PATRIZIA

CHANGING COURSE: GREEN SHIPPING CORRIDORS

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Green shipping corridors are emerging as an important pathway in decarbonising the shipping industry. Momentum is building, but almost all the work with regards to alternative fuels, the global shipping fleet and the existing landside port infrastructure, lies ahead.

International shipping is the linchpin of global economic output. Approximately 90% of goods traded globally are transported by ship.[1] With its outsized contribution to the global economy comes its significant global greenhouse gas (GHG) emissions footprint. GHG emissions from shipping currently represent nearly 3% of total global emissions.[2] Without significant decarbonisation efforts within the sector, this share could more than triple by 2050.

Decarbonising shipping is critical if the International Energy Agency's (IEA's) Net Zero Emissions by 2050 Scenario is to be met. To be on track for 2050, emissions caused by shipping need to be reduced by 15% from 2021 levels by 2030, per Figure 1.[3] This requires at least 5% of all shipping fuels to be zero-emission fuels by 2030, compared to the negligible levels of such fuels in use in shipping today.[4] Achieving these targets requires ambitious and supportive policies, technological innovation, significant public and private investment, and the collaboration of governments with each other and with the entire supply chain of shipping.

Green shipping corridors - shipping routes entirely dedicated to ships that run exclusively on zero-emissions fuels - are emerging as an important pathway in achieving the 2030 targets, and ultimately, the full decarbonisation of the shipping industry. The challenge ahead in achieving green shipping corridors is enormous: significant investment is required in alternative fuels, zero-emissions ships and landside infrastructure for the production and supply of alternative fuels, alongside supportive government policy and regulation to incentivise such investment.

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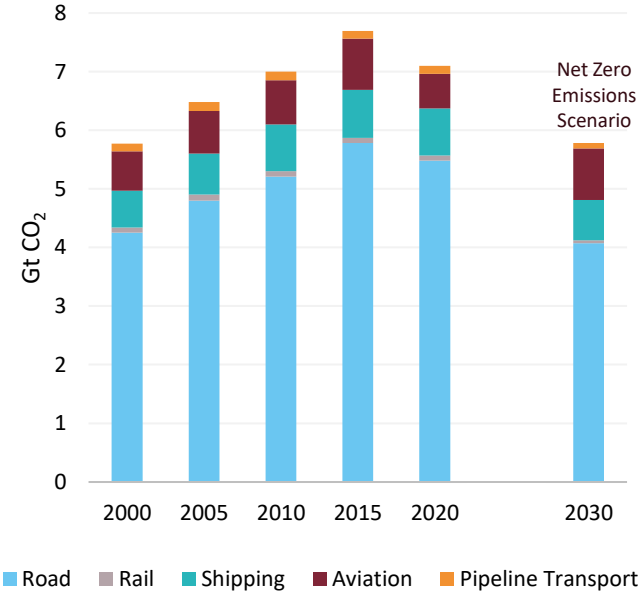
FIGURE 1: CO_2 EMISSIONS BY TRANSPORT SECTOR



Source: International Energy Agency

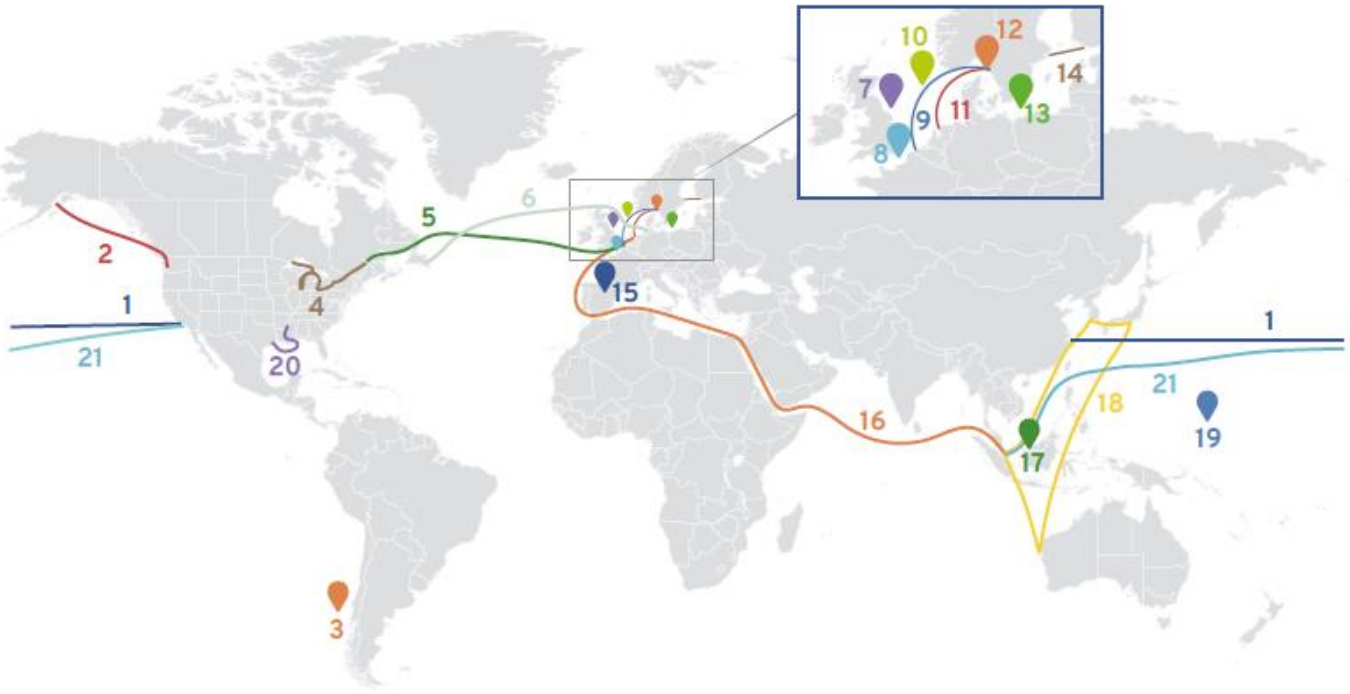
[1] OECD, *Ocean shipping and shipbuilding:* https://www.oecd.org/ocean/topics/ocean-shipping/
[2] International Maritime Organisation, *Greenhouse Gas Emissions:* https://www.imo.org/en/ourwork/environment/pages/ghg-emissions.aspx
[3] International Energy Agency, *International Shipping:* https://www.iea.org/reports/international-shipping
[4] Getting to Zero Coalition, March 2021, *Five percent zero emission fuels by 2030 needed for Paris-aligned shipping decarbonization*

Momentum behind green corridors is building.

Since the Clydebank Declaration for Green Shipping Corridors was signed by 22 countries at the COP26 conference held in late 2021, 21 initiatives have been announced, covering multiple geographies and many important global shipping routes.[5] Figure 2 illustrates the breadth of the initiatives announced to date.

Importantly, most of the initiatives so far announced remain at a very preliminary stage. Only a third have reached the stage where feasibility assessments are being initiated and/or implementation plans developed.[6] While progress is promising, almost all the work lies ahead. Progress on alternative fuels becoming scalable and cost-effective, zero-emissions ships replacing the existing fleet, and decarbonising ports needs to be prioritised.

FIGURE 2: GREEN SHIPPING CORRIDOR INITIATIVES ANNOUNCED TO DATE



Source: The Global Maritime Forum, The 2022 Annual Progress Report on Green Shipping Corridors

[5] Global Maritime Forum, 2022, *Annual Progress Report on Green Shipping Corridors*
[6] ibid.

A viable fuel pathway is essential to a green corridor's success.

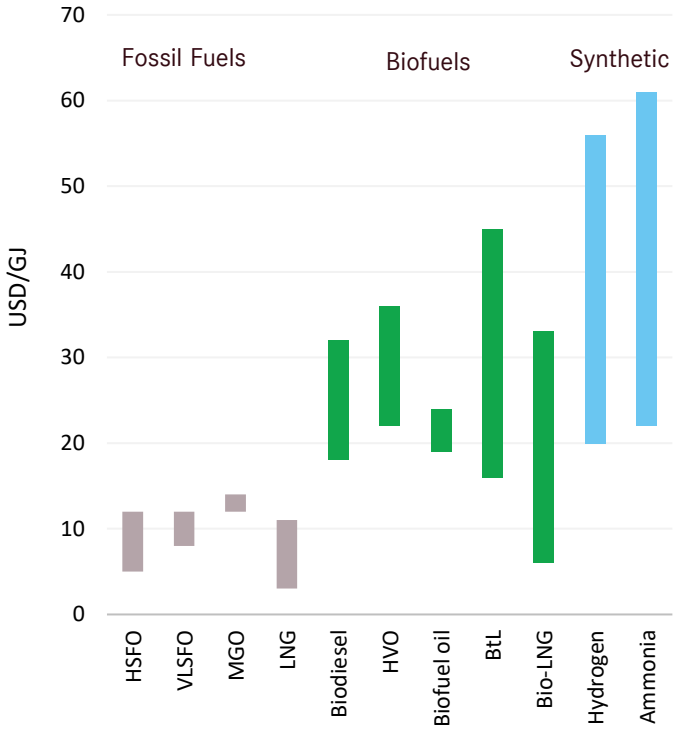
Several different alternative fuels are being considered, but not all of them appear viable at this stage. Green methanol and green ammonia are broadly considered as the two frontrunners at the time of writing; however a variety of fuels and energy sources continue to be considered.

- **Green methanol** is produced from sustainable biomass or green hydrogen. It is liquid at ambient temperature, making handling and storage easier. It is the most technologically advanced currently as ships with methanol internal combustion engines are already in use.
- **Green ammonia** is produced using renewable hydrogen, and is considered to be the most likely marine fuel to be used in the long term as it has no carbon in its molecular structure. It has scalability benefits as it is already produced for other energy and industrial uses. However, it is a toxic gas, so it is complex and expensive to handle.
- **Liquified Natural Gas** is being deployed as an alternative in shipping at scale today. However, it is not a zero-emissions fuel, so it is unlikely to be considered a long-term alternative fuel.
- **Biomethane**, also known as renewable natural gas or biogas, is indistinguishable from natural gas, and can be used in existing gas transmission and distribution infrastructure.
- **Hydrogen** is about half as energy dense compared to traditional marine fuels. Bigger fuel storage tanks impede cargo carrying capacity. Liquid hydrogen is more energy dense, however the liquefaction process and cyrogenic storage requirements increase costs.
- **Batteries and fuel cells** used in electric systems remain in early development. Fully electric ships are unlikely to be suitable for long-haul shipping given technology limitations.

Biomass-based fuels are unlikely to be scalable in the long term as there are global supply constraints on low-emissions biomass. Biomass-based marine fuels could be used as a transition fuel but are unlikely to be a long-term solution for the shipping industry.

Zero-emission fuels currently cost significantly more than conventional fuels[7] – current indicative ranges for a variety of shipping fuels are presented in Figure 3. Fuels make up a comparatively large portion of the overall costs of deep-sea shipping. For green corridors to gain traction, the production of zero-emission fuels needs to be scaled up, be made widely available via adequate production capacity and made cost effective. The challenge for fuel producers is understanding future demand, specifically to secure a level of advance orders so that it can access finance to produce new, carbon-neutral fuel production plants. Government support in bridging the price gap between alternative and conventional fuels will be necessary to incentivise investment in alternative fuel production and infrastructure.

FIGURE 3: INDICATIVE SHIPPING FUEL COST RANGES



Source: International Energy Agency

Supportive government policy is already emerging. The Inflation Reduction Act passed in the United States in August 2022 introduced significant tax credits for hydrogen production. This should, in turn, support lower alternative fuel costs as fuels such as green ammonia and green methanol are produced using green hydrogen. However, for green shipping corridors to gain momentum, countries need to be united in their policy initiatives. The shipping industry is global, and so the playing field needs to be reasonably level so that all companies within the sector can operate on equal terms.

[7] McKinsey Sustainability, 21 December 2022, *Green corridors: A lane for zero-carbon shipping*

Fit-for-purpose shipping vessels that operate on zero-emission fuels need to be introduced to the global shipping fleet.

Fit-for-purpose shipping vessels that operate on zero-emission fuels need to be introduced to the global shipping fleet. Given that ships typically have a 20-to-25-year operating life, shipbuilders need to be adopting zero-emissions technologies soon to support the sector's decarbonisation ambitions and to make the implementation of green shipping corridors plausible.

For shipbuilders to be confident in their future investment plans, understanding which fuel(s) will be available and at what scale is essential. It is somewhat of a chicken and egg situation for shipbuilders, however, as fuel producers need to understand future demand, while shipbuilders need certainty on future supply. Maersk, the largest container shipping firm in the world, has indicated it will have carbon-neutral ships on the water in 2023 and by 2025, will have 19 ships that run on green methanol in its fleet.[8] But until the production of green methanol is scaled up, the ships will run on fossil fuels. While not immediately impactful on decarbonisation efforts, proactive moves, such as the one by Maersk, are important as they act as a signal to fuel providers that supply needs to be ramped up to meet increasing demand.

Ports play an obvious but critical role in the development of green corridors.

Looking forward, significant investment in port infrastructure is required to support zero-emissions vessels.

Historically, ports have only required infrastructure to store and bunker heavy fuel oil. To achieve green corridors, ports will need access to an alternative fuel supply, facilities in place to both access and store the alternative fuel, and the infrastructure to safely bunker the fuel. Some alternative fuels are significantly less energy dense than fossil fuels and may be required to be stored in different physical states (for example, pressurised or refrigerated), so ports will need to focus on the storage requirements.

Appropriate energy supply infrastructure will be critical in a port's success. Consider the case of a port where green ammonia is the alternative fuel of choice. The production of green ammonia requires a renewable energy supply, electrolysers to produce hydrogen, an ammonia synthesis plant and significant storage facilities. This type of facility is expected to cost hundreds of millions of dollars and would require significant land suitable for hydrogen and ammonia production. For ports based in cities, such infrastructure would likely be necessary at a distance away from the port. Storage, transportation and refueling infrastructure will be required in the port. Significant public and private investment opportunities will exist for ports involved in shipping corridors becoming green.

Implementing green corridors will be challenging because the concept is abstract and coordination among stakeholders is critical.

Due to the global nature of shipping, the corridors must navigate a landscape characterised by numerous stakeholders across a multitude of sectors and jurisdictions, ultimately complicating decision-making and cooperation.

The challenges around the price and supply of alternative fuels are obvious hurdles that need to be overcome. There are other, potentially more nuanced, challenges as well. Many shipping corridors feature competitors, so collaboration and information-sharing may be complicated. Designing governance structures to address these issues has so far proven difficult. Government policy and regulation can kickstart action, but it needs to be coordinated across countries to ensure the global playing field remains level.

Early movers need to be shipping corridors of sufficient scale and volume to be impactful. Stakeholders across the value chain that are committed to decarbonisation and are willing to collaborate must be included. They need to involve countries with supportive government policy and regulation. Finally, for momentum in the decarbonisation of the shipping industry to build, early movers need to have the potential for large scale reduction in GHG emissions. In the case study that follows, we illustrate why the iron ore shipping route between Australia and Japan has emerged as an attractive early mover.

[8] Maersk, 5 October 2022, *Maersk continues green transformation with six additional large container vessels*

AUSTRALIA-JAPAN IRON ORE GREEN CORRIDOR

The iron ore trade route between Australia and Japan has been nominated as an attractive option for an early mover as a green corridor. The passage is the third largest dry-bulk trade route in the world and decarbonisation momentum among key stakeholders involved in this shipping route is building.

Mining Companies
Rio Tinto, BHP and Fortescue Metals Group are responsible for 90% of the iron ore exported to Japan. All three companies have net-zero emissions commitments.

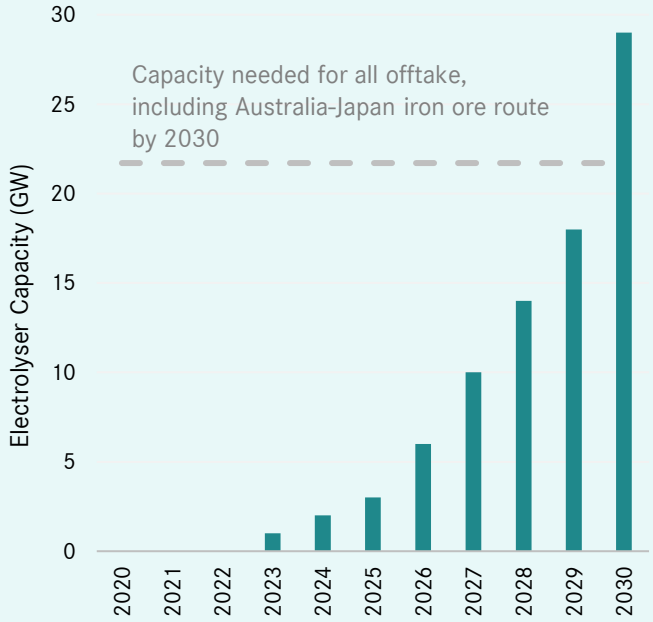
Vessel Operators
Five shipowners cover more than 50% of the route's capacity and four have committed to emissions reduction beyond that mandated by the IMO.

Steel Mills
Japanese steelmakers are decarbonising production, with a focus on reducing Scope 1 and 2 emissions. Many have set ambitious 2030 targets, as well as 2050 decarbonisation commitments.

Fuel Producers
There is significant planned capacity for alternative fuel production in Australia, specifically hydrogen, a key input in green ammonia. By 2030, it could comprise close to half of the world's new green hydrogen electrolysis capacity.

The establishment of a green corridor between Australia and Japan will require zero-emissions fuels derived from green hydrogen, green ammonia being the obvious choice. The amount of fuel for the estimated number of ships required to service the trade route is estimated to be approximately 1.7 GW of electrolyser capacity. Based on projects already announced, there is expected to be 29 GW of capacity online in Australia by 2030, as shown in Figure 4.[9]

FIGURE 4: PROJECTED CUMULATIVE CAPACITY RAMP UP FROM ANNOUNCED PROJECTS



Source: Global Maritime Forum

It is expected that the bunkering needs for this trade route would be relatively small, with two bunkering vessels and one onshore tank facility required per port.[10] The Global Maritime Forum has estimated that the capex requirements would be between US$42-72 million for the three Australian ports,[11] very small relative to the investment needs for fuel production. Nevertheless, the cost of bunkering would add to the cost of fuel.

The Global Maritime Forum estimates that by 2030, the total annualised end-to-end cost of vessel ownership will continue to be 65% higher for green ammonia vessels over current ships powered by heavy fuel oil. By 2050, the gap is forecasted to narrow to 50%.[12] Supportive government policy and regulation will be needed to narrow the gap.

While the trade route has been identified as an ideal green corridor candidate, progress on its implementation is in its infancy. In November 2022, stakeholders from the Australian shipping and energy sectors met in Sydney, forming a taskforce convened by the Global Maritime Forum to support the development of the Australia-East Asia Iron Ore Green Corridor. The participants in the taskforce represent a cross-section of the Australian shipping industry, including resource companies BHP and Rio Tinto, shipping companies including Cargill and NYK Line, and fuel suppliers including Fortescue Future Industries and Woodside Energy. Other stakeholders, including those from clean energy finance and research sectors, were also involved.

[9] Getting to Zero Coalition, 10 November 2021, *The Next Wave: Green Corridors*
[10, 11, 12] Ibid

THE FINAL WORD

Achieving green shipping corridors will require stakeholders from every corner of the shipping industry to act collectively and intentionally. It is not just about sourcing the alternative fuels and building the ships; landside infrastructure that supports refueling and maintaining the ships is just as important. Given that the shipping industry is on the front line of climate change – physical infrastructure, port activities and shipping lanes are vulnerable to sea level changes and extreme weather events – action is urgent.

Momentum behind sustainability is strong, for both consumers and investors alike. As consumers become increasingly alive to the carbon footprint of the shipping associated with their spending - the transport sector, and its contribution to GHG emissions, will come into the spotlight. Similarly, infrastructure investors and fund managers are already running magnifying glasses across their portfolios, seeking ways to reduce their carbon footprints. Ports will be increasingly flagged as a carbon intense part of any portfolio given shipping's current and projected contribution to global emissions. If the shipping sector successfully changes course towards green shipping corridors, ports, as well as the supporting energy infrastructure, may present as the opportunity for sustainability-minded investors to maintain exposure to the transport sector.