Briefing
Decarbonising shipping
January 2023

green alliance...

Summary

The international maritime sector is responsible for three per cent of global greenhouse gas emissions. If it were a country, it would be the eighth largest emitter in the world.[1] In 2021, 95 per cent of trade was moved by sea, yet plans to decarbonise shipping, at both a domestic and international level, fall far behind other modes of transportation.[2]

Recent years have seen promising developments in greener shipping vessels and fuel technology. However, stocks of zero carbon fuels must rise to meet the capacity needed for the maritime sector to move to net zero carbon. There is likely to be no single 'silver bullet' zero carbon fuel for shipping, rather a fuel mix made up largely of green ammonia, hydrogen and battery power.[3]

In the meantime, there are several measures the UK can take to futureproof its shipping industry and position itself at the forefront of the green maritime revolution, including:

- mandating a percentage of zero emissions marine fuels by 2030;
- calculating the UK's portion of international emissions on a voyage basis (based on shipping activity rather than bunker fuel sales);
- broadening the scope of shipping emissions proposed to be included in the UK Emissions Trading Scheme (ETS);
- encouraging measures to improve vessel efficiency including wind propulsion and shore power.

Barriers to decarbonisation

The maritime industry has been challenging to decarbonise due to the practical barriers of a lack of global feedstocks of scalable zero emission fuels, the relatively small number of vessels and their long lifetimes and controversy around methods used to allocate international emissions.

Zero emission fuel feedstocks

A major barrier is that current global feedstocks of potential alternative marine fuels must first be decarbonised, to provide the volume of green fuel the maritime industry needs to transition away from fossil fuels. For example, more than 90 per cent of ammonia is currently produced using the Haber Bosch process which is highly greenhouse gas emitting, despite green

production methods existing.[4,5] Policy levers, such as a mandate on alternative fuels (in combination with a well to wake assessment of fuels to determine which fuels are classed as zero emission) can be used to increase the demand for zero emission options, which will increase the proportion produced.

Long vessel lifetimes

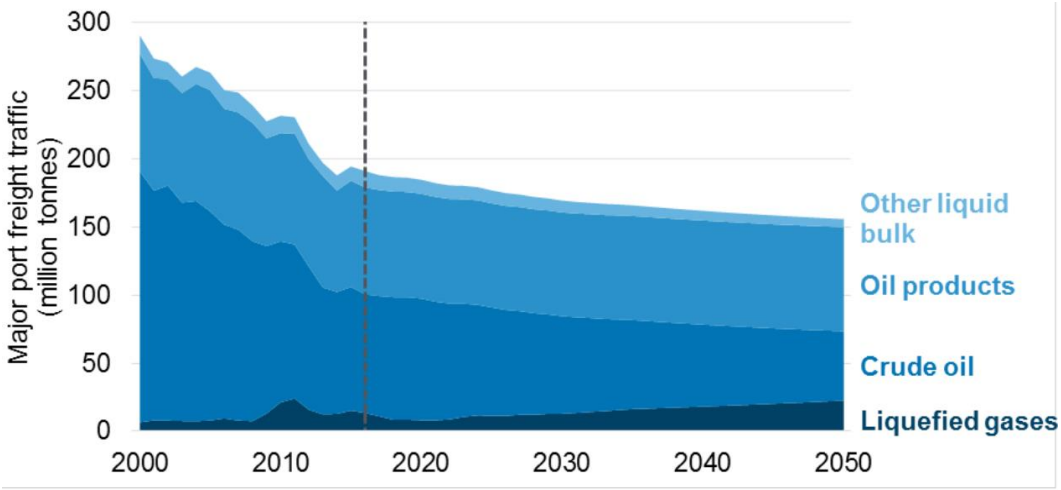
The global average age for a ship is over 20 years.[6] This means technology development is slow to filter into the global fleet. However, compared to aeroplanes, ships are relatively easily retrofitted to run on different fuels.[7]

Allocation of international emissions

Currently, countries report international shipping emissions to the UN based on bunker sales. If, instead, these emissions were measured on a voyage by voyage basis, the UK would be responsible for a greater portion of international shipping emissions than bunker estimates suggest.[8] It is predicted that there will be a move towards voyage based international accounting of emissions in the future.[9] As the UK has included international aviation and shipping emissions in its sixth carbon budget, we suggest that international shipping emissions are addressed in UK shipping decarbonisation policy on a voyage basis.

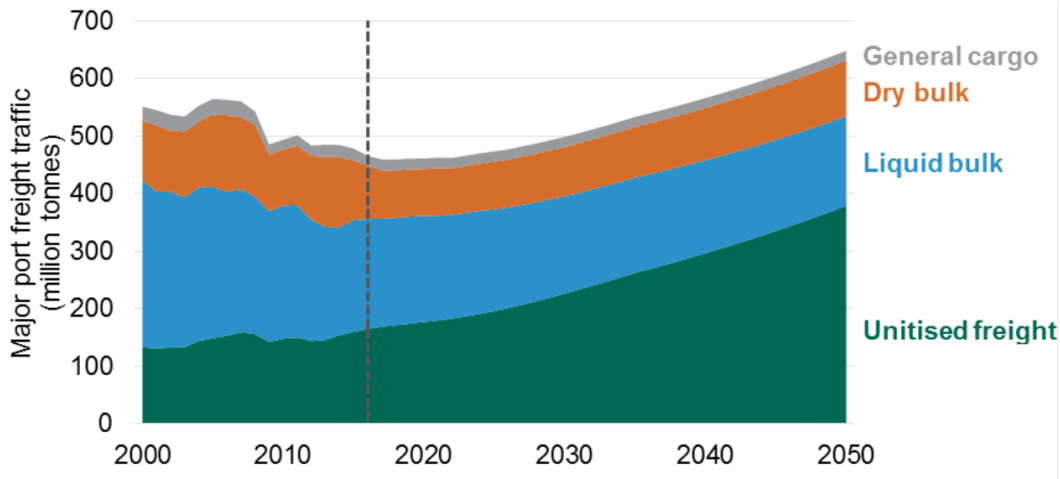
Demand and emissions

Overall, UK shipping greenhouse gas emissions have decreased by 21 per cent between 1990 and 2018, but emissions in the UK are still projected to increase in future.[10] The reduction in emissions over recent decades is due to a fall in demand for oil, a part of 'liquid bulk cargo' resulting in less being transported, as shown below.[11]



Source: BEIS, UK port freight traffic: 2019 forecasts

UK demand for shipping liquid bulk is forecast to decrease further, but to plateau in the coming years as the UK continues to ship a smaller consistent amount of liquid bulk (as shown above), while the national demand for unitised freight, made up largely of motor vehicles and freight containers, is set to increase steadily until 2050. Without action, this projected increase in shipping freight would lead to domestic shipping greenhouse gas emissions doubling between 2019 and 2050.[12]



Source: BEIS, UK port freight traffic: 2019 forecasts

If sustainable fuel uptake and electrification do not progress at the necessary pace, demand side policy levers may be required to reduce the cargo that requires shipping. These levers can include encouraging consumers to opt for locally produced goods, where possible, or developing a circular economy for industrial materials.

Alternative fuels

Zero emission shipping fuels can save 87 per cent of UK shipping emissions.[13] Below, we compare the desirability of alternative marine fuel options.[14] It is important that the impacts of marine fuels should be considered from 'well to wake', including emissions from fuel production, transport and combustion. This will avoid locking in fuels that do not offer material emissions reductions, such as liquified natural gas (LNG).

There are barriers with the most optimal sustainable marine fuels. The Global Maritime Fund estimates that five per cent of global shipping fuel must be scalable and zero emission by 2030, for a breakthrough moment to scale up zero emission fuels enough for global shipping to decarbonise by 2050. [15]

The table below shows that green ammonia is a comparatively favourable low carbon fuel. Even so, there are safety and environmental risks associated with ammonia, as it is highly toxic, meaning vessel retrofit and training will be needed to protect crews from exposure.[16] As well as requiring strict

precautions to prevent the impact of nitrous oxide escape on the nitrogen cycle.[17] Most scenarios used by the Climate Change Committee anticipate that an ammonia-centred suite of sustainable fuels will be deployed, with some methanol and electrification used for domestic passenger vessels, for example.[18]

Alternative sources of shipping fuel

	Emissions reductions	Environmental impacts	Costs	Scalability
Green ammonia	🟢	🟠	🟠	🟠
Bio methanol	🟠	🟠	🟠	🟠
Green hydrogen	🟢	🟢	🔴	🟠
Electric	🟢	🟢	🔴	🔴
Liquid natural gas	🔴	🔴	🟢	🟢
Onboard solar	🟢	🟢	🔴	🔴
Biofuels	🟠	🔴	🟢	🔴
Nuclear	🟢	🟠	🔴	🔴

Technology innovation in green shipping fuels is making good progress and should not be a barrier to decarbonisation.[19] The challenge lies in the scalability and comparative price of alternatives. Signalling to the market that a suite of sustainable options will be used by shipping in the coming years, with a focus on green ammonia, as well as growth in methanol and electrification, will increase demand and reduce the uncertainty currently preventing widespread upskilling of seafarers.[20]

There are several policy levers which could be used to increase demand. These include implementing green corridors, using market-based measures to put a price on carbon, such as the UK emissions trading scheme (ETS), and mandating zero emission fuel use.

- **Green corridors:** The UK has shown promise as a world leader in the use of green corridors to increase ambition on sustainable fuels. Both the Clydebank Declaration at COP26, and the following COP27 pledges made with the Netherlands, the US and Norway, show the UK plans to roll out shipping routes that are voluntarily decarbonised end to end, including vessels and port infrastructure. Green shipping corridors are a useful way to harness public-private collaboration to raise ambition above the international baseline set by the International Maritime Organization (IMO). Although, most are in the early stages, we encourage rapid implementation of the Clean Tyne Corridor, the Dover-Calais/Dunkirk corridor and the development of further routes.[21]
- **UK ETS:** We welcome the recent consultation on broadening the UK ETS to include domestic shipping emissions. Putting a price on carbon emissions from shipping is important to encourage the uptake of sustainable fuels. To further increase the effectiveness of this mechanism, we support Transport & Environment's suggestion that the qualifying vessel weight should be reduced below the proposed minimum of 5000GT (gross tonnage) and applied to all ship types.[22] The emissions targeted should include all greenhouse gases rather than just CO_2 and at least half of international journeys that start or finish at a UK port should be included (as will soon be the case in the EU).
- **Zero emission fuel mandate:** The Getting to Zero Coalition estimates that ten per cent of shipping fuel consumption has promising conditions to transition to scalable zero emissions fuel this decade and that at least five per cent must transition by 2030 to reach a crucial decarbonisation tipping point.[23] Domestically, DfT have committed to making UK shipping net zero by 2050 in the transport decarbonisation plan.[24] To meet the trajectory for the Climate Change Committee's 'balanced net zero pathway', 34 per cent of fuel demand from shipping must be zero emissions by 2035.[25] However, zero carbon marine fuels remain more expensive than the alternatives.[26] Mandating a percentage of zero emission marine fuel supply would ensure green marine fuel uptake, with ambitious targets that increase year on year, similarly to the sustainable aviation fuel (SAF) mandate, starting in 2025.

Efficiency

As sustainable fuel production increases to the level required, a quick win for reducing the UK shipping greenhouse gas emissions could be to increase efficiency.

While shipping is a comparatively efficient form of transport, due to the bulk of goods which can be transported at once, reducing the energy per item transported, there is still scope for short term emissions reductions using energy efficient technology. The IMO continues to develop regulatory baselines for shipping efficiency, including new CO_2 regulations as of January 2023.[27] Deployment of measures beyond the IMO baseline will bring commercial rewards to ship owners and operators, particularly in a decarbonised shipping landscape. And a range of efficiency measures have the capacity to reduce maritime greenhouse gas emissions by over 20 per cent.[28]

Two examples that will improve ship efficiency and offer emissions reductions are wind propulsion (which could reduce emissions by up to 24 per cent) and shore power (which cuts ships' energy use and air pollution at ports by connecting to land grids).[29] Increasing the funding available through DfT's Clean Maritime Demonstration Competition (CMDC) for research, development and deployment of energy efficiency technology would speed up the gains.

Recommendations

The UK could be world leading in decarbonising the shipping sector. As the Department for Transport revisits its Clean Maritime Plan in 2023, the government should consider:

- **a zero emissions fuel mandate** for shipping to be at 5 per cent by 2030, to increase the supply of green marine fuel despite price disparity;
- **calculating the UK's allocation of international emissions on a voyage basis**, as opposed to through bunker sales, to ensure the UK accounts for the international emissions it is responsible for;
- **broadening the proposed scope of shipping emissions in the UK ETS** to include smaller vessels and at least half of the UK's international emissions, to ensure that alternative fuels can be a competitive option in the UK;
- **increasing funding** through the CMDC for research, development and deployment of efficiency measures, including shore power and wind propulsion, for short term emissions reductions.

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Endnotes

[1] Department for Transport (DfT), November 2022, 'Maritime sector given green boost with major COP27 pledge'.
[2] DfT, December 2022, 'Transport statistics Great Britain: 2022 summary.'
[3] Climate Change Committee (CCC), December 2020, *The sixth carbon budget: shipping*
[4] G Seyedehhoma, et al, March 2021, 'Sustainable Ammonia Production Processes', *Frontiers in energy research*
[5] Royal Society, February 2020, *Ammonia: zero-carbon fertiliser, fuel and energy store*
[6] UNCTAD, November 2022, *Review of maritime transport*
[7] Getting to Zero Coalition, September 2021, *Alternative fuels: Retrofitting ship engines*
[8] CCC, December 2020, op cit
[9] Tyndall Centre, March 2022, 'Written evidence (MAR0008)'
[10] CCC, December 2020, op cit
[11] Liquid bulk cargo is a term that refers to cargo including liquefied gas, crude oil and oil products.
[12] Based on the CCC's 2021 dataset, *Sixth carbon budget - dataset (version 2 – December 2021)*
[13] On a bunker fuel basis. CCC, December 2020, op cit
[14] [See appendix below for references used for the alternative fuel comparison table.]
[15] Getting to Zero Coalition, September 2022, *Climate action in shipping: progress towards shipping's 2030 breakthrough*
[16] Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, October 2021, 'Fuel pathway maturity map'
[17] P Wolfram, et al, October 2022, 'Using ammonia as a shipping fuel could disturb the nitrogen cycle,' *Nature Energy*, vol 7, pp 1-3
[18] UMAS, et al for DfT, July 2019, *Reducing the maritime sector's contribution to climate change and air pollution: scenario analysis*
[19] UMAS, for the Getting to Zero Coalition, October 2021, *A strategy for the transition to zero-emission shipping*
[20] Maritime Just Transition Taskforce, November 2022, *Mapping a maritime just transition for seafarers*
[21] Getting to Zero Coalition, November 2022, *Annual progress report on green shipping corridors*
[22] Transport & Environment, June 2022, 'Consultation Response to "Developing the Emissions Trading Scheme"'
[23] UMAS, October 2021, op cit
[24] DfT, July 2021, *Decarbonising transport: a better, greener Britain*
[25] CCC, December 2020, op cit
[26] CCC, December 2020, op cit
[27] The IMO's new CO_2 regulations include the Energy Efficiency Existing Ship Index (EEXI) regulating the technical efficiency of vessels, the Carbon Intensity Indicator (CII) scheme regulating the operational efficiency of vessels and the Ship Energy

Efficiency Management Plan (SEEMP) Part III, regulating the efficiency of maritime management systems.

[28] DNV, September 2022, *Maritime forecast to 2050*

[29] Tyndall Centre, October 2022, 'Course to zero consultation. Response from the Tyndall entre, University of Manchester'

Appendix: sources for alternative fuels table

- C Chin Law, et al, December 2021, 'A comparison of alternative fuels for shipping in terms of lifecycle energy and cost,' *Energies,* vol 14
- DNV, July 2019, Comparison of alternative marine fuels
- M Issa, et al, October 2022, 'Ship energy efficiency and maritime sector initiatives to reduce carbon emissions,' *Energies,* vol 15
- Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, October 2021, 'Fuel pathway maturity map'
- P Wolfram, et al, October 2022, 'Using ammonia as a shipping fuel could disturb the nitrogen cycle,' *Nature Energy,* vol 7, pp 1-3