent wind conditions and high solar radiation.

However, hydrogen and (net) zero carbon fuel facilities must be urgently developed to ensure access to a highly competitive market. In setting up these facilities location is important. Export strategies and policies, along with enhanced international cooperation agreements, must also be created rapidly. Countries such as Algeria, Argentina, Australia, Chile and Morocco have already begun this journey.

Developing economies must be supported by the international community to increase capacity building, construct necessary infrastructure and access finance to gain early-mover advantage and establish themselves as energy supply hubs in the global (net) zero fuel markets.



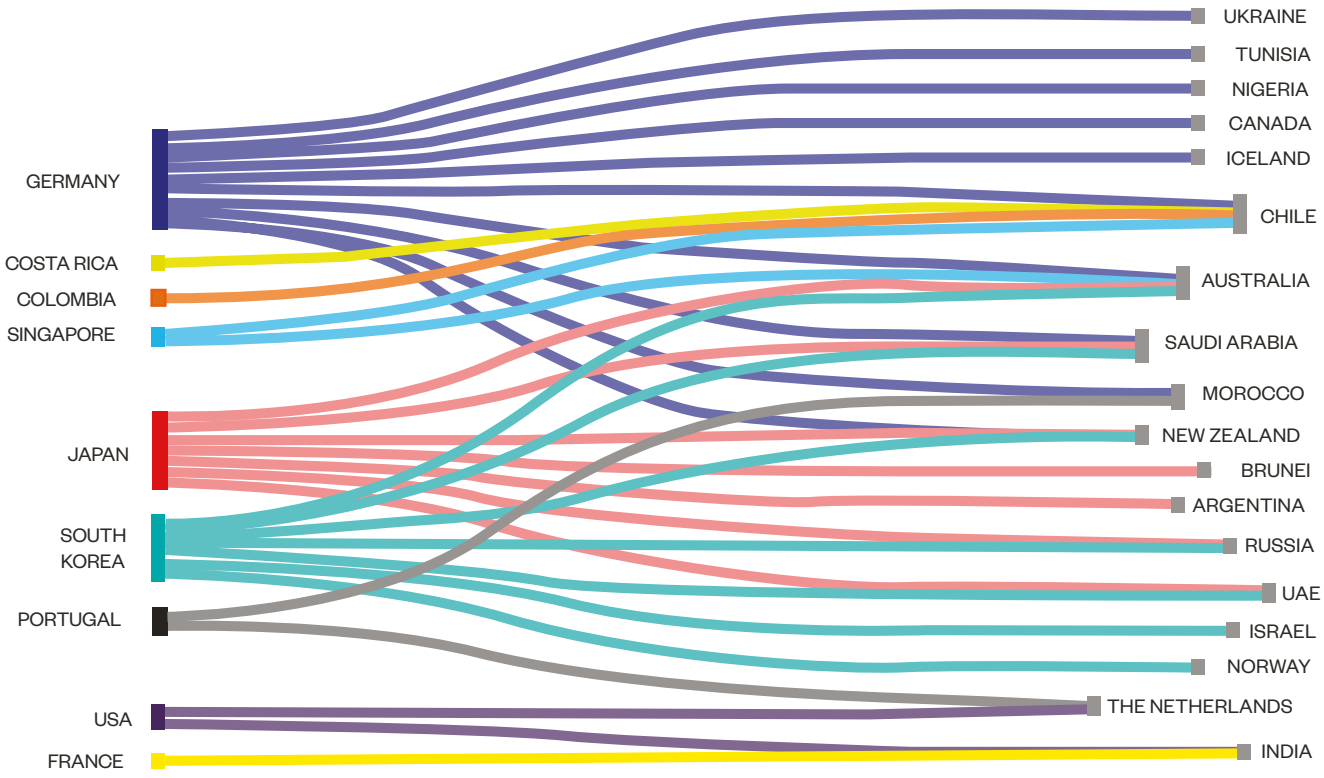

***Countries that have currently identified their import/export preference. We see significant growth opportunities as countries around the world clarify their positions as they seek to enhance their energy security needs.***

## 4 Demand side dynamics: renewable energy production poses massive economic opportunities for all stakeholders

As the (IEA) Net Zero Emissions by 2050 scenario outlines, in order to decarbonise the world, electricity demand will need to increase to 60,000 TWh, up from 23,230 TWh in 2020. Specifically, the demand for hydrogen-based solutions is expected to increase sharply from countries without the capacity to produce sufficient renewable hydrogen to meet their green targets. IEA's Net Zero Emissions by 2050 scenario states electricity demand for hydrogen production (including synthetic ammonia) is expected to be 14,500 TWh by 2050. All hard-to-abate sectors, including shipping, cement and steel, will require these fuels to reach decarbonisation targets. This should give investors confidence to back the most promising hydrogen production sites and logistics, including those in developing economies. Shipping offers the security of cost effective supply of (net) zero carbon fuels from a multitude of exporting countries to receiving countries across the globe. High fossil fuel prices – driven both by market scarcity and carbon pricing – will help to develop the hydrogen market further.

Given the expected production cost differentials across the world (expected range of €72.60/MWh to €156.40/MWh in 2050), the global trading of hydrogen could create substantial benefits for exporting and importing countries. The first international cooperation projects between countries have already been established. Over time, these bilateral initiatives should merge into a truly global, harmonised and level playing field. The global value chain can benefit from accepted global standards for contracts and quality. Most of the bilateral agreements will spur maritime transport demand as they will likely need to be shipped over long distances, whilst offering flexibility to supply and demand hubs.

Shipping's decarbonisation is deeply intertwined with the wider energy transition and the industry will compete for (net) zero carbon fuels with other sectors. Production facilities for new bunkering fuels need to be within easy access of ports, unless future technologies and bunkering systems permit otherwise. Estimates show a production potential of more than 10,000 TWh for (net) zero carbon fuels in coastal regions worldwide making the case for immediate investment.




***Bilateral agreements on hydrogen.***

*Source: Based on the World Energy Council, National Hydrogen Strategies, 2021.*

## 5 Invest in infrastructure and RD&D now or economic opportunities will be delayed

Substantial investment is needed to achieve the enormous potential for (net) zero carbon fuels, including hydrogen, hydrogen-based fuels and sustainable biofuels. Funding for Research, Development and Demonstration (RD&D) from both industry and the public sector, as well as for production facilities and transport infrastructure around emerging fuel hubs is imperative. Despite some promising announcements and plans, there continues to be a lack of investment in zero-emission technologies, with the IEA highlighting that the total amount of corporate R&D investment for maritime has decreased, from $2.7 billion in 2017 to $1.6 billion in 2019.

Fuel exporters seeking financing will want proof of a stable demand outlook for (net) zero carbon fuels, including hydrogen, in order to present bankable projects. To achieve this physical infrastructure will need to be established at pace, as well as generic trading infrastructure. The latter might already be available within existing global trading houses for commodities. To meet all these challenges coordinated global efforts are needed.

There is a significant opportunity for the development finance community to catalyse the global energy transformation and de-risk future investments. Investment in renewable projects in developing economies does not always present the scale needed to meet the requirements of development finance institutions, leading to what is sometimes referred to as a lack of bankable projects. Investing in larger scale generation, production and transportation infrastructure enables existing development finance to be unlocked creating a strong pipeline of bankable projects that meet development finance criteria. Such early investment would send a significant market signal, which can then be easily scaled when additional revenue sources are available. Without re-risking investment economic opportunity for all could be delayed.

Additional investment is key. This will accelerate technology-readiness levels, increase demonstration and deployment to reach the required scale of production, and drive down production costs of (net) zero carbon fuels within this decade.

# Conclusion

It is clear that the transition to a green fourth propulsion future will be a once-in-a-generation opportunity. Shipping will be a key enabler of the global energy transition, providing cost effective and flexible solutions to transport at least half of (net) zero carbon fuels around the world by 2050. Immediate investment in technology, infrastructure and the establishment of international cooperation projects is needed. As a user and carrier of (net) zero carbon fuels, shipping will underpin and benefit from this transition – and it must be adequately supported.

The speed and scale of change cannot come at the cost of safety. Defined and agreed global safety and sustainability standards for hydrogen-based fuels and strong safety standards for the transport and use of (net) zero fuels must be developed quickly, to keep pace with the transformation. Seafarers and those in the supply chain must be trained and new standards developed to maintain safety and minimise risk.

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Cover image: 3d rendering of a liquid hydrogen renewable energy ship, Shutterstock

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